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Ministry of Economic Development of Georgia

ENVIRONMENTAL SCOPING REPORT

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VOLUME II

ENVIRONMENTAL SCOPING REPORT

PREFACE

Expansion of the E-60 Highway between Agaiani and Sveneti has been tentatively divided into three sections: (I) Agaiani – Igoeti; (II) Igoeti By-pass; and (III) Igoeti – Sveneti. Section I is proposed for financing under the World Bank financed First East West Highway Improvement Project.

This Environmental Assessment reviews baseline information, key environmental sensitivities and provides an analysis of alternatives for section I as well as for potential future projects (sections II and III) to assist the Ministry of Economy and RDMED in planning and scheduling. The Environmental Review also identifies mitigation measures for the entire alignment.

A site specific EIA and Environmental Management Plan is currently being prepared for section I to supplement this EA to meet national legislative requirements and World Bank safeguard policies.

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Executive Summary

Project Background

Georgia's geographical location positions the country at the center of East-West (the Black and Caspian Seas) and North-South (between Russia and Turkey) transits. Transit activities generate a direct turnover estimated more than US$2 billion. One of the government top priorities is to develop Georgia's competitiveness as a transit country by improving its East-West Transport Corridor.

An Economic and Financial Feasibility Report has been carried out by Atkins Consultants Ltd in the year 2005, in response to the Government's requirements for an improvement to the east-west corridor in accordance with the aspirations of the Government of Georgia. The summarizing conclusion of the study confirmed: "In general, the social-economic effect resulting from the proposed road modernization project can provide for overall increase in wealth and access to livelihoods for the national population.

The Georgia's Country Partnership Strategy (CPS) for 2006-2009 (CPS report 33295-GE) was approved by the Board on September 15, 2005. The overarching objective of the CPS is to enable income and employment generating growth. The Government has requested IDA to support modernization of the East-West Transport Corridor and US$60 million is allocated to the Transit Corridor out of the CPS four-year IDA envelop of US$143 million

The Government is expecting the East-West Highway Upgrade on Agaiani-Sveneti section from 2 lanes to 4 lanes will be financed with IDA credits. Modernization of the East-West Highway would focus on upgrading the Agaiani-Sveneti section of the highway from 2 to 4 lanes. Formal investigations and studies are presently underway to demonstrate the technical, financial, environmental and social viability of these proposed investments. The World Bank's environmental and social safeguard policies, including OP/BP 4.01 Environmental Assessment and OP/BP 4.12 Involuntary Resettlement, are therefore being applied. In addition, the Bank's policy on Disclosure of Operational Information and the following safeguard policies would also apply to this project:

- OP/ BP 4.01 Environmental Assessment
- OP/ BP 4.04 Natural Habitats
- OP 4.09 Pest Management
- OP 4.11 Cultural Heritage
- OP/BP 4.36 Forests
- OP/ BP 4.12 Involuntary Resettlement

Technical and Environmental Standards and Regulations

Technical design of the Highway should be in compliance with the Trans-European Motorway (TEM) standards. The project should be implemented in compliance with the Georgian legislation and environmental standards, as well as WB safeguard policies.

Georgian environmental legislation, as well as WB guidelines require that the project is screened in to determine whether it needs Environmental Impact Assessment (EIA) for obtaining construction

permit or not. According to national and WB regulations, comparison of alternatives preceding final design is one of the key requirements for preliminary environmental analysis.

Environmental Screening

The project "Rehabilitation of the road between Agaiani and Sveneti" requires EIA according to Georgian legislation and WB safeguard policies. The project could be considered as several road sections with Section I, Agaiani - Igoeti, planned under the Credit that is under preparation.

The mentioned section (Agaiani-Igoeti) is not environmentally sensitive and could be attributed to category B according to WB classification but would require the preparation of a site specific EIA (including EMP) to meet national and World Bank requirements.

The road section between Igoeti and Sveneti is the most sensitive particularly in the vicinity of Igoeti and would be classified as a Category A project for environmental assessment purposes requiring the preparation of a site specific EIA and EMP to meet World Bank and national requirements.

General Technical Requirements Proposed in the Feasibility Study

The proposed modernization design is based on the Trans-European Motorway (TEM) standards. These standards refer to a highway which:

- is specially designed and built for motor traffic and does not serve properties bordering on it;
- is provided, except at special points or temporarily, with separate carriageways for the two directions of traffic, separated from each other by a dividing strip (central reserve) not intended for traffic or, exceptionally, by other means;
- does not cross at level with any road, railway or tramway track, or footpath;
- In order to meet the TEM standards the new by-pass sections are proposed to avoid urban areas.

For the projected traffic the following motorway design solution is selected: two one-way carriageways with two lanes each (2x2), with a central reserve and full control of access. Traffic lanes should have a width of 3.75 m. Horizontal and vertical alignment should be such that the user notices no unjustified breaks in continuity, and is given timely warning of the critical points along the route, especially in the vicinity of interchanges, so that he can execute the necessary maneuvers."

Site Description and Alternative Options for the Road Alignment

Section 1, Agaiani - Igoeti - generally crosses a rolling terrain throughout the entire length along this section starting from KP43 to KP55.

Section 2, Igoeti Bypass - the existing road passes through the Igoeti town as a winding alignment that passes the Lekhura River. The terrain is gentle, rolling and mountainous with a series of rounded hills. The Gamdlistsjkjaro River starts at KP55 and continues to KP60.

Throughout the entire length of the road section, there is an existing partially prepared bypass that was constructed during the soviet period. There are existing (partial) walls and viaduct structures. To minimize the costs and the environmental impact use of the existing alignment is being considered.

Several solutions were reviewed by the Consultant for the Igoeti bypass and were checked at the site:

1. crossing using an alternative alignment and based on the soviet designed path;
2. crossing Lekhura River with tight curve to preserve the existing buildings but without meeting technical standards;
3. Crossing Lekhura River with a larger curve to respect the highway standards but passing over the existing buildings

Section 3, Igoeti – Sveneti - the alignment traverses rural areas with presence of several small villages and isolated kiosks and buildings from KP55 to KP80.

One short urban section which is at Shavshvebi and Qvemo Shavshvebi villages were passed through by the existing road. The alternative alignment available is to bypass the two villages maintaining the existing road as a secondary road to link the two villages and create an intersection at two levels.

Sensitive Environmental Receptors and Potential Impacts

Expansion of the E-60 Highway between Agaiani and Sveneti is planned in three sections: (I) Agaiani – Igoeti; (II) Igoeti By-pass; and (III) Igoeti – Sveneti. During the preparation of this proposed project (section I) a review of baseline information, key environmental sensitivities and an analysis of alternatives has been conducted for sections I to III to assist in planning and scheduling for this and future projects. The review also identified mitigation measures.

The desk studies and site visits revealed that the proposed project areas form part of a significantly transformed landscape. No significant sensitive environmental receptors were identified through literature reviews and site visits and no long term residual adverse impacts are therefore expected.

The most sensitive area is that proposed for section II (Igoeti By-pass) where the construction of new by-passes and bridges is envisaged, due to the presence of archaeological sites, erosion and land stability issues and natural (terrestrial and aquatic) habitats. At the same time, no 'showstoppers' were identified by this review and anticipated impacts even in the Igoeti area are considered to be manageable through the application of conventional slope stabilization techniques, road design and construction standards; and good environmental practices.

A summary of key sensitivities for each section is provided below.

For this project, section I (Agaiani – Igoeti), a site specific Environmental Impact Assessment and Environmental Management Plan to mitigate and manage impacts associated with direct or indirect impacts of construction are currently under preparation. Equivalent work will subsequently be completed for Phases II and III.

Section 1. Key Sensitivities - Agaiani - Sveneti

Type of Receptor	Location – designation on the sensitivity map	Environmental Value	Sensitivity in the Project Context
Landscape and Flora	Landscape 51 - Floodplain of river Ksani in the vicinity of v. Agaiani (floodplain forests)	Medium	Medium
Surface Water	r. Ksani near v. Agaiani	High	Medium
Groundwater	Landscape 51 - Floodplain of river Ksani in the vicinity of v. Agaiani (depth 0-3m)	Medium	Low
Archeological Sites	No 1 – 11 (see 3.10) near villages Agaiani and Okami	High	Medium
Sites prone to natural hazards	Not detected	No	No

Section 2. Key Sensitivities - Igoeti Bypass

Type of Receptor	Location – designation on the sensitivity map	Environmental Value	Sensitivity in the Project Context
Landscape and Flora	Landscape 51 - Floodplains of r. Lekhura and Tortla (floodplain forests) near Igoeti, from v.Igoeti to Kaspi, and from Kaspi in the direction of v.Gamdlistskaro	Medium	Medium
	Zone of landscapes 19a and 19b in the vicinity of v. Igoeti - In the Igoeti area the endemic and Red Data Book (RDB) species *Paeonia tenuifolia* and *P. carthalinica* are found in steppes, while the endemic and RDB species *P. majko* and *P. caucasica* are found in *Quercus-Carpinus* forest edges. Groups of *Amygdalus georgica* (RDB Georgia) are also found close to Igoeti, as well as groups of the shrub *Nitraria schoberi* (RDB Georgia) which is characteristic of Asian deserts.	High	Medium
Surface Water	r. Lekhura and Tortla	High	Medium
Groundwater	Landscape 51 - Floodplains of r. Lekhura and Tortla (depth 0-3m)	Medium	Low
Archeological Sites	No 12 – 21 (see 3.10) near villages Igoeti and Samtavisi	High	High
Sites prone to natural hazards	landslide body formed in the conglomerates of Dusheti suit (N_1+$_2$dš$^2_1$) on the right of the motor road, east of the village of Igoeti	High risk	Manageable
	Similar landslide body is met 150 meters left of the motor road leading from the village of Igoeti to the village of Lamiskana (Out of mainline, located On cross-road)	High risk	Manageable
	The banks wash-out and debris flow drifts in the areas adjacent to the point where the motor	Medium	Manageable

Type of Receptor	Location – designation on the sensitivity map	Environmental Value	Sensitivity in the Project Context
	road crosses the river Lekhura Erosion and risk of landslide triggering a steep slope on the right of the existing motor road, 700-800 meters from the right bank of the river Lekhura	High risk	Manageable

Section 3. Key Sensitivities - Igoeti – Sveneti

Type of Receptor	Location – designation on the sensitivity map	Environmental Value	Sensitivity in the Project Context
Landscape and Flora	Landscapes 19a - Kvernaki ridge slopes of Northern exposition present sensitive ecological and valuable aesthetic landscapes. The landscape is vulnerable to anthropogenic influence in general but is out of the project impact zone.	From medium to high	Low (so far as this landscape is not within the impact zone)
Surface Water	r. Tortla	High	Medium
Groundwater		From Low to Medium	From Low to Medium
Archeological Sites	No 22 – 31 (see 3.10)	High	High
Sites prone to natural hazards	The section of the motor road from the village of Akhalsheni to eastern periphery of the village of Sveneti. In one part of this section the river Western Tortla meanders violently and gets close the motor road. The slope on the left side of the road is structured with weakly cemented and depleted conglomerates, in case of its cutting off; there is high risk of collapse. As for the widening the road in the direction of the river Western Tortla, it should be mentioned that so-called “island” having formed as a result of the river meandering is mainly structured by loessial-like subsiding grounds (clays, loams).	High	Manageable

Analysis of Alternatives

No “showstoppers” have been identified during preliminary environmental assessment performed by Consultant’s environmental team and it is likely that the anticipated impacts even in the sensitive zone (Igoeti) could be managed by application of conventional slope stabilization technologies, TEM design and construction standards and good environmental practices. Therefore, no extraordinary costs are imposed by the necessity of mitigation measures.

Therefore, taking into account socio-economic benefits of the project, it may be concluded that the "No Project" alternative should be rejected and only alignment alternatives are subject for further analysis

The environmental analysis of alternative alignments demonstrates that the preferable options for the Igoeti section, as well for the Shavshvebi site are those, which enables to bypass the villages (see paragraph 5.2). The preference is determined by lower safety risks associated with traffic, lower emission and noise impacts on the residents of villages and by better technical-economical features of the project.

List of Acronyms

BP –Bank Procedures (World Bank)

EA – Environmental Assessment

EIA – Environmental Impact Assessment

EMP – Environmental Management Plan

ESIA – Environmental and Social Impact Assessment

GP – Good Practices (World Bank)

GIS – Geographical Information System

GPS – Global Positioning System

IDA – International Development Association

KP – Kilometer Point

MoE – Ministry of Environment Protection and Natural Resources

OP – Operational Manual (World Bank)

PIU – Project Implementing Unit

RAP – Resettlement Action Plan

RDB – Red Data Book

RDMED – Road Department of the Ministry of Economic Development

SEA – Strategic Environmental Assessment

TEM - Trans-European Motorway

TRRC - Transport Reform and Rehabilitation Center

WB – World Bank

Project Context

1.1 Project Background

Georgia's geographical location positions the country at the center of East-West (the Black and Caspian Seas) and North-South (between Russia and Turkey) transits. Trade with neighboring countries is also an important feature of Georgia's economy. Transit activities generate a direct turnover estimated more than US$2 billion. The Government of Georgia (which assumed office after the Rose Revolution in 2002) made it a key priority to rehabilitate transport, energy and rural infrastructure, which had deteriorated significantly since 1990. Recognizing the importance of infrastructure to sustainable economic development of the country over the course of the last two years, the Government managed to substantially increase investments in these areas.

One of the Government's top priorities is to develop Georgia's competitiveness as a transit country by improving its East-West Transport Corridor. Recognizing that the full potential of its transit corridor has not materialized yet, the Government decided to carry out the modernization of the itinerary from the Turkish Border in Sarpi to the Azeri Border located at the so-called Red Bridge border crossing.

In the years 2003-2004 Louis Berger and Transprojekt Roads Survey and Design Institute, Georgia has prepared a TACIS funded study on Rehabilitation of Caucasian Roads. This provided a significant amount of data for the existing road and also a possible 'on line' improvement strategy and additional by-pass options to relieve possible traffic congestion and dangers in the urban areas still crossed by the existing M27.

An Economic and Financial Feasibility Report has been carried out by Atkins Consultants Ltd in the year 2005, in response to the Government's requirements for an improvement to the east-west corridor in accordance with the aspirations of the Government of Georgia. This project assumes many of the findings set in the above mentioned Louis Berger study. The summarizing conclusion of the study confirmed: "In general, the social-economic effect resulting from the proposed road modernization project can provide for overall increase in wealth and access to livelihoods for the national population. The main national benefit is: increased quality of the major transport artery which contributes in national economy, better infrastructure, increased government revenues from transit taxes which could contribute to improved social services. The use of local labor will provide inflow of cash into the local economies along the motorway route".

The Georgia's Country Partnership Strategy (CPS) for 2006-2009 (CPS report 33295-GE) was approved by the Board on September 15, 2005. The overarching objective of the CPS is to enable income and employment generating growth. The Government has requested IDA to support modernization of the East-West Transport Corridor and US$60 million is allocated to the Transit Corridor out of the CPS four-year IDA envelop of US$143 million. Modernization of the East-West Highway would focus on upgrading the Agaiani-Sveneti section of the highway from 2 to 4 lanes. Formal investigations and studies are presently underway to demonstrate the technical, financial, environmental and social viability of these proposed investments. The World Bank's environmental and social safeguard policies, including OP/BP 4.01 Environmental Assessment and OP/BP 4.12 Involuntary Resettlement, are therefore being applied.

1.2 Purpose of this Environmental Assessment

This Environmental Assessment reviews baseline information, key environmental sensitivities and provides an analysis of alternatives for all potential modernization projects to assist the Ministry of Economy and RDMED in planning and scheduling. The Environmental Review also identifies mitigation measures for the entire alignment between Agaiani and Sveneti.

1.3 Design and Construction Activities

The itinerary Agaiani-Sveneti is a 2-lane highway with standard characteristics. The upgrade to 4 lanes was envisaged in the 80's and some works regarding culverts, retaining walls and bridges have started especially at Igoeti bypass. This effort stopped with the collapse of the Former Soviet Union. Traffic is known to be between 8,000 to 12,000 Vpd depending on the section with 20% to 25% trucks.

General technical requirements proposed in the Feasibility Study

The proposed modernization design is based on Trans-European Motorway (TEM) standards. These standards refer to a highway which:

- is specially designed and built for motor traffic and does not serve properties bordering on it;
- is provided, except at special points or temporarily, with separate carriageways for the two directions of traffic, separated from each other by a dividing strip (central reserve) not intended for traffic or, exceptionally, by other means;
- does not cross at level with any road, railway or tramway track, or footpath;

Based on the projected traffic levels the following motorway design solution is proposed: two one-way carriageways with two lanes each (2x2), with a central reserve and full control of access. Traffic lanes with a width of 3.75 m. Horizontal and vertical alignments so the user notices no unjustified breaks in continuity, and is given timely warning of the critical points along the route, especially in the vicinity of interchanges, so that he can execute the necessary maneuvers. To meet the TEM standards the new by-pass sections are proposed to avoid urban areas.

Based on these provisions of the Feasibility Study and international standards, the Government of Georgia has defined the characteristics of the proposed road and these are summarized below.

Characteristics of the road proposed by the Government.

The itinerary is a 2-lane highway with standard characteristics. The upgrade to 4 lanes was envisaged in the 80's and some works regarding culverts, retaining walls and bridges have started especially at Igoeti bypass. Proposed characteristics of the road for upgrading are as follows:

<u>*Cross section*</u>: the standard cross section will be dimensioned as follows: (i) *Carriage way* width 7.5 m with two lanes 3.75 m each; (ii) *verge* 3.75 m with (a) *shoulder* 3 m of which 0.75 will be paved using the same structure at the right lane (a rumble strip could be placed to separate the carriage way from the verge) and 2.25 m will be made of light structure with aggregate instead of bituminous pavement and with standard overlay and (b) 0.75 m berm; (iii) *left hard strip:* 1 m each

in case concrete barriers are used in the median and 0.75 m if step beam guardrail are used in the median strip; (iv) *median strip*: not less than 3 m including barriers to separate physically the traffic flow. The median strip can contain sign supports, drainage, bridge piers and landscaping elements. Exception can be granted to the cross section for singular locations and for large bridges.

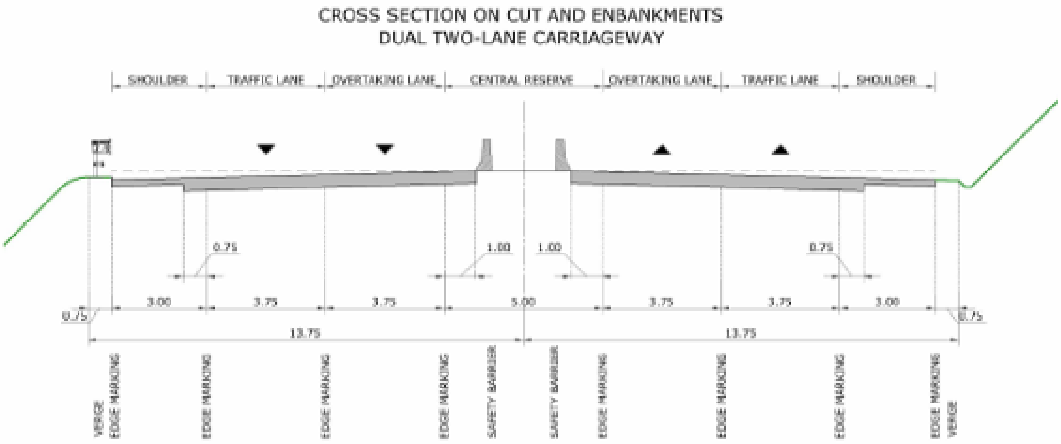


Figure 1

Alignment and profile: The minimum radius at level terrain will be 600 meters (with possible exception for Igoeti bypass where minimum radius proposed by Consultant is 400 m). If the radius is more than 1,600 m, superelevation will not be mandatory. The maximum grade for superelevation will be 6% and the minimum 2%. Superelevation between 6% maximum (radius 600 m) and 2% (radius 1,600 m) will be calculated using a linear formula. Regarding profile, the maximum gradient will be 5%, the minimum radius for sags will be 5,000 m and the minimum radius for crests will be 15,000 m.

The geometrical elements as bends and straight elements will be linked with clothoidic elements following the optic, parameters. The design speed proposed will be 120 km/h; exceptions will be applied for minimum characteristics design speed (100 km/h – 80 km/h) at Igoeti bypass.

Barriers

Guardrails will be installed on the right-hand site if one or more of the following circumstances occurs: (i) height of embankment more than 3 m, (iii) alignment radius less than 1.5 time the minimum radius, (iii) need to limit random accesses (concrete barriers could be considered in this case in urbanized areas), (iv) presence of obstacles within the safety zone, i.e., within 8.5m of the right side of the carriage way. As for the barriers on the median strip, they will be mandatory where the two traffic flows are less than 10 m apart. The designer will have to suggest a system made of one or two separators –concrete or steel plates- that can fulfill safety requirement first, but which will also be compatible with drainage requirement (especially in areas with superelevation in which case steel plate guardrails have an advantage over concrete barriers as they allow better drainage).

Bridge vertical clearance

Bridge vertical clearance will be 5 m for all overpasses. Underpasses clearance will range from 5m to 2.4 m depending on the type of traffic to be accommodated. Underpasses clearance will have to

be approved by RDMED at Preliminary Design, the consultant suggest applying 5m clearance for vehicle underpass and 2.4 meters for pedestrian underpass.

Site description and alternative options of alignment

Expansion of the E-60 Highway between Agaiani and Sveneti has been tentatively divided into three sections: (I) Agaiani – Igoeti; (II) Igoeti By-pass; and (III) Igoeti – Sveneti. These are outlined below in turn.

Section 1, Agaiani - Igoeti, generally crosses a rolling terrain throughout the entire length along this section starting from KP43 to KP55.

Generally exhibits the same existing road geometry actually built with two lane with a paved width variable from 7,00 to 9,00 m and with no paved shoulders, minimum 1,00 m each. Good horizontal geometry was observed along the route as evidenced by soviet design till first 3 kilometres with an already done embankment on the right side of the existing road, the following 9,00 km are in worst condition not suitable with highway standards. The alignment proposed for the following nine kilometres appears with several technical solutions. After a preliminary screening two design options have been selected:

1. build one carriageway and upgrade the existing road;
2. Build two new carriageways and leave the existing road as local road.

A few intersections are proposed for this section with a new crossing overpass and existing underpasses. No dfesign issues have been identified regarding closer built-up areas although it will be necessary to relocate some kiosks and to build bus stops.

However, in view of comparative economic concerns and to contain costs, RDMED has agreed to relax certain technical standards to build only one carriageway and use the existing road as second carriageway.

Highway Section 2, Igoeti bypass, the existing road runs through the Igoeti town as a winding alignment and passes the Lekhura River. The terrain is gentle, rolling and mountainous with a series of rounded hills. The Gamdlistsjkjaro River runs along the road from km54.5 to km 58.8.

Throughout the entire length of the road section, there is an existing partially prepared strip that was constructed during the Soviet period as part of a planned bypass road. Partially constructed walls and viaduct structures exist. To minimize costs and environmental impacts this existing route can be used.

Variants

Several proposals have been examined by the Consultant to all the bypass of Igoeti:

- bypassing Igoeti village as two alternative alignment to cross Lekura river and using the soviet designed alignment before and after the Lekura river:
- crossing the Lekhura river with a tight curve to preserve existing buildings but without meeting the TEM design standards;
- crossing the Lekhura river with a larger curve to respect the TEM standards but this would

impact some existing buildings;
- Bypassing Igoeti village using the existed road alignment as two carriageways or one carriageway combining with one of the crossing alternatives for the second carriageway.

In this area will be constructed the most important two level interchange of the alignment that will be useful for relevant traffic request; it's laying along the existing and future road and is joint with functional roundabouts to the secondary roads.

All the solutions shown have to be evaluated with creep soils observed along the alignment and main river bodies as Lekura and Tortla east river, the environmental impact and the possibility of using the existing structures as much as they appear or after a rehabilitation program.

Between km 57+100 and 58+200 a soil creep was observed and important archaeological sites are found on the right hand of the existing road where the land quickly raises on the hill. On the left side was observed cultivated land and Tortla east river flowing close to the existing road.

The particular situation forces the highway in a very narrow corridor and two design options have been evaluated:

1. building the highway preferring to move on the right side;
2. building the highway preferring to move on the left side;

n.	**Left side**		**Right side**	
	Advantages	*Disadvantage*	*Advantages*	*Disadvantage*
1	No huge wall needed but only gabions at the edge of the embankment	Land acquisition needed	No significant land acquisition needed	Huge and expensive walls needed
2	No huge consolidating works needed			Huge and expensive consolidating works needed
3	Save an important archaeological site			Destroying important archaeological site

The suggested solution at this stage of the preliminary design is to preserve the hill by huge cutting and construction of important retaining structures, so the recommendation is to set the new highway in the middle of the existing road with two effects:

1. reducing the land expropriation and the occupation of Tortla east river basin using construction of gabions walls at the edge of the embankment;
2. reducing hill cutting to preserve the archaeological area and to moderate the soil creep issues.

Further geological and archaeological surveys are recommended during detail design to explore the opportunity to site the highway on the right position.

Highway Section 3, Igoeti - Sveneti, the alignment traverses rural areas passing through several small villages and isolated kiosks and buildings from Km 58.8 to Km 79.2.

Poor horizontal geometry was observed along the route as evidenced by very dangerous "blind curves/black spots", coupled with several reversed bends and narrowing to single lane road widths, eventually leading to potential vehicular accidents.

Further aggravating the horizontal geometry, depriving safety to the travelling public, are the absence of required road signs.

The recommended solution for this Section is to update the existing road for the above mentioned existing road conditions with corrections of dangerous horizontal and vertical geometry. Wherever is possible the alignment will be lying along the existing road with the scope to reduce the earthworks and consequently the cost of the highway or adopting some variants as already described at chapter 1.2.

Variants
The existing road traverses a short urban section at Shavshvebi and Qvemo Shavshvebi villages between km 70.00 and km 73.00. One alignment alternative is to install a bypass around the two villages and to maintain the existing road as a secondary road to link the two villages. This will ensure that the existing school at the opposite side of existing road is not cut off and it will enclose the urbanized soil already existing, although destroyed, into the urban area with two advantages: (i) to create a shield between the highway and the invalidated area (ii) and to realize a potential employment area directly linked with the village.

Correction of alignment out of existing road
A correction of alignment is adopted between km 73.5 and km 76.5 where poor horizontal and vertical geometry was observed. The existing road will be used as local road and the closed areas will be rehabilitated as multi functional service and commercial areas and bus stop services. During construction this area can be used as temporary road work site. In the same area the underpass for the interchange for Akhalsheni village is located at km 74.850.

Construction Activities

General

Construction activities are proposed to be divided into three lots; one per section. The road work site is mainly linear. Basic work sites and satellite work sites will be developed to cater for the whole length of the itinerary.

The basic work sites, of major dimensions, will be located in each section close to the existing road for easy accessibility. The satellite work sites will be placed in centre stage along the alignment to support the earthworks and the main structure constructions and the access site should be mainly foreseen by the processing embankment construction (as work track).

In identifying preferable basic and satellite work sites future interchange location areas and the closed areas between the existing road and the future highway strip have to be taken into account.

Timetable

The scheduled program foresees a 3-4 years period for construction of the entire itinerary; starting in fall 2007 in three sections each with a different start time:

- Section 1 - 1 year for construction;
- Section 2 – 2 years for construction;
- Section 3 – 1.5 years for construction.

To finish the entire construction in 3-4 years it will be necessary an overlap construction periods for Sections 2 and 3.

Earthworks

The most important items to be considered for Sections 2 and 3 are the earthworks and pavement construction activity; no significant structures have to be built. It foresee to use the main part of cutting earth for making embankments as most of surface soil (88%) of the samples examined pertain, according to the AASHTO Classification System (AASHTO designation: M 145 "the Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes"), to the groups A-2-6 and A-2-7.

Earthworks estimation –Full new highway solution for Section 1 from km 45 to 54

EARTHWORKS												
Section n.	Total lenght	Cut	Embankment	Balance	no qualified earth	qualified earth	earth requirement	reclaimed land				Total earth requirement
	(m)	(mc)	(mc)	(mc)	(mc)	(mc)	(mc)	Length	width	tickness	(mc)	(mc)
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)
				(c - b)	(15% b)	(b - e) x 1,1	(c - f/1,05)	(m)	(m)	(m)	(h x i x j)	(j - g)
Section I	12.325,00	178.847,60	215.444,30	36.596,70	26.827,14	167.222,51	56.184,77	3.200,00	7,00	0,20	4.480,00	60.664,77
Section II	4.100,00	276.467,60	223.383,29	-53.084,31	41.470,14	258.497,21	-22.804,53	3.000,00	7,00	0,20	4.200,00	-18.604,53
Section III	20.410,00	475.141,70	386.061,40	-89.080,30	71.271,26	444.257,49	-37.040,97	5.200,00	7,00	0,20	7.280,00	-29.760,97
TOTAL	36.835,00	930.456,90	824.888,99	-105.567,91	139.568,54	869.977,20	-3.660,73				15.960,00	12.299,27

The no qualified earth will be used as fill soil for 1/3 slope embankment and for vegetal soil; for Section 1, considering the solution with the construction of full new highway from km 45 to km 54 it can be evaluated for construction of embankment a cement or lime treatment.

Reclaimed land is requested under embankment for a thickness of 0.20 m.

Pavement

Existing pavement has to be demolished and rebuilt; there are two possible options:

1. recycling the pavement material for construction;
2. Not using material and consider it as waste material to be transport at dump site.

Structures

The main structures are placed at Igoeti bypass (Section 2). It has to build two viaducts:

1. Igoeti viaduct (length 178 - 180 m);
2. Lekhura viaduct (length 222 m).

Igoeti viaduct is already partially built: 6 piers, 2 capitals, 1 abutment and beams for first span already exist. Piers consist of 2 octagon-shaped elements (1.5 mt diameter) for each carriageway, joined with a capital at the top and a concrete block at the bottom. Spans are roughly 25.5 meters wide.

Two options are able:

1. If it is possible to use existing elements, construction will be completed with missing structures, reinforcing (where needed) existing ones;
2. If is not possible to use the existing elements, has to be demolished the existing piers and rebuild a new structure shifting the spans to build new foundations.

Traffic interference

Construction under traffic has to be mentioned, considering that for the main part of the itinerary the design of new highway foresees the rehabilitation of existing road as one carriageway of the future infrastructure.

The construction in this case has to be divided in two phases:

1. phase 1: construction of new carriageway;
2. Phase 2: shifting the traffic on the already done carriageway and upgrading of existing road.

The intermediate phase to shift traffic needs additional safety costs for accident prevention. This problem has to be mentioned and take into consideration in schedule planning for low production activity due the shared activity of above mentioned phases.

If Section 1 will be build as a new full highway from km 45 to km 54 the possibility to build the whole highway in one phase helps to reduce the construction period and the total construction costs linked to the possibility of a higher production.

1.3 Overview of Potential Environmental and Social Impacts and Mitigation Measures Typical for the Highway Projects

To estimate potential environmental impacts of the project, project related activities have been reviewed against the variety of associated possible impacts and existing environmental receptors that may be affected. The baseline environmental conditions and environmental receptors that have been considered are described in chapter III. Analysis of most expected and significant impacts and mitigating strategies to be considered during further studies at the stage of detailed design are provided in chapter IV.

Below, as a first step in the impact analysis we provide a review of impacts that are typical for road construction and rehabilitation projects. The list of potential impacts has been sourced from:

- WB Environmental Sourcebook (Vol. II chapter 8 Rural Roads p. 113 and Chapter 9 Roads and Highways p. 168)
- WB Guidelines for Environmental Screening of Road Projects; Juan Quintero; WB 1997
- WB Technical Paper No 376; Roads and the Environment; A Handbook; 1997;

#	Potential Impacts Typical for the Construction and Upgrading of Highways
1	Destruction of natural landscape (relief, soil cover, vegetation, eco-systems, habitats and wildlife) in the right-of-way occupied by the highway.
2	Destruction of natural landscape (relief, soil cover, vegetation, eco-systems, habitats and wildlife) on the access roads, in the borrow pit sites, waste dumps, construction camps and equipment yards.
3	Landslides, slumps, slips and other mass movements in road cuts triggered by the construction activities.
4	Erosion stimulated from fresh road cuts and fills and temporary sedimentation of natural drainage ways.
5	Erosion of lands below the road bed receiving concentrated outflow from covered or open drains.
6	Increased suspended sediment in streams affected by erosion at construction sites and fresh road cuts, fills and waste dumps. Declined water quality and increased sedimentation
7	Impact of construction activities on aquatic ecosystems of the rivers and streams crossed by the highway
8	Soil and water contamination during construction by oil, grease, fuel and paint in the RoW, equipment yards and asphalt plants.
9	Poor sanitation and solid waste disposal in construction camps and work sites (sewerage, sanitation, waste management)
10	Construction wastes alongside the RoW and roadside litter.
11	Air pollution from vehicle operations during construction in populated areas traversed by the highway, notably metropolitan areas or densely settled rural areas. Local dust.
12	Air pollution from asphalt plants.
13	Noise pollution from vehicle operation during construction in populated areas traversed by the highway, notably metropolitan areas or densely settled rural areas. Local noise.
14	Poaching by construction workers
15	Creation of temporary breeding habitats for mosquito vectors of disease e.g. sunny, stagnant pools of water. Creation of stagnant water bodies in borrow pits, quarries, etc. suited to mosquito breeding and other disease vectors.
16	Health hazards by noise, air emissions and dust raised and blown by vehicles during construction activities.
17	Social disruption caused by the construction related activities in the RoW, the borrow pit sites, waste dumps, construction camps and equipment yards.
18	Hazardous driving conditions where construction interferes with pre- existing roads.
19	Accident risks associated with vehicular traffic and transport, that may result in spills of toxic materials, detonation of explosive load, injuries or loss of life(see 'Hazardous Materials Management' section), injuries or loss of life (see 'Public Health and Safety section)
#	**Potential Long-term impacts of Highway (Impact of Physical Installations and Traffic)**
20	Long-term degradation of natural landscape (relief, soil cover, vegetation, habitats and wildlife) in the right-of-way occupied by the highway.
21	Long-term degradation of natural landscape (relief, soil cover, vegetation, habitats and wildlife) on the access roads, in the borrow pit sites, waste dumps, construction camps and

	equipment yards.
22	Landslides, slumps, slips and other mass movements in road cuts and adjacent territories stimulated or triggered by the project (woodcutting and clearance of slope vegetation, change of drainage patterns, change of relief and soil compactness etc.).
23	Erosion from fresh road cuts and fills and temporary sedimentation of natural drainage ways. Erosion of lands below the road bed receiving concentrated outflow from covered or open drains.
24	Landscape disfiguration by embankments and deep cuts, fills and quarries. Marred landscape (scars from rod cuts, induced landslides and slumps etc.).
25	Changes of hydrological patterns of the rivers and streams crossed by the highways induced by installation of bridges, revetments, river-bank protection installations and other hydro technical installations and related impacts on infrastructure, arable lands and ecosystems located on adjacent territories
26	Alteration of overland drainage and subsoil drainage patterns (where road cuts intercept perched water tables, springs, etc.)
27	Increased suspended sediment in streams affected by erosion at construction sites and fresh road cuts, fills and waste dumps. declined water quality and increased sedimentation
28	Soil and water contamination by oil, grease, fuel and paint alongside the highway
29	Contamination of ground and surface waters by herbicides for vegetation control or chemicals (e.g. calcium chloride) for dust control
30	Air pollution from asphalt plants during maintenance works.
31	Air pollution from vehicle operation, in populated areas traversed by the highway, notably metropolitan areas or densely settled rural areas. Local dust.
32	Noise pollution from vehicle operation, in populated areas traversed by the highway, notably metropolitan areas or densely settled rural areas.
33	Local noise.
34	Roadside litter.
35	Creation of a new pathway for disease vectors affecting humans and animals.
36	Creation of a transmission corridor for diseases, pests, weeds and other undesirable organisms
37	Health hazards by dust raised and blown by vehicles.
38	• Dislocation and compulsory resettlement of people living on the right of way • Near cites and in rich farming regions, many people can be affected
39	Obstruction of routes from homes to farms, etc, increasing travel time.
40	Impairment of non-motored transportation in the highway corridor due to reduced or impeded rights-of-way.
41	Induced development: roadside commercial, industrial, residential, and “urban sprawl”.
42	Planned development and illegal invasion of homelands of indigenous peoples by squatters and poachers causing serious social and economic disruption
Potential Operation Phase Emergency Related Impacts	
43	Accident risks associated with vehicular traffic and transport, that may result in spills of toxic materials injuries or loss of life(see 'Hazardous Materials Management' section), injuries or loss of life (see 'Public Health and Safety section)

II. Policy, Legal and Institutional Framework

Introduction

This chapter presents the review and analysis of the environmental legislation of Georgia and the procedures for ensuring full consideration of WB's environmental safeguards and the WB environmental assessment guidelines in the implementation of projects financed under WB loans. It describes existing in Georgia environmental regulations relevant to the project, provides guidance on the measures required for ensuring consistency with environmental assessment and makes reference to institutions at the local and national levels responsible for issuing permits, licenses, and enforcing compliance of environmental standards. The chapter also provides guidance on environmental screening for the proposed East West Highway rehabilitaitonaccording to WB guidelines.

2.1 Georgian Legislation

Framework Legislation

The basic legal document is "**The Constitution of Georgia**", which was adopted in 1995. While the Constitution of Georgia does not directly address environmental matters, it does lay down the legal framework that guarantees environmental protection and public access to information with regard to environmental conditions.

Article 37, Part 3 states that "any person has the right to live in a healthy environment, use the natural and cultural environment. Any person is obliged to take care of the natural and cultural environment." Article 37, Part 5 states that "an individual has the right to obtain full, unbiased and timely information regarding his working and living environment."

Article 41, Part 1 states that "a citizen of Georgia is entitled to access information on such citizen as well as official documents available in State Institutions provided it does not contain confidential information of state, professional or commercial importance, in accordance with the applicable legal rules.

Legislative execution of constitutional requirements in the sphere of environmental protection is implemented through framework Georgian "**Law on Environmental Protection**" (1996, as amended). After independence, numerous laws and normative–legal documents were adopted to regulate specific environmental problems in Georgia. Further below the environmental regulations most relevant to the project – and first of all, to the permitting process - are described.

Responsible Institutions

Ministry of Environmental Protection and Natural Resources of Georgia (MoE) is the main state body pursuing state policy in the sphere of environment. Their functions for regulating economic activities with regard to environmental protection include:

- Issuing permits for project development
- Setting emission limits and issuing discharge consents
- Inspection of operating plants

- Responding to incidents and complaint
- Periodic review of discharge consents.

The Ministry defines and evaluates real and possible risk of impact on natural environment during implementation of different types of activities. Accordingly the Ministry has been assigned as responsible body for making decision on granting permission to the proponent on implementation of projects, which require Environmental Impact Assessment (EIA).

The **Roads Department of the Ministry of Economic Development (RDMED)** of Georgia is responsible for elaboration of policy and strategic plans related to developing motor roads, management of road and traffic related issues and construction, rehabilitation, reconstruction and maintenance of the roads of public use utilizing funds from the state budget, lawns, grants and other financial sources.

The main principles, purposes and procedures of granting permission are regulated by the legislative basis and the relevant normative acts described below.

Legislation Related to Environmental Permitting

A new **Law on Licenses and Permits** was adopted by Parliament of Georgia, on June 24, 2005. The new Law regulates legally organized activities posing certain threats to human life and health, and addresses specific state or public interests, including usage of state resources. It also regulates activities requiring licenses or permits, determines types of licenses and permits, and defines the procedures for issuing, revising and canceling of licenses and permits (Article 1, Paragraph 1). Amendments to existing Georgian EIA and permitting requirements based on the new Law will be phased in during a transitional period until the new law on Environmental Impact Permit shall be adopted by the parliament of Georgia.

The Governmental decree dated February 3, 2006 introduced amendments to the previous **Governmental decree dated September 1, 2005 on the Procedure and Terms of Issuing Environmental Permits,** which served to resolve the problem related to the terms of the issuance procedure, namely: an investor, seeking a permit, prepares, within the desired timeframe and according to the desired procedure, the EA, organizes its public discussion and other measures. It also invites the Ministry of Environment Protection and Natural Resources to take part in the process and afterwards applies to the Ministry for a permit. The Ministry carries out state ecological expertise of the project (for which the EIA has already been conducted) and issues a permit within the timeframe of 20 days. Under such a procedure, the timeframe appears reasonable. This will eliminate the need for submitting multiple applications to the Government with a request of extending the deadline, yet this will be allowed. This procedure will ensure timely issuance of permits and covers the requirements for public information and participation.

The newly amended Decree will remain in force throughout the transitional period, until the adoption of the law on Environmental Impact Assessment Permits established under the Law on Licenses and Permits. Additional analysis (though not extensive) will be required upon the adoption of the law which will set new provisions.

At present, the environmental permitting procedure in Georgia is set out in three laws:

The project proponent, in implementing projects, will comply with (i) **The Law on Licenses and Permits** (2005); (ii) **The Law on Environmental Permits** (EP), and (iii) **The Law on State Ecological Examination** (SEE) 1996, as amended. The latest are still enforced, however they are supported with the decision of the prime minister that determines procedures for issuance of the environmental permits. Decision dated September 1, 2005. **No** 145 as amended February 3, 2005 **"On the procedure and terms for issuance of an environmental permit".** Granting procedures differ slightly for different type of projects.

- For projects which do not require Construction Permit, the Environmental permit is being issued by the MoE on the ground of State Ecological Examination. State Ecological Examination is carried out by MoE upon official submission of Environmental Impact Assessment (EIA) prepared by project developers.

- For projects requiring Construction Permit, no special permit is issued by the MoE (according to "One window principle", only one permit shall be issued for each activity). The Construction Permit is issued by the Ministry of Economic Development of Georgia, but the issuance of the Permit is subject to the consent of the MoE, as well as the Ministry of Culture (Center of Archaeological Studies, Department of Monuments protection). Consent of the MoE in such cases should be issued according to the same procedures (EIA, public consultations; SEA etc.) as for issuing Environmental Permit. The Ministry of Economic Development as an administrative body issuing a permit ensures the involvement of the MoE as a different administrative body in the administrative proceedings initiated for the purpose of permit issuance, in accordance with Georgia's Law on Licenses and Permits.

The legislation specifies procedures for obtaining environmental permits for project implementation based on the nature of project activities. The list of the activities that are subject to EIA are listed in the Decision (Decree) dated February 3, 2005 and are presented below:

1. Activity means an industrial, economic or any other activity (including construction), including infrastructural plans, programs and projects, as well as technological modernization of the existing industries. Technical modernization is the "replacement of the existing technologies of an enterprise in a way that does not require modification of operational conditions". (At the same time and especially for the road rehabilitation project, it is important to note that according to the Law on Environmental Permit 1996, which is still in force, definition of "Activity" includes term – "significant reconstruction")

2. The activities subject to the environmental impact assessment:
   a) procession of mineral resources;
   b) collection and gathering of excavation;
   c) any industrial technology making use of asbestos;
   d) cement plants and asphalt-concrete plants;
   e) glass and glassware producing plants;
   f) recycling of solid domestic wastes (including burning plants) and/or provision of dumps;
   g) disposal of toxic and hazardous wastes, disposal and functioning of dumps and/or their chemical treatment;
   h) industries of all capacities related to gasification, liquefaction, performing and coking;

i) oil and gas mains;
j) reserves and terminals of oil and oil products, liquid gas storages, and terminals, the capacity of one of the pools located on the territory of which exceeds 1000 cubic meters or whose total capacity is more than 1000 cubic meters;
k) motorways and railways of international and national significance or bridges, express roads and tunnels above them, as well as engineering structures for the protection of the area on which these facilities are located;
l) high-voltage power lines (air and cable) (35kw and more) and a substation (110kw and more);
m) hydropower stations (2megawats or more); thermal power stations (2 megawatts or more);
n) metros;
o) reservoirs with a capacity of 10 000 cubic meter and more;
p) regional and city/town water outlet and main water pipes;
q) amelioration and irrigation schemes (water inlet structures and main canals);
r) regional and city cleaning structures, as well as a main sewage collector;
s) airdromes, airports, railway stations, sea ports, etc;
t) dams of all heights; embankments of 5m height and 50m width or more, as well as harbors, etc;
u) industrial sites, as determined by the Ministry of Economic Development, engaged in hazardous industrial processes (mining, chemical, metallurgical, oil processing, explosive), using high-pressure and high-temperature requiring facilities, as well as hazardous substances (inflammable, oxidant, combustive, explosive, toxic).
v) structures with minimum 10m height and 50.0m width designed for the protection from impacts of potential natural disasters and technogenic processes;
w) underground structures of mines;
x) Storage of toxic and other hazardous substances.

The Decree does not provide details of screening procedure (assessment of category of the project and need of EIA) and scoping (scope of work for further studies) and does not define responsibilities of parties. According to the practice, the screening of project proposals and the preliminary assessment of their environmental impact and proposed mitigation measures should be carried out by the project proponent in consultation with the MoE. It is recommended practice to discuss the results of screening/scoping with the MoE, although there is no legal requirement for such consultations.

Public Consultation on Environmental Impact Assessment

The Decree dated February 3, 2005 "**On the Procedure and Terms for Issuance Environmental Permit**" provides details of procedures for public consultations on EIA and established timeframes for information disclosure and discussion, namely:

- A developer is obliged to carry out public discussion of the EIA before its submission to an administrative body responsible for issuing a permit (in case of activity requiring construction permit before initiating stage 2 procedure for construction permit issuance).

- A developer is obliged to disclose (publish) information to the end of conducting public discussion on the planned activity. Information is subject to publication in the central periodical

as well as in the printing organ existing within the administrative territory of the same rayon (if such exists) where an activity is planned.

- Information (advertisement) shall contain the following information:
  - The objectives, title and location of the planned activity;
  - The location where interested individuals may obtain the activity related documents (including the environmental impact report);
  - Deadline for the submission of their opinions;
  - The place and time of public discussion.

- A developer is obliged:
  - To submit a hard copy and an electronic version of the Environmental Impact Assessment to administrative body issuing a permit within a week from the date of the publication;
  - To receive and consider within 45 days from the date of publication from citizens written comments and suggestions;
  - Hold a public discussion on a planned activity not later than 60 days from the publication of an advertisement;
  - To ensure invitation to public discussion of the representatives of respective local self-governmental and governmental bodies; the Ministry and the Ministry of Economic Development and other interested administrative bodies.

- Discussion shall be held publicly and any citizen has a right to attend it.

- Public discussion shall be held in the administrative center of the rayon where an activity is planned.

Documentation of Outcomes of a Public Discussion

A developer is obliged to provide minutes within 5 days from the public discussion, which shall contain details of comments and opinions expressed by the attendants. It shall be signed by a developer (or an authorized representative) and representatives of respective local self-governing and governing bodies; the Ministry; the Ministry of Economic Development (in the event of their attendance at the public discussion).

A developer is obliged to learn the comments and suggestions made by citizens and take into account their arguments when finalizing the EA report.

In the event of ignorance of the comments and suggestions provided by citizens by a developer, the latter is obliged to provide written justification of the reason of non-consideration and send it to the author(s) of those comments and suggestions. Such justification (together with written comments and suggestions from public) shall be submitted to the administrative body issuing permit together with the minutes of the discussion and the EIA report.

After documenting the process of public discussion, and the respective outcomes and finalization of the EIA document, a developer is authorized to submit an request to the administrative body issuing permits (in the event of the need for construction permit – to the administrative body issuing

construction permits) with a request to issue a permit (or a construction permit) in accordance with the rule established under the legislation of Georgia.

2.2 The World Bank's Safeguards Policies and Environmental Guidelines

WB Environmental Guidelines

All projects funded by WB must comply with the Bank's Safeguards policies and procedures including OP/BP 4.01 Environmental Assessment. The purpose of OP/ BP 4.01 is to establish an environmental review process to ensure that the projects undertaken as part of programs funded under WB loans are environmentally sound and sustainable and are designed to operate in compliance with applicable regulatory requirements.

The WB is committed to program design that reflects the results of public participation in host countries during all phases of the program, integrating governmental interests with those of private business and civil society. Procedures for consultation and disclosure of environmental information are outlined in OP/BP 4.01 Environmental Assessment and the Bank's Policy on Disclosure of Operational Information.

Finally, WB is committed to the principles of host-country responsibility for measures to mitigate adverse environmental and social impacts. WB funded projects shall therefore comply with host-country laws, regulations and standards, as well as requirements by which the host country is bound under international agreements.

The following safeguard policies would apply to the East West Highway Rehabilitaiton project:

- OP/ BP 4.01 Environmental Assessment
- OP/ BP 4.04 Natural Habitats
- OP 4.09 Pest Management
- OP 4.11 Cultural Heritage
- OP/BP 4.36 Forests
- OP/ BP 4.12 Involuntary Resettlement

WB Environmental Screening Guidelines

The Bank undertakes environmental screening of each proposed project to determine the appropriate extent and type of EA. Screening principles and procedures, as well as other conceptual and procedural details of EIA process, are described in OP/BP 4.01 Environmental Assessment. The Bank classifies the proposed project into one of four categories, depending on the type, location, sensitivity, and scale of the project and the nature and magnitude of its potential environmental impacts. The Bank establishes three categories.

- Category A is assigned to a proposed project if it is likely to have significant adverse environmental impacts that are sensitive, diverse, or unprecedented. These impacts may affect an area broader than the sites or facilities subject to physical works. EA for a Category A project examines the project's potential negative and positive environmental impacts, compares them with those of feasible alternatives (including the "without project" situation), and recommends any measures needed to prevent, minimize, mitigate, or compensate for adverse impacts and

improve environmental performance. For a Category A project, the Borrower is responsible for preparing a report.

- Category B is assigned to a proposed project if its potential adverse environmental impacts on human environment are less adverse than those of Category A projects. Like Category A EA, it examines the project's potential negative and positive environmental impacts and recommends any measures needed to prevent, minimize, mitigate, or compensate for adverse impacts. The findings and results of Category B EA are described in the project documentation (Project Appraisal Document and Project Information Document).

- Category C is assigned to a proposed project if it is likely to have minimal or no adverse environmental impacts. Beyond screening, no further EA action is required for a Category C project.

As additional criteria in support for screening procedures the GP-4.01 Annex B provides – "Types of Projects and Their Typical Classifications" with following comment: "Bank and international experience shows that projects in certain sectors or of certain types are normally best classified as illustrated below. These examples are only illustrative; it is the extent of the impacts, not the sector, that determines the extent of the environmental assessment and, hence, the category."

Category A Projects/Components

(a) Dams and reservoirs
(b) Forestry production projects
(c) Industrial plants (large-scale) and industrial estates, including major expansion, rehabilitation, or modification
(d) Irrigation, drainage, and flood control (large-scale)
(e) Aquaculture and mariculture (large-scale)
(f) Land clearance and levelling
(g) Mineral development (including oil and gas)
(h) Port and harbour development
(i) Reclamation and new land development
(j) Resettlement
(k) River basin development
(l) Thermal power and hydropower development or expansion
(m) Manufacture, transportation, and use of pesticides or other hazardous and/ or toxic materials
(n) New construction or major upgrading of highways or rural roads
(o) Hazardous waste management and disposal

Category B Projects/Components

(a) Agro industries (small-scale)
(b) Electrical transmission
(c) Irrigation and drainage (small-scale)
(d) Renewable energy (other than hydroelectric dams)
(e) Rural electrification
(f) Tourism

(g) Rural water supply and sanitation
(h) Watershed projects (management or rehabilitation)
(i) Protected areas and biodiversity conservation
(j) Rehabilitation or maintenance of highways or rural roads
(k) Rehabilitation or modification of existing industrial facilities (small-scale)
(l) Energy efficiency and energy conservation
Category C Projects/Components
(a) Education
(b) Family planning
(c) Health
(d) Nutrition
(e) Institutional development
(f) Most human resources projects

EIA

EIA evaluates the potential environmental risks and impacts of a specific project in its area of influence, examines alternatives to the project, identifies ways of improving project selection, siting, planning, design, and implementation by preventing, minimizing, mitigating, or compensating for adverse environmental impacts and enhancing positive impacts. EIA includes the process of mitigating and managing adverse environmental impacts during the implementation of a project.

EIA should:

- be initiated as early as possible in project development and be integrated closely with the economic, financial, institutional, social, and technical analyses of a proposed project
- Take into account the natural environment (air, water and land), human health and safety, social aspects (involuntary resettlement, indigenous peoples and cultural Property), and trans-boundary global environmental aspects.
- Also take into account specific host- country conditions – the findings of environmental studies, National Environmental Action Plans, national legislation, the capabilities of the entity implementing the project, as they relate to managing environmental and social impacts, and obligations of the country under relevant international environmental treaties and agreements.

EIA report should include:

- Executive summary – significant findings and recommended actions
- Policy, legal and administrative framework within which the EIA is carried out
- Project description
- Baseline data
- Environmental impacts
- Analysis of alternatives (including mitigation measures)
- Environmental Management Plan (EMP) including associated costs
- Consultation - lists and describes consultation meetings, including consultations for obtaining the informed views of the affected people, local NGOs and regulatory agencies.

Public Consultation and Disclosure

Consistent with WB principles of host-country ownership of the projects implemented under its loans, the Borrower will ensure meaningful public consultation in the development of EIAs and make public the results of EIAs. Public disclosure and consultation procedures are defined in WB BP 17.50 – "Disclosure of Operational Information" and described in detail in the WB Environmental Sourcebook Vol. I chapter 7 and Updates #5 - "Public Involvement in Environmental Assessment: Requirements, Opportunities and Issues".

The Bank requires public consultation for A and B Category projects. For category A projects public consultation should be held at least twice (once at scoping and later when the draft EIA is available). EIAs and EMPs (both draft and final documents) should be disclosed in country and through the WB's InfoShop.

Comparison of the National legislation and WB Requirements

Environmental assessment established in the Bank under OP/ BP 4.01 Environmental Assessment is analogous to the EIA provided under the legislation of Georgia. The following considerations are the main differences between the Bank guidelines and the national legislation.

- Screening and Classification – The Bank's guidelines provide detailed description of procedures for screening, scoping and conducting EIA and explain a complete list of stages, which are not envisaged under the national legislation.
- Considering an ecological risk, cultural heritage, resettlement and other factors, the Bank classifies projects supported by them under categories A, B and C. As mentioned in the Georgian national legislation review section, EIA is carried out only if a developer seeks to implement projects listed in the Governmental Decree on the Procedure and Terms of Environmental Impact Permit. This list is compatible with the category A projects of the Bank classification. According to the Georgian legislation EIA is not required in other instances, while World Bank guidelines may require limited EA or Environmental Reviews for the B category projects, as well.

- Environmental Management Plans - Georgian legislation does not specify format of environmental management plans (EMPs) and stage of their provision for the projects requiring EIA and do not request EMPs for the projects not requiring EIAs. The World Bank guidelines require EMPs for Category A and B projects and provide detailed instructions on the content.

- Involuntary Resettlement - The most significant difference between the Bank's approaches on one hand and the national legislation on the other is that the latter does not take into account the issue of involuntary resettlement at any stage of environmental permit issuance. The Georgian legislation considers social factor only in regard with life and health safety (e.g. if a project contains a risk of triggering landslide, or emission/discharge of harmful substances or any other anthropogenic impact). Thus, the national legislation does not consider resettlement as an issue in the process of issuing environmental permits, unlike the Bank which takes a comprehensive approach to this issue.

- Responsibilities for EIA - While the Bank's document establishes the responsibility of a Borrower for conducting an environmental assessment, the national legislation provides for the responsibility of a project implementing unit to prepare EIA and ensure its consultation.

  According to the Georgian legislation the MoE is responsible for monitoring of project implementation and compliance with the standards and commitments provided in the EIA and less clearly are defined role of EMPs. The PIU or "Project Proponent" is responsible for implementing "self-monitoring" programs for the projects requiring EIA. The WB guidelines stress the role of EMPs, which are important for all categories of projects and the Project Proponent (for the East West Highway Rehabilitation – RDMED in conjunction with TRRC) is requested to ensure inclusion of monitoring scheme and plans into EMPs. Monitoring of performance compliance against EMPs is important element of WB requirements.

- Consultation: The Bank provides for consultations for A and B Category projects (at least two consultations for Category A projects) and requires a timetable of consultations from the Borrower. The national legislation until recently contained only a brief reference to this issue without providing real tools of its fulfillment. The amendments to the Governmental Decree On the Procedure and Conditions of Environmental Impact Assessment established the requirement of public consultation of the EIA, which obligates a developer (i) to ensure public consultation of EIA, (ii) publication of information, (iii) receive comments within 45 days, (iv) arrange consultation not later than 60 days from the date of publication, invite stakeholders and determine the place of consultation).

Summary Comparison of Georgian and World Bank Environmental Assessment Processes

#	Action	Georgian Legislation	WB Requirements
1	Screening	Project Proponent in consultation with MoE	Project Proponent in consultation with the Bank
2	Scoping	Not required. Could be conducted voluntarily by Project Proponent.	Obligatory. Project Proponent in consultation with the Bank.
3	Draft EIA	To be prepared by Environmental Consultant.	To be prepared by the Project Proponent with support from Environmental Consultants as necessary.
4	Public Consultation and Disclosure	The EIA should be available for public review for a period of 45 days. Publication of information in central and regional mass-media. Arrange consultation not later than 60 days from the date of publication.	At least two consultations for Category A projects – one at the scoping stage and one for the draft EIA. For Category B projects, consultation should be held on the draft EA/ EMP or equivalent reports. All documents should be disclosed in country (in a form and language that is accessible) and through the Bank's Infoshop.
5	Final EIA	Consider all comments received during public	Consider all comments received. Incorporate accepted

		consultations, incorporate accepted remarks and explain rational when the comments are disregarded.	public comments and explain rationale when the comments are disregarded.
6	Management Plans	No clear guidelines on format, content and timing	Incorporate Monitoring and Management Plans in the EIA as well as institutional arrangements for their implementation.
7	Review and Approval	MoE	MoE (if the EIA is required by Georgian legislation) and no objection from the Bank
8	Disclosure of final EIA	Not requested	Publication in country and through the Bank's InfoShop of the final EIA or equivalent documents (see 4).

2.3. Environmental Screening – East West Highway Project

Requirements of Georgian Legislation

A new Law on Licenses and Permits regulates legally organized activities posing certain threats to human life and health, and addresses specific state or public interests, including usage of state resources. The Law on Licenses and Permits was adopted by Parliament of Georgia, on June 24, 2005. The project implementation should comply with the aforementioned law, as well as with the Law on Environmental Permits (EP), and the Law on State Ecological Review (SEE) 1997, as amended. The latest are still enforced, however they are supported with the decision of the Government of Georgia that determines procedures for issuance of the environmental permits. Decision dated September 1, 2005. No 145 as amended February 3, 2006 "On the procedure and terms for issuance of an environmental permit".

According to the Decision of the Government of Georgia dated February 3, 2005 "On the procedure and terms for issuance of an environmental permit", the projects and activities related to the motorways and railways of international or national importance and relevant infrastructure are subject to the EIA. In more details the meaning of "activities" is given in the Law on Environmental Permits (1997), which is still in force. According to determination given in this law the term "activities" comprise "significant reconstruction or technological renovation". The project of upgrading the 37km length portion of the existing 2-lane highway to a 4 lane highway should be considered as a significant reconstruction of the highway and, therefore, according to the Georgian legislation the project is subject to EIA. In case if the project would be split into three independent subprojects for section 1 (Agaiani-Igoeti), section 2 (Igoeti) and section 3 (Igoeti-Sveneti) EIA is required for each of these subprojects.

Besides that, also other international best practice guidelines could be in help. In particular, the Article 4(1) of Directive 97/11/EC unambiguously requires that the projects considering "Construction of a new road of four or more lanes, or realignment and/or widening of an existing road of two lanes or less so as to provide four or more lanes, where such new road, or realigned

and/or widened section of road would be 10 km or more in a continuous length" must be subject to EIA.

WB Procedures and Guidelines

According to the WB environmental guidelines (particularly OP/BP4.01 Environmental Assessment) the projects are classified as Category A projects for EA purposes if they are "likely to have significant adverse impacts that are sensitive, diverse, or unprecedented, or that affect an area broader than the sites or facilities subject to physical works." The impacts of Category B projects are "site-specific in nature and do not significantly affect human populations or alter environmentally important areas, including wetlands, native forests, grasslands, and other major natural habitats. Few if any of the impacts are irreversible, and in most cases mitigatory measures can be designed more readily than for Category A projects."

At the same time, the indicative list of projects provided in the GP 4.01 - Annex B (January 1999 Types of Projects and Their Typical Classifications) determines that construction or major upgrading of highways or rural roads falls into Category A Projects, while "rehabilitation or maintenance of highways or rural roads" falls into the category B. Therefore, to attribute the rehabilitation project to the category A or B it should be clarified are the project activities of major rehabilitation range or of routine rehabilitation and maintenance. According to the WB Guidelines for Environmental Screening of Road Projects; (Juan Quintero; WB 1997) widening of the road and adding new lanes is considered as major rehabilitation defined by term – "Upgrading" and construction of bypass – as "New Construction". According to this source, "upgrading" in high sensitive areas or "new construction" in medium and high sensitive areas requires full EIA.

As a summary, we can make following conclusions. The project "Rehabilitation of the road between Agaiani and Sveneti" requires EIA according to Georgian legislation and WB regulations. The project could be considered as several road sections with Section I, Agaiani - Igoeti, planned under the Credit that is under preparation. The mentioned section (Agaiani-Igoeti) is not environmentally sensitive and could be attributed to category B according to WB classification but would still require the preparation of a site specific EIA to meet national requirements.

The Igoeti – Sveneti section including the construction of a new bypass and bridges at Igoeti is sensitive environmental area due to archeological sites, erosion and land instability issues and natural (terrestrial and aquatic) habitats at Igoeti particularly. According to WB environmental guidelines the section from Igoeti – Sveneti would therefore be classified as a Category A project requiring the preparation of a site specific EIA and EMP. At the same time, no "showstoppers" have been identified and it is likely that the anticipated impacts even in the sensitive zone (Igoeti) could be managed by application of conventional slope stabilization technologies, TEM design and construction standards and good environmental practices.

2.4 RDMED Responsibilities and Capacity Analysis

The Roads Department of the Ministry of Economic Development (RDMED) of Georgia is responsible for elaboration of policy and strategic plans related to developing motor roads, management of road and traffic related issues and construction, rehabilitation, reconstruction and maintenance of the roads of public use utilizing funds from the state budget, lawns, grants and other financial sources. The RDMED is carrying function of State Procurement entity in relation with the

aforementioned services and activities (in accordance with the law of Georgia on State Procurements) and is responsible for preparing tender documentation and realization of tenders.

Thus, the RDMED is responsible for the procurement of design and EIA studies, as well as works on construction and rehabilitation of roads and is responsible for ensuring compliance with the Georgian legislation and environmental and social requirements of the relevant donor organizations.

The RDMED should have adequate capacity to ensure due consideration of environmental and social concerns at the stages of strategic planning, project development, design and environmental studies and construction or reconstruction activities.

Within the RDMED there is special unit dealing with the environmental issues of the RDMED managed projects. The name of the unit is Division of the Project Assessment, New Technologies and Environmental Protection within the Office of the Technical Policy. The head of the division is Mr. David Kerashvili and Environmental Specialist – Mrs. Neli Khidasheli.

This division is supposed to review the EIAs and EMPs related to the RDMED projects and perform monitoring of compliance of the contractor's performance with the approved EMPs, EIAs, environmental standards and other environmental commitments of the contractor.

Actual capacity of the team is estimated to be sufficient for execution of monitoring of the Agaiani – Sveneti Highway project. At the same time, so far as amount of road rehabilitation and construction projects is increasing, we consider that some capacity building is appropriate for RDMED.

To cope with its general tasks, the RDMED needs capacity building including but not limited to following:

- Employment of the assistant for the Environmental Specialist, who will be responsible on routine monitoring of ongoing projects under the instructions of the Environmental Specialist

- Development of the GIS and Data Management system and procurement of corresponding equipment. The GIS system should provide geographical maps with linked databases and layers of technical and environmental information including but not limited to: as-built drawings, current alignment and technical conditions of roads and infrastructure; geohazards; environmental sensitivities; land-use and other socio-economic information on villages and settlements near highway; monitoring and maintenance plans etc. Later developed GIS system could become good basis for GPS based traffic monitoring.

- Training on GIS and Environmental Management Systems

III. Summary of the Baseline Information on Key Environmental Sensitivities

Introduction

This chapter presents a summary of the key environmental baseline issues that should be considered during impact analysis. Detailed environmental baseline information on climate, air and noise environment, ground and surface water receptors, flora and fauna, cultural heritage is provided in Annex 1.

The approach taken in presenting a summary of baseline environmental information is to link this to the natural landscape which is considered to be a genetically homogeneous natural-territorial complex with uniform geological base, single relief, climate and correspondent soil-vegetation cover. Climate, rocks and soils, surface- and ground-water, relief and vegetation cover are the major components naturally integrated as a landscape. The natural landscape therefore provides a basis for forming different ecosystems and biocenoses. Therefore, the landscape is an appropriate natural unit for summarizing integral features of environmental sensitivities, including habitats, ecosystems, and water resources. Mutual influences of the mentioned components should be considered during assessment of direct and indirect impacts of the project activities. Landscape based analysis of sensitivities is provided in paragraph 3.1.

Air quality and baseline noise is important for impact analysis but there is a lack of sufficient and recent information. In paragraph 3.2 we therefore provide summary of existing information, as well as recommendations for further survey that would be required, especially in the vicinity of populated areas adjacent to the motorway. This will help to fill baseline information gaps and allow impact analysis.

Information on other environmental receptors, including habitats and ecosystems, flora and fauna, groundwater and surface water, as well as land instability and geohazards are summarized below in paragraphs 3.1, 3.3 and 3.4.

Land instability issues are discussed in paragraph 3.3. Summary tables are presented in paragraph 3.4 of the environmental sensitivities (including cultural heritage) for each section of the highway.

3.1 Landscapes

Landscapes in Environmental Impact Assessment

Though landscapes consist of smaller natural-territorial complexes, they are unified into larger typological units. The largest classification unit of natural landscapes is “class” (Beruchashvili, 1979). Geomorphologic factor can be used for its determination. According to the mentioned factor there are 2 classes of landscapes: mountain and plain landscapes.

The next classification unit is a “type”. The type of natural landscapes – the landscapes with the common features of the relief morpho-structure, connected with various levels of mountains (low, medium, high mountains), with the common character of climate, with the predominance of one type or group of vegetation and with the common character of hydrological conditions.

For their part natural landscape types are divided into landscape subtypes, kinds (sorts, genus) and species. On the basis of minor sector and zonal symptoms, subtypes of landscape are singled out within the type of landscape. On the entire territory of Georgia 21 subtypes have been selected. The next classification unit is the kind of landscapes that is identified on the basis of morphostructural peculiarities and the prevailing type of relief (erosive, karst, erosive-accumulative, etc.) It is also based on prevalence of one or several geological formations or groups of vegetation formation, concrete hydrological conditions and finally because of complex and diverse morphological structures. In all there are 72 kinds (sorts, genus) of landscapes in Georgia. The maps with the scale of 1: 500000 also show species of landscapes – the lowest typological classification unit in the landscape system of Georgia. On the whole there are 260 species of landscapes in Georgia.

During the landscape impact assessment, the following variety of landscapes should be distinguished within the territory:

- Unchanged natural landscapes - natural territories having been changed at a relatively lesser degree, which are interesting in respect of their biological diversity, ecological or esthetic value. After these natural-territorial complexes are studied, their environment should be protected and conserved.

- Partially transformed natural landscapes - natural-anthropogenic territories. The biodiversity supporting role of such landscapes is decreased, although ecological, recreational and visual aspects, as well as economical significance (e.g. agricultural) could be valuable. Their ecological and esthetic conditions should be considered during impact assessment and planning mitigation measures.

- Severely transformed natural landscapes. - Natural-territorial complexes having been strongly and violently changed. Urban or rural landscapes, which do not have ecological, biodiversity and recreational significance, although, may have historical, architectural or economical value (arable lands, pastures etc.)

Value of natural landscapes could be estimated applying multi-criteria analysis:

- from the point of view of biodiversity
- from the point of view of ecology
- from the aesthetic and visual point of view
- from the point of view of cultural heritage
- from the recreational point of view

Stability/fragility of the landscapes is determined by several factors:

- Susceptibility to natural degradation (erosion, landslides and debris flows, deforestation and degradation of phyto-landscapes, desertification, degradation of watershed etc.)
- vulnerability/resistance to anthropogenic factors

- self-regeneration capabilities

Description of the Landscape Along the Motor Road: Agaiani-Sveneti

For the area of concern the list of landscapes has been developed using landscape maps of Caucasus and Georgia (Beruchashvili, 1979, 1995). The numeration of kinds of landscapes is given in accordance with this source describing in total 150 kinds of landscapes for Caucasus, from which 72 kinds are represented in Georgia. The kinds of the landscapes are distinguished based on morphostructural peculiarities and prevailing type of relief (erosive, karst, erosive-accumulative, etc.), concrete hydrological and hydro geological conditions and humidity, as well as on prevalence of one or several types of soil cover and groups of vegetation formation.

This review has demonstrated that:

- Four kinds of landscapes belonging to 3 subtypes are represented in the area of concern (see annex 2.Maps; landscape maps):

  - **Landscapes 19a and 19b** - hill-mound erosive-denudative landscapes belonging to the subtype of Plain and Hilly Sub- Mediterranean Iveria landscapes.

  - **Landscape 23** - plain-hill-mound accumulative landscape belonging to the subtype of Plain and Hilly Semi-Arid Iveria landscapes

  - **Landscape 51** - plain accumulative and floodplain grove landscape belonging to the subtype of Hydromorphic and Subhydromorphic landscapes.

- All the landscapes represented in the area of concern (corridor for the highway section Agaiani-Sveneti) belong to the common class of plain landscapes.

- All these landscapes are characterized by similar climate conditions - cool winter and hot summer (see paragraph 3.1 and annex 1, para 1.1).

Landscape 23. Agrarian transformed landscapes

Summary of Landscape Types

(a) Landscape 19a

Classification **Kind:** **Subtype:**	 **<u>Landscape 19a</u> (see landscape map) –** hill-mound erosive-denudative landscape, with oriental hornbeam-oak derivates, thorny shrubs (sibljak), Plain and Hilly Sub- Mediterranean Iveria landscapes
Spatial distribution	South to the highway route – along the whole section from Agaiani to Sveneti. See the landscape map
Geomorphology	N_{1+2} $dS_1^{\wedge 2}$ - Upper part of the Lower Sub-Zone of the Dusheti Suit: well sorted out and cemented medium grain pebble conglomerates with alteration of sandstone and clayey
Relief	Low-hill knolls and ridges, of which Kvernaki and Tselebi ridges are the best known ones. The average sizes of hillock ridges are 800-1000 meters, although their maximum height reaches 1112 meters. The knolls are characterized by erosive-denudative relief, slanting Northern and steep Southern slopes
Soil cover	cinnamon -colored soils (ref. Annex 1/ 1.5)
Groundwater depth	more than 10m
Humidity	The indicator of the soil humidity in the landscape of Iveria steppe is low, and therefore, the amount of hydro masses is lower than average. Relatively humid and cool conditions. As the height increases, hydrothermal conditions are improved and therefore, sibljak is spread on the slopes of other expositions and crests.
Type of vegetation cover	Oriental hornbeam-oak derivates, thorny shrubs (sibljak), partially aridic, thin woods Thornshrub-hornbeam-oak forests on cinnamon-colored soils are spread on the bottom of well-humidified gullies, 800 meters above sea level. The natural-territorial complexes on the bottom of dry gullies, in hollows and on the slopes of Northern exposition are represented by sibljak - xerophilous bushes (Christ's-thorn, oriental hornbeam) growing in groups. (ref. see annex 1. / 1.6)
Intact/Transformed	Partially and strongly transformed natural landscapes Only some areas of Kvernaki ridge and Igoeti have relatively better preserved natural-territorial complexes.
Value	In general – varies from low to medium value. Kvernaki ridge slopes (section 3) have high aesthetic and medium ecologic value; Igoeti landscape (section 2) has high ecologic and scenic value
Vulnerability	Although the valuable landscapes near Igoeti in the vicinity of the highway routes are already strongly transformed, the less transformed sites should be protected. High risks of erosion and landslide triggering by construction activities. Valuable Kvernaki ridge landscapes are out of project impact.

(b) Landscape 19b

Classification **Kind:** **Subtype:**	**<u>Landscape 19b</u> (see landscape map) -** hill-mound erosive-denudative landscape, phryganon, beard steppes, sometimes badlands. Plain and Hilly Sub- Mediterranean Iveria landscapes
Spatial distribution	See the landscape map
Geomorphology	N_{1+2} dS_1^2 - Upper part of the Lower Sub-Zone of the Dusheti Suit: well sorted out and cemented medium grain pebble conglomerates with alteration of sandstone and clayey
Relief	Low-hill knolls and ridges. The knolls are characterized by erosive-denudative relief, slanting Northern and steep Southern slopes
Soil cover	cinnamon -colored soils (ref. Annex 1/ 1.5)
Groundwater	more than 10m
Humidity	The slopes mainly of South expositions and crests are drier and hot as compared with 19a. The indicator of the soil humidity in the steppe landscape is low, and therefore, the amount of hydro masses is lower than average.
Type of vegetation cover	The natural complexes are represented with phrygana, with beard-grass steppes, sometimes with bad lands. The secondary beard-grass steppes are developed in the places previously occupied by forests of foothill slopes (oakwoods, hornbeam forests). (ref. see annex 1. / 1.6)
Intact/Transformed	Partially and strongly transformed natural landscapes Only some areas of Kvernaki ridge and Igoeti have relatively better preserved natural-territorial complexes.
Value	In general – varies from low to medium value Kvernaki ridge slopes have high aesthetic and medium ecologic value; Igoeti landscape has high ecologic and scenic value
Vulnerability	Although the valuable landscapes near Igoeti in the vicinity of the highway routes are already strongly transformed, the less transformed sites should be protected. High risks of erosion and landslide triggering by construction activities. Valuable Kvernaki ridge landscapes are out of project impact.

(c) Landscape 23

Classification **Kind:** **Subtype:**	 **<u>Landscape 23</u> (see landscape map)** - plain-hill-mound accumulative landscape, with beard steppes, thorny shrubs (sibljak), rarely meadows. Hilly Semi-Arid Iveria landscapes
Spatial distribution	See the landscape map
Geomorphology	aQ_{IV} - modern alluvial river floodplain sediments: pebbles, boulders, gravel, sand and loamy sand; p-d Q_4 - modern proalluvial-delluvial (talus) formations: clayey, loamy sand, inclusions of bed-rock debris; a-p Q_{IV} - alluvial – proalluvial - pebble, boulders, clayey, loam a^2Q_{IV} and a^3Q_{IV} - alluvial sediments of the second and third over-floodplain terraces: pebbles, boulders, sand; loam and clayey
Relief	Alluvial plains of Tiriponi and Mukhran-Saguramo, which are structured with stone talus, sand, loams and clays. These plains are characterized by relatively even basin-like relief, with slight dissection by the influence of river erosion.
Soil cover	The meadow cinnamon-colored soil (ref. Annex 1/ 1.5)
Groundwater depth	3 – 9m Dense network of artificial channels is widely spread here
Humidity	In summer, the soil humidity decreases to 15-16%. Unfavorable hydrothermal conditions and lack of humidity hampers development of forests within these landscapes. Intense agriculture here depends on the irrigation system.
Type of vegetation cover	At present, landscapes are well developed by a human. Significant area is occupied by natural-agrarian complexes. Almost 90% of the plains are covered by arable lands with crops, gardens and vegetable pitches. (ref. see annex 1. / 1.6)
Intact/Transformed	The mentioned natural landscape, as represented along the motor highway, is almost fully transformed into agrarian landscape.
Value	In general – varies from low to medium value No ecological and aesthetic value. Economic value – arable lands, gardens and vegetable pitches.
Vulnerability	In general – low Some agricultural plots will be replaced during the highway widening and should be compensated.

(d) Landscape 51

Classification **Kind:** **Subtype:**	 **<u>Landscape 51</u> (see landscape map)** - plain accumulative and floodplain grove landscape, with riparian (tugai) forests, meadows, rarely bogs and solonchaks (salt-marshes) – floodplains of rivers Ksani, Tortla and Lekhura. Hydromorphic and Subhydromorphic landscapes
Spatial distribution	Spread near v.Agaiani, v.Igoeti, from Igoeti to Kaspi, and from Kaspi in the direction of v.Gamdlistskaro. See the landscape map
Geomorphology	a^1Q_{IV} - alluvial sediments of the first over-floodplain terraces: pebbles, boulders, sand and loamy sand filler, loamy sand, clayey
Relief	In the floodplains of major rivers, where there are natural-territorial complexes with grove forests located on alluvial soils.
Soil cover	Alluvial soils (ref. Annex 1/ 1.5.)
Groundwater depth	0 – 3m
Humidity	Due to the close location of ground waters to the earth surface the level of humidity is permanently high;
Type of vegetation cover	The fragments of riparian forests: Aspen woods, willow woods, oak woods, elm woods and others are mainly spread here; the grass is as a rule, moisture-proof. Of the grass, one can meet cattail, reed, water plantain, etc. in this area (ref. see annex 1. / 1.6)
Intact/Transformed	Partially transformed natural landscapes
Value	In general – varies from medium to high value; Riparian forests are of high ecologic and scenic value;
Vulnerability	The riparian forests are not in the zone of direct impact; The landscape may be vulnerable to indirect impacts of the project connected with the quarrying of gravel and inert construction materials;

Fragment of landscape 51. Riparian Forest. Willow

Regions with Relatively Well-preserved Natural Landscapes

The main section of the route passes across the landscapes with strongly changed natural landscapes. Only some areas of Kvernaki (located at a distance from the highway route) ridge have relatively better preserved natural-territorial complexes.

Regions with Sensitive landscapes

Fortunately, the highway route mainly passes through the natural-territorial landscapes with relatively less or average esthetic value. Site reconnaissance allowed identifying the following areas, which need detailed landscape research:

Section 1 (Agaiani – Igoeti)

- Landscape 51 - Floodplain of river Ksani in the vicinity of v. Agaiani (riparian forests).

Section 2 (Igoeti)

- Landscape 51 - Floodplains of r. Lekhura and Tortla (riparian forests) near Igoeti, from v.Igoeti to Kaspi, and from Kaspi in the direction of v.Gamdlistskaro
- Zone of landscapes 19a and 19b in the vicinity of v. Igoeti - In the Igoeti area the endemic and Red Data Book (RDB) species *Paeonia tenuifolia* and *P. carthalinica* are found in steppes, while the endemic and RDB species *P. majko* and *P. caucasica* are found in *Quercus-Carpinus* forest edges. Groups of *Amygdalus georgica* (RDB Georgia) are also found close to Igoeti, as

well as groups of the shrub *Nitraria schoberi* (RDB Georgia) which is characteristic of Asian deserts.

Section 3 (Igoeti – Sveneti)

- Landscapes 19a - Kvernaki ridge forested slopes of Northern exposition present sensitive ecological and valuable aesthetic landscapes. The landscape is vulnerable to anthropogenic influence in general but is out of the project impact zone.

Landscape 19a. Forested Northern Slopes of Kvernaki Ridge

Conclusions

Construction activities related to the highway upgrading on the section of Agaiani-Sveneti should not cause basic landscape changes, moreover when the mentioned territory is fully anthropogenised. The issues of quarrying gravel, pebble and other construction material in connection with the project and related impact on the landscape should be studied and will be the subject of expertise later at the EIA stage.

More attention should be paid to the impact assessment is sensitive landscapes – riparian forest groves (e.g. Lekhura and Ksani floodplains) and Igoeti landscape - sensitive as it provides habitats for endangered and Red Data Book (RDB) species

3.2 Climate, Air Quality, Noise

Climate

According to the classification of the authorized climatologist M. Kordzakhia, the considered territory - the highway "corridor" - belongs to the dry subtropical climatic zone, extending from the Likhi ridge to the East Georgia until Georgia-Azerbaijan border.

Based on the classification made by M. Kordzakhia we can conclude that the considered territory covers the climatic region of the Shida Kartli Plain. The climatic survey of this region is based on the information provided by Gori, Mukhrani and partially, Kaspi meteorological stations. Detailed data is provided in the Annex 1.

Air Quality

Before the breakdown of the Soviet Union, the State Hydro meteorological Services were responsible for regularly measuring the concentrations (3 times daily) of the basic air pollutants: particulate matter, SO2, NO2 and CO, as well as some specific pollutants from local stationary sources. These measurements were carried out in Georgia until 1991 in 11 large cities at 33 measuring sites. Over time, however, their scope has slowly been reduced. There are also no monitoring stations that would comply with the requirements of the Cooperative Program for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe (EMEP). Reliable measurements of air quality after 1994 are not currently available. In most cities the maximum allowable concentrations (MAC) are exceeded.

Yet this existing data, particularly data on Kaspi, is not representative for the road section of Agaiani-Sveneti, as the city is yet quite at a distance from the road and the road section is entirely located within the rural area. Air pollution is not measured in rural areas. However, the proposed section is located in rural areas and it is expected that air quality would be very good owing to the current relatively limited scale of industry and road traffic in Georgia.

Road traffic is the major source of air pollution in Georgia, followed by the energy sector and industry. Traffic intensity is high in larger cities and, in extreme cases, it amounts to 60,000 vehicles per day (e.g. in Tbilisi).

In general the baseline data indicates that levels of measured pollutants are high only in large cities. The air quality along the motorway route except Tbilisi, Rustavi, (partially Zestaphoni and Kutaisi) is currently very good. These findings are unsurprising given the current extent of industrial activity and road transport currently within Georgia.

In summary, the existing air quality should be examined so that any potential for impact on air quality associated with releases to atmosphere from increased traffic can be assessed in an additive context. The major points for additional sampling and analysis should be located in the vicinity of villages and populated areas along the highway.

Noise

The Scientific Research Institute of Environmental Protection until its dissolution was responsible for the monitoring and management of noise, but there is no systematic nationwide monitoring of noise, because of limited resources. Noise is measured as a response to complaints by the public.

From 1999 to 2002, noise was measured in five sites in Tbilisi. The noise level at 7.5 m above the curb ranged from 71dB to 80 dB. Railroad noise 25 m from the track was 65 dB during the day and 63dB at night. Noise was also measured in 1999-2001 in Rustavi (73-75 dB), Poti (72-74 dB), Telavi (70dB) and Gori (72 dB). According to European standards, the maximum noise level for urban areas is 65 dB during the day and 55 dB at night. These sporadic measurements indicate that traffic noise has reached disturbing levels in the major cities, and the levels are expected to increase due to a rising trend in traffic density.

In summary, there is no sufficient information to be sure that along the road section Agaiani-Sveneti noise level is within the standards, although the expectations are that no real problems should arise in that regard. However, at the detailed design and site specific EIA stage there is a need to monitor noise levels near the settlements and consider preventive measures against noise in planning.

3.3 Geohazards and Landscape Stability

Geological Hazards Connected With Construction Corridor of Agaiani-Sveneti Section of the Motor Road

The section of Agaiani-Sveneti of the existing motor road, in respect of geological hazard is mainly attributed to the category of low and medium tension. According to seismic risk, the mentioned section is included in the earthquake zone of scores 8-9, with the period of repetition of twice in 1000 years. The strongest earthquake registered in the studied region for the last 100 years was the 8-score earthquake (Richter scale) in the city of Gori in 1920. Seismic impacts, as a rule deteriorate the slope stability followed by the induction and/or activation of landslide fractions. Earthquakes often result in falling stones, especially from the artificially cut slopes along the motor road. Quite dangerous modern geological processes are quite frequent thus deteriorating the engineering-geological conditions of the territory and especially, in the zones of their intense development. The degree of intensity and character of those processes is mostly dependant on geological and geomorphologic structure of the studied territory, as well as rude and violent interference in the natural processes through human's economic activities. Among the modern hazardous geological processes one should mention weathering, gravitational debris-slide (falling stones), landslide, mudflow and debris flow, erosion, ground subsidence, floods, and banks washing-off (lateral erosion). All the above-listed processes take place along the motor road. Below we are giving their description from East to West.

In the areas adjacent to the points where the motor road crosses the river Ksani, the banks are intensely washed out. It should be mentioned that the present morphology of the banks of the river Ksani (especially its left bank) much differs from the relevant drawings on the topographic map of the 1970s. This difference is the result of erosive action of the river during the high waters and floods. High waters in the spring seasons of 2005-2006 are a clear evidence of frequent floods of

the river Ksani, and flooding and washing-out of its banks having greatly damaged the village of Ferma located 2 kilometres from the motor road.

Section 1. Agaiani – Igoeti

As for the section from the village of Agaiani to the village of Igoeti, any kind of dangerous geological process capable of significantly damaging the motor road has not been registered.

Section 2. Igoeti

At the end of the 1980s, during the building works of a bypass road of village Igoeti, due to cutting off the vertical wall there was a landslide body formed in the conglomerates of Dusheti suit ($N_1+_2d\check{s}^2_1$) on the right of the motor road, east of the village of Igoeti (See Fig. site 1). Conglomerates in the given section are weakly cemented and during the artificial cutting (benching) cannot retain the vertical wall (cut, shear). In the outcrop the clay interbeds with the bed thickness of 0.5 m. are well fixed between the conglomerates. Landslide is of a block type, and it is partially a flow slide. In respect of its spreading area it is of a medium size category. The landslide is active at present.

In fact, a similar landslide body is met 150 meters left of the motor road leading from the village of Igoeti to the village of Lamiskana. This landslide was also formed during the road works (See Fig. site 2). On the territory of the village of Igoeti, an almost 2-km-long section of the design road, in respect of geological hazard is included in the category of high risk. For the purpose of completing the engineering works the studies of the mentioned section are necessary.

In the areas adjacent to the point where the motor road crosses the river Lekhura the banks are washed-out, dry gullies are formed, and there are debris flows. The river Lekhura has a varying hydrological regime and is debris flow prone river. Of the mentioned processes, the banks wash-out and debris flow drifts are most dangerous for the motor road. The cases of destructing the fundamental bridges and intense wash-out of banks by the river Lekhura unfortunately, followed by human victims are known in the past (beginning of the 1950s).

The conglomerate (Dusheti suit) of a steep slope on the right of the existing motor road, 700-800 meters from the right bank of the river Lekhura is slightly cemented and strongly weathered resulting in frequent gravitational debris fall of coarse-grained material onto the motor road. As we know, the project envisages widening of the existing motor road along this section. This will require either cutting off the slope on the right of the road, or widening the area to the left at the expense of the floodplain terrace of the river Eastern Tortla. In the first instance, the situation having occurred in the 1980s during the road construction adjacent to the village of Igoeti and described by us may be the case (landslide is meant here). As for the widening of the road to the direction of the river Eastern Tortla, we should mention that the distance between the road and the vertical stage of the river, which is of average height about 4-5 meters, is little (3-4 m) and therefore, widening should take place at the expense of the river floodplain terrace. Implementation of all necessary engineering works needs special studies of this section.

Igoeti. Landslide induced by road construction: site 1

Igoeti. Landslide induced by road construction: site 1

Igoeti. Landslide induced by road construction: site 2

Section 3. Igoeti-Sveneti

The section of the motor road between the village of Gamdlistskaro and the village of Sveneti mostly follows a southern edge of Tiriponi plain and in respect of geological danger it is included in the category of low risk. However, there are some sections dominated by the clays and loams of proalluvial-dealluvial and alluvial-proalluvial genesis distinguished by low physical-mechanical (geotechnical) properties. This is particularly true with the section of the motor road from the village of Akhalsheni to eastern periphery of the village of Sveneti. In one part of this section (between the restaurant "Gudabertkia" and the gas-filling station), the river Western Tortla meanders violently and gets close the motor road (See Fig. site 3). As we know, the existing road along the mentioned section is planned to be widened. Due to the fact that the slope on the left side of the road is structured with weakly cemented and depleted conglomerates, in case of its cutting off, it will be unable to preserve stability and will collapse. As for the widening the road in the direction of the river Western Tortla, it should be mentioned that so-called "island" having formed as a result of the river meandering is mainly structured by loessial-like subsiding grounds (clays, loams). Therefore, we consider special studies of the mentioned section to be organized prior to starting the road construction aiming at successfully implementing the engineering works.

As practice has demonstrated, one of the main reasons for damaging the motor roads in the Region of Shida Kartli is their violent and incorrect exploitation and therefore, we consider strict control through monitoring absolutely necessary.

Vicinity of v. Sveneti. Unstable ground near meandering river. Tortla: site 3

3.4 Protected Areas, Sensitive Environmental Receptors and Sites Prone to Natural Hazards

3.4.1 Protected Areas and Sensitive Zones along the Highway

No protected areas and extremely valuable and sensitive sites are crossed by the Agaiani – Sveneti section of the highway, The nearest sensitive zones crossed or passed close by the highway are Saguramo Nature Reserve and Agameti Nature Reserve and Surami (Likhi ridge) sensitive area. These are described below. The area of concern – Agaiani –Sveneti section of the highway is located just between these sensitive zones and project related activities will not have any direct impact on these areas. The indirect impact should be reviewed in the context of the operation of the whole length of the highway.

- **Saguramo Nature Reserve -** Saguramo Nature Reserve was established in 1946 and covered an area of 4000 ha. During the following years the territory of Nature Reserve was expanded to 5359 ha, 4979 ha of which are covered by forest. This complex nature reserve was created for the protection of the natural landscapes of East Georgia, broadleaved forests, the relicts of the tertiary period Kolkhidean flora and the animals, which are near to extinction (Caucasian noble deer, lynx).

  The nature reserve is located on Saguramo mountain ridge, to the North-East from Mtskheta, on the right bank of river Mtkvari. It is 20km from Tbilisi and is included in its green zone. To the

North -West forest-reserve is conterminous with river Aragvi and villages: Saguramo, Akhalsopeli, Galavani, Shankevani, Kotoraantkari and Buriani. To the South-East it borders up the villages: Tsitsamuri, Avchala, Gldani, territories of the Tbilisi National Park and Mtsketa Forest Farm.

- **Ajameti Nature Reserve -** In 1928 the area of 20 ha in Kutaisi Forest was declared a reserve. In 1935 a botanical reserve was established on the whole area of Ajameti Forest (3620 ha). At present the area of the reserve covers 4848 ha. The purpose of the reserve is to protect and maintain the rare relict species of the tertiary period - Quareus imeretica and Zelcova caspirinifolia; to carry out scientific research and biotechnical measures; and to facilitate the reproduction of these species.

  Ajameti Reserve is located in the eastern part of Kolkheti lowland, on the left side of the river Rioni in the basin of its tributaries Kvirila and Khanis Tskali. The forest tract extends from east to the west for 13 km. The average width of the forest tract is 3-5 km. Vertical boundaries are 80 - 200 m above sea level. Reserve is located in densely populated area with intensive agriculture. The territory of reserve is surrounded by the lands of Vartsikhe Farm and lands of the villages Dimi, Persati, Bagdati, Rodinouli, etc.

- **Likhi Ridge -** Likhi (Surami) ridge serves as dividing line between western and eastern Georgia. It is characterized with floristic peculiarities; moreover, it is a migration corridor for a number of animal species. This section is of particular significance from zoological point of view since Likhi is the linking chain between Great Caucasus and Caucasus Minor and at present it is the only “bridge” in Georgia that connects the isolated animal populations of these areas. The section is of no less importance in botanical terms as it covers large forests as well as habitats with forest fragments. Many plant species present here belong to the relics of the Tertiary period and are included in the Georgian Red Data Book. (E.g. Quercus imeretina).

3.4.2 Sensitive Zones and Zones with the Maximum Concentration of Rare and Endemic Species Crossed by the Agaiani – Sveneti Section of Highway

Section 1. Agaiani - Igoeti

Type of Receptor	Location – designation on the sensitivity map	Environmental Value	Sensitivity in the Project Context
Landscape, ecosystems; terrestrial habitats;	**Landscape 51** - Floodplain of river Ksani in the vicinity of v. Agaiani Floodplain (tugai) forests and River Coast ecosystems: Aspen woods (Populus hybrida), willow woods (Salix australior), oak woods (Quercus longipes), elm woods (Ulmus suberosa). Small mammal species and mustelids including endemics of the Caucasus and 4 endangered in Georgia and, the bats, are observed in remnants of Tugai forests. The riparian forests are protected according to the Forestry Code. See floristic and faunistic description of landscape 51 in annex 1.	Medium	Medium
Surface Water; Aquatic habitats;	**r. Ksani** near v. Agaiani The most important areas for conservation of main habitats are the breeding grounds for reophilous and non-reophilous fish (see Ichtyofauna in annex 1)	High	Medium
Groundwater	Landscape 51 - Floodplain of river Ksani in the vicinity of v. Agaiani (depth 0-3m)	Medium	Low
Archeological Sites	No 1 – 11 (see 3.10) near villages Agaiani and Okami	High	Medium
Sites prone to natural hazards	Not detected	No	No

Section 2. Igoeti Bypass

Type of Receptor	Location – designation on the sensitivity map	Environmental Value	Sensitivity in the Project Context
Landscape, ecosystems; terrestrial habitats;	**Landscape 51** - Floodplains of r. Lekhura and Tortla (floodplain forests) near Igoeti, from v.Igoeti to Kaspi, and from Kaspi in the direction of v.Gamdlistskaro; The riparian forests are protected according to the Forestry Code. *Hippophae rhamnoides (*RDB) and floodplain forests: Aspen woods (Populus hybrida), willow woods (Salix australior), oak woods (Quercus longipes), elm woods (Ulmus suberosa). Small mammal species and mustelids	Medium High	Medium Medium

Type of Receptor	Location – designation on the sensitivity map	Environmental Value	Sensitivity in the Project Context
	including endemics of the Caucasus and 4 endangered in Georgia and, the bats, are observed in remnants of Tugai forests. **Zone of landscapes 19a and 19b** in the vicinity of v. Igoeti - Ecosystems of this type are quite diverse in regard of bush vegetation and species composition of plants and animals. In the Igoeti area the endemic and Red Data Book (RDB) species *Paeonia tenuifolia* and *P. carthalinica* are found in steppes, while the endemic and RDB species *P. majko* and *P. caucasica* are found in *Quercus-Carpinus* forest edges; *Hippophae rhamnoides is found within 19a zone*. Groups of *Amygdalus georgica* (RDB Georgia) are also found close to Igoeti, as well as groups of the shrub *Nitraria schoberi* (RDB Georgia) which is characteristic of Asian deserts. see 3.2 and floristic and faunistic description of landscapes 19a and b and 51 in annex 1		
Surface Water; Aquatic habitats;	**r. Lekhura and Tortla** The most important areas for conservation of main habitats are the breeding grounds for reophilous and non-reophilous fish (see Ichtyofauna in annex 1)	High	Medium
Groundwater	Landscape 51 - Floodplains of r. Lekhura and Tortla (depth 0-3m)	Medium	Low
Archeological Sites	No 12 – 21 (see 3.10) near villages Igoeti and Samtavisi	High	High
Sites prone to natural hazards	**landslide body** formed in the conglomerates of Dusheti suit (N_1+$_2$dš$^2_1$) on the right of the motor road, east of the village of Igoeti **Similar landslide body** is met 150 meters left of the motor road leading from the village of Igoeti to the village of Lamiskana (ut of mainline, located On cross-road) The banks wash-out and debris flow drifts in the areas adjacent to the point where the motor road crosses the river Lekhura Erosion and risk of landslide triggering a steep slope on the right of the existing motor road, 700-800 meters from the right bank of the river Lekhura	High risk High risk Medium High risk	Manageable Manageable Manageable Manageable

Section 3. Igoeti – Sveneti

Type of Receptor	Location – designation on the sensitivity map	Environmental Value	Sensitivity in the Project Context
Landscape, ecosystems; terrestrial habitats;	**Landscapes 19a** - Kvernaki ridge forested slopes of Northern exposition present sensitive ecological and valuable aesthetic landscapes. Ecosystems of this type are quite diverse in regard of bush vegetation and species composition of plants and animals Oakwoods and hornbeam forests and sibljak steppes developed on the foot-hill slopes in the places of oakwoods and hornbeam forests. (see 3.2 and floristic description of landscape 19a in annex 1) The landscape is vulnerable to anthropogenic influence in general but is out of the project impact zone.	From medium to high	Low (so far as this landscape is not within the impact zone)
Surface Water; Aquatic habitats;	**r. Tortla** The most important areas for conservation of main habitats are the breeding grounds for reophilous and non-reophilous fish (see Ichtyofauna in annex 1)	High	Medium
Groundwater		From Low to Medium	From Low to Medium
Archeological Sites	No 22 – 31 (see 3.10)	High	High
Sites prone to natural hazards	The section of the motor road from the village of Akhalsheni to eastern periphery of the village of Sveneti. In one part of this section the river Western Tortla meanders violently and gets close the motor road. The slope on the left side of the road is structured with weakly cemented and depleted conglomerates. In case of its cutting off there is high risk of collapse. As for the widening the road in the direction of the river Western Tortla, it should be mentioned that so-called “island” having formed as a result of the river meandering is mainly structured by loessial-like subsiding grounds (clays, loams).	High	Manageable

IV. Environmental Impacts and Their Mitigation

4.1 Summary of Anticipated Impacts and Required Mitigation Measures

Construction Phase

#	Impacts Related to Construction Activities		
	Impacts	Section and Site	Mitigation Measures
1	Destruction of natural landscape (relief, soil cover, vegetation, eco-systems, habitats and wildlife) in the right-of-way occupied by the highway. **Character of impact**: immediate drastic changes of landscape in the construction corridor.	Section II – Igoeti Bypass Beard-grass and shibliak steppe landscapes with RDB species of plants River floodplain landscapes and floodplain forests should be considered.	**Mitigation strategy**: prevalence of preventive measures: Realignment where possible to detour exceptional areas, identified by prior surveys (valuable landscapes, ecosystems, cultural landscapes). Pre-entry survey, replanting of rare species, prevention of damage to fauna, top-soil storage **long-term (remediation)**: – see mitigation strategy for operation phase
2	Destruction of natural landscape (relief, soil cover, vegetation, eco-systems, habitats and wildlife) on the access roads, in the borrow pit sites, waste dumps, construction camps and equipment yards. **Character of impact**: immediate drastic changes of landscape in the construction corridor.	To be identified during EIA	**Mitigation strategy**: prevalence of preventive measures: • Realignment where possible to detour exceptional areas, identified by prior surveys • Pre-entry survey, replanting of rare species, prevention of damage to fauna, top-soil storage • Harvest and utilization of public domain forest resources prior to construction. • Compensation given to private landowners. **long-term (remediation)**: – see mitigation strategy for operation phase
3	Landslides, slumps, slips and other mass movements in road cuts triggered by the construction activities. **Character of impact**: **immediate** -triggering of failure (during construction or soon after completion) –	Section II – Igoeti Bypass See the map: "Sensitive environmental Receptors and Sites Prone to Natural Hazards"	**mitigation strategy**: proper routing to avoid inherently unstable areas, and prevention through implementing slope failure protection engineering measures – temporary retaining installations, temporary drainage etc. These are combination of construction safety and environmental mitigation

4	Erosion stimulated from fresh road cuts and fills and temporary sedimentation of natural drainage ways. **Character of impact: immediate**; Fresh road cuts may immediately trigger intensive erosion during construction and drastic increase of sedimentation	Slopes and vicinity of surface water streams Sections I, II and III	**mitigation strategy**: avoidance, proper routing, and prevention through implementing temporary anti-erosion measures – temporary drainage, biomatting or geo -textile cover, berms etc. • Limitation of earth moving to dry periods. • Protection of most susceptible soil surfaces with mulch. • Protection of drainage channels with berms, straw or fabric barriers. • Installation of sedimentation basins
5	Erosion of lands below the road bed receiving concentrated outflow from covered or open drains.	Slopes and vicinity of surface water streams	• Increase number of drain outlets. • Place drain outlets so as to avoid cascade effect. • Line receiving surface with stones, concrete.
6	Increased suspended sediment in streams affected by erosion at construction sites and fresh road cuts, fills and waste dumps. Declined water quality and increased sedimentation **Character of impact**: immediate; Fresh road cuts may immediately **trigger** intensive erosion during construction and drastic increase of sedimentation	In the vicinity of surface water streams Sections II and III	**Mitigation strategy**: prevention through implementing temporary anti-erosion measures – temporary drainage, temporary sediment cathments etc. • Protect susceptible surfaces with r fabric, • Establishment of retention ponds to reduce sediment loads before water enters streams
7	Impact of construction activities on aquatic ecosystems of the rivers and streams crossed by the highway	Direct - Sections II and III Indirect – quarries	Consider seasonal constraints Protect water applying sediment catchments etc.
8	Soil and water contamination during construction by oil, grease, fuel and paint in the RoW, equipment yards and asphalt plants.	Sections I, II and III	• Collect and recycle lubricants. – • Avoid accidental spills through good practice. • Avoid refueling near watercourses • Check vehicles (leaking of fuel etc.)

9	Poor sanitation and solid waste disposal in construction camps and work sites (sewerage, sanitation, waste management)	Sections I, II and III	Provide adequately located and maintained latrines and waste disposal facilities
10	Construction wastes alongside the RoW and roadside litter.	Sections I, II and III	• Provide for disposal facilities agreed with MoE
11	Air pollution from vehicle operations during construction in populated areas traversed by the highway, notably metropolitan areas or densely settled rural areas. Local dust.	Sections I, II and III Villages and settlements	• Require adherence to engine maintenance schedules and standards (or use alternative fuels) to reduce air pollution. • Periodically water down or lightly oil temporary roads. • Enhance public transportation and traffic management capability.
12	Air pollution from asphalt plants.	To be identified during EIA	Install and operate air pollution control equipment.
13	Noise pollution from vehicle operation during construction in populated areas traversed by the highway, notably metropolitan areas or densely settled rural areas. Local noise.	Sections I, II and III Villages and settlements	• Include physical barriers to noise in plans. • Enhance public transportation and traffic management capability. • Install and maintain mufflers on equipment.
14	Poaching by construction workers	Near rivers and forested areas Sections I, II and III	Prohibit poaching
15	Creation of temporary breeding habitats for mosquito vectors of disease e.g. sunny, stagnant pools of water. Creation of stagnant water bodies in borrow pits, quarries, etc. suited to mosquito breeding and other disease vectors.	Sections I, II and III	Assessment of vector ecology in work areas and employment of measures (e.g., improved landscaping, filling or drainage) to avoid creating habitats.
16	Health hazards by noise, air emissions and dust raised and blown by vehicles during construction activities.	Sections I, II and III Villages and settlements	Dust control by application of water or chemicals. Noise control, installation of mufflers on equipment, daytime works;

17	Social disruption caused by the construction related activities in the RoW, the borrow pit sites, waste dumps, construction camps and equipment yards.	Sections I, II and III Villages and settlements	Provide for disposal facilities. Waste Management and Monitoring
18	Hazardous driving conditions where construction interferes with pre-existing roads.	Sections I, II and III Villages and settlements	Provide in design for proper markers on roads, including lights. Instruct the drivers
19	Accident risks associated with vehicular traffic and transport, that may result in spills of toxic materials, detonation of explosive load, injuries or loss of life(see WB Environmental Sourcebook 'Hazardous Materials Management' section), injuries or loss of life (see 'Public Health and Safety section) Accidents due to construction related vehicles and heavy machinery or traffic interference with construction activities.	Sections I, II and III Villages and settlements	• Design and implement safety measures and an emergency plan to contain damages from accidental spills. • Designate special routes for hazardous materials transport. • Regulation of transport of toxic materials to minimize danger. • Prohibition of toxic waste transport through ecologically sensitive areas. • See "Industrial Hazard Management" and "Public Health and Safety" sections in the WB Environmental Sourcebook

Operation Phase

#	Long-term impacts of Project Implementation and Specific Impacts of Operation Phase		
20	**Lon-term degradation of natural landscape** at land strips and slopes adjacent to highway. Visual impacts. Change of drainage patterns, erosion, degradation of vegetation, fragmentation of habitats.	Special attention to Section II – Igoeti Bypass See the map: "Sensitive environmental Receptors and Sites Prone to Natural Hazards" Sectiones I, II, III	Realignment where possible to avoid valuable landscapes and ecosystems; **Mitigation strategy:** prevalence of long-term remediation and conservation measures. Reinstatement of landscape and vegetation cover, bio-restoration, landscaping, mitigation of visual impacts, conservation of replanted rare species
21	Lon-term degradation of natural landscape (relief, soil cover, vegetation, habitats and wildlife) on the access roads, in the borrow pit sites, waste dumps, construction camps and equipment yards.	To be identified during EIA	• Alternative alignments • Harvest and utilization of public domain forest resources prior to construction. • Compensation given to private landowners. • Restoration of sites to original conditions to extent possible through reclamation measures
22	Landslides, slumps, slips and other mass movements in road cuts and adjacent territories stimulated or triggered by the project. **Character**: long-term impact caused by woodcutting and clearance of slope vegetation, change of drainage patterns, change of relief and soil compactness ,deep cuts etc.- gradual development of landslide and postponed failure during operation phase.	Section II – Igoeti Bypass See the map: "Sensitive environmental Receptors and Sites Prone to Natural Hazards"	• Provide drainage works as needed to reduce risk, according to prior surveys. If it is not possible to realign route to avoid inherently unstable areas: **Mitigation strategy**: long-term remediation and stabilization works: reinstatement of relief, vegetation cover and landscape; Long-term monitoring; Installation of long-term drainage systems and retaining structures.
23	Erosion from road cuts and fills and sedimentation of natural drainage ways. Erosion of lands below the road bed receiving concentrated outflow from	Slopes and vicinity of surface water streams Sections I, II and III	**Mitigation strategy:** long-term – remediation; reinstatement of relief and landscape; Long-term monitoring; Installation of long-term drainage systems and anti-erosion structures. Reinstatement

24	Landscape disfiguration by embankments and deep cuts, fills and quarries. Marred landscape (scars from rod cuts, induced landslides and slumps etc.).	Specific attention to the section II	• Tourist site access roads planned with regard for visual aesthetics. • Grade limitations to avoid cutting ad filling where scenery would be spoiled • Maintenance and and/or restoration of roadside vegetation • Use an architectural design to 'blend with the landscape. • Replant disfigured surfaces.
25	Changes of hydrological patterns of the rivers and streams crossed by the highways induced by installation of bridges, revetments, river-bank protection installations and other hydrotechnical installations and related impacts on infrastructure, arable lands and ecosystems located on adjacent territories	Sections II and III	Monitoring of effects like lateral erosion of riverbanks etc. River bank protection measures, where needed
26	Alteration of overland drainage and subsoil drainage patterns (where road cuts intercept perched water tables, springs, etc.)	Sections I, II and special attention to section III (crossings of dry gullies)	Installation of adequate drainage works.
27	Increased suspended sediment in streams affected by erosion at construction sites and fresh road cuts, fills and waste dumps. declined water quality due to increased sedimentation. **Character of impact**: long-term. Change of relief, drainage patterns, land clearance, may cause gradual but stabile intensification of erosion	Slopes and vicinity of surface water streams Sections II and III	**Mitigation strategy:** long-term – remediation; Reinstatement of relief and landscape; Long-term monitoring; Installation of long-term drainage systems and anti-erosion structures. Reinstatement of vegetation cover. • Protect susceptible surfaces with mulch or fabric, • Establishment of vegetative cover on erodible surfaces as soon as possible • Establishment of retention ponds to reduce sediment loads before water enters streams

28	Soil and water contamination by oil, grease, fuel and paint alongside the highway	Sections I, II and III	Standard refueling stations and repair shops along the highway
29	Contamination of ground and surface waters by herbicides for vegetation control or chemicals (e.g. calcium chloride) for dust control	Sections I, II and III	• Reduction of use • Alternative (non chemical) methods of control
30	Air pollution from asphalt plants during maintenance works.	Sections I, II and III	Install and operate air pollution control equipment.
31	Air pollution from vehicle operation, in populated areas traversed by the highway, notably metropolitan areas or densely settled rural areas. Local dust.	Sections I, II and III Villages and settlements	• Require adherence to engine maintenance schedules and standards (or use alternative fuels) to reduce air pollution. • Enhance public transportation and traffic management capability. • Periodically water down temporary roads.
32	Noise pollution from vehicle operation, in populated areas traversed by the highway, notably metropolitan areas or densely settled rural areas.	Sections I, II and III Villages and settlements	• Include physical barriers to noise in plans. • Enhance public transportation and traffic management capability.
33	Roadside litter.	Sections I, II and III	• Provide for disposal facilities. • Encourage anti-littering laws and regulations.
34	Creation of a new pathway for disease vectors affecting humans and animals.	Sections I, II and III	Establishment of plant ad animal sanitation service and related checkpoints
35	Creation of a transmission corridor for diseases, pests, weeds and other undesirable organisms	Sections I, II and III	Set up plant and animal sanitation service and related checkpoints.
36	Health hazards by dust raised and blown by vehicles.	Sections I, II and III Villages and settlements	Dust control by application of water or chemicals.

37	• Dislocation and compulsory resettlement of people living on the right of way • Near cites and in rich farming regions, many people can be affected	Minimal impact (landowners and owners of trading kiosks along the highway)	See "Involuntary Resettlement" section Locally unprecedented mechanisms and procedures may be required to arrive at equitable and adequate compensation, and a companion effort to develop the capacity may be required
38	Obstruction of routes from homes to farms, etc, increasing travel time.	Positive impact is expected due to better organization of interchanges.	Provide appropriate designed and located crossings
39	Impairment of non-motored transportation in the highway corridor due to reduced or impeded rights-of-way.		Include slow traffic lanes and/or paved shoulders and safe crossings.
40	Induced development: roadside commercial, industrial, residential, and "urban sprawl".	May have positive socio-economic impact. Requires preliminary assessment and development planning (required infrastructure: sanitation, solid waste disposal facilities etc.)	Involve land use planning agencies at all levels in project design and EA, and plan for controlled development.
41	Planned development and illegal invasion of homelands of indigenous peoples by squatters and poachers causing serious social and economic disruption	Should be considered in EIA	. See Indigenous Peoples" section (WB environmental Sourcebook).
Operation Phase Emergency Related Impacts			
42	Accident risks associated with vehicular traffic and transport, that may result in spills of toxic materials injuries or loss of life(see WB Environmental Sourcebook: 'Hazardous Materials Management' section), injuries or loss of life (see 'Public Health and Safety section) Accidents due to increased traffic.	Sections I, II and III	• Design and implement safety measures and an emergency plan to contain damages from accidental spills. • Designate special routes for hazardous materials transport. • Regulation of transport of toxic materials to minimize danger. • Prohibition of toxic waste transport through ecologically sensitive areas.

4.2 Recommendations on Further Studies

Site specific EIAs and Environmental Management Plans (EMPs) will be required to meet Georgian environmental requirements and the safeguard policies of the World Bank. While this Environmental Assessment report provides a description of sensitive sites and the most important impacts for project proposals for the alignment between Agaiani and Sveneti the preliminary list of possible impacts and mitigation measures (per media or activity) provided here is not exhaustive. A comprehensive project specific list and in-depth analysis will therefore be prepared under the site specific EIA. Annex 3 provides an outline of the scope of work for a site specific EIA.

Here we summarize recommendations embedded in this report and related to the requirement for further extended baseline studies and/ or impact analysis during the preparation of the site specific EIAs and EMPs.

Cultural Heritage

Field survey of the archaeological monuments located close to highway and access roads used for construction, their identification through literary sources, fixing and marking the limits of spread of the archaeological monuments and description of their technical state should be conducted. Close locations of the monuments to hazardous geological events and the engineering-technical limitations are to be considered, as well. As for the aboveground monuments, their present state is to be documented, their present physical state is to be evaluated, and the probability of negative affects of the construction activities on them and mitigation measures are to be determined.

It should be mentioned that taking preventive measures among other things first of all, means the archaeological urgent supervision during the construction period, what is the guarantee for studying an archaeological monument unexpectedly found in the course of construction in case of necessity. If considering topography of archaeological monuments in the given section, such an opportunity seems absolutely real.

Pre Construction Geohazard Evaluation

We consider special studies of the geohazard prone sections should be organized prior to starting the road construction. List of proposed engineering-geological (geotechnical) studies to be carried out at the detailed design and EIA stage of Agaiani-Sveneti Motor Road Upgrading Project in respect of geological hazard as follow will be provide:

- Engineering-geological survey;
- Drilling works;
- Laboratory research;
- Survey operations;
- Drawing up a report.

Post Construction Geohazard Monitoring

As practice has demonstrated, one of the main reasons for damaging the motor roads in the Region of Shida Kartli is shortages of maintenance, particularly control of rock falls and landslides and

corresponding damages. Therefore, we consider strict control through monitoring is absolutely necessary.

Air Quality

The existing air quality should be examined. The major points for additional sampling and analysis should be located in the vicinity of villages and populated areas along the highway. Modeling of expected emissions for the upgraded highway should be provided, so that any potential for impact on air quality associated with releases to atmosphere from increased traffic can be assessed in an additive context.

Noise

However, at the detailed design and EIA stage there is a need to assess baseline noise levels near the settlements, perform noise level forecasts for the upgraded highway and consider preventive measures against noise during planning set of mitigation measures.

Quarrying

The issues of quarrying gravel, pebble and other construction material in connection with the project and related impact on the landscape should be studied and will be the subject of expertise later at the EIA stage.

Ecology

More attention should be paid to the impact assessment is sensitive landscapes – riparian forest groves (e.g. Lekhura and Ksani floodplains) and Igoeti landscape - sensitive as it provides habitats for endangered and Red Data Book (RDB) species. Preentry survey is required as mitigation measure to avoid impacts on fauna and damage of habitats. Potential seasonal constraints (e.g. migration of waterfowls and using the floodplains as resting sites) should be considered in EIA.

Construction of bridges across the rivers or construction activities close to the rivers should be planned considering seasonal character of environmental risks: springtime is the period for spawning of the fish species in the rivers of Kura basin and the fish populations are most vulnerable during this period.

Hazardous Materials Management

Accident risks associated with vehicular traffic and transport, that may result in spills of toxic materials injuries or loss of life should be analyzed based on preliminary assessment of hazardous materials transportation patterns: statistical data and regulations related to fuel and other materials transportation. In particular, transportation of fuel by road-tankers should be analyzed and related risks estimated.

Pest Management

Highway projects are often associated with the pest dissemination impacts. On the territory of concern number of parasites, pests, diseases, weeds, and harmful micro organisms is expected to increase and could be spread during the highway construction and due to increased traffic.

During construction specific attention should be paid to soil related dangerous diseases, like Anthrax. Preliminary mapping of Anthrax risk sites (part of EIA) and monitoring during construction activities (part of EMPs) should be applied. The monitoring considers observation during construction in order to identify burial sites and to apply further required sanitation procedures.

The plant pest dissemination also requires control. Special attention should be paid to such quarantine pests as Fall webworm (*Hyphantria cunea Drury*), which damages about 300 plant species, including wood species. The attention should be paid to eggar *Oceria dispar*, bark beetles *Ipidae*, phylloxera (*Viteus vitifoliae*), grape stock withering (*Phomopsis viticola*), corn diploid (*Stenocarpella macrospora*), ragweed (*Ambrosia antemisiifolia*), etc. as to avoid the expected damage.

V. Analysis of Alternatives

5.1 "No Project" Alternative

Socio-economical benefits of the project have been identified during the Feasibility Studies performed by Louis Berger and Transprojekt Roads Survey and Design Institute in the years 2003-2004 and by Atkins Consultants Ltd in the year 2005. The abovementioned studies have confirmed that - "In general, the social-economic effect resulting from the proposed road modernization project can provide for overall increase in wealth and access to livelihoods for the national population. The main national benefit is: increased quality of the major transport artery which contributes in national economy, better infrastructure, increased government revenues from transit taxes which could contribute to improved social services. The use of local labor will provide inflow of cash into the local economies along the motorway route".

As we have mentioned earlier, no "showstoppers" have been identified during preliminary environmental assessment performed by Consultant's environmental team and it is likely that the anticipated impacts even in the sensitive zone (Igoeti) could be managed by application of conventional slope stabilization technologies, TEM design and construction standards and good environmental practices. Therefore, no extraordinary costs are imposed by the necessity of mitigation measures.

Final conclusion is that the "No Project" alternative should be rejected and only alignment alternatives are subject for further analysis.

6.2 Alternative Alignments

Introduction

The Alternative Alignments for consideration have been proposed for two short segments of the road between Agaiani and Sveneti:

1. The first alternative to the existing alignment is given for the site near the village Igoeti.
2. The second is proposed for the village Shavshebi.

The alternatives will be compared on a ground of qualitative multi-criteria analysis taking into account conclusion of the Feasibility Study and general technical requirements set forth in relevant international standards and requested by the Government of Georgia.

Criteria for Comparing Different Alignments

- The objectives of the project should be met
- Compliance with the TEM technical standards and WB environmental guidelines is mandatory. Technical requirements and standards to be respected during all stages of project development and useful for comparing alternatives, as well, are described in the chapter I of this report.
- The environmental and social impacts should be mitigated and compensated to the acceptable level

- Very rough consideration of additional costs (in terms of – acceptable/unacceptable) imposed by necessity of mitigation

Notes on Methodological Approach

According to the Terms of Reference for current assignment, the aim of Consultant is "to conduct a rapid analysis of the alternatives that are currently envisaged by RDMED regarding the upgrade of this road to a 4-lane highway. The Consultant will gather existing information at RDMED and will check that the alternatives that are proposed by RDMED are feasible. The Consultants will make sure that the alternatives are compatible with the Bank requirements regarding environmental assessment and resettlement. As a result the Consultants should be able to confirm or to comment the alternatives envisaged by the Government. At this stage, the Consultants are not expected to carry out large multi-criteria analysis to investigate on potential benefits and impacts of the investment on economy, social pattern, urban, environment and so on but rather to comment on the alternatives that were selected by the Government".

In accordance with the ToR, we propose qualitative multi-criteria analysis, which, to our opinion, provides sufficient ground for decision-making. Very rough consideration of additional costs (in terms of – acceptable/unacceptable) imposed by necessity of mitigation and compensation seems to us feasible and sufficient to meet ToR requirements. Quantitative cost-benefit analysis would be excessive exercise not being necessary for decision making and not required by the ToR.

6.2.1 Igoeti Alternatives

Technical description of alternatives for Igoeti Section

Option 1. Using the Existing Road - The existing road (yellow line on the picture 1) is 2-lane highway with standard characteristics. The radius and profile gradients for some segments of the section do not comply with the technical requirements.

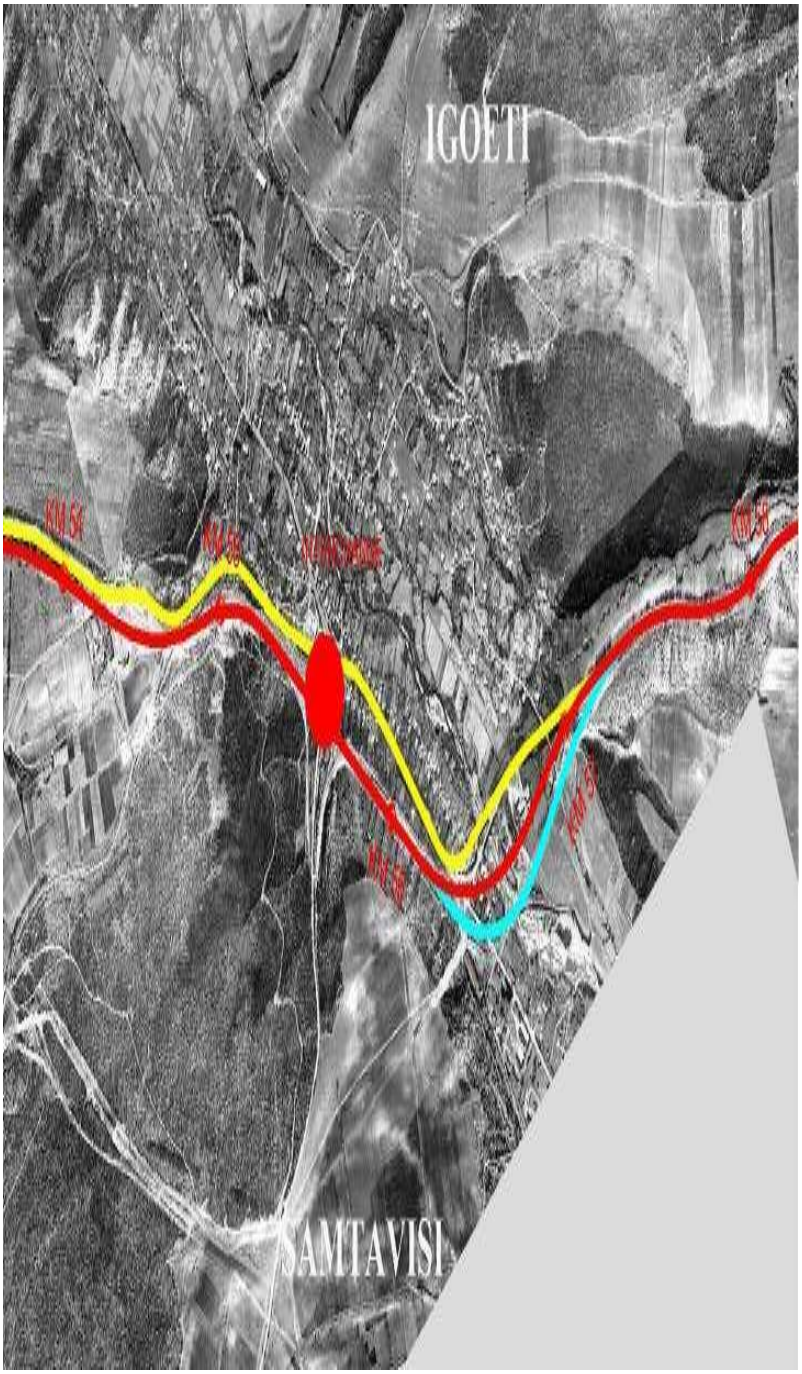
The upgrade of this road to 4 lanes using the current alignment is not possible due to physical constraints – terrain limitations. Therefore, the option of using the current alignment boils down to either (i) a "no project" alternative or (ii) separation of the 2 carriageways – one 2-lane carriageway using the current alignment and the other in a new and parallel alignment. Both of these options are not feasible from the engineering and traffic management standpoint and do not comply with the requirements of the Government and international standards.

Options 2. and 3. Construction of a Bypass - The proposed bypass would require the construction of a new road section. Two options for this alignment are shown in picture 1 as red and blue lines correspondingly. Both alignments would enable a 4-lane highway to be constructed.

The "blue alignment" (**option 2**) has been proposed to avoid several buildings that would result in resettlement. However, the characteristics of the road for the "blue alignment" option (especially – the radius) are not in full compliance with the technical requirements.

The "red alignment" (**option 3**) is considered to be the most feasible from the engineering and traffic management standpoint. The land clearance for the "red alignment" was completed in Soviet times.

Option 1[3] – Combination of option 1 and option 3 - We have analyzed one additional option that proposes a combination of options 1 and 3: 2-lane carriageway for one direction using the existing alignment and a 2-lane carriageway for opposite direction following the option 3 alignment. This option considers rehabilitation of existing 2-lane road and construction of new 2-lane section.



Aerial Photo with alternative alignments (Igoeti section)

Comparison of Alternatives (Igoeti)

Factors	Option 1 2x2 Lane highway on the existing alignment Yellow line on the picture	Option 1[3] 2 Lane carriageway on the existing alignment and other 2 Lane Carriageway at option 3 alignment Yellow and red alignments	Option 2 2x2 Lane highway on the alignment The "blue alignment" (more distant from the village) Blue line on the picture	Option 3 2x2 Lane highway on the alignment The "red alignment" (closer to the village) Red line on the picture
Technical Constraints				
Constraints to meet Project objective (2x2lane Highway)	Due to terrain limitations 2x2-lane highway could not be provided by widening the existing road	No constraints	No constraints	No constraints
Specific Design Measures enabling to meet Project objective	To keep this alignment and construct 2x2 lane highway substantial change of design and construction of specific installations of very large overall dimensions (e.g. overpass viaducts etc.) will be required. **No feasible design. Unacceptably High Costs**	Normal Viaducts Acceptable Costs	Normal Viaducts Acceptable Costs	Normal Viaducts Acceptable Costs
Constraints to comply with TEM standards	The segment of existing road is not in compliance with the TEM standards (superelevation gradient; radius of alignment in horizontal cross-section)	The segment of existing road is not in compliance with the TEM standards (superelevation gradient; radius of alignment in horizontal cross-section)	**The radius of the alignment (in horizontal cross-section) does not comply with the TEM standards .**	**Compliance**

Specific Design Changes enabling to comply with TEM standards	To keep this alignment in conformance with the TEM standards substantial change of design and construction of specific installations of very large overall dimensions (e.g. overpass viaducts etc.) will be required. **No feasible design. Unacceptably High Costs**	Substantial change of design and construction of specific installations of very large overall dimensions (e.g. overpass viaducts etc.) will be required. **No feasible design. Unacceptably High Costs**	**Could not be provided**	**No additional costs**
Terrain Constraints				
Terrain limitations for construction (2x2lane Highway)	Due to terrain limitations 2x2-lane highway could not be provided by widening the existing road	Due to terrain limitations benching of the slopes is unavoidable	Due to terrain limitations benching of the slopes is unavoidable	Due to terrain limitations benching of the slopes is unavoidable
Specific Design Changes required to overcome terrain limitations	To keep this alignment and construct 2x2 lane highway substantial change of design and construction of specific installations of very large overall dimensions (e.g. overpass viaducts etc.) will be required. **No feasible design. Unacceptably High Costs**	Benching and slope stabilization Acceptable Costs	Benching and slope stabilization Acceptable Costs	Benching and slope stabilization Acceptable Costs
Geohazards	No	2 active landslides and one potential	2 active landslides and one potential	2 active landslides and one potential

Geohazard mitigation	Not required	drainage and slope stabilization Acceptable Costs	drainage and slope stabilization Acceptable Costs	drainage and slope stabilization Acceptable Costs
Eorsion	No	Yes	Yes	Yes
Eorsion Mitigation	Not required	drainage and slope stabilization Acceptable Costs	drainage and slope stabilization Acceptable Costs	drainage and slope stabilization Acceptable Costs
Environmental Constraints				
Triggering erosion	No	Yes	Yes	Yes
Mitigation of erosion	No	drainage and slope stabilization Acceptable Costs	drainage and slope stabilization Acceptable Costs	drainage and slope stabilization Acceptable Costs
Triggering landslides and rock falls	No	Yes	Yes	Yes
Mitigation of landslides	No	drainage and slope stabilization Acceptable Costs	drainage and slope stabilization Acceptable Costs	drainage and slope stabilization Acceptable Costs
Impact on Cultural Heritage	Low Risks	**Relatively Higher Risk**	**Relatively Higher Risk**	**Medium Risk**
Mitigation of impacts on cultural heritage	Supervision during construction. Conservation of findings. Minimal efforts and resources	Supervision during construction. Conservation of findings. More human and financial resources are needed as compared with other options	Supervision during construction. Conservation of findings. **More human and financial resources are needed as compared with other options**	Supervision during construction. Conservation of findings. **Minimal efforts and resources** Acceptable Costs

Impacts on terrestrial ecosystems and habitats	No	Valuable ecological habitats of endemic and RDB species are under the Risk. Risk level is from low to medium due to the fact that the land clearance for this alignment has been partially completed in Soviet times..	Valuable ecological habitats of endemic and RDB species are under the Risk. **Risk level is from medium to high.**	Valuable ecological habitats of endemic and RDB species are under the Risk. **Risk level is from low to medium due to the fact that the land clearance for this alignment has been partially completed in Soviet times.**
Mitigation Measures	No	Pre-entry survey supervision Reinstatement Conservation **Relatively Lower costs than for option 2**	Pre-entry survey supervision Reinstatement Conservation **Acceptable costs**	Pre-entry survey supervision Reinstatement Conservation **Relatively Lower costs than for option 2**
Impacts on aquatic habitats	Minimal	Valuable aquatic habitats of endemic and economically valuable fish species are under the Risk. Risk is manageable.	Valuable aquatic habitats of endemic and economically valuable fish species are under the Risk. Risk is manageable.	Valuable aquatic habitats of endemic and economically valuable fish species are under the Risk. Risk is manageable.
Mitigation Measures	Minimal. Apply construction standards Compensation calculated by MoE acceptable costs	Minimal. Apply construction standards. Compensation calculated by MoE acceptable costs	Minimal. Apply construction standards. Compensation calculated by MoE acceptable costs	Minimal. Apply construction standards. Compensation calculated by MoE acceptable costs
Impacts on water resources	Insignificant and temporary	Insignificant and temporary	Insignificant and temporary	Insignificant and temporary

Mitigation	Minimal. Apply construction standards	Minimal. Apply construction standards	Minimal. Apply construction standards	Minimal. Apply construction standards
Residual Impact of Traffic Noise on the Population in case of implementing possible mitigation measures	From low to medium Acceptable but requires further assessment and control	Lower than for option 1	**Lower than for option 1**	**Lower than for option 1**
Mitigation of Noise	Regulatory requirements on vehicle good repair and traffic speed limitations	Regulatory requirements on vehicle good repair and traffic speed limitations	Regulatory requirements on vehicle good repair and traffic speed limitations	Regulatory requirements on vehicle good repair and traffic speed limitations
Residual Impact of Traffic Emissions on the Population in case of implementing possible mitigation measures	From low to medium Acceptable but requires further assessment and control	Lower than for option 1	**Lower than for option 1**	**Lower than for option 1**
Mitigation	Regulatory requirements on vehicle good repair and fuel quality	Regulatory requirements on vehicle good repair and fuel quality	Regulatory requirements on vehicle good repair and fuel quality	Regulatory requirements on vehicle good repair and fuel quality
Safety of Traffic	Incompliance with TEM standards. Closeness to the village. One level interchange. Medium level risks.	Incompliance with TEM standards. Closeness to the village. One level interchange. Medium level risks.	Incompliance with TEM standards. **The radius of the alignment (in horizontal cross-section) does not comply with the TEM standards.** **From low to medium risk.**	Compliance with TEM standards. **Low risk**
Mitigation of Traffic Risks	No efficient measures are possible	No efficient measures are possible	No efficient measures are possible	Not required

Conclusion	To keep this alignment and construct A2 class highway substantial change of design and construction of specific installations of very large overall dimensions (e.g. overpass viaducts etc.) will be required. Unacceptably high costs should be paid to meet project objectives, comply with the TEN standards and ensure acceptable safety risks	The alignment does not provide compliance with the TEN standards. Therefore, the level of safety is less than for the option 3.	The alignment does not provide full compliance with the TEN standards. Radius in the horizontal cross-section is less than required 400m. Therefore, the level of safety is less than for the option 3. Environmental and social impacts are manageable and costs of mitigation/compensation are of acceptable range.	Full compliance with the TEN standards and project objectives could be met. Environmental and social impacts are manageable and costs of mitigation/compensation are of acceptable range.

Main Environmental Issues in the Area of Concern

The Igoeti section is the most sensitive area on the whole alignment of the Agaiani-Sveneti road. See Annex 1 for a detailed description of the baseline environmental conditions. Here we will focus on the principle issues. Igoeti area should be considered as sensitive because of the following factors:

a) This is erosion and landslide prone area. There are three sections (two at the bypass alignment and one – immediately after the bypass enters the main alignment) affected by the landslides, which were activated by the slope cutting during the land clearance for the bypass in Soviet times.

b) The area is ecologically sensitive. In the Igoeti area the endemic and Red Data Book (RDB) species Paeonia tenuifolia and P. carthalinica are found in steppes, while the endemic and RDB species P. majko and P. caucasica are found in Quercus-Carpinus forest edges. Groups of Amygdalus georgica (RDB Georgia) are also found close to Igoeti, as are groups of the shrub Nitraria schoberi (RDB Georgia) which is characteristic of Asian deserts. The river Lekhura is sensitive aquatic habitat. The most important areas for conservation of main habitats in this segment of r. Mtkvari (Kura) basin are the breeding grounds for reophilous and non-reophilous fish (endemic species and species used for fishery are among them) between Mtskheta and Gori and fish mass growth areas in the Avchala-Mtskheta region. River Lekhura is important element of this system.

c) The Igoeti area is important in terms of historical monuments and archaeological sites. Several churches, settlements, burial grounds of antique and medieval periods are represented in the area. Some of the archaeological sites have been partly damaged during the construction of the Tbilisi-Gori segment of the highway.

Comparison of Alternatives at Igoeti

As we have mentioned earlier, from the engineering and traffic management standpoint the existing alignment (option 1) and “blue alignment” (option 2) are not feasible. The option 1 has been rejected because of “constructability” issue – the terrain is limiting possibility of constructing 4-lane highway. The option 2 has been denied because of worse geometrical parameters. The option 3 provides better alignment characteristics (radius about 600m, as required) and accordingly – better safety features of the new road.

The impacts on landscape and archaeological sites for construction of the new section (both – option 2 and option 3) are expected to be higher than in case of upgrading the existing 2-lane alignment, but the anticipated impacts are not severe and could be well mitigated through application of the convenient landslide stabilization techniques, archaeological survey and general “good environmental practices”. At the same time, the benefits of constructing new sections of the 4-lane road as compared with the existing situation (“no project” option) are obvious:

- suits the needs for traffic capacity
- more safe traffic conditions for transport, as well as for the local population

- less noise impacts on the village Igoeti (more distant location and better driving conditions)
- less emission impacts on the village Igoeti (more distant location and efficient driving regime)

Therefore, the environmental arguments could be useful to compare option 2 and 3 but could not be used as argument against construction of the new section of the 4-lane highway, whereas the old alignment can not be upgraded to the 4-lane highway due to the physical constraints.

Comparison of option 2 and 3 reveals that the options are equivalent in terms of landslide risks. At the same time the option 3 has following advantages:

- option 3 is preferable due to better geometrical features of the road and accordingly higher level of safety
- option 3 is preferable due to the fact that the land clearance already have been completed for this alignment in Soviet times and new disturbance to the land (ecology, archaeology, landscape) is much less for this option than for the option 2

The only advantage of the option 2 is that few buildings are avoided.

Summarizing, we can say that the option 3 is the preferable option. At the same time we would like to stress that the Igoeti section of the highway is the most environmentally sensitive and special attention should be paid to this section within the EIA. Appropriate mitigation and compensation measures should be integrated into the relevant EMPs and implemented during construction and operation phase.

6.2.2 Shavshebi Alternative

Technical Description of Alternatives

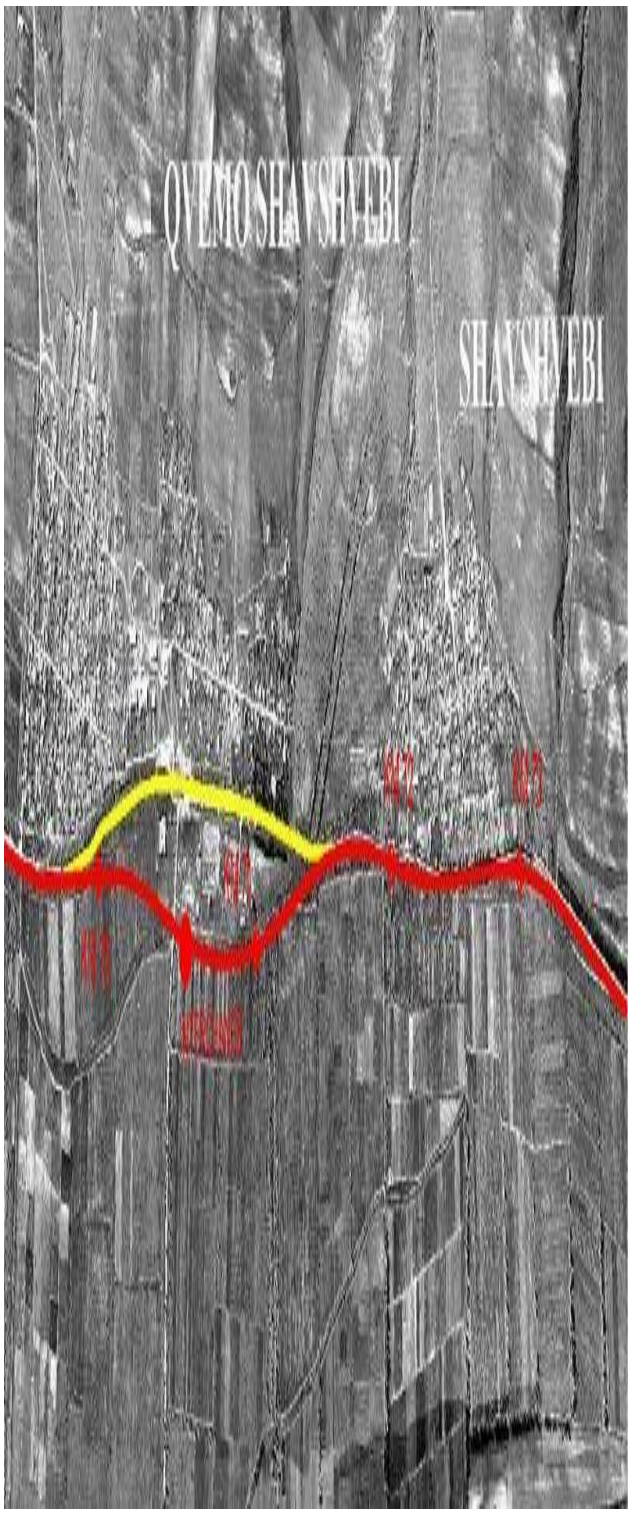
The alternative options in Shavshvebi area are presented by two alternative alignments:

a) 4-lane highway on the existing 2-lane alignment and

b) 4-lane highway bypassing to the northern side. In this case the existing road will be maintained as rural road for the village interconnection. The bypass gives possibility to avoid the villages and optimize highway and rural traffic.

Main Environmental Issues in the Area of Concern

The area is not sensitive from environmental standpoint. The landscape is transformed and is not interesting from the standpoint of nature conservation or protection. The only receptors definitely affected by the project are the agricultural lands (relevant concerns are described in more details in the sociological report). The other types of adverse environmental impacts (risks of groundwater contamination, etc.) are considered to be minimal, mitigable and what is more important for comparing alternatives – equal for both options of the alignment.



Aerial Photo – Alternative alignments Shavshvebi.

Comparison of Alternatives (Shavshvebi)

Factors	**Option 1** **2x2 Lane highway on the existing alignment** Yellow-green line on the picture	**Option 2** **2x2 Lane highway bypassing villages** The red curve enveloping settlements (red spots)
Technical Constraints		
Constraints to meet Project objective (2x2lane Highway)	No constraints	No constraints
Specific Design Measures enabling to meet Project objective	Standard design Acceptable Costs	Standard design Acceptable Costs
Constraints to comply with TEM standards	Standard design Acceptable Costs	Standard design Acceptable Costs
Specific Design Changes enabling to comply with TEM standards	Standard design Acceptable Costs	Standard design Acceptable Costs
Terrain Constraints		
Terrain limitations for construction (2x2lane Highway)	No constraints	No constraints
Specific Design Changes required to overcome terrain limitations	No constraints	No constraints
Geohazards	No	No
Geohazard mitigation	Not required	Not required
Erosion	No	No
Erosion Mitigation	Not required	Not required
Environmental Constraints		
Triggering erosion	No	No
Mitigation of erosion	Not required	Not required
Triggering landslides and rock falls	No	No
Mitigation of landslides	Not required	Not required
Impact on Cultural Heritage	Low Risks	Low Risks
Mitigation of impacts on	Supervision during	Supervision during

cultural heritage	construction. Conservation of findings. Minimal efforts and resources	construction. Conservation of findings. Minimal efforts and resources
Impacts on terrestrial ecosystems and habitats	No	No
Mitigation Measures	Not required	Not required
Impacts on aquatic habitats	No	No
Mitigation Measures	Not required	Not required
Impacts on water resources	No	No
Mitigation	Not required	Not required
Residual Impact of Traffic Noise on the Population in case of implementing possible mitigation measures	From low to medium Acceptable but requires further assessment and control	**Lower than for option 1**
Mitigation of Noise	Regulatory requirements on vehicle good repair and traffic speed limitations	Regulatory requirements on vehicle good repair and traffic speed limitations
Residual Impact of Traffic Emissions on the Population in case of implementing possible mitigation measures	From low to medium Acceptable but requires further assessment and control	**Lower than for option 1**
Mitigation	Regulatory requirements on vehicle good repair and fuel quality	Regulatory requirements on vehicle good repair and fuel quality
Safety of Traffic	Incompliance with TEM standards. Closeness to the village. One level interchange. **Medium level risks.**	**Compliance with TEM standards. Bypassing villages.** **Two level interchange.** **Low risks.**
Mitigation of Traffic Risks	No efficient measures are possible	No efficient measures are possible
Conclusion	Does not fully comply with the TEM Higher safety risks and presumably higher emission and noise	Full compliance with the TEM standards and project objectives could be met. Environmental and social impacts are manageable and costs of

	impacts on the villages.	mitigation/compensation are of acceptable range.

Comparison of Alternatives

Comparison of the option 1 (existing alignment) and option 2 (bypass) reveals that the option 2 should be preferable:

- suits the needs for the highway traffic capacity and convenience of local rural traffic
- more safe traffic conditions for transport, as well as for the local population
- less noise impacts on the villages (more distant location and better driving conditions)
- less emission impacts on the villages (more distant location and efficient driving regime)
- Complies with the TEM standards requirement to avoid urban areas

Therefore the new alignment (option 2) has the only disadvantage – part of the arable lands used for agricultural needs should be passed to the road project. Resettlement procedures and compensation in accordance with the WB rules and local conditions should be applied.

Annexes

Annex 1. Environmental Baseline Data

A1.1 Air Quality, Noise and Climate

Air Quality

Before the breakdown of the Soviet Union, the State Hydro meteorological Services were responsible for regularly measuring the concentrations (3 times daily) of the basic air pollutants: particulate matter, SO2, NO2 and CO, as well as some specific pollutants from local stationary sources. These measurements were carried out in Georgia until 1991 in 11 large cities at 33 measuring sites. Over time, however, their scope has slowly been reduced. Reliable measurements of air quality after 1994 are not currently available. In most cities the maximum allowable concentrations (MAC) are exceeded. Table below gives the ratio of the measured concentrations at the municipal measurement stations to the maximum allowable values for four cities: Tbilisi, Kutaisi, Batumi and Rustavi.

Air Quality in Tbilisi

Pollutant	WHO air quality guidelines	EC limit value	Georgian MAC	Averages measured over five-year periods		
				1984-1988	1989-1993	1994-1998
Particulate matter, µg/m^3	50.0	150.0	150.0	400.0	350.0	300.0
SO_2, µg/m^3	60.0	50.0	50.0	120.0	90.0	140.0
NO_x, µg/m^3	40.0	..	40.0	45.0	50.0	40.0
CO, mg/m^3	1.0	..	3.0	4.2	4.0	3.2
Phenol, µg/m^3	..	..	3.0	4.4	7.0	4.4
Formaldehyde, µg/m^3	..	..	3.0	12.0	12.5	12.0

Source: UNEP-GRID. Tbilisi Environmental Atlas. Tbilisi, 1999.

The situation is similar in the city of Kaspi, which is the closest to the Agaiani-Sveneti area where measurements are also taken. Yet the data on Kaspi is not representative for the road section of Agaiani-Sveneti, as the city is yet quite at a distance from the road and the road section is entirely located within the rural area. Air pollution is not measured in rural areas. There are also no monitoring stations that would comply with the requirements of the Cooperative Program for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe (EMEP). However, the proposed section is located in rural areas and it is expected that air quality would be very good owing to the current relatively limited scale of industry and road traffic in Georgia.

Exceedances of maximum allowable concentrations (MAC) of selected air pollutants in selected cities

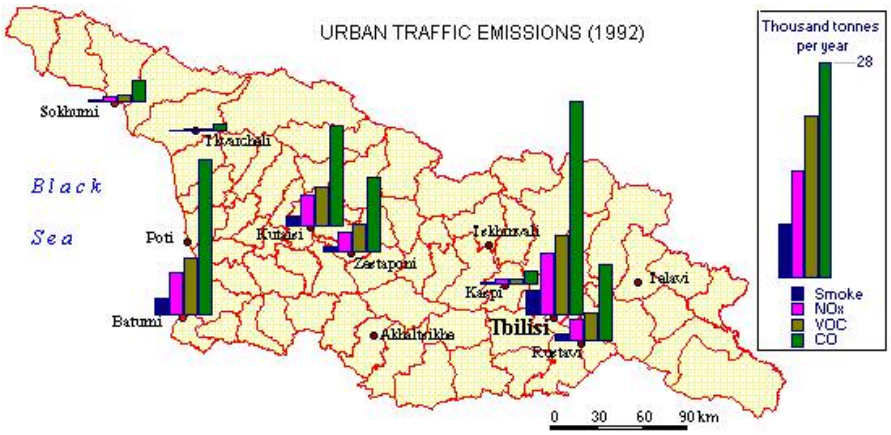
City / pollutant	Exceeded level coefficient		
	1997	1998	1999
Tbilisi			
Particulate matter	2.0	2.0	2.0
SO_2	3.4	3.8	3.5
NO_x	=1.0	=1.0	=1.0
CO	1.3	=1.0	=1.0
Phenol	1.6	1.3	1.6
Formaldehyde	5.0	4.0	4.0
Kutaisi			
Particulate matter	4.0	4.0	4.0
SO_2	1.6	1.2	1.2
NO_x	1.7	1.5	1.2
CO	=1.0	=1.0	=1.0
H_2S	=1.0	=1.0	=1.0
Batumi			
Particulate matter	1.3	1.3	1.3
SO_2	3.2	2.8	3.0
NO_x	1.5	1.5	1.2
CO	=1.0	=1.0	=1.0
H_2S	=1.0	=1.0	=1.0
Rustavi			
Particulate matter	=1.0	2.0	2.0
SO_2	6.0	8.0	8.5
NO_x	2.3	1.7	1.7
CO	=1.0	=1.0	=1.0
Phenol	2.2	2.0	2.0
NH_3	4.9	4.2	4.4
H_2S	=1.0	=1.0	=1.0

Source: Ministry of Environment and Natural Resources Protection, 2001.

Air Emissions

Road traffic is the major source of air pollution in Georgia, followed by the energy sector and industry. Traffic intensity is high in larger cities and, in extreme cases, it amounts to 60,000 vehicles per day (e.g. in Tbilisi).

Georgia has about 3000 stationary sources of air pollution in its main industrial sectors such as energy, iron and steel, chemical and petrochemical, timber and paper, and food. At present, however, few are working at full capacity. The total emission of selected air pollutants is presented in table below. These data are obtained with the use of the CORINAIR methodology, on the basis of emission indicators and activity indicators (mainly in the form of energy consumption or production rate) for different sectors. They include the following stationary sources: power stations, fuel combustion in both industrial and non-industrial enterprises, and industrial processes. Mobile sources include road transport, railway transport, air transport, marine transport and “other” mobile sources.



1000 tons

Pollutants	1999	2000	2001	Share of mobile source emissions (average of 1999-2001)
Particulate matter				
Total	**4.96**	**4.58**	**4.72**	
Stationary sources	3.47	3.11	3.24	
Mobile sources	1.49	1.47	1.48	31%
SO_2				
Total	**6.52**	**6.14**	**6.35**	
Stationary sources	4.16	3.81	4.01	
Mobile sources	2.36	2.33	2.34	37%
NO_x				
Total	**26.79**	**26.04**	**27.7**	
Stationary sources	4.74	4.24	5.03	
Mobile sources	22.05	21.8	22.67	83%
NMVOC				
Total	**28.74**	**27.74**	**28.85**	
Stationary sources	3.26	2.93	3.05	
Mobile sources	25.48	24.81	25.8	89%
NH_3				
Total	**0.04**	**0.03**	*	
Stationary sources	0.04	0.03	*	
Mobile sources	*	*	*	*
CO				
Total	**163.84**	**162.26**	**163.22**	
Stationary sources	4.06	3.76	3.91	
Mobile sources	159.78	158.5	159.31	98%
N_2O				
Total	**0.96**	**0.84**	**0.86**	
Stationary sources	0.93	0.81	0.83	
Mobile sources	0.03	0.03	0.03	3%
CH_4				
Total	**0.73**	**0.62**	**0.64**	
Stationary sources	0.42	0.31	0.32	
Mobile sources	0.31	0.31	0.32	47%
CO_2				
Total	**3235**	**3127**	**3253**	
Stationary sources	1472.0	1371.0	1427.0	
Mobile sources	1763.0	1756.0	1826.0	56%

Source: Ministry of Environment and Natural Resources Protection and State Statistical Department, 2002.
Note: * no data available.

The existing air quality should be examined so that any potential for impact on air quality associated with releases to atmosphere from increased traffic can be assessed in an additive context. However, in general the baseline data indicates that levels of measured pollutants are high only in large cities. The air quality along the motorway route except Tbilisi, Rustavi, (partially Zestaphoni and Kutaisi) is currently very good. These findings are unsurprising given the current extent of industrial activity and road transport currently within Georgia.

Noise

The Scientific Research Institute of Environmental Protection until its dissolution was responsible for the monitoring and management of noise, but there is no systematic nationwide monitoring of noise, because of limited resources. Noise is measured as a response to complaints by the public.

From 1999 to 2002, noise was measured in five sites in Tbilisi. The noise level at 7.5 m above the curb ranged from 71dB to 80 dB. Railroad noise 25 m from the track was 65 dB during the day and 63dB at night. Noise was also measured in 1999-2001 in Rustavi (73-75 dB), Poti (72-74 dB), Telavi (70dB) and Gori (72 dB). According to European standards, the maximum noise level for urban areas is 65 dB during the day and 55 dB at night. These sporadic measurements indicate that traffic noise has reached disturbing levels in the major cities, and the levels are expected to increase due to a rising trend in traffic density.

Therefore, there is no sufficient information to be sure that along the road section Agaiani-Sveneti noise level is within the standards, although the expectations are that no real problems should arise in that regard. However, at the detailed design and EIA stage there is a need to monitor noise levels near the settlements and consider preventive measures against noise in planning.

The current Georgian standards for the noise level are based on former soviet sanitary norms No. 3077-84 and specify different noise levels for different zones. The most relevant standards are the noise limits inside the residential building and outside it (at the wall) which are as follows:
Inside the residential buildings:
For Leq (7a.m. - 11p.m.) the indicative(equivalent) sound = 40dB(A), maximum level = 55dB(A)
For Leq (11p.m. - 7a.m.) the indicative(equivalent) sound = 30dB(A), maximum level = 45dB(A)

Outside the residential buildings (measured at the wall):
For Leq (7a.m. - 11p.m.) the indicative(equivalent) sound = 55dB(A), maximum level = 70dB(A)
For Leq (11p.m. - 7a.m.) the indicative(equivalent) sound = 45dB(A), maximum level = 60dB(A)

Climate

According to the classification of the authorized climatologist M. Kordzakhia, the considered territory - the highway “corridor” - belongs to the dry subtropical climatic zone, extending from the Likhi ridge to the East Georgia until Georgia-Azerbaijan border. The climate within the East Georgian dry subtropical climatic zone is being formed on the border between subtropical and moderate latitudes. In addition there are complex regional physical-geographic conditions (where the Likhi mountain ridge plays a significant role) and the presence of Azerbaijan dry planes from the east side. Here, unlike the damp subtropics, the precipitation amount is lower, the seasonal climate parameters, like differences between seasonal temperatures, are more pronounced; the solar radiation is higher and the humidity is much lower.

Based on the classification made by M. Kordzakhia we can conclude that the considered territory covers the climatic region of the Shida Kartli Plain. The climatic survey of this region is based on the information provided by Gori, Mukhrani and partially, Kaspi meteorological stations.

The region is located at 500-600 meters above the sea level. Cold winters and hot, long summers are typical for it. The *negative shape of the relief* in the region results in temperature inversions, due to overcooling of lower atmospheric layers. It should be noted for comparison, that in Korbouli it is warmer by 0.90C in January, than in Gori which has 200 meters lower altitude. The absolute minimum of the air temperature is also very low in this region. It may even fall down to 29^0C (Table 3 Annex 1). Here, the number of frosty days fluctuates within the range of 90-100. The first frosts start here from the end of October, and the last one takes place by the end of April. Absolute maximum of atmospheric temperature reaches 40^0C (Table 4 Annex 1), but it falls down to 16^0C in January and remains the lowest along the highway.

The annual amount of precipitation is 450-500 mm. Precipitation rate is five times less here, than on the Achara sea coast. During the year the minimum precipitation takes place in winter and maximum is in summer (Table 12 Annex 1). The small amount of precipitation and its annual distribution like this is the basic feature characteristic to the dry subtropical climate in general. The recorded maximum of the atmospheric precipitation, during the whole observation period, are (94 mm) for January and 217 mm in May (Table 13).

Number of the days with snow in the region amounts to 40-50. Snow cover height is usually does not exceed 16 cm. Temperature of the soil surface, like the air temperature is lowest here in December and January (Table 5 Annex 1). Its absolute minimum is also very low (Table 7 Annex 1). Sometimes it falls down even to -31^0C.

Relative humidity in the region goes down along with precipitation amount, especially in summer times (Table 19 Annex 1). In this season of the year it is within 65-68%. Absolute humidity of atmosphere is especially low in January (4.9 Mb), its annual mean value does not exceed 10.4 Mb (Table 20 Annex 1).

Average annual temperature of the soil surface is $12\text{-}13^0$C; it is the lowest in dry subtropical zone (Table 5). Equally low is the calculated soil temperature at the depth of 2 meters (Table 8 Annex 1).

Thus, the region is characterized by cold winter and the hot summer. High intensity of the solar radiation, longer period of sunshine and rare cloudy days result in a high thermal regime in summer.

The annual sunshine period amounts to 2,350-2,360 hours in the region (Table 1 Annex 1). Here it is 223 hours more.

List of meteorological stations along the oil highway "corridor"

#	Meteorological station	altitude m. (a.s.l)	operation period
1	Gori	588	1925-60
2	Kaspi	522	1956-59
3	Mukhrani	550	1922-60

Table.1

Duration of sunshine (hours)

meteorological station	m o n t h s												Annual Total
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	
Gori	106	112	169	203	242	274	295	280	245	197	126	97	2346
Mukhrani	122	128	171	194	232	278	295	284	225	192	132	108	2361

Table 2

Air temperature °C

meteorological station	Months												Average	Annual
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Annual	amplitude
Gori	-1.2	0.2	4.8	10.3	15.7	19.1	22.2	22.3	18.0	12.3	6.0	0.9	10.9	23.5
Kaspi	-0.5	0.6	5.4	10.7	15.8	19.7	23.1	23.2	18.9	13.0	6.4	1.7	11.4	23.7
Mukhrani	-1.1	0.5	4.9	10.2	15.5	18.9	22.1	22.0	17.7	12.2	6.1	1.0	10.8	23.2

Table 3

Absolute minima of atmospheric temperatures °C

meteorological Station	Months												Annual
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	
Gori	-28	-26	-20	-9	-3	2	6	5	-3	-9	-18	-24	-28
Mukhrani	-29	-25	-19	-9	-3	3	5	5	-3	-9	-16	-24	-29

Table. 4

Absolute maxima of atmospheric temperatures °C

meteorological Station	Months												Annual
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	
Gori	16	19	28	31	34	38	38	40	37	32	25	18	40
Mukhrani	16	20	28	31	34	36	39	38	36	32	26	21	39

Table.5

Soil surfase temperature °C

meteorological Station	Months												Annual
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	
Gori	-2	1	6	12	19	23	27	26	20	12	6	0	12
Mukhrani	-1	1	7	13	20	24	28	27	21	13	6	1	13

Table.6

Absolute maxima of soil surface temperatures°C

meteorological Station	Months												Annual
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	
Gori	23	30	44	51	55	61	60	62	55	46	33	25	62
Mukhrani	25	32	48	52	60	67	65	64	58	52	35	26	67

Table.7

Absolute minima of soil surface temperatures°C

meteorological Station	Months												Annual
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	
Gori	-31	-28	-22	-11	-4	0	5	4	-5	-9	-19	-26	-31
Mukhrani	-31	-27	-20	-10	-4	2	6	3	-4	-10	-13	-26	-31

Table.8

Soil Temperature (at 2 m depth) °C

meteorological Station	Months												Average annual	Annual amplitude
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII		
Gori	9.4	9.4	8.0	9.1	11.6	13.9	16.0	17.2	18.3	16.6	13.7	10.8	12.7	8.3
Mukhrani	11.0	9.9	8.4	9.1	10.9	12.8	15.0	17.2	18.0	17.1	15.3	12.1	13.1	9.5

Table 9

Annual repetition of wind directions

meteorological Station	cardinal points								
	north	northeast	east	southeast	south	southwest	west	northwest	without wind
Gori	3	0	7	41	1	0	3	45	22
Mukhrani	2	8	31	7	2	1	32	17	39

Table 10

Wind speed (m/sec)

meteorological Station	Months												Average
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Annual
Gori	3.2	4.0	4.9	5.1	4.6	4.3	4.6	4.3	4.2	3.5	3.4	2.9	4.1
Mukhrani	3.3	4.4	4.7	4.6	4.0	3.7	4.0	3.2	3.2	3.0	2.8	2.6	3.6

Table.11

Mean number of strong wind days (≥15m/sec)

meteorological Station	Months												Annual
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	
Gori	3.2	4.8	6.7	6.6	4.3	4.6	5.8	6.2	4.8	3.1	2.8	2.7	56
Mukhrani	5.1	6.0	7.6	7.8	5.9	6.0	6.2	5.7	5.2	4.4	3.5	3.2	67

Table.12

Average atmospheric precipitation (mm)

meteorological Station	Months												Annual
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	
Gori	31	32	34	46	69	56	40	32	39	43	40	36	498
Kaspi	17	20	23	44	87	63	44	35	39	31	28	19	450
Mukhrani	20	23	26	50	100	72	51	40	44	36	32	22	516

Table.13

Maximal atmospheric precipitation (mm)

meteorological Station	Months												Annual
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	
Gori	92	122	113	119	170	132	131	130	97	131	202	122	836
Mukhrani	94	101	135	120	217	164	186	148	135	125	104	59	792

Table.14

Minimal atmospheric precipitation (mm)

meteorological Station	Months												Annual
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	
Gori	0	3	1	2	1	8	0	0	0	7	2	4	333
Mukhrani	0	0	1	3	14	5	0	0	3	5	4	3	333

Table.15

Maximum daily precipitation (mm)

meteorological Station	Months											
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Gori	25	25	39	37	38	51	45	42	45	43	71	37
Mukhrani	20	43	66	40	52	87	75	72	36	58	34	23

Table.16

Maximum rate of precipitation for different time intervals (mm/min)

Weather-station	**Rainfall duration**						
	Minutes				**Hours**		
	5	10	20	30	1	12	24
Gori	1,5	1,1	1,0	0,8	0,4	0,04	0,03

Table.17

Daily maximums of different precipitation probabilities according to monthly data, mm
(Reference of the Climate of the USSR, ed. 14, Table #6, p.237**)**

Weather-station	**Month**	**Mean max.**	**Probability, %**							**Observed maximum**	
			63	20	10	5	2	1	0,5	**mm.**	**Date**
Gori	I	9	7	13	16	19	23	26	29	25	2.1927
	II	9	6	14	19	22	24	26	29	25	12.1894
	III	11	7	16	21	26	33	39	45	39	31.1955
	IV	14	11	20	25	29	36	40	46	37	21.1903
	V	19	17	27	32	34	37	38	41	38	28.1906
	VI	17	13	24	28	34	45	53	63	51	18.1914
	VII	15	10	22	28	34	42	48	55	45	16.1935
	VIII	15	10	22	27	32	40	44	50	42	13.1934
	IX	16	11	23	29	35	43	48	54	45	12.1911
	X	15	11	21	26	32	38	43	49	43	27.1913
	XI	15	10	20	26	35	55	69	90	71	11.1895
	XII	11	8	15	21	27	36	43	50	37	26.1913
Mukhrani	I	7	5	10	13	16	19	22	25	20	20.1961
	II	9	5	13	19	27	35	41	48	43	26.1938
	III	12	7	15	22	33	56	74	97	66	20.1958
	IV	15	12	22	27	31	37	43	49	40	30.1932
	V	21	15	29	38	42	50	59	70	52	23.1926
	VI	27	20	35	44	58	78	93	110	87	24.1952
	VII	19	13	28	38	52	70	83	97	75	27.1963
	VIII	19	10	31	44	56	70	80	91	72	6.1965
	IX	15	12	23	28	34	35	37	41	36	22.1958
	X	15	9	22	29	40	54	64	74	58	4.1950
	XI	12	8	17	22	27	33	37	42	34	29.1933
	XII	9	5	12	16	19	22	25	28	23	1.1961

Table.18

Daily maximums of different precipitation probabilities
according to annual data, mm
(Reference of the Climate of the USSR, ed. 14, Table #5, p. 236**)**

Weather-station	**Mean max.**	**Probability, %**							**Observed maximum**	
		63	20	10	5	2	1	0,5	**mm**	**Date**
Gori	32	28	40	47	54	65	74	84	71	11.XI.1895
Mukhrani	40	31	52	64	74	87	97	107	87	24.VI.1952

Table.19

Relative air humidity (%)

meteorological Station	M o n t h s												Average
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Annual
Gori	82	79	74	68	70	68	66	66	70	77	81	82	74
Mukhrani	80	78	72	67	70	68	65	66	71	76	79	81	73

Table.20

Air absolute humidity (mb)

meteorological Station	M o n t h s												Average
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Annual
Gori	5.1	5.3	6.0	8.5	12.2	14.7	17.3	16.9	14.1	10.7	7.9	5.8	10.4
Mukhrani	4.9	5.2	5.9	8.2	12.2	14.9	17.4	17.0	14.0	10.3	7.7	5.6	10.3

Table 21

A1.2 Geology and Geomorphology

Geology of Agaiani-Sveneti Section of the Motor Highway and Physical-Mechanical (geotechnical) Properties of the Existing Rocks

Tectonically, the construction corridor of Agaiani-Sveneti section of the motor road is component of the Mukhrani-Tiriponi block of Molassa sub-zone of Kartli of Caucasus intermountain region (Gamkrelidze E., Tectonic Distribution of the Territory of Georgia, 2000). The geology of the studied area is mainly represented by the Mio-Pliocene sediments of Dusheti suit ($N_1+_2dŠ_1^{1+2}$) of neogenic period (N), well known in geological literature. Within the area of concern they are represented by upper and lower parts of the lower sub-zone of Dusheti suit. Quaternary deposits (Q) are also widely spread. In the extreme southern-western part of the construction route, the rocks of Albi-Senoman period (k,al - $k_2$cm) occupy an insignificant area. We have chosen to unite the rocks of various layers (stage) into one single complex because of their similar facies - lithological characters and mechanical (geotechnical) properties. In lithological respect, the rocks of the complex are mainly represented by loose quartzitic and glauconitic sandstones and glauconitic marls. Glauconitic sandstones occupy 60-65% of the section. Aggregate bed thickness of the complex is 240-350 m. As we can see, the given complex is built with hard and half hard rocks. Glauconitic sandstones are of yellowish-green colour of different granularity, medium-layered, argillized on surface and highly fractured in some places. Sandstones are composed of Palaeozoic crystalline rocks and Baios porphyrites. Cement is carbonate-clay. Quota of SIO_2 in the rock constitutes 28-39%, Al_2O_3-7-11%, CaO-17.7- 24.2%, and the rest constituent elements amount to 13-25%. Physical-mechanical (geotechnical) properties are as follows: volume weight is 2.29-2.38 gr/cm^3, water absorption is 1.88-4.31%, ultimate stress limit after water absorption is 230-290 kg/cm^2, softening ratio is 0.92-0.93, ultimate stress limit after freezing is 177-260 kg/cm^2, freeze-proof factor - 0.84-0.98. Fracturing ratio of sandstones is 5-10, coefficient of hardness is 4, processing (excavation) category - V. It should be mentioned that the hardness of rocks varies within a wide range due to their petrographic composition, structural and texture state and degree of weathering. The marls of the complex are of dark grey and greenish colour. Physical-mechanical (geotechnical) properties are as follows: volume weight is 2.2-2.5 gr/cm^3, water absorption is 0.84-1.81%, ultimate stress after water absorption is 215-385 kg/cm^2, softening ratio is 0.76-0.94, ultimate stress after freezing is 205-365 kg/cm^2, freeze-proof factor – 0.94-0.97, coefficient of hardness is 4, processing (excavation) category - V.

Mio-Pliocene sediments of Dusheti suit ($N_1+_2dŠ_1^{1+2}$), as already mentioned, and are represented by upper and lower parts of the lower sub-zone with the aggregate bed thickness of 720 m. In addition to well-sorted and cemented conglomerates mixed with fine and medium-grained pebbles, the coarse-grained sandstones, clays and loam are also met. Conglomerates are of yellowish, yellowish-grey or dark grey colour. The grain-size of shingle increases and the degree of cementation decreases in the ascending cross-section. The shingle material being a constituent part of conglomerates is represented by limestone, marls, sandstones and clint as well as tufogenic rocks of Baios porphyrite stratum. Sandy material composed of maltreated quartz fragments, feldspars, peaches, flints, etc. functions as cement. Limestone cement of fine hardness is met here and there. At some places, mostly in the upper part of the section, conglomerates, due to unstable coarse-grained sandy and clay polymictic cement, are weakly cemented and partly look like shingle. It decomposes easily due to weathering and in some cases are met as talus debris at the artificially cut slopes (especially, along the motor road). Physical-mechanical (geotechnical) properties of

conglomerates are as follows: volume weight is 1.90-2.05 gr/cm^3, water absorption is 1.19-1.79%, point of maximum compressive resistance – 100-250 kg/cm^2, and softening ratio is 0.6-0.9. Conglomerates are not freeze-proof. Their strength factor is 4-7, and the processing (excavation) coefficient is IV-V. On natural slopes the conglomerates preserve quite a solid and stabile vertical form. Mean grain-size classification of conglomerates is as follows: boulders – 0.0-8.5%, coarse- and medium-grained pebbles – 40-45%, fine-grained pebbles – 8-20%, gravel – 7-15%, sandy and clay material – 5-20%. Physical-mechanical (geotechnical) properties of the clays of the complex are as follows: natural humidity is 20.49-27.85%, volume weight in natural conditions is 1.39-2.89 gr/cm^3, relative density is 2.68-2-70 gr/cm^3, porosity is 38.9-58.1%, yield limit is 44-51%, plastic limit is 20-34%, plasticity number is 21-25, total moisture capacity (water-absorbing capacity) is 28.73-41.58%, swelling is 6.1-22.0%, amount of clay fraction is 44-70%, among them 34-60% of colloidal part, coefficient of internal friction is 0.270-0.360, angle of internal friction is 15-20°, cohesion is 0.24-0.61 kg/cm^2, subsidence module per 5 kg. Load is 16.83-42.70; natural humidity is 13.85-28.97%. It should be mentioned that the clays after water saturation loose hardness by 15-20%. The clays soak during 10-35 minutes to 8 hours.

Modern Proalluvial and delluvial deposits (pdQ_{IV}) are widely spread on the studied territory. Complex sediments are of mixed genesis and were mainly originated by delluvial wash-outs and their consequent sedimentation. The bed thickness of the sediments varies between 5 and 20 meters and is mainly represented by clay-loam. Boulder-and-pebble and detritus soil is spread in limited amounts as streaks and interbeds with the bed thickness of 0.5-2.0 meters. In engineering-geological respect, the rocks of the complex are attributed to cohesive-plastic and clastic-fragmental grounds. Clays are of yellowish-brown, yellowish-grey or bluish colour. Chemical composition of the clays are as follows: SiO_2 - 30.46-66.84%, Al_2O_3-7.72-14.45, Fe_2O_3 - 3.45-9.37, TiO_2 - 0.26-0-52, GaO-1.69-26.35, MgO-1.14-3.20, SO_3 - 0.2-0.25, K_2O-1.2-2.5, Na_2O-0.66-1.92. Secondary minerals are represented by hydromica and montmorillonite with tiff and peach compound. Physical-mechanical (geotechnical) properties of the clays are as follows: natural humidity is 16.75-23.27%, volume weight is 1.72-2.06, relative density is 2.70-2.72 gr/cm^3, porosity is 39.1-48.5%, plasticity number is 20-26, angle of internal friction is 17-20°, coherence is 0.470-0.610 kg/cm^2. Clays swell relatively more slightly and their maximum number reaches 11.8-16.6%. Subsidence module per 5 kg load is 22.5-115.0, constituting on average 70%. Deformation module is 15.4-86.2. According to consistence, clays are hard, and rarely semisolid. Filtration factor after pouring the water in the bore-pit at the depth of 0.5-0.8 m. is 0.0002-0.008 m/day. The mentioned indicator in laboratory conditions decreases and constitutes 0.0-0.27 m/day. Pebble-and-boulder sediments of the complex, as mentioned before, are spread in limited amounts and their grain-size classification is quite diversified: more than 200 mm - 0.0-8.0%, 200-100 mm - 0.0–12.5%, 100-50 mm - 3.3-15.0%, 50-20 mm - 3.3-14.7%, 20-10 mm - 4.4-15.0%, 10-5 mm - 5.6-16.3%, 5-2 mm - 8.2-20.8%, 2-1 mm - 12.8-24.6, and less than 1 mm- 11.5-30.0. Volume weight is 1.48-1.86. As the indicated properties demonstrate, fine-grained fraction (less than 2 mm) plays an important role in the ground composition what is characteristic to Kartli Region.

Modern alluvial-proalluvial sediments (apQ_{IV}) are quite widely-spread. They are mostly spread in the beds of small rivers and functioning dry gullies drained from separate elevations of depression of Shida Kartli. Favorable landscape-climatic, morphological and geological conditions promote the formation of the given complex. The above-mentioned sediments at some points cover and are mixed with the floodplain terraces of relatively greater rivers. The bed thickness of the sediments does not exceed 3-5 meters and is, for the main part, represented by shingles, gravel, clays and loam, as well as sands. Coarse-grained fraction of the complex is quite well-processed.

Sands of the complex are mostly represented by streaks (lens) and interbeds with the bed thickness of 0.5-1.0 m. They are of yellowish or brownish-yellow colour, and in separate places of light grey colour with the admixtures of fine-grained shingle and gravel (10-15%). Admixtures of clay particles amount to 10-15%. Volume weight constitutes 1.40-1.75 gr/cm^3; relative density is 1.60-1.66 gr/cm^3. The sands are characterized by good water conductivity with the filtration factor of 20-40 m/day. Coefficient of hardness is 0.5-0.6. Clays dominate in clay and loamy sediments. In the locations where the mentioned clays are formed in stable dry gullies and in the drifts of small rivers the buried soils of little bed thickness (0.1-0.2 m) are spread indicating that deposit formation took place with intervals. Natural humidity of clays is 17.13-27.44%, volume weight is 1.58-2.05 gr/cm^3, relative density is 2.70-2.76 gr/cm^3, porosity is 40.2-53.5%, and plasticity number is 22-31. The proportion of clay fraction in the rock constitutes 45-57%, with 38-47% of colloidal particles among them (less than 0.001 mm). Dusty fraction varies from 17 to 26%, coefficient of internal friction is 0.220-0.360, angle of internal friction is 17-18°, and adherence is 0.55-0.72 kg/cm^2. Clay consistence is mostly 0.05-0.15 and is rarely fluid-plastic. The clays of the mentioned complex (apQ_{IV}) on the studied territory along the river Tortla (in the Eastern periphery of the village of Sveneti) are characterized by relatively low physical-mechanical (geotechnical) properties and in separate sections are similar to loessial soil with the suppressed physical-mechanical (geotechnical) properties. The mentioned clays are characterized by subsidence.

Modern alluvial precipitations of the I, II and III over-floodplain river terraces (a^1Q_{IV}, a^2Q_{IV}, a^3Q_{IV}) within the studied territory are mainly spread in the gorges of the rivers Ksani and Lekhura. Terraces I and II occupy the greatest area among the three, and terrace III is represented only by insignificant fragments. Terrace surfaces are flat, in fact horizontal in some places, and are structured by pebble-and-sandy precipitation with its aggregate bed thickness varying between 8-15 m. In some places, clays represented by streaks and interbeds play an important part in the terrace structures.

Shingle material is for the main part well-processed and is represented by medium-grained sound pebbles. In some sections the terraces are buried under the proalluvial-dealluvial clay-and-loam. The volume weight of shingle varies from 1.50 to 1.98 t/m^3. Filtration factor, following the grain-size classification of rocks, varies from 3.6-7.4 m/day to several tens of meters a day. Grounds starting from the depth of 1.0-3.0 meters are mainly water-bearing. This is particularly true with the I over-floodplain terraces. Shingle sediments of the complex are connected to quarrying of great quantities of inert material, especially within the limits of the I over-floodplain terrace of the river Ksani. The clays of the complex are of dark brown, brownish-yellowish or yellow colours.

Their physical-mechanical (geotechnical) properties are as follows: natural humidity is 13.58-27.33, volume weight is 1.52-2.11 gr/cm^3, relative density is 2.63-2.76 gr/cm^3, porosity is 37.0-53.2%, plasticity number is 12-37, coefficient of internal friction is 0.240-0.360, angle of internal friction is 14-20°, coherence is 0.200-0.950 kg/cm^2. The proportion of the clay fraction varies between 33 and 78%, with 25-60% of colloidal particles (less than 0.001 mm). The rate of grounds swelling is relatively low and varies between 3.9 and 10.42%. According to consistence, the clays are hard and rarely semisolid. Chemical composition of the clays is as follows: SiO^2 – 44.21-62.2%, Al_2O_3 - 8.16-14.79%, Fe_2O_3 - 3.93-6.20%, CaO - 3.5-19.52%, etc. Clay minerals are mainly represented by montmorillonite, quartz and feldspar. Coefficient of clay hardness is 0.8, the treatment class is VII.

Floodplain-channel modern alluvial Facies sediments (aQ^{IV}) within the studied territory are spread within the gorges of the rivers Ksani, Lekhura and Tortla. In lithological respect, there are

channel precipitations represented by shingle, boulders-and-shingle and gravel, and floodplain fraction represented by shingle, sandy-gravel, sandstone and strongly sandy loams identified in the complex. The widths of floodplain-channel vary from 20-25 meters to 500 meters. The rates of the bed thickness of the precipitations are 3-10 meters, rarely more. Shingle ground distinguished by favourable rate of treatment and virtually not differing from the constituent ground of the I floodplain terrace is dominated in the section. Sands and gravel act as filler material of shingle dominating in some places. Their bed thickness exceeds 1.0 m. Loams and sandstones are for the most part covered with shingles. Their spreading area is limited, mainly occupying in the upper part of the floodplain terraces. They are of light grey or brownish-yellowish colour, are homogenous and have no admixtures of pebbles or gravel (about 10-15%).

Under the Order No. 42 of June 7, 1991 issued by the Ministry of Architecture and Building Affairs of the Republic of Georgia, the studied territory, according to the seismic risk zoning pattern with extra numbers, is included in the seismic zone of numbers 8-9.

A1.3 General Hydrological Description of the Area

The river Ksani heads from Lake Keli in the Keli high mountainous depression, 2914.0 meters above sea level and at the village of Khidiskuri flows into the river Mtkvari from its left side.
The length of the river is 84 km, total incidence (fall of the water surface) is 2439 m; average slope of the river is 0,029%. The area of the catchment's basin is 885 sq. km., and the average height of the basin is 1470 m.

330 tributaries with the total length of 715 km. flow into the river. Among them the rivers Tskhradzma (15 km-long), Churta (18 km-long) and Aleura (21-km-long) are the most important ones. The upper section of the catchment's basin of the river Ksani is located on the Southern slope of the Caucasioni Range, with its middle and lower sections located on Shida Kartli Plain. The geological composition includes limestone, clay shales (slate), sandstones and conglomerates. In the Keli depression, volcanic formations - andesites and basalts - prevail. The soil cover of the basin is represented by mountain-meadow, brown forest and old alluvial cinnamon-colored soils.

Above 2000 meters there are alpine and subalpine meadows spread, which are used as pastures. From 2000 meters to 1000 meters there is a hardwood forest, and a great part of lowland and foothills is occupied by crops. 65% of the basin is occupied by forest.

A 50-80-meter-wide terrace runs along the whole River line and is occupied by gardens, arable lands and vegetable gardens.

The River bed is moderately winding and is branched off at the foot of the village of Korintha. The river width varies between 4 and 30 meters, with its depth ranging from 0.3-0.7 m to 1-2 m. The River current velocity varies from 2-3.5 m/sec to 0.8-1.5 m/sec.

The river Ksani is fed by snow, rain and ground waters. Its water regime is characterized by spring stream rise and winter unstable low-water season. The River annual flow among the seasons is distributed as follows: 30-35% of the annual flow flows in spring, 19-20% - in summer, 13-15% - in autumn and 10-12% - in winter.

The river is used for irrigation and power supply purposes. Since 1955, there has been a trunk channel of "Tezi-Okami" constructed on the river, which under the project, should irrigate 3477 hectares of Kaspi Region and supply hydroelectric power station of Igoeti with water, whose installed capacity is 1765 kilowatts. It should be mentioned that for the last years, due to the lack of financing of the field of land-reclamation (amelioration), the channel has been impossible to be exploited at a full load resulting in the failure of the irrigation system of "Tezi-Okami" to supply the total area with the irrigation water. A distributor of the trunk channel "Tezi-Okami" crossing the design road East of the village of Igoeti, according to the project, should deliver 1,5m^3/sec flow quantity; however, due to the above-mentioned reasons, at present the flow quantity constitutes 0,7-0,8 m^3/sec. only.

The length of the river up to the motor road bridge is 71 km, with its average slope of 34.3%. The area of the catchment's basin is 795 sq. km. and the average height of the basin is 1600 meters.

The river Lekhura heads from the southern slopes of mount Tskhratskaro originating through the existing streams at 1720 meters above sea level. It flows into the river Mtkvari from its left side, south of the city of Kaspi. The length of the river is 43 km, total incidence is 1217 m, and average slope is 0.0283%. The area of the catchment's basin is 285 sq. km. and the average height of the basin is 1070 m. The drainage network of the basin is represented by several insignificant tributaries with the total length of 108 km.

The basin is located in front mounts of the Central Caucasus and is directed from North to South. The geological composition of the basin includes sandstones, limestone and conglomerates. The soil cover of the basin is represented by brown soils. Major part of the upper section of the basin is occupied by hardwood forest, and the middle and lower sections of the basin are occupied by crops. Forest occupies about 40% of the basin.

A great portion of the river valley is terraced. The terrace surfaces are covered with loamy soil and are occupied by gardens, arable lands and vegetable gardens. A floodplain is spread along the whole length of the river. It is, for the main part, dry with no vegetation in it. During the periods of flooding and stream rise, the floodplain is flooded along its entire width. The river channel is moderately winding and is, for the main part, not branched off. The width of the river current varies between 1 and 3 m. with its depth varying between 0.1 and 0.3 m. The river current velocity is 0.8-0.9m/sec. The river bed is flat and gravelly.

The river Lekhura is fed by snow, rain and ground waters. Its water regime is characterized by stream rises in spring and by low-water season in other seasons of the year. In some years, more or less stable low-water season is disturbed by flooding of frequently high levels resulted by steady rains. The River annual flow among the seasons is distributed as follows: 45.2% of the annual flow flows in spring, 19.3% - in summer, 18.9% - in autumn and 16.6% - in winter. The river is used for the village mills and for the irrigation purposes.

Survey over the river flow took place in the years of 1964-1990 near the village of Igoeti.
The length of the river up to the design bridge of the motor road of Agaiani-Berbuki is 33.8 km; the area of the catch basin is 188 sq. km. Total fall of the water surface is 1410 m., average slope is 42.0%, and the average height of the basin is 1130 m.

The river Western Tortla (Kirbalula) heads from the point elevated at 1400 meters, 2.5 km south-west of the village of Kveda Tsolda. It flows into the river Medjuda from its left side, on the territory of the city of Gori. The length of the river is 31 km, total incidence of the water surface is 813 m, and average slope is 0.0262%. The area of the catchment's basin is 197 sq. km.; average height of the basin is 750 m. Several insignificant tributaries flow into the river.

The geology of the catchment's basin is mainly represented by tertiary deposits covered with clay and loamy soils. The forest vegetation grows only at the river heads, and the great part of the basin below is occupied by crops.

The river valley is narrow at its heads widening as the river flows downward and being unclearly represented on Shida Kartli Plain. The river bed across Shida Kartli Plain is violently winding and is not branched off. The width of the river along this section varies between 2 and 6 meters, with the depth of about 0.1-0.6 m., and the current velocity varies from 0.4 to 1.0 m/sec.

The river is fed by snow, rain and ground waters. Its water regime is characterized by spring stream rises, autumn flooding and summer and winter unstable low-water season.

The river supplies several small-size local irrigation channels with the irrigation water.

The river Western Tortla may be crossed by the design road east of the village of Sveneti, where its meandering bed approximates the existing motor road at about 20-30 meters. The length of the river up to this point is 25.8 km., average slope is 31.5%, the area of the catchment's basin is 186 sq. km., and the average height of the basin is 870 m.

The river Western Tortla is crossed by the motor road bridge on the territory of the village of Berbuki. The length of the river up to the crossing point is 29.0 km., average slope is 28.0%. The area of the catchment's basin is 193 sq. km, and the average height of the basin is 800 m.

The river Eastern Tortla heads from the point elevated at 1340 meters, one kilometer north from the village of Zemo Bagebi. The river flows into the river Lekhura from its right side, south of the village of Igoeti. The length of the river is 26.5 km., total incidence is 690 m., average slope is 0.026%. The area of the catchment's basin is 54.0 sq. km and the average height of the basin is 910 m. Several insignificant tributaries flow into the river.

The geology of the catchment's basin is mainly represented by tertiary deposits covered with loamy and brown soils. The forest vegetation grows only at the river heads, and the great part of the basin below is occupied by crops.

The river valley at the heads is narrow widening as the river flows downward with the width not exceeding 250-300 meters at the point where the river crosses the motor road. The river bed is moderately winding and is not branched off. The width of the river at the point where the river crosses the motor road varies between 2 and 4 meters, depth is 0,1-0,5 m, and the current velocity is 0,2-0,8 m/sec.

The river is fed by snow, rain and ground waters. Its water regime is characterized by spring stream rises, autumn flooding and summer and winter unstable low-water season.

The river supplies several small-size local irrigation channels with the irrigation water. It should be mentioned that one of the small irrigation channels is supplied with the irrigation water from the primitive headwork arranged at the motor bridge. There is an artificial dike in the channel arranged by the population to gain water, which decreases the bridge conductivity and in case of stream rising imposes risk of flooding the plots of fields above the bridge.

The length of the river up to the point where the river crosses the bridge is 24.0 km, average slope is 27.1%. The area of the catchment basin is 49.7 sq. km., and the average height of the basin is 960 meters.

River Didi Liakhvi heads from the point elevated at 2337.7 meters near the village of Goluatha. It flows into the river Mtkvari from its left side, at the city of Gori. The length of the river is 98 km., total incidence is 1755 m., and average slope is 0.0179%. The area of the catchment's basin is 2440 sq. km., and the average elevation of the basin is 1590 m. 591 tributaries with the total length of 1800 km. flow into the river. The most significant among them are the rivers Patara Liakhvi with the length of 63 km and Medjuda with the length of 46 km.

The basin is located on the southern slope of the Caucasus Range. The whole of the basin is geomorphologically divided into the mountainous, piedmont and low-land zones. In the past the mountainous zone of the basin was subjected to severe glacial impact evident by numerous swallow holes, troughs and moraines. On the territory of the Caucasus Range, the basin incorporates twelve glaciers with the total area of 5.5 sq. km. The mountainous zone of the basin is represented by clay shale, marls and limestone.

The geology of the piedmont zone, among other materials, is represented by sandstone and clay shales, and the structure of the low-land is represented by old and new alluvial deposits. The following soil types are met in the basin: cinnamon-colored, dark brown, mountain brown, mountain-meadow and alluvial soils.

The vegetation of the basin is characterized by vertical zoning. Shrubs are grown in the low-land, mixed forest at the height of 1000-1100 meters are grown in the piedmont zone, and the mountainous zone is distinguished by alpine and subalpine meadows. 32% of the basin is occupied by forest.

One section of the river from its head to the village of Kekhvi is 56 kilometers long with its valley terraced along the great distance. The surface of the terraces is flat and slightly articulated. It is structured with clay shales and skeletal soil and is, for the main part, covered with grass and shrubs. There is a floodplain along the whole of this section of the river. It is mainly dry and covered with shrubs here and there. During summer flooding the floodplain is flooded for 2 or 3 days. The river bed is moderately winding and for the main part, is not branched off. The width of the river varies between 4 and 32 meters, its depth is 0.3-2.4 m., and the current velocity is 1.4-3.0 m/sec.

The rest of the river section from the village of Kekhvi up to the river-mouth is 42 km long. The valley along this section is of a trapezoid form. Part of the slope is covered with sparse forest and shrubs. The whole length of the river gorge is terraced. The terraces are occupied by vegetable gardens, gardens and arable lands. The floodplain is clearly established. It is two-sided and its major part lacks vegetation. During summer flooding the floodplain is flooded for 1 to 5 days. The river bed is moderately winding and branched off. The width of the river current varies between 4 meters

(in the village of Shindisi) and 60 meters (the city of Gori). The river depth varies between 0.1 and 0.7 meters, and the current velocity is 0.2-2.5 m/sec.

The river is fed by snow, rain and ground waters. Its water regime is characterized by summer flooding and winter low-water season. The River annual flow among the seasons is distributed as follows: 30-39% of the annual flow flows in spring, 37-42% - in summer, 14-16% - in autumn and 8-9% - in winter.

The river Didi Liakhvi is used for the irrigation purposes. By exploiting a 69-meter-high and 455-meter-long earth dam there is a water reservoir of Zonkari with the irrigation function arranged on the river Patara Liakhvi, near the village of Zonkari, a tributary of the Didi Liakhvi. The total volume of the dam reservoir is 40.3 million cubic meters. The net capacity of the water reservoir is 39.0 million cubic meters. The reservoir is filled during the summer season and is emptied as the vegetation irrigation comes to an end. It is an additional source of water for Tiriponi irrigation system during the low-water season in summer. The head works of the irrigation systems of Tiriponi and Saltvisi are erected on the river Didi Liakhvi, the city of Tskhinvali. Tiriponi irrigation system was constructed in 1928 (rehabilitated in 1973) and Saltvisi irrigation system was constructed in 1949. The irrigation system of Tiriponi, according to the project, should irrigate 20 885 hectares in the Regions of Kaspi, Gori and Tskhinvali, and the irrigation system of Saltvisi - 7125 hectares in Gori and Kareli Regions. It should be mentioned that the water from the irrigation system of Tiriponi through a pumping station is supplied to Lake Nadarbazevi (off-channel reservoir), south of the motor way. The Lake, on its turn, “returns” the water to the irrigation system of Tiriponi in the low-water season in summer to irrigate plots of fields of Kaspi Region. The total volume of the off-channel reservoir (Lake) Nadarbazevi is 7.2 million cubic meters, and the net capacity thereof is 6.2 million cubic meters.

The river Didi Liakhvi also supplies the irrigation system of Kekhvi with the irrigation water. The head works of Kekhvi irrigation system is in the village of Kekhvi and the system, according to the project, should irrigate 5384 hectares in Gori and Tskhinvali Regions. The irrigation system of Vanati irrigating 3176 hectares in Gori and Tskhinvali Regions is supplied by the irrigation water from the river Patara Liakhvi.

The length of the river Didi Liakhvi up to the point where the existing motor road crosses the river is 94.5 km., average slope is 18.8%. The area of the catchment’s basin is 1650 sq. km., and the average elevation of the basin is 1700 meters.
The principal morphometric characteristics of the above-described rivers are referred to in Table 1.

Principal morphometric characteristics of major rivers crossing the design motor way

Table 1

River	Area of catchment’s basin, sq. km.	River length up to the mouth, km	River slope, %	Average elevation of the catchment basin, m
Ksani	885	84,0	0,029,0	1470
Lekhura	285	43,0	0,0283	1070
Eastern Tortla	54,0	26,5	0,026	910
Western Tortla	197	31,0	0,0262	750
Didi Liakhvi	2440	98,0	0,0179	1590

The design road, besides the above-mentioned great rivers, is crossed by 27 small unnamed dry gullies. The dry gullies start from the northern slopes of the Kverinaki Range and cross the motor road along the section between the villages of Kvemo Rene and Berbuki. The dry gullies

From the village of Agaiani to the village of Kvemo Rene do not represent any serious danger to the motor road due to very little areas of catchment basins and insignificant slopes. At the same time, the same dry gullies are crossed by a distributor of the trunk channel of Tezi-Okami running south of the motor road and will presumably retain the certain proportion of floods in the dry gullies.

It is known that the maximum flow of the dry gullies should by no means get into the soil-reclamation canal, for this will result its filling and putting out of operation. However, on the topographic map at hand with the scale of 1:50000 there is not a single culvert aqueduct shown on the distributor of the trunk channel of Tezi-Okami, which would pass the maximum flow of dry gullies over the channel. The distributors of the third grade running from the distributing canal, according to the same topographic map, cross the motor road at 15 points. Most of the third grade distributors are polluted and thus, are unable to pass the estimated flow.
The catchment basins of the dry gullies with proper numeration are referred to on the topographic map with the scale 1:50000.

Table 2 below shows the areas and lengths of catch basins of the dry gullies crossing the motor road at the road crossing points.

Dry gullies crossing the design roads
Table 2

Dry gully No.	Area, ha	Dry gully No.	Area, ha	Dry gully No.	Area, ha
1	24 ha	10	123 ha	19	110 ha
2	58 ha	11	119 ha	20	168 ha
3	49 ha	12	142 ha	21	146 ha
4	12 ha	13	110 ha	22	190 ha
5	31 ha	14	39 ha	23	270 ha
6	56 ha	15	88 ha	24	98 ha
7	82 ha	16	26 ha	25	272 ha
8	35 ha	17	62 ha	26	154 ha
9	22 ha	18	71 ha	27	82 ha

Peak Discharges

In accordance with the project hydrologist's requirements, the peak discharge rates with the 200-year recurrence periods have been calculated in the cross-sections of the bridges to be erected over the major rivers crossing the design road and the runoff coefficients have been defined. The morphometric elements of the rivers in the design sections have been defined by using a topographic map with the scale of 1:50000, and the rates of peak discharge and runoff coefficients have been defined by the methods recommended by "Technical Instruction on calculating maximum peak discharges under the conditions of Caucasus".

The mentioned method, which is widely used in a number of countries worldwide, is established for the conditions of Caucasus and namely, for Georgia and is named "Regional Formula". The values of peak discharged gained by the Regional Formula are referred to in literary sources (Resources of surface waters of the USSR, v. 9, "Transcaucasian and Dagestan". ed. 1, "Western Transcaucasia". Gidrometeoizdat, Leningrad, 1974).
According to the mentioned technical guideline, the Regional Formula is the following for the conditions of Georgia:

$$q_{5\%} = \frac{10{,}0}{(F+1)^{0{,}5}}$$

Where ***q*** is maximal module flow, m^3/sec from km^2;
B is maximal module of inflow, m^3/sec from km^2;
F is the area of the catch basin, km^2;
b is the coefficient characterizing the reduction extinction of module in the zones of small basins;
n is the indicator of reduction degree.
By multiplying the maximal module of flow by the area of catch basin we will receive the peak discharge.

The Regional Formula for the region where the basins are located will be presented as follows:

$$q_{5\%} = \frac{10{,}0}{(F+1)^{0{,}5}}$$

Where $q_{5\%}$ is the maximal flow module of 5% provision, and if multiplied by the area of catch basin, peak discharge of the same provision is gained.
Transfer from a maximal discharge of the 5% provision to other discharges is made through transfer coefficients, whose values are given in table #2[I]:

Transfer coefficients from a maximal discharge of 5% provision to other discharges

Table 2[I]

P%	0,01	0,1	0,5	1	2	3	5	10	20
KK	2,85	2,20	1,82	1,52	1,28	1,20	1,00	0,80	0,65

Table 3 below refers to the principal morphometric elements of the rivers crossing the road, peak discharges and runoff coefficients in the sections of design bridges.

Principal morphometric elements of the rivers crossing the road, peak discharges and runoff coefficients in the sections of design bridges

Table 3

River	Catchment basin area, km^2	River length, km	River slope, %	Average elevation, m	Maximum flow, m^3/sec	Runoff coefficient	
						200-year-long	50-year-long
Ksani	795	71,0	34,3	1600	515	0,50	0,47
Lekhura	188	33,8	42,0	1130	250	0,39	0,37
Eastern Tortla	49,7	24,0	27,1	960	130	0,40	0,38
Western Tortla I	186	25,8	31,5	870	245	0,39	0,37
Western Tortla II	193	29,0	28,0	800	255	0,39	0,37
Didi Liakhvi	1650	93,5	18,8	1700	740	0,50	0,46

Note: Western Tortla I – East of the village of Sveneti
Western Tortla II – At the bridge of the village of Berbuki

While constructing the bridges at the crossing points of great rivers, besides the rates of peak discharges, fixing the maximal water levels relevant to peak discharges and maximum general and local scouring depths of the river bed are necessary as to avoid flooding the piers and washing away the bridge walls. The river Western Tortla meandering and approximating the existing motor road is a potential hazard. Mudflow currents have never been occurred in this region.

A1.4 General Hydrogeological Description of the Area

According to the task, a hydro geological map for a 4-km-wide corridor adjacent to the motor route has been charted at the stage of Scoping. The factual information gathered during a double field reconnaissance, as well as the existing archives and literary sources about the artesian basin of Kartli were used to chart the map.

According to the hydro geological zoning plan of the territory of Georgia, the studied region is a constituent part of Kartli artesian basin of porous, crumbling (fractured) and crumbling-cavern (Karst) waters along the section of Natakhtari-Gori (See Map).
Before discussing main water-bearing horizons and complexes, we will deliver a brief discussion of general morphological, geological and hydro geological features of the route.

The initial point of the route section to be studied is located on the left bank of the river Ksani, at an eastern end of the motor road bridge, about 2 km. east from the village of Agaiani. The absolute elevation H=529 m. The coordinates are: $N41^0 54' 42.6''$ and $E044^0 33' 51.9''$. The floodplain of the river Ksani at this point is wide. The floodplain terrace is covered with dense vegetation. The river is branched off. A bank-protection structure made of right concrete blocks is erected on the right erosive river bank, above the bridge. The length of the structure along the river current is

approximately 200 meters. The elevation of the pedestrian area of the bridge is 7-8 meter from the river bed.

The relief conditions of the route from the initial point and along 2.5 km are identical. The roadway is slightly elevated (□2 m) as compared with the basic relief. The latter is represented by over-floodplain terrace of the river Ksani covered with dense vegetation – shrubs and low trees. The band along the route adjacent to the terrace is marshed with characteristic flora and fauna. From this point, the route runs up the elevation. The roadway along this section is gradually rising reaching the elevation of 10 meters from the basic relief at the top of the rise distanced from the initial point by 5,2 kilometers. The elevation of the top point of the rise H=651 m., coordinates are: $N41^{0}56'15.7'', E044^{0}30'44.1''$. To the north-east from this point, azimuth 55° is the village of Ferma, distanced by 1-1.5 km. The village is built on the right over-floodplain terrace of the river Ksani and according to local residents it is intensely flooded in stream rise seasons. The next section of the route, up to the eastern periphery of the village of Igoeti, follows the homogenous relief structured with proalluvial-delluvial (talus) sediments. The relief runs aslope to the over-floodplain terrace of the river Ksani. The terrace is divided into two by the ridge of brown wood with the maximum elevation of 812.0 meters.

In respect of morphological and hydro geological complexity there are two main areas distinguished along the route.

The first area is located at the bypass of the village of Igoeti, north-east, approximately, in the alignment of the Red church at the existing road, at the point where the retention wall built of concrete blocks ends. The absolute elevation here H= 699 m., and the coordinates are as follows: $N41^{0}59'09.5'', E044^{0}25'22.3''$. Behind the wall there is a classical example of rock outcrop mostly represented by coarse-grained loose conglomerates. The conglomerates, in addition to 0.5-0.7-m-thick clay interbeds, include thicker clay layers (with the bed thickness of more than 5 meters). On the opposite side of the wall, to the south, there are two parallel metal irrigation water-supply pipes running along the slope edge, 1-meter-diameter each. Over the highway, the slope descends steeply to the existing motor road. There is a 40-50-meter-wide flattened plain between the concrete wall and irrigation water-supply pipes followed along by an earth road built in the 1980s, to the unfinished bridge piers. The ground at the plain line of the relief is intensely watered, as the soil on it is composed of hard loamy soil decreasing the infiltration ability to the depths to a minimum. Presumably, besides the atmospheric precipitations, seepage waters from the high slope above the wall should play a certain role in soil watering. About 100 meters from the end of the wall, there is a large block-landslide. In the landslide mass, besides main rocks, there are the fragments of concrete plates used for channel facing. There is of a relatively small-diameter irrigation water-supply pipe running over the ridge of the slope. Presumably, intense water losses from the mountain has played a significant role in collapse and sliding of the landslide mass. The rock deposition elements in the above-mentioned outcrop are as follows: inclination azimuth W-270°, layers tilt angle is 40-45°. In the plain area between the retaining wall and the irrigation pipes the depth of ground waters should be no less than 10 meters, for the southern slope is high and steep and the mentioned area is accordingly, deeply drained.

The unfinished bridge is erected over the road leading to the village of Lamiskana. Its maximum elevation from the roadway is 15-20 meters. There is a retaining concrete wall erected at the other end of the bridge. Behind the wall, at approximately 15 meters high there is a steep edge of the river bank showing the layers of conglomerates and clays. The presumable depth from Lamiskana

roadway to the ground water level is 7-8m. It should be mentioned that the depth of ground waters in the Igoeti village well is 7 meters.

Another area complex for the building works is located in the western periphery of the village of Akhalsheni, at the point where there is a marsh at the beginning of the village of Sveneti. This was the old river bed of Tortla. The depth from the roadway to the marsh surface level is 6-7 meters. The marsh includes yellowish-muddy liquid what is caused by the fact that the meandering bed of the river Tortla is cut into the loessial loamy soils, which are presented as a 2-3-meter-high steep outcropped walls on the both sides of the river bed. It is clear that the route should be laid here with a trestle needing a borehole to be made to determine the lithological section and thorough laboratory studies of the rocks to be performed.

The main peculiarity of the existing and design motor roads is that the southern edge of the great part of the route, with some exceptions, follows the steep hilly relief structured with main rocks of Mio-plyocene age, and its northern edge, with some exceptions as well, is located in the southern zone of Mukhrani-Tiriponi Plain.

The design road along about 40-44-km-long section of Natakhtari-Gori road in the descending cross-section crosses the following main water-bearing horizons and complexes:

- Water-bearing horizon of modern alluvial river precipitations (aQ_4);
- Water-bearing horizon of alluvial precipitation of floodplain and over-floodplain terraces (a_1Q_4);
- Water-bearing horizon of modern proalluvial-delluvial (talus) formations ($p - d\ Q_4$);
- Water-bearing horizon of old-quaternary alluvial precipitations (aQ_{3+1});
- Mio-plyocene sporadically water-bearing lagoon-continental precipitations ($N_2^1 - N_2^3$).

The modern alluvial precipitations of the river bed are developed in the beds of the rivers Ksani and Lekhura and are lithologically built with shingle, boulder, sand and sandstone filler materials. The depth of the underflow in this zone is about 2 meters. The direction of the current coincides with that of the river flow. The current has quite a high hydraulic gradient - $i = 0.04$. The river beds are crossed by the bridge over the motor road and therefore, special attention should be paid to the study of the hydrologic conditions of the rivers in order to avoid possible affect of the wash-out depths on the bridge piers.

The route under consideration follows only the beginning of the spreading zone of over-floodplain alluvial precipitations, at about 3 kilometers, and the depths of ground waters in this section is 0-3 meters; in chemical respect, there are waters containing hydrogen carbonate and calcium with general mineralization of 0.4 gr/l.

Modern proalluvial-delluvial precipitations, which are lithologically structured with loam and sandstones, are spread along a 4-km-long section of the route along the northern-eastern edge, as well as southern edge, in the section from the village of Gamdlistskaro to the village of Natsreti. The depths of the ground waters location in the proalluvial-delluvial cover developed to the north of the route, on the section of village Chigilari-village Igoeti, is 7-10 meters, and the same indicator on the section of village Gamdlistskaro-village Natsreti, on the southern edge is 3-5 meters. In the first instance hydrocarbonate-calcium waters chemically prevail, and in the latter instance sulphate-hydrocarbonate, and partly, hydrocarbonate-suplhate waters prevail.

As mentioned above, the southern edge of the motor road is followed by Mio-plyocene sporadically water-bearing facies lagoon-continental rocks – clays, conglomerates, rarely limestone and marls, as a continuous line. The depths of the ground waters here mainly exceed 10 meters, and in a chemical respect, sulphate-hydrocarbonate-sodium waters with general mineralization of 1-3 g/l prevail here.

The northern side of the motorway, beginning from the village of Gamdlistskaro and up to the village of Berbuki, is represented by water-bearing horizon of old quaternary alluvial precipitations developed on Tiriponi Plain – shingle, conglomerate, sands, sandstone, and loam. The depths of ground waters vary from 2 to 5 meters. General mineralization does not exceed 1 gr/l. The waters by their chemical composition are hydrocarbonate-calcium, and hydrocarbonate-sulphate in some sections.

Prevailing sulphate-ion in the chemical composition of the ground waters circulating in Mio-plyocene principal rocks can be explained by high composition of gypsum in these rocks.
The description of the complex section of the route (Igoeti, Akhalsheni – Sveneti) is referred to above and we will not stop over this question here.

The legend on the hydro geological map shows the necessary information on the hydro geological situation of the map. It is clear that detailed description of separate sections will be dealt with at the stage of evaluation of the effect of the building and exploitation of the motorway on the environment.

A1.5 Soils

The section of Agaiani- Sveneti of the central highway, belongs to the soil area of dry subtropical zone of Georgia.

The soils of Georgia are characterized by sharply expressed vertical zonality and because the hypsometric indicators of auto car's road section varies within limits 500-700 meters, so this highway- (from Agaiani- till Sveneti) passes completely in the zone of the cinnamon-colored soils. Here it is possible to meet: 1. cinnamon-colored heavy loamy-clay soil, carbonatic, in some places skeletal. 2. Meadow cinnamon-colored carbonatic, clay soil. 3. Alluvial soil. Cinnamon-colored soils are alternating with meadow cinnamon-colored soils along the highway. We observe the cinnamon-colored soils mainly on the laps and slopes of the mountain, on the relief of the hillock- hill, but the Meadow cinnamon-colored soil occupies plain places, where the ground waters are near the surface. The alluvial soils are in all soil zones along the rivers.

Territorially these soils are distributed in the following way: from Agaiani till the village Okami's pass on the both side of the highway there is the plain. These areas are occupied with gardens, vineyards and arable lands. Here are presented the Meadow cinnamon-colored soils , but from Agaiani till Sveneti on the left side of the bypass road, agricultural lands are followed by North-East exposition of the ridge of Tslevi, the slopes , on which are covered by cinnamon-colored carbonatic soils and are vegetated with hornbeam- oak forests. At the bottom of the forest we meet the brushes. These slopes are quite far from the highway and the widening of the highway will not create the problems to these sensitive areas... From the crossroad way towards village Okami till the entrance Igoeti on the left side of the highway the cinnamon-colored soils approach little by little the highway, replace gradually the area of

the meadow cinnamon-colored soils and in the environs of the village Igoeti the soils are presented completely with the cinnamon-colored carbonatic soils. . These soils in the vicinity of v Rene's environs to the right side of the highway are once again replaced by the meadow cinnamon-colored soils, which are expended till environs of the villages Kvemo Shavshvebi and Shavshvebi, although on the left side of the highway the skirts and slopes of Kvernaki's ridge, which descent down to these villages are also covered with cinnamon-colored carboantic soil. The slope is completely covered with the forest, where the dominated species are oak, hornbeam, at the bottom of the slope is Carpinus, Paliurus spinachristi. This landscape is expended till the entrances of Sveneti. At the section of Agaiani -Sveneti the alluvial soils are situated in the floodplain environs of the rivers Ksani, Lekhura, Tortla, where fine riparian forests are formed of the grove with aspen (*Populus piramidalis*; *Populus Canadensis)*, the willow, sea-buckthorn (*Hippopae ramnoides),* blackberry *(Rubus Argutus)*. These places are quite valuable for recreation.

The spread of three types soil are presented on the map with the indexes: cinnamon-colored soils - 1, meadow cinnamon-colored soils -2, alluvial -3.
Below each type of the soil is described separately.

The cinnamon-colored soil

The cinnamon-colored soils are formed in the conditions of warm, dry subtropical climate, under the light oak and oak-hornbeam forests. The characteristic property of theses soils is the activity of soil production processes in the deep layers, the significant depth of the complete profile (if it is not limited by the existence of rocks), moderately developed topsoil layer and the infiltration of humus matter into the depth. The profile of the soil is well differentiated as genesis horizons. The dark color is characteristic to the accumulative horizon, which has the good structure and texture. The mentioned horizon is characterized with positive physical properties, like: high water conductivity and aeration, good thermal conditions, etc. The thickness of topsoil horizon is 20 - 25 cm. The cinnamon-colored soils presented at the Agaiani- Sveneti section of the highway are carbonatic at the surface . In the depth of profile, in the alluvial horizon it is well expressed the accumulation of carbonates as the space of new formed structures, miceliums and grains. The soil is skeletal, has the capacity of the high absorption and the absorptive complex is quiet saturated with the basic compounds. Has the week alkali reaction at the surface, but in the depth is the alkali. The mechanical composition of the soil is heavy loamy and clay. The middle part of soil's profile is distinguished with the high extent of argillization.

From the agricultural point of view these soils are high fertile and accordingly its major part is used for production of annual, as well as perennial crops. So far as the cinnamon-colored soils are presented on the hillock-hill relief, on the slopes, so in case of non correct exploitation the wash off process of the soil develops very quickly. The risk of erosion of these soils is quite high. From this standpoint it is especially noteworthy that the right slope of the road bypass to village Igoeti was affected by the construction of the new road that initiated at Soviet times and later abandoned. The slope has been cut. In such place the concrete retaining wall has been installed , but at the neighboring sites where the wall does not exist the erosion processes are developed intensively. At this place the relief is quite complex and fragmented. The descent of the slope here reaches 20-25 degrees. The water erosion channels are formed alongside the slope and.

not only soil but soil forming delluvial- proalluvial layers are washed down from the slopes onto the abandoned right of way.

In parallel with the erosion processes the landslide has developed at the mentioned site. This landslide is very close to the proposed alignment for the alternative option of the existing highway.

The protection of the above mentioned slopes must be the problem of the first order. It is necessary to provide the complex measures against the landslip and erosion.

In the environs of Agaiani-Sveneti developed cinnamon-colored soil forming rocks are Tertiary sedimental rocks and Quaternary delluvial-proalluvial sedimental layers.

The meadow cinnamon-colored soil

These soils are formed under the influence of surface's waters in the conditions of plain relief between the hilly areas covered by the cinnamon-colored soils . The profile of the meadow cinnamon-colored soil is monotone. It is not differentiated as the genesis horizons. Its structure is rough, and the physical properties are not as good, as of the cinnamon-colored soils. In these soils the fraction of deposit and of physical clay is high, that's why in the wet conditions it is much glued, but in the dry situation it hardens and becomes fractured. The soil has the bad drainage features.

The whole profile of this soil is carbonatic. The carbonates are not visually well detectable but rarely are presented as speckles and gypsum.

The meadow cinnamon-colored soil as compared with the cinnamon-colored soil is weekly humused, although the existence of topsoil is imprinted in the whole depth of the profile.

The reaction of the soil's solution is the week alkali. So far as the process of the soil formation is connected with the excessive humidity, in some places we observed gluey soil. Despite of all above said these soils in case of correct agro technical treatment, is efficient in crop production. That's why in east Georgia these soils are widely used in agriculture.

As we have mentioned these soils are formed in the conditions of plain relief and therefore, the processes of water induced erosion is not developed here, although the protection measures against deflation still are required.. Unfortunately, the wind belt afforestation zone (32m in width) in the vicinity of Shavshvebi has been almost totally destroyed and only few plants of asp have survived.

The alluvial soil

The alluvial soil in the area of the Agaiani- Sveneti section of the motorway has little spread. It is more or less spread along the rivers Lekhura and Tortla in a narrow strip. The soil has the layered structure, formed by sedimentation of different material imported by the rivers during different periods. The soil is of week alkali reaction, carbonatic. The mechanical composition is not homogenous and varies from loamy sand to clay. At this soil type soil cover the riparian forests are developed. The riparian groves consist of species like populus *deltoides* and Populus *piramidalis*, willow, *Hippophae rhamnoides* and other.

A1.6 Ecology: Flora

General Floristic Description of Agaiani-Sveneti Section of Motor Highway Landscapes and Plant Communities

This territory belongs to the east Trans-Caucasian BG province; Kartli BG, Shida Kartli geo-botanic and according L.Maruashvilis (1970) to Zemo Kartli. It has plain-hilly relief, with hill-ridges (Kvernaqi and Tselebi hill-ridges) and terraced valleys. The absolute elevations of this physical-geographic region vary from 400m to 1200 m (tops of Kvernaqi hill-ridge).

The greatest part of the territory is almost completely reclaimed by human economic activity and occupied by cultivated agricultural land. In spite of this fact according to N. Ketskhoveli (1960) on the plains and mountain slopes there are still left the fragments of primary vegetation cover: beard-grass steppes and sibljak (spiny shrubwood steppes); flood-plain forests; fragments of plain, mountain slope and arid forests; semi-desert fragments (Igoeti, Kvernaqi); fragments of lake and reservoir bank marshes vegetation (near Nadarbazevi lake bank Kvernaqi ridge *lowering* at 856 m elevation); phryganoid vegetation fragments (Kaspi, Igoeti).

Sibliak (spiny shrubwood) steppes – mainly correspond to the landscape of 19a kind

On the major part of the territory surrounding Agaiani-Sveneti section of the highway in the steppe range (to the west from Mtskheta Kldekari) there is sibliak (spiny shrubwood groups) which represents the first stage of secondary steppes development (Ketskhoveli, 1960). In these coenoses sibljak-*Paliurus spina-christi* prevails. The main participants are: *Rhamnus pallasii, Cerasus incana, Spiraea hypericifolia, Prunus spinosa, Rosa canina, Cotoneaster* and *Crataegus* species, *Carpinus orientalis,* etc. These shrubs do not participate equally in sibljak on the whole length of highway; in general these secondary sibljaks differ from each other depending on the original vegetation cover which previously occupied the territory (foothill slopes, flood-plain forests or arid forests). Correspondingly there will be sibljaks of diverse floristic composition developed along the highway route.

If the sibljak is developed in the place of flood-plain forests (landscape 51), along with steppe vegetation there will be an abundance of *Asparagus officinalis, Phisalis alkekengi, Melilotus officinalis,* etc.

In sibljak steppes developed on the foot-hill slopes in the places of oakwoods and hornbeam forests, *Pteridium aquilinum, Polygonatum glaberrinum, Tamus communis,* etc are growing.

In sibljak steppes developed in places of arid forests *Artemisia meyeriana, Kochia prostrata, Rostraria glabriflora (=Koeleria phleoides),* etc are found.

In general the floristic composition of sibljak is quite rich: *Paliurus spina-christi, Rhamnus pallasii, Amygdalus georgica, Briza media, Brachypodium silvaticum, Festuca valesiaca (=F. sulcata), Melica transsilvanica, Bromus japonicus, Elytrigia repens (=Agropyron repens), Dactylus*

glomerata, Koeleria gracilis, Lolium rigidum, Medicago caucasica, Onobrychis iberica, O. kachetica, Coronilla varia, Astragalus borissovae, Medicago minima, Glycyrrhiza glabra, Phlomis pungens, Thymus tiflisiensis, Origanum vulgare, Teucrium polium, Paeonia tenuifolia, Achillea micrantha, Centaurea solstifialis, Chondrilla juncea, Tragopogon reticulatus, Eryngium biebersteinii, Falcaria vulgaris, Hypericum perforatum, Filipendula vulgaris, Potentilla canescens, Agrimonia eupatoria, Asphodeline dendroides, etc.

Amygdalus georgica is Georgian endemic species and is included into the "Red Data Book of Georgia". It is also a participant of sibljak. The groups of this plant are still found close to Igoeti. In these places one can also find more specific local endemics *Paeonia majko* and *P.carthalinica.*

One should also mention the species *Astragalus carthlicus,* which is distributed on stony ecotopes between Tbilisi and Gori; other Georgian endemics are *Astragalus cyri.* growing on the foothills and solonetz soils in Kartli.

Along the highway route there is a remarkable distribution of wormwood steppe fragments near the village Igoeti, close to Kaspi. It develops on structure less soil brought down from mountain slopes. On Ashuriani plain, close to Grakali and, Kaspi still there remain the groups of shrub *Nitraria schoberi* which is characteristic to Asian deserts. This species is also included into the "Red Data Book of Georgia".

The beard-grass steppes – mainly correspond to the landscape of 19b kind

Along the Agaiani-Sveneti section of the highway corridor one of the main groups of beard-grass steppes are the secondary beard-grass steppe fragments (Ketskhoveli, 1960). As noted above, the secondary beard-grass steppes are developed in the places previously occupied by forests of foothill slopes (oakwoods, hornbeam forests) and flood-plains. They are formed with equal participation of *Bothriochloa ischaemum, Festuca valesiaca (=F. sulcata), Stipa*-s species. The floristic composition of these secondary beard-grass steppes is comparatively rich.

Thus in the fragments of secondary beard-grass steppes the prevalence belongs to: *Bothriochloa ischaemum, Festuca valesiaca (=F. sulcata), Elythrigia repens (=Agropyron repens), Stipa stenophylla, S. pessingiana, S. capillata.*

The general (overall) floristic composition is as follows: *Koeleria gracilis, Melica transsilvanica, Aegilops triuncialis, Phleum phleoides, Dactylis glomerata, Poa bulbosa, Agropyron cristatum, Scorzonera biebersteinii (=S. eriosperma), Jurinea arachnoidea, Inula aspera (=I. cordata), Achillea millefolium, A. micrantha, Salvia nemorosa, Thymus tiflisiensi, Phlomis pungens, Teucrium polium, T. nuchensis (=T. chamaedrys), Linum austriacum, Gypsophila stevenii, Lappula squarrosa (=L.echinata), Scabiosa micrantha, Onobrychis kachetica, O. iberica, Medicago caucasica, M. coerulea, Filipendula vulgaris (=F. hexapetala), Veronica multifida, Dianthus subulosus, Galium verum,* etc.

Riparian (tugai) forests – landscapes of 51 kind

The fragments of riparian forests are mainly spread near v.Agaiani, v.Igoeti, from v.Igoeti to Kaspi, and from Kaspi in the direction of v.Gamdlistskaro. Aspen woods (Populus hybrida), willow woods (Salix australior), oak woods (Quercus longipes), elm woods (Ulmus suberosa) and others are mainly spread here; the grass is as a rule, moisture-proof. Of the grass, one can meet cattail, reed, water plantain, etc. in this area.

Rare and Protected Species

Rare, endemic and protected plants are found also in beard-grass and sibljak steppes around Kaspi, Igoeti, Tirifoni plain, on Kvernaqi.

Species	Status	Landscape	Sites
Amygdalus georgica	**Georgian endemic species "Red Data Book of Georgia" 1982; Included in new (interim) Red List , 2006**	**19a; 19b**	**Agaiani;** **Igoeti; Kaspi**
Astragalus carthlicus	**Georgian endemics**	**19a;**	**Igoeti;**
Astragalus cyri	**Georgian endemics**	**19a;**	**Igoeti;**
Berberis iberica	**Red Data Book of Georgia;1982** **To be included in updated RDB**	**19a;**	**Igoeti;**
Iris iberica	**Red Data Book of Georgia; 1982** **To be included in updated RDB**	**19a; 19b**	**Igoeti;**
Nitraria schoberi	**Red Data Book of Georgia; 1982; Included in new (interim) Red List , 2006**	**19a;**	**Igoeti; Kaspi;**
Paeonia tenuifolia	**Red Data Book of Georgia; 1982**	**19a; 19b**	**Igoeti;**
P.caucasica	**Red Data Book of Georgia; 1982** **To be included in updated RDB**	**19a; 19b**	**Igoeti;**

P.majko	**local endemics**	**19a; 19b**	**Igoeti;**
P.karthalinica	**local endemics**	**19a; 19b**	**Igoeti;**
Quercus Iberica	**Red Data Book of Georgia; 1982** **To be included in updated RDB**	**19a; 19b**	**Igoeti;**
Hippophae rhamnoides	**Red Data Book of Georgia; 1982** **To be included in updated RDB**	**51; 19b**	**Igoeti;**

Igoeti Environs. ***Quercus iberica***

Igoeti Environs. ***Peonia carthalinica*** **and** ***Quercus iberica***

Economically Valuable Plants

There is a considerable diversity of economically valuable plants within the highway corridor and its adjacent areas on the Georgian territory. They are represented with different floristic-coenotic frequency in different amounts and with varying productivity. Besides it should be noted, that in the highway corridor as well as for all Georgia, the resources (productivity) of economically valuable plants (Cornelian cherry, raspberry, bilberry, cherry plum, wild pear, etc.) have not been properly studied and evaluated. Special effort is needed in order to fill up this gap.

During the last 5-6 years, due to economic crisis and general hardship, the output of crop production has substantially decreased; as a result the population has turned to consumption of wild fruits, edible mushrooms, medicinal plants and other natural vegetation resources. The attention should be paid to the following aspect of the problem of anthropogenic impact of the highway project on economically valuable plants:

- Economically valuable species, as a part of vegetation diversity preservation and stable development problem.
- Economically valuable species, as primitive ancestors of cultural plants, with valuable gene fund, needed for plant breeding.
- Economically valuable species, as a food (nutrition), other resources, and income source for population.

Thus it is crucially important to estimate the possible impact of the highway reconstruction and operation on vegetation and in particular the economically valuable species.
In order to predict the expected negative impact the study and modeling of abiotic (physical) and biotic (vegetation, animals, fungi, microorganisms) factors is needed.

In definite places of the Agaiani-Sveneti section of the highway and namely in environs of vil.IGoeti the wild fruit, especially Cornellian cherry (*Cornus mas*) are represented in greater quantities than on the previous section. Besides cornelian cherry one can find Hazel (*Corylus avellana*), wild pear (*Pyrus communis*), wild apple (*Malus orientalis*), cherry plum(*Prunus divaricata*), (*Rosa canina*), hawthorn (*Crataegus* spp.), medlar (*Mespilus germanica*), barberry (*Berberis vulgaris*), etc.

Planting of greenery in Agaiani-Sveneti motor highway

Artificial plantings follow the both sides of Agaiani-Sveneti motor road along its full length. This is the greenery of this motor way – walnut-trees with the fragments of ash-trees, apricots, oleaster and horse chestnut. Of the conifers, pine-trees, cedars and thuja dominate here. Great number of ash-trees and oleaster grow naturally from seeds, and there are only several cherry-trees, cherry-plums and sweet cherry-trees.

Planting of greenery in Agaiani-Sveneti motor highway

Sensitive Zones of Agaiani-Sveneti Section of the Motor Highway (floristic aspect)

Section 1 (Agaiani – Igoeti)

- Fragments of riparian forests in the vicinity of v. Agaiani (Landscape 51). The riparian forests are protected according to the Forestry Code.

Section 2

- Fragments of riparian forests, mainly in the vicinity of v.Igoeti, from Igoeti to Kaspi and from Igoeti to v.Gamdlistskaro (Landscape 51). The riparian forests are protected according to the Forestry Code.
- A particularly sensitive section in the plain of Zemo Kartli is the territory of Igoeti, where the following species of peony registered in the Red Book are concentrated: *Paeonia tenuifolia, P.caucasica* and local endemic species *P. cartalinica.* The following rare and endemic species registered in the Red book are spread in Igoeti: Georgian almond-trees (*Amygdalus georgica*) and Georgian barberry (*Berberis iberica*). Intersection of different landscapes (19a; 19b).

Section 3

- Landscapes 19a - Kvernaki ridge slopes of Northern exposition present sensitive ecological and valuable aesthetic landscapes. The landscape is vulnerable to anthropogenic influence in general but is out of the project impact zone

Expected Impacts

The protected areas nearest to the Agaiani to Sveneti section of the highway (see 3.7.2) are located on substantial distance and do not fall within the limits of the direct influence of the project, and therefore, any influence on them is not expected.

The sensitive area in the vicinity of Igoeti and riparian forests are most vulnerable ecosystems from floristic standpoint. Potential impact on these habitats related to construction activities should be considered and appropriate mitigation and conservation measures should be applied.

The greenery from Agaiani to Sveneti will be affected by the project activities, during the building and exploitation periods. The plants in the strip of greenery are expected to be damaged, and the number of parasites and diseases is expected to increase, for during the building and exploitation periods the plant resistance is expected to be reduced what will make them more vulnerable. Therefore, additional studies and compensation measures are necessary.

The orchards, crops, vegetable pitches, the wind-breaks, fragments of the adjacent wood might be influenced by the project activities. On the given territory the number of parasites, pests, diseases, weeds, harmful micro organisms is expected to increase and could be spread during the highway construction and exploitation periods. Reduction in the plant resistance observed during last years and the possibility of spreading harmful micro organisms through the means of transportation increase the probability of damage. Therefore, additional research is necessary to identify adequate mitigation and compensation measures. Special attention should be paid to such quarantine pests as Fall webworm (*Hyphantria cunea Drury*), which damages about 300 plant species, including wood species. The attention should be paid to eggar *Oceria dispar*, bark beetles *Ipidae*, phylloxera (*Viteus vitifoliae*), grape stock withering (*Phomopsis viticola*), corn diploid (*Stenocarpella macrospora*), ragweed (*Ambrosia antemisiifolia*), etc. as to avoid the expected damage.

A 1.7 Ecology: Fauna

General description of types of landscapes crossed by the highway (significant for fauna)

From the physical-geographic point of view, the highway section in the territory of Georgia is going along the central and western parts of the Tran Caucasian depression (area located between mountain ridges of the Great Caucasus and the Minor Caucasus, that are bordering from the North large region of Near East Uplands (Museibov et al., 1986; Devdariani, 1986)). Central part of the Transcaucasian depression, situated in the eastern and central parts of Georgia, belongs to the Mtkvari physical-geographic province, the Mtkvari-Alazani sub province (another sub province of this province, Mtkvari-Arax lowland, is located in Azerbaijan). Within the Mtkvari-Alazani sub province, the highway crosses: Kveda-Kartli (Lower Kartli) lowland, namely Gardabani lowland (section Akstafa-Gatchiani), Tbilisi section of the Mtkvari canyon, Shida-Kartli (Inner-Kartli) Plain and eastern foothills of the Surami (Likhi) mountain ridge. All rivers and streams, located on the territory of this region, belong to the basin of the river Mtkvari and, thus, to the basin of the Caspian Sea.

According to the most wide-spread zoogeographic systems (Nikolsky, 1913; Vereshchagin, 1958; Gadjiev, 1986; Tuniev, 1987; Tarkhnishvili and Kikodze (eds.), 1996), all territory of Transcaucasia, including the Transcaucasian Depression, belongs to the East-Mediterranean sub region of

Palaearctis. At the same time, physical-geographic regions crossed by the highway belong to two distinctly different zoogeographic provinces: the Near-Eastern (its borders, within the territory of Georgia crossed by the highway, coincide with the Mtkvari-Alazani physical-geographic sub province, except eastern foothills of the Surami ridge) In their turn, these provinces are subdivided into several zoogeographic districts, each of them characterized with specific faunistic complexes (ranges of distribution of an important part of animal species coincide with borders of these districts)

Within the Near-Eastern province, Georgian sector of the highway crosses one zoogeographic district: the Mtkvari district. North-western borders of distribution of a large number of animal species typical for this district coincide with the Tbilisi valley section of the Mtkvari canyon. Shida-Kartli Plain which usually is also included in this district contains substantially less species typical for Near-Eastern fauna than territories located to the South-East from Tbilisi (Kveda-Kartli lowland).

However we accepted here the simplified scheme, more appropriate from zoological point.

The most important types of landscapes are the following: (1) "Tugai" forests, located in valleys of large rivers surrounded with arid or semi-arid areas (mainly, landscape # 51). Such forests will be crossed by the highway in the Kveda-Kartli Plain (the Mtkvari district). (2) River Coast ecosystems, usually differing from surrounding landscapes by the higher humidity, less developed soil layer, sometimes - the higher concentration of shelters, more developed bush vegetation and less covered with agricultural landscapes (mainly, landscape # 51). These ecosystems usually form narrow strips along rivers up to several hundred meters wide. (3) Ecosystems of current waters. (4) Freshwater lake ecosystems, which are fed from rivers and streams crossed by the highway. (5) Foothills and hills covered with xeric bush vegetation and steppes (landscapes 19a and 19b). Ecosystems of this type are quite diverse in regard of bush vegetation and species composition of plants and animals, and cover an important part of territory crossed by the highway within the Shida-Kartli Plain, from Tbilisi to foothills of the Surami ridge. (6) Agrocenoses (Cultivated lands; mainly landscape 23) cover probably most part of the territory crossed by the highway. Largest massifs of agrocenoses are located: in Kveda Kartli - from Gardabani to Tbilisi; in Shida Kartli: Mtskheta-Mukhrani and Gori-Kareli areas;

Agaiani – Sveneti Section of the highway

From zoogeographic point, this area (Shida-Kartli Plateau) contains "mixed" type fauna, mainly represented by poorer version of faunistic complex of the Mtkvari district. Within this area, the highway crosses four types of landscapes: river coast ecosystems (mainly, landscape # 51). Especially important are the coastal ecosystems, in particular, areas where the highway crosses the rivers Ksani and Didi Liakhvi. However, the former is connected more with freshwater, than terrestrial ecosystems), hills covered with xeric vegetation, (landscapes 19a and 19b) agrocenoses and (landscape 23) industrial landscapes.

In the eastern part of the plateau, before crossing the river Aragvi near Mtskheta, the highway passes along the southern edge of the Saguramo Nature Reserve - mountain slopes, covered mainly with hornbeam bushes. The landscape map shows the natural landscapes crossed by the Agaiani – Sveneti section of the highway.

Mammals in the zone of impact of the Agaiani – Sveneti Section of the highway

Mammal fauna of the region counts 35 species (Vereshchagin, 1959; Shidlovsky, 1975; Sokolov and Tembolov, 1989; Bukhnikashvili and Kandaurov, 1996). Presence of four more species is suggested. Populations of vulnerable species of large mammals (are brown bear *Ursus arctos, Lynx lynx, Felis silvestris, Canis lupus,* red deer *Cervus elapus*) are concentrated in the eastern part of the plateau, in the territory of the Surami Ridge sensitive area. It's doubtful that any of them will be significantly damaged due to construction works and operation of the highway. At the same time, main part of small mammal species and mustelids are found on the whole length of the impact zone. Of these species, 10 are endemics of the Caucasus (Kandaurov and Bukhnikashvili, 1996) and 4 are endangered in Georgia: *Canis lupus, Lutra lutra, Felis silvestris, Lynx lynx, Cricetulus migratorius, Mesocricetus brandti* and probably, the bats: *Rhinolophus mehelyi, Barbastella barbastellus, Miniopterus schrebersi, Miotis emarginatus,* which are included in the Red Data Book of Georgia. Highest densities of these species are observed in: (1) remnants of Tugai forests at confluence of the river Aragvi; (2) at foothills covered by dry forests (Shio-Mghvime, southern border of the Saguramo Nature Reserve, Mtskheta-Chardakhi section). Almost all of these habitats are situated in the eastern part of Zemo Kartli section.

Birds in the zone of impact

Throughout this area of highway impact 148 bird species, representing 17 orders, are recorded. 98 species of them are nesting here, 34 are migratory and 12 are wintering, 4 species were recorded as separate specimens only (Chikovani et al., 1990). There are noticeable abundant populations of hawks (*Accipiter gentilis*) and the population of the re-introduced species of partridges (*Perdix perdix*), located near the confluence of the river Aragvi, in the eastern part of the plateau. Nearby, on the territory of the Shio-Mgvime monastery, there are nesting places of birds of prey: colonies of vulture (Egyptian vulture *Neophron percnopterus*), separate nests of buzzard (*Buteo rufinus*) and small eagle (*Hieraaetus pennatus*). At the same time, whether or not these nesting places are covered by the 4-km corridor needs special study. There is also noticeable population of *Luscinia megarhynchos,* declining for the present time.

Amphibians and reptiles in the zone of impact

Within the impact area of this section there are found 22 species of reptiles, including two tortoises, nine lizards, and nine or ten (according to different authors) snakes (Darevsky, 1967; Muskhelishvili, 1970; Bannikov et al., 1977). High diversity of reptiles is found on southern slopes of the Saguramo ridge. Only here the endangered species of sand boa *Eryx jaculus, Tarbophis fallax, Coluber ravergieri, Elaphe hohenackeri,* endemics Derujins lizard *Lacerta derjugini, L.praticola, L.portchinskii* are found. Species *E.hohenackeri* is included into the Red Data Books of the USSR and Georgia. Amphibian complex includes four species (Tarkhnishvili et al., in prep.; presence of the common (or Kolkhic) toad, indicated by Chikovani et al., is doubtful), no one of them are endangered now.

Ichtyofauna

There are 26 fish species in the Mktvari basin, 12 are used for fisheries, 11 in the rivers, 3 in tributaries (*Salmo fario, Barbus capito* and *Barbus mursa*) and four are migratory (*Rutilus rutilus caspius, Aspius aspius taeniatus, Chalcaburnus chalcoides* and *Abramis brama orientalis*). There are seven endemics of the River Mktvari and its basin (*Chondrostoma cyri, Gobio persa, Varicorhinus capoeta, Barbus lacerta cyri, Barbus mursa, Acanthalburnus microlepis, Nemachilus brandti*), and two Caucasian endemics (*Barbus capito* and *Alburnus filippi*). Four of these nine species, including *Varicorhinus capoeta* and *Barbus* spp., are important for fisheries. The former species, plus *Barbus lacerta cyri* and *Leuciscus cephalis orientalis* are found in high densities in Ortachala reservoir (near Metekhi power station). The latter two have breeding centers to the west of Mtskheta. The most vulnerable will be non-reophilous fish including the endemic species mentioned above, all of which have breeding centers to the west of Mtskheta.
The most important areas for conservation of main habitats are the breeding grounds for reophilous and non-reophilous fish between Mtskheta and Gori and fish mass growth areas in the Avchala-Mtskheta region. This is relevant to all the rivers of the r.Kura basin within the area of concern: r. Ksani, Lekhura, Eastern and Western Tortla and Didi Liakhvi.

Resume

Although the highway crosses quite strongly transformed landscapes, possibility of some impact of the fauna could not be excluded and additional studies in the zone of construction (EIA stage) and preentry survey in the corridor of construction is needed to assess real value of potential risks and to plan adequate mitigation measures.

A1.8 Archaeological, Historic and Cultural sites

Introduction

We have been mainly guided by "Description of Historical and Cultural Monuments of Georgia", volume 5, to elaborate on the list and locations of cultural monuments within the 2-km-width and 37km-long corridor along the Agaiani-Sveneti section of the motorway, which is the section under our consideration. The mentioned book, based on the scientific literature (scientific reports of archaeological surveys and research, data of the list of Georgian Soviet Encyclopaedia, passports of the Department of Monument Preservation, as well as studies and publications on individual monuments), contains the information on archaeological and architectural-historical monuments. Site reconnaissance has been carried out to specify proximity of the monuments to the highway and determine most sensitive sites requiring specific consideration during project implementation.

The information is delivered in the following way: in order to elaborate on the locations of the monuments, we used a principle commonly used in literature and namely, locations are given in respect of settlements, followed by the monument number (numbering increases from East to West), type of a monument (a tomb, a site of ancient dwelling, a site of ancient village, a fortress, church, etc.), the date of its establishment with the indication of the period, age, epoch, and so on.

Historical context of the Region

Most of the territory of historical Kartli, the principal region of Eastern Georgia, is mostly a plain. The area is distinguished among other corners of Georgia for beneficial geographical location and natural conditions. Rivers richly flow from the surrounded ridges enabling the local residents to use this region for settlement and farming purposes since the ancient past. Historical Shida Kartli, in every epoch of Georgian history, was a consolidation center of Georgian tribes and a support of the state life. Archaeological monuments prove that the Georgian tribes living on this territory had reached the high level of social-economic and cultural development as far back as by the IV-III cc. B.C. This fact is evidenced by a hill, the site of ancient dwelling of Kvarstskela, Khizanaantgora, Berikldeebi, Orgora (Kartli Region), Gudabertka (Gori region) and many others, revealed and partly studied on Kartli Plain. Based on the archeological monuments of the II-I cc. B.C. revealed on this site (Samtavro hill of ancient dwelling and a churchyard of Mtskheta, a churchyard and site of ancient dwelling of Narekvavi, hill of ancient dwelling of Khovle, graveyards of Agaiani, and a site of ancient dwelling of Kaspi Region, Goris Tsikhe (Gori Fortress), Dedoplis Gora, Dediplis Mindori, and graveyards of Doglauri in Kareli Region), the researchers conclude that there were pre-state unions here in the past, so-called “Khevebi” (“Gorges”), which later, due to extension were transformed into independent political and social-economic units headed by a patrimonial aristocracy. In the VII-VI cc. B.C., these units were formed as independent political-administrative centers evidenced by rich inventory of that period (gold, silver, bronze, iron) found in the tombs excavated in Akhalgori, Kanchaeti, Tsinskaro and other sites. Those tombs are considered as the ones of patrimonial aristocracy by the scientists. Such state of affairs was a precondition for emerging the cities and establishing first state unions. In the IV-III cc. B.C., a strong political union referred to as “Iberia” by ancient Greek and Romans, and as “Kartli” according to Georgian narrative sources, were formed. The center and capital of the union was the city of Mtskheta. According to historical sources (Leonti Mroveli, XI c.), the founder of Kartli Kingdom and its first king was Parnavaz. Together with Mtskheta, ancient Greek, Roman and Georgian historical sources mention other important strategic, fortification and cultural-religious centers, such as Sarkine, Samadlo, Nastakisi, Dzalisi, Agaiani, Kaspi, Uplistsikhe, Tsikhiagora, Gori, Urbnisi, Dedolis Mindori, etc.

The data by Strabo, ancient Greek geographer (I c. B.C. - I c. A.D.) evidence high level of development of the city life: “Iberia is for the most part, scattered with cities and settlements so that we can see tile roofs and the houses built with high architecture, bazaars and other public buildings”. Strabo also mentions the four routes leading to Iberia, among which a principal caravan-trade-transit mains leading from Phazisi to the Caspian Sea was the most important one. The mains was greatly significant not only in antique period, but it functioned during the Medieval Ages, too (it is interesting that this mains in fact, coincides with the trajectory of the present motor road). The following cities were located along the mentioned mains or near it: Mtskheta, Kaspi, Agaiani, Uplistsikhe, Gori, Urbnisi. On the basis of studying the materials and written sources found during the archaeological excavations, it has been established that the above-mentioned cities were well-developed city centers of Hellenic period having close trade and cultural contacts with the Greek world, Achemenide Iran, Seleudic Syria, Armenia, Parthia, etc.

At the beginning of the First century B.C. Rome Empire embarked on active political expansion to Eastern countries affecting Iberia, as well. As a result of the first campaign of the Romans in Iberia (65 B.C.) the country was subjected to the political influence by Rome. The I-III cc. A.D. saw strong Kartli Kingdom, and a peaceful relationship between Rome and Kartli Kingdom. The

Romans realized that Transcaucasian countries virtually represented a route connecting them to the North Black Sea coast, an inexhaustible source of slaves. The Romans also took trade and economic interests in the mains leading from India and across Kartli to the Black Sea and then to the Mediterranean and different countries of Europe. Thus, Kartli linked Eastern countries to the Western world. In the II century A.D. a Roman emperor Antoninus Pius invited king of Kartli Parsman II with his family and Iberian noblemen to Rome where, on Mars Square he erected a statue in honor of King of Kartli. Close cultural and trade contacts between East and West are evidenced by the gain of Hellenic-late antique age (IV c. B.C. - IV c. A.D.) found in the sites of ancient settlements, graveyards and other monuments. Remains of palaces, churches, bath-houses and other public buildings of various designations were found here; almost every architectural remain, besides obviously original developmental elements, shows the traces of foreign culture. Such kind of material is for instance, tower-like fire cathedrals widely spread in ancient Eastern world (Urartu, Midia, Iran) and extensive religious centers (Tsikhia Gora, Samadlo, Dedoplis Mindori, Uplistsikhe), on the one hand, and there are gorgeous cathedrals built according to Greek-Roman architectural norms (Sarkine, Shiomgvime, Mtskheta, Bagineti) and bath-houses (Dzalisa, Agaiani, and Armaztsikhe in Mtskheta), on the other hand. All these monuments and buildings point to the high cultural and sanitary habits of the local society. Silver, bronze, glass and clay wares, statues, seals, great diversity of ornamentation and precious stones brought here from different countries are also great in numbers. Greek, Roman, Parthian and local gold and silver coins found on the territory of Kartli evidence the intense trade and economic relations. The high intellectual level of the local society is clearly evidenced by the specimens of Greek and Aramaic scripts and many other similar literary sources .They are reference monuments in dating the archaeological cultures of Caucasus, studying urban processes and history of the societal development. Some monuments of Mtskheta, Nastakisi, Agaiani and Urbnisi clearly show the appearance of the first Christian subjects and the existing ethnic situation (e.g. first appearance of the Jews in Georgia), following the establishment of ancient cities.

In the 1330s, there happened a great event in Georgia - Christianity was declared a state religion. The arena for this action was Shida Kartli (Mtskheta, Tkhoti Mount in Agaiani). St. Nino, Enlightener of the Georgians started preaching in Mtskheta, and in was Tkhoti mountain where King Mirian fallen to disaster during his hunting believed in the miraculous power of Nino's God. This was the reason for building St. Nino church on Tkhoti Mountain and generally, for intense building of churches and monasteries in the whole country right after the adoption of Christianity.

In the V century A.D. Vakhtang Gorgasali unified Eastern and Western Georgia dividing the country into administrative units called provinces (which were headed by voevodes). Shida Kartli remained an individual administrative unit. This fact once again accents a particular significance of Kartli in the whole of Georgian state system.
It was during the reign of Vakhtang Gorgasali, when the country was divided into Episcopal provinces. Such provinces of Shida Kartli were: Samtavro, Samtavisi, Tsilkani, Urbnisi, Ruisi, Nikozi. A greatest achievement of the religious-cultural development of early feudal age was the construction of Jvari Cathedral in Mtskheta by Kartli voevodes in 587-604. Jvari Monastery is an artistically complete architectural monument of a classical style of the ascent period. It has great significance in the evolution of Georgian cult architecture. Cathedrals of Samtsevrisi, Tsromi, Aten Zion and Urbnisi and Anchiskhati Basilicas belong to the same period.

In the VII century, Arab invasions significantly hampered the country's development. First of all, the regions of Shida Kartli fell victim to full burden of their dominance, while the extreme corners

of Georgia were relatively defended against Arab violence. Kingdom of Egrisi-Apkhazeti, princedoms of Kakheti, Hereti and Tao-Klarjeti tried to obtain political influence on Shida Kartli, for the one able to subordinate this region would have an honor of the title of the country unifier. Marvelous architectural monuments of so-called "Transition period" of Georgian architecture, such as Zedazeni, Tsilkani, Davati, Uplistsikhe Basilica, Armazi, Tsirkoli, Kabeni, Bziana in the gorges of the rivers Mtkvari, Aragvi and Ksani, and "Jvarpatiosani" - in Telovani and many others belong to the same period.

Georgia was ultimately unified during the reign of David IV the Builder. He succeeded in winning a coalition army of Moslem countries on Didgori Valley in 1121, and freed Tbilisi making it the capital city of the unified Georgia. During his successors (Demetre I, Giorgi III and Queen Tamara) Georgia was the strongest state in Front Asia. The country reached its peak in social, political and cultural development. Georgia once again became the principal trade and caravan mains between East and West. The following extremely important routes ran at Gori and across Shida Kartli: Surami Pass to the West, Dariali Gorge - to the North, Mtkvari Gorge - to the South, and Kakheti-Gombori Pass - to the East. Caravanserais, coaching inns, fortresses with their remains survived to our days were built along the roads and passes and in Shida Kartli (Ksani Fortress, Skhvilo Fortress, Gori Fortress, Surami Fortress). Great cathedrals of Bagrat, Oshki, Alaverdi, Svetitskhoveli, Atskuri were built in the same period. Much significant Episcopal cathedrals of Samtavro, Samtavisi, Ikorta, Kvatakhevi, Betania, Kintsvisi, Nikozi and others were also built in Shida Kartli.

In the XIII-XIV centuries, Mongol invasions caused huge damage to the country with Eastern Georgia subjected to the severest burden of these invasions (the Mongols did not invade Western Georgia). Invasions by Tamerlane ended up with unified Georgia. Country was divided into individual provinces. Princedoms of Aragvi and Ksani, Estate of Amilakhvari - Satsitsiano, Estate of Mukhran the Prince, etc. were formed in Kartli.
The country weakened, its farming was destroyed, cities and villages were emptied and demolished. Most of the population died in battles or immigrated.
Despite such grave times, church building was not stopped. "Metekhi" and Ertatsminda in Kaspi, and the St. Nokoloz church on Narikala and churches of Holy Virgin on Metekhi plateau, Tbilisi were built during this time.

The XV-XVI centuries mostly saw the restoration and renovation of the churches and monasteries and fortresses ruined during the invasions.
Strengthening of Osman Empire and fall of Byzantine Empire in the XV century deprived Georgia of establishing close relations with European countries. The subsequent history of Kartli is the history of struggle against Osmans and Kyzilbashs. However, the Georgian people did not give up struggling for independence. During this period, the residents of Kartli won several battles against the invaders. Freeing Gori Fortress and the city from Osmans in 1599 by the people of Kartli led by King Simon is worth mentioning.

In the XVII-XVIII centuries, Kartli was under the influence of Iranians or Osmans and was ruled by Mohammedized kings. Local disorders impeded preserving the independence of the country. In 1762, Erekle II was declared the King of the united Kartli-Kakheti. He tried to reorganize the state structure. He abolished the princedoms of Aragvi and Ksani, established a permanent army with the principle of duty, and prohibited selling the forests. He took important steps towards revitalization and development of industry and culture. There appeared gold-, silver-, iron-treatment and arms enterprises. Ekerle II opened a mint and founded seminaries. However, the neighboring Mohamed

countries got even more anxious to capture Transcaucasia. It is in this period, Russia embarked on the expansion policy to Transcaucasia and Eastern countries. In fact, Georgia became a target range of the wars waged by Russia and Osman Empire. The situation in Georgia was even more aggravated by local disorders among the feudal lords. All the occurred events turned out to be insurmountable obstacle for Erekle II on his way to revitalize and strengthen the country.
Erekle II decided on the contact with Christian Russia to rescue the country, and in 1783, he concluded the Russian-Georgian Friendship and Protection Treaty. However, Georgia did not feel much of Russian patronage. In 1795, Iranian army led by Aga Mohammed Khan severely ruined Tbilisi. In 1801, after the death of Erekle II, Russia abolished the kingship in Georgia.
Despite all the above-mentioned, such architectural monuments, as Ananuri Complex, Mchadijvari and Tkhinvali Churches and numerous village churches were built in the late middle centuries. At the same time, the influence of Eastern architecture on Georgian architecture can be clearly seen.

List of archaeological and cultural-historical monuments along Agaiani-Gori motorway

Section 1. Agaiani – Igoeti

Village of Agaiani

1. Agaiani Plain, a historical monument.
In 1625, the army of Shah Abas under the commandment of Karchikha Khan camped on Agaiani Plain. Karchikha Khan ordered princes and noblemen of Kakheti to appear before him with the select army, as if to grant presents to the Shah. The Kakhetians were taken into the tent for "presents" and cut their heads. After killing of about 400 men, the treachery of Kyzilbash was revealed and the remained Kakhetians struggled to pave their way in the direction of Kakheti (Zhamburia G., 1964).

2. Tkhoti Mountain, a historical monument.
It is situated in 1.5 km South-East of the village. According to historical sources, when Mirian, King of Kartli hunted on Tkhoti Mountain, the solar eclipse occurred. The King in vein begged his gods to help him. Then he applied to "Nino's God", and a miracle happened - the sun appeared and the sky got clear. Mirian promised Nino to erect a wooden cross on this site.
In the first centuries of Christianity, St. Nino Church was built on Tkhoti Mountain. The church is partly restored now (**DMG**. 1990).

3. Burial place on Tkhoti Mountain, an archaeological monument, IV-V cc. A.D.
It is located on the terraces, on the left side of Tbilisi-Gori motorway, on the lower slopes of Tkhoti Mountain, south of Agaiani. In 1975, five burial places of four types were excavated here: clay sarcophagi, burials built of brick and covered with wooden beams, catacombs burials and pit-graves. Golden jewelry, Roman and Byzantine golden coins and other items were found in the burial places of the IV century.

Is situated in the village Akhaluban-Akhalsopeli. (Mirianashvili, 1980).

4. Dwelling site hill, an archaeological monument, early Iron Period. It is situated in 100 meters from the Agaiani-Sveneti motorway, at the new cemetery of the village. **(DMG. 1990).**

5. Burial ground, an archaeological monument, Late Bronze Age (XI c. B.C.). It is situated to the east of the village, in 0.5 km from the vine factory, on the left side of Tbilisi-Gori highway, occupying the area of 3 hectares. It was partly excavated in 1964. Bronze axes, lances, belts, buckles, deer statues and other items were found here. **(Baramidze, 1974).**

6. Town site and a burial ground, an archaeological monument of the Late Hellenic period, late antique period, early feudal period. It situated in the north-west from the village, at place called "Rikianebis Veli", on the right side of Tbilisi-Gori highway. It was partly excavated in the years of 1975, 1977-78. There were five levels of antique period revealed on the town site and namely, remains of the walls built of adobe brick on the cobble foundation, tiles painted red, and fragments of wall paintings, flotsams of clay pipes, heaters and bath-house facing tiles, and numerous local or imported glass and clay items of high artistic value. The clay sarcophagi, jar-graves and pit-graves excavated in the burial ground revealed golden and silver ornamentations, bowls, jugs, spoons, seals and about 120 gold and silver coins. **(Bokhochadze, 1981; Mirianashvili, 1983).**

7. St. George's Church, and architectural monument, XIX century. It is situated in the village center (DMG, 1990).

8. Castle, an architectural monument, XVIII c. five-stored, cylinder-shaped. It is situated in the yard of one of the village residents. **(Dvali, 1990).**

Village of Okami

9. Dwelling site hill, an archaeological monument. It is situated on the new cemetery, in the west of the village. Early iron period (XI-IX cc. B.C.). (**DMG**. 1990).

10. Church of Holy Virgin, an architectural monument of the XVIII-VIX cc. It is one of the best specimens of the Late Medieval Ages. It is situated at the edge of the village, to the North. (**DMG.** 1990).

11. St. George Church, an architectural monument of the Late Feudal Age. It is situated on the new cemetery, at the edge of the village, to the North. At present, it is damaged. (**DMG**. 1990).

Section 2. Igoeti

Village of Igoeti

12. Dwelling site of "Nakalakiant Khevi", an archaeological monument of the Late Antique Period. It is situated in 1 km from Igoeti-Lamiskana turn, on the left. **(Gvetadze, 1990).**

13. Burial ground, an archaeological monument of the Late Bronze-Early Iron Period. It was found and damaged during Tbilisi-Gori road construction. The bronze items found here are preserved at Gori Museum. **(Baramidze, 1965).**

14. Dwelling site, "Glaklis Seri", an archaeological monument of the Late Antique Period-Medieval Ages. It is situated on the mountain slope, right of the river Lekhura, on the right side of Tbilisi-Gori highway (Oral information was delivered by Mindiashvili G.).

15. Dwelling site, an archaeological monument of Antique Period. It is situated at the road at Kaspi turn. Burnt layers and tiles were found (Oral information was delivered by Nikolaishvili V., a scientific-worker of the Institute of Archaeology).

16. Dwelling site, an archaeological monument of Antique Period. It is situated on the left bank of the river Lekhura, near the bridge over the river.

17. St. George Hall Church of Punageti, an architectural monument of Early Feudal Period. It is situated on the South-Western slope of the village (**DMG**. 1990). **(Mgaloblishvili, 1990).**

18. St. Virgin hall church, an architectural monument - Early feudal period. It is situated on a hill, in the south-west from the village, near the cemetery. (**DMG**. 1990). (Mgaloblishvili, 1990).

19. Red Church, an architectural monument. Developed feudal period. It is situated in the South-East of the village, directly at the motorway. (Giorgobiani and Mgaloblishvili, 1990). It was restored in 1983.

Village of Samtavisi

20. Samtavisi, a Historical village. It is situated in 1 km to the right of Tbilisi-Gori Highway, North-West from Igoeti. It was an Episcopal center since the VI century and an important educational center in Mediaeval Ages (XV-XVIII cc.). Here famous literary men and penmen acted. There are a number of battle events linked with the history of the village and its vicinity.

21. Samtavisi architectural complex is situated in the village center. Its principal building is a cupola cathedral built in the XI century, a stage specimen of Georgian Christian architecture. Inscriptions on the facades and interior of the cathedral tell us about the history of its construction and restoration in the XI, XIV, XV and XVI centuries. The complex includes an Episcopal church, a small church, a bell-tower and a fortified enclosure of Late Medieval Ages.

Section 3. Igoeti - Sveneti

Village of Kvemo-Chala

22. Skhvilo Castle, an architectural monument of the X-XVII cc. It is situated in 2.5 km to the right of Tbilisi-Gori Highway, on a slope of a high mountain, to the east of the village. It was a strategically important point of Medieval Ages and controlled the vicinity of the rivers of Ksani and Lekhura for some kilometers. In the XVII-XVIII cc. the Castle played an important role in the battles by kings and nobles of Kartli against the Osmans, Kyzilbashs and Lezghins.

Village of Gamdlistskaro

22. ***Burial ground, an archaeological monument of the I century B.C.*** It is situated in the place "Khodabunebi", on the slope of the dry gully of the river Tortla, in 0.5 km to the west of the village. Bronze items were accidentally found on the territory of the burial ground. A bronze item with the images of a shepherd, flock and a dog is the most important one among other bronze items.

Village of Kodistskaro

23. Kodistskaro village is a historical monument. It is situated in 1.5 km from Tbilisi-Gori highway. Historical sources first mentioned it in the XI century, then in the XV century. Taka Zedvdginidze, a nobleman of Kartli donated the village to Shio-Mgvime Monastery.

24. In 1982, during the earth works in the east of the village, a ***statue of Dionysos*** was accidentally found. This is an excellent sample of monumental art.

25. Dwelling site and a burial ground, an archaeological monument of Early Feudal Period. It is situated at the edge of the village, at the place called "Khriakebi". The monument is crossed by the dry gully formed through downpour. The section of its edges clearly shows ashes-and-coal layers and remains of clay sarcophagi.

v. Kvemo Rene

26. Dwelling site hill, an archaeological monument of Early Iron Age (XII-IX cc. B.C.). It is situated in arable lands, 2 km to the south of the village. There are the remains of the Trinity Church survived on the hill.

v. Nigoza

27. Burial ground, an archaeological monument of the Late Bronze-Early Iron Age (XIV-IX cc. B.C.). It is situated at the place "Dachrilebi", 2 km to the west of the village. During the land cultivation, a plough threw out the fragments of ceramic ware.

28. Dwelling site, "Nadarbazevi", Feudal Period.

Shavshvebi

29. St. Virgin hall church, an architectural monument of the developed Feudal Age (XI-XIV cc.). It is situated in 1 km to the south of the village.

30. Dwelling site hill, an archaeological monument of Early Bronze-Late Bronze Age, Feudal Period. It is situated between the villages of Kvemo Akhalsopeli and Shavshvebi, in 1.5 km to the North of the village, on the right side of Tbilisi-Gori highway (Oral communication by Mindiashvili G.).

Sveneti

31. Gudabertka dwelling site hill, an archaeological monument of the Early Bronze-Late Bronze Age-Iron Age (III c. B.C. - second part of the I c. A.D.), feudal Age. It is situated at Tbilisi-Gori highway, to the left, to the South-East of the village. The cultural layers of the dwelling site also spread to the North, right of the road.

Recommendations

As it can be seen from the brief historical review of the Region, generally, Kartli section of motorway crosses much important archaeological and cultural-historical regions. Besides, a 2-km-

width corridor along the motorway is distinguished for a bulk of ground and underground monuments of various periods and of various type depicting an interminable picture of the cultural development of Georgia from the IV Millennium B.C. through XVIII-XIX Millenniums A.D.

We will refer to the road section from Agaiani to Sveneti in greater details. This section includes a historical Estate of Amilakhvari and an Estate of Mukhran the Prince. The ground and underground monuments in the mentioned section are characterized by local peculiarities and are therefore, very valuable in historical respect. It should be considered that some of the archaeological monuments are situated directly at the road, e.g. dwelling site hill, such as Gudabertka (at the village of Sveneti) or Agaiani site of ancient settlement and its burial ground. Consideration should be given to the archaeological objects having been already damaged during the road construction in the past (hill slope of Okami, Grakliani dwelling site at Igoeti). In the course of subsequent works, in order to avoid destroy and damage to historical and cultural monuments, we consider special protection measures along a 2-km-width route of this section absolutely necessary.

Here, under protection we mean field survey of the monuments, their identification through literary sources, fixing and marking the limits of spread of the archaeological monuments and description of their technical state. Near locations of the monuments to hazardous geological events and the engineering-technical limitations are to be considered, as well. As for the ground monuments, their present state is to be documented, their present physical state is to be evaluated, and the probability of negative affects of the building activities on them and mitigation measures are to be determined.

It should be mentioned that taking preventive measures among other things first of all, means the archaeological urgent supervision during the construction period, what is the guarantee for studying an archaeological monument unexpectedly found in the course of construction in case of necessity. If considering topography of archaeological monuments in the given section, such an opportunity seems absolutely real.

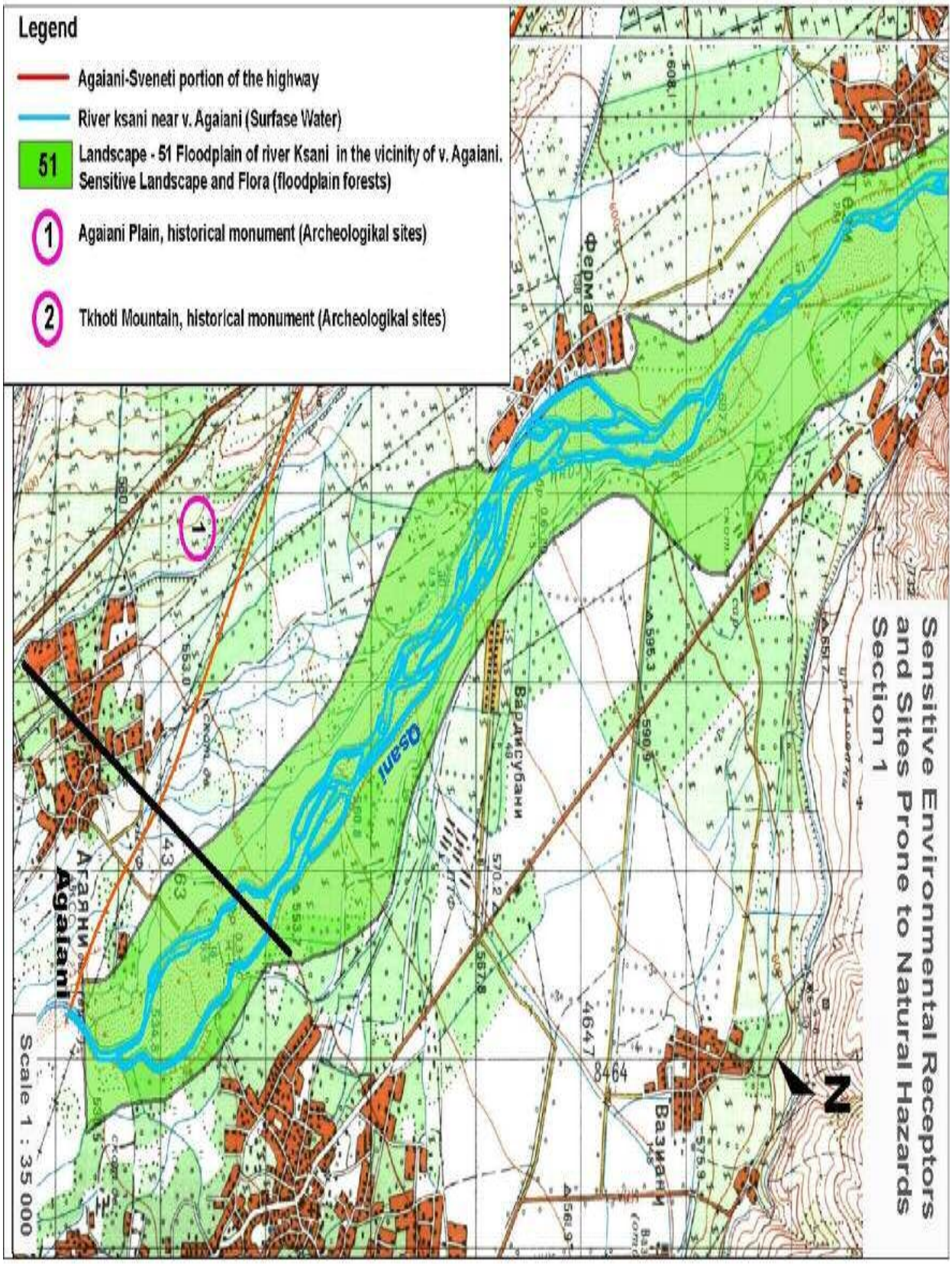
Red Church, an architectural monument. Developed feudal period. Current alignment of the road.

Red Church, an architectural monument. Developed feudal period. Proposed alignment of the road.

SamTavisi Cathedral Church (X I century) and v. Samtavisisi

Annex 2. Maps and Drawings

01. Sensitive Environmental Receptors and Sites Prone to Natural Hazards - Section 1
02. Sensitive Environmental Receptors and Sites Prone to Natural Hazards - Section 2
03. Sensitive Environmental Receptors and Sites Prone to Natural Hazards - Section 3
04. Archeology
05. Geology
06. Hydrogeology
07. Landscape
08. River Basins
09. Soils


Legend
Agaiani-Sveneti portion of the highway
River ksani near v. Agaiani (Surfase Water)
51
Landscape - 51 Floodplain of river Ksani in the vicinity of v. Agaiani. Sensitive Landscape and Flora (floodplain forests)
1
Agaiani Plain, historical monument (Archeologikal sites)
2
Tkhoti Mountain, historical monument (Archeologikal sites)
Sensitive Environmental Receptors and Sites Prone to Natural Hazards
Section 1
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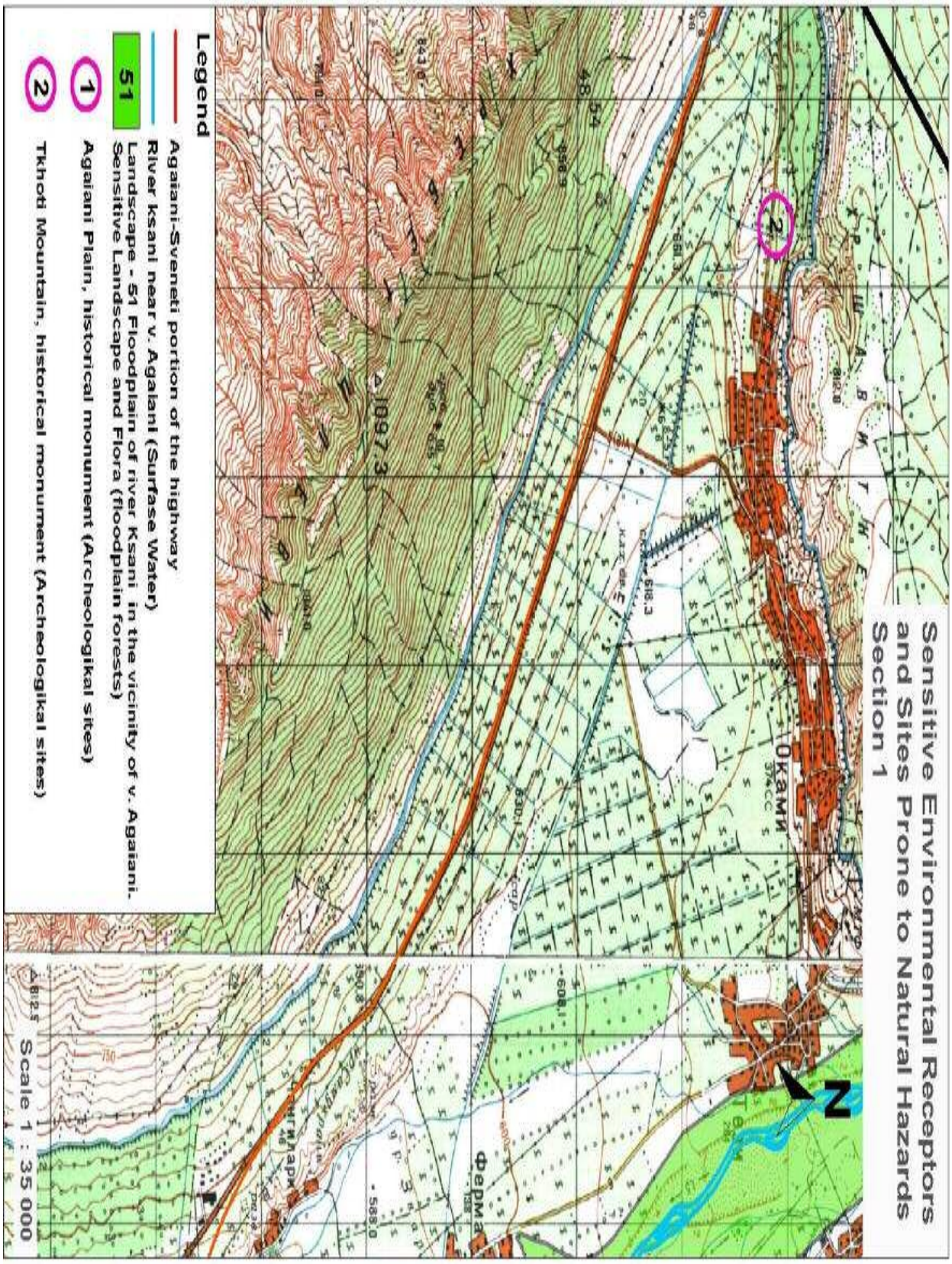
Agaiani
Ksani
N


Sensitive Environmental Receptors and Sites Prone to Natural Hazards
Section 1
Legend
Agaiani-Sveneti portion of the highway
River ksani near v. Agalani (Surfase Water)
51
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Agaiani Plain, historical monument (Archeologikal sites)
2
Tkhoti Mountain, historical monument (Archeologikal sites)
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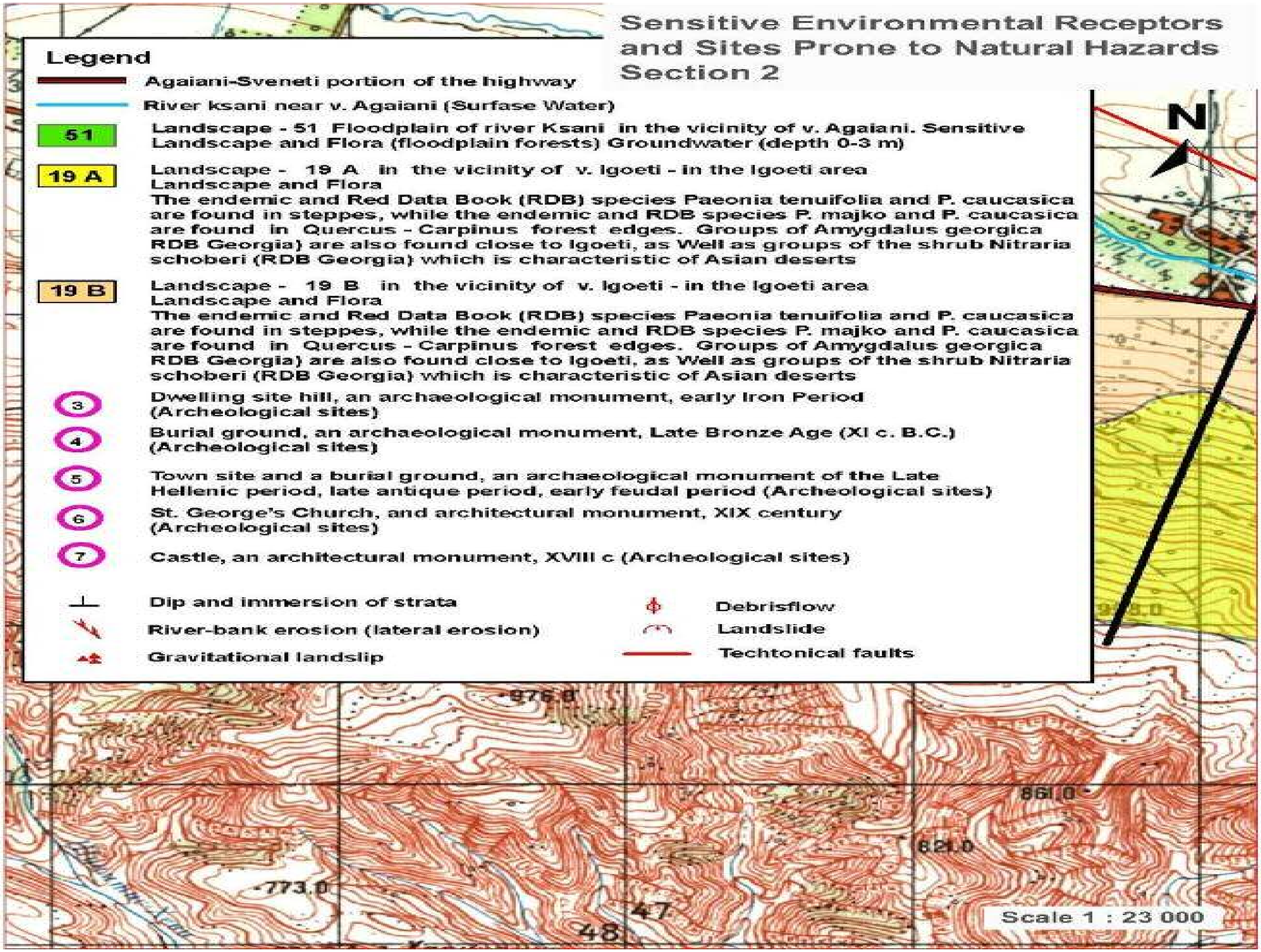
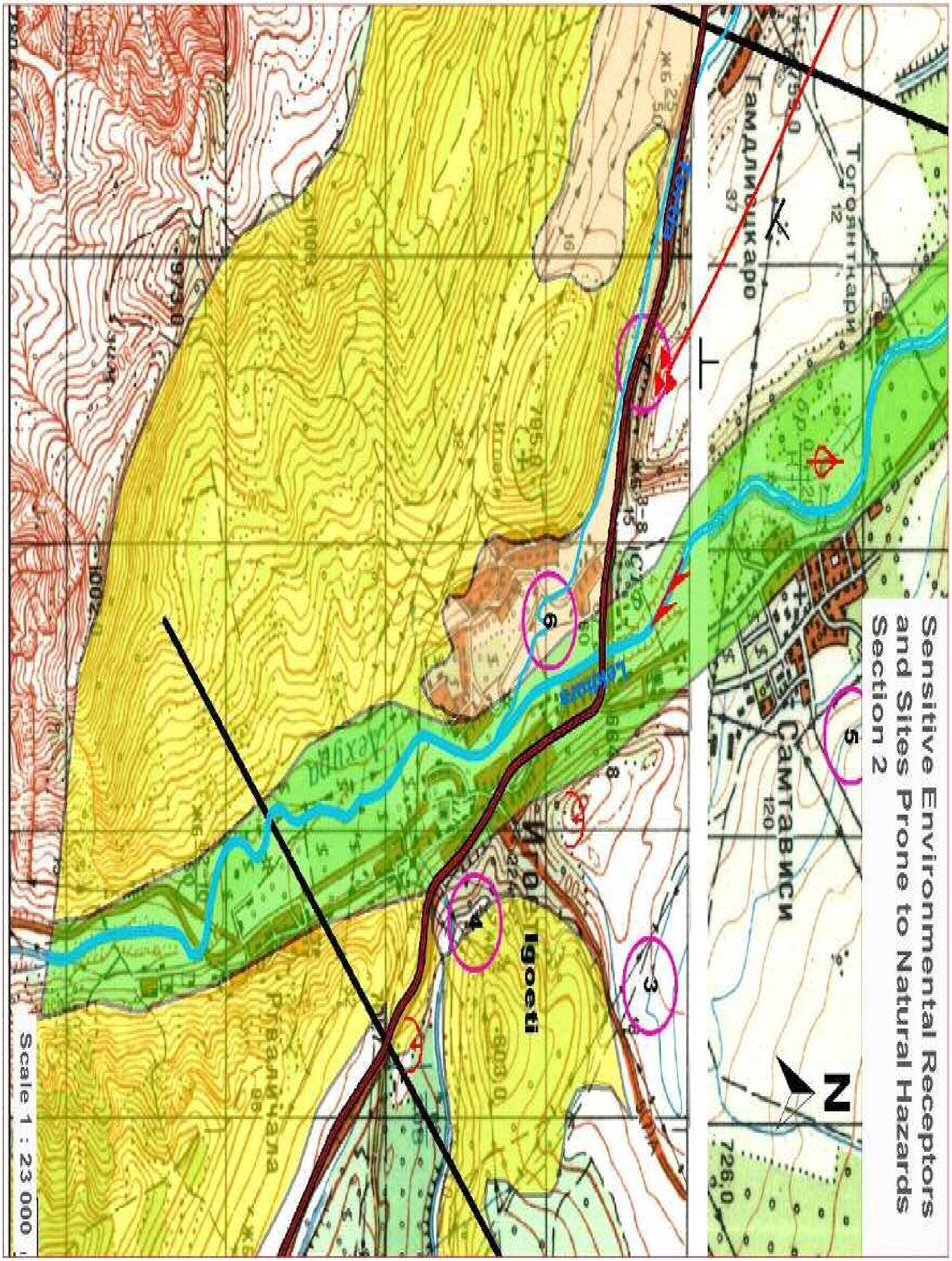
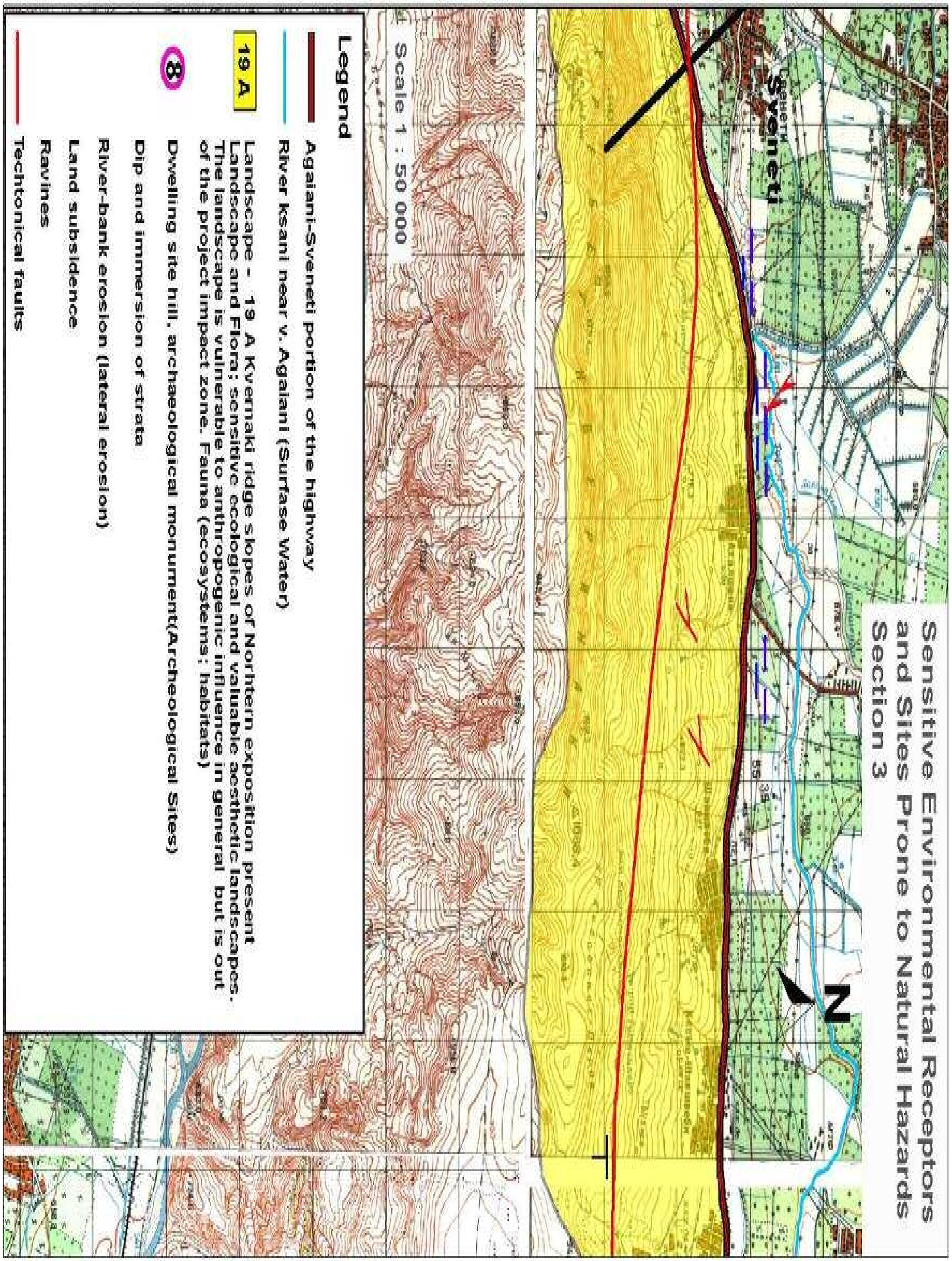
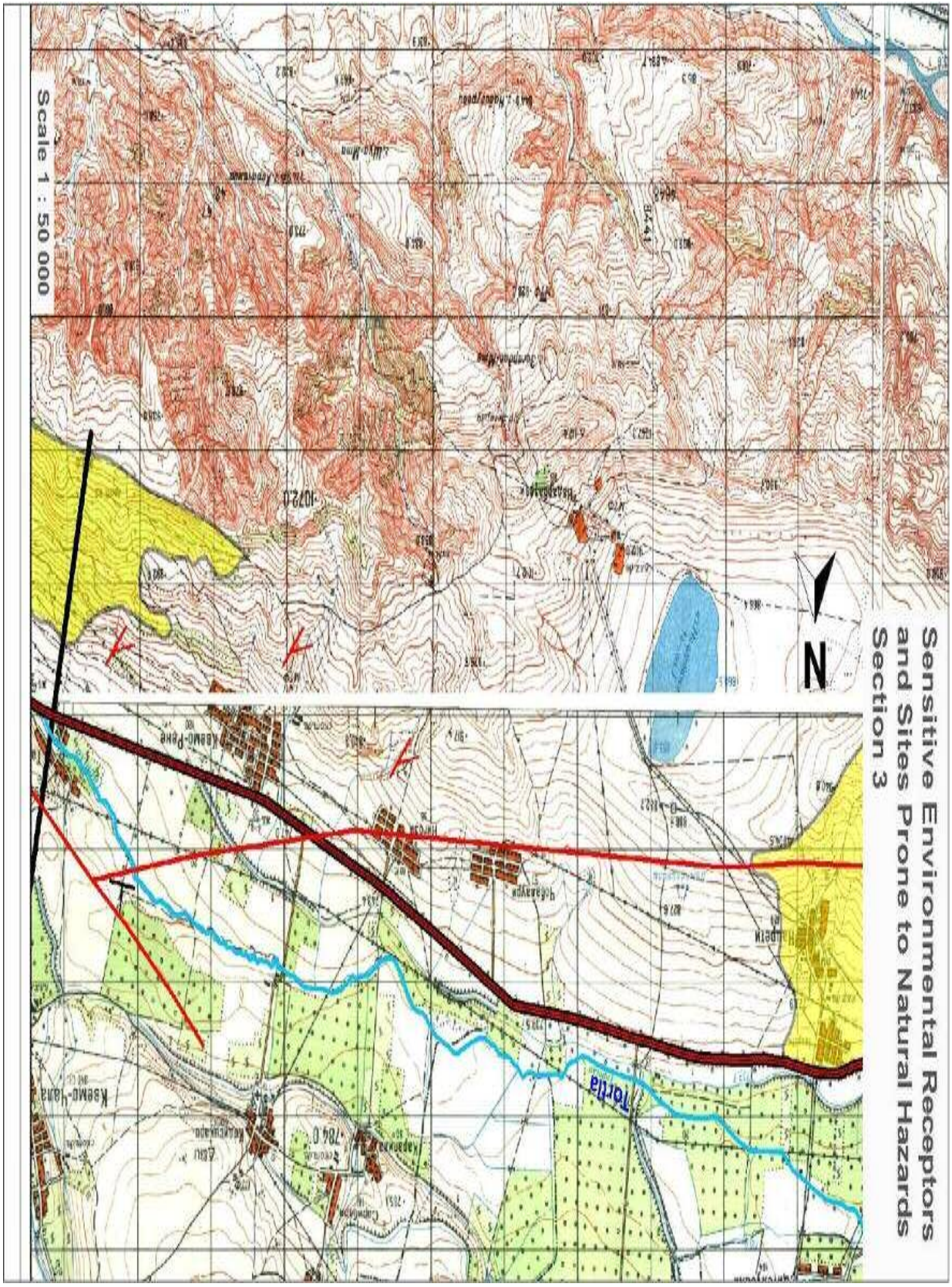

Sensitive Environmental Receptors and Sites Prone to Natural Hazards Section 2
Legend
Agaiani-Sveneti portion of the highway
River ksani near v. Agaiani (Surfase Water)
51
Landscape - 51 Floodplain of river Ksani in the vicinity of v. Agaiani. Sensitive Landscape and Flora (floodplain forests) Groundwater (depth 0-3 m)
19 A
Landscape - 19 A in the vicinity of v. Igoeti - in the Igoeti area Landscape and Flora The endemic and Red Data Book (RDB) species Paeonia tenuifolia and P. caucasica are found in steppes, while the endemic and RDB species P. majko and P. caucasica are found in Quercus - Carpinus forest edges. Groups of Amygdalus georgica RDB Georgia) are also found close to Igoeti, as Well as groups of the shrub Nitraria schoberi (RDB Georgia) which is characteristic of Asian deserts
19 B
Landscape - 19 B in the vicinity of v. Igoeti - in the Igoeti area Landscape and Flora The endemic and Red Data Book (RDB) species Paeonia tenuifolia and P. caucasica are found in steppes, while the endemic and RDB species P. majko and P. caucasica are found in Quercus - Carpinus forest edges. Groups of Amygdalus georgica RDB Georgia) are also found close to Igoeti, as Well as groups of the shrub Nitraria schoberi (RDB Georgia) which is characteristic of Asian deserts
3
Dwelling site hill, an archaeological monument, early Iron Period (Archeological sites)
4
Burial ground, an archaeological monument, Late Bronze Age (XI c. B.C.) (Archeological sites)
5
Town site and a burial ground, an archaeological monument of the Late Hellenic period, late antique period, early feudal period (Archeological sites)
6
St. George's Church, and architectural monument, XIX century (Archeological sites)
7
Castle, an architectural monument, XVIII c (Archeological sites)
Dip and immersion of strata
River-bank erosion (lateral erosion)
Gravitational landslip
Debrisflow
Landslide
Techtonical faults
N
976.0
861.0
821.0
773.0
47
48
Scale 1 : 23 000


Sensitive Environmental Receptors
and Sites Prone to Natural Hazards
Section 2
N
Igoeti
Scale 1 : 23 000


Sensitive Environmental Receptors
and Sites Prone to Natural Hazards
Section 3
Sveneti
N
Scale 1 : 50 000
Legend
Agaiani-Sveneti portion of the highway
River ksani near v. Agaiani (Surfase Water)
19 A
Landscape - 19 A Kvernaki ridge slopes of Norhtern exposition present Landscape and Flora; sensitive ecological and valuable aesthetic landscapes. The landscape is vulnerable to anthropogenic influence in general but is out of the project impact zone. Fauna (ecosystems; habitats)
8
Dwelling site hill, archaeological monument(Archeological Sites)
Dip and immersion of strata
River-bank erosion (lateral erosion)
Land subsidence
Ravines
Techtonical faults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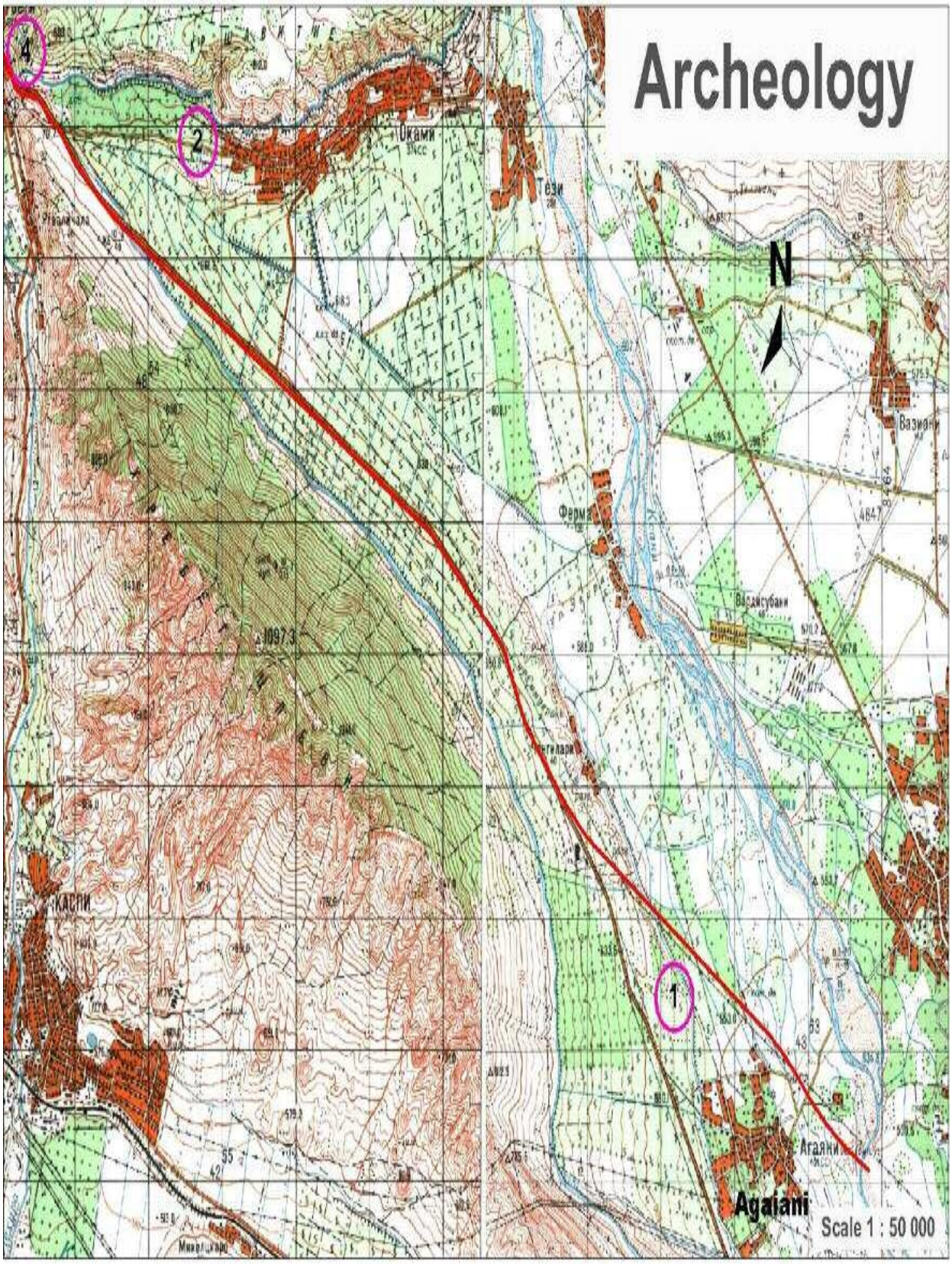
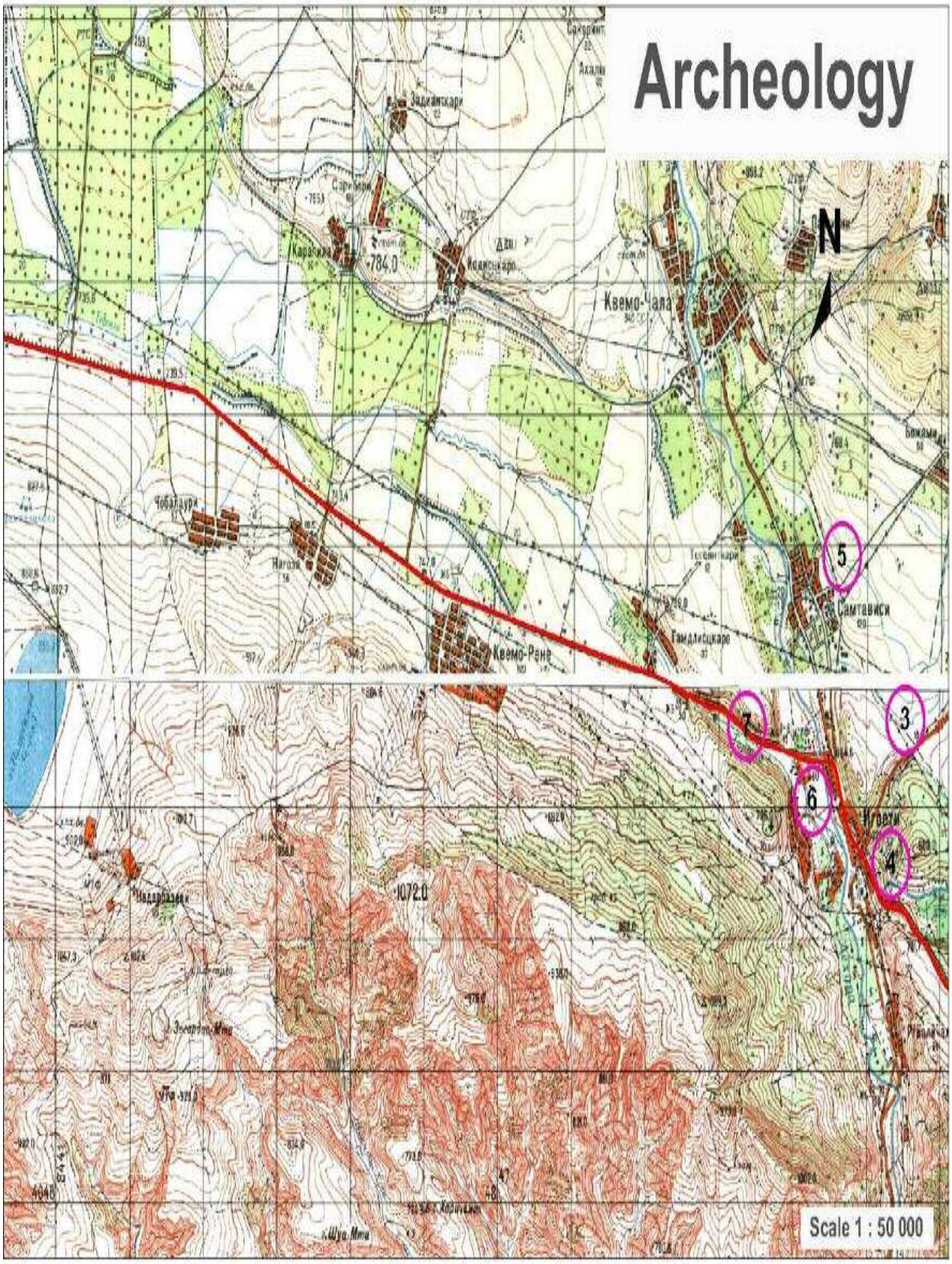
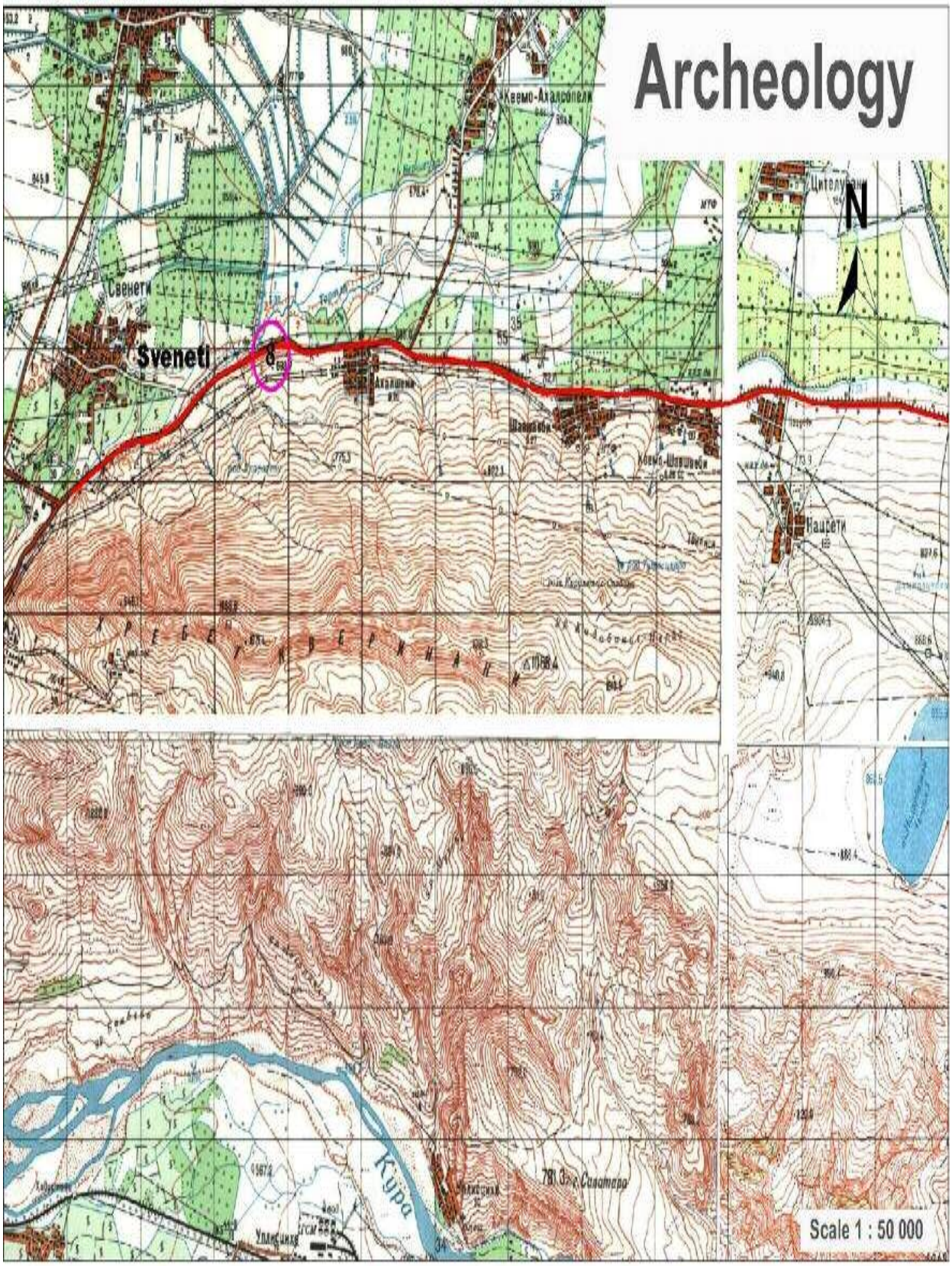
N
Sensitive Environmental Receptors
and Sites Prone to Natural Hazards
Section 3
Tortla

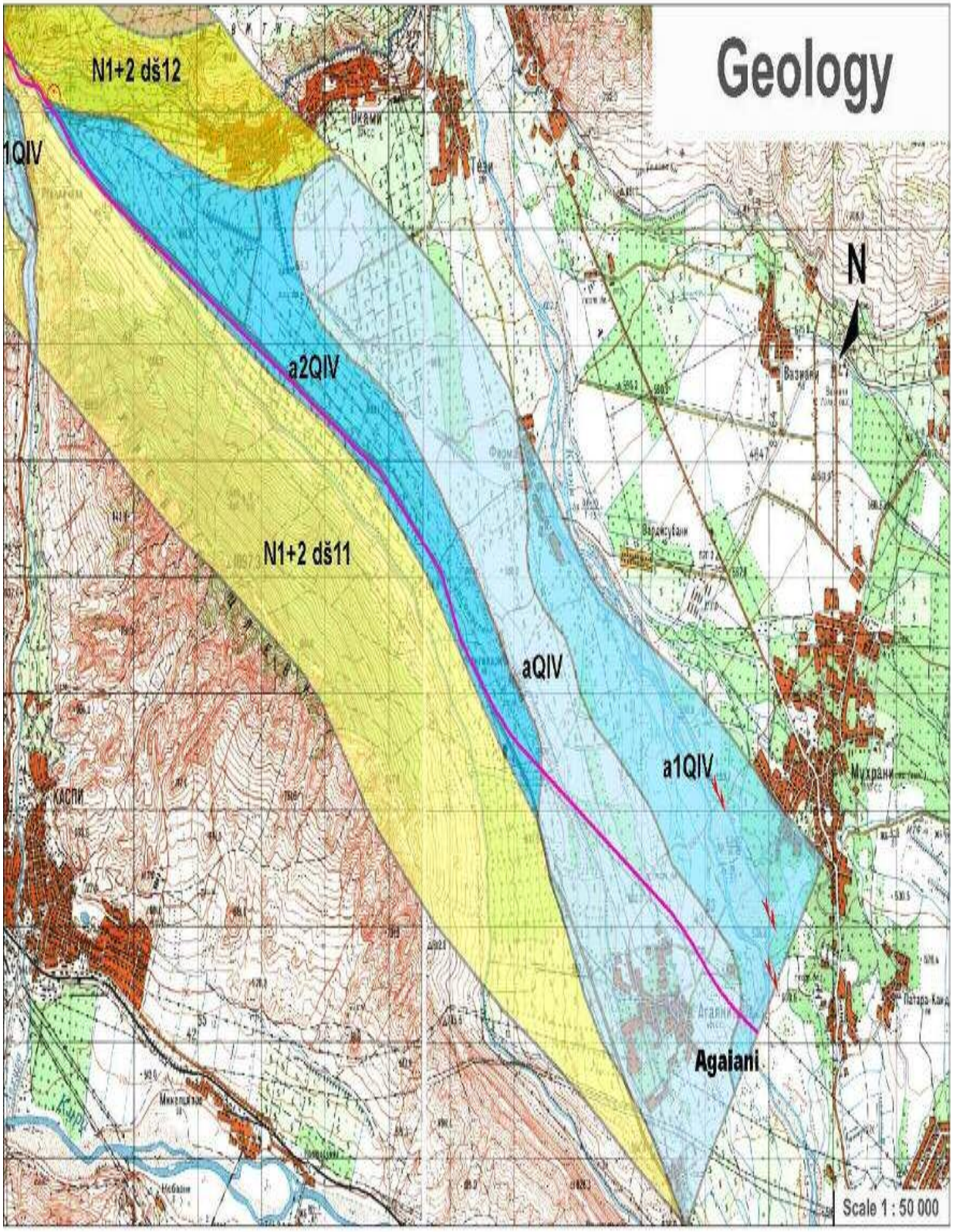
Archeology

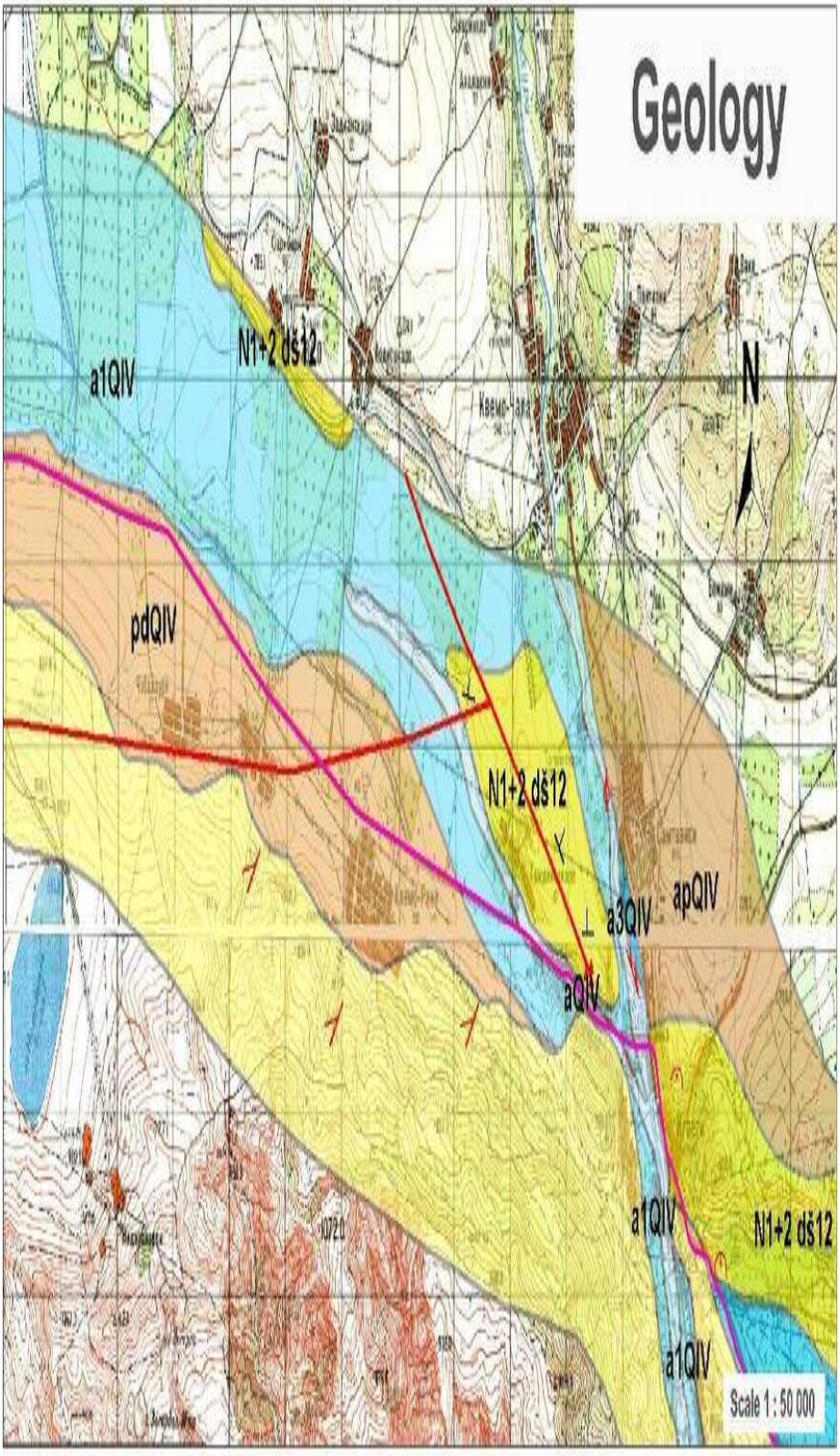

Archeology
N
4
2
1
Agaiani
Scale 1 : 50 000

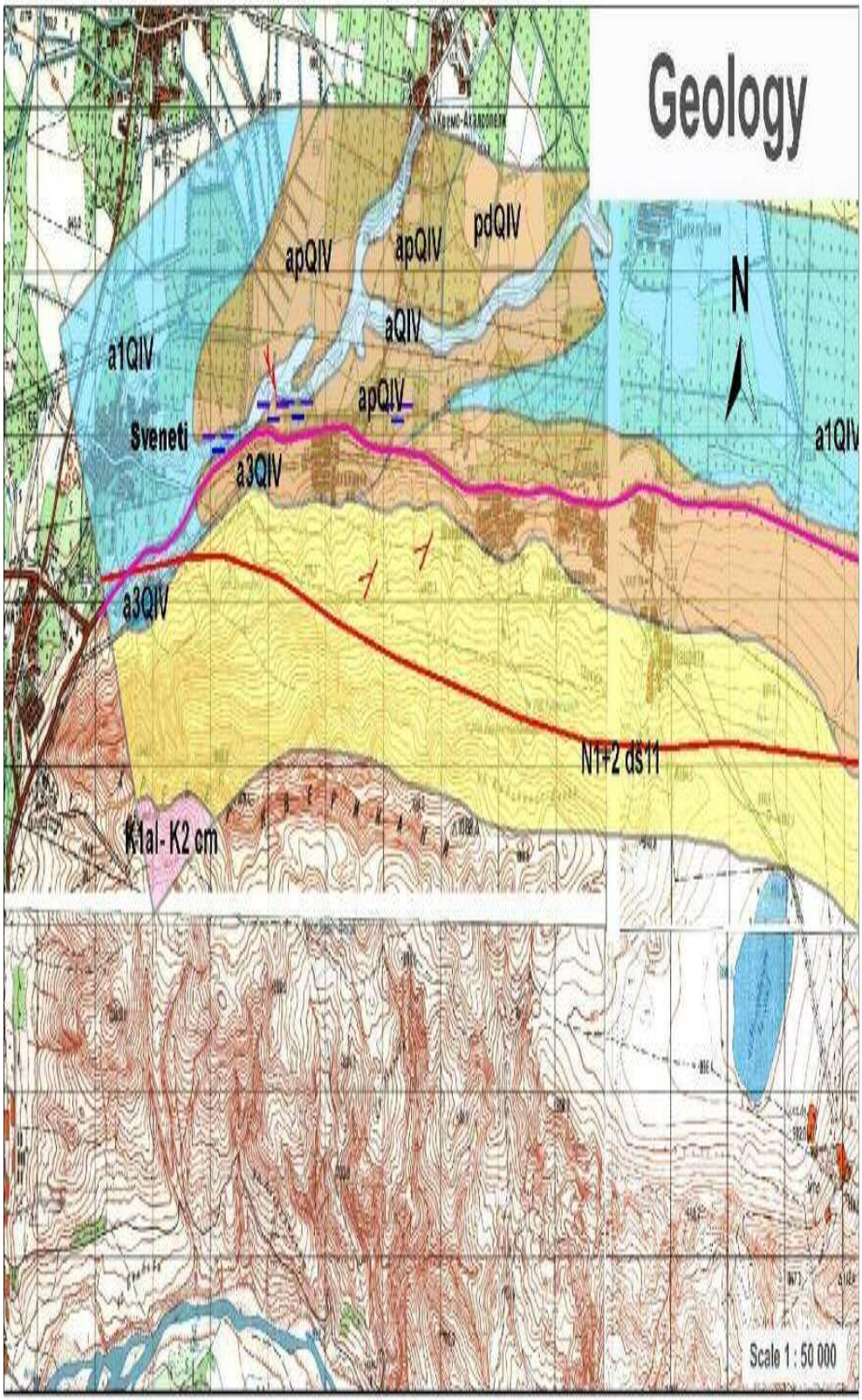

Archeology
N
Квемо-Чала
Самтависи
Квемо-Рене
Квети
1072.0
Scale 1 : 50 000


Archeology
N
Sveneti
Scale 1 : 50 000

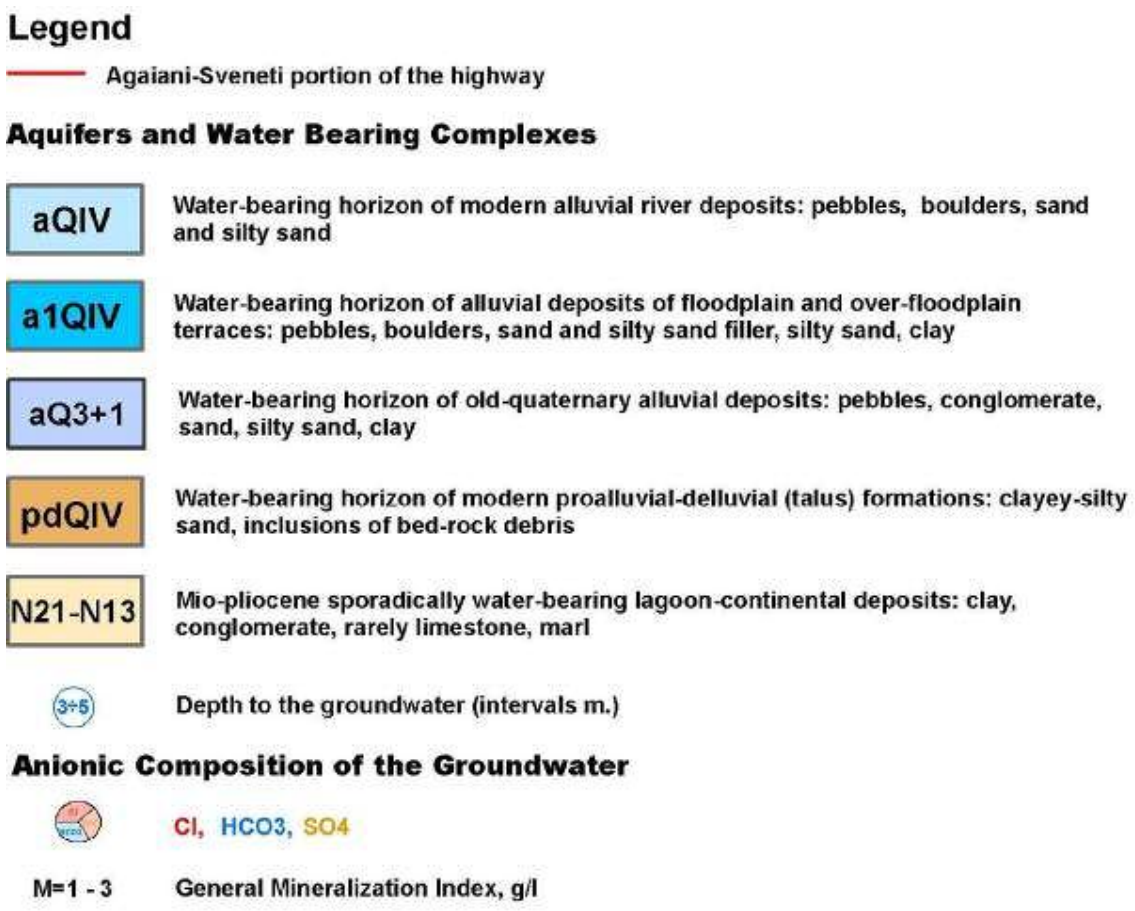

Legend
Agaiani-Sveneti portion of the highway
Sediments of different age
aQIV
Modern alluvial river floodplain sediments: pebbles, boulders, gravel, sand and silty sand
a1QIV
Alluvial sediments of the first over-floodplain terraces: pebbles, boulders, sand and silty sand filler, silty sand, clay
a2QIV
Alluvial sediments of the second over-floodplain terraces: pebbles, boulders, sand; silt and clay
a3QIV
Alluvial sediments of the third over-floodplain terraces: pebbles, boulders, sand; silt and clay
apQIV
Alluvial - proluvial pebbles, boulders, clay, silt
pdQIV
Modern proalluvial-delluvial (talus) formations: clayey, loamy sand, inclusions of bed-rock debris
N1+2 dš12
Upper part of the Lower Sub-Zone of the Dusheti Suit: well sorted out and cemented medium-grain edpebble conglomerates with inclusious of sandstone and clay
N1+2 dš11
Lower part of the Lower Sub-Zone of the Dusheti Suit: sorted out and cemented fine grain edpebble conglomerates with inclusious of sandstone and clay
K1al- K2cm
Rocks of Albi-Senonian period: loose quartzitic and glauconite sandstones and glauconite marls; rarely clay
Geology
Dip and immersion of strata
River-bank erosion (lateral erosion)
Land subsidence
Ravines
Gravitational landslip
Debrisflow
Landslide
Techtonical faults

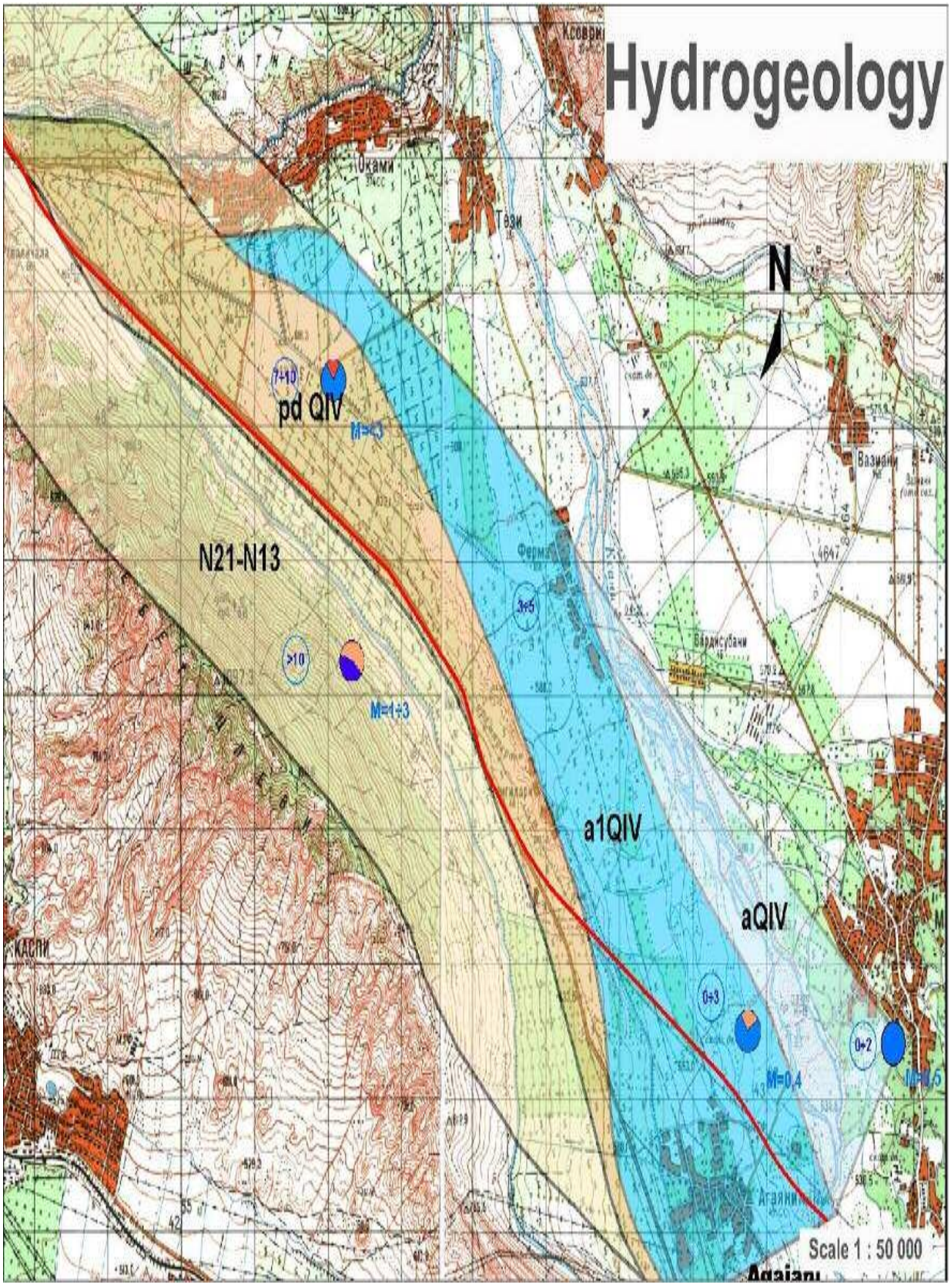

Geology
N1+2 dš12
1QIV
a2QIV
N1+2 dš11
aQIV
a1QIV
N
Agaiani
Scale 1 : 50 000

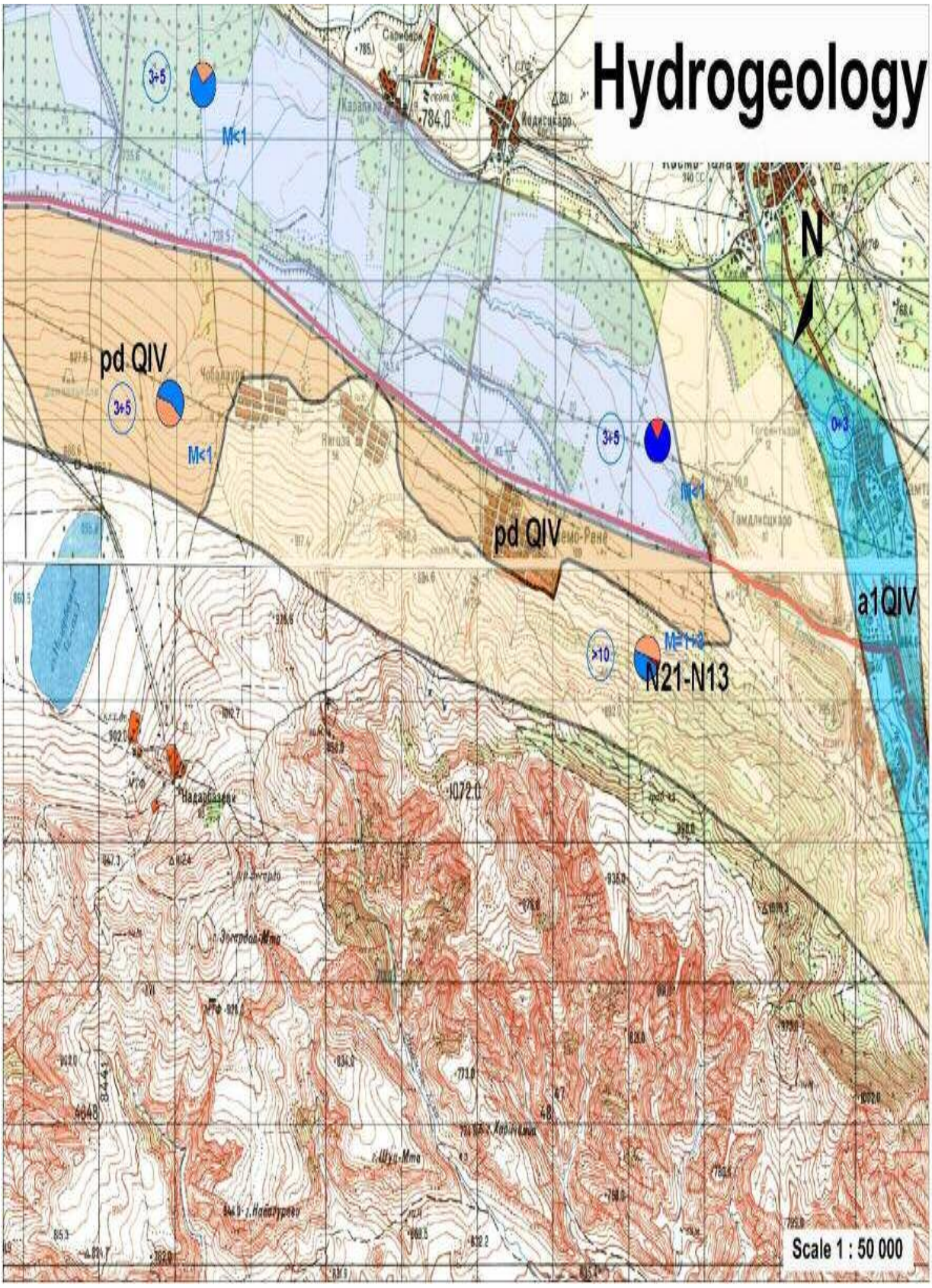

Geology
N
a1QIV
N1+2 dš12
pdQIV
N1+2 dš12
a3QIV
apQIV
aQIV
a1QIV
N1+2 dš12
a1QIV
Scale 1 : 50 000

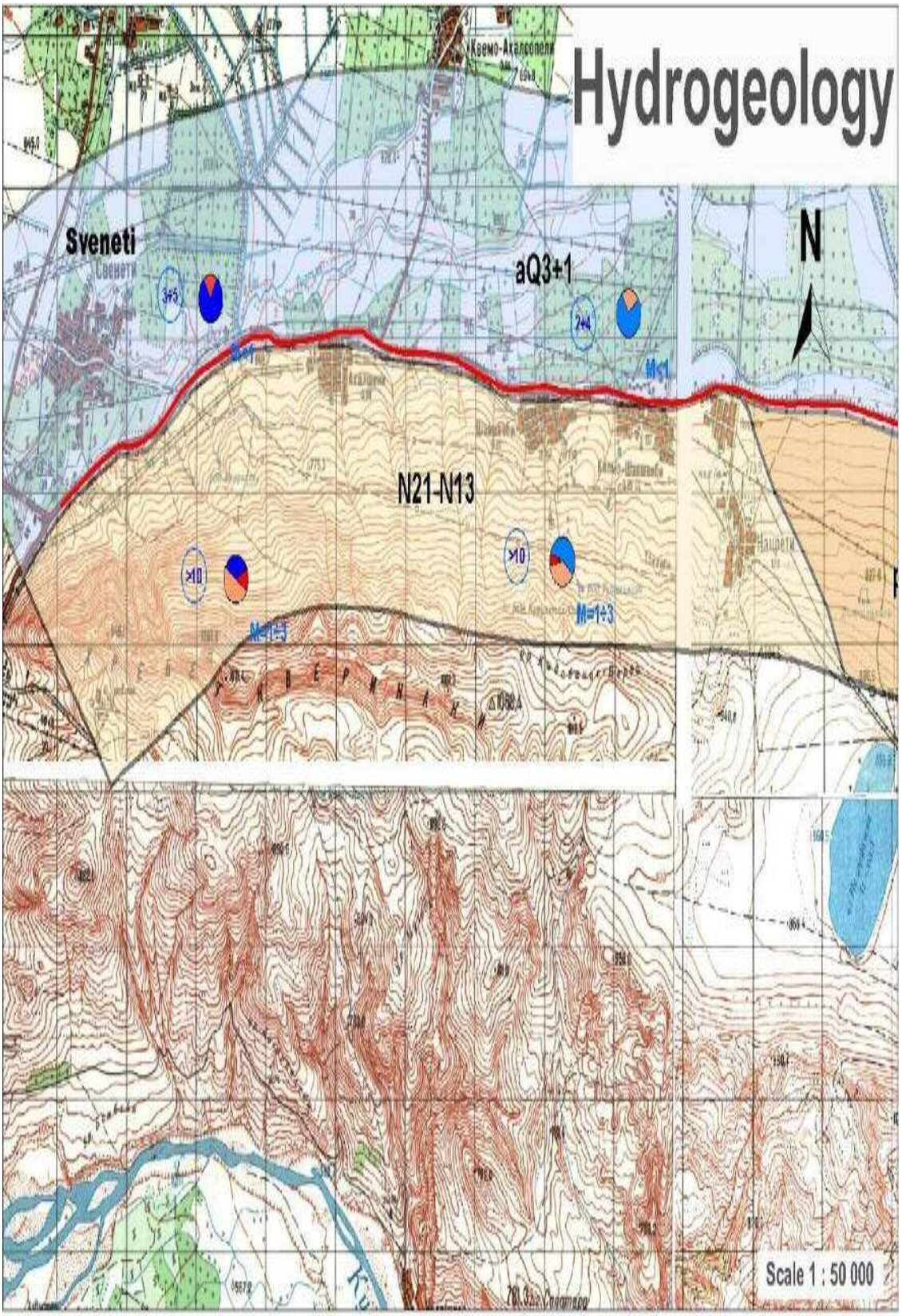

Geology
apQIV
apQIV
pdQIV
aQIV
a1QIV
apQIV
Sveneti
a3QIV
a1QIV
a3QIV
N1+2 ds11
K1al- K2 cm
N
Scale 1 : 50 000

Hydrogeology




Hydrogeology
N
pd QIV
N21-N13
a1QIV
aQIV
Scale 1 : 50 000


Hydrogeology
N
pd QIV
pd QIV
a1QIV
N21-N13
3÷5
M<1
>10
Scale 1 : 50 000


Hydrogeology
Sveneti
aQ3+1
N
N21-N13
M=1÷3
Scale 1 : 50 000

Landscape

Legend

Agaiani-Sveneti portion of the highway

Ecological sensitivity areas

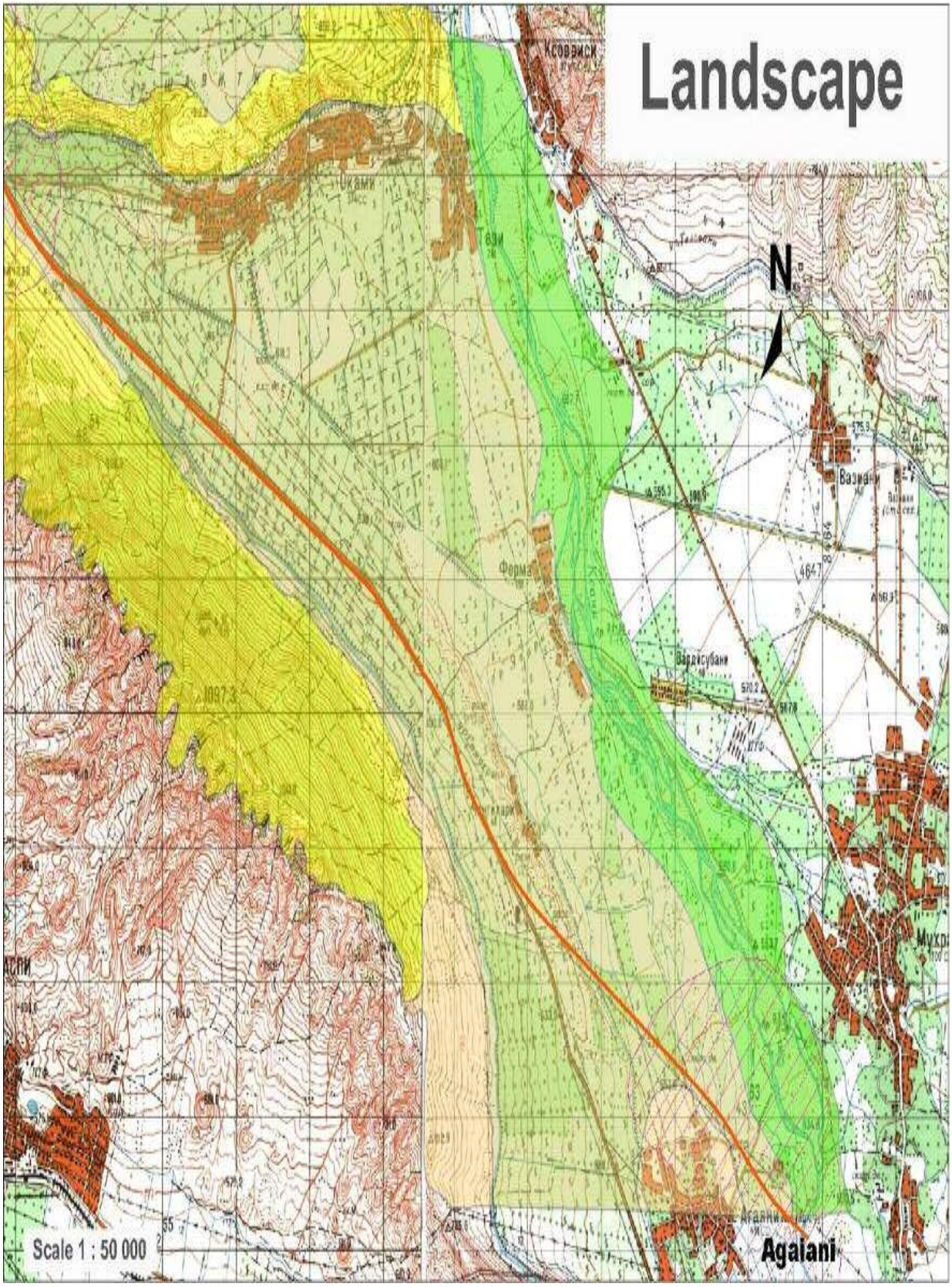
Lanscape Types

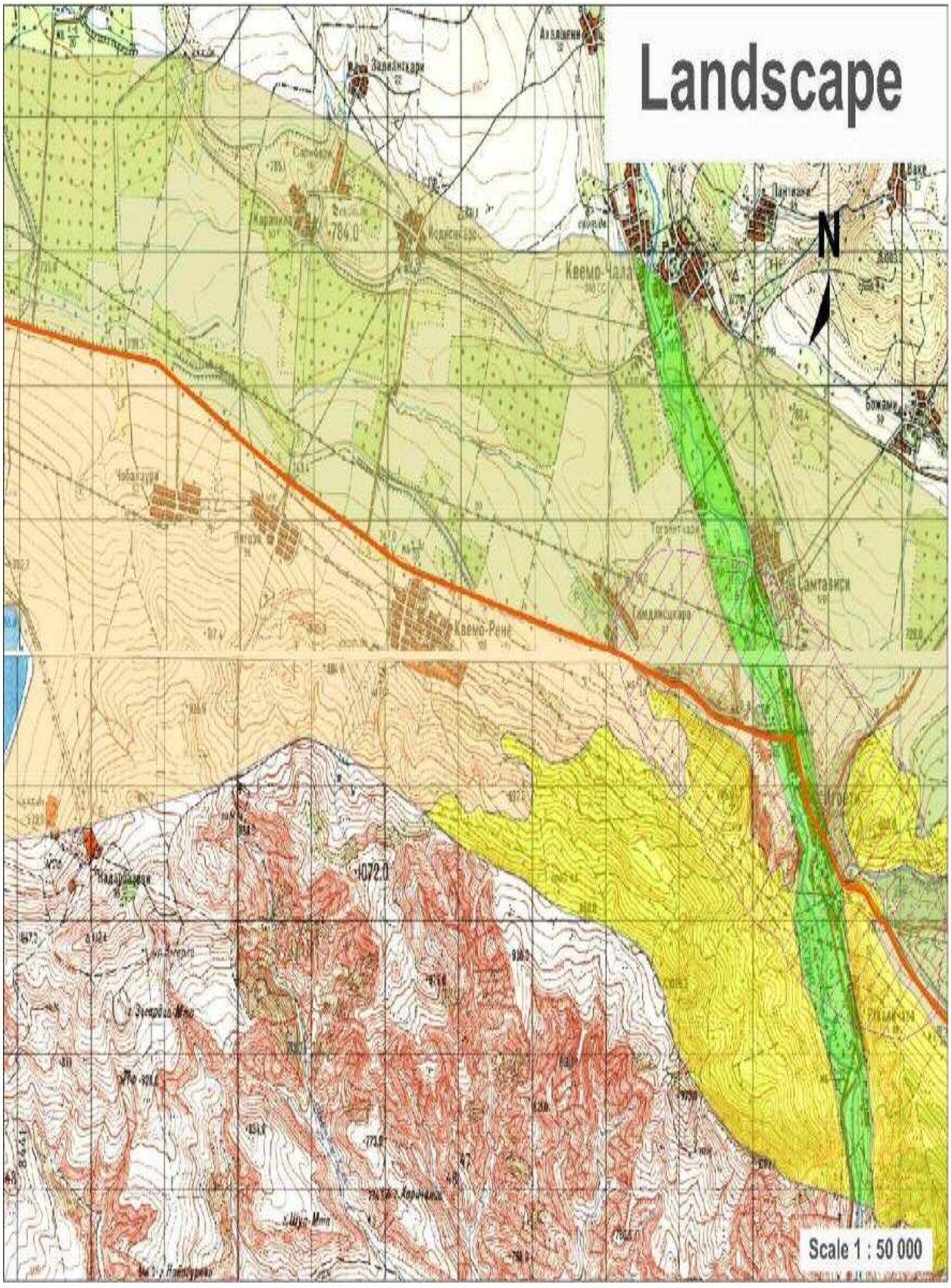
19 A Landscape - with the derivatives of hilly, ero-sion-denuded and thor-nbush-hornbeam-oak forests.With sibljak, with partly arid thin wood

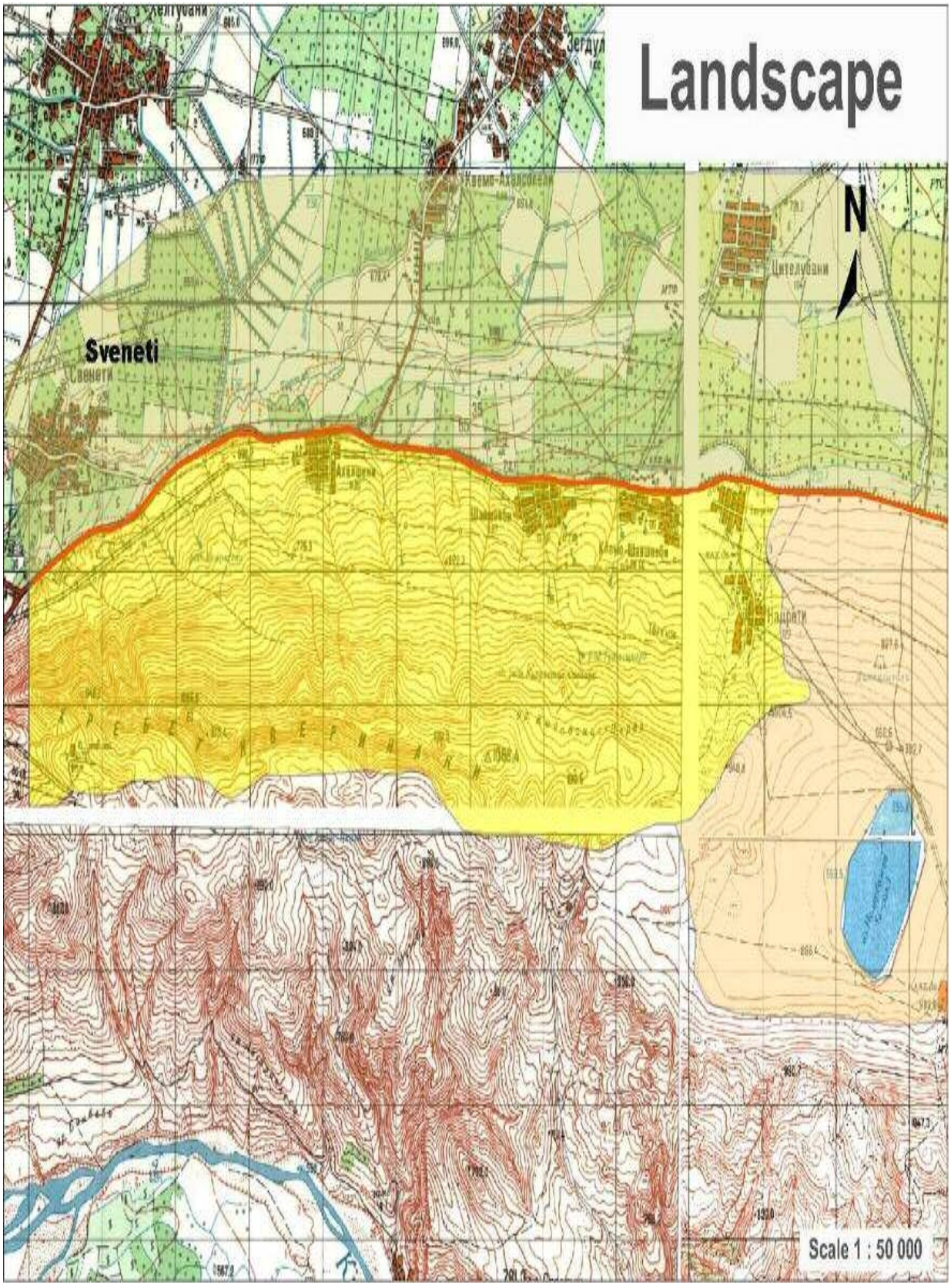
19 B Landscape - with the derivatives of hilly, erosion-denuded and thornbush-hornbeam-oak forests. phrygana, with beard-grass steppes, sometimes with Bad Lands.

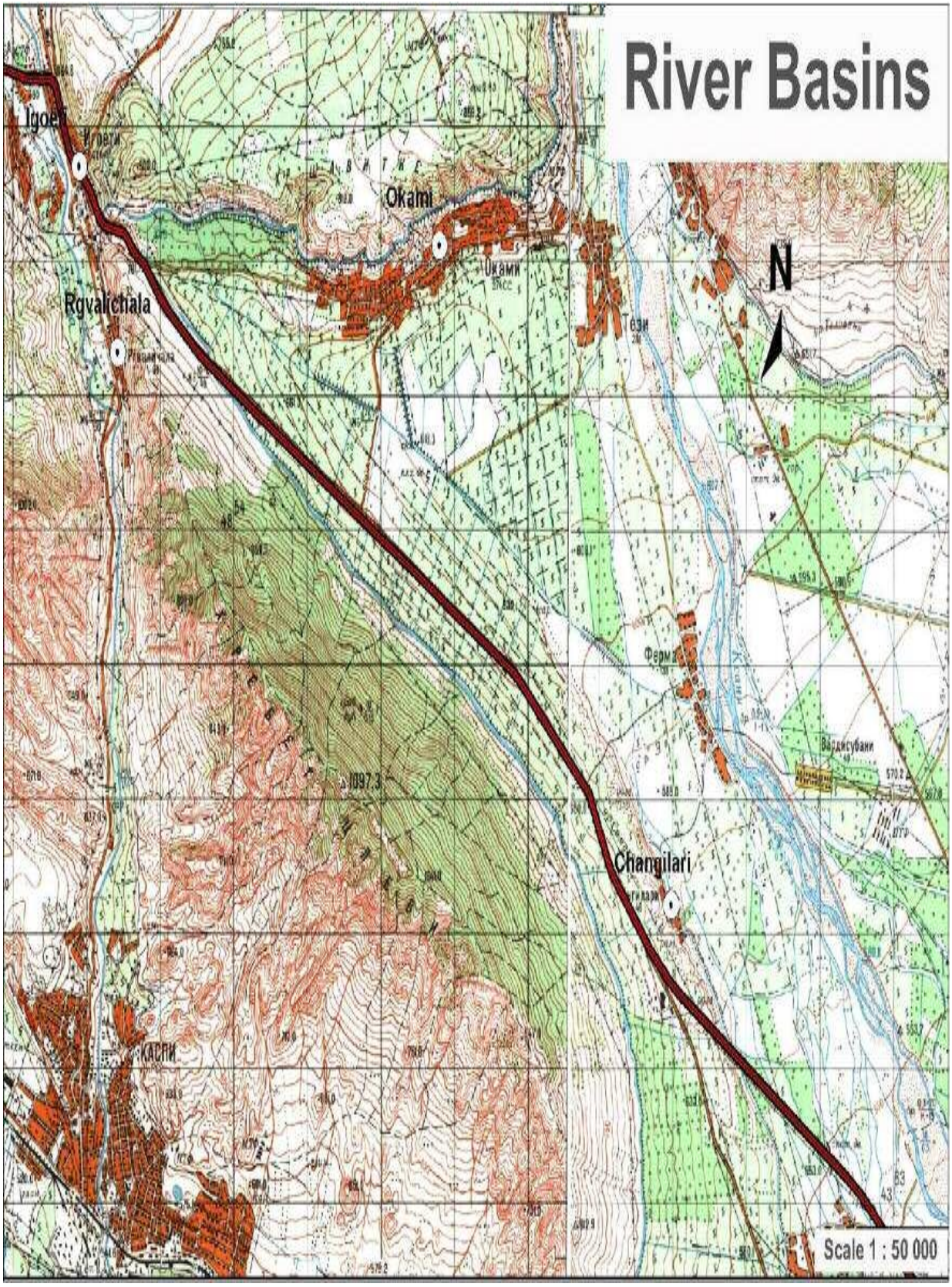
23 Landscape - with plain-hilly, accumulative, beard-grass steppes, sibljak, rarely with meadows. (The mentioned landscape is almost fully transformed into agrarian landscape)

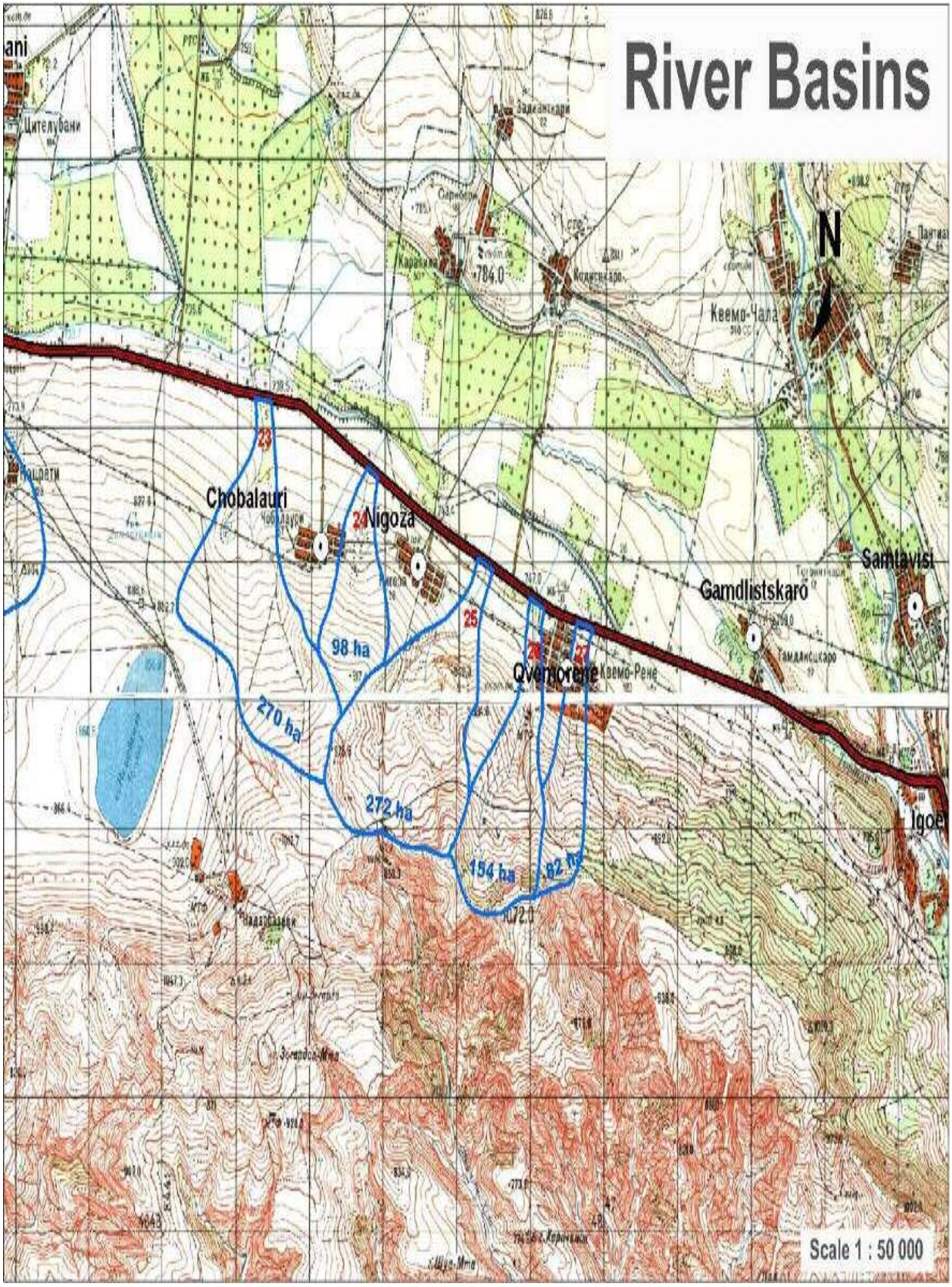
51 Landscape - with plain accumulative, grove Tugai forests, meadows, rarely with marshes and salt-marshes (Ksani and Lekhura dry gullies)

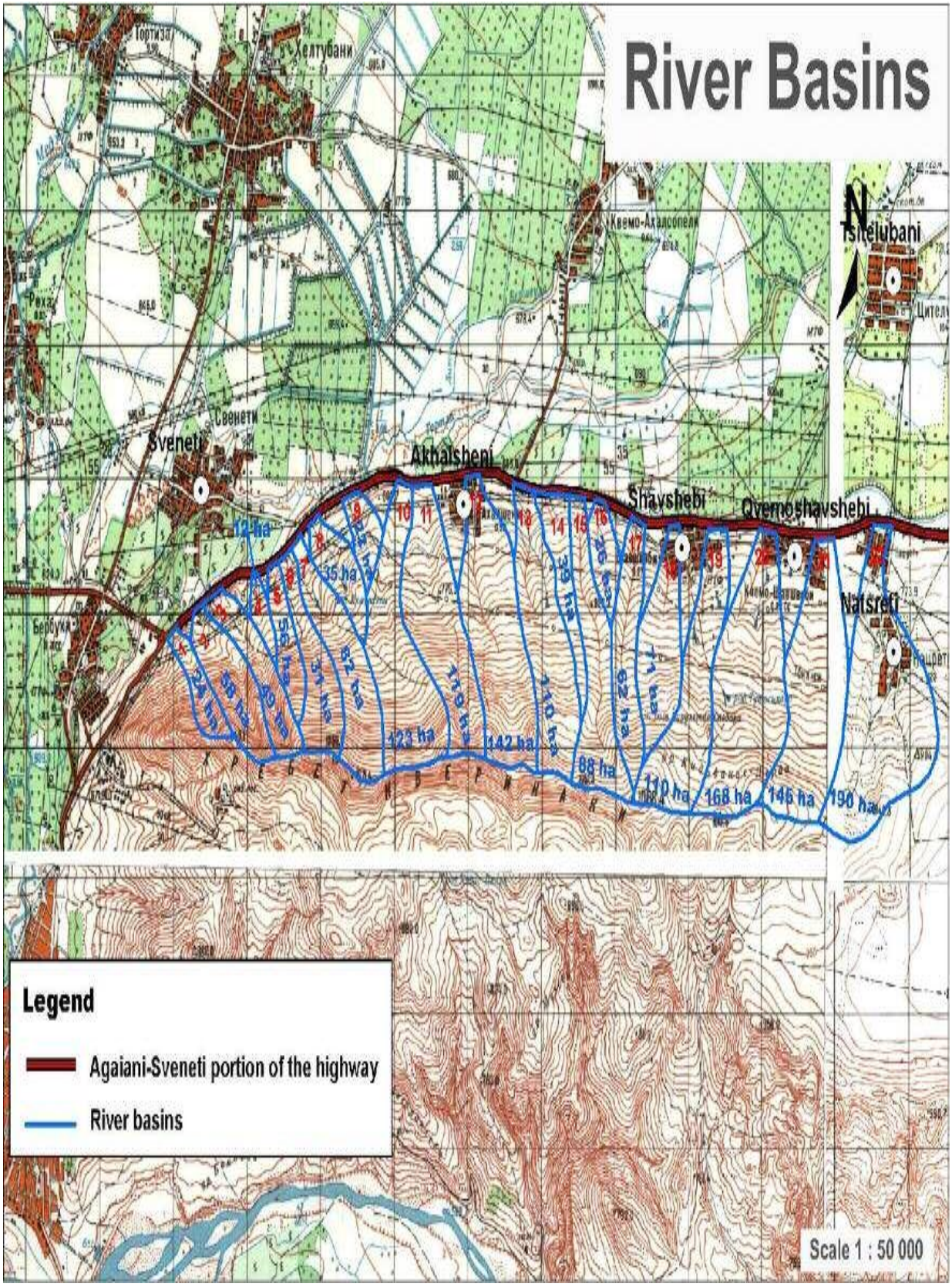

Landscape
N
Scale 1 : 50 000
Agaiani


Landscape
N
Scale 1 : 50 000

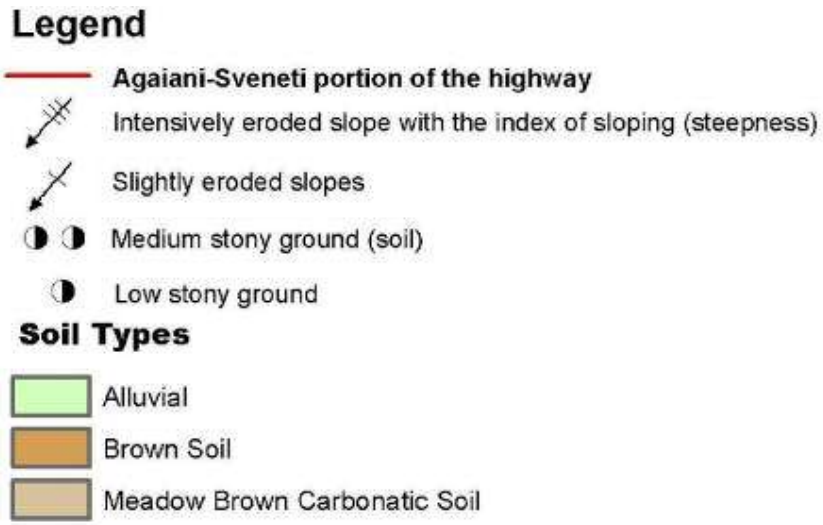

Landscape
N
Sveneti
Scale 1 : 50 000

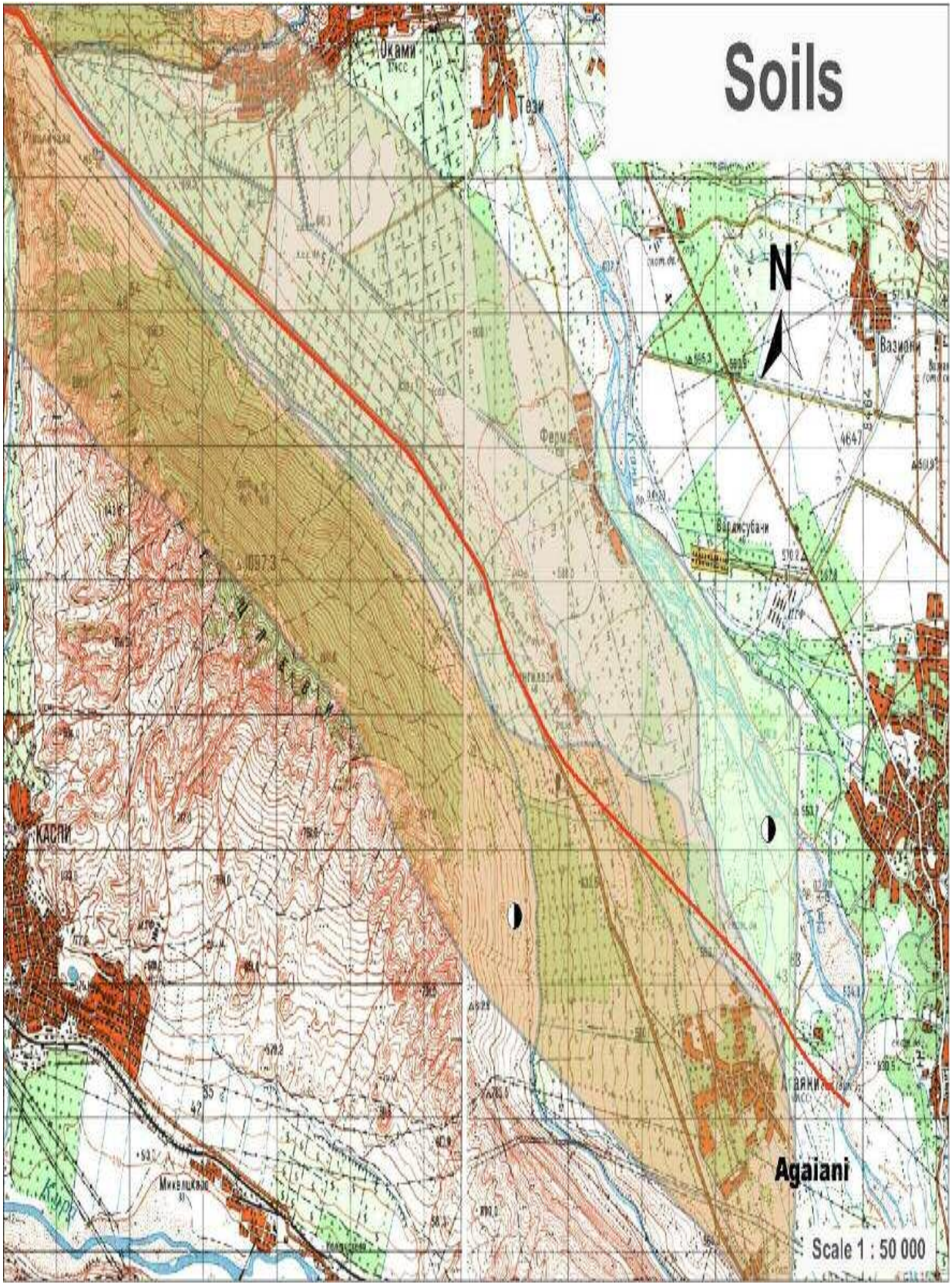

River Basins
Okami
Rgvalichala
Changilari
N
Scale 1 : 50 000

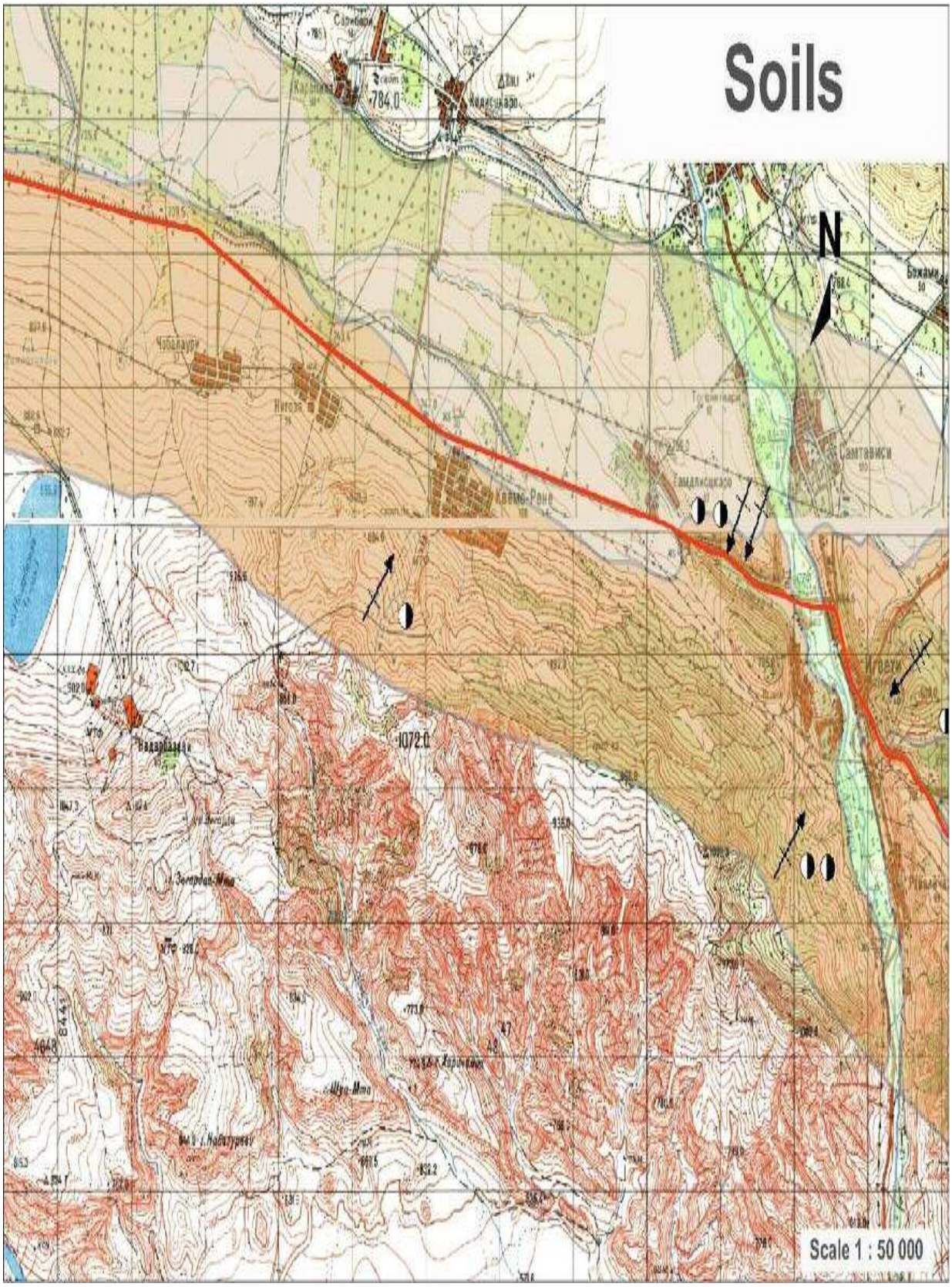

River Basins
N
Chobalauri
Nigoza
Samtavisi
Gamdlistskaro
Qvemorene
23
24
25
26
27
98 ha
270 ha
272 ha
154 ha
Scale 1 : 50 000

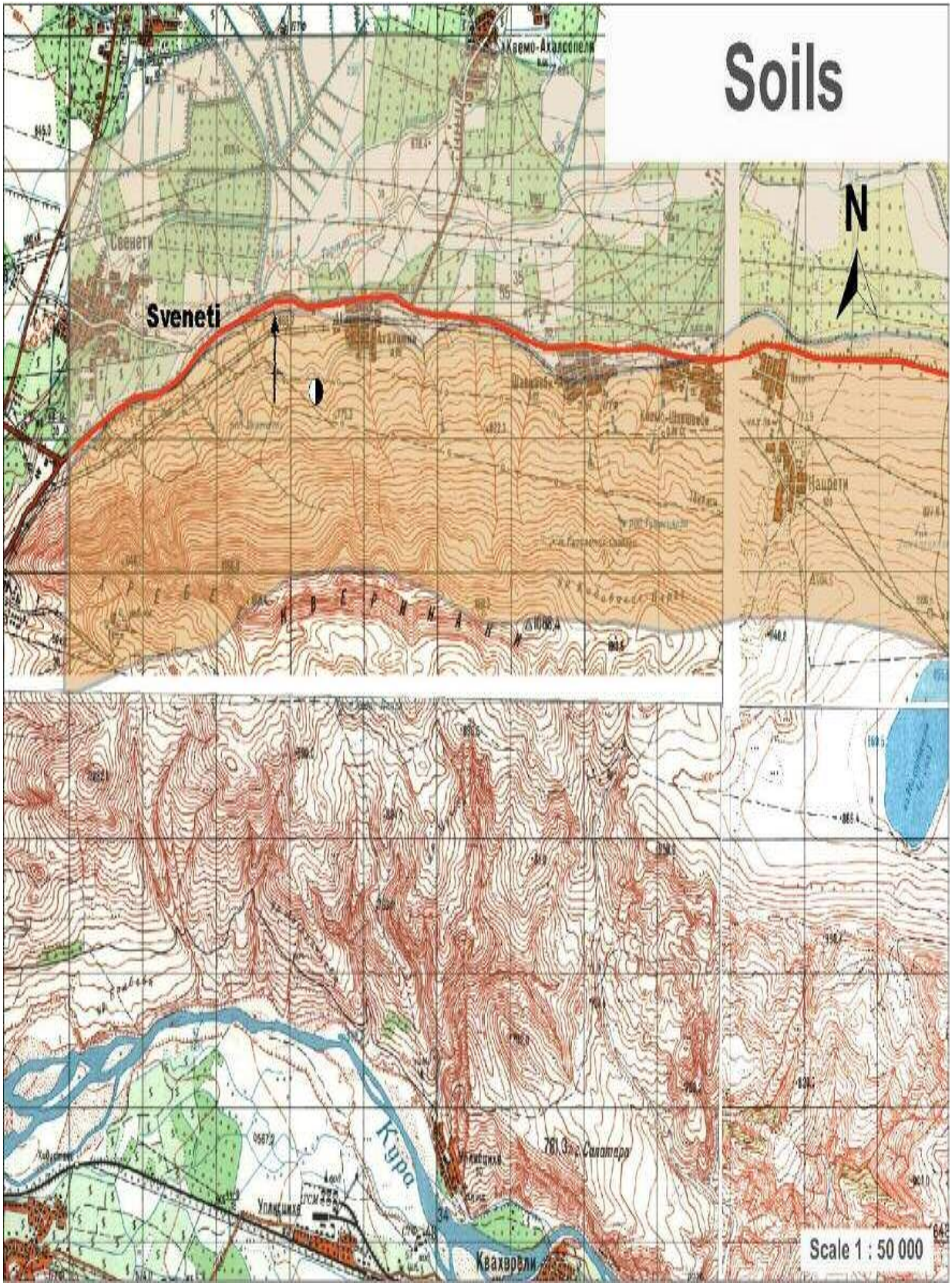

River Basins
N
Tsitelubani
Sveneti
Akhalsheni
Shavshebi
Qvemoshavshebi
Natsrefi
12 ha
35 ha
123 ha
142 ha
88 ha
110 ha
168 ha
146 ha
190 ha
Legend
Agaiani-Sveneti portion of the highway
River basins
Scale 1 : 50 000

Soils


Legend
Agaiani-Sveneti portion of the highway
Intensively eroded slope with the index of sloping (steepness)
Slightly eroded slopes
Medium stony ground (soil)
Low stony ground
Soil Types
Alluvial
Brown Soil
Meadow Brown Carbonatic Soil


Soils
N
Agaiani
Scale 1 : 50 000


Soils
N
Scale 1 : 50 000


Soils
N
Sveneti
Scale 1 : 50 000

Annex 3. Outline of the Scope of Work for the Development of Site Specific Environmental Impact Assessments and Management Plans

Site specific EIAs and Environmental Management Plans (EMPs) will be required to meet Georgian environmental requirements and the safeguard policies of the World Bank. While this Environmental Assessment report provides a description of sensitive sites and the most important impacts for project proposals for the alignment between Agaiani and Sveneti the preliminary list of possible impacts and mitigation measures (per media or activity) provided here is not exhaustive. A comprehensive project specific list and in-depth analysis will therefore be prepared under the site specific EIA. This annex provides an outline of the scope of work for a site specific EIA.

Objectives of the Site Specific EIA

The objectives of the site specific EIA are to:

- Review the potential negative and positive environmental impacts of the different alternatives being considered;
- Conduct detailed environmental studies in sensitive areas (e.g. Igoeti bypass) and pre-entry surveys along the final route and the sites assigned for the supporting facilities (camps, storage sites, waste disposal sites, quarries etc.) and access roads.
- Prepare a site specific Environmental Management Plan (EMP) which includes: a mitigation program (with quantification of associated costs), monitoring plan, and program of technical assistance; and describes institutional arrangements.

Scope of Work

The site specific EIA will comprise all the tasks that are required for a full environmental assessment, as described hereinafter. The Consultant will be responsible for gathering, reviewing and analyzing all necessary data and information. Where these are insufficient, the Consultant will make all practical efforts to produce the missing information/data including professional estimates and predictions based on the most likely conditions at the Project area, reliable information and data from similar situations and conditions.

The Consultant will characterize the extent and quality of available data and describe the key-data gaps and the uncertainties associated with estimates, predictions, and data used from similar situations. The methods of accommodating these gaps and uncertainties in the EIA will be well stated and presented by the Consultant. Topics and areas, which do not need further attention, will be specified with the supporting rationale. When estimated values are used in place of data, the Consultant will provide the uncertainty limits associated with these values and perform an appropriate sensitivity analysis.

The work will include support for RDMED for consultations and meetings with all parties concerned (affected population or their representatives; local, regional, and national authorities; representatives of the scientific community; NGOs; and others), in strict accordance with Government requirements and the World Bank's policies and procedures.

The Consultant will update and complete all tasks outlined below, provide a brief description for each one of them, and classify them according to the following two Project-related main phases:

- construction
- Operation & maintenance (O&M) (including winter maintenance).

Remedial measures (prevention, avoidance and mitigation) will include solutions to be incorporated into the Project's final design and Environmental Management Plans (EMP).

The EIA Report

The EIA Report will be concise and limited to significant environmental issues, land acquisition and resettlement implications and requirements. The main text will focus on findings, conclusions and recommended actions, supported by summaries of the data collected and citations for any references used in interpreting those data. Detailed or unanalyzed data that are not appropriate in the main text will be presented in appendices or in a separate volume. Unpublished documents used in the assessment may not be readily available and will also be assembled in an appendix. The Consultant will organize the EIA Report according to the outline below:

Executive Summary;

Policy, Legal and Administrative Framework;

Description of the Proposed Project;

Baseline Data;

Environmental Impacts and Mitigation;

Social Impacts and Mitigation;

Analysis of Alternatives;

Environmental Management Plan;

Public Consultation and Disclosure;

Appendices:

List of persons who prepared and contributed to the EIA
Records of coordination and consultation meetings and events
References
EIA TOR
Other, as appropriate

The Consultant will submit the Draft EIA Report to RDMED. Following the receipt of comments from RDMED, the Consultant will incorporate these and then submit the Final EIA Report and supporting documents relevant to the complete findings of the assignment. Any relevant diagrams will be presented in the report.

TASK 1 Description of the Proposed Project

The Consultant will provide a full description of the Project including: on-site works, elements (e.g., viaducts, bridges), and components (e.g., rehabilitation, reconstruction, construction, operation and maintenance, and institutional development activities);

Locations: general layout; support facilities and services (e.g., storages; construction camps); off-site works (e.g., quarries, borrow pits, spoil dumps, access roads); Description of used quarries and borrow pits and sources of raw and construction materials; transportation modes and routes;

Complete list and specifications of the equipment and facilities to be used, describing fuel consumption and emission characteristics, demand on energy and water supply, associated discharges and waste production, requirements for personal qualification;

Staffing, procurement and implementation schedule for construction.

Operational management plan: technical supervision and maintenance plan, monitoring, responsible entities; plans for development of maintenance and supporting services; and institutional development plans.

Description of possible emergency situations and an Emergency Response Plan

TASK 2 Description of Baseline Environment

The Consultant shall assemble, evaluate and present baseline data – measurable and quantifiable wherever possible - on the relevant environmental characteristics of the study area (including changes, which can be anticipated before commencement of the Project and expected trends if the Project is not implemented). The Consultant should draw upon this report to the extent possible. The baseline description should include but not be limited to the following elements:

Physical environment: geology; hydrogeology; geomorphology; geo- and seismic hazards; topography; soils; climate and meteorology; surface and ground-water hydrology; water use; water quality; air quality; and landscape;

Biological environment: flora; fauna; sensitive area habitats (e.g., wetlands); protected areas, existing and planned; and significant natural sites;

Socio-economic environment: present and projected population; employment; sources of income; land use (including current crops and cropping patterns, grazing, etc.); land tenure and land titling; human settlements; health conditions; economic activities (including agriculture, livestock, fisheries, commerce. industries, power stations, etc.); social services; infrastructures; archaeological, historic and cultural sites; developmental needs and priorities; and present and projected traffic;

Pollution: sources, levels, and impacts of existing air, water, soil, nature, and noise pollution in the study area, including pollution from waste disposal sites

Note: *baseline information provided in this Environmental Assessment covers a substantial part of requirements for EIA. Sensitive environmental areas in the project zone have been identified. The data gaps to be filled by the Consultant are:*

- *Existing dumping sites (legal and illegal) and "brown lands" and polluted areas within the project zone.*
- *water quality; air quality; noise (sampling and instrumental assessment in sensitive areas and near the settlements)*
- *Geotechnical studies required for the final design*
- *Pre-entry environmental survey within the final route and at the sites for supporting facilities (camps; storage sites; sites for temporary storage of wastes) and*
- *audit of the used quarries and waste disposal facilities*

TASK 3 Environmental Legislation and Regulatory Considerations

The Consultant will describe the pertinent regulations and standards governing: environmental quality, health and safety, protection of agricultural land and sensitive areas, protection of historical and cultural sites, land use control.

This section will also describe current legislation for the acquisition of land and property and how it will be used in the case of this Project. It will also describe the procedural process how compensation is estimated, processed and paid. An assessment of the present Georgian EIA and Environmental Permitting requirements and procedures, requirements of public hearings at the local level and as well as of the Government's capacity to handle these now and in the future will be included in the EIA.

Note: *information about the legal framework is provided in this Environmental Assessment Report which covers a substantial part of the requirements for EIA in relation to general legislation, permitting processes, land acquisition and public consultations. The data gaps to be filled by the Consultant are: regulations and standards governing environmental quality, health and safety, protection of agricultural land and sensitive areas, protection of historical and cultural sites.*

TASK 4 Determination of Potential Impacts

The Consultant will identify and analyze all significant potential impacts of the proposed Project. A clear distinction will be made between positive and negative impacts, direct and indirect induced impacts, short- term (immediate) and long-term or residual impacts, single and cumulative impacts, and avoidable and unavoidable impacts.

Impacts will be assessed for each alternative route and according to each phase (i.e., construction, operation, and maintenance) and to each main type of work (e.g., widening the existing road; clearing for the new road near Igoeti and Shavshvebi sites; asphalting; bridge construction; establishment and use of construction camps; transport and storage of materials; quarrying; land acquisition; etc.). Special attention should be given to:

- Socio-economic issues (including land acquisition, resettlement, community impact issues);
- Impacts on archaeological sites

- Impacts from project-induced development;
- Loss of agricultural land (from direct and induced impacts);
- Sensitive environmental Receptors and Sites Prone to Natural Hazards (see paragraph 3.11 of the present report and relevant maps)
- Cumulative impacts – risks and contingency plans

Note: *Analysis of potential impacts provided in this Environmental Assessment Report and corresponding tables (chapter IV) could be used as a basis for impact analysis within the EIA. Main types of the expected impacts have been identified and analyzed. The EIA to be carried out by the Consultant needs further detailed elaboration, including but not limited to:*

- *More site specific and facility specific analysis;*
- *Quantitative assessment of emissions from stationary and mobile sources, discharges and noise and their modeling; (According to Georgian legislation, inventory of stationary sources of emission associated with the project is required, as well as approval of emission limits. This document should be submitted as a separate document to MoE)*
- *Assessment of waste flows and risks of contamination due to improper fuel management*
- *Emergency risks and risks related to transportation of hazardous substances*

TASK 5 Analysis of Alternatives

The Consultant will describe briefly the main alternatives considered in the course of developing the proposed Project and indicate reasons for their rejection or selection. The Consultant will compare these alternatives (including both alignment alternatives and geometric/pavement design alternatives) in terms of their potential environmental and social impacts, using appropriate multi-criteria evaluation and comparison methods for analyzing and presenting environmental data; in terms of capital and operating costs; results of cost/benefit evaluation; and institutional, training, and monitoring requirements.

All alternatives will be compared to the "no project" alternative. The need to still maintain and rehabilitate the existing road will be considered and analyzed in evaluating and comparing the merits of a new alignment. The Consultant will, to the extent possible, quantify the costs and benefits of each alternative and incorporate the estimated cost of any associated mitigating measures.

Note: *Analysis of Alternatives provided in this Environmental Assessment Report covers a substantial part of the requirements for EIA. The main alignment alternatives and "No project" alternative have been analyzed to some extent. The gaps to be filled by the Consultant mainly include a review of: geometric/pavement design options and other technical alternatives.*

TASK 6 Development of a Site Specific Environmental Management Plan

The development of the EMP will focus on the areas outlined below. The degree of emphasis on each of these areas will depend on the specific needs of the Project as will be identified by the EIA itself.

Activities and Impacts: Conduct thorough analysis of environmental impacts based on the nature and requirements of each major activity of the Project. The activities will be identified and analyzed in accordance with each phase and alternative of the Project.

Mitigation of Environmental Impact: Recommend feasible and cost-effective measures to prevent or reduce significant negative impacts to acceptable levels. Estimate the impacts and costs of those measures. Consider compensation to affected parties for impacts, which cannot be mitigated. The plan will include proposed work programs, budget estimates, schedules, staffing and training requirements, and other necessary support services to implement the mitigating measures.

Implementation and Monitoring: Prepare a detailed plan to monitor the implementation of mitigating measures and the impacts of the project during construction and operation. Include in the plan an estimate of capital and operating costs and a description of other inputs (such as training and institutional strengthening) needed to carry it out. Prepare detailed institutional arrangements (responsibilities) for implementing EMPs and environmental commitments and for monitoring implementation of mitigating measures and the impacts of the Project during construction and O&M. Include in the plan an estimate of capital and operating costs and a description of other inputs (such as training and institutional strengthening) needed to carry it out.

Sanitation and Protection Zones and their management.

Record of Public Consultation: These records will follow the requirements of World Bank document OP 4.01, paragraph 15. The EMP will, after presentation and analysis, be summarized in a table/matrix format, in accordance with WB requirements.

TASK 7 Public Consultations and Disclosure

Community involvement is important to understand the nature and extent of potential impacts, especially socio-cultural impacts, and to assess the suitability and acceptability of mitigation measures or compensation, where relevant. The Consultant will support RDMED in consultations with project-affected people and other interested parties throughout the development of the EIA. This consultation should, at least:

- Be based on regular and systematic information about the Project; for category A projects as minimum 2 public consultations are required (during scoping of the EIA and when the draft EIA is available).
- Be culturally and linguistically appropriate;
- Be gender-sensitive;

- Provide feedback on how the comments are taken into account in Project design and implementation.
- Detail on how the public has been consulted, to include what information has been made available, in what format, where, and when (disclosure), will be part of the EIA Report.

Reference Documents

Reference documents for the site specific EIA in addition to this EA Report include:

Georgian legislation: the Law on Licenses and Permits adopted by Parliament of Georgia, on June 24, 2005; the Law of Georgia on Environmental Permits (1996); The Governmental decree # 154 dated September 1, 2005 on the Procedure and Terms of Issuing Environmental Permits and the Governmental decree dated February 3, 2006 introducing amendments to the Decree # 154.

The World Bank's safeguard policies and procedures including:

- OP/BP 4.01 Environmental Assessment
- OP/BP 4.04 Natural Habitats
- OP/BP 4.36 Forests
- OP 4.09 Pest Management
- OP 4.11 Cultural Heritage
- OP/BP 4.12 Involuntary Resettlement
- Policy on Disclosure of Operation Information

Other resources include the World Bank's EA Sourcebook, Technical Paper 376, Roads and the Environment Handbook.

Annex 4 . Protocol of Public Consultation meetings of the project "Rehabilitation of the road between Agaiani and Sveneti" (19.10.2006)

On 19 October 2006 the public consultation meetings have taken place in the villages of Georgia: Agaiani, Okami and Berbuki.

Cconsultation of the stakeholders is an important component of the 'review and approval process.' Because of the OP's public consultation requirements, public concerns are now recognized at an early stage in the planning of major project environmental assessments (EAs).
Public involvement contributes to better projects, better development and collaborative governance. The involvement of these stakeholders will contribute to collection of data and information from the stakeholders; Iinvolvement of communities at the early planning (scoping) stages of the EA; Providing effective and timely disclosure of information to all stakeholders; Improvement of the EIA; Mutual respect and understanding of stakeholders' (including the public, the proponent and the decision-maker) values, interests, rights and obligations.

Scoping report have been presented:

1. By the Consultant "Bonifica" and its representatives: Dario Volpe, Deputy project Manager, Giorgi Lapiashvili, Georgian Expert, Giorgi Sophadze, Georgian Environmental Consultant, Keti Dgebuadze, Public Consultation Expert;
2. By the Road Departmen: Dato Korakhashvili, Lawyer, Givi Ambriashvili, Spiridon Kokhreidze
3. By TRRC Director Giorgi Tsagareli.

Technical aspects of the project has been presented by Dario Volpe, Deputy project Manager. Project background, context and feasibility has been presented by Giorgi Tsagareishvili, Georgian Expert of Bonifica.
Environmental aspects of the project has been presented by Giorgi Sophadze, Georgian Environmental Consultant. Land compensation issues has been presented by the lawyer of the Road Department Dato Korakhashvili. World Bank and Georgian Legislation and requirements regarding public consultations has been presented by Keti Dgebuadze, Georgian Public Consultation Expert of Bonifica.

Questions and comments of stakeholders have been answered and commented by the relevant experts representing the project. Questions and answers are provided below (see tables 1,2,3).

Table 1.

Location: Village Agaiani, Local Government (Sakrebulo)

Participants:
Road Department - Dato Korakhashvili, Lawyer, Givi Ambriashvili, Spiridon Kokhreidze
Consultant "Bonifica"- Dario Volpe, Giorgi Lapiashvili, Giorgi sopadze, Keti Dgebuadze
TRRC Director - Giorgi Tsagareli
Sakrebulo representatives: Otar Iremashvili, Tristan Tatarashvili, Temuri Gelxauri
Zviad Tatunashvili, Deputy of Gamgebeli
Village Agaiani community representatives: 23 people

#	Question/comment	Author	Comments of the experts
1.	What are the prices for the land compensation for the land plots with crops and without?	Otar Blodzeli (Agaiani village representative)	As a result of audit process performed by independent auditor prices will be identified for each section of land separately.
2.	How far the new road will be extended in width as compared with existing alignment?	Otar Blodzeli (Agaiani village representative)	The itinerary Agaiani-Sveneti is a 2-lane highway with standard characteristics. The upgrade to 4 lanes was envisaged in the 80's and some works regarding culverts, retaining walls and bridges have started especially at Igoeti bypass. This effort stopped with the collapse of the Former Soviet Union. Traffic is known to be between 8,000 to 12,000 Vpd depending on the Section with 20 to 25% trucks.
3.	Houses are located close to the projected road alignment and we consider there is a safety risk related with traffic accidents. What are the guarantees and protective measures for avoiding injury of residents and damage of properties?	Agaiani village representative	Additional risk assessment as well as planning of preventive and protective measures will be implemented under the WB financed special project during 4 months before completion of construction. This study will cover 1400 km. length of highway including the section of concern. According to this study metal revetment of protective walls could be installed.
4.	Issue about urgent need of well designed (convenient for local needs of population) interchange and bridge for local road near the village Agaiani was raised.	Agaiani village representatives	Alternative options of design are reviewed and optimal design will be implemented. Preliminary public consultations will be provided during EIA public disclosure. The possibility of the bridge construction will be considered.

Table 2.

Location: Village Okami, Kaspi region, Local Government (Sakrebulo)

Participants:
Road Department - Dato Korakhashvili, Lawyer, Givi Ambriashvili, Spiridon Kokhreidze
Consultant "Bonifica"- Dario Volpe, Giorgi Lapiashvili, Giorgi sopadze, Keti Dgebuadze
TRRC Director - Giorgi Tsagareli
Head of Okami Sakrebulo - Nukri Khrikuli
Village Okami community representatives: 25 people

#	Question/comment	Author	Comments of the experts
1.	I have land plot with crops (vineyard) how it will be compensated?	Gogi Chitashvili	You can receive money compensation for land and crop separately or the new land for agricultural activities at other place.
2.	How many land plots owned by the private owners will be crossed by the highway and can you mention owners of the plots?	Vaza Shamanauri	Igoeti bypass final alignment will be determined by the project designers in the nearest future and corresponding Resettlement Action Plan (RAP) will be developed to precisely evaluate and compensate loses of the population land plots and crops and will provide recommendations for fear compensation. RAP will be publicly disclosed.
3.	Which company will be hired for construction activities?	Zaza Shukakidze	It is not selected yet. Tender will be announced in a week period. Most likely it will be International company.
4.	Will be employment opportunities for local residents provided during the road construction?	Gogi Chitashvili	The employment opportunities could be provided for law qualified workers, the company which will win the tender will be instructed to use local employees as law qualified workers.
5.	Is the internal roads rehabilitation envisaged by the project?	Gogi Chitashvili	It is not envisaged by this project, this issue should be solved and financed by the local government.
6.	Intensive traffic on the highway creates difficulties for access to the agricultural land plots at the other side of the highway. How the access problems for the population and domestic animals will be solved?	Zaza Shukakidze	New design of the highway considers special interchanges each 2-3 km in order to provide access to the other side of the highway. This small size interchanges will be designed to serve the population as well as the domestic animals.
7.	Greenery plantation (e.g. hazelnut trees) are located along certain sections of the highway, will they be affected by the project?	Gia Iluridze	Final alignment will be determined during the detailed design faze. Several sections of the existing greenery could be destroyed. New greenery plantations and sanitary protection belts will be implemented.

Table 3.

Location: Village Berbuki, Gori region, local government (Sakrebulo)

Participants:
Road Department - Dato Korakhashvili, Lawyer, Givi Ambriashvili, Spiridon Kokhreidze
Consultant "Bonifica"- Dario Volpe, Giorgi Lapiashvili, Giorgi Sopadze, Keti Dgebuadze
TRRC Director - Giorgi Tsagareli
Village Berbuki community representatives: 23 people

#	Question/comment	Author	Comments of the experts
1.	What are the prices for the land compensation for the land plots with crops and without?	Lavrenti Merabishvili	As a result of audit process performed by independent auditor prices will be identified for each section of land separately.
2.	If the land plots owned by the private owners are not mapped but it owned during 2 years by the owner will it be compensated?	Lavrenti Merabishvili	Compensation process will start in 2008, by this time the mentioned land plots will be owned during 4 years and accordingly they will be compensated.
3.	When does road rehabilitation activities (earth works) start?	Suren Saatashvili	It will start in 2008 according to the WB timetable.
4.	Who will pay for the land plots?	Suren Saatashvili	Georgian Government.
5.	Local irrigation system is located in the vicinity of highway and is following along the road alignment near village Berbuki, in case of damage of irrigation system during construction activities arable lands will be left without irrigation, what preventive and protective measures are envisaged by the project to avoid such impact?	Lavrenti Merabishvili	If the project design requires removal of the irrigation system from current position removal activities will be carried out before the rehabilitation of the road starts at this particular site. Therefore the new irrigation system will be implemented as a preventive measure to avoid damage of the irrigation system.
6.	In case of removal of the trading kiosks or other business facilities (restaurants) will be the related loses compensated by the government?	Lavrenti Merabishvili	The legal business loses will be compensated and mechanisms and details will be described in RAP (subject to public disclosure). Illegal business will not be compensated.

References

Climate

1. M.Kordzakhia. “The Climate of Georgia”. Tbilisi, 1961, p.245. (in Georgian).

2. Sh.Javakhishvili. “Description of Georgian Climate According to Months”. Tbilisi, 1988, p.155. (in Georgian).

3. Scientific-Applications Handbook on Climate of the USSR, Series 3, vols. 1-6, 14, Georgian SSR, Leningrad, 1990, pp.76-77. (in Russian).

4. USSR Climate Reference Book, vol. 14. “Atmospheric and Soil Temperature” , Hydrometeoizdat, Leningrad, 1968, p.373. (in Russian).

5. USSR Climate Reference Book, vol. 14, “Solar Radiation, Radiation Balance and Sun Radiance” Hydrometeoizdat, Leningrad. 1968, p.71. (in Russian).

6. USSR Climate Reference Book, vol. 14, “Atmospheric Humidity, Atmospheric Precipitation, Snow Cover”, Hydrometeoizdat, Leningrad, 1970, p.425. (in Russian).

7. USSR Climate Reference Book, vol. 14, “Wind”, Hydrometeoizdat, Leningrad, 1968, p.378. (in Russian).

8. Environmental Performance Reviews. Georgia. Economic Comission for Europe. Committee on Environmental Policy 2003

9. G.INFO: State of the Environment - Georgia – Air; 1995

Geology and Geomorphology

10. Report on geological study of map sheet K-38-64-В,Г and geological mapping of sheets K-38-65-В,Г and K-38-66-В (в,г). M.I.Gamkrelidze et al, Tbilisi, 1988 (in Russian).

11. Informational bulletin on geological situation of the underground hydrosphere and about studying and forecasting of hazardous geological processes. State Department of Geology, Tbilisi, 2000 (in Georgian).

12. L.I.Maruashvili, et al “Geomorphology of Georgia”, publisher “Metsniereba”, Tbilisi,1971.(in Russian)

13. Engineering-geological report: visual engineering-geological assessment of West direction’s export oil-pipe line route on the territory of Georgia (Jandara-Samgori-Supsa terminal-Black Seas seaside). State Department of Geology. Tbilisi, 1977. (in Georgian)

14. Pleistocene sediment in Georgia. D V Tsereteli, Publisher “Metsniereba”, Tbilisi, 1966 (in Russian).

15. The tectonic map of Caucasus, Georgian SSR; Scale 1:200 000, sheets K-38-XV, K-38-XXI, Tbilisi, 1977. (in Russian).

16. State Geological Map of the USSR. Scale 1 : 200 000; sheets K-38-XV, K-38-XXI, 1971г., Tbilisi. (in Russian)

17. Engineering-geologic map of development of the hazardous geological processes in Georgian SSR.; 1985 Tbilisi (in Russian)

18. Tectonic division of the territory of Georgia. E.Gamkrelidze; 2000 Tbilisi (in Georgian)

Hydrology

19. The resource of surface waters in USSR, vol. 9, Transcaucasia and Dagestan, number 1, West Transcaucasia. Hidrometeopublishing, Leningrad, 1974, p.578. (in Russian)

20. Gazetteer on climate in USSR, number 14 (air humidity, atmospheric precipitates, blanket of snow). Hidrometeopublishing, Leningrad, 1970, p.426. (in Russian).

21. Technical instructions on calculation of the maximal flow rates of rivers in conditions of Caucasus. Transcaucasial Regional Scientific-research Institute, Tbilisi, 1980, p.71. (in Russian).

Hydrogeology

22. Reference manual of hydrogeologist. vol.1, editor V.M.Maksimova, publisher “Nedra”. Leningrad, 1967.(in Russian).

23. Geology of the USSR. vol. X. Georgian SSR, part 1. Geological description. editor P.D. Gamkrelidze. publisher “Nedra”. Moscow, 1964.(in Russian).
24. Hydrogeology of the USSR. vol.X. Georgian SSR. editor I.M.Buachidze, publisher “Nedra”, Moscow, 1970. (in Russian).

25. Atlas of Georgian SSR. Main directorate of geodesy and cartography of the State Geologic Committee of the USSR. Tbilisi-Moscow,1964. (in Russian)

26. Geologic map of Georgia. scale 1:500 000, author G.E.Gujabidze, editor I.P.Gamkrelidze, Tbilisi, 2003 (in Russian).

37. L.Haratishvili. Report – “ About the complex studies of formation of groundwater resources of Mukhrani valley and its recharge zone (infiltration fields), rational assimilation, environmental

assessment and protection". Geological state department funds of Georgia, Tbilisi, 2005. (in Georgian).

Soils

38. Anjaparidze – "Brown soils in Georgia", publisher "Sabtchota Sakartvelo",Tbilisi, 1972.(in Georgian)

39. G. Talahadze, I. Anjaparidze, V. Lataria, Ch. Kirvalidze, K. Mindeli, L. Nakashidze –"Soils in Georgia (zone of middle hills and valley). Tbilisi, publisher "Ganatleba", 1983 (in Georgian).

40. G.Talahadze, K.Mindeli – "Special issues of soil science". Tbilisi, publisher "Ganatleba", 1976. (in Georgian)

41. "Soils atlas of Georgia"-edit by G.Talahadze and I.Anjaparidze, Tbilisi, publisher "Sabtchota Sakartvelo", 1984. (in Georgian)

42. Classification and diagnostic of soils in the USSR, Moscow, publisher "Kolos", 1977. (in Russia)

Landscapes

43. N.Beruchashvili. Landscape science (a course of lectures) – Tbilisi, 1992, p.134. (in Georgian).

44. N.Beruchashvili. The geography of Georgia. (textbook for the secondary school, 8-9 classes) – Tbilisi, publisher "Ganatleba", 1996, p.200. (in Georgian)

45. D.Ukleba. Physical- geographic division on regions in Eastern Georgia (for agriculture objectives), Tbilisi, 1968. (in Georgian).

46. D.Ukleba. The mountainous regions landscapes and physical-geographic regions in the Eastern Georgia. part two, Tbilisi, publisher "Metsniereba",1974,p.197. (in Georgian)

47. D.Ukleba. The nature of Tbilisi and its suburbs. "Tbilisi",1989, p.22-62. (in Georgian).

Ecology: Flora

48. A.Grossheim , D.Sosnovskyi , N.Ttroitskyi, 1928. Vegetation of Georgia. ed. of Bureau for study of Natural Production Resources of Georgia, Tbilisi, p. 198 (in Georgian).

49. Ketskhoveli N., 1960. Vegetation of Georgia. Tbilisi, edition of Acad.Sciences of Georgia p.443(in Georgian).

50. Vegetation Cover of Georgia. Ed. Academy of Sciences of Georgia 443p. (in Georgian)

51. Maruashvili l., 1970. Physical Geography of Georgia . Tbilisi, Mecniereba, 300 (in Georgian).

52. Georgian flora (eds. Ketskhoveli, Kharadze, Gagnidze), 1970-1987. tt. I-XI, Tbilisi, Mecniereba, 328, 517 (in Georgian)

53. Georgian SSR Red Data Book (eds. Kacharava, Ketskhoveli, Maruashvili, Kurashvili), 1982, Tbilisi, Sabchota Saqartvelo, p. 255 (in Georgian).

54. Red List of Georgia; 2006

55. Reference Book of spore plants in Georgia. III. stem-leaved, moss- sphagnums, Acrocarpous. 1984. Tbilisi, Mecniereba, 149 (in Georgian).

56. T.Svanidze , L.Kanchaveli, Dekanoidze N., 1991. New and rare species of lignophile hyphomycetes from the Black Sea coast of Georgia. Geo Acad. Sci.. moambe, 142(3):589-592(in Georgian).

57. Ukleba D., 1968. Physical-geographic zoning of the East Georgia, Tbilisi, Mecniereba, 350 (in Georgian).

58. Kvachakidze R., 1996. Geobotanic zoning of Georgia. Tbilisi, Mecniereba, p.126 (in Georgian).

59. T.Svanidze; R.Gagnidze; M.Gvritishvili; N.Dekanoidze; K.Kanchaveli; N.Chikovani 1996; Botanical Description of Territories Along the Pipeline Route from Azerbaijan Border to Supsa Terminal. Literature Review.

60. EIA-Western Route Export Pipeline. Chapter IV. Existing Environmental Conditions 1996; Tbilisi

61. P.Shanshiashvili; N.Bokeria; Description of Existing Environmental Conditions on Territories Along the Pipeline Route from Azerbaijan Border to Supsa Terminal. Protected Areas; 1996

62. G.Kanchaveli; G.Supatashvili; 1968; Forestry Entomology, Tbilisi ed: Ganatleba 371p.

Ecology: Fauna

63. Arabuli A., 1970. Bear in Georgia. (in Georgian).

64. Bannikov A.G., Darevskii I.S., Ishchenko V.G., Rustamov A.K., Shcherbak N.N., 1977. List of Amphibians and Reptiles of USSR Fauna. Moscow, Prosveshchenie. (in Russian).

65. Bukhnikasvili A.K., Kandaurov A.S., 1992. On Relations Between Various Species of (Crocidura) in Tugai Forests of Georgia. I All Union Workshops on Biology of Insectivora Mammals. Novosibirsk, 4-7 February 1992. Abstracts of Talks. Moscow, pp.21-22. (in Russian).

65. Chikovani et al., 1990. In book: Reserves of Caucasus. Moscow, Mir. (in Russian).

66. Darevskii I.S., 1967. Rock Lizards of the Caucasus. Leningrad. Nauka. (in Russian).

67. Devdariani G.S., 1986. Region of Transcaucasian Depression. In book: Physical Geography of Transcaucasia. Ed. by G.Gabrielian.Yerevan, Publ. Yerevan State Univ. (in Russian).

68. Gadjiev F.A., 1986. Animal World. In book: Physical Geography of the Caucasus. Edited by G.Gabrielian. Yerevan, Publ. Yerevan State Univ. (in Russian).

69. Muskhelishvili T., and Negmedianov V., 1984. Reptiles. In book: Animal Population of Typical Biocenoses of the Kolkheti Lowland. Ed. B.Kurashvili, Tbilisi, Metsniereba. (In Georgian).

70. Kandaurov A., Bukhnikashvili A., 1996. Small Mammals (Insectivora, Chiroptera, Lagomorpha, Rodentia). In: Georgian Biodiversity Country Study Report. Wide Version. Manuscript. Tbilisi. (in Russian).

71. Kutubidze M., 1956. Birds of Georgia. Tbilisi, Metsniereba. (in Georgian).

72. Mussibov M.A., Nazarian Kh.E., Gabrielian G.K., Jakeli Kh.G., 1986. Physical-Geographical Zoning. In book: G.Gabrielian (Ed.). Physical Geography of Transcaucasia. Yerevan. Publ. of Yerevan State University. (in Russian).

73. Muskhelishvili T.A., 1970. Reptiles of Eastern Georgia. Tbilisi, Metsniereba. (in Russian).

74. Nikolski G., 1913. Amphibians and Reptiles of Caucasus. Tbilisi. Publ. of Caucasian Museum. (in Russian).

Sokolov V.E., Tembolov A.K., 1989. Mammals, Insectivora. Vertebrates of Caucasus. Moscow, Nauka. (in Russian).

75. Shidlovskii M.V., 1976. List of Rodents of Transcaucasia. Second edition. Tbilisi, Metsniereba. (in Russian).

76. Tarkhnishvili D., Kikodze D. (Eds.). Principal Characteristics of Georgia Biodiversity. In: Natura Caucasica (publication of the NGO CUNA Georgica), v. 1, No. 2.

77. Vereshchagin N.K., 1959, Mammals of the Caucasus. History of Fauna Formation. Academy of Sciences of the USSR. Moscow-Leningrad. (in Russian).

78. The Red Data Book of Georgia, 1982. Tbilisi, Sabchota Saqartvelo. (in Georgian).

79. 1994 IUCN Red List of Threatened Animals. IUCN. 1993.

80. IUCN Red List Categories. 1994. IUCN. 30 November 1994.

81. Review of Literature and Other Sources About Conditions of the Environment on the Territory of Georgia Along the Early Oil Transportation Pipeline and Adjacent Territories From Georgia-Azerbaijan Border To Supsa Terminal 1996; Head of group Tarkhnishvili D.

82. Red List of Georgia; 2006

Cultural Heritage

83. Studies of history of Georgia, vol. 1-8, Tbilisi, 1970-80. (in Georgian)
Ph.Javahishvili. History of Georgian nation, book 3, Tbilisi, 1966. (in Georgian).

84. N.Berdzenishvili. History of Georgia in XII-XIV century, questions of history of Georgia, book 2, Tbilisi, 1965. (in Georgian)

85. G.Jamburia. Giorgi Saakadze, Tbilisi, 1964. (In Georgian)

86. Ot.Lortkipanidze. Antic world and kingdom of Kartli (Iberia), Tbilisi, 1968. (In Georgian)

87. N.Berdzenishvili. The issues of history of Georgia, book 2, Tbilisi, 1965 (in Georgian)

88. A.Apakidze. Towns and town-life in old Georgia. book 1, Tbilisi, 1963. (in Georgian)

89. N.Berdzenishvili. The roads of Georgia in the epoch of Rustaveli, Tbilisi, 1966. (in Georgian)

90. K.Zakaraia. The old towns and castles of Georgia, Tbilisi, 1973. (in Georgian)

91. V.Beridze. Georgian architecture, Tbilisi, 1974. (in Georgian)

92. N.Mirianashvili. The architecture monuments from material culture history of middle Kartli. Proceeding of the archeological expedition. vol.2, Tbilisi, 1983. (in Georgian)

93. A.Bohichadze. The archeological excavation in Agaiani and Dzalisi. Tbilisi, 1981. (in Georgian)

94. The description of the history and culture-monuments of Georgia, vol.V, Tbilisi, 1990. (in Georgian)

95. G.Mindiashvili. The hills-settlement of the Kura-Araksi period in Gudabertkha. Lecture, reading on the report session of the research center of archeology. 2006, April.