



**Roads Department
Ministry of Regional Development and Infrastructure**



KAKHETI REGIONAL ROADS IMPROVEMENT PROJECT

Rehabilitation of Sasadilo-Sioni Road

ENVIRONMENTAL IMPACT ASSESSMENT

Draft Final Report

**Tbilisi
August 2013**

LIST OF ACRONYMS

BP	Bank Procedures
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EMS	Environmental Management System
GIS	Geographical Information Systems
GPS	Global Positioning System
HSE	Health, Safety and Environment
IFI	International Financial Institution
MAC	Maximum Admissible Concentrations
MoE	Ministry of Environmental Protection and Natural Resources
MLHSA	Ministry of Labor, Health and Social Affairs
MoI	Ministry of Interior
OP	Operational Policy
PPE	Personal protective equipment
RDMRDI	Roads Department of the Ministry of Regional Development and Infrastructure
RoW	Right of Way
WB	World Bank
SA	“Engineer” according to FIDIC terms or Supervising Agency (SA) in general

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Executive Summary

Introduction

Road improvements are one of the most successful means of encouraging economic growth and trade in Georgia. At present one of the top national priorities is to establish smooth transport connection between various regions of the country so that the roads network operates throughout the year without traffic delays.

The Government of Georgia (GoG) requested the World Bank to support upgrade and modernization of a number of highways and roads in the country. One of the ongoing World Bank supported operations is the Kakhreti Regional Roads Improvement (KRRI) project, commenced in 2009. KRRI Project finances rehabilitation 56 km road linking Vaziani, Gombori, and Telavi (VGT). The cost of rehabilitation is below the estimate, therefore there are substantial cost savings. GoG proposed to use the Project savings to rehabilitate additional road section which connects village Sasadilo - located about mid-point of the VGT road - with the village Sioni. The section of road proposed for rehabilitation commences at the village of Sasadilo in a junction at km 27 of the VGT road. It passes the villages of Kochbaani, Bochorma, and Kudro, ending at the village of Orkhevi at km 17.3, where the road splits into the branch remaining to Sioni (3.7km in length) and the branch leading to the village of Khevsurtsopeli.

An Environmental Impact Assessment (EIA) was carried out for the rehabilitation of VGT road as part of the KRRI Project preparation and Environmental Management Plans (EMPs) were developed in accordance with the EIA report for the two sections of VGT road: km 0-27 and km 27-56. Most part of the VGT Road rehabilitation is now completed in compliance with these EMPs. Present EIA report is supplemental to the EIA report produced for VGT road in 2009 and carries and EMP specific for the Sasadilo-Sioni section.

The present EIA report was drafted in August 2011 prepared as a supplemental document to the EIA report for the rehabilitation of VGT. However tendering of works for Sasadilo-Sioni road were delayed upon GoG's decision. The Government renewed project preparation for the rehabilitation of Sasadilo-Sioni road in 2013 and the draft EIA report of 2011 was re-visited in June 2013.

For the purpose of updating the draft EIA report for Sasadilo-Sioni road under the framework of KRRI Project, Roads Department of the Ministry of Regional Development and Infrastructure (RDMRDI) created the a working group with participation of the following specialists:

- Deputy Head of the Resettlement and Environmental Division;
- Head of the Resettlement Unit;
- Social Safeguards Consultant;
- Environmental Safeguards Consultant;

The team did not find any tangible changes in the natural and social environment which would call for revising the existing draft EIA report. Therefore, the present draft EIA report carries only minor editorial changes as compared to the initial draft dated August 2011.

Technical and Environmental Standards and regulations

The proposed works will be implemented in compliance with the Georgian legislation and environmental standards, as well as the World Bank's safeguards policies. These regulations

required screening of the project with the purpose of its environmental classification, and determination of the scope and extent of its environmental assessment.

Environmental Screening

In accordance with the WB safeguard policy (OP 4.01 Environmental Assessment), the KRRI Project was classified as environmental Category B. Rehabilitation of the additional section of road linking the village of Sasadilo to the village of Sioni falls under the same environmental category. Carrying out of an environmental assessment relevant for a Category B activity and development of an EMP is required by the WB policies. Therefore, this supplemental EIA has been carried out for Sasadilo-Sioni section. According to the Georgian law, present EIA report is not subject to the State Ecological Expertise and does not require issuance of permit for impacting the environment.

Geohazards, Sensitive Environmental Receptors, and Potential Impacts

Sasadilo-Sioni road passes through the landscape characterized with high geological activity posing considerable geohazards at both – construction and operation phases of the road. A landslide area starts at the beginning of the road between km 0+200. The landslide has been recorded here for a long time and although it is not intense, cut the slope during road rehabilitation works will undoubtedly cause its activation. Geological activities of various magnitude is observed and a number of other locations long the Sasadilo-Sioni road: km 4+000, km 4+200, km 5+000 - km 7+000, km 8+100, km 8+600, and km 10+000 - km 12+000. Also, according to the Decree No. 1-1/2284 on approving the Building Norms and Rules of Earthquake Resistant Construction (PN 01.01-09) of October 7, 2009 of the Minister of Economic Development of Georgia, Sasadilo-Sioni road falls in the zone of 8-point earthquake intensity. Geological hazards and potential seismic threats will have to be taken into account while designing, building, and operating of Sasadilo-Sioni road.

Sasadilo-Sioni road passes through forested areas, including fragments of floodplain forests, and makes several river crossings. Some of these forest stands carry well developed specimen of valuable and rare species of trees. Damage and removal of these trees during construction works should be avoided to the extent possible. If that is inevitable, compensatory planting at the ratio of 1:10 will be applied (10 seedlings planted for each tree extracted). Km 10 - km 13 section of the road passes close to the Tbilisi National Park: at a distance of 2.0 – 2.5km from the traditional use zone and 6 km from the strict protection zone, however no impact on these protected areas is expected as the hills and river Iori separate the road and the National Park. All river crossings along the road are environmental sensitive due to the risk of water pollution with oil, lubricants, and construction waste. The project area drains into river Iori which flows into Paldo and Tbilisi reservoirs.

The main environmental impacts are expected at the construction phase and come from clearing of the right-of-way (RoW); operation and servicing of construction machinery; sourcing of construction materials; earth works and works in waterways; and generation of the construction and household waste.

Clearing of the RoW would imply removal of topsoil as well as cutting of shrubs and trees. Generation of the construction waste and excess material is also expected. Parking, operating, and servicing of the construction machinery will carry the risk of operational spillage of oils and lubricants, will generate some noise, vibration, dust, and emissions. Supply of asphalt, gravel,

and sand carries the risks of damaging landscapes and river beds due to borrowing. Construction works will also have implications for the occupational health and safety of workers/personnel.

Impacts of the improvement of the Sasadilo-Sioni road during its operation phase are much less significant and diverse. Three environmental aspects of the road operation will be air pollution from automobile emissions, noise, and pollution of soil and surface water with litter and drainage from the road.

Project Alternatives

The Project envisages rehabilitation of the existing Sasadilo-Sioni road. No re-alignment of this road has been considered, as any new alignment would be associated with occupation of greenlands and private land plots and would have significant adverse environmental and social impacts. The existing bridges, culverts and other infrastructure is also in a need of rehabilitation without any new construction. No alternative engineering solutions have been proposed.

The only considered alternative is “do-nothing”, i.e. no-project scenario. According to the Feasibility Study, improvements to the Sasadilo-Sioni road are warranted and the improved roadway will be beneficial to the development of the recreation area at Sioni. As in many other local road projects, low traffic volumes together with relatively high construction costs challenge economic feasibility of the road rehabilitation, however, the proposed rehabilitation option shows sufficient economic rate of return. Furthermore, if the road is not rehabilitated and continues to deteriorate, the local communities would suffer inconveniences of poor internal connection, carrying negative social and economic implications for them. Therefore the “do-nothing” alternative is rejected and the justifiable decision is taken to implement the proposed road rehabilitation project.

Project Description

The section of Sasadilo-Sioni road proposed for rehabilitation commences at the village of Sasadilo in a junction at km 27 of the VGT road and ends at km 17.3 near the village of Orkhevi. The road is of a low volume which provides access to several residential villages and resort destination. The average daily traffic is not expected to exceed 200 and the road service functions meet standards of the rural road system. According to the design standard, the Sasadilo-Sioni road is classified as a road of local importance and the design speed is set as 60 km/h to reflect the rural characteristics of the road. This classification will be retained after completion of rehabilitation works. The geometrical parameters of the road are respective of the design speed. The design elements for the cross section of the road are as follows: number of lanes: 2; lane width: 3.00 m; carriageway width: 6.00 m; width of shoulder: 1.25 m; and total road width: 8.50 m.

The rehabilitation of the Sasadilo-Sioni road will follow the existing road alignment, with the possible exception of limited realignments to improve geometric characteristics, and eliminate safety hazards. Rehabilitation includes widening of shoulders by stripping of surface, excavation for widening, construction of embankment in benching by compacted layers, and pavement reconstruction and shoulders. The main types of construction activities are: embankment construction; repair and rehabilitation of bridges and culverts where necessary; provision of new culverts if necessary; re-establishment unlined side drains; pavement construction; provision of road marking, guardrails, and road signage installation; miscellaneous minor rehabilitation and repair works to be defined under the design-and-build contract.

Environmental Impact Assessment Methodology

The EIA of the rehabilitation of Sasadilo-Sioni road under KRRI Project is supplemental to the EIA carried out for the VGT road under the same Project. Therefore it commenced by defining what additional information and field work had been required for completing the baseline data. The main part of the baseline information is available from the original EIA Report and the present Report refers to that document in many instances. After filling in the specific baseline data related to the proposed additional works, their expected impacts were assessed, mitigation measures outlined, and the environmental management and monitoring plans developed.

Public Participation

[to be revised after conduct of consultation meeting]

Disclosure of documents

The electronic versions of the draft EIA will be placed on the RDMRDI web-site
The hard copies of Project environmental documentation (draft EIA and Executive Summary) will be placed in:

- the RDMRDI office
- Sakrebulo of v.Sasadilo and v. Sioni

Public consultation meetings

One public consultation meeting in v. Sioni will be conducted following 3 weeks after the disclosure of the EIA documentation:

Information about the planned meetings

Information about the public consultation process will be made available for public through:

- distribution of information via the CENN internet resources
- placing information on the RDMRDI web-site

The disseminated announcement will contain information on:

- where the interested parties can find the electronic versions and hard copies of the disclosed documents
- place and schedule of the planned public consultation meetings
- the deadlines for providing comments
- details of contact persons for submitting comments.

Expected Impacts and Mitigation

The results of the EIA show that majority of the potential environmental impacts of the proposed works are associated with the construction phase and are temporary in nature. The main approach of the EIA was to provide adequate recommendations for the prevention or mitigation of the expected negative environmental impacts. Most of the recommendations provided for the works originally planned for the rehabilitation of VGT under the KRRI Project are directly applicable to the works on Sasadilo-Sioni section of the road and some are modified to better fit the specific needs related to this section.

- Landslides and other geohazards. Surface water management is considered as a major mitigation factor for prevention of landslides during construction activities, as well as during operation phase. Temporary drainage systems should be installed to prevent landsliding during construction (cutting slopes, deep trenches etc.). Permanent drainage systems for the surface water management and slope stabilization should be installed and adequate monitoring and

maintenance should be ensured. This may require also installation of drainage pipes at a deeper level than for temporary drainage system. Seasonal aspects should be considered during planning the monitoring activities: snow-melting and flooding periods are of great importance. Slope stabilization techniques to prevent erosion, and further triggering of landslides are extremely important. Mechanical means such as berms, geogrids, biomats, as well as anti-erosion and re-vegetation of slopes should be applied. At very particular locations, revetment structures or reshaping of relief may be required. Maintaining a vegetative cover in the cut and mountainous areas will reduce erosion through run-offs, landslides and mud slides. The landslide protective measures are generally costly and in many cases will not completely eliminate the risk of further damages to the road. In some cases it might be advisable to choose the “do nothing” option and repair damages when they occur.

- Impacts on vegetative cover. According to the current basic design, the most sensitive sections of the road corridor will not be affected by any re-alignment or road widening. Widening is planned for the section of the road which is crossing the natural habitat of medium sensitivity. This would imply removal of sea-buckthorn shrubs on the both sides of the road. Compensatory planting of the sea-buckthorn shrubs with the ratio of 1:10 is recommended as a mitigation measure, so 10 seedlings are planted instead of 1 cut tree/bush.
- Accumulation of construction waste. Prior to commencement of works, contractor must obtain from the local authorities written permission for temporary storage and for permanent disposal of construction waste and excess material of various types in the designated locations. The plan for disposal of debris shall also be established and approved by construction supervisor. Before transporting construction waste to its final disposal site, it should be piled in places designated for temporary storage of waste.
- Operation of construction machinery. The technical condition of the construction machinery will be checked on regular basis to minimize air pollution from exhausts oil and soil/water pollution from leakage of fuel. The risk of operational and emergency spills of fuel and lubricants will be mitigated by designation of special parking and servicing sites, to be located away from waterways and other sensitive environmental receptors.
- Earth works. Prior to excavation, top soil will be removed and stored separately for later reinstatement of the area. Landscape restoration will be carried out to prevent erosion and to harmonize the site with the natural setting.
- Operation of quarries and borrow pits. The extraction of the material from the soil and rock quarries can be carried out only in presence of a relevant license. Materials may be purchased only from the licensed legal or physical entities. Only the deposits approved by the environment protection body may be used. Management and reinstatement of quarries will be carried in accordance with all the relevant environment protection standards and principles. Excavation from quarries will be carried out under the thorough oversight of the supervision engineer and the environment protection agencies.
- Protection of the cultural heritage. Project implementation will not have any physical impact on any cultural /historical monuments which exist within the project area, as they are in a safe distance from the RoW, though there is a possibility of chance finds during excavation. In such cases works will be immediately taken on hold and relevant authorities under the Ministry of Culture contacted for further action. Works may resume only upon receipt of written communication from the supervision engineer.

- Disturbance of local communities. Movement of construction machinery, location of the temporary work camps, and temporary storage of construction materials and waste will be planned to avoid or minimize barriers for free movement of the local population. No need for temporary or permanent land take is expected for the purposes of the planned civil works. Deterioration of the air quality near populated areas will be controlled through oversight on the technical condition of construction machinery. Operation of engines in idle regime will be discouraged. Within the settlements operation of construction machinery will be limited to the regular working hours.
- Operation of the work camp. The works contractor is unlikely to need a construction camp to house workers, as the lodging will be provided by local communities. It is expected that the contractor will arrange and keep one or more equipment yards with some light temporary sheds inside. The yards must be located in the urbanized areas to avoid affecting the natural sites, but should not cause nuisance to the residing communities. Safe lining and confinement should be provided for vehicle servicing and fuelling so that operational and accidental spills do not pollute soil and water.
- Occupational health and safety. Civil works contractor will be obligated to provide workers and employees with detailed information on the technologies and equipment used, deliver specialized training in its safe use, give adequate instructions for action in case of contingency, and provide and ensure use of the personal safety gear.

Environmental Management Plan

This EIA Report contains the EMP with a full set of the proposed mitigation measures, as summarized above, and monitoring indicators. It also describes the role of Roads Department of the Ministry of Regional Development and Infrastructure (RDMRDI) in overseeing adherence of construction works with the recommended mitigation measures and identifies the needs for RDMRDI's technical and institutional capacity building for ensuring full environmental compliance of the project. Institutional arrangements for the implementation of the EMP for Sasadilo-Sioni section of the road are identical to those for the works under the VGT road. They imply maintenance of institutional arrangements sufficient to provide technical control and quality assurance of civil works, including environmental monitoring, satisfactory to the World Bank.

Operation of the Sasadilo-Sioni Road

Traffic related noise is not expected to exceed standard limits at a distance more than 10m from the road shoulder. Introduction and enforcement of the speed limit for the settled areas would be sufficient to mitigate the noise impacts of the road operation. RDMRDI should ensure permanent erosion and land stability control and monitoring of landscape restoration after completion of construction works, as well as timely implementation of corrective actions. Corrective actions include, but are not limited to, the maintenance of drainage systems and implementation of anti-erosion measures as required. RDMRDI should coordinate with the local governmental institutions to establish and monitor implementation of good waste management practices for preventing pollution with roadside litter and construction waste from regular road maintenance works. Emergency response plans in case of traffic accidents, including those implying spillage of hazardous substances, should be elaborated in cooperation of RDMRDI and the Department for Managing Emergency Situations, Ministry of Interior.

1. Introduction

1.1 Background

Road improvements are one of the most successful means of encouraging economic growth and trade in Georgia. At present one of the top national priorities is to establish smooth transport connection between various regions of the country so that the roads network operates throughout the year without traffic delays.

The Government of Georgia (GoG) requested the World Bank to support upgrade and modernization of a number of highways and roads in the country. One of the ongoing World Bank supported operations is the Kakhreti Regional Roads Improvement (KRRI) project, commenced in 2009. KRRI Project finances rehabilitation 56 km road linking Vaziani, Gombori, and Telavi (VGT). The cost of rehabilitation is below the estimate, therefore there are substantial cost savings. GoG proposed to use the Project savings to rehabilitate additional road section which connects village Sasadilo - located about mid-point of the VGT road - with the village Sioni. The section of road proposed for rehabilitation commences at the village of Sasadilo in a junction at km 27 of the VGT road. It passes the villages of Kochbaani, Bochorma, and Kudro, ending at the village of Orkhevi at km 17.3, where the road splits into the branch remaining to Sioni (3.7km in length) and the branch leading to the village of Khevsurtsopeli.

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1.2 Traffic Estimations

The survey conducted within the Feasibility Study in 2011 (traffic count station located near v. Bochorma) consisted of a manual classified count (MCC), classifying vehicles by vehicle class, hour and direction. The following vehicle classes were used for the survey:

- i. Car/4x4 - including private cars, taxis and four- wheel drive vehicles, which are being used as private vehicles
- ii. Minibus - minibuses and small buses of up to 15 seats used for the transport of passengers
- iii. Medium bus - including buses with between 15 and 30 seats used for the transport of passengers
- iv. Large bus - including large buses with more than 30 seats used for the transport of passengers
- v. Light goods vehicle (LGV) - vans and pick-ups with four-wheels used predominantly for the transport of goods
- vi. 2 axle medium goods vehicle (MGV) - trucks with a total of two axles and six wheels.
- vii. 3 axle heavy goods vehicle (HGV) - 3 axle trucks with a single axle at the front and two axles at the rear
- viii. 4 + axle heavy goods vehicle (HGV4+) - 4+ axle trucks or truck - trailer combinations with 4 or more axles
- ix. Motorcycles – two-wheeled motorized vehicles
- x. Bicycles – two-wheeled non-motorized vehicles
- xi. Animal carts – carts hauled by horses, cattle, etc for the carriage of passengers and goods
- xii. Pedestrians

The results of traffic count (average daily traffic flows) are provided in the table below. The results of the MCCs over a total of three days in March (24 hour counts) were converted to an estimate of Annual Average Daily Traffic (AADT) for 2011.

Base Year 2011 Traffic

Car	Minibus	Medium/ Large Bus	LGV	MGV	HGV 3	HGV 4+	AADT
44	11	3	10	2	7	3	80

Source: The Consultant

Motorcycle	Bicycle	Animal cart	Pedestrians
1	0	0	26

Source: The Consultant

Table 1-1. Current daily traffic values. Source: Kocks Consult GmbH, 2011

Traffic forecasts have been developed for a 20 year period commencing with 2011. The following components of traffic growth have been considered as relevant for the traffic forecast for Sasadilo - Sioni road:

- Normal traffic growth driven by national and regional economic growth in Georgia/ Mtshketa-Tianeti region
- Generated traffic as a result of road rehabilitation: improved accessibility for the existing population and businesses served by the road plus the potential encouragement for increased economic activity afforded by a rehabilitated Sasadilo – Sioni road.

Significant increase of traffic is expected for the next 20 years in case of improvement of the existing road and development of tourism in region (see table 1- 2).

1.3 Current Condition of the Road and Road Infrastructure

Road

The road is of two-lane standard, approximately 6m wide and in very poor condition. It is evident that the road was originally constructed with an asphalt concrete pavement but much of the original surface has been lost due to lack of maintenance and there are no remaining lengths of intact pavement greater than 100m. Many sections have effectively reverted to unpaved and the surviving sections of asphalt pavement are substantially damaged including many, large potholes.

The road has five bridges, all in need of repair, including two in excess of 80m, both over the River Iori. The road surface over these two larger structures is particularly bad.

The road does not pass through the center of the villages served, a considerable majority of properties being reached by access roads of which there are approximately 35 along the length of the road. These access roads connect approximately 200 premises, predominantly residences, to the study road while approximately 35 premises have access directly on to the study road. An assessment of land-use along the road suggests that most of the properties are residential although there are a limited number of large farms.

The existing road surface is severely damaged and it is impossible to keep the required speed for the roughness measurement. The surface shows more than axle-deep potholes and for long stretches the average speed with a 4WD reached 20 km/hr only, whereas in better sections 25 km/hr could be achieved.

In accordance with the qualitative evaluation of the ride quality as described in the Overseas Road Note 5, the average road roughness of the project road has been established with a value of 20 m/km. Comfortable travel speed is no more than 20 km/hr, giving an end to end journey time of almost 55 minutes.

Table 2.2.8 Central Growth Traffic Forecasts for Sasadilo - Sioni road, 2011-2030

	Car	Minibus	LGV	Bus	MGV	HGV3	HGV Artic	AADT	Grand Total
<i>AADT Growth Rate (% pa) 2011 - 2015</i>	6.00	6.00	5.00	6.00	5.00	5.00	5.00		
<i>AADT Growth Rate (%/pa) 2015 - 2020</i>	4.80	4.80	4.00	4.80	4.00	4.00	4.00		
<i>AADT Growth Rate (%/pa) 2020 - 2025</i>	4.20	4.20	3.50	4.20	3.50	3.50	3.50		
<i>AADT Growth Rate (%/pa) 2025 - 2030</i>	3.30	3.30	2.80	3.30	2.80	2.80	2.80		
AADT 2011	44	11	3	10	2	7	3	80	107
Generated traffic (2012-2015)	49	12	11	3	2	8	3	89	90
AADT									
2012	66	17	15	5	3	10	4	120	148
2013	80	20	18	5	4	13	5	145	173
2014	95	24	21	6	4	15	6	171	199
2015	110	27	24	7	5	17	7	198	227
2016	115	29	25	8	5	18	8	208	236
2017	121	30	26	8	5	18	8	217	245
2018	127	32	27	9	5	19	8	227	255
2019	133	33	28	9	6	20	9	237	266
2020	139	35	30	9	6	21	9	248	277
2021	145	36	31	10	6	21	9	258	287
2022	151	38	32	10	6	22	10	269	297
2023	157	39	33	11	7	23	10	279	308
2024	164	41	34	11	7	24	10	291	319
2025	171	43	35	12	7	25	11	302	331
2026	176	44	36	12	7	25	11	312	341
2027	182	46	37	12	7	26	11	322	351
2028	188	47	38	13	8	27	11	332	361
2029	194	49	39	13	8	27	12	342	372
2030	201	50	40	14	8	28	12	353	382
2031	207	52	41	14	8	29	12	364	394

Source: The Consultant

Table 1-2. Traffic Forecasts for Sasadilo-Sioni Road. Source: Kocks Consult Gmbh, 2011

Bridges and other structures

The location of existing bridges along the project road alignments and the main geometrical data of these bridges are presented in Table 1-3 below.

Bridge No.	Location / Chainage	Length (m)	Roadway Width (m)	Sidewalk Width (m)	No. of Span
1	2+078 - 2+166	88.0	7.00	2 x 1.25	7
2	3+312 – 3+400	88.0	8.50	2 x 1.30	4
3	3+930 – 3+980	49.0	5.60	-	4
4	7+525 – 7+572	47.0	7.00	-	4
5	15+678 – 15+714	34.8	6.50	-	-

Table 1-3. Bridges on the Sasadilo – Sioni Road. Source: Kocks Consult GmbH, 2011

Bridges start ageing and deteriorating from the day they are built due to the natural weathering of materials, environment and traffic. Bridge inspection aims at following up this ageing and deterioration process and recording which components have changed since the last inspection and to what extent.

The visible inspection has been carried out of all bridge elements. It involves a thorough check of all bridge elements, e.g. approaches for potholes and related damage, settlement of the pavement, erosion, excessive vegetation, any obstruction, or missing bridge signs; checking the superstructure from above and underneath for damage caused by traffic, cracks, spalling and similar damage, deflections etc; examining whether the bearings are functioning well, and for any blockage, rust, change of shape etc; checking the substructure for cracks, settlement, bulging, wearing of pointing, under scouring etc, and waterway for erosion, scour, widening or narrowing of the river, silting up, obstructions, etc.

Typical revealed defects are:

Substructure

- Cracks and spalling in concrete and corrosion at reinforcement bars are common.
- The connection between piers and crossbeam is insufficient.

Superstructure

- The quality of the prefabricated units is poor. Local spalling on pre-cast elements is frequent.
- Defects of the asphalt concrete surface range from small cracks to potholes.
- Expansion joints are provided as construction joints, filled with bituminous mixtures.
- Drainage of the bridge surface is only partly functioning.

Railing and sidewalks

- The railing is damaged and inadequate.



Beginning of the Project Road, km 0



Junction at km 0.7



Culvert under access road, km 0.95



Bridge at km 2.1



Bridge at km 2.1



Iori River crossing at km 3.3



Road at km 3.9



End of the Project Road, Junction

Fig.2 Condition of Sasadilo – Sioni Road



Bridge No 1



Bridge No 1



Bridge No 2



Bridge No 2



Bridge No 3



Bridge No 3



Bridge No 4

Bridge No 4

Bridge No 5

Bridge No 5

Fig.3 Current condition of bridges on the Sasadilo – Sioni Road

On the Sasadilo – Sioni road are in total 49 culverts. Most of them are reinforced concrete pipes in fair to satisfactory condition.

The adequacy of the hydraulic capacity and structural conditions of existing culverts has been determined. For the existing culverts, preliminary required rehabilitation measures are defined. In case of replacement of drainage structures, the hydraulic opening of the new structure should not be less than the opening of the existing structure.



Fig.4 Current condition of culverts on the Sasadilo – Sioni Road

1.4 Rational for the Project

The overall conclusion of the road rehabilitation assessment study is that improvements to the Sasadilo – Sioni road are warranted and that an improved roadway will be beneficial to the development of the recreation area at Sioni.

As in many other local road projects, low traffic volumes together with relatively high construction costs challenges the economic feasibility. However, as identified in the study the proposed rehabilitation option shows sufficient economic rates of return.

Permits	<p>Environmental Permits,</p> <ul style="list-style-type: none"> - Monitoring compliance with the conditions of Environmental Permits.
Department of Environmental Supervision	<ul style="list-style-type: none"> - Inspecting compliance with the natural resource use regulations, - Inspecting compliance with the conditions of Environmental Permits.
Department of Environmental Policy and International Relations	<ul style="list-style-type: none"> - Developing the State environmental policies and the State environmental programs.
Ambient Air Protection Services	<ul style="list-style-type: none"> - Developing ambient air and water protection strategy, - Approving reports on “Inventory of Stationary Sources of Emissions” and “Norms of Maximally Admissible Emissions.”
Water Resources Management Services	<ul style="list-style-type: none"> - Development of water protection strategy, - Approving reports on “Norms of Maximally Admissible Discharges”, - Approving technical regulations for Water Intake from the Surface Water Bodies, - Adopting environmental Standards and Norms.
Waste and Chemical Substance Management Services	<ul style="list-style-type: none"> - Managing waste, - Managing hazardous substances.
Climate Change Services	<ul style="list-style-type: none"> - Developing national policy, strategy and legislation and controlling compliance with international treaties on climate change matters, and analysis of risks.
Biodiversity Protection Department	<ul style="list-style-type: none"> - Participating in the development of the State policy in the field of biodiversity protection and management of biological resources, and implementing this policy; - Organizing and coordinating the State system of biodiversity monitoring; - Determining methods and quotes for the biodiversity resource extraction.
Natural and Anthropogenic Hazard Management Services	<ul style="list-style-type: none"> - Developing emergency prevention and response strategy and plans.
Nuclear and Radiation Security Department	<ul style="list-style-type: none"> - Developing national policy, strategy and legislation and controlling compliance with international treaties on nuclear security and safety issues.
Legal Department	<ul style="list-style-type: none"> - Developing environmental legislation.

There are three agencies operating under the umbrella of the MoEPNR:

National Forest Agency	<ul style="list-style-type: none"> - Managing the State Forest Fund; participating in the development of the State policy on forest restoration and the use of forest resources and implementing this policy; - Protecting forests from fires, illegal wood cutting, diseases and pests; identifying and implementing activities for the conservation of forests carrying the function of maintaining water and micro-climatic balance, sanitary, soil stabilization, and recreational functions.
Agency of Protected Areas	<ul style="list-style-type: none"> - Planning and Managing the national system of protected areas; - Overseeing and participating in the management of the categories of protected areas that are not under full discretion of the Agency and of the multiple use territories adjacent to the protected areas; - Organizing monitoring, scientific research, education activities in the protected areas, and cooperating with gateway communities, NGOs, and other stakeholders of the protected areas.
National Environment Agency	<ul style="list-style-type: none"> - Issuing licenses for natural resource extraction (except oil and gas), - Delivering hydro-meteorological services, - Monitoring geodynamic processes, and levels of ambient pollution of the environment.

In relation with the road projects, the MoEPNR is has an important function of issuing Environmental Permits. MoEPNR is also carrying responsibilities for monitoring compliance with the conditions of Environmental Permits, although the efficient monitoring system still needs to be developed. MoEPNR is mandated to issue licenses for operating quarries and borrow pits required for roads construction and reconstruction works.

2.2 Changes in Environmental Legislation

Georgian Regulations Related to Environmental Permitting

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 Impact Permits (EIP), and (iii) The Law on Ecological Examination (2008).

The Laws on Environmental Impact Permit and on Ecological Examination were published on 14.12.2007 and entered into force on 01.01.2008. The Law of Georgia on Environmental Impact Permit determines the complete list of the activities and projects subject to the ecological examination (clause 4, p.1) and the legal basis for public participation in the process of environmental assessment, ecological examination and decision making on issuance of an environmental impact permit.

Some minor changes in the Law on Environmental Impact Permit have been introduced in 2010, one year later after approval of the VGT EIA:

- **Technical Summary** is requested to be attached to EIA report as part of application documents for obtaining Environmental Impact Permit. Technical Summary is considered as brief description of the project design, technological cycle, location and layout of facilities etc. In previous version of the Law **Non-technical summary** was requested instead, which was considered as Executive Summary of the EIA.
- Conclusions and Conditions of the Ecological Expertise represent Conditions of the Environmental Permit. Those mitigation measures proposed in EIA report, which are deemed as necessary and obligatory for execution, are included in the Conditions of Permit. In fact Conditions of Permit are subject for execution but not the set of mitigation measures proposed in EIA report and EMP. By this provision the MoE has formalized a practice and understanding of implementation aspects of EIA established within MoEPNR during recent years.

Procedures for Tree Felling¹.

If a need emerges for clearing trees from a site included in the State Forest Fund, then this site has to be excluded from the Fund according to the procedures in force. If the trees are not within the plots included in the State Forest Fund (which is the case for rehabilitation of Sasadilo-Sioni road), then the project proponent is required to keep a registry of extracted trees and hand them over to the Ministry of the Economy and Sustainable Development. Also, the extracted trees may be handed over to the local municipality and the municipality will then distribute wood to the local population below the poverty line.

Environmental Standards and Norms Pertinent to the Project

Maximum Admissible Concentration (MAC) for NO₂, which is one of the critical factors of traffic related emissions, was revised in 2010 from 0.085 mg/m³ to 0.2 mg/m³. Current figures of MAC for some pollutants related to traffic emissions are given below.

The provisions for the protection of ambient air against contamination and the values of Maximum Admissible Concentrations of the harmful substances in the ambient air in the vicinity of the settlements is provided in the Environmental Quality Norms approved by the Order #297N (16.08.2001) of the Ministry of Labor, Health and Social Protection (as amended by the Order No 38/n of the same Ministry of 24.02.2003). The quality of atmospheric air (pollution with hazardous matter) is also defined by the order of the Minister of Environment Protection and Natural Resources (#89, 23 October 2001) on approval of the rule for calculation of index of pollution of atmospheric air with hazardous pollution.

N	Substance	N according to CAS	Formula	MAC (mg/m ³)		Class of harmfulness
				Maximum fugitive	Average Daily	
1	2	3	4	5	6	8
6	Nitrogen (IV) Dioxide	10102-44-0	NO ₂	0.2	0.04	2
111	Sulfur Dioxide	9/5/7446	SO ₂	0.5	0.05	3

¹ The described procedures are currently practiced in Georgia. Formal regulations are yet to be adopted to reflect recent institutional changes affecting the management of natural resources.

359	Carbone Oxide	630-08-0	CO	5	3	4
360	Soot (Carbone black)	1333-86-4	C	0.15	0.05	3

2.3 Screening Determination for the Project

According to Georgian legislation the activities related to construction or reconstruction of the roads of National Importance require carrying out of an EIA and obtaining of an Environmental Impacting Permit. However, rehabilitation of the existing roads does not require Environmental Impact Permit and no EIA or EMP is requested. Accordingly, rehabilitation of Sasadilo-Sioni road section is not subject to environmental permitting.

In accordance with the WB safeguard policy (OP 4.01 Environmental Assessment), the KRRI Project was classified as environmental Category B. Rehabilitation of the additional section of road linking the village of Sasadilo to the village of Sioni falls under the same environmental category. Carrying out of an environmental assessment relevant for a Category B activity and development of an EMP is required by the WB policies. Therefore, this supplemental EIA has been carried out for Sasadilo-Sioni section. The KRRI Project also triggers two other safeguard policies of the WB: OP/BP 4.11 Physical Cultural Resources, and OP/BP 4.12 Involuntary Resettlement.

In order to comply with both – the Georgian law and the WB regulations – it is required to prepare the EIA report, including EMP, for Sasadilo-Sioni section of the road as a supplement to the original EIA report produced for VGT road under the KRRI Project and to conduct public disclosure of the mentioned documents in compliance with the WB regulations.

Institutional Capacity of RDMRDI

The Resettlement and Environmental Protection Division with Environmental Protection Unit was established within RDMRDI. Currently, besides the head of the Unit, there are three environmental specialists in the staff. In addition, one Environmental Safeguards Consultant will be hired within a month. The staff received professional on-the-job training as a part of the World Bank's technical assistance to the RDMRDI. Current environmental capacity of the RDMRDI needs strengthening to ensure full environmental compliance of the Project. In spite of the fact that the day-to-day quality control of works will be outsourced to the engineering supervisor of works, RDMRDI shall retain the critical in-house human capacity to oversee performance of such technical supervisor and to work out decisions for addressing issues which the supervisor may bring up for RDMRDI's attention.

3. Project Description

3.1 Design Requirements and Standards

The Sasadilo - Sioni road commences at the village of Sasadilo in a junction at km 27 of the Vaziani – Gombori – Telavi (VGT) road. It accesses the villages of Kochbaani, Bochorma, Kudro and Orkhevi before ending at km 17.3 where the road to Sioni (3.7km in length) diverges from the continuation of the Sasadilo – Orkhevi road to Khevsurtsopeli (see map on the fig. 1).

The Sasadilo – Sioni road could be categorized as low volume road which provides access to resort developments. A low volume road is a road with an average Daily Traffic not exceeding 200 and whose service functions are oriented toward a rural road system. In 2009 a new Georgian geometric design standard has been introduced. According to the design standard the Sasadilo – Sioni Road is classified as road with local importance and the design speed has been set as 60 km/h to reflect the rural characteristics of the road. The appropriate road geometrical parameters should meet requirements for the design speed.

The design elements for the cross section of the project road are as follows:

- Number of lanes: 2
- Lane width: 3.00 m
- Carriageway width: 6.00 m
- Width of shoulder: 1.25 m
- Total road width: 8.50 m

The geometrical design parameters for the selected design speed of 60 km/h are as follows:

- Min. horizontal radius 120 m
- Max. gradient 8 %
- Min. crest curve 1,800 m
- Min. sag curve 1,700 m
- Min. cross slope 2.5 %
- Max super elevation 7 %

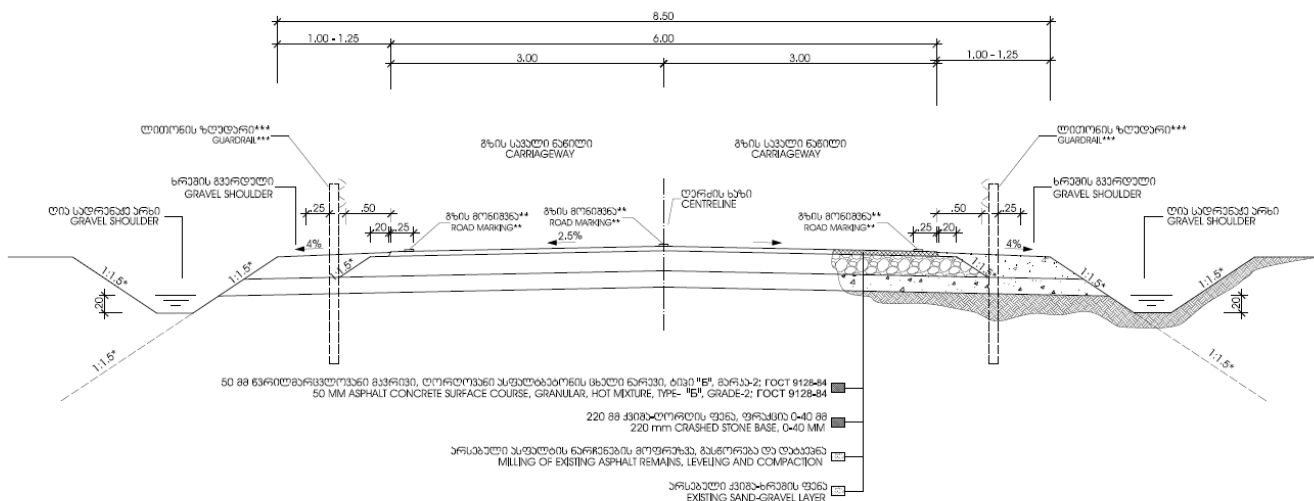
The preliminary road design is carried out considering following design philosophy:

- The proposed solution of the project is the rehabilitation of the existing carriageway. The alignment therefore follows the existing road.
- The standards to be applied will follow the Georgian geometric design standard for the selected design speed of 60 km/h, with some flexibility in application when the strict application of the standards would result in an excessively costly technical solution.
- In order to avoid social and environmental problems that arise when land taking is required, any road realignments will be limited to what can be achieved within the existing road corridor. In general the design follows the existing alignment wherever possible and considers the existing structures. Where the existing alignment does not correspond to the proposed parameters, certain improvements depending on topography, build-up areas and structures are considered.
- The design will result in a cost effective construction, considering the low traffic volumes on the road and the economic viability of the design.

The horizontal alignment follows the existing road with minor alignment improvements within the existing right-of-way. Longitudinal gradients and slope stability of the vertical alignment are generally acceptable. The vertical design allows an increase in the road elevation to accommodate additional pavement layers where possible to minimize the quantities for removal of existing embankment material. Along the project road section minor roads join the main road. These side road connections are, in general, unregulated with no road marking and little signing. This minor junction has to be furnished with adequate marking and traffic signs for safety of the road user.

შპს ბანიონი პროექტი
ROAD CROSS SECTION

მასშაბი:
SCALE: 1:50



შენიშვნა / NOTES	
*	ვერტიკალიზაცია; ჰორიზონტალიზაცია VERTICAL : HORIZONTAL
**	შპს FOCT 23467-79 "სადაიო" მიწის რეგულაციის ტექნიკური საბუღალტრო საკანონმდებლო საბუღალტრო SEE GOCT "TRAFFIC REGULATION TECHNICAL FACILITIES"
***	ზღვრების მოწყობა, როდესაც სიმაღლეა 3 მეტრი PLACING OF GUARDRAILS WHEN EMBANKMENT HEIGHT ≥ 3 METERS

შპს ბანიონი პროექტი REVISIONS / AMENDMENTS	შპს ბანიონი პროექტი BY	შპს ბანიონი პროექტი APPROVED	შპს ბანიონი პროექტი DATE	შპს ბანიონი პროექტი / DESIGNED	შპს ბანიონი პროექტი / DRAWN	შპს ბანიონი პროექტი / APPROVED / DATE	შპს ბანიონი პროექტი / ORIGINAL DRAWING SIZE: A3 (420 x 297)	შპს ბანიონი პროექტი / NOTES
				შპს ბანიონი პროექტი / CHECKED	შპს ბანიონი პროექტი / DATE			

Fig. 5. Road Cross Section

3.2 Rehabilitation Works

The rehabilitation of the Sasadilo – Sioni road is expected to follow the existing road alignment, with the possible exception of limited realignments to improve geometric characteristics, and eliminate safety hazards. The final alignment will be specified in the detailed design of sections to be provided under the design-and-build contract, subject to clearance by the client and the World Bank. Rehabilitation includes widening of shoulders by stripping of surface, excavation for widening, construction of embankment in benching by compacted layers, and pavement reconstruction and shoulders.

The works comprise:

- Embankment construction
- Repair and rehabilitation of bridges and culverts, a where necessary
- Provision of new culverts, if necessary
- Re-establishment unlined side drains
- Pavement construction
- Provision of road marking, guardrails and road signage installation
- Miscellaneous minor rehabilitation and repair works

3.2.1 Preparatory Works

Setting out 17.5km and Site Clearance. Site clearance is defined as the clearing, grubbing, removal and disposal of all vegetation, grass, debris, bushes, scrub, dense bush, trees, hedges, undergrowth, stumps, roots, shrubs, plants and backfilling of holes left by the removal of stumps and roots within the corridor of 17.5 ha.

Clearing of existing side drains and ditches, 500.0m³. This work consists of all clearing, grubbing and re-grading of existing ditches for the project. Disposal of clearing and grubbing debris off the project site to a dump area.

Removal of Structures, Obstructions and Trees

This work consists of salvaging, removing, and disposing of trees; signs and posts; sign pole mounts, and any other obstructions.

- Relocation, replacement and rerouting of all utilities located on the Project.
- Demolition of existing wooden power transmission posts an relocation at new sites
- Relocation and protection-in-place of gas pipe linear meter
- Relocation and protection-in-place of electrical cable linear meter
- Relocation and protection-in-place of communication cable linear meter
- Construction of duct crossings

3.2.2 Earthworks

- Removal of top soil and stockpiling, conform to Specification Clause 500m³
- Excavation in road cut - 30,700m³
- Embankment construction from road cut - 4,420 m³
- Disposal of unsuitable and surplus material - 26,280 m³
- Construction of ditches and site drains, conform to Specification - 14,160 m³
- Milling of existing asphalt 1,375 m³
- Shape, level and compact formation level, 148,750 m²
- Transport of stockpiled topsoil and topsoiling 500, m³

This type of works include all works on road sub-grading, excavation, embankments (soil replacement, layer by layer placing and soil compaction, road-bed layout and slope grading) in accordance to designed profiles.

Excavation. Excavation consists of the following:

- Roadway excavation. All material excavated from within the right-of-way or easement areas
- Borrow excavation. Material used for embankment construction that is obtained from outside the right of way limits of the project road. Borrow excavation includes unclassified borrow, select borrow, and select topping.

Milling of Bituminous Bound Pavement

This work consists of milling of existing asphalt pavements, breaking down material and adding gradation as necessary to comply with the requirements of granular sub-base and base material. Where cold-milling of bituminous bound flexible pavement is required, the area of carriageway to be milled shall be removed by a suitable milling machine.

The existing bituminous pavement made from cold asphalt shall be milled and sieved to grading for re-use as sub-base material or base material. The existing bituminous pavement material does not conform to any given grading, but consists locally of larger gravel and finer material.

3.2.3 Pavement

- Provide and place crushed stone base, 220 mm thick, CBR > 100 %, 33,495 m³
- Provide and apply prime coat, 76.3 ton
- Provide and place asphalt concrete surface course, 50 mm thick, 109,005 m²
- Provide and place shoulder fill material 1,800 m³

This work consists of saw cutting (when applicable) patching of potholes, reconditioning of designated areas of asphalt pavement, and cleaning and filling cracks and joints in the asphalt pavement

3.3 Bridges

Bridge No 1. Km 2+078 – Km2+166

The design solution includes:

- Replacement of damaged sidewalk slabs by new one
- Replacement of damaged expansion joints by new ones
- Replacement of remained steel handrails by new ones
- Cleaning of river bed of debris trees and shrubs



Fig. 6 Bridge No 1

Waste generation:

Dismantling, loading on dump trucks and hauling to dump of the existing damaged metal railings - 0.50 ton

Removal by pneumatic hammer, loading on dump trucks by hand and hauling to dump of the existing damaged fragments of road pavement - 63.00 m³

Collection, loading on dump truck and hauling to dump of the construction waste - 5.00 m³

Cleaning of concrete surface by low pressure water jet 350.00 m²

Clearing the riverbed from vegetation runoff and trees/bushes growing in a bed m² 5000.00

Clearing the riverbed from sandy soil runoff (moving to 20 m by bulldozer)

Bridge No 2. Km 3+ 312/km 3 +400

The design solution includes:

- Replacement of damaged 4 sidewalk slabs by new ones
- Replacement of damaged expansion joints by new ones
- Construction of new steel handrails
- Cleaning of river bed of debris and shrubs



Fig. 7 Bridge No 2

Removal from abutments by pneumatic hammer of the existing r/concrete barrier blocks, and hauling of construction debris to dump 3.84 m³

Removal by pneumatic hammer, loading on dump trucks by hand and hauling to dump of the existing damaged fragments of road pavement 75.60 m³

Cleaning of concrete surface by low pressure water jet 200.00 m²

Clearing the riverbed from vegetation runoff and trees/bushes growing in a bed 2000.00 m²

Clearing the riverbed from sandy soil runoff (moving to 20 m by bulldozer) m³

Bridge No 3. Km 3+ 930/km 3 +980

The design solution includes:

- Demolition of 4 beams and 3 piers
- Partial demolition of abutments, reinforcement and construction
- Construction of one pier and 2 r/c beams
- Construction of wire mesh gabions
- Cleaning of river bed



Fig. 8 Bridge No 3

Construction Site Preparation

For diversion of the riverbed, excavation of soil and moving to 10 m m³ 1500.00

Compaction of soil collected at the banks of new riverbed m³ 1500.00

Provide and installation of 28 R/C pipes (d-150 cm) in the new river bed for bypass road m³ 13.19

For providing the bypass road, hauling, delivering, leveling and compacting the sand and gravel aggregates, including hand operations - Rehabilitation works along the existing 2 km long dirt road with 5 m wide carriageway m³ 1000.00

Waste generation:

Dismantling the load bearing metal elements of superstructure (hauling to dump) 45.00 m³

Earthworks

Removing/stripping out the slope protection rip-rap and gravelly soil for excavation of the pits at abutments (including hand works) 302.00 m³

Cleaning of concrete surface by low pressure water jet m² 65.00

Bridge No 4. Km 15+ 678/km 15 +714

The design solution includes:

- Construction of monolith reinforced concrete sidewalks and bridge slab
- Replacement of damaged expansion joints by new ones
- Replacement of damages steel handrails by new ones
- Construction of steel guardrails at bridge and approaches
- Cleaning of river bed of debris and shrubs



Fig. 9 Bridge No 4

Dismantling, loading on dump trucks by hand and hauling to dump the metal elements of bridge railing 0.20 ton

Removal of damaged road pavement from the bridge by pneumatic hammer, loading on dump trucks by hand and hauling to dump. 30.55 m³

Collection, loading on dump trucks by hand and hauling to dump of construction waste 5.00 m³

Painting of metal elements and load bearing structures of the bridge with corrosion resistant paint. ton 50.66

Excavation of the soil by hand for preparation of the underlying surface for placement of gabions m³ 60.00

Placement of gabion boxes with sizes of 2x1x1 m and 1.5x1x1 m m³ 144.00

Collection of gabion stones by hand, 287x1,04 m³ 149.76

Loading the stones on dump trucks and hauling to 5 km; 299x1,75 ton 262.08

Bridge No 5. Km 7+ 525/km 3 +572

The design solution includes:

- Construction of monolith reinforced concrete sidewalks and bridge slab
- Replacement of damages steel handrails by new ones
- Construction of steel guardrails at bridge and approaches
- Construction of gabion wall at right abutment
- Cleaning of river bed of debris and shrubs



Fig. 10. Bridge No 5

Dismantling, loading on dump trucks by hand and hauling to dump the metal elements of bridge railing 0.18 tone

Removal of damaged road pavement from the bridge by pneumatic hammer, loading on dump trucks by hand and hauling to dump. 24.50 m³

Collection, loading on dump trucks by hand and hauling to dump of construction waste 5.00 m³

Painting of metal elements and load bearing structures of the bridge with corrosion resistant paint. tone 4.11

Clearing the riverbed from sandy soil runoff (moving to 20 m by bulldozer) m³ 3500.00

Excavation of the soil by hand for preparation of the underlying surface for placement of gabions m³ 60.00

Placement of gabion boxes with sizes of 2x1x1 m and 1.5x1x1 m m³ 144.00

Collection of gabion stones by hand, 287x1,04 m³ 149.76

Cleaning of concrete surface by low pressure water jet m² 420.00

3.4 Organization of Construction and Rehabilitation Works

Required Equipment

- Grader, 140 hp hour 30
- Bulldozer, 150 hp hour 30
- Dumper Truck, 8 m³ hour 30
- Concrete Mixer, 0.3 m³ hour 30
- Paver, laydown rate over 80 t/hour hour 10
- Steel Roller, operating weight 29 t hour 10
- Rubber Tyre Roller, operating weight 11 t hour 10
- Jack Hammer hour 30
- Asphalt Mixing Plant, capacity over 80 t/hour hour 10

Traffic Management during Construction

Road construction will almost disrupt normal traffic operations and travelling through a construction zone can be difficult and confusing to drivers. The frequency of crashes in work zones is disproportionately higher than at other locations. Therefore the primary consideration in work zone traffic control is safety. If driver can easily understand the traffic control and have adequate time to make decisions, they will operate their vehicle in a safe manner.

Maintaining the full carrying capacity is usually not possible during construction periods. As construction progresses, travel lanes are either narrowed, closed or rerouted. For construction sites on low-volume roads the use of alternating traffic on 1-lane roadway is appropriate. Adequate sight distance and signing must be available at the site to ensure the driver understands the appropriate actions to take. Temporary traffic signals are preferable to flaggers due to the long duration of the project and activities that would require flagging at night.

Temporary traffic control signals shall meet the physical display and operational requirements of conventional traffic signals. The typical layout of lane closure on two-lane road using traffic signals is presented in the figure below.

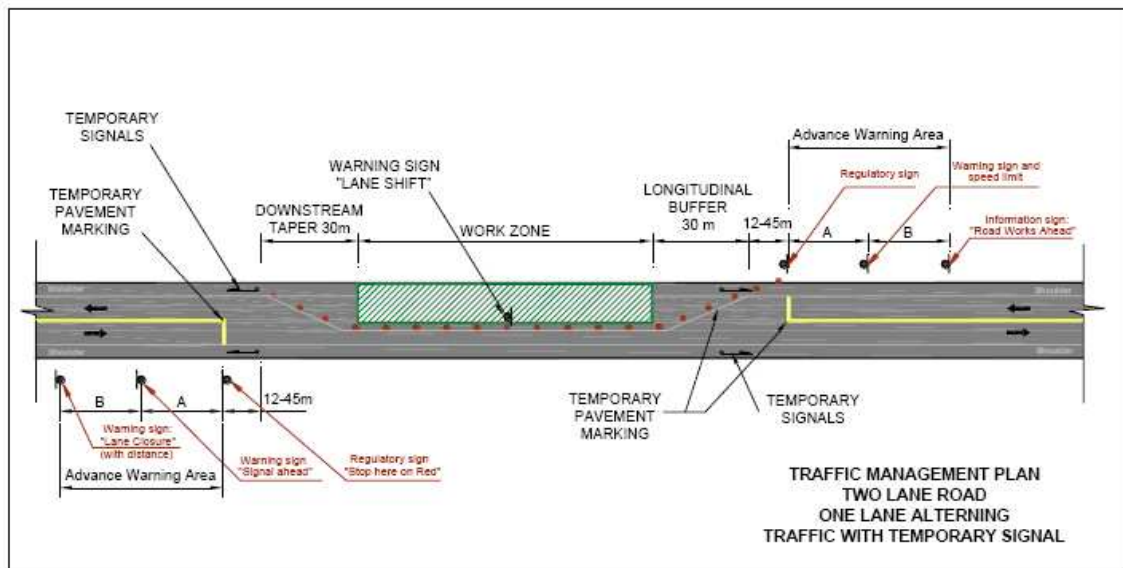


Fig. 11 Traffic Management Scheme

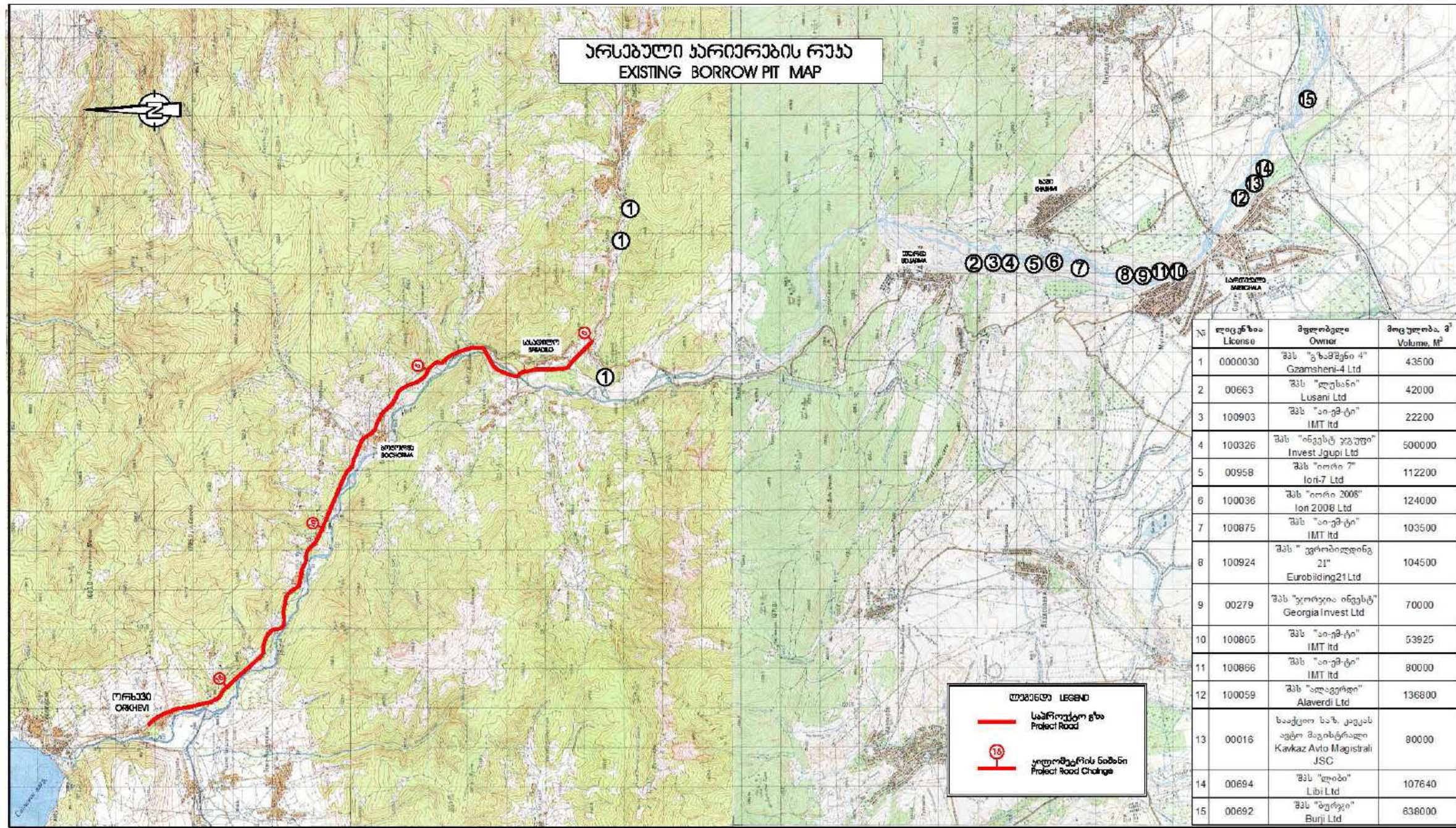
3.5 Quarries

During the field investigation areas with suitable construction material have been located and inspected. Existing borrow pits and quarries have been located and assessed for their suitability to meet contract requirements regarding adequate quality and quantity.

The investigations and the test results indicate that the naturally occurring granular material in the project area is in most cases suitable for fill, capping, and sub-base construction but in most cases requires some processing (screening).

Production of crushed aggregates in the project area will require the use of river gravel. There are number of operating crusher plants in the vicinity of the project site and the quality of their produce is known to be of the consistently good quality. Existing material sources near the study road have been identified and are shown on the attached borrow pit location map (see fig. 12).

At all borrow locations, including river beds, permissions and licenses for the extraction of material have to be obtained from the relevant Government agencies. It is preferable that construction contractors purchase material from the suppliers already operating within the reasonable distance from the project site.



შპს "სადალო-სიონი" / SHS "SADALO-SIONI"	კონსულტანტი: KOCKS CONSULT GMBH, STEGEMANNSTRASSE 32-38, 69068 KOBLENZ, GERMANY WITH SUBCONSULTING DESIGNING AND CONSULTING RT.LTD, ARSENA ST 38, TBILISI, GEORGIA	შეამოწმა / APPROVED: [Signature]	საპროექტო გზის რეაბილიტაციის დეტალური შეფასება
საპროექტო გზის რეაბილიტაციის დეტალური შეფასება	საპროექტო გზის რეაბილიტაციის დეტალური შეფასება	შეამოწმა / APPROVED: [Signature]	საპროექტო გზის რეაბილიტაციის დეტალური შეფასება
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Fig. 12. Location of the Proposed 3 Quarries

3.6 Spoil and Construction Wastes

Earthworks for the rehabilitation measures will be minor and are mainly limited to excavation of unsuitable material and soil replacement. Where the existing profile is altered or the road widened, care has to be taken to adequately choose and place the material according requirements and that new fill is properly bonded to the existing work and that new fill material is suitable for use in the specific circumstances in which it is to be placed.

As far as practical the material resulting from cuts, widening of cuts or other excavations in the road reserve shall be utilized for construction of earthworks if suitable. Material which will not be used in earthworks due to quality or other reasons may be stockpiled for future use as side fill. The earth-works balance is as follows:

- Excavation in road cut - 30,700m³
- Road cut material used for construction of embankment - 4,420 m³
- Disposal of unsuitable and surplus material - 26,280 m³

Existing patches of asphalt pavement are milled and used at site as filling material.

	Bridge 1 Km 2+078 – Km2+166	Bridge 2 Km 3+ 312 km 3 +400	Bridge 3 Km 3+ 930 km 3 +980	Bridge 4 Km 15+ 678 - km 15 +714	Bridge 5 Km 7+ 525 -km 3 +572	Total
demolished metal railings and other metal elements	0.50 ton		45.00 m ³	0.20 ton	0.18 tone	0.88 tone + 45 m ³ load bearing metal members of superstructure
demolished road pavement	63.00 m ³	75.60 m ³		30.55 m ³	24.50 m ³	193,65
demolished concrete debris		3.84 m ³				3.84 m ³
Other construction waste	5.00 m ³			5.00 m ³	5.00 m ³	15.00 m ³

3.7 Asphalt Mixing Plants

Below we provide figures for asphalt requirement for the project:

109,005m² of asphalt concrete surface coarse of 50 mm thickness, conform to specification Clause 4.05.

Mix Type	Grading limits; Grading (passing %)										
	Sieve size (mm)										
	0.071	0.14	0.31	0.63	1.25	2.5	5	10	15	20	40
Fine	2-8	3-15	4-22	7-28	10-38	18-50	27-65	45-76	57-100	70-100	-
Coarse	2-8	3-15	4-22	7-28	10-38	18-50	27-65	45-76	57-100	70-100	95-100

The constructing contractor has a choice either to use licensed suppliers already operating in the area or to install its own asphalt plant. In case if the constructing contractor takes decision to install new asphalt plant, prior to installation the company is obliged to prepare the relevant EIA and to get Environmental Impact Permit on installation and operation of the asphalt plant. In case if the contractor utilizes supplied asphalt, he is obliged to control license of supplier and ensure required quality of the asphalt.

Required asphalt mixing plant should be of the capacity of over 80 t/hour hour. The asphalt plants shall be of batch mix type with automatic controls and with a capacity of at least 50- 80

tons/hour. At least four cold containers for different aggregate fractions are required. All containers shall be covered to prevent the ingress of moisture. The weighs of the plant shall be calibrated before the start of the production or whenever directed by the Engineer. Asphalt concrete mix should be weighed on vehicle scales up to 2% in accuracy.

The bitumen tank shall be capable of maintaining its contents at the specified temperature within a tolerance of plus or minus 5°C and shall be equipped with a thermostat to prevent the temperature rising above 180°C and a fixed thermometer easily read from outside the tank. Any bitumen which has been heated above 180°C or has suffered carbonization from prolonged heating shall be removed from the plant.

3.8 Construction Camps

It is expected that the contractor will need to establish several equipment yards with 2 or 3 temporary shelters rather than full scale construction camps. The accommodation for the workers will be provided in the nearest villages. The workers will not live in the shelters on-camp. Shelters are supposed to be used as office, storage site and building for the guard personnel. The yard will be used for storage of equipment and machinery, fueling, simple maintenance works. The equipment yards could be located close to the village Udjarma, Paldo, and Sasadilo, as well as to the Vaziani area. The exact location will be selected by the constructing contractor. The location should be selected to comply with the following criteria:

- transformed urban or rural landscape not sensitive from ecological standpoint
- the fueling facilities could be located at a distance of 50m and more from the surface water objects
- the yards should not be located closer than 350m to the residential settlements. The distance should be sufficient for reducing the noise impact to acceptable level and not too large, so far as it is supposed that the accommodation and sanitary-hygienic facilities are available for the workers in the villages.



Fig. 13. Proposed Camp site

4. Baseline Environmental Conditions

4.1 Physical Environment

4.1.1 Climate, Air Quality, Background Noise and Radiation

Climate

Data on climate could be found in VGT EIA Vol. II/Annex 2/page 44 - 45.

Air Quality and Air Emissions

Data on baseline air quality and air emissions could be observed in VGT EIA Vol. II/Annex 2/page 39 – 43.

Background noise

Information on the present situation with the noise monitoring in Georgia, as well as noise standards for the residential areas, could be found in VGT EIA Vol. II/Annex 2/page 44.

The vehicle movement along the road rehabilitation section is not intense and therefore, the background noise is within the norm.

The background noise was measured with the equipment UK “PCE-EM882”. The measurements were conducted in every 2 km along the rehabilitation road. The following methodology was used to measure the noise at every specified point: the data were recorded at each point by using the measuring equipment with 5-minute-long intervals for a half an hour (total 6 data were collected) and mean value of the background noise at each point was calculated.



Fig.14 Background noise measurements

The background noise along the total length of the road rehabilitation section varied within the limits of 48-50 dB.

Background radiation

The measurements were conducted on April 17 with standard certified Russian equipment CПИ 6801. Continuous measurements were made along the total length of the road rehabilitation section. According to the data of measurements, the background radiation in the selected corridor is the mean value of the radiation background in Georgia and varies from 6 to 11 micro roentgen/hr.



Fig.15. Background radiation measurements

4.1.2 Geology - Geomorphology

Geomorphologic conditions

The design section of the road, stretching between the village Sasadilo and the settlement Sioni, includes the lower part of the left slope of the river Iori, which in a geomorphologic respect is included in the folded system of the East Caucasioni, where within the limits of the study area, according to the geomorphologic zoning there is a low and average-mountainous erosive-denudation hilly and strongly dissected relief identified over the Cretaceous Age deposits developed through the landslide and mudflow processes.

The topography of the relief is the result of the modern ascending tectonic movements and is characterized with longitudinal ridges, which have smooth flattened crests and step-like slopes. The absolute altitudes of the relief of the given type vary between 1000 and 1500 m, and the slope gradient is 5-25°. The surfaces of the slopes are dissected with the dissection coefficient varying from 2.5 km/km² (slight) to 3.5 km/km² (significant). The dissection coefficient increases to 5 km/km² as we get close to the crest area of the slopes at the expense of the secondary rivers. The cutting depth of the gorges, following the lithological varieties and degree of weathering, varies in a wide range (from 30-50 m to 300-600 m). The river gorges are V-shaped and they are box-like in the lower sections, with strongly inclined slopes. There is mostly detritus of the bedrock accumulated at the bottom of the slopes.

An accumulative-terraced relief is identified as a narrow strip along the river Iori gorge, which widens in a conic shape from north to south reaching several hundreds of meters in width. The origination of the given type of relief is associated with the characteristic accumulation of the Quaternary alluvial formations. In a morphological respect, the given type of relief is a wide accumulative flattened surface, with the exo-geological processes playing a great role in its formation, together with the modern tectonic movements.

Geological and geotectonic condition

In a geological respect, the study area is included in Mestia-Tianeti zone of the folded system of the East Caucasioni southern slope, with its geology presented as the deposits of a terrigenous-carbonate formation of the Cretaceous Age, which on the left slope of the Iori river are presented as sandstones, conglomerates and clays, covered with deluvial sediments.

The major part of the road on the left side of the river Iori is constructed across the deposits of the alluvial and alluvial-proluvial genesis presented as shingle with the loamy and sandy-loamy filler. Below, we give the description of the design engineering-geological conditions of the road

section, with the geological sections studied by the natural and artificial outcrops along the road as well as geotechnical bores, which were cut down to fix the rock strata of the road cover layers. In addition, the materials of the engineering-geological study in the region of the past years were used. The design section of the road runs in the following geological conditions:

- along km 0+000 – km 2+000 section, the design road runs in the lower part of the left slope of the river Iori gorge. The gradient of the slope is 10-15%; It is covered with forest and with bushes in its lower part. The bedrocks of the slope are covered with deluvial sediments of a great thickness, presented by clay loams with gravel admixtures of up to 15% (EGE-2). At the beginning of the section, along km 0+200, the slope is old sliding, with the activation observed in its roadside area.
- at km 2+000 - km 2+500 the lower part of the left slope of the river Iori with the slope gradient of 15%; however, the road is constructed across the terrace surface, which is built with alluvial shingle with a clay loamy filler (EGE-3). The terrace has a flattened surface, which is slightly inclined to the river;
- at km 2+500 - km 4+000, the road runs in the lower part of the left slope of the river Iori. The slope inclination is 15-20% and it is covered with a forest. The geology of the slope is presented by sandstones of the Lower Cretaceous Age (EGE-5), which are covered with deluvial clay loams with gravel admixtures of 15-20% (EGE-2);
- at km 4+000, there runs a dry gully, which is of a mudflow nature.
- at km 4+000 - km 5+000 is the lower part of the left slope of the river Iori. The slope has a wavy surface, dissectioned with dry and shallow gullies. The sandstones, which are the bedrocks of the slope, are covered with deluvial clay loams of a great thickness with 20% of gravel and shingle admixtures. The clay loams are wet and plastic (EGE-2);
- along km 4+200 section, a small landslide talus with the length of 30 m and width of 50 m at base is fixed at the roadside. The landslide is developed in the clay loamy deposits;
- along km 5+000 - km 7+000, the road runs over the area where the left over-floodplain terrace and the slope of the river Iori merge. The road is constructed across the alluvial deposits, presented by the shingle with clay loam filler (EGE-3), and in village Bochorma it runs over the proluvial (mudflow) deposits, which are presented by a shingle and gravely material with up to 20% of the boulder admixtures and clay loam filler (EGE-4). The river Orvili characterized by strong flashfloods and mudflow torrents flows in the village of Bochorma;
- km 7+000 - km 8+000 is the first left above-floodplain terrace of the river Iori. The terrace has a flattened surface and it is built with alluvial shingle with the boulder admixtures and a sandy-clay loamy filler (EGE-3);
- km 8+000 - km 8+500 is the lower part of the left slope of the river Iori. The slope gradient is 20% and is covered with forest. The geology of the slope is presented by the Lower Cretaceous Age sandstones, which are covered with deluvial clay loams of a great thickness. The motor road is built over the clay loamy grounds (EGE-2);
- along km 8+100, there is a landslide developed, with the length of up to 50 m and width of 40 m. The landslide damages the roadway; along km 8+500 - km 10+000, the road runs over the first left over-floodplain terrace of the river Iori, which is built with the alluvial shingle with boulder admixtures (EGE-3). There are bogged areas fixed along the both sides of the road;
- along km 8+600 section, at the bottom of the slope, there is a landslide developed, which does not pose a hazard to the road;
- km 10+000 - km 12+000 section is the lower part of the left slope of river Iori. The slope gradient is 15-25%. Its surface is wavy and dissectioned with dry and shallow gullies. The road runs across deluvial deposits, which are presented by clay loams with the admixtures of pebbles and gravel of up to 25% (EGE-2). The thickness of the deluvial deposits is up to 5 m. The river Sajinobos Khevi flows down the slope and is of a mudflow nature;

- along km 12+000 - km 13+000 section, the road runs in the lower part of the left slope of the river Iori. Geologically, the slope is built with conglomerates of the Upper Cretaceous Age. The conglomerates are average- and coarse-grained and are cemented with the carbonate cement (EGE-6). The river Sajinobos Khevi flows at the end of the section. The river is of a mudflow nature and river bank-protecting structures will be necessary to build across the river, adjacent to the bridge;
- km 13+000 - km 13+800 section runs over the first left over-floodplain terrace of the river Iori, across the alluvial deposits, which are presented by shingle (EGE-3). The slope bedrocks are covered with deluvial sediments of a great thickness;
- km 13+800 - km 15+000 section is the lower part of the left slope of river Iori. The gradient of the slope is 10-15%. In a geological respect, it is structured with deluvial clay loams of a great thickness covered with the sandstones of the Lower Cretaceous Age, with gravel and shingle admixtures of 20-25% (EGE-2). The road is constructed across the mentioned clay loamy deposits;
- km 15+000 - km 17+000 section is the lower part of the left slope of river Iori. The general inclination of the slope is 10-12%, with 5-8% in its lower part. The slope bedrocks are covered with deluvial sediments with the thickness of up to 5 m, clay loams with gravel and pebbles admixtures of up to 25-30% (EGE-2).

Geohazards

As for the Geological hazard, which may hamper the trouble-free operation of the rehabilitation road, a landslide is fixed at the beginning of the design road, where proper protective measures will be necessary. At the beginning of the section, along km 0+200, the slope is old sliding, with the activation observed in its roadside area. The length of the landslide body is up to 100 m and its width is 200 m along the road. Its surface is slightly wavy and salient with lateral fissures. The landslide is formed in deluvial deposits. Cutting down the slope in the road rehabilitation process will undoubtedly cause the activation of the landslide processes. Therefore, it will be necessary to take relevant protective measures:

- at km 4+000, there runs a dry gully, which is of a mudflow nature. The mud torrents have drifted average- and coarse-grain material with the boulder admixtures; the torrents wash and pose a hazard to the right pier of the road bridge;
- along km 4+200 section, a small landslide talus with the length of 30 m and width of 50 m at base is fixed at the roadside. The landslide is developed in the clay loamy deposits;
- along km 5+000 - km 7+000 The river Orville characterized by strong flashfloods and mudflow torrents flows in the village of Bochorma;
- in addition, the gorges and dry gullies formed on the left slope of river Iori are of a mudflow nature and may pose a certain hazard to the operation of bridges and road.
- along the road km 8+100, there is a landslide developed, with the length of up to 50 m and width of 40 m. The landslide damages the roadway; along km 8+600 section, at the bottom of the slope, there is a landslide developed, which does not pose a hazard to the road. Km 10+000 - km 12+000 the river Sajinobos Khevi flows at the end of the section. The river is of a mudflow nature and coast-protecting structures will be necessary to build across the river, adjacent to the bridge.

According to the Decree No. 1-1/2284 on approving the Building Norms and Rules of "Earthquake-resisting construction" (PN 01.01-09) of October 7, 2009 of the Minister of Economic Development of Georgia, the study territory is included in the zone of 8-point earthquake intensity.

4.1.3 Hydrology

The Sasadilo - Orkhevi road section is crossed by 25 watercourses including Iori River, two relatively large rivers and 23 unnamed ravines. These rivers and ravines originate on the southwest slopes of Tsiv-Gombori Range and finally enter into Iori River from the left side. From the foregoing watercourses the major ones are Iori, Orvili and Vashliani Rivers.

Iori River originates on the south slope of Caucasus Range, at 2600 m elevation above sea level and mouths into Mingechauri reserve at Azerbaijan Territory. The length of the river is 320 km, total decrease in elevation is 2520 m and average gradient is 7.9‰. The catchment area of the river is 4650 km². The river has various tributaries with the length of 1777 km, main ones are River Khashrula (12 km), Sagome (18 km), Adedi (16 km), Gombori (13km), Lapiankhevi (10 km), Ragolanttskali (12 km), Lakbe (32 km) and Ole (29 km).

The river upper catchment lies on the south slope of Caucasus Range, lower part lies on Kartli-Kakheti valley. Upper part is characterized by numerous tributaries and dry ravines, while lower part has smooth forms and relatively low levels. Geological structure of upper part comprises sandstones, marl, limestone and breccias with mix of porphyries and conglomerates. The lower part comprises sandstones conglomerates and alluvial deposits. Mountain zone of the catchment (above 200 m) is covered by alpine vegetation and lower part is covered by beech forest.

The river valley has v-shape to the village of Sioni, followed box type shape to village Khashma, while the more downstream section has trapezoidal cross-section. The valley mainly has steep sides, which directly convert into the slopes of adjacent mountain ranges. The rocky outcrops almost vertically descending towards the valley floor are observed along the right side ravine. The terraces run along both sides of the river from village Omaraani to the mouth. The heights of these terraces are 3-5 m, widths varies between 100 and 170 m, and lengths between 1.0 -1.6 km.

The riverbed meanders moderately and is mainly without branches from head to the Ujarma village, after that river is branching, producing small sandy islands. The river is fed by snow, rain and ground waters. Its water regime is characterized by spring floods, autumn flash floods and unstable/stable low flows in summer/winter. River charge is divided as follows: 40-44% in springs, 27-33% in summers, 16-17% in autumns and 8-14% in winters. A water dam was constructed near Sioni village in 1964, with height of 84.8 m, length of 780 m, and with volume of 325 million cubic meters. This reservoir had irrigation purpose and serves 68.4 ha of agricultural land, powering up 4 hydroelectric stations.

Orvili River originates on the south-west slope of Tsiv-Gombori Range, at 1500 m elevation above sea level and joins into Iori River from the left side at village of Bochormi. The length of the river is 9.25 km, and the catchment area is 23.8 km². The river has one first category tributary with the length of 2.90 km.

The river catchment lies on the south-west slope of Tsiv-Gombori Range occupying its mountain and piedmont zones. The geological structure of the catchment comprises the sandstone and older conglomerates covered by brown mountain-forest soils. The mountain zone of the catchment is fully covered by deciduous beech forest. Some area of the piedmont zone is cleared for cultivation of the agricultural crops. The forest cover occupies 70% of catchment area.

The river valley is v-shaped from the head to village of Omaraani, while its more downstream section has a trapezoidal cross-section. The valley mainly has steep sides, which directly convert into the slopes of adjacent mountain ranges. The rocky outcrops almost vertically descending towards the valley floor are observed along the right side ravine. The terraces run along both

sides of the river from vil. Omaraani to the mouth. The heights of these terraces are 3-5 m and the width varies between 100 and 170 m. The length of the terraces is 1.0-1.6 km.

The riverbed meanders moderately and is mainly unbranched. At the head the bed is stony and blocked by large boulders, while along the downstream section its bottom is covered with pebbles and gravel. The flow width ranges from 1-2 m to 3-4 m, depth – from 0.2 m to 0.6 m, and velocity – from 1.8 m/s to 1.0 m/s.

The river is fed by snow, rain and ground waters. Its water regime is characterized by spring floods, autumn flash floods and unstable/stable low flows in summer/winter. The river is used for operating the rural water mills.

Vashliani River originates on the south-west slope of Tsiv-Gombori Range, at 1500 m elevation above sea level and joins into Iori River from the left side 1.3 km north-west of village of Vashliani. The length of the river is 6.70 km, total drop – 482 m, average gradient – 72%, catchment area – 9.54 km². The river has three first category tributaries with the overall length of 4.40 km.

The river catchment lies on the south-west slope of Tsiv-Gombori Range, and mainly occupies its piedmont zone. The geological structure of the catchment comprises the sandstone and older conglomerates covered by brown mountain-forest soils. About 55% of the catchment area is under deciduous forest cover.

The river valley has from the source down to elevation of 1250 m is v-shaped, the further downstream section is trapezoidal, and from village of Vashliani to the mouth goes back to v-form.

The valley sides are mainly steep and turn into the flanks of adjacent ranges. The riverbed meanders moderately and is unbranched. Along the entire length, the bed bottom is made of stones and gravel. The flow width varies from 0.5 m to 3 m, depth – from 0.2 m to 0.5 m, and velocity – from 1.7 m/s to 0.8 m/s.

The river is fed by snow, rain and ground waters. Its water regime is characterized by spring floods, autumn flash floods and unstable/stable low flows in summer/winter.

The river is used for operating the rural water mills.

The water regimes, and geological, geomorphological and climate conditions characteristic to the other smaller rivers and ravines are similar to ones described above, and thus their detailed review was found to be unnecessary.

Peak Flows

Among the rivers crossing the project road, Iori river flows were more or less surveyed, survey stations were located at Orkhevi and Padlo villages, but dam had stabilized river flow after its construction in 1964, making those survey data obsolete. Therefore, peak flow of Iori River is calculated by empiric regional formula, given in “Technical Guidance for Estimating the Maximum River Runoffs in Caucasus Conditions” and “Surface water of USSR, volume IX publication I”. Formula is as follows:

$$Q_{5\%} = \left[\frac{20.8}{(F + 1)^{0.5}} - 0.135 \right] \cdot F \quad \text{m}^3/\text{sec}$$

Where Q5%-is maximum discharge with 5% probability

F – Surface of water basin in sq.km

The project road crosses Iori rived by 2 bridges distanced from each other by 0.9 km. Due to close locations of bridges; decision was made to define river peak flow at lower bridge cross section.

It also has to be considered that during heavy flows water is released from Sioni Dam and this amount also has to be added to peak flow. Peak flows of Iori River including released water from Sioni dam is presented in Table 4.1 below.

Probability in P%	1	2	10
Repeat rate in years τ	100	50	10
Maximum discharge from dam to design cross section Q m ³ /s	480	405	250
Dam water release amount Q m ³ /s	235	180	125
Design charge in design cross section Q m ³ /s	715	605	375

Table 4.1 Maximum discharges

Maximum discharges, presented in the last row in Table 4.1 is considered for sections, where road crosses Iori River.

The other rivers and ravines crossing the Sasadilo - Orkhevi road have never been subjected to any hydrological studies. Therefore, their estimated peak flows have been determined using the method given in “Technical Guidance for Estimating the Maximum River Runoffs in Caucasus Conditions”.

Based on this method, for the rivers and gullies with catchment areas not exceeding 400 km², the estimated maximum flows are calculated using the following formula:

$$Q = R \cdot \left[\frac{F^{2/3} \cdot K^{1,35} \cdot \tau^{0,38} \cdot \bar{i}^{0,125}}{(L + 10)^{0,44}} \right] \cdot \Pi \cdot \lambda \cdot \delta \text{ m}^3/\text{sec}$$

where:

R is the regional parameter, which value for the East Georgia's conditions is 1.15;

F is a catchment area at the design cross section in km²;

K is a regional climate coefficient, which value shall be obtained from the special map and in our case equals to 6;

τ is a recurrence period in years;

\bar{i} is an average (stabilized) gradient of the flow from the river head to design section;

L is a river length from the head to the design section in km;

Π – is a catchment's vegetation cover coefficient, which value can be obtained from the special map and reference table, and in our case equals to 1;

λ – is a coefficient of forest cover calculated from the formula:

$$\lambda = \frac{1}{1 + 0,2 \cdot \frac{F_t}{F}}$$

where: F_t - is the catchment area covered with forest in %;

δ – is the catchment shape coefficient, which value is calculated as follows:

$$\delta = 0,25 \cdot \frac{B_{\max}}{B_{sas}} + 0,75$$

where B_{\max} - is a maximum width of catchment area in km;

B_{sas} - is an average width of catchment area calculated from the formula: $B_{sas} = \frac{F}{L}$;

Besides the foregoing parameters, estimation of the peak flows in the rivers and ravines with catchment areas less than 5 km² also require additional coefficients matching with the specific catchment areas, which calculated values are provided below:

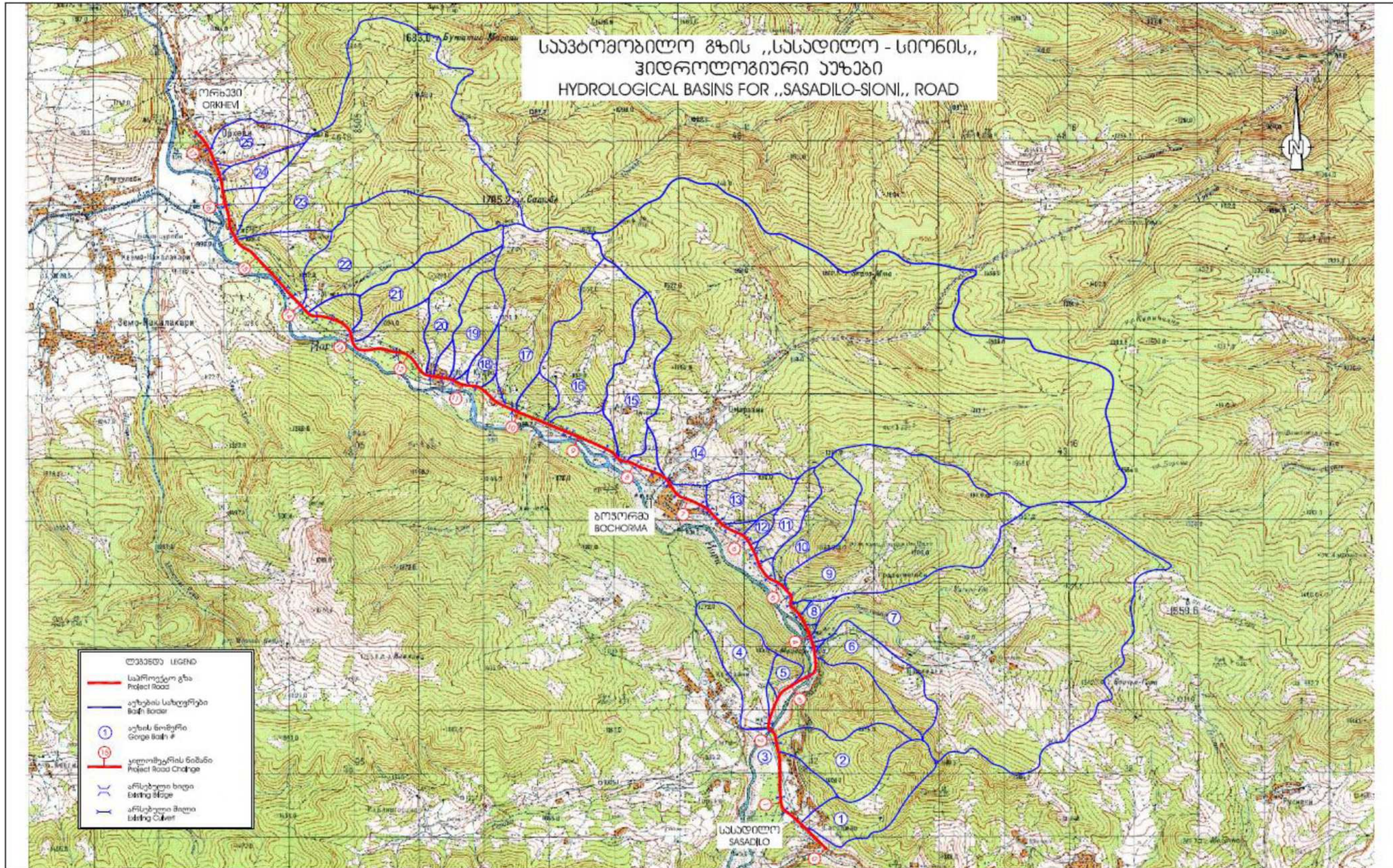
F km ²	<1	1	2	3	4	5
K	0.70	0.80	0.83	0.87	0.93	1.00

Table 4.2 Morphometric elements

The following Table 4.2 provides values of the morphometric elements required for estimation of the peak flows in the rivers and gullies crossing the design motor road retrieved from 1:25000 scale map, as well as 100, 50 and 10 year recurrence peak flows calculated from the foregoing formula.

Ravine No. and Name of River	F km ²	L km	i Riverbed	K	δ	λ	Peak Flows		
							$\tau = 100$ years	$\tau = 50$ years	$\tau = 10$ years
Ravine No.1	1.35	2.80	0.207	0.80	1.04	0.85	16.5	12.7	6.88
Ravine No.2	1.31	2.15	0.223	0.81	1.11	0.84	17.8	13.6	7.41
No. 3 Riv Iori	847	-	-	-	-	-	715	605	375
Ravine No.4	1.13	2.20	0.020	0.80	1.12	0.90	12.8	9.84	5.34
Ravine No.5	0.27	0.60	0.075	0.70	1.00	0.84	4.49	3.45	1.87
Ravine No.6	1.19	2.48	0.131	0.80	1.08	0.88	15.6	12.0	6.51
No.7 / Vashliani R.	9.54	6.70	0.072	1.00	1.31	0.90	78.9	61.3	33.3
Ravine No.8	0.13	0.45	0.156	0.70	1.00	0.87	3.14	2.41	1.31
Ravine No.9	4.99	3.90	0.151	1.00	1.00	0.85	44.4	34.1	18.5
Ravine No.10	1.13	2.25	0.191	0.80	1.10	0.84	15.4	11.9	6.47
Ravine No.11	0.56	1.55	0.226	0.70	1.06	0.94	9.59	7.37	4.00
Ravine No.12	0.15	0.52	0.308	0.70	1.00	0.86	3.68	2.83	1.54
Ravine No.13	0.81	1.20	0.233	0.70	1.03	0.92	11.9	9.13	4.96
No.14 / Orvili R.	23.8	9.25	0.056	1.00	1.09	0.87	108	83.0	45.1
Ravine No.15	1.40	2.75	0.193	0.81	1.12	0.91	19.8	15.2	8.26
Ravine No.16	2.25	2.85	0.203	0.85	1.13	0.85	26.7	20.5	11.2
Ravine No.17	2.85	3.25	0.194	0.86	1.11	0.85	30.8	23.7	12.9
Ravine No.18	0.23	0.62	0.226	0.70	1.04	0.87	4.97	3.82	2.07
Ravine No.19	0.79	1.95	0.256	0.70	1.15	0.84	11.7	9.00	4.89
Ravine No.20	0.70	2.30	0.252	0.70	1.16	0.84	10.7	8.25	4.48
Ravine No.21	1.25	2.90	0.224	0.81	1.11	0.84	16.9	13.0	7.05
Ravine No.22	2.70	3.10	0.182	0.86	1.14	0.83	29.6	22.8	12.4
Ravine No.23	7.26	5.32	0.124	1.00	1.07	0.85	56.8	43.6	23.7
Ravine No.24	0.46	1.15	0.165	0.70	1.03	0.99	8.39	6.45	3.50
Ravine No.25	0.71	1.52	0.145	0.70	1.08	1.00	11.6	8.90	4.83

Table 4.2, Morphometric elements and peak flows (m³/s) of the rivers and ravines crossing the Sasadilo - Orkhevi road



საავტომობილო გზის „სასადილო - სიონის,,
ჰიდროლოგიური აუზები
HYDROLOGICAL BASINS FOR „SASADIL0-SIONI,, ROAD

- საპროექტო გზა
Project Road
- აუზების საზღვრები
Basin border
- აუზის ნომერი
Gorge basin #
- კუთხოვრის ნიშანი
Project Road Change
- არსებული ხიფა
Existing bridge
- არსებული მილი
Existing Culvert

საპროექტო გზა Project Road	აუზების საზღვრები Basin border	აუზის ნომერი Gorge basin #	კუთხოვრის ნიშანი Project Road Change	არსებული ხიფა Existing bridge	არსებული მილი Existing Culvert
საპროექტო გზა Project Road	აუზების საზღვრები Basin border	აუზის ნომერი Gorge basin #	კუთხოვრის ნიშანი Project Road Change	არსებული ხიფა Existing bridge	არსებული მილი Existing Culvert

Fig.17 Hydrology Map

4.2 Biological Environment

4.2.1 Landscape and Flora

4.2.1.1 Landscape

The existing road starts from vil. Sasadilo and follows the left bank of r. Iori. 5 medium size villages (Sasadilo, Kotchbaani, Botchorma, Kudro, Orkhevi, Sioni) are located within 22 km section till vil. Sioni. Landslip slopes occur along the road. The road crosses both dry ravines and r. Iori and its tributaries. Agricultural land borders with the road. The research area is located within a landscape:

Foothill hilly denudational-accumulative landscape with Botriochloa steppes and Shibliak complex, rarely – with phryganoid vegetation and forest derivatives.

Administrative districts. Tianeti and Sagarejo district.

True altitude. This type of landscape mainly occurs from 500 m till 700-800 m above the sea level, at some areas higher. The true altitude for the project road is 1000m.

Terrain. Erosive-accumulative relief, which is characterized by sequence of hills and terrace ravines. The surface inclination is 20-30° 12 % and 10-20° 88 %.

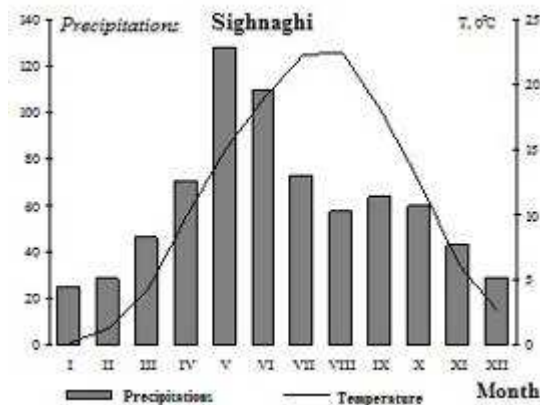
Modern geo-morphological processes. Accumulation, surface erosion.

Migration regime. Alluvial-accumulative, trans-alluvial.

Dynamics of Meteorological Parameters

Meteo-station	Meteorological indexes	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Annual
siRnaRi	Precipitation	25	29	46	71	128	110	73	57	64	60	43	29	735
	Temperature, 0°C	0,2	1,3	4,2	9,9	15,1	19	22,3	22,5	17,9	12,4	6,1	2,5	11,1

Climate. Sub-tropical semi-humid, transitional to moderately warm semi-arid and moderately continental. It is characterized with relatively dry winter and hot summer.



Soils. Brown alkaline, brown carbonate. Average soil humidity – 25-27 %.

Vegetation cover. Botriochloa steppes and Shibliak are dominant. Distribution of Shibliak and forest derivatives is relatively limited. Steppe vegetation is broadly represented, although it is different from the real steppes in the European part of Russia. Botriochloa steppes are most typical, although fescue-needle grass, wormwood-needle grass and pubescent wheatgrass steppes also occur. Thorny shrubbery and xerophytes are frequent as well.

Supplies of Some Components

The interval of the variation of amount of vegetation cover is 5-100 t/ha. The large amount of vegetation is present within those natural territorial complexes, which are characterized with iso-line of 30 % humidity of soil at the depth of 15-20 cm. The average amount of mortmass is 1-3 t/ha.

The index of intensity of biological cycle – 0.3-1.5.

Summer	Autumn	Rainy
84	51	69
23	14	19

The favorable days for accumulation of mortmasses – 45-50 %, length of productive days – 40 %.

Character of anthropogenic transformation. The initial natural state has been significantly changed and agricultural land occupies fairly large areas, mainly consisting of fields and gardens (orchards, wheat, maize, fruit and vegetables, rarely – vineyards). Vegetation of arid forests and shrubbery has penetrated as a result of anthropogenic impact.

Level of anthropogenic transformation – 75 %.

Main threats to the landscape. Erosion, desertification as a result of rehabilitation of the road. More specifically, its functionary load and visual changes are not observed. The landscape is stable towards the mentioned load and any special mitigation measures are not required now.

4.2.1.2 Review of Flora and Vegetation in Project Area

The Sasadilo-Sioni road crosses the geo-botanical districts of mountainous Kakheti of the province of the southern slope of Caucasus. Gombori ridge is also included in the geo-botanical district of mountainous Kakheti. The ridge is the continuation of Kakheti ridge and is closely connected to Caucasus in geological and landscape terms. The territory is characterized by complex relief. The dominant terrain form is erosive. Landslide and badland relief is also widely represented on Gombori ridge (absolute height – 2000 m above the sea level). The common characteristic of the terrain is the weak development of the foothill stripe; in some areas it is entirely absent. Mudflows are fairly typical in the district (Duruji ravine, gorges of Gombori ridge). Gombori ridge crown, namely, vicinities of m. Tsivi (max. height 2000 m above the sea level) are prominent for peculiar temperature regime (over-cooling of air). Due to this fact it is the center of hail and poses great threat to Kakheti orchards and vineyards.

Description of the Geo-botanical district of mountainous Kakheti is given in VGT EIA Volume II/Annex 2 page 67 – 68.

Methodology of the Sensitivity Assessment for the Floral and Vegetation Receptors

The complex criteria recommended by Morris&Therivel (1995) were used when assessing the importance or sensitivity of various plant communities (refer to Table 4.3):

Table 4.3: Summary of criteria recommended by Morris&Therivel

Criterion	High	Medium	Low
Species richness	High species richness noted or likely to occur. Endemic or threatened species included in the Georgian Red List and/or IUCN Red List recorded or likely to be present	Medium species diversity. Few rare or threatened species	Low species diversity and almost no threatened species that may be affected
Naturalness and level of modification	Natural or slightly modified habitats	Moderately modified habitats e.g. those which can still support characteristic species assemblages	Heavily modified habitats
Human disturbance	Very little or no human disturbance	Little human disturbance	High human disturbance (grazing, forest felling, etc.)
Rarity and geographical location of habitat	Rare or endangered habitat in the country or region.	Not so common habitat in the region	Nationally common habitat

Detailed Characterization of Flora and Vegetation of Sasadilo-Sioni Section of the Project Corridor

Degraded grain-forb grass meadow-pasture, agricultural land (arable land, gardens, orchards) are located in vil. Sasadilo vicinities of the project corridor. Fragments of floodplain forests with these species: *Populus canescens*, *Salix excelsa*, *Ulmus foliacea* - in asp forest, are represented on the following section (marked on the Map of Sensitivity as a Sensitive Zone 1 (SZ1) - description SZ1, habitat of high sensitivity); *Hippophaë rhamnoides* is present in the second layer of the forest; *Rosa canina*, *Rubus sanguineus*, *Thalictrania australis*, etc. – in the undergrowth as well as lianas: *Smilax excelsa*, *Clematis vitalba*, etc. and alder - *Alnus barbata*. Hawthorn is frequent in the forest edges.



Fig.18 SZ1

Dense sea-buckthorn (*Hippophaë rhamnoides*) is developed on the next section of the road in the vicinity of the highway (description SZ2, habitat of high sensitivity). Mixed leaved forest is also represented in the area with the following species: *Carpinus caucasica*, *Acer campestre*, *Alnus barbata*, *Fraxinus excelsior*, *Corylus avellana*.



Fig.19 SZ2

The same forest follows the next section of the project corridor at roadsides (description **SZ 3**, habitat of high sensitivity). *Crataegus pentagyna*, *Rosa canina*, *Carpinus orientalis*, *Cytisus caucasicus* should be noted from shrubbery. Several large individuals of Georgian oak (*Quercus iberica*) are present at some distance from the road.



Fig.20 SZ3

The next territory of the project corridor is located in the vicinities of vil. Botchorma (description 4, habitat of low sensitivity). Arable land is represented in the area. The following grasses occur along the roadsides: *Taraxacum officinale*, *Poa bulbosa* var. *vivipera*, *Achillea millefolium*, *Lamium album*, *Ranunculus* sp., etc.



Fig.21 SZ4

At vil. Omarauli (description **SZ4a**, habitat of high sensitivity) a marsh has developed with established water surface and area of 30 m X 50 m. The following plants are present: *Juncus acutus*, *Iris sibirica*, *Lemna minor*, etc. The road rehabilitation presumably will not damage this marsh, although preventive measures should be implemented during construction.



Fig.22 SZ4a

At this section of the construction corridor (description **MSZ 5**, habitat of medium sensitivity) willows - *Salix excelsa*, asp - *Populus canescens*, maple - *Acer campestre*; from shrubbery – blackberry, hawthorn, sea-buckthorn, etc. are present. Clearance of bushes that have occupied sides of the existing (but not so much used) road is planned during the road rehabilitation project. As a result, some sea-buckthorn shrubs on the both sides of the road will be destroyed.



Fig.23 MSZ 5

Within vil. Kudro of the project corridor (description 6, habitat of low sensitivity) arable land and shrubbery is developed. The following occur: dog rose - *Rosa canina*, sea-buckthorn - *Hippophaë rhamnoides*, hawthorn - *Crataegus pentagyna*. Shrubby – hawthorn, sea-buckthorn, dog rose, blackberry grows at the roadsides of the next section (description §7, habitat of low sensitivity). At vil. Orkhevi (description §8, habitat of low sensitivity) the same shrubbery at the roadsides as in previous section is represented.

Sensitive Areas

After the completion of the detailed botanical survey of the designed project corridor the precise identification of sensitive areas and their detailed description has become possible. To sum up, the below areas of medium and high sensitivity have been revealed proceeding from the review of the literature and field research (description is given above and on the map – see fig. 24).

Areas of high sensitivity:

- Sensitive Zone (**SZ 1**) – Km 0 – Km 2: represents fragments of floodplain forests with following species: *Populus canescens*, *Salix excelsa*, *Ulmus foliacea* - in asp forest, *Hippophaë rhamnoides* is present in the second layer of the forest; *Rosa canina*, *Rubus sanguineus*, *Thelictaria australis*, etc. – in the undergrowth as well as lianas: *Smilax excelsa*, *Clematis vitalba*, etc. and alder - *Alnus barbata*. The floodplain forests in general are considered as sensitive habitats. The habitat is natural or slightly disturbed and modified, characterized by species richness. Sea-buckthorn (*Hippophaë rhamnoides*) presented in the habitat is not currently included in the Red List of Georgia. However, earlier it was included in the List and, according to informal information, it may be brought back to the expanded Red List, which is currently under preparation.
- Sensitive Zone (**SZ 2**) – Km 3 – Km 5: Mixed leaved forest with the following species: *Carpinus caucasica*, *Acer campestre*, *Alnus barbata*, *Fraxinus excelsior*, *Corylus avellana* and dense population of sea-buckthorn (*Hippophaë rhamnoides*). Natural forest habitat adjacent to the road is not modified and is only slightly disturbed, and accordingly should be considered as sensitive.
- Sensitive Zone (**SZ 3**) – Km 5 – Km 6: Mixed leaved forest with the following species: *Carpinus caucasica*, *Acer campestre*, *Alnus barbata*, *Fraxinus excelsior*, *Corylus avellana* and dense population of sea-buckthorn (*Hippophaë rhamnoides*). *Crataegus pentagyna*, *Rosa canina*, *Carpinus orientalis*, *Cytisus caucasicus* should be noted from shrubbery. Several large individuals of Georgian oak (*Quercus iberica*), included in red list are present at some distance from the road. Fragments of natural forest habitat are not modified and are only slightly disturbed and, accordingly, should be considered as sensitive.
- Sensitive Zone (**SZ 4a**) – Km 6 – Km 7 North-East to the road: a small size marsh of 30 m X 50 m. The following plants are present: *Juncus acutus*, *Iris sibirica*, *Lemna minor*, etc. Undisturbed mountainous wetland habitat is considered as sensitive.

Areas of medium sensitivity:

- Medium Sensitive Zone (**MSZ 5**) – Km 6 – Km 10; willows - *Salix excelsa*, asp - *Populus canescens*, maple - *Acer campestre*; from shrubbery – blackberry, hawthorn, sea-buckthorn, etc. are present. Moderately modified habitat with medium species diversity. Sea-buckthorn bushes are encroaching existing road.

Species Included in the Red List of Georgia and Occurring in the Designed Project Corridor

The Georgian Red List, which consists of 56 species of plants, is not full. At present the further modification of species in the Red List is being conducted. Through extrapolation of the mentioned data the number of the species shall increase significantly in the Red List.

As a result of the detailed field botanical research only one species currently on the Red List of Georgia has been found - *Ulmus foliacea* (*Ulmus minor*). After the planned rehabilitation works up to 20 individuals of this species are under potential risk. The mentioned individuals are located quite close to the road, although they are not affected according to the current plan. Populations of some rare and endemic species occur in the project corridor. Namely: sea-buckthorn (*Hippophaë rhamnoides*) and old man's beard (*Clematis vitalba*).

4.2.2 Fauna

Introduction

The report is based upon review of the literature and unpublished field material. The goal of the completed work is to identify habitats significant for animals in the impact corridor of Sasadilo-Sioni highway during the implementation of the reconstruction activities and exploitation of the highway. Zoological description of the zone is based upon literature sources, existing open documents and unpublished material.

The review, first of all, focuses on the species protected by law and international agreements (species included in Red Lists, species protected by the Bonn convention, etc.) as well as other animals of high conservation value for the local population (fishes) and species interesting to tourists.

Geography and Landscapes of Sasadilo-Sioni Section, Animal Populations in the Landscapes

The corridor of the highway for reconstruction (from vil. Sasadilo till vil. Orkhevi) is located within Sagarejo and Tianeti municipalities and comprises two large landscapes: leaved forests and secondary meadows representing pastures and fields within the environment of the residential areas. The main landscape under the impact of the highway reconstruction is forest. In inaccessible areas the forest has been well preserved, although it has been fairly degraded due to human impact (logging) in accessible areas. From Sasadilo till Orkhevi the highway is located in r. Iori ravine and from vil. Kotchbaani until almost the end follows the bank of r. Iori. The highway traverses or passes in direct proximity of large and small rivers and rivulets, of which r. Iori, Gombori, Orvili, Adzezi are notable.

In zoo-geographic terms Southern Caucasus is included in the Eastern Mediterranean sub-province of pale-arctic province. The highway passes the Caucasus part of this sub-province (Верещагин 1958; Гаджиев 1986). R. Iori ravine is located between Gombori and Ialno ridges and their branches in the area.

Significant Animal Species and Their Location

The species included in the Red List of Georgia (the species which occur on the territories adjacent to the Sasadilo-Sioni road corridor or could be observed in the area are listed below).

Table 4.4

№	Latin Name	Georgian Name	English Name	Status
Mammals				
1	<i>Barbastella barbastellus</i>	ევროპული მახკათელა	Western Barbastelle	VU
2	<i>Sciurus anomalus</i>	კავკასიური ციცი	Caucasian squirrel	VU
3	<i>Lynx lynx</i>	ფოცხვერი	Lynx	CR
4	<i>Lutra lutra</i>	წავი	Common Otter	VU

5	<i>Ursus arctos</i>	მურა ღათვი	Brown Bear	VU
Birds				
6	<i>Ciconia nigra</i>	ყარყატი	Black Stork	VU
7	<i>Aquila chrysaetus</i>	მთის არწივი	Imperial Eagle	VU
8	<i>Aquila heliaca</i>	ბეგობის არწივი	Golden Eagle	VU
9	<i>Accipiter brevipes</i>	ქორცქვიტა	Levant Sparrowhawk	VU
10	<i>Falco cherrug</i>	გაკაზი	Saker Falcon	CR
11	<i>Falco vespertinus</i>	თვალშავი	Red-Footed Falcon	EN
12	<i>Buteo rufinus</i>	ველის კაკაჩა	Long-Legged Buzzard	VU
13	<i>Neophron percnopterus</i>	ფასკუნჯი	Egyptian Vulture	VU
14	<i>Gyps fulvus</i>	ორბი	Griffon Vulture	VU
15	<i>Aegolius funereus</i>	ჭოტი	Boreal Owl	VU
16	<i>Panurus biarmicus</i>	ულვამა წიწკანა	Bearded Tit	VU
Reptiles				
17	<i>Testudo graeca</i>	სმელთაშუაზღვის კუ	Mediterranean tortoise	VU
Boney Fishes				
18	<i>Salmo fario</i>	მდინარის/ტბის კალმახი	Brook Trout	VU
19	<i>Sabanejewia aurata</i>	ჭინაკაკასიური გველანა	Golden Spined Loach	VU
20	<i>Aspius aspius taeniatus</i>	წითელტუზა ჭერეხი	Caspian asp	VU
Vertebrates				
21	<i>Eudia pavonia</i>	ლამის მცირე ფარშეკანგთვალა	Small Emperor Moth	VU
22	<i>Sphingonaepiopsis gorgoniades</i>	ჯუჯა სფინქსი	Gorgon Hawkmoth	VU
23	<i>Callimorpha dominula</i>	ღათუნელა ჰერა	Scarlet Tiger	VU
24	<i>Parnassius apollo</i>	აპოლონი	Appolo	VU
25	<i>Erebia iranica</i>	ირანული საგერდულა	Iranian Brassy Ringlet	VU
26	<i>Bombus eriophorus</i>	ბაზი ერიოფორუსი	Stone Humble-bee	VU
27	<i>Xylocopa violacea</i>	იისფერი ქსილოკოპა	Violet Carpenter bee	VU
28	<i>Onychogomphus assimilis</i>	მსვავსი ნემსიფლაპია	Dark Pincertail	VU

Georgia is a party to Bonn convention on the protection of the migratory species and agreement on the protection of European Cherioptera EUROBATS. According to this agreement, Georgia is obliged to protect 12 Cherioptera species within the territory and its vicinities. Cherioptera under protection of the Bonn convention within the impact corridor of the highway reconstruction:

Table 4.5

№	Latin Name	Georgian Name	English Name
1	<i>Rhinolophus ferrumequinum</i>	დიდი ცხვირნალა	Greater Horseshoe Bat
2	<i>Rhinolophus hipposideros</i>	მცირე ცხვირნალა	Lesser Horseshoe Bat
3	<i>Barbastella barbastellus</i>	ევროპული მარქათელა	Western Barbastelle
4	<i>Eptesicus serotinus</i>	მეგვიანე ღამურა	Serotine Bat
5	<i>Myotis blythii</i>	წვეტყურა მლამიობი	Lesser Mouse-eared Bat
6	<i>Myotis mystacinus</i>	ულვამა მლამიობი	Whiskered Bat
7	<i>Myotis nattereri</i>	ნატერერის მლამიობი	Natterer's Bat
8	<i>Myotis daubentonii</i>	წყლის მლამიობი	Daubenton's Bat
9	<i>Pipistrellus pipistrellus</i>	ჯუჯა ღამორი	Common Pipistrelle
10	<i>Pipistrellus pygmaeus</i>	პაწია ღამორი	Soprano Pipistrelle
11	<i>Pipistrellus nathusii</i>	ტყის ღამორი	Nathusius's Pipistrelle
12	<i>Plecotus auritus</i>	რუხი ყურა	Brown Big-eared Bat

Proceeding from the biotopes the Cherioptera and insect species should be more abundant, although due to the fact that the middle and upper reaches of r. Iori has been insufficiently studied we cannot form a fuller picture of these groups.

It is noteworthy that the road follows r. Iori banks, which are rich in economic and other fishes. In addition, r. Iori is the key source facilitating Tbilisi and Sioni reservoirs with these fishes. The following 21 fish species occur in the river:

Table 4.6

№	Latin Name	Georgian Name	English Name
1	<i>Salmo fario</i>	მდინარის/ტბის კალმახი	Brook Trout
2	<i>Squalius cephalus orientalis</i>	კავკასიური ქაშაბი	Caucasian chub
3	<i>Chondrostoma cyri</i>	მტკვრის ტობი	Kura nase
4	<i>Romanogobio persus</i>	მტკვრის ციმორი	Kura gudgeon
5	<i>Abramis brama orientalis</i>	აღმოსავლური კაპარჭინა	Eastern bream
6	<i>Alburnus hohemackeri</i>	ამიერკავკასიური თაღლითა	North Caucasian bleak
7	<i>Alburnus filippi</i>	მტკვრის თაღლითა	Kura bleak
8	<i>Acanthalburnus microlepis</i>	შაფწარბა	Blackbrow bleak
9	<i>Alburnoides bipunctatus eihwaldi</i>	ფრიტა	Riffle minnow
10	<i>Chalcalburnus chalcoides</i>	კასპიური შამაია	Caspian shemaya
11	<i>Aspius aspius taeniatus</i>	წითელტუჩა ჭერეხი	Caspian asp
12	<i>Capoeta capoeta</i>	ხრამული	Khramulya
13	<i>Rutilus rutilus kurensis</i>	მტკვრის ნაფულა	Kura roach
14	<i>Barbus lacerta cyri</i>	მტკვრის წვერა	Kura barbel
15	<i>Barbus capito</i>	ჭანარი	Bulatmai barbel
16	<i>Barbus mursa</i>	მურწა	Mursa
17	<i>Cyprinus carpio</i>	ჩვეულებრივი კობრი, გოჭა	Common carp
18	<i>Barbatula brandtii</i>	მტკვრის გოჭალა	Kura stone loach
19	<i>Sabanejewia aurata</i>	წინაკავკასიური გველანა	Golden Spined Loach
20	<i>Silurus glanis</i>	ლოქო	European catfish
21	<i>Pseudorasbora parva</i>	მცირე ფსევდორასბორა	Stone morocco

Other fish species occur in the lower reaches of r. Iori. They do not go to the middle and upper reaches.

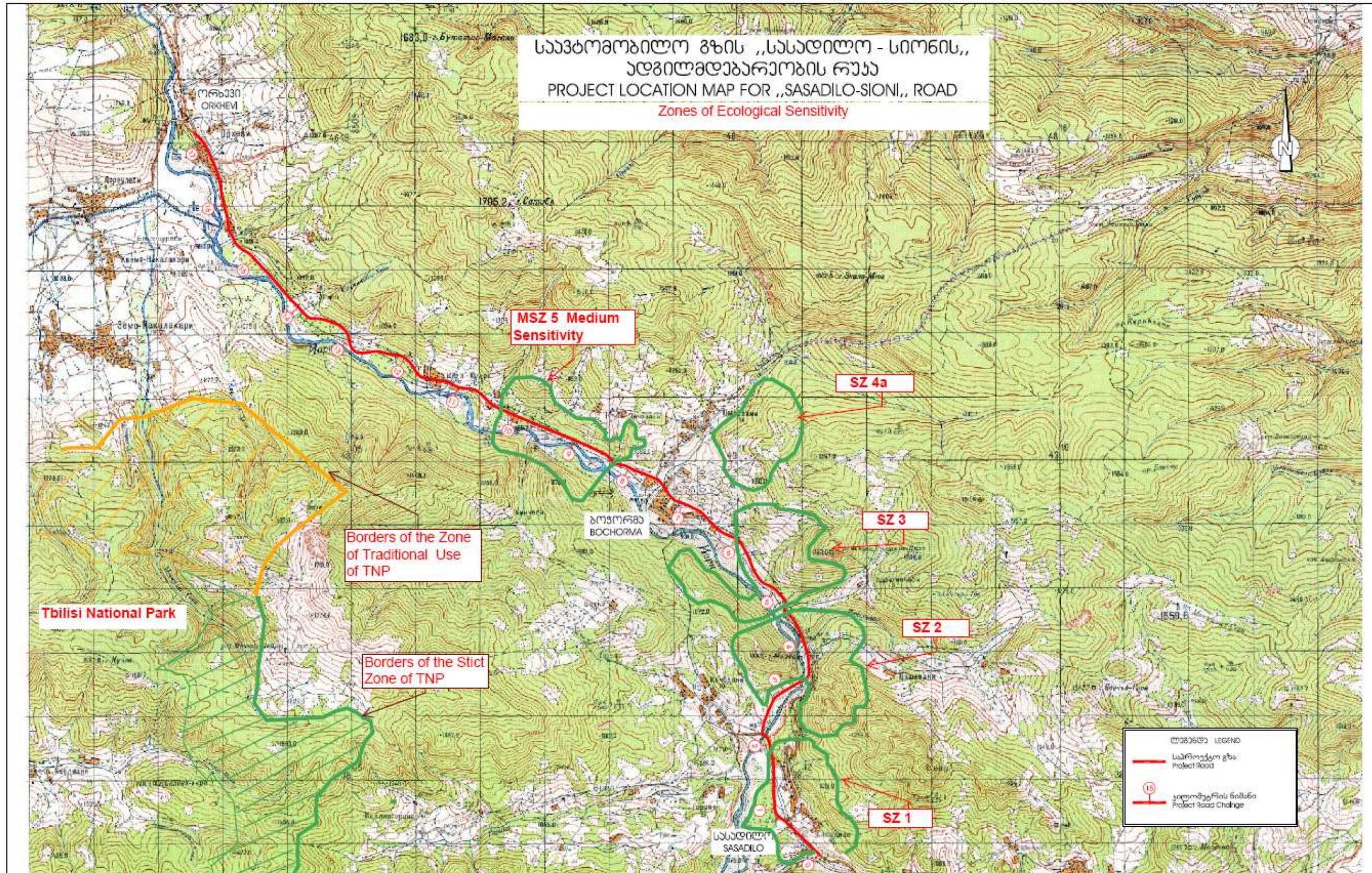
Sensitive Sites

The forest section considered as the most sensitive location lies along Sasadilo-Sioni highway are between vil. Sasadilo and Botchorma km 0 – km 5 to the right of the road (SZ 1 and SZ 2 at the map of sensitivity).

Forests located to the left of the road (km 3 - km 13.5 territory between vil. Kotchbaani and Zemo (Upper) Nakalakari), of which 10-13 km section to the left of the road passes close to the Tbilisi National Park. However, these zones are separated from the road by r. Iori and are not under the project impact. The road passes at a distance of 2.0 – 2.5km from the borders of the traditional use and 6km from the strict zone of the Tbilisi National Park (TNP) and is separated by hilly areas and r. Iori.

8-10 km section to the right of the road (between vil. Botchorma and Kudro) and 12-16 km section to the right of the road (between vil. Kudro and Orkhevi) are less sensitive. In some areas the forest is partially substituted by agricultural land, but in approximately 500-1000 m the forest is uninterrupted again.

All bridges within the section of the highway are sensitive because fuel or other type of contaminants easily flow into r. Iori from rivers and rivulets and finally – into Paldo and Tbilisi reservoirs (Tbilisi Sea).



Description (SZ 1) - habitat of high sensitivity: Fragments of floodplain forests with these species: *Populus canescens*, *Salix excelsa*, *Ulmus foliacea* - in asp forest, are represented; *Hippophaë rhamnoides* is present in the second layer of the forest; *Rosa canina*, *Rubus sanguineus*, *T. thalictriana australis*, etc. - in the undergrowth as well as lianas: *Smilax excelsa*, *Clematis vitalba*, etc. and alder - *Alnus barbata*. Hawthorn is frequent in the forest edges;

Description (SZ 2) - habitat of high sensitivity: Dense sea-buckthorn (*Hippophaë rhamnoides*) is developed in the vicinity of the highway. Mixed leaved forest is also represented in the area with the following species: *Carpinus caucasica*, *Acer campestre*, *Alnus barbata*, *Fraxinus excelsior*, *Corylus avellana*.

Description (SZ 3) - habitat of high sensitivity: The same forest follows the next section of the project corridor at roadsides. *Crataegus pentagyna*, *Rosa canina*, *Carpinus orientalis*, *Cytisus caucasicus* should be noted from shrubbery. Several large individuals of Georgian oak (*Quercus iberica*) are present at some distance from the road

Description (SZ 4a) - habitat of high sensitivity: At vil. Omarauli a marsh has developed with established water surface and area of 30 m X 50 m. The following plants are present: *Juncus acutus*, *Iris sibirica*, *Lemna minor*, etc

Fig.24 Map of sensitive Zones

5. Social Impact Assessment

5.1 Socio-Economic Environment

5.1.1 Introduction

Sasadilo-Sioni road is located within two administrative districts of Georgia: Kakheti and Mtskheta-Mtianeti. It connects villages Sasadilo and Sioni and passes through the following villages: Sasdilo (Kotchbaani community), Botchorma (Sagarejo municipality), Kurdo, and Orkhevi (Tianeti municipality).

5.1.2 General Information

Sagarejo Municipality

Sagarejo municipality (historically – Outer Kakheti) is located in the eastern part of Georgia. Sagarejo municipality is bordered with Gurjaani to the east, Gardabani to the west and Tianeti municipality to the north. The southern border of Sagarejo municipality is with Azerbaijan. The center of the municipality is t. Sagarejo, which is located at 45 km from Tbilisi to the east. The town is situated at the altitude of 772 m above the sea level. The municipality is 1553.69 km². The terrain is characterized with hilly-mountainous upland, which is crossed by r. Iori. Climate is moderately continental, amount of precipitations fluctuate within 500-700 mm. The highest point is m. Tsivi (1991 m above the sea level).

Tianeti Municipality

Tianeti Municipality is located in the mountainous region of East Georgia, 1,100 m above sea level. In the lowest part of the Municipality the climate is moderately humid, winter is moderate and summer is longer than usual. Winter is cold in the areas above 1,100-1,900m above sea level. There are two small towns and 81 villages in the Municipality that are united into 12 self governance territorial units. There are five rivers in the Municipality with a total length of 420 km.

5.1.3 Demography

Sagarejo Municipality

According to 2009 data, the population of the municipality is 59 000, of which 11 800 live in town and 47 200 – in villages; the population density is 38.87 men/m². The national structure of the population is as follows (Table 1):

- Georgians – 40 127;
- Azeri – 17 050;
- Greek – 27;
- Ukrainians – 21;
- Armenians – 231;
- Russians – 377;
- Iezid – 33.

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Population	58000	59800	59200	58700	58300	58400	58800	58800	58700	59000
Town	11600	11960	11640	11740	11660	11680	11160	11160	11740	11800
Village	46400	47840	47360	46960	46640	46720	47640	47640	46960	47200

Table 5-1 Population Numbers (Sagarejo Municipality)

As the table shows the number of population in 2000-2009 did not change. Only insignificant growth occurs in the period – 1.8 % (Table 5-1).

The number of newborns increased almost twice in 2004-2009. The increase is 280 in natural units. The number of the deceased decreased for almost 28 units in 2001-2009 (Table 5-2). It is noteworthy that the number of newborns in 2009 exceeds the number of the deceased for the first time in the recent 10 years.

	2001	2002	2003	2004	2005	2006	2007	2008	2009
Born	434	406	378	504	462	532	574	686	742
Deceased	714	712	644	770	560	574	573	658	686

Table 5-2 Birth-Death Dynamics

Tianeti Municipality

Population indicators for the Municipality during 2002-2006 were mainly stable. There was a tendency toward decrease (4.4%), which constituted 13,300 people (table 5-3).

Administrative Unit	2002	2003	2004	2005	2006
Town (Tianeti, Sioni)	4,000	4,000	3,800	3,800	4,000
Village	9,900	9,900	9,500	9,400	9,400
Total	13,900	13,900	13,300	13,200	13,400

Table 5-3: Population Census

30% of the population lives in the small towns Tianeti and Sioni, and the rest of the population is distributed in different villages of the Municipality. 51% of the population is female and 49% male.

	2002	2003	2004	2005	2006
Birth	2	5	14	15	0
Death	09	36	42	190	100

Table 5-4 Birth and Death Indicators

Based on the 2002 Population Census, 98.3% of the population is Georgians, 1% Ossetian and the rest represented by other nationalities. According to the population age distribution, most of the population are people 65 years old and above. This means that in the future the population of the Municipality may dramatically reduce. Moreover, the number of births has decreased by 16.7% from 2002-2006 or 12 units in real numbers. As for 2005-2006, the number of births decreased by 52% or 55 units in real numbers although we also need to consider the fact that the

number deaths also decreased from 2002-2006 and was nearly halved, a reduction of 109 units (Table 5-4).

	2002	2003	2004	2005	2006
Marriage	28	32	27	19	27

Table 5-5 Marriage and Divorce Indicators

Marriage and divorce indicators also changed. The number of marriages from 2002-2006 decreased by 1 unit and constituted 27 (Table 5-5).

5.1.3 Employment

55.1% of the population was economically active, and 95.8% of the economically active population was employed. This represents 52.9% of the Municipality's total population. We should mention that according to data from Department of Statistics, 53.8% of the total population (15 years old and above) was employed in the country. Most of the employed people in the Municipality were self-employed (54%). These people owned 1 ha or more land (mainly in villages). According to the economic activities, employment in the industrial field declined (23.7%) although the number of people employed in the trade simultaneously increased by 65%. This means that it was more profitable for the population to be employed in wholesale or retail sales (see table 5-6).

5.1.4 Land use

Based on data from January 1, 2006, land resources of the Municipality were 90,629 ha, of which 91.3 % was owned by the government. 60.3% of the total land resources of the Municipality are covered by forests. The Ministry of Environment and Natural Resources had issued 24 1-year licenses for wood production and processing to 10 organizations and individuals (see Attachment 8). However, beginning in 2008, the government will start a new program for wood processing and will issue long-term (20 years) licenses from 2008 on. Only one organization or individual will be able to get the license; consequently, this will reduce the number of employed people in the field.

Although the biggest portion of the land is in the possession of the state, 100% of the land with perennial plants is privately owned. 71.4% of arable lands (6,749 ha), 72.9% of hayfields (518 ha) and a small portion of pastureland (161 ha) also are under the private possession. 22.2% of the total land resources are pasturelands. We are not aware if only the Tianeti population uses the pasturelands or if the population of other municipalities are using it.

	Total	Including	
		Female	Male
Total population:	14,014	7,132	6,882
Economically active population	7,733	3,683	4,050
Employed population	7,415	3,534	3,881
Among them:			
Hired workers	1,141	406	735
Employees	4	1	3
Self-employed without hiring additional workforce	2	1	1
Working individually	294	101	193
Workers of family production with irregular payment	12	3	9
Persons with no classified employment	5,962	2,693	3,269
Pensioners among the total employed population	1,650	992	658
Pupils	3	1	2
Unemployed population	961	442	519
Among them:			
Unemployed that are willing to start working	318	149	169
Among them:			
Pensioners	9	8	1
Economically inactive population	6,281	3,449	2,832
Among them:			
Pensioners	1,796	1,209	587
Pupils	8	5	3
Persons receiving assistance or other kinds of state subsidies	24	14	10
Persons that gain income from property or other savings	1	1	0
Persons supported by other persons	4,350	2,198	2,152

Table 5-6 Population Employment indicators

	2002	2003	2004	2005
Enterprise - total	351	340	274	351
Agriculture, hunting, forestry	–	–	–	–
Fishery	4	1	2	2
Industry	70	68	73	–
Construction	45	30	7	15
Wholesale and retail trade, rehabilitation of vehicles, motorcycles, household items and personal items	32	34	44	48
Hotels and restaurants	–	–	–	–
Transport, warehouses and communication	65	62	7	19
Financial mediation	–	–	–	–
Operations with real assets, rent and commercial activities	7	13	11	18
Education				
Healthcare and social service	128	132	130	166
Other communal, social and personal service				

Table 5-7 Number of Employed Population According to Economic Activities

5.1.5 Education

26 public schools function within the municipality. In 25 of these schools elementary-basic-secondary education (I-IX-XII classes) is provided and in 1 – elementary-basic (I-IX classes). 4 of the mentioned schools are located within t. Sagarejo.

In addition to the public schools 5 non-state (private) educational institutions function within the municipality. Tamar Garejeli LLC and Patardzeuli Georgian-French School-Lyceum SLC provide education on the elementary-basic-secondary level, while Ilia LLC, Ilia Tchavtchavadze Higher Education Institution of t. Sagarejo – secondary and professional education programs. Gotsi LLC, the higher professional educational institutions teaches craftsmanship to the basic education graduates (IX class), t. Sagarejo Training Center of Georgian-Ukrainian Institute of Social Relationships organized non-formal professional education for graduates of IX-XII classes.

26 preschool (kindergarten and crèches) educational institutions, two institutions outside schools: t. Sagarejo pupil-youth house and the center of Georgian language study of vil. Dazagrami as well as Jemal Burjanadze Music School in t. Sagarejo function within the municipality.

Three sport schools are presents in Sagarejo municipality. The young people train in 9 sports: Georgian wrestling, Sambo, Judo, free wrestling, football, rugby, chess, field and track athletics, swimming. At present 10 wrestling gyms function in Sagarejo municipality – 10 mini and one standard sport ground. Three recreational zones have been arranged, a swimming pool and tennis courts are also in place.

12 public schools are located in Tianeti municipality (see table 5-8).

Nº	Name	Address	Level
1	#2 Tianeti School	Tianeti	elementary-basic-secondary
2	School of village Nakalakari	Village Nakalakari	elementary-basic-secondary
3	School of Village Sioni	Village Sioni	elementary-basic-secondary
4	School of Village Zaridzebi	Village Zaridzebi	elementary-basic-secondary
5	School of Village Ghulelebi	Village Ghulelebi	elementary-basic-secondary
6	School of Village KhevsuretSopeli	Village Khevsuretsopeli	elementary-basic-secondary
7	School of Village Simoniantkhevi	Village Simoniantkhevi	elementary-basic-secondary
8	School of Village Zhebota	Village Zhebota	elementary-basic-secondary
9	School of Village Akhalsopeli	Village Akhalsopeli	elementary-basic-secondary
10	School of Village Tushurebi	Village Tushurebi	elementary-basic-secondary
11	School of Village Shekuraantgori	Village Chekuraantgori	Elementary- basic
12	School of Village Bortsorma	Village Botsorma	Elementary-basic

Table 5-8 Schools in Tianeti Region

5.1.6 Infrastructure and Services

According to the SWOT analysis prepared by Tianeti Gamgeoba and Sagarejo gameoba, improper infrastructure was identified as one weakness of the Those regions.

In those Municipalities five year economic development plan following infrastructural sectors have been prioritized:

- Repairs to major and minor roads;
- Supplying the municipality with gas;
- Repairing the potable water supply system;
- Improving the waste disposal system.

Major and Minor Roads

Road repairs in the region came under the Department of Highways budget until 2007, however road works were not conducted during that period. As of January 1st, 2007 road repairs have been transferred to regional authorities. The overall length of internal roads of the Tianeti region is 204 km (mostly unsurfaced) according to data from Tianeti Gamgeoba.

№	Name of the Road	Length of the road (km)	Cover		Road Category
			Concrete	Crushed Stone	
1	Tbilisi (Gldadi) – Tianeti; 24-61 kms	37	19.0	18.0	IV
2	Tianeti-Zaridzebi – Zhinvali; 1-10.7 kms	10.7	4.4	6.3	V
3	Tianeti-Akhmeta – Pshavela- Khvareli- Ninigori	14	1.0	13.0	V
4	Sasadilo-Orxevi - Khevsuretsiteli	22	11.0	11.0	V
5	Orkhevi- Sioni 1-3.7 km	3.7	1.7	2.0	V

Table 5-9 List of the highways of national importance vicinity of the project area by length, cover and category

As illustrated in the chart, the main roads of the project are classified as category V roads. Such road conditions hinder the development of trade and tourism in this region. Tianety’s main trade relations are with Tbilisi and Akhmeta, it is therefore of high priority to repair roads on these routes.

It currently takes approximately 2hrs 20 min to cover the 78km from Tbilisi to Daba Tianeti (Sioni Route), whereas with good roads the journey time would decrease by 35-50 minutes to 1 hr 30 mins–1 hr 45mins. Only 28km of the road to Akhmeta Tianeti is not heavily damaged.

Tianeti Gamgeoba has calculated the cost of necessary road repairs and plans to proceed with the work. However, road repairs using local funds will probably be a long-term process and it is necessary to diversify resources (e.g. by more active cooperation with the World Bank).

Gas Supply in the Region

Old gas pipelines in project area, installed during the Soviet era, require repair or total replacement. There are no gas pipelines at all in some parts of the region (e.g. in the major part of Project area). A survey of Tianeti inhabitants Tianeti showed they prioritize the need for road repairs (30.33%), followed by the creation of jobs (18.33%) and then repairing the gas infrastructure (11.76%)². T. Sagarejo is entirely gasified as well as villages: Patardzeuli, Giorgitsminda, Ninotsminda, Tskharostavi, Iormughanlo. Company Socar provides the above with gas.

Rehabilitation of Potable Water System

Zhinvali supplies Project area with water and the southern part of the region is supplied by the Sioni Reservoir.

Projects implemented by CHF Georgia in project area as follows:

² Voted budget of Tianety Municipality and “Tianety Municipality Economic Development Plan” USAID, CHF Georgia, Civitas Georgia;

1. Rehabilitation of potable water system in the village Ghulelebi (Total project cost: 8951.75GEL);
2. Rehabilitation of potable water system in Khesvureti (Total project cost: 9044 GEL);
3. Rehabilitation of potable water system in Simoniantkhevi (Total project cost: 8444.97 GEL);
4. Rehabilitation of potable water system in Simoniantkhevi (Total project cost: 8444.97 GEL);

Many villages in the region reportedly experience water supply problems. Aside from expense calculations conducted by the Gamgeoba it is necessary to research the locations of villages with supply problems and to set up water system rehabilitation projects.

Waste Disposal System

Municipal waste disposal system is under developed and needs significant improvement, especially as the project area is being promoted as a tourist destination. A lack of proper disposal dumps is having a negative impact on both local inhabitants and tourism development in the region. In Sioni, a tourist hotspot in the summer, there is no proper waste disposal site. This is a serious problem, especially since the majority of summer visitors, when questioned, said they visited Tianety for its good climate (26%) and ecologic conditions (20%).

At present population of the villages along the project road disposes household waste in ravines and at river banks in uncontrolled manner.

5.1.7 Anticipated Social Impact of the project

Overall Social Impacts of the Project

The proposed project will have short-term and long-term impact on the local communities. The social impact of the road rehabilitation project should be viewed under the broader context of developing tourism infrastructure in the region. Impact will be tangible not only for the communities residing along the rehabilitated road, but also for the residents of resort Sioni and surrounding villages.

Currently the residents of the villages are mainly self-employers working on their agricultural land parcels. Only small part of agricultural products is produced for sale: most part of the harvested products is intended for internal consumption by the households. Low demand on agricultural products at site and difficulties with transportation to the distant markets (bad road; high indirect costs etc.) makes agriculture less profitable. Transportation problems impose additional limitations on initially limited employment opportunities in the region.

In general the project will have positive impact on socio-economic development of the region: firstly, it will support tourism development and, as a result of increased tourist flow several opportunities arise:

- creation of new jobs in tourism services sector
- increased demand on agricultural products in the region will make agriculture profitable
- commercial sector and small businesses (shops, café and small restaurants, entertainment) will be also supported by increased tourist flow

The road rehabilitation will have also more direct social impacts:

- improved transportation system will facilitate agriculture not only through the development of tourism-dependent local markets, but also through making easier and cheaper access to the distant markets

- Rehabilitation of the road will trigger development of the roadside commercial activities

The improved roads will ensure better integration of local population in the entire socio-economic system of the country and ensure better access to the markets, supplies and services. This comprises better opportunities for timely provided medical services.

The project will have positive impact on real estate market in the region. Value of land as asset, as well as construction cost, is significantly dependent on road infrastructure, especially in the resort area. The local population will benefit from the road rehabilitation project, as it will result in decreased costs of construction and increased value of land in resort Sioni, as well as villages adjacent to the road.

Construction Related Social Impacts

In short term perspective, the project will have some benefit for local population, providing job opportunities (about 50 new jobs could be available for local residents).

Resettlement impacts are described in section 5.3 below.

Impact: The negative impact related to the construction nuisance (dust, emissions, and noise) is temporary, insignificant and manageable by application good construction practices.

Mitigation measure: Dust control by application of watering. Use as minimum as 2 browsers; Noise control, installation of mufflers on equipment, daytime works.

Impact: Creation of vectors of disease e.g. temporary breeding habitats for mosquito as stagnant pools of water, stagnant water bodies in borrow pits, quarries, etc. suited to mosquito breeding and other disease vectors.

Mitigation measure: pools should be drained down. Remove all created pools till spring-time. Reinstatement relief and landscape.

Impact: Hazardous driving conditions where construction interferes with pre-existing roads.

Mitigation measure: Provide in design for proper markers and safety signs on roads, including lights. Instruct the drivers.

Impact: Infrastructure. The main infrastructure elements that could be affected are the power transmission lines, water supply systems and irrigation pipes and channels.

Mitigation measure: Replace the affected infrastructure elements. Permanent monitoring during construction. Full reinstatement in case of damage.

Impact: Potential conflicts with local population due to impacts on water supply or power resources, other infrastructure, access to land or facilities, disturbance caused by noise, conflicts with workers etc. **Mitigation measure:** Construction contractor should assign liaison officer and develop liaison plan. All conflict matters should be resolved through negotiation and sound compromise.

5.2 Socio Cultural Environment

5.2.1 Brief Historical Context of the Region

This section of the road mainly crosses Tianeti district, namely – follows Iori ravine. Small section traverses two villages of Sagarejo district – Sasadolo and Kotchbaani. This territory was historically included in Kakheta feud along with Ertso-Tianeti.

Tianeti district, that is administrative-territorial unit of historical Ertso-Tianeti, has been the crossroads of active relationships between the highland and lowland. Roads to Pshav-Khevsureti, Tusheti and further into the entire northern Caucasus were located in the area. A significant trade-strategic road headed from Kartli to Albania-Armenia in the Early and Developed Middle Ages. Georgian kings and feudals successfully used Ertso-Tianeti as a certain springboard of military-political supremacy over Caucasus highlands. According to historical sources, since the spread of Christianity in Georgia Iori ravine had been included in the Christian-educational activities of St. Nino. From the times of Vakhtang Gorgasali till Erekle II the province had been a stable basis for the royal court of Georgia; in terms of feudal belonging, Ertso-Tianeti had been the territory passed by the royal court from the epoch of David the Builder till XIX c. After the political disintegration of Georgian in XV-XVIII c.c. Ertso-Tianeti had been the place of internal political battles between the kings and feudals as well as the center of the struggle for freedom against the external enemies. Therefore, enemies had ruthlessly devastated the area. The territory was severely destroyed during the military campaign of Shah-Abaz in 1614, when Shah invaded Kaheti and needed to strengthen the rear and clear Ertso-Tianeti from Georgians. So Shah ravaged the province and took 40 thousand captives. After this and due to the decline in the Georgian population the migration of the Georgian highlanders had started into the region.

More than 300 architectural and archeological monuments of different periods have been recorded for Ertso-Tianeti. The majority of the archeological monuments have been discovered accidentally during various land works. The archeological monuments of the upper and middle reaches of Iori ravine had been found during the construction of Sioni reservoir. The oldest archeological monuments found in Ertso-Tianeti dates back to IV-III millennia B.C., while continuous presence of population is confirmed by monuments in the period between XI-IX c.c. B.C. and XVII-XVIII c.c. A.D. Iori ravine seems especially advanced in late Antique – Early Middle Ages (IV-XI c.c. A.D.). The development of the region was favored by the trade route to Albania-Armenia. Roman, Samarian and Byzantine coins have been found in large numbers both accidentally and during excavations in the ravine.

5.2.2 Archeological Potential of the Road

According to the special literature, following is the list of the cultural monuments recorded for villages in the vicinity of the road interesting to us. It is noteworthy that according to the location of the monuments described in the sources their presence is not expected directly in the proximity of the road.

Sagarejo District

Vil. Sasadilo – a church is located at a distance from the village. Developed Middle Ages.

Vil. Kotchbaani – Tchekhila fortress complex – fortress-tower, church, residential chamber is located on a mountain near the village. Middle Ages.

The village has two cemeteries. Chamber churches of Late Middle Ages are located at the both areas.

Tianeti District

Vil. Botchorma – many archeological and architectural monuments have been recorded in the village.

1. Remnants of settlement – XI-VIII c.c. B.C. It is located to the north of the village at 0.5 km on the cemetery.
2. Remnants of settlement – Early Middle Ages. It is located to the north of the village at 0.5 km.

3. Remnants of settlement – Middle Ages. It is located to the north-east of the village, in the place called Kistaurebi.
4. Remnants of settlement – Middle Ages. It is located to the east of the village, at 2 km, in the woods - the place called Mkliavani. A damaged church is also located in the area.
5. Remnants of settlement – Middle Ages. It is located to the east of the village, on Sajdomi Gora (Seat Hill).
6. Sepulcher – Middle Ages. It is located to the north-east of the village, at 1 km, in the place Kistaurebi.
7. Church – Late Middle Ages. It is located to the north-east of the village, at 1 km, in the place Kistaurebi.
8. Church – Late Middle Ages. It is located on the northern edge of the village within the cemetery.
9. Botchorma fortress complex is especially notable from the monuments of the Middle Ages. It is located to the north-east of the village, at 2 km, on Gombori ridge – the area of strategic importance. The fortress with uneven outline according to the design comprises fairly large area on the mountain peak. The major part of the complex had been destroyed. Internal fortress is separated in the northern corner of the fortress. It was surrounded with towers and tall walls. The internal fortress comprises St. George's church with six conches and central dome, a small chamber church and several buildings of Late Middle Ages. The interior of St. George's church is entirely decorated. The paintings date back to XI-XII c.c. The church is restored. After the fall of Ujarma fortress-town in X c. this complex had been the political center of Kakheti feud.

Village Kudro

1. Church – Adgilis Dedis Khati (Place Mother's Icon), Late Middle Ages. It is located to the north of the village at 0.5 km in the forest. It is half destroyed.
2. Church – Late Middle Ages. It is located to the north of the village at 1 km in Sakdriskhevi. It is damaged.
3. Church – Late Middle Ages. It is located to the north-west of the village at 1.3 km in Sakdriskhevi. It is severely damaged.
4. Church – Late Middle Ages. It is located to the north-east of the village at 3 km on the left side of Sakdriskhevi. It is damaged.
5. Tower – XVII-XVIII c.c. Three-storied building is located to the north-east of the village at 3 km on the left side of Sakdriskhevi.

Village Orkhevi

1. Remnants of settlement – second half of III millennium B.C. It is located at the end of the village to the south on the northern slope of the left-hand tall terrace of r. Iori. The reconnaissance trenches confirm that the remnants occupy more than 1 ha. 600 sq. km had been excavated in 1986-1988.
2. Ditch sepulchers – III millennium B.C. They are located on the southern edge of the village, on the first terrace of r. Iori. Only several sepulchers exposes as a result of torrents have been excavated.
3. Sepulcher – II-I millennia B.C. They are located on the southern edge of the village, the left terrace of r. Iori – the place called Irmis Salokela (Deer Lick). The major part of the sepulcher had been excavated in 1979-1983.
4. Church – XIX c. It is located at the edge of the village, on the cemetery. It is damaged.
5. Church – Late Middle Ages. It is located on the edge of the village to the north, in Khutsurauli district within the cemetery. It is damaged.
6. Church – Late Middle Ages. It is located to the south-east of the village at 1 km on the right side of r. Orkhevi. It is damaged.

7. Zakariebi's Church – Late Middle Ages. It is located at the edge of the village to the north. It is damaged.
8. Church Kviria's Khati (Kviria's Icon) – Late Middle Ages. It is located at the edge of the village to the south-east, in the woods. It is damaged.

Large Village Sioni

In the 50-60s of the past c. due to the construction of Sioni reservoir several architectural and archeological monuments were under the flooding threat. The archeological monuments were excavated as far as possible, while the most significant of the architectural monuments – a prominent example of Georgian architecture of the Early Christianity, V c. Sioni basilica was measured in detail, numbered, dismantled, moved to Tbilisi and restored in the state museum of Georgian folk architecture and life (Ku lake). The areas adjacent to the basilica were archeologically studied. More than 100 two-three storied sepulchers dating back to V-XVIII c.c. were discovered. The most noteworthy from the sepulchers is an underground sepulcher built from finely processed Shirimi quadras. The sepulcher has a dromos and couches for the deceased. The sepulcher was built under the influence of the late Antiquity tradition and dates back to V c. The sepulcher has been moved to the museum along with the basilica.

1. Kupriantkari sepulcher – XI-IX c.c. B.C. It is located to the north of the large village, on the left side of r. Iori at the eastern edge of the remnants of village Kupriantkari dating back to the Middle Ages. Minor excavations were conducted in 1964. During the maximal level of Sioni reservoir the sepulcher is covered with water.
2. Remnants of settlement – IV-III millennia B.C. It is located at the dam at the beginning of the water connector. Minor excavations were conducted in 1962.
3. Remnants of settlement – Middle Ages. It is located at the edge of the large village to the north at Ormoebisgora.
4. Sepulcher – IV-V c.c. It is located at the beginning of the water connector and at present is covered with the dam embankment. Minor excavations were conducted in 1963.
5. Sakaraulo sepulcher – X-VI c.c. B.C. It is located to the north of large village Sioni on the right side of r. Iori. 10 sepulchers were excavated in 1963. During the maximal level of the reservoir the sepulcher is covered with water.
6. Church – Late Middle Ages. It is located between large village Sioni and village Lelovani. It is damaged.
7. Church – Late Middle Ages. It is located above the estuaries of r. Iori and Lalaantkhevi on the left side of r. Iori within remnants of settlement Ukughmarti. It is damaged.
8. Lodebi (Rocks) St. George's church – Developed Middle Ages. It is located to the north of the large village, at 2 km by the forest. It is damaged.
9. Zhaleti basilica – IX-X c.c. It is located to the north of large village Sioni on a small mountain slope covered with dense forest. The church is conserved at present.
10. Zhaleti St. George's church complex – it is located to the north of the large village at 6.5 km above remnants of settlement Tchiotiantkari. The complex comprises VIII-IX c.c. chamber church, tower, wall, remnants of constructions, remnants of settlement and XI-XIV c.c. sepulcher. The excavations of the monument were conducted in 1963-1964. During wall excavations a jar was discovered with XVI-XIX c.c. Georgian and Turkish coins, silver rings, earrings, pendant crosses.
11. Tchiantchveltgora Kvirike's monastery – VIII-IX c.c. It is located to the east of the large village at 9-10 km in the forest. It is damaged.

According to the above information found in special literature, cultural heritage monuments in the direct vicinity of the road are not confirmed, though considering the fact that the majority of the archeological monuments of the region have been discovered accidentally during earth works, chance finds during rehabilitation of Sasadilo-Sioni road can not be excluded.

5.3 Land Acquisition and Resettlement

The road alignment proposed within the Feasibility Study precisely follows the existing road. The EIA team has first analysed alignment provided by the engineering team (AutoCad files in coordinates) superimposing it on the topographic maps and aerial photos with existing cadastral data(see Annex 3). Next step was at site verification along the whole alignment. Critical subsections were verified together with the engineering team.

The initial desk studies mostly clearly indicated that no private lands are affected by the construction corridor, as it was stated by the road engineers and topographers of Kocks Consultant GmbH. The only section requiring additional comprehensive verification was section km8 – km10 (page 5 on the cadastral maps). At this section, because of slight deviation of the plotted RoW from the alignment of the existing road on the aerial photos, the question raised: is the deviation just a result of slight shift of coordinates or alignment is in reality shifted a bit from the existing road (in that case 1 land plot could be under the impact – 16cm was maximum width of overlapping of the land plot and road polygons). However, following explanations from the Kocks Consultant GmbH team and site verification performed together with the road engineers confirmed that the mentioned overlapping is within the margins of mapping error and in reality the project alignment is precisely fitting the existing road alignment and no single private land plot, roadside fence or other structure is affected by the project. Accordingly, no new land take is required. OP 4.12 is not triggered and no Resettlement Action Plan is to be prepared.

The only task for the resettlement specialist at the detailed design (DD) stage is to verify that the final alignment of the road specified by the DD & Build Consultant is still matching the existing road footprint and no new land take is imposed. In case of deviation, need of private land acquisition should be analysed and appropriate actions planned in accordance with the WB regulations and Georgian legislation.



Fig.26 Section requiring precise verification

6. ANALYSIS OF ALTERNATIVES

The project envisages rehabilitation of existing road. The road is considered as economically and technically viable and environmentally reasonable. Therefore, no other new alignments have been reviewed, as any new alignment is associated with occupation of greenlands and private land plots and definitely would have significant adverse environmental and social impact.

The existing bridges, culverts and other infrastructure also needs only rehabilitation and no new construction is planned. No alternative engineering solutions have been proposed.

The only considered alternative is “do nothing”. As it has been presented in the Feasibility Study, The overall conclusion of the road rehabilitation assessment study is that improvements to the Sasadilo – Sioni road are warranted and that an improved roadway will be beneficial to the development of the recreation area at Sioni. As in many other local road projects, low traffic volumes together with relatively high construction costs determine the economic feasibility. However, as identified in the study the proposed rehabilitation option shows sufficient economic rates of return. Therefore, the “do nothing” alternative should be rejected and the only justified decision is to implement the proposed road rehabilitation project.

7. ANTICIPATED ENVIRONMENTAL IMPACTS

7.1 SUMMARY OF ACTIVITIES AND ANTICIPATED IMPACTS

The project will be implemented through a design-and-build type contract. Detailed design of individual sections of Sasadilo-Sioni road will be produced by contractor on the rolling basis before starting construction activities in each section. Detailed design for a section of the road will include plans for construction material supply along with management plans for all types of borrowing; waste storage and disposal; topsoil storage and landscape reinstatement; equipment yards; and traffic management. This paragraph provides brief description of anticipated site-specific impacts related to the design, construction and operation phases of reconstruction of the Sasadilo - Sioni motor road. Description of operation related impacts is mainly limited to this paragraph. Most specific issues for the road projects (construction and operation phase), like air emissions and noise related impacts are addressed in sections 7.2 and 7.3. Construction related impacts are reviewed in more details in section 7.4.

Environmental Impacts – Design and Pre-construction Phase

#	Design Related Impacts	Yes/No	Comments
1	Siting of borrow pits, gravel extraction borrows, waste disposal sites, asphalt mixing plants, work camps, fueling and storage places and equipment yards	Medium	Dust/air pollution, water pollution, landscape degradation impacts will depend on proper siting at the detailed engineering stage or at the mobilization stage (planning conducted by the constructing contractor)
2	Soil Erosion – Design of temporary and permanent drainage systems, retaining walls, berms and embankments, design of anti-erosion engineering measures and reinstatement plan	Medium	Proper design is important for minimizing erosion and secondary impacts: landscape degradation and increased sedimentation of watercourses, slow destruction of the highway pavement
3	Planning and design of interchanges and interception sites	Medium	Interference on local transportation and access; Safety of traffic
4	Compliance with international design standards	Medium	Safety; efficiency of operations and maintenance
5	Noise and traffic emission nuisance	Medium	Noise and emissions related to traffic are tangible only in densely populated areas where the residential houses are located close to the road
6	Bridges, viaducts, interchanges and flood protection installations	Medium	Proper design defines level of safety and risks of road destruction related to flooding, landslides, rockfalls etc. Implementation of drainage systems is important for the maintenance and safety
7	Damage of infrastructure elements.	Medium	The road crosses electric power transmission systems, water supply systems and local gas pipelines. At the design stage it is important to consider protection and reinstatement of this infrastructure

Environmental Impacts - Construction Phase

#	Potential Impacts During Rehabilitation Works	Yes/No Severity	Sites
1	Destruction of natural landscape (relief, soil cover, vegetation, eco-systems, habitats and wildlife) in the right-of-way occupied by the highway.	Minor	Whole alignment; Landscapes of Moderate Sensitivity km 0 – 5km (right to road) 3 – 10km left to the road Road passes near the Landscapes of High Sensitivity 10 – 13Km left to the road (forests adjacent to the TNP at a distance of 2km from the border of TNP).
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.	Medium	Borrow pit sites (Iori floodplain). The impact of the project is minimal, as the quarries are already operated by licensed companies without regard to the project. Waste dumps, construction camps and equipment yards finally will be defined at the preconstruction stage by the constructing contractor. Sites described in EIA are only proposed as potential locations.
3	Landslides, slumps, slips and other mass movements in road cuts triggered by the construction activities.	Medium or High	KM 0 +200 Landslide KM 4+ 200 mudflow gully km 4+200 small landslide km 5+000 - km 7+000 r. Orville (flashfloods and debrisflows) km 8+100 landslide
4	Erosion stimulated 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.	Medium	Most part of alignment
5	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	Medium	Most part of alignment
6	Impact of construction activities on aquatic ecosystems of the rivers and streams crossed by the highway	Medium	River Iori
7	Soil and water contamination during construction by oil, grease, fuel and paint in the RoW, access roads, construction camps and equipment yards and asphalt mixing sites.	Medium	Contamination risks for the surface water (rivers): r. Iori (Km 11-25), Soil contamination: Along the whole alignment; Camps, equipment yards and asphalt mixing sites to be defined by constructing contractor
8	Poor sanitation and solid waste disposal in construction camps and work sites (sewerage, sanitation, waste management)	Medium	Camps will not provide accommodation for the workers. They will live in nearest villages. Sites -to be defined at preconstruction stage by the constructing contractor

9	<p>Construction wastes alongside the RoW and roadside litter. Spoil –</p> <p>Demolition of old pavement</p> <p>Concrete and metal constructions</p> <p>Roadside litter and garbage</p>	Medium	<p>Whole alignment; mainly generated at cut sites;</p> <p>Whole alignment; Demolition of old guardrails and bridge constructions during the rehabilitation process.</p> <p>All worksites</p>
10	Air pollution from vehicle operations during construction in populated areas traversed by the highway, notably metropolitan areas or densely settled rural areas. Local dust.	Minor or Medium	Near the settlements: Sasadilo, Kochbaani, Bochorma, Kudro, Orkhevi
11	Air pollution from asphalt plants.	Medium	Supplier site
12	Noise pollution from vehicle operation during construction in populated areas traversed by the highway, notably metropolitan areas or densely settled rural areas. Local noise.	Minor	Near the settlements: Sasadilo, Kochbaani, Bochorma, Kudro, Orkhevi
13	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. Recontamination by infectious biological materials (e.g. Anthrax) during earth works near the pest holes (i.e. not registered Anthrax sites)	Minor	Whole alignment
14	Health hazards by noise, air emissions and dust raised and blown by vehicles during construction activities.	Minor or Medium	Near the settlements: Sasadilo, Kochbaani, Bochorma, Kudro, Orkhevi
15	Impacts on potential archaeological sites in case of chance finds during earth works	Minor or Medium	Whole alignment
16	Hazardous driving conditions where construction interferes with pre- existing roads.	Minor	Whole alignment Near the settlements
17	Impact on existing infrastructure The highway is crossing or bypassing in close vicinity to several important infrastructure systems: 1. power lines 2. Local gas pipelines	Medium or High	Near the settlements mainly near v.
18	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	Minor	Whole alignment; Most sensitive sites are near the settlements:

Character of Main of the Anticipated Impacts - Construction Stage

Activity	Impact	Character of impact							
		Direct	Indirect	Positive	Negative	Reversible	Irreversible	Temporary	Residual
Land clearance and grading in the RoW	Destruction of natural landscape, habitats, erosion	+			+		+		+
	Emissions	+			+	+		+	
	Noise, vibration	+			+	+		+	
	Ground pollution and/or waste generation		+		+	+		+	
	Ground and surface water pollution		+		+	+		+	
Construction of the new carriageway; pavement	Destruction of natural landscape, habitats, erosion								
	Emissions	+			+	+		+	
	Noise, vibration	+			+	+		+	
	Ground pollution and/or waste generation		+		+	+		+	
	Ground and surface water pollution		+		+	+		+	
Exploration of borrow pits	Destruction of natural landscape, habitats, erosion	+			+		+		+
	Emissions	+			+	+		+	
	Noise, vibration	+			+	+		+	
	Ground pollution and/or waste generation		+		+	+		+	
	Ground and surface water pollution	+			+	+		+	
Transportation of sand, gravel, stones from borrow pits. Material supply.	Destruction of natural landscape, habitats, erosion								
	Emissions	+			+	+		+	
	Noise, vibration	+			+	+		+	
	Ground pollution and/or waste generation		+		+	+		+	
	Ground and surface water pollution		+		+	+		+	

Demolition of part of existing pavement during rehabilitation of the existing carriageway	Destruction of natural landscape, habitats, erosion								
	Emissions	+			+	+		+	
	Noise, vibration	+			+	+		+	
	Ground pollution and/or waste generation		+		+	+		+	
	Ground and surface water pollution		+		+	+		+	
Disposal of spoil and wastes	Destruction of natural landscape, habitats, erosion	+			+	+		+	
	Emissions	+			+	+		+	
	Noise, vibration	+			+	+		+	
	Ground pollution and/or waste generation		+		+	+		+	
	Ground and surface water pollution		+		+	+		+	

Environmental Impacts - Operation Phase

#	Potential Long-term impacts (Impact of Physical Installations; Traffic and Emergencies)	Severity	Sites
19	Long-term degradation of natural landscape (relief, soil cover, vegetation, habitats) in the certain part of the right-of-way (land strips adjacent to the highway – affected by construction activities).	Minor	Whole alignment; Sensitive forested areas Km 11 – 25 km 30 – 36 km 48 - 60
20	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.).	Medium	km 0 +200 Landslide km 4+ 200 mudflow gully km 4+200 small landslide km 5+00 - km 7+00 r. Orville (flashfloods and debrisflows) km 8+100 landslide
21	Erosion from 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.	Medium	Most part of alignment, which passes hilly and mountainous landscape
22	Landscape disfiguration by embankments and deep cuts, fills and quarries. Marred landscape (scars from rod cuts, induced landslides and slumps etc.).	Minor	Most part of alignment, which passes hilly and mountainous landscape
23	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	Minor	Most part of alignment, which passes hilly and mountainous landscape
24	Soil and water contamination by oil, grease, fuel and paint alongside the highway	Minor	Most part of alignment
25	Air pollution from asphalt plants during maintenance works.	Minor	Asphalt mixing site
26	Air pollution from vehicle operation, in populated areas traversed by the highway, notably metropolitan areas or densely settled rural areas. Local dust.	Minor	Near the settlements: Sasadilo, Kochbaani, Bochorma, Kudro, Orkhevi
27	Noise pollution from vehicle operation, in populated areas traversed by the highway, notably metropolitan areas or densely settled rural areas.	Minor	Near the settlements: Sasadilo, Kochbaani, Bochorma, Kudro, Orkhevi
28	Roadside litter.	Medium	Most part of alignment
29	Creation of a new pathway for disease vectors affecting humans and animals.	Medium	Most part of alignment
30	Creation of a transmission corridor for diseases, pests, weeds and other undesirable organisms	Medium	Most part of alignment
31	Health hazards by dust raised and blown by vehicles.	Minor	Near the settlements: Sasadilo, Kochbaani, Bochorma, Kudro, Orkhevi
32	Induced development: roadside commercial, industrial, residential, and “urban sprawl”.	Minor	insignificant
#	Potential Operation Phase Emergency Related Impacts	Severity	
33	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)	Medium	Near the settlements Most part of alignment

Character of Main of the Anticipated Impacts - Operation Stage

Activity/Factor	Impact	Character of impact							
		Direct	Indirect	Positive	Negative	Reversible	Irreversible	Temporary	Residual or long-term
Physical existence of linear installation	Destruction of natural landscape, habitats, erosion	+					+		+
	Emissions								
	Noise, vibration								
	Ground pollution and/or waste generation								
	Ground and surface water pollution								
Traffic	Destruction of natural landscape, habitats, erosion								
	Emissions	+			+				+
	Noise, vibration	+			+				+
	Ground pollution and/or waste generation		+		+	+		+	
	Ground and surface water pollution		+		+	+		+	
Maintenance works	Destruction of natural landscape, habitats, erosion	+		+					
	Emissions	+			+				+
	Noise, vibration	+			+				+
	Ground pollution and/or waste generation		+		+	+		+	
	Ground and surface water pollution		+		+	+		+	
Accidents	Destruction of natural landscape, habitats, erosion		+		+	+		+	
	Emissions		+		+	+		+	
	Noise, vibration								
	Ground pollution and/or waste generation		+		+	+		+	
	Ground and surface water pollution		+		+	+		+	

7.2 IMPACTS RELATED TO AIR EMISSIONS

Air emission related impacts and mitigations are usually considered as most typical and significant issues for the road rehabilitation projects. Here we provide potential impact analysis.

Operation Phase

Emission impacts related to current and planned conditions of traffic. Potential impact analysis is based on the worst case scenario. As a worst case scenario we consider the emission data for the Vaziani-Sasadilo - Gombori-Telavi road traffic emissions, available from the VGT EIA (2009). Sasadilo – Sioni road crosses Vaziani – Sasadilo-Gombori-Telavi road and environmental conditions for the both projects are very similar. Emission modeling for the VGT road has been performed for the Sasadilo-Gombori section of the road. The results of the modeling could be considered as a worst case scenario for the Sasadilo – sioni road, as the traffic capacity of the VGT used for modeling is much higher (almost 10 times) than the traffic forecast for the Sasadilo-Sioni road (see for comparison the tables with traffic data below).

Year	Light vehicle	minibus	busses and trucks	Trailers	Total
2009	915	180	98	24	1217
2028	2431	480	261	64	3242

Table 7-1. Traffic estimations for Vaziani – Gombori - Telavi Road

Detailed Assessment of Rehabilitation of the Sasadilo – Sioni (Sasadilo - Orkhevi – Khevsurtsopeli) Road

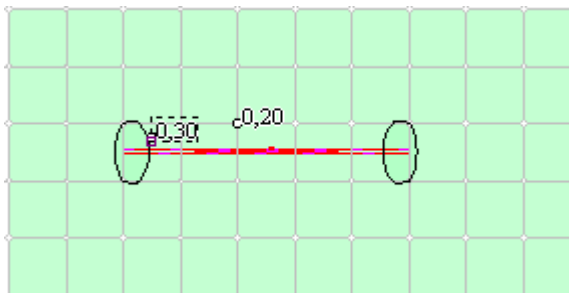
Assessment Report

	Car	Minibus	LGV	Bus	MGV	HGV3	HGV Artic	AADT	Grand Total
AADT Growth Rate (% pa) 2011 - 2015	6.00	6.00	5.00	6.00	5.00	5.00	5.00		
AADT Growth Rate (%pa) 2015 - 2020	4.80	4.80	4.00	4.80	4.00	4.00	4.00		
AADT Growth Rate (%pa) 2020 - 2025	4.20	4.20	3.50	4.20	3.50	3.50	3.50		
AADT Growth Rate (%pa) 2025 - 2030	3.30	3.30	2.80	3.30	2.80	2.80	2.80		
AADT 2011	44	11	3	10	2	7	3	80	107
Generated traffic (2012-2015)	49	12	11	3	2	8	3	89	90
AADT									
2012	66	17	15	5	3	10	4	120	148
2013	80	20	18	5	4	13	5	145	173
2014	95	24	21	6	4	15	6	171	199
2015	110	27	24	7	5	17	7	198	227
2016	115	29	25	8	5	18	8	208	236
2017	121	30	26	8	5	18	8	217	245
2018	127	32	27	9	5	19	8	227	255
2019	133	33	28	9	6	20	9	237	266
2020	139	35	30	9	6	21	9	248	277
2021	145	36	31	10	6	21	9	258	287
2022	151	38	32	10	6	22	10	269	297
2023	157	39	33	11	7	23	10	279	308
2024	164	41	34	11	7	24	10	291	319
2025	171	43	35	12	7	25	11	302	331
2026	176	44	36	12	7	25	11	312	341
2027	182	46	37	12	7	26	11	322	351
2028	188	47	38	13	8	27	11	332	361
2029	194	49	39	13	8	27	12	342	372
2030	201	50	40	14	8	28	12	353	382
2031	207	52	41	14	8	29	12	364	394

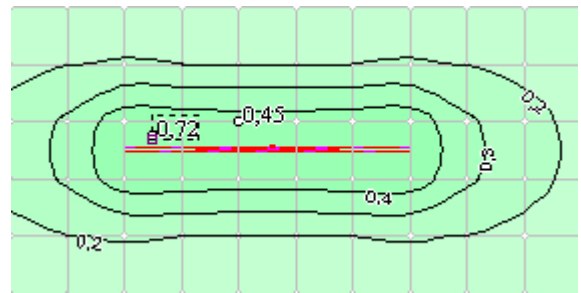
Source: The Consultant

Table 7-2. Traffic forecast for the Sasadilo – Sioni Road.

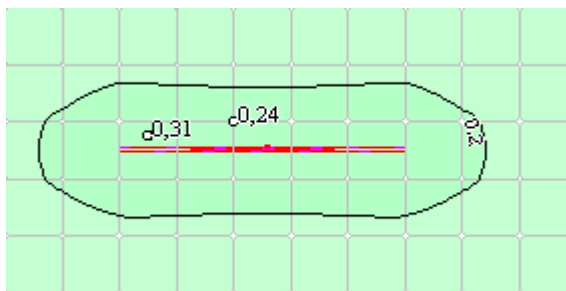
The air quality modeling for Sasadilo – Gombori section of the VGT has been performed considering the area of rectangle (700m x 100m) with centerline coinciding with the highway centerline. Spacing was taken as 50m. In addition, maximal concentrations of harmful substances have been calculated in two points: at a distance of 25 m (point 1) and 50m (point 2) athwart to the centerline.



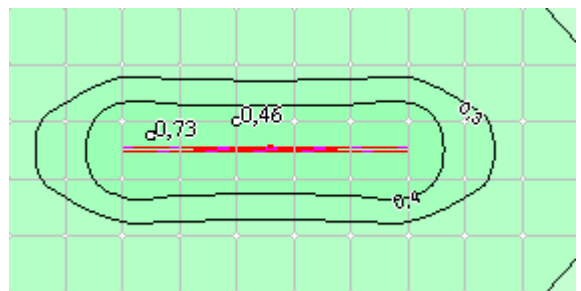
Nitrogen dioxide (301)



Nitrogen dioxide (301)



Supperposition 6009 groupe (301+330)



Supperposition 6009 groupe (301+330)

Note: points on the diagramme marke concentrations in the checkpoints (N° 1, N° 2)

Fig. 27 Air emission dispersion modelling for Sioni-Gombori section of the VGT road, Source: EIA for Vaziani-Gombori-Telavi Road Upgrading Project, 2009

According to the modeling data maximum concentrations of harmful substances in check points located at 1 and point 2 for different sections is, as demonstrated in the table below:

Harmfu Substance	Current Situation		Anticipated for 2028	
	1	2	1	2
N° of check point				
NO2	0,3	0,2	0,72	0,45
NO	0,0085	0,0052	0,02	0,01
Soot (PM)	0,002	0,0013	0,0045	0,0028
SO2	0,04	0,04	0,04	0,04
CO	0,09	0,09	0,11	0,10
Benz(a)pyrene	0,0017	0,001	0,0034	0,0021
Formaldehyde	0,0063	0,0039	0,02	0,0095
Fractions of benzine	0,0017	0,001	0,0048	0,0029
Fractions of kerosene	0,0038	0,0023	0,0092	0,0057
Impact summation groups (NO2 and SO2)	0,31	0,24	0,73	0,46

As it is demonstrated by calculations, maximum concentrations of harmful substances for current traffic conditions do not exceed Maximum Admissible Concentrations (MAC) and traffic related

contamination at the territories adjacent to the road is not expected to be significant in nearest future.

Mitigation of the impacts related to the increased traffic emissions during following years could be subdivided on local /project-specific measures and general regulatory/policy measures .

Local measures: proper planning of greenery planting to screen emission impacts on the settlements.

General measures: state control over the fuel quality and engine maintenance and technical compliance.

Construction Phase

Impacts of construction related emissions and dust and relevant mitigation measures are discussed in section 7.4.

7.3 IMPACTS RELATED TO NOISE

Noise is usually considered as most typical and significant impact characteristic for the road rehabilitation projects. Here we provide brief summary of the analysis.

Construction Phase

Evaluation of construction related noise relies upon known information on the noise produced by various equipment and activities at individual stages of construction. For example noise levels produced at 50 ft (15.24m) as provided by the U.S. Department of Transportation, FHWA, CADOT, and SBAG 1993; and Country Sanitation Districts of Los Angeles County 1994 are about:

Table 7.3-1

Source of Noise	Equivalent noise level, dBA
1. Construction machinery and mechanisms	
backhoes	84 - 85
bulldozers	84 - 85
graders	91 - 92
compressors	80 - 88
jackhammers	85 - 98
pile drivers	96 - 107

According to other sources (U.S. Environmental Protection Agency, 1972,):

Table 7.3-2

Source of Noise	Equivalent noise level, dBA
Construction machinery and mechanisms	
Compactors (rollers)	72 - 75
Front loaders	72 - 83
Backhoes	72 - 92

Tractors	78 - 95
Scrapers, graders	80 - 95
Pavers	85 - 88
Trucks	83 - 93
Compressors	75 - 88
crane, movable	75 - 85
Jackhammers and rock drills	82 - 98
Vibrator	70 - 82
Saws	72 - 82

Noise generated by mobile sources naturally attenuates at a certain distance. Attenuation follows logarithmic pattern. In case of construction related noise, point source propagation model should be applied. Point-source propagation can be defined as follows: $\text{Sound level}_1 - \text{Sound level}_2 = 20 \log r_2/r_1$. This means that for every doubling of distance, the sound level decreases by 6dBA (“inverse square law”).

Table 7.3 - 3

Distance from the Edge of the Road m	Predicted Noise Level Average Value - dBa	Predicted Noise Level Maximum Value - dBa
5	80	90
10	74	84
20	68	78
40	62	72
80	56	66
160	50	60
320	44	54

Project Impact and Mitigation (Construction Phase).

As a result of rough estimation of construction related noise, we can assume that the noise impact will not exceed radius of 320m. Temporary increase of the noise level near the construction ground within the 300m radius is acceptable impact. The residential houses in the villages are not so densely concentrated near the road.

Mitigation of this minor impact is possible by engine maintenance practice and avoidance of engine work in non-operational mode. The only limitation that could be recommended is to deploy high noise devices, like crushers, outside the residential zone and exclude the night-time works in v. Sasadilo, Bochorma, Kudro and Orkhevi. The night-works at other sites could be carried out without limitation.

Operation Phase

The amount of houses located within the 60-80m distance zone along the road is as follows: 7 in v. few Sasadilo, 22 in Bochorma, 18 in Kudro and about 30 in v. Orkhevi. For the most of these houses the distance from the road exceeds 20m. Traffic related noise will not affect significantly area out of 10m from the road. The impact is not expected to increase significantly even in 2031, when the traffic intensity is expected to increase 3-fold as compared with the current situation. The impact of the increased traffic will be to certain extent compensated by improvement of road characteristics (geometrical and pavement) and better driving conditions. For the forecasted traffic intensity the noise impact will be acceptable out of 20m distance from the road boarder.

For those houses that are within the 20 distance from the road, a need for the application of costly mitigation measures, like installation of special noise barriers³, is not expected. In villages v. Sasadilo, Bochorma, Kudro and Orkhevi, where the residential houses are located close to the road, high solid wooden or brick/stone walls should be constucted, where they do not exist. The additional mitigation measure should be:

- a) limitation of traffic velocity;
- b) implementation of engine maintenance control mechanisms.

7.4 POTENTIAL IMPACTS RELATED TO CONSTRUCTION ACTIVITIES

7.4.1 Pollution and Waste

Improper handling, storage, use and disposal of construction materials and wastes could pose a risk of water/ soil contamination at the construction site and storage site. Improper maintenance and fuelling of equipment could also lead to the potential contamination of soil/ water.

7.4.1.1 Construction Related Wastes

Usually, the major waste generation during construction activities is related to spoil generation in cuts and inert materials resulting from the demolition of existing structures. Earthworks for the road rehabilitation works will be minor and are mainly limited to excavation of unsuitable material and soil replacement. As far as practical the material resulting from cuts, widening of cuts or other excavations in the road reserve shall be utilized for construction of earthworks if suitable. Material which will not be used in earthworks due to quality or other reasons may be stockpiled for future use as side fill. The earth-works balance is as follows:

- Excavation in road cut - 30,700m³
- Road cut material used for construction of embankment - 4,420 m³
- **Disposal of unsuitable and surplus material - 26,280 m³**

Existing patches of asphalt pavement are milled and used at site as filling material.

The wastes produced during the rehabilitation of the existing bridges:

	Bridge 1 Km 2+078 - Km2+166	Bridge 2 Km 3+ 312 km 3 +400	Bridge 3 Km 3+ 930 km 3 +980	Bridge 4 Km 15+ 678 - km 15 +714	Bridge 5 Km 7+ 525 -km 3 +572	Total
demolished metal railings and other metal elements	0.50 ton		45.00 m ³	0.20 ton	0.18 tone	0.88 tone + 45 m ³ load bearing metal members of superstructure
demolished road pavement	63.00 m ³	75.60 m ³		30.55 m ³	24.50 m ³	193,65
demolished concrete debris		3.84 m ³				3.84 m ³
Other construction waste	5.00 m ³			5.00 m ³	5.00 m ³	15.00 m ³

³ Noise barriers have their own negative impact creating acoustic corridors (tube effect) if applied in narrow streets, and besides, they affect adversely the visual aspect of landscape (particularly, urban and rural landscapes). Therefore, the noise barriers should be used only when they are absolutely necessary.

Hazardous Construction Wastes

Small quantities of the hazardous wastes will arise mainly from the vehicle maintenance activities. A number of hazardous wastes, which could be generated, include:

- paints used for painting metal elements of bridges (guardrails etc.);
- bitumen;
- liquid fuels;
- lubricants, hydraulic oils;
- chemicals, such as anti-freeze;
- contaminated soil;
- spillage control materials used to absorb oil and chemical spillages;
- machine/engine filter cartridges;
- oily rags, spent filters, contaminated soil, etc).

7.4.1.2 Soil Pollution

Potential pollutants from a project of this nature include the following (this list is not exhaustive):

- Diesel fuel, lubrication oils and hydraulic fluids, antifreeze, etc. from construction vehicles and machinery
- Miscellaneous pollutants (e.g. asphalt, cement and concrete)
- Construction wastes (packaging, stones and gravel, cement and concrete residue, wood, etc.)
- Extremely small amount of hazardous wastes (e.g. waste oils, oily rags, spent filters, contaminated soil, etc) constituting about 0.1% of total amount of the wastes.

7.4.1.3 Surface Water and Groundwater Pollution

Water pollution may result from a variety of sources, including the following:

- Spillages of fuel, oil or other hazardous substance, especially during refueling
- Silt suspended in runoff waters (“construction water”)
- Washing of vehicles or equipment or disturbance of watercourse banks and bed during watercourse crossings by heavy machinery
- Exposure of contaminated land and groundwater

Spillages etc may travel quickly downhill to a watercourse or water body. Once in a watercourse, it can be difficult to contain the pollution which can then impact over a wide area downstream. It is therefore vital that prompt action is taken in the event of any potential water pollution incident.

Once the working width has been stripped of topsoil, the subsoil becomes exposed. During earthworks in a wet weather this may result in uncontrolled release of suspended solids from the work area. River Iori is the major receptor sensitive to the increased sediment load.

7.4.1.4 Topsoil losses due to topsoil stripping

- Topsoil washout due to improper storage and reinstatement
- Silt runoff to watercourses and water bodies
- Exposure of contaminated land

7.4.1.5 Impacts on Flora

The road rehabilitation works are mostly concentrated within the existing RoW and new footprint at the landscape is limited. The only locations, where the landscape and vegetation cover may be affected, are zones of minor changes of the alignment to improve the geometric characteristics of the road. Up to this moment no tree felling is envisaged, only small amount of bushes are subject for clearance.

According to the current basic design, the most sensitive sections (SZ1, SZ2, SZ3 and SZ4a) are not affected by any route changes or local widening of the road. Clearance of bushes that have occupied sides of the existing (but not so much used) road is planned during the road rehabilitation for the section, which is crossing medium sensitivity zone (**MSZ 5**, habitat of medium sensitivity), characterized by following species composition: willows - *Salix excelsa*, asp - *Populus canescens*, maple - *Acer campestre*; from shrubbery – blackberry, hawthorn, sea-buckthorn, etc. are present. As a result, sea-buckthorn shrubs encroaching both sides of the road will be destroyed. The land with affected sea-buckthorn shrubs is part of existing RoW and belongs to the RD.

As a result of the detailed field botanical research one species from the Red List of Georgia has been found within the section - *Ulmus minor* Mill. (field elm; VU), about 20 individuals. The mentioned individuals are located quite close to the road, although they are not affected according to the current plan.

7.4.1.6 Fauna

With regard to the biological environment it is important to note, that the rehabilitation of the existing road, as it is designed, will not cause the loss of valuable habitat or ecosystems, or new fragmentation of currently undisturbed natural habitats. Animals and birds inhabiting forested areas adjacent to the existing road are adapted to the traffic related disturbance. However, certain mitigation measures would be required to prevent low probable and small scale impacts on bats (during demolition of old structures) and small animals (risk of falling into the construction ditches and pits).

The works conducted in the river channel near the bridges are mainly limited to the cleaning of channel from debris. Only for the bridge 3 diversion of the channel of small tributary of r. Iori is envisaged. Excavations, related to channel diversion, as well as debris cleaning, may cause pollution of water (increased turbidity, fuel leakage etc.).

Potential impact on ichthyofauna is also related to the possible pollution of the river Iori by increased sediment runoff during earthworks and contamination due to improper fuel and waste management.

Construction related noise and emissions are not too much disturbing for waterfowls. Poaching practiced by the workers could be an issue (although unlikely), but this is a matter easily manageable in case of proper internal monitoring and external supervision of construction works. The mentioned impacts are of low probability, temporary, insignificant and manageable.

To certain extent, the project implementation may increase fire risks (camps, work sites near forests). In case of fire along the highway and in sensitive areas the habitat in forests and forest edges will be destroyed for rare mammals, birds, reptiles and invertebrates occurring in these areas.

7.4.1.7 Protected Areas

The project road passes at a distance of 2km from the Eastern border of the Zone of Traditional Use of the Tbilisi National Park (TNP) and at 6km distance from the borders of Strict Protection Zone. The road is separated from the TNP by the r. Iori and hilly areas. No impact on TNP is envisaged in relation with the road rehabilitation works or increased traffic.

7.4.1.8 Landscape. The project design does not envisage substantial changes of valuable landscape. However, certain impact is imposed at the sites where land clearance is required for construction of new sections (improvement of geometry). No widening the road in a forested area is envisaged. The existing and licensed quarry and gravel extraction sites are proposed for material supply, thus no new impacts are envisaged on the landscape.

7.4.1.9 Water use. Water will be required for maintenance works and for dust protection measures (water bowsers). The amount of required water is not high and the sources exist in the vicinity of the project sites (river Iori). While water intake for the above purposes is not regulated under the Georgian law, wastewater discharge in surface water objects is subject to agreement on the volumes and admissible concentrations of pollutants. Maximum Admissible Discharge Limits shall be established and agreed with the Ministry of Environment Protection and Natural Resources. These limits must be set in compliance with the sanitary norms for surface water determined in the regulations issued by the Ministry of Labor, Health and Social Affairs

7.4.1.10 Impacts on Archaeological Sites. Land clearance works, grading and excavations are associated with the risks of damaging underground archaeological remnants. Archaeological sites registered in the area of Sasadilo-Sioni road are listed in section.5.2. and none of them would be affected during the project implementation. However, chance finds have been common in this part of the country, some of which got destroyed as a result of construction under Soviet times. Therefore, occurrence of chance find during earth works along Sasadilo-Sioni road can not be excluded. In such cases established rules for handling chance finds must strictly apply. Project proponent has a fresh experience of going through the due course of action upon uncovering of an archaeological site during road works under the World Bank financed Georgia East-West Highway Improvement Project is exemplary.

7.4.1.11 Transport related impacts

Heavy trucks are required to deliver required amount of inert materials to the needed sites within the construction corridor. Different types of impacts are anticipated in that regard:

- Noise & Vibration Impacts
- Traffic congestion (nuisance)
- Air pollution (dust; emissions)
- Mud on roads
- Refueling, maintenance and vehicle cleaning and related risks of soil and water contamination

7.4.1.12 Traffic Disruption. Intensive runs of heavy trucks are required to deliver required amount of inert materials amount of materials to the needed sites within the construction corridor. The construction sites impose certain safety risks for the population and, therefore, compliance with safety rules is important. Local traffic can be impacted by transport activities related to the project. The mentioned impact is temporary, insignificant and manageable. Long-term impact on local traffic should be beneficial.

7.4.1.13 Infrastructure. The main identified infrastructure elements that could be affected during construction activities are listed below:

- electro power transmission lines
- local water supply pipelines
- local gas supply pipelines

7.4.1.14 Risks associated with the rehabilitation works on bridges

Bridge rehabilitation works do not impose any risks of changing the hydrological patterns, lateral bank erosion or scouring features. The works conducted in the river channel are mainly limited to the debris cleaning. Only for the bridge 3 diversion of the channel of small tributary of r. Iori is envisaged. Excavations, related to channel diversion, as well as debris cleaning, may cause pollution of water (increased turbidity, fuel leakage etc.). In addition – risk of contamination with the cement or concrete solutions and/or paints used for painting bridge guardrails should be considered.

7.4.1.15 Construction Related Impacts at the Quarrying Sites

4,420 m³ embankment construction will mainly utilize materials from road cut. Materials supply from the quarries is mainly related to the pavement construction.

- Provide and place crushed stone base, 220 mm thick, CBR > 100 %, 33,495 m³
- Provide and apply prime coat, 76.3 ton
- Provide and place asphalt concrete surface course, 50 mm thick, 109,005 m²
- Provide and place shoulder fill material 1,800 m³.

The exploration of the borrow pits should be conducted by the licensed companies or the Constructing Contractor has to obtain its own license. However, potential impact of the increased quarrying activities on river bed and floodplain landscape, ichthyofauna and groundwater should be considered.

The dust and emission impacts should be considered during planning mitigation measures, as well as potential river contamination due to improper fueling and vehicle operations. These additional potential impacts should be subject for the management plan.

7.4.1.16 Construction Related Impacts at the Camp Site

In fact, these are supposed to be the equipment yards (for 40 persons each) with 2 or 3 trailers but not complete construction camps. It is planned that the accommodation and sanitary-hygienic facilities are available for the workers in the villages. The workers will not live in the trailers. The equipment yard could be located close to the village Sasadilo. The exact location will be selected by the constructing contractor. The potential impacts related to the construction and operation of the camp could be summarized as follows:

- Potential damage of topsoil
- Contamination related to fuel storage and fuelling operations
- Waste and wastewater management

7.4.1.17 Construction Related Impacts at the Asphalt Plant Sites

Asphalt will be provided to constructing contractor by the suppliers and, therefore, the asphalt plant related impacts are not direct impact of the project. However, the impacts of the asphalt plants (particularly emissions, waste disposal and pollution) should be considered as indirect impact of the project due to the increased production of asphalt by the existing plants.

Direct impacts of the asphalt plants (landscape degradation; emissions and dust; noise etc.) should be considered in case if the constructing company will decide to use its own mobile asphalt plants. In that case relevant EIA should be prepared and environmental Impact Permit should be obtained for installation and operation of the plant.

8. MITIGATION MEASURES AND ENVIRONMENTAL MANAGEMENT PLAN

8.1 MITIGATION MEASURES

8.1.1 Mitigation of Construction Related Impacts

8.1.1.1 Prevention and Mitigation of Landslides and Other Geohazardous processes

The design is prepared considering 8 degree seismic zone and is relevant to existing seismic risks.

km 0 +200 Landslide. Cutting down the slope in the road rehabilitation process will undoubtedly cause the activation of the landslide processes. Therefore, it will be necessary to take relevant protective measures

km 4+ 200 mudflow gully

km 4+200 small landslide

km 5+000 - km 7+000 r. Orville (flashfloods and debris flows)

km 8+100 landslide

km 10+000 - km 12+000 The river Sajinobos Khevi. The river is of a mudflow nature and river bank protecting structures will be necessary to build across the river, adjacent to the bridge;

As the mitigation measure against flashfloods and debris flows the project envisages cleaning of the river channels in the vicinity of bridges, construction of the river bank and bridge protective structures and permanent monitoring.

For the landslide areas following approaches are reviewed:

- Surface water management is considered as a major mitigation factor for prevention of landslides during construction activities, as well as during operation phase. Temporary drainage systems should be installed to prevent landsliding during construction (cutting slopes, deep trenches etc.). Permanent drainage systems for the surface water management and slope stabilization should be installed and adequate monitoring and maintenance should be ensured. This may require also installation of drainage pipes at a deeper level than for temporary drainage system. Seasonal aspects should be considered during planning the monitoring activities: snow-melting and flooding periods are of great importance.
- Slope stabilization techniques to prevent erosion, and further triggering of landslides is extremely important. Mechanical means, like berms, geogrids, biomats, as well as anti-erosion and re-vegetation of slopes should be applied.
- At very particular locations, revetment structures or reshaping of relief may be required
- The design for landslide prevention structures should be based on the borehole data and slope stability analysis.

- As a long term mitigation measure, it is crucial that land degradation is stopped. Maintaining a vegetative cover in the cut and mountainous areas will reduce erosion through run-offs, land and mud slides.

Detailed design of the road sections including landslide-prone areas will provide site specific solutions for the soil stabilization works required for the complex zones. The design of potential landslide zones may include also soil nails. Soil nails are the horizontal steel nails drilled into the geological strata for soil stabilization. A typical design of the soil nails are shown in Fig. 28.

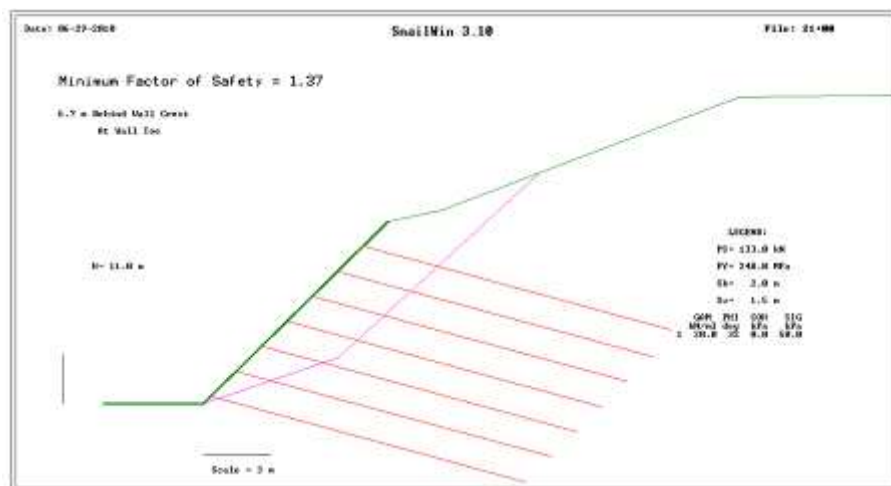


Fig. 28 Typical Design of Soil Nails

At the end, it should be stressed that the landslide protective measures are generally costly and in many cases will not completely eliminate the risk of further damages to the road. Further detailed investigations will be necessary at the DD stage to take decision if protective measures have to be designed. In many cases it might be advisable to choose the “do nothing” option and repair damages when they occur.

Technical solutions found optimal for individual sections of the road and recommended in the detailed designs of section will be evaluation and cleared by the client of the design-and-build contract and the World Bank.

8.1.1.2 Pollution Prevention Measures:

Water/ Soil Pollution. Specific mitigation measures should be implemented at the construction site for prevention of water and soil pollution:

Prevent operation of vehicles in the river and if there is no alternative, inspection of vehicles will be required to ensure that there is no leakage of fuel and lubricating materials.

Contractors will ensure the proper handling of lubricants, fuel and solvents. Fuel and lubricant storage tanks will not be located within 50m of any watercourse, well or dry gorges. All tanks will be placed in a bund of at least 110% of the tank’s maximum capacity. If more than one tank is stored within the bund, the system must be capable of storing 110% of the biggest container’s capacity or 25% of their total capacity, whichever is greater. The bund will be impermeable (e.g. concrete-lined), without drainage points or other breaches. Accumulated rainwater in bunds will be pumped out of the bund to either drains or the ground if uncontaminated. In case of fuel spillage the spilled fuel should be recollected and contaminated bund treated by the absorbents: sawdust, sand or straw.

All fuel / hydrocarbon dispensing nozzles are to be of a drip control design and securely locked when not in use.

No fuel storage or refueling of vehicles or equipment will be allowed within 50m of any watercourse, water body, well, dry gorge or within any designated wetland area or aquifer. Vehicles will not be left without supervision during refueling process. All refueling operations on the working sites will use absorbent pads and/or straw to minimize spills, which will be put in place prior to the commencement of refueling operations. Ground water and surface water pollution risk will be reduced or eliminated in case of immediate removal of polluted ground. Soiled ground and absorbents will be removed, stored and treated as hazardous waste. In case of significant spill authorized and responsible person will be informed, works will be stopped till the elimination of pollution risk. Refueling will always be carried out with the correct equipment (i.e. nozzles of the appropriate size), and only by suitably trained and experienced Refueling Operators. Fuel supply equipment will be regularly revised to prevent leakage due to inappropriate condition of refueling equipment. Equipment and storages will be isolated and guarded to prevent pollution due to cases of stealing or vandalism. All mobile plant, including but not limited to cranes, compressors, generators, bulldozers, excavators etc. and storage tanks will be maintained and operated such that all leaks and spills of materials will be minimized. Daily plant checks (Vehicle Maintenance Procedure) will be undertaken to ensure no leaks or other problems are apparent. Vehicle maintenance, cleaning, degreasing etc will be undertaken in designated areas of hard-standing, not over made unstable ground (embankments etc.). Water Tanks with sprinklers are envisaged for watering roads and machinery maintenance. Maintenance points will not be located within 50m of any watercourse, well or dry gorge. The storage of potentially polluting materials, refueling and maintenance of mobile plant within 50m of all watercourses/water bodies, dry riverbeds and within designated wetlands and aquifers will be prohibited.

Erosion control measures will be applied during construction activities to prevent increased runoff into the watercourses.

Contractor will plan all excavations, topsoil and subsoil storage so as to reduce to a minimum any runoff. Contractors will be required to organize and cover material storage areas and to isolate wash down areas from watercourses by selecting areas that are not free draining into any watercourse.

Where any area of the spread is at risk from silt pollution washing off into a watercourse of water body, effective measures will be put in place to ensure that such pollution does not occur. Such measures may include:

- Use of silt fences
- Use of straw bales to deflect and filter water
- Use of a system of bunds and grips to prevent water from entering watercourses, etc.
- Use of holding/settling lagoons to store water running off the spread. It is intended to use natural settling rather than flocculants to facilitate sedimentation following which clean water can be disposed.

Asphalt or wet cement and/or concrete will not be allowed to enter any watercourse, pond or ditch.

No impacts are envisaged on groundwater (depth is more than 5m), as no deep excavations are planned within the frames of present project

8.1.1.3 Construction Waste Management

Generally, it is recognized that the best option has always been the avoidance of waste generation resulting in minimizing the quantities and hazard. Then it is recognized that it is better to reuse, restore and recycle the waste rather than to process it, and the placement is the last resort.

Waste originating after the removal of the existing asphalt layer. The anticipated quantity of the given kind of waste is 1375 m³. The given waste will be crumbled and mixed with the asphalt to be used for road cover. Therefore, the principle of reuse is fully applicable. The process shall be carried out so as not to produce excessive quantities of dust, which shall be minimized by damping with water sprays. Immediately after milling, surplus materials shall be removed by a machine of suitable and efficient design and the milled surface swept to remove all dust and loose debris. The material removed from the carriageway shall be removed from site, unless otherwise directed by the Engineer. No stockpiling shall be allowed on Site unless the material is to be used in the Works.

Excavation in road cut will generate spoil of 30,700m³. Road cut material partly (4,420 m³) could be used for construction of embankment. The rest - 26,280 m³ of spoil should be disposed off. Other wastes subject to disposal are given in the table below:

	Bridge 1 Km 2+078 - Km2+166	Bridge 2 Km 3+ 312 km 3 +400	Bridge 3 Km 3+ 930 km 3 +980	Bridge 4 Km 15+ 678 - km 15 +714	Bridge 5 Km 7+ 525 -km 3 +572	Total
demolished metal railings and other metal elements	0.50 ton		45.00 m ³	0.20 ton	0.18 tone	0.88 tone + 45 m ³ load bearing metal members of superstructure
demolished road pavement	63.00 m ³	75.60 m ³		30.55 m ³	24.50 m ³	193,65
demolished concrete debris		3.84 m ³				3.84 m ³
Other construction waste	5.00 m ³			5.00 m ³	5.00 m ³	15.00 m ³

In terms of spoil and rock disposal, the main purpose is not to damage valuable landscapes or soil deposits and other ecological sensitivities. Disposal of the spoil should be executed according following rules:

- Allow local communities to utilize any excess rock, which may be left following reuse. Suitable access to the materials will be agreed with the local authorities in consultation with the community
- Transport any further material to the nearest spoil disposal sites agreed in consultations with the local authority. There is lack of plain sites and transformed landscapes that could be used for spoil disposal. Eroded and ragged (ravained) sites could used for that purpose. Sites should be selected and agreed with local authorities and spoil material could be used for improving relief and reinstatement of the eroded sites. River bank protection projects are also suitable for utilization of the excess rocks. Only eroded ravines could be used for the mentioned purpose and the spoil should not be disposed irregularly. Erosion stabilization design with additional structures (berms, drainage systems etc.) and regular structure of compacted stockpiles matching specific features of relief is required. The aim is to stabilize instable slopes but not to create new instabilities.

- For the rock disposal (if required) licensed borrow pits could be used. Rock disposal pits used for final disposal must meet the MoE requirements for Inert Landfills or Technogenic Rock Deposits and should be agreed with the MoE.
- spoil could be used at the unused/illegal landfill site for reclamation purposes

The costs for disposal of the rocks within the private borrow pits should be agreed with the concrete owners. The spoil disposal in eroded sites will cost only the price of work related to transportation of spoil and reinstatement of eroded sites.

All other nonhazardous waste (garbage, litter etc.) from the construction sites and camps will be disposed on municipal landfills in cooperation with the official municipal waste operators.

Burning of waste on any construction site is forbidden with the exception of stub and small branches from felled trees and bushes, which is better to be burned in order to avoid pest dissemination.

Hazardous Construction Wastes

According to local legislation (Order #36/N of the Minister of Labor, Health and Social Protection of 24.02.2003) small amounts of listed types of hazardous wastes could be disposed on municipal landfills. Disposal of the most part of hazardous wastes should be agreed with the MoE and local authorities. Constructing Contractor shall collect hydrocarbon wastes, including lube oils, for safe transport off-site for reuse, recycling, treatment or disposal at the temporary storage sites and further at the locations approved by MoE or pass it to the licensed operator (e.g. Sanitari Ltd), having environmental permit on operation of the hazardous wastes.

8.1.1.4 Noise, dust and emissions

The settlements are not affected significantly by the construction related emissions. However, emissions of heavy machinery involved in the construction should be managed by proper engine maintenance practice and usage of good quality fuel. The work of engines in a no-operation mode should be excluded.

Relatively high impact is connected with the dust emissions, which hardly can be quantified. However, it is obvious that the earth works and transportation of gravel and other inert materials from borrow-pits will impose nuisance related with dust. This is temporary impact, and should be mitigated by periodical watering of the work sites.

As a result of rough estimation of construction related noise, we can assume that the noise impact will not exceed radius of 320m. Temporary increase of the noise level near the construction ground within the 300m radius is acceptable impact. The residential houses in the villages are not so densely concentrated near the road.

Mitigation of this minor impact is possible by engine maintenance practice and avoidance of engine work in non-operational mode. The only limitation that could be recommended is to deploy high noise devices, like crushers, outside the residential zone and exclude the night-time works in v. Sasadilo, Bochorma, Kudro and Orkhevi. The night-works at other sites could be carried out without limitation.

All vehicles shall be maintained so that their noise and emissions do not cause nuisance to workers or local people. Near the settlements, the rehabilitation activities will be limited to daylight working hours to reduce impacts. All vehicles will be checked and repaired in case of need to eliminate increased level of noise due to damaged parts.

Regular maintenance of diesel engines will be undertaken to ensure that emissions are minimized, for example by cleaning fuel injectors. Routine maintenance will be to a high standard to ensure that vehicles are safe and that emissions and noise are minimized. All plant used on site will be regularly maintained so as to be in good working order at all times to minimize potentially polluting exhaust emissions.

Vehicle refueling will be undertaken so as to avoid fugitive emissions of volatile organic compounds through the use of fuel nozzles and pumps and enclosed tanks (no open containers will be used to store fuel).

If deemed necessary in dry conditions or where significant quantities of dust are being or are likely to be produced mitigation measures will be arranged with the Construction Manager. Mitigation measures will include:

- Damping down using water bowsers with spray bars or other technical means; Minimum 2 bowsers will be required for that purpose. However, the constructing contractor should not be limited by this figure, and if required additional bowsers should be engaged.
- Sheeting of construction materials and storage piles; and
- Use of defined haulage routes and reductions in vehicle speed where required. Materials will be transported to site in off peak hours.
- Materials transported to site will be covered/ wetted down to reduce dust. The construction site will be watered as appropriate. Protective equipment will be provided to workers as necessary. All vehicles will be checked and repaired in case of need to eliminate increased emission due to damaged parts

Such measures will be used, where human or animal receptors lie within 300 m of the ROW

8.1.1.5 Quarrying Sites and Borrow Pits

4,420 m³ embankment construction will mainly utilize materials from road cut. Materials supply from the quarries is mainly related to the pavement construction.

- crushed stone base, 220 mm thick, CBR > 100 %, 33,495 m³
- prime coat, 76.3 ton
- asphalt concrete surface course, 50 mm thick, 109,005 m²
- shoulder fill material 1,800 m³
- sand and gravel - 22,800m³
- sand for asphalt concrete mixes - 5,450 m³.

Generally quarry sites are the major sources of environmental impact due to dust and noise pollution, loss of biodiversity, and generation of spills. Operation of the quarries above the approved limits may cause change of floodplain hydrology and trigger erosion and landscape degradation. The operating procedure for borrow pits shall consider following principles: (i) maximize the amount of fill that can be effectively used from the pit, (ii) minimize erosion and sedimentation, (iii) preserve the water quality of the rivers, (iv) protect air quality during excavation, (v) prevent wildlife from falling into the pit, and (vi) reinstatement of the site after construction. Only approved borrow and quarry sites will be used by the contractors and produce copy of necessary government licenses to the client before procurement.

The mitigation plan to be followed by the Contractor at the borrow sites is: (i) only borrow areas approved by the environmental authority will be used for the project; (ii) pits management, (including restoration if it will follow the completion of certain works) shall be in full compliance with all applicable environmental standards and specifications; (iii) the excavation and restoration of borrow areas and their surroundings, in an environmentally sound manner to the satisfaction of the MoE and RD; (iv) borrow pit areas will be graded to ensure drainage and

visual uniformity or to create permanent tanks/dams. Additional borrow pits, if necessary, will not be opened without the restoration of those areas no longer in use, and without the approval of MoE. Topsoil from the opening of borrow pits will be saved and reused to revegetate the pits to the satisfaction of the MoE.

General principles recommended for borrow pit and quarries management:

- Do not use borrow excavation until all suitable roadway excavation is used. Use select borrow and select topping as shown on the plans.
- Develop and restore Government located and provided borrow sources as approved by the Engineer.
- Do not excavate beyond the established limits.
- The borrow pit shall be landscaped after the excavation.

After the closure of the borrow pits, reinstatement and landscaping plan should be implemented by Construction Contractor.

Local roads will be damaged during transportation of borrow materials and by the construction equipment. In order to reduce impact on all borrow sites and local roads, contractors will water the local roads close to the settlements used by the borrow trucks and rehabilitate the local roads to their original conditions.

The measures aimed on mitigation of the dust and emission impacts, as well as potential river contamination due to improper fueling and vehicle operation, should be the same as above described pollution prevention measures, but control on this sensitive site should be more strict. Road Department and Constructing Contractor's environmental personnel should pay more attention to the quarrying site during monitoring.

The MoE and Environmental Inspectorate are in charge to control compliance of the quarrying company's performance. The Road Department will control the licenses of Construction Contractors in case they are exploring some quarries and borrow pits.

8.1.1.6 Topsoil Protection

Topsoil of cultivated land used for temporary work areas will be stripped off and stockpiled, to be replaced when the construction is completed and the cultivated land rehabilitated. The top soil along the Project road will also be stripped, preserved for reuse. There may potentially be some topsoil washout due to improper storage and reinstatement. Contractors will be encouraged to minimize usage of productive agricultural land and convert them to their original state after completion of civil works. Embankments should be monitored during construction for signs of erosion; long-term material stockpiles will be covered to prevent wind erosion.

The storage of topsoil in stockpiles, no more than 2m high with side slopes at a maximum angle of 45⁰, will take into consideration the following:

- Segregation of the topsoil from the subsoil stockpiles
- Dedicated storage locations that prevent the stockpiles being compacted by vehicle movements or contaminated by other materials;
- Segregation from subsoil stockpiles;
- No storage where there is a potential for flooding;
- No storage at less than 100 m from river/streams, subject to site specific topography.

Contractor will protect the stockpiles from flooding and run-off by placing berms or equivalent around the outside where necessary. Topsoil stockpiles will be monitored and should any adverse conditions be identified corrective actions will include: (i) anaerobic conditions - turning the stockpile or creating ventilation holes through the stockpile; and (ii) erosion - temporary protective silt fencing will be erected;

Topsoil removed from the construction sites will be used for reinstatement of the topsoil on the embankments or in the adjacent construction corridor affected by the project activities. Topsoil will be reinstated separately from subsoil, with care taken to avoid mixing of the materials. The topsoil reinstatement will be sufficient to restore the fertile depth to the initial conditions as judged by the topsoil strip during visual observation and comparison of the reinstated site and adjacent land. When replacing the topsoil Contractor will program the works such that the areas farthest away from the stockpiles are reinstated first with reinstatement getting progressively closer to the stockpiles, thus reducing the number of vehicle movements over the reinstated topsoil. The reinstated topsoil will then be harrowed, where practical, to protect the stability and promote vegetative growth.

Subsoil Storage The storage of subsoil in stockpiles, no more than 3m high with side slopes at a maximum angle of 60°, will take into consideration the following:

- Dedicated storage locations where the stockpiles will not be compacted by vehicle movements or contaminated by other materials; and
- Segregation from topsoil stockpiles.

In the event that the subsoil stockpiles experience significant erosion Contractor will institute corrective action such as installing erosion matting over the stockpiles.

Temporary Erosion Control Measures

The measures, by which Contractor will address the protection of “slopes” adjacent to the highway against erosion before permanent reinstatement, are outlined in this section. Temporary erosion control measures will be introduced as necessary, paying special attention to:

- Construction activities that increase the potential for erosion from the slope sides and/or sediment mobilization in watercourses;
- Straw bale barriers in locations requiring small volumes of sediment interception;

Temporary erosion control measures will be left in place until the slopes are stabilized to the approval of Road Department. The purpose of temporary erosion control measures is to:

- Interrupt surface water run-off;
- Slow the velocity of water runoff to the extent practical;
- Divert water off exposed check dam areas;
- Prevent and minimize sediment transportation off the construction sites.

8.1.1.7 Final Reinstatement and Long-term Anti-erosion Measures

All the work sites (except permanently occupied by the road and supporting facilities) should be reinstated to its initial conditions (relief, topsoil, vegetation cover). So far as very limited bush clearance and no woodcutting is required for the highway upgrading, preservation of top-soil is sufficient for reinstating the natural grass vegetation cover as well. Replanting of bushes and trees is considered below in a section “Landscaping and planting of greenery”.

8.1.1.8 Landscape Reinstatement and Protection of Flora

According to the current basic design the most sensitive sections (SZ1, SZ2, SZ3 and SZ4a) are not affected by any route changes or road widening. Clearance of bushes that have encroached

sides of the existing (but not so much used) road is planned during the road rehabilitation for the section, which is crossing medium sensitivity zone (**MSZ 5**, habitat of medium sensitivity), characterized by following species composition: willows - *Salix excelsa*, asp - *Populus canescens*, maple - *Acer campestre*; from shrubbery – blackberry, hawthorn, sea-buckthorn, etc. are present. As a result, sea-buckthorn shrubs encroaching on both sides of the road will be destroyed. The land with affected sea-buckthorn shrubs is part of existing RoW and belongs to the RD.

Following mitigation/compensation measure are proposed: As a result of the detailed field botanical research one species from the Red List of Georgia has been found within the section - *Ulmus minor* Mill. (field elm; VU), about 20 individuals. The mentioned individuals are located quite close to the road, although they are not affected according to the current plan. However, care should be taken to ensure that they are kept intact during the project implementation (possible design changes or deviations). In case if the red-data species are damaged, compensatory planting of the species should be facilitated with the proportion of 1:10, so 10 trees should be planted instead of 1 cut tree (sapling of *Ulmus minor*), total of 200 saplings.

The same approach is applicable for the sea-buckthorn shrubs subject for clearance, because it is a valuable species; and because sea-buckthorn is likely to get back on the Red List of Georgia as a result of the ongoing revision of this document (Sea-buckthorn was included in the pre-last edition of the Red List). Cost of sea-buckthorn seedlings is about 5 Gel and they are available in Sartichala Plant Nursery. Maximum value of compensation planting could be calculated as: 20 cut bushes x 10 x 5Gel + 500Gel for workers = 1500 Gel.

Slight changes of the route during the finalization of design could be introduced. In that case additional (pre-entry) survey is needed to identify trees and other flora species under the impact and to plan appropriate mitigation and compensation schemes. After the identification of the endemic, rare and endangered and other species under the project impact appropriate mitigation measures, which shall facilitate the protection, conservation and sustainability of these endangered species within the direct impact of the project construction, should be elaborated. Planting is expected within the RoW or within the municipalities located on the Sasadilo-Sioni road. Specific information about the species and number of trees/shrubs marked for extraction as well as the plans for compensatory tree planting must be part of the detailed design of individual sections of Sasadilo-Sioni road, which are subject to clearance by the client of the design-and-build contract and the World Bank.

8.1.1.9 Protection of Fauna

The rehabilitation of the existing road, as it is designed, will not cause the loss of valuable habitat or ecosystems, or new fragmentation of currently undisturbed natural habitats. Animals inhabiting forested areas adjacent to the existing road are adapted to the traffic related disturbance.

Mitigation measures would be required to prevent low probable and small scale impacts on bats during demolition of old bridge structures. Preliminary survey of old bridges is required and in case of presence of bat colonies, smooth methods (mainly acoustic) of scaring them away should be applied.

Pits, trenches and similar should be limited by some barrier to prevent falling of animals into them – i.e. large bright colored bands perceptible for medium-size and larger mammals and any flat material for small animals: tin, polyethylene, etc. Long boards or logs should be put in pits

and trenches at night so that small animals are able to get out. Pits and trenches should be checked prior to land filling.

It is desirable, that cleaning of channel from debris near the bridges No 1 and No 2 over river Iori is conducted during the spawning season (May – August). For other bridges over small and turbulent tributaries of river Iori this requirement is not so urgent, as these water bodies are not known to be spawning area for fish.

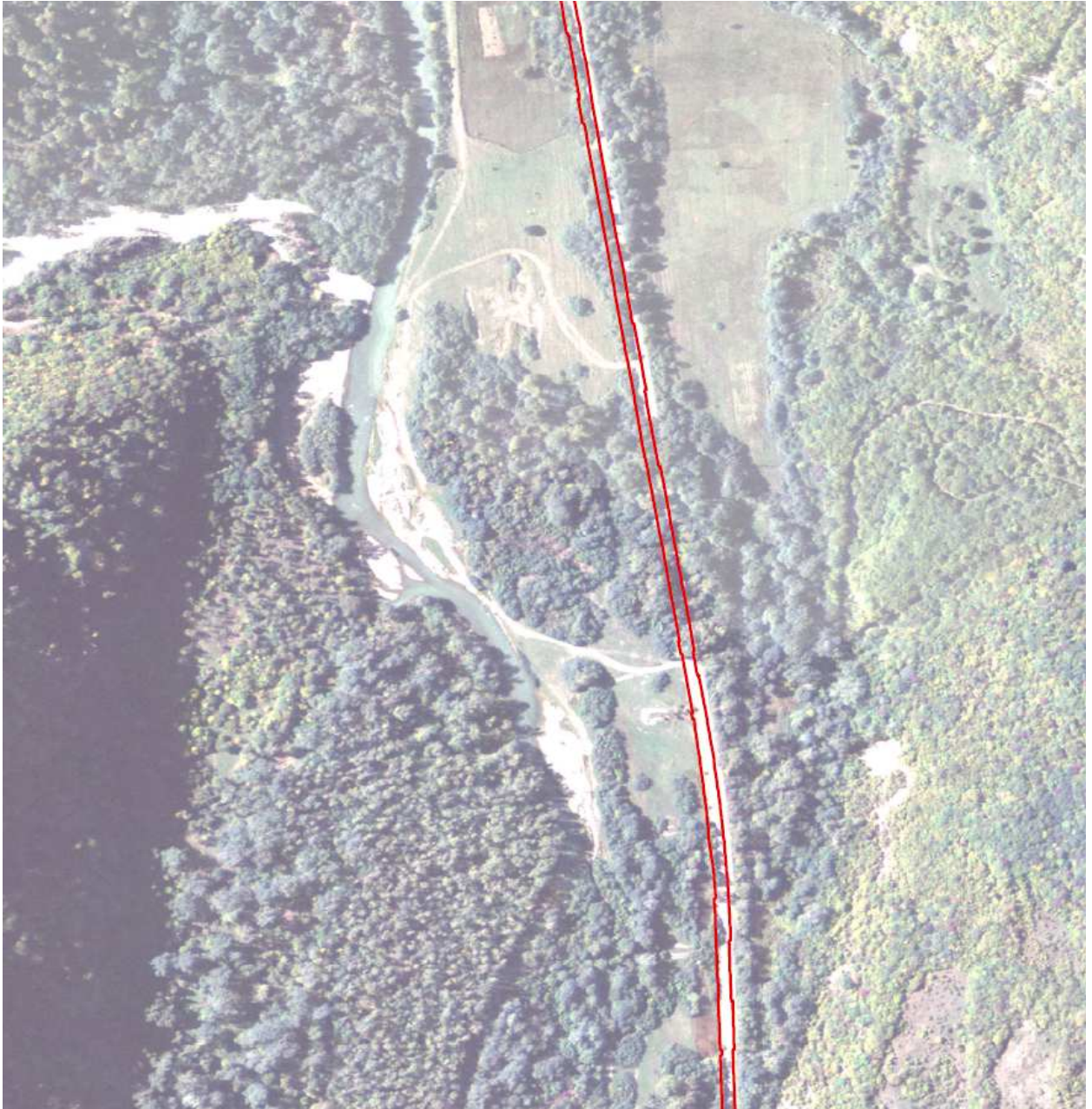


Fig. 29 Sea-buckthorn impact site

Potential impact on ichthyofauna is also related to the possible pollution of the river Iori by increased sediment runoff during earthworks and contamination due to improper fuel and waste management. Accordingly, anti erosion and pollution prevention measures discussed above are also considered as measures mitigating impacts on ichthyofauna.

Noise, emission and dust minimization actions, as well as prevention of poaching by the workers should be included in the EMP as mitigation procedures.

The plants will be covered with dust, which will impact the feeding base and reproduction of vertebrate and invertebrate species (Яблоков, Остроумов 1985). The impact is limited to the territories in the immediate vicinity (adjacent to) of the road.

Fire prevention and protection procedures should reflect specific risks related to forest fires. Appropriate equipment and management system should be at place.

8.1.1.10 Protection of the cultural heritage

Despite the fact that the project footprint is mostly limited to the existing road and construction sites are not located near any known subterranean monuments or areas of an archeological interest, destruction of archeological layers during the construction process is possible (although unlikely). If archaeological sites are revealed during the earth work, the finds shall be registered, works taken on hold, the information promptly communicated to the Georgian Ministry of Culture and Protection of Monuments, and instruction on the further course of action sought from this agency. Works contractor is allowed to resume activity only upon receipt of a written communication from the client.

8.1.1.11 Protection of the Infrastructural Elements

During the mobilization and preconstruction stage required activities are planned to remove the existing transmission lines, water supply pipelines and local gas pipelines to the safe sites. All of these infrastructural systems should be uninterruptedly functional during and after completion of construction activities. Permanent monitoring is required to avoid damage of the infrastructure systems, which are not removed. All the damaged systems should be reinstated.

Relocation, replacement and rerouting of all utilities located on the Project:

- The contractor is responsible for working closely with any utility company having their infrastructure located within the public right-of-way.
- Before any construction is begun the Contractor shall notify the utility companies of the proposed work area and request that they mark the location of any types of equipment in the area.
- The Contractor shall establish the position of existing services such as pipelines, sewers, surface water drains, cables for electricity and telephones, overhead lines and water mains, before starting any excavation or other work likely to damage them.
- The Contractor shall be responsible for arranging in liaison with the appropriate Authority, the moving of or alterations to services such as pipelines, power and telephone lines, water mains, sewers and surface water drains which are affected by the Works. The arrangements for such moving or alteration shall be subject to the agreement of the Engineer and the appropriate Authority.
- The Contractor is responsible for any and all damage caused to any utility during construction and shall repair them with his equipment or, if the utility company desires, they shall be allowed a free use of his equipment and personnel as required in order to complete repair works.
- Should the utility company chose to repair the damaged utility themselves costs incurred shall be the responsibility of the Contractor.
- If any utility equipment is encountered in the proposed work area the Contractor shall submit to the Engineer for approval his proposal to relocate the utility outside the construction limits in writing. This proposal shall include, but not be limited to the proposed duration of the works, plans and details of a new utility route, materials to be used, together with any required certification that the material meets the utility company's specification and details of protection methods to be used for any utility materials to be left in place. After the utility has been rerouted the interested utility company shall be

notified to inspect the work prior to commencing the backfill operation. Demolition of existing wooden power transmission posts an relocation at new sites

- Relocation and protection-in-place of gas pipe linear meter
- Relocation and protection-in-place of electrical cable linear meter
- Relocation and protection-in-place of communication cable linear meter
- Construction of duct crossings

8.1.1.12 Health and Safety

It is required to observe safety measures, industrial sanitation and fire precaution measures and instructions whilst performing the works, as well as to train the staff. The Contractor is required to instruct the staff on safety measures prior to the commencement of works.

Road vehicles shall have small turning radius, equipped with sound signals and light signals which should be in good operating conditions. Parking place shall be fenced with barriers and equipped with red signals of emergency stop during the day and with red signal floodlight at night.

Roadmen shall be provided with special uniforms and special footwear. It is required to observe overall safety measures such as fencing of work site, various safety activities. The Contractor should ensure special shelter for protecting workers from unfavorable weather conditions.

Alternate access will be provided for vehicles and pedestrians. Appropriate lighting and signs will be employed.

The Contractor is responsible to perform the works in accordance with labor protection and safety requirements as well as industrial sanitation requirements.

8.1.1.13 Asphalt Mixing Plants

Below we provide figures for asphalt requirement for the project:

109,005m² of asphalt concrete surface coarse 50 mm thick, conform to specification Clause 4.05.

Mix Type	Grading limits; Grading (passing %)										
	Sieve size (mm)										
	0.071	0.14	0.31	0.63	1.25	2.5	5	10	15	20	40
Fine	2-8	3-15	4-22	7-28	10-38	18-50	27-65	45-76	57-100	70-100	-
Coarse	2-8	3-15	4-22	7-28	10-38	18-50	27-65	45-76	57-100	70-100	95-100

Required Asphalt Mixing Plant is of capacity over 80 t/hour hour. The asphalt plants shall be of batch mix type with automatic controls and with a capacity of at least 50- 80 tons/hour. At least four cold containers for different aggregate fractions are required. All containers shall be covered to prevent the ingress of moisture. The weighs of the plant shall be calibrated before the start of the production or whenever directed by the Engineer. Asphalt concrete mix should be weighed on vehicle scales up to 2% in accuracy.

The bitumen tank shall be capable of maintaining its contents at the specified temperature within a tolerance of plus or minus 5°C and shall be equipped with a thermostat to prevent the temperature rising above 180°C and a fixed thermometer easily read from outside the tank. Any bitumen which has been heated above 180°C or has suffered carbonization from prolonged heating shall be removed from the plant.

The constructing contractor has a choice either to use licensed suppliers already operating in the area or to install its own asphalt plant.

In case if the constructing contractor takes decision to install new asphalt plant, prior to installation the company is obliged to prepare the relevant EIA and to get Environmental Impact Permit on installation and operation of the asphalt plant.

In case if the contractor utilizes supplied asphalt, he is obliged to control license of supplier and ensure required quality of the asphalt. Special requirements should be met in relation with transportation of asphalt:

Use vehicles with tight, clean, and smooth surface for hauling asphalt concrete mixtures and provide each vehicle with necessary documentation related weigh calibration. The duration of asphalt concrete hauling is determined by the minimum temperature condition for spreading in accordance with Subsection 'Compaction' below. The surface of beds should be covered by thin coat of approved material to prevent the mixture from adhering to the beds. Do not use petroleum derivatives or other coating materials which contaminate or alter the characteristics of the mixture. Drain the bed before mix loading. Equip each truck with a canvas cover or other suitable material of sufficient size to protect the mixture from the weather influence. Where necessary to maintain the mix temperature, use insulated truck beds and securely fastened covers. Provide access ports or holes for checking the temperature of the asphalt mixture in the truck.

8.1.1.14 Construction Camps

It is expected that the contractor will need to establish several equipment yards with 2 or 3 temporary shelters rather than full scale construction camps. The accommodation for the workers will be provided in the nearest villages. The workers will not live in the shelters on-camp. Shelters are supposed to be used as office, storage site and building for the guard personnel. The yard will be used for storage of equipment and machinery, fueling, simple maintenance works. The equipment yards could be located close to the village Udjarma, Paldo, and Sasadilo, as well as to the Vaziani area. The exact location will be selected by the constructing contractor. The location should be selected to comply with the following criteria:

- transformed urban or rural landscape not sensitive from ecological standpoint
- the fueling facilities could be located at a distance of 50m and more from the surface water objects
- the camps should not be located closer than 350m to the residential settlements. The distance should be sufficient for reducing the noise impact to acceptable level and not too large, so far as it is supposed that the accommodation and sanitary-hygienic facilities are available for the workers in the villages.

Waste Management Plan for Construction Camp is given in annex 2. Here below we provide brief summary.

The following categories of waste are expected during object exploitation:

- Household waste;
- Office waste (paper, cartridges, bulbs, etc.);
- Packaging (wood, paper, etc.);
- Oil contaminated clothes, filters, absorption pillows;
- Oil contaminated soil;
- Polymer waste;
- Medical waste.

The amount of household waste produced during plant functioning is connected with the staff number. According to the preliminary data, up to 100 people shall be employed. Following the accepted norm, 0.70 m³ of household waste is produced per employee annually. Proceeding from the above, the amount of household waste per year will be: 0.70 X 100 = 70 m³. The installation of closed containers is planned for household waste at the object. The removal of this waste and disposal at the grounds will be conducted on the basis of the contract with the municipal cleaning service.

Oil contaminated mass as well as other hazardous waste shall be temporarily allocated within the plant in accordance with environmental and hygienic requirements and proceeding from the collection passed to the organization with appropriate environmental impact permit for further processing/disposal/treatment.

Wooden packaging material shall be passed to the local population for further re-use.

The management of waste produced at the object (classification, inventory, segregation, collection, storage, passing and transportation) and monitoring shall be conducted in accordance with the principles, procedures and rules described in Annex 2.

8.1.2 Mitigation of Long-term and Operation Related Impacts

Here we would mention the mitigation measures to be implemented at operational stage. Most of these measures (predominantly maintenance works) should be implemented by Road Department utilizing funds from the state budget, lawns, grants and other financial sources.

Noise Abatement

Traffic related noise is not exceeding standard limits at a distance more than 10m-s from the road border. The impact will not be significantly higher for the year 2031 , when the traffic volume is expected to increase threefold. Introduction of the speed limitation and control measures for the settled areas should be sufficient to mitigate the noise impacts to the acceptable level..

Erosion and land stability control and landscaping. Road Department should ensure permanent erosion and land stability control and monitoring of landscape restoration after completion of construction works, as well as timely implementation of corrective actions. Corrective actions include, but are not limited to maintenance of drainage systems and implementation of anti-erosion measures (berms, vegetation cover etc.) whenever required.

Roadside litter and fuel pollution. RDMRDI should coordinate with the local Governmental institutions and private companies and facilitate arrangement and proper functionality of supporting facilities and services (fueling stations, waste management services)

Air emissions, noise and pollution during the maintenance works. RDMRDI should ensure incorporation of environmental considerations in the maintenance contracts and monitor implementation.

Landscaping and planting of greenery. In a long-term perspective and in relation with the entire length of highway RDMRDI should plan development of the roadside zone applying proper landscaping and greenery planting strategies. Visual and aesthetic, as well as emission screening aspects should be taken into consideration.

Prevention and mitigation of accident risks associated with vehicular traffic and transport, that may result in spills of toxic materials injuries or loss of life Emergency preparedness. RDMRDI in conjunction with the Ministry of Interior (Department for Managing Emergency

Situations) should facilitate development of legislation and emergency response plans regulating transportation of hazardous materials. The system of measures may include but not limited to:

- 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.

The abovementioned measures and plans should be elaborated in accordance with the Law of Georgia on Hazardous Substances and Regulations of the MoE on “Norms of Usage of Chemicals in the Environment and Rules of Transportation, Storage and Usage of Chemicals”. Regulations of other countries (e.g. Order of the Minister of Transport of Russia # 73 issued 08.08.1995 as amended in 1999) could be used as supporting materials.

8.2 MONITORING AND ENFORCEMENT

Institutional Framework for EMP Implementation

Construction contractor is obligated to follow the present EMP; develop section-specific detailed designs in the way least damaging to the vegetative cover of the road corridor and including best solutions against erosion and other geological activities observed in the project site; produce section specific plans for the disposal of construction waste, borrowing of construction material, placement of machinery yards, traffic regulation during construction, and compensatory tree planting after completion of works; and to apply good construction practice. In order to meet these obligations, a contractor shall have at least one environmental specialist on the team, who is able to fully understand recommendations of EMP and professionally apply prescribed mitigation measures to the contractor’s daily operations.

Technical supervisor of works commissioned by RDMRDI (“Engineer” according to FIDIC terms or Supervising Agency (SA) in general) is responsible to establish strong field presence in the Project area and keep a close eye on the course of works. Along with ensuring consistency with the design and ensuring quality of works, the supervisor is mandated to track implementation of EMP by the contractor, reveal any deviations from the prescribed actions, as well as identify any unexpected environmental issues should they emerge at any stage of works.

RDMRDI provides a general oversight on the environmental compliance of works through ensuring quality performance of the technical supervisor and of the contractor. RDMRDI also liaises with the World Bank, ensures availability of all environmental information, and facilitates environmental supervision of the Project by the World Bank.

Reporting on EMP Implementation

Contractor, through the environmental specialist on the team, shall prepare monthly status reports on the EMP implementation. Such reports must carry information on the main types of activities carried out within the reporting period, status of any clearances/permits/licenses which are required for carrying out such activities, mitigation measures applied, and any environmental issues emerged in relations with suppliers, local authorities, affected communities, etc. Contractor’s monthly status reports shall be submitted to the technical supervisor and RDMRDI.

Technical supervisor prepares monthly reports on the status of EMP implementation and environmental performance of the contractor. These reports shall be based on the contractor’s reports and carry analysis of their contents. Technical supervisor shall assess how accurate is the

factual information provided in the contractor's reports, fill any gaps identified in them, and evaluate adequacy of mitigation measures applied by contractor. Technical supervisor must highlight any cases of incompliance with EMPs, inform on any acute issues brought up by contractor or revealed by supervisor himself, and propose corrective actions.

RDMRDI must ensure that monthly reports from the contractor and from the technical supervisor are made available for the environmental specialists of the Department promptly upon their arrival in RDMRDI administration. The Department, through its environmental specialists, shall report each semester to the World Bank on the status of environmental compliance of construction works. Such reporting shall contain information on all violations identified and the actions taken for fixing of such cases. RDMRDI shall inform the World Bank on any major environmental issues at any time, independently from the schedule of regular reporting.

Remedies for EMP Violation

RDMRDI, as a client of construction works, will be responsible for enforcing compliance of contractor with the terms of the contract, including adherence to the EMP. For minor infringements, an incident which causes temporary but reversible damage, the contractor will be given 48 hours to remedy the problem and to restore the environment. If restoration is done satisfactorily during this period, no further actions will be taken. If it is not done during this period, RDMRDI will arrange for another contractor to do the restoration, and deduct the cost from the offending contractor's next payment. For major infringements, causing a long-term or irreversible damage, there will be a financial penalty up to 1% of the contract value in addition to the cost for restoration activities.

Institutional Capacity of RDMRDI

Within RDMRDI, The Resettlement and Environmental Protection Devsion was established, there is Environmental Protection Unit. Currently, besides the head of the Unit there are three environmental specialists in this staff, and will be one Environmental Safeguards Consultant within one month period, the staff received professional on-the-job training as a part of the World Bank's technical assistance to the RDMRDI. Current environmental capacity of the RDMRDI needs strengthening to ensure full environmental compliance of the Project. Although day-to-day quality control of works will be outsourced to the engineering supervisor of works, RDMRDI should have in-house human resources to oversee performance of such technical supervisor and to work out decision to address issues which the supervisor may bring up for RDMRDI's attention.

Key Lessons Learned from Environmental Management of VGT Section Rehabilitation

Rehabilitation of the VGT Road revealed shortcomings in environmental and general project management resulting in environmental impacts.

The major problem was disposal of spoil and excessive rocks: at early stages, the sites for spoil and rock disposal were not agreed with the local government and the issue was ignored in principle. Spoil was disposed close to the road, often in sensitive areas, - even in forests adjacent to the road. The visual and ecological impacts on landscape and sensitive ecosystems were significant. At later stage, when the problem was recognized by RD the first corrective measures also appeared to be not efficient and sometimes imposed additional impacts. The local government was involved in selection of the spoil disposal sites, but the selection process, as well as spoil disposal activities were conducted in a great haste and without involving professionals. No disposal plan and design has been elaborated. Instead of using spoil as a filling

material for stabilizing slopes of eroded ravines and river banks (according to appropriate design), the spoil material was disposed irregularly in inappropriate dry gorges, creating instable, easily erodible masses, changing hydrological patterns for the flooding period and increasing risks of debris-sliding and contamination of rivers with increased sediment and debris load. Significant efforts have to be applied to improve spoil disposal practice and to restore disfigured landscapes and forests.

Topsoil storage and management also was far from good environmental practices and prescriptions given in the EMP. Due to the fact that significant part of stripped topsoil was lost, reinstatement of affected landscapes and embankments faced significant problem.

At the landslide prone sections of the road drainage systems and retaining structures could be installed at earlier stages and that would let to minimize landslide related damages of the road.

Procedures of tree felling and storage of wood were not conducted in full compliance with the current regulations.

All the mentioned violations and shortcomings were resulting from inadequacy of the EMS of construction Contractor and monitoring capacity of the RD to the extremely intensive rate of construction activities requested by the Government. In future, the EMS capacity should be brought in compliance with the construction demands and construction rates should be limited to the feasible frames. It is expected that the nature of design-and-build contract intended for rehabilitation of Sasadilo-Sioni road will be permissive for closer control over the presence and adequacy of the arrangements for waste disposal, topsoil storage, material extraction, drainage, and a few other critical aspects in the detailed designs of road section, as long as the client and the World Bank will be clearing these detailed designs for individual sections one by one, prior to commencement of work in each individual section. RD's in-house oversight capacity remains a concern as the current policy of outsourcing this function cannot fully make up for the internal expertise necessary for at least quality control of the provided services.

The Spoil and Rock Disposal Plan, including description of selected sites, design of stockpiles and supporting structures (berms, drainage etc.), as well as description of works, should be elaborated by constructing contractor.

Offset tree planting project (if required in case of some changes of route) should be also developed. Relevant costs should be reflected in the overall construction budget.

8.3 COSTS OF IMPLEMENTATION

The costs of environmental activities associated with the construction will be included in the contract for construction.

Costs of spoil and rock disposal is variable and could not be precisely defined before elaboration of the concrete plan. The costs for disposal of the rocks within the private borrow pits should be agreed with the concrete owners. The spoil disposal at eroded sites will cost only the price of work related to transportation of spoil and reinstatement of eroded sites. These expenses are to be covered by constructing contractor and the related condition should be stipulated in the contract.

At the detailed design stage, in case of new land take is planned for widening some sections of the road or for camp sites and new borrow pits, additional ecological and archaeological studies

may be required. Possible need for financing these studies should be considered under the “design and build” contract.

In case if the red-data species are damaged, compensatory planting of the species should be facilitated with the proportion of 1:10, so 10 trees should be planted instead of 1 cut tree (sapling of *Ulmus minor*), total of 200 saplings. Cost of seedlings is about 5 Gel and they are available in Sartichala Plant Nursery. Maximum value of compensation planting could be calculated as: 20 cut trees x 10 x 5Gel + 500Gel for workers = 1500 Gel. Planting of sea-buckthorn saplings to compensate removal of individuals belonging to this species will be necessary. Associated cost are similar to those provided above for *Ulmus* trees.

The main expenses are associated with the need to hire environmental and H&S specialists. Related costs are approximately 60,000 GEL annually.

8.4 Environmental Management Matrix

8.4.1 Preventive and Mitigation Measures to be Implemented During the Design Phase

Impacts	Sites	Mitigation Measures/Costs	Timeframe	Responsibility for Implementation	Responsibility for Monitoring
<p>Impact: Destruction of natural landscape and valuable habitats in sensitive zones adjacent to the Right-of-Way occupied by the highway.</p> <p>Design stage factors influencing impact severity or risks: Changes in RoW layout introduced at the Detailed Design stage or improper siting for camp.</p>	SZ 1, 2, 3, 4a	<p>Prevention and Mitigation Measures: Detailed Design Contractors should be aware of the sensitive ecological zones adjacent to the RoW. Detailed Design Contractor will apply following basic principles:</p> <ul style="list-style-type: none"> - Minimize project footprint by avoiding any unnecessary widening or change of layout of the existing road. The need for expansion of the borders of existing RoW, where it is absolutely necessary should be well justified - Expansion of the RoW within the sensitive zones, as well as temporary use of these territories (for soil storage, camp deployment or other needs) will be excluded (Optimal siting; Agree the site with the local authorities); 	Design stage	Design and Constructing company.	RDMRDI
<p>Impact: Landslides, debrisflows and other mass movements at the landslide prone areas.</p> <p>Design stage factors influencing impact severity or risks: Engineering solutions (or “no action” decision) taken at the DD stage influence to the great instance the geohazard risks;</p>	km 0 +200 Landsl. km 4+ 200 mudflow km 4+200 landslide km 5+00 - km 7+00 r. Orville debrisflow km 8+100 landslide km 10 - km 12 r. Sajinobos Khevi debris-flow	<p>Detailed Design will include site-specific engineering solutions for the landslide prone areas: The detailed design should include surface water collection and drainage systems, antierosion measures (berms, revegetation etc.) and retainment walls and gabions where required. Further detailed investigations will be necessary at the DD stage to take decision if protective measures have to be designed. In many cases it might be advisable to choose the “do nothing “option and repair damages when they occur.</p>	Detailed design stage	Design and Constructing company.	RDMRDI
<p>Impact: Erosion stimulated from cuts and erosion of lands below the road receiving concentrated outflow from drains.</p> <p>Design stage factors influencing impact severity or risks: Improper design of road cuts and drainage system;</p>	Along the whole section of the road	<p>Prevention through designing site-specific anti-erosion measures – temporary drainage, biomatting or geo -textile cover, berms etc. for erosion prone sites</p> <p>Design drain outlets so as to avoid cascade effect</p>	Detailed design stage	Design and Constructing company	RDMRDI
<p>Impact: Increased suspended sediment in streams affected by erosion at construction sites</p>	Subsections close to the r. Iori,	Prevention by designing temporary anti-erosion measures – temporary drainage, temporary sediment catchments and	Detailed design stage	Design and Constructing	RDMRDI

and fresh road cuts, fills and waste dumps. Declined water quality and increased sedimentation Design stage factors influencing impact severity or risks: Improper design;		retention ponds etc. So far as no high erosion-risk sites are identified, there is no need of developing site-specific design. However, typical design solutions should be provided within the Detailed Design.		company	
Impact: River contamination due to fuel spillages Design stage factors influencing impact severity or risks: Design of Bridges;	Rivers - subsections close to the r. Iori,	Specific storm-water collection, secondary catchment and oil separation constructions should be designed for the major bridges;	Detailed design stage	Design and Constructing company	RDMRDI
Impact: Infrastructure. The main infrastructure element that could be affected are the power transmission lines, water supply systems and irrigation pipes and channels. Design stage factors influencing impact severity or risks: Engineering solutions at the DD stage influence the magnitude of impact	1. power lines 2. Local water supply pipelines 3. Local gas pipelines	Protection of infrastructure. Relocation plan for the affected infrastructure elements or “crossing design” should be provided within the Detailed Design	Detailed design stage	Design and Constructing company	RDMRDI
Impact at the Quarrying Sites: impact on landscape Design stage factors influencing impact severity or risks: Volumes to be explored and reinstatement plans are elaborated at the design stage. Excessive exploration may cause longterm damage to the river floodplain;	presumably, r.Iori floodplain	At the DD stage proper exploration and reinstatement plans should be elaborated for the quarries explored by the construction company	Detailed design stage	Design and Constructing company	RDMRDI Ministry of Energy and Natural Resources
Impacts on Construction Camp Site: Some of the potential impacts related to the operation of the camp: - Contamination related to fuel storage and fuelling operations - Sewerage related contamination Design stage factors influencing impact severity or risks: Design of construction camps determines possibility for reduction of contamination risks	camp site	Ensure that Detailed Design includes: - secondary containment structures and oil separator plants at the fuelling sites - proper sewerage and wastewater/stormwater collection and treatment facilities	Detailed design stage	Design and Constructing company	RDMRDI
Impact: Impacts on archaeological sites and remnants Design stage factors influencing impact severity or risks: Preliminary archaeological survey at the design stage can minimize impacts	Quarrying and Camp sites	During obtaining the Construction Permit archaeological clearance procedures should be met. In particular, for construction of camps and exploration of quarries preliminary survey is recommended, to prevent massive destruction of archaeological artifacts. (Road rehabilitation works may not need survey, as impact is limited to the existing RoW).	Detailed design stage	RDMRDI Design and Constructing company	RDMRDI Archaeologist from CAS

8.4.2 Mitigation Measures to be Implemented During the Construction Phase

Impacts	Sites	Mitigation Measures/Costs	Timeframe	Responsibility for Implementation	Responsibility for Monitoring
<p>Destruction of natural landscape (relief, soil cover, vegetation, eco-systems, habitats and wildlife) in the Right-of-Way occupied by the highway.</p> <p>Activities: land clearance, topsoil stripping and excavations</p>	<p>at sites of road widening or slight corrections of the alignment;</p> <p>Km 8.0-10 ; MSZ 5 As a result of road rehabilitation, sea-buckthorn shrubs on the both sides of the road will be destroyed. Camp site;</p>	<p>Pre-entry survey for preventing damage to fauna will be conducted prior to start up of land clearance (inspection of bat living sites; inspection of nests in RoW)</p> <p>Sticks will be installed in pits and trenches for escaping small mammals.</p> <p>Proper top-soil storage practice, as described below, will be applied and stored topsoil will be used for reinstatement and landscaping;</p> <p>Compensatory planting of the sea-buckthorn species should be facilitated with the proportion of 1:10; Cost of sea-buckthorn seedlings is about 5 Gel and they are available in Sartichala Plant Nursery. Maximum value of compensation planting could be calculated as: 20 cutted bushes x 10 x5Gel + 500Gel for workers = 1500 Gel Pre-entry survey will be conducted for preventing damage to flora and fauna;</p>	<p>prior to start up of land clearance</p> <p>Excavation period</p> <p>From land clearance – till reinstatement</p> <p>Develop planting plan before construction start up. implement before completion</p>	<p>Constructing Contractor</p>	<p>RDMRDI</p> <p>Inspectorate of MoE</p> <p>RDMRDI</p> <p>Inspectorate of MoE</p>
<p>Destruction of natural landscape, at the borrow pit sites, waste dumps, construction camps and equipment yards.</p>	<p>Quarry sites; (e.g. Iori floodplain).</p> <p>Waste dumps, construction camps and equipment yards.</p>	<p>In a case of unavoidable impact on rare or protected species of flora, replanting program will be planned and executed;</p> <p>Landscaping plan will be developed and implemented for quarries and all work sites;</p>	<p>prior to start up of land clearance</p> <p>After completion of civil works</p>	<p>Design and Constructing company.</p>	<p>RDMRDI</p> <p>Inspectorate of MoE</p>
<p>Existing landslides or slope failure triggered in road cuts during the construction activities.</p>	<p>km 0 +200 Landslide. km 4+ 200 mudflow gully km 4+200 small landslide km 5+000 - km 7+000 r. Orville (flashfloods and debrisflows) km 8+100 landslide</p>	<p>The surface water collection and drainage systems, antierosion measures (berms, revegetation etc.) and retaining walls and gabions will be installed as provided in the Detailed Design</p>	<p>Construction period</p>	<p>Design and Constructing company.</p>	<p>RDMRDI</p> <p>Inspectorate of MoE</p>

	km 10+000 - km 12+000 The river Sajinobos Khevi prone to debris-flow				
<p>Erosion stimulated from fresh road cuts and fills and temporary sedimentation of natural drainage ways.</p> <p>Erosion of lands below the road bed receiving concentrated outflow from covered or open drains.</p>	Along the whole section of the road	<p>Permanent and temporary anti-erosion measures will be implemented according to the Detailed Design (temporary drainage, biomatting or geo -textile cover, berms etc.)</p> <p>For mitigation of sedimentation impact following measures will be implemented:</p> <ul style="list-style-type: none"> - 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 <p>For mitigation of induced erosion following measures will be implemented:</p> <ul style="list-style-type: none"> - Appropriate sized rain-storm-water channels will be constructed. - Drain outlets designed so as to avoid cascade effect. - Provision for cross drainage structures will be made. <p>Water receiving surfaces to be lined with stones, concrete.</p>	Construction period	Constructing Contractor	RDMRDI Inspectorate of MoE
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	Subsections close to the r. Iori,	<p>Prevention through implementing temporary anti-erosion measures – temporary drainage, temporary sediment catchments etc.</p> <ul style="list-style-type: none"> - Protect susceptible surfaces with r fabric, - Establishment of retention ponds to reduce sediment loads before water enters streams 	Construction period	Constructing Contractor	RDMRDI Inspectorate of MoE
<p>Topsoil losses due to improper storage and handling</p> <p>Earthworks will impact the fertile top soils that are enriched with nutrients required for plant growth or agricultural development</p>	Whole alignment: the sections of road;	<p>The Contractor shall</p> <ul style="list-style-type: none"> - Strip the top soil to a depth of 15 cm and store in stock piles of height not exceeding 2m and with a slope of 1:2 - Spread the topsoil to maintain the physico-chemical and biological activity of the soil. The stored top soil will be utilized for covering all disturbed area and along the proposed plantation sites - Topsoil stockpiles will be monitored and should any adverse conditions be identified corrective actions will include: 	Construction period: starting from topsoil stripping and ending with reinstatement;	Constructing Contractor	RDMRDI Inspectorate of MoE

		<ul style="list-style-type: none"> Anaerobic conditions - turning the stockpile or creating ventilation holes through the stockpile; Erosion - temporary protective silt fencing will be erected 			
<p>Soil and surface water contamination by oil, lubricants, fuel and paint in the RoW, bridge sites and equipment yards caused by construction activities and operation of construction equipment;</p> <p>Materials used in construction have a potential to be a source of contamination. Improper storage and handling of fuels, lubricants, chemicals and hazardous goods/materials on-site, and potential spills from these goods may harm the environment or health of construction workers.</p>	<p>Soil - the whole alignment;</p> <p>Rivers - subsections close to the r. Iori,</p>	<p>The Contractor shall</p> <ul style="list-style-type: none"> Prepare spill control procedures and submit the plan for RD approval (or Engineer approval). Train the relevant construction personnel in handling of fuels and spill control procedures. Store dangerous goods in bunded areas on a top of a sealed plastic sheet minimum 100 m away from watercourses. Do not store any hazardous waste in the in the restricted areas, which include <ul style="list-style-type: none"> within 100m from the banks of r Iori or other streams within 500m from any residential areas, cultural or archaeological sites in ecologically sensitive zones 1,2 3 and 4a All refueling operations on the working sites will use absorbent pads and/or straw to minimize spills, which will be put in place prior to the commencement of refueling operations. Polluted ground will be removed immediately. Soiled ground and absorbents will be removed, stored and treated as hazardous waste. In case of significant spill authorized and responsible person will be informed, works will be stopped till the elimination of pollution risk Refueling will always be carried out with the correct equipment (i.e. nozzles of the appropriate size), and only by suitably trained and experienced Refueling Operators. 	Construction period	Constructing Contractor	RDMRDI Inspectorate of MoE
<p>Construction waste generation alongside the RoW :</p> <ul style="list-style-type: none"> excess soil and rock, demolished structures, packaging materials etc.) Demolished asphalt pavement 	Construction sites	<p>Assess and, if required, develop spoil and rock disposal plan</p> <p>Provide for disposal facilities agreed with local municipalities;</p> <p>Allow local communities to utilize any excess rock, which</p>	<p>Mobilization stage</p> <p>Construction</p>	<p>Design and Constructing Contractor</p> <p>Constructing</p>	RDMRDI Inspectorate of MoE

		fugitive emissions of volatile organic compounds through the use of fuel nozzles and pumps and enclosed tanks (no open containers will be used to stored fuel).			
Dust generation from construction sites, material stockpiles and transportation of materials. Dust is a nuisance in the environment causing health impacts for workers and local population;	The whole alignment near v. Sasadilo, Bochorma, Orkhevi Material (gravel, sand etc.) transportation routes;	<ul style="list-style-type: none"> - All precautions to be taken to reduce dust level emissions from batching plants & portable crushers with spraying of water and containment measures. - During dry conditions material delivery vehicles and haul vehicles carrying sand and fill material will be covered with tarpaulin. The construction site and any local roads will be watered as appropriate. - Protective equipment to be provided to workers as necessary e.g. at quarries, stone crushers. - Use of defined haul routes and reductions in vehicle speed where required with appropriate traffic management planning - Sheeting of construction materials and storage piles; and 	Construction period	Constructing Contractor	RDMRDI
Noise pollution from vehicle operation during construction in populated areas traversed by the highway, notably metropolitan areas or densely settled rural areas. Local noise.	near v. Sasadilo, Bochorma, Orkhevi etc.	<p>Install and maintain mufflers on equipment. Routine maintenance will be to a high standard to ensure that vehicles are safe and that emissions and noise are minimized. All plant used on site will be regularly maintained so as to be in good working order at all times to minimize noise.</p> <p>Prohibit night works near the settlements</p>	Construction period	Constructing Contractor	RDMRDI
Infrastructure. The main infrastructure element that could be affected are the power transmission lines, water supply systems and irrigation pipes and channels.	<ol style="list-style-type: none"> 1. power lines 2. Local water supply pipelines 3. Local gas pipelines 	<p>Protection of infrastructure.</p> <p>Replace the affected infrastructure elements</p> <p>Permanent monitoring during construction. Full reinstatement in case of damage.</p>	Preparatory works before the construction start up	Constructing Contractor	RDMRDI
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.	whole alignment	Remove all created pools till spring-time. Reinstate relief and landscape.	Construction period	Constructing Contractor	RDMRDI

Health hazards by noise, air emissions and dust raised and blown by vehicles during construction activities.	v. Sasadilo, Bochorma, Kudro, Orkhevi etc.	Dust control by application of watering. Use as minimum as 2 browsers; Noise control, installation of mufflers on equipment, daytime works; See points 11 - 13	Construction period	Constructing Contractor	RDMRDI
Impacts on archaeological sites and remnants	Whole alignment	Permanent monitoring during land clearance and excavation activities. Stoppage and suspension of construction activities in case of archaeological findings. Completion of required archaeological works before restarting construction activities. Conservation of remnants.	Before start up of construction; Construction period	Archaeologist from CAS Constructing Contractor	RDMRDI Archaeologist from CAS
Biological recontamination during earthworks near pest-holes of soil infections (e.g. anthrax);	Whole alignment	Permanent monitoring during land clearance and excavation activities. Stoppage and suspension of construction activities in case of burial site findings. Notification to the local division of Veterinary Department. Veterinary clearance before start up.	Construction period	Constructing Contractor	RDMRDI
Hazardous driving conditions where construction interferes with pre-existing roads.	v. Sasadilo, Bochorma, Kudro, Orkhevi etc.	Provide in design for proper markers and safety signs on roads, including lights. Instruct the drivers	Construction period	Constructing Contractor	RDMRDI
Final Reinstatement and Long-term Anti-erosion Measures	Whole alignment	All the work sites (except permanently occupied by the road and supporting facilities) should be reinstated to its initial conditions (relief, topsoil, vegetation cover). So far as very limited bush clearance is required for the highway upgrading, preservation of top-soil is sufficient for reinstating the natural grass vegetation cover as well		Constructing Contractor	RDMRDI
Compensatory tree planting program.	Km 8.0-10 ; MSZ 5 As a result of road clearing, sea-buckthorn shrubs on the both sides of the road will be destroyed.	Compensatory planting of the species should be undertaken with the proportion of 1:10; Cost of sea-buckthorn seedlings is about 5 GEL and they are available in Sartichala Plant Nursery.	Develop before construction start up. Implement before completion	Constructing Contractor	RDMRDI
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	The whole alignment	<ul style="list-style-type: none"> - Provide in design for proper markers and safety signs on roads, including lights. Instruct the drivers - Design and implement safety measures and an emergency plan to contain damages from accidental spills. - Designate special routes for hazardous materials transport. - Regulation of construction transport in terms of traffic 		Constructing Contractor	RDMRDI

Safety section) Accidents due to construction vehicles and heavy machinery or traffic interference with construction activities.		interference. - Prohibition of toxic waste transport through ecologically sensitive areas and densely populated areas.			
Quarrying Sites Taking of Borrow and Quarry Materials for construction of embankments for road, bridge approaches with potential for loss and degradation of land; Potential impact of the increased quarrying activities on ichthyofauna, groundwater and landscape	presumably, r.Iori floodplain	Quarry and borrow pit materials will be obtained from existing operating sites with proper licenses & environmental clearances. Control of validity of licenses. (The license is given with description of exploration limits and reinstatement commitments). In case of need for opening new borrow areas, all required licenses will be obtained from the Ministry of Energy and Natural Resources; Measures will be taken to conserve top soil at close of use the area to be reclaimed according to licensing conditions. Control of vehicle operations at quarry sites. Avoid traverse of watercourse. Exclude leakage of oil or fuel. Check the condition of vehicles.	Construction period	Constructing Contractor	RDMRDI Inspectorate of MoE
Asphalt plants.	Plant site	Contract only licensed supplier having all required environmental permits. In case if the Constructing Contractor takes decision to install and operate its own plant, specific EIA should be prepared and Environmental Impact Permit obtained	Construction period	Constructing Contractor	RDMRDI
Construction Camp Site The potential impacts related to the construction and operation of the camp could be summarized as follows: - Clearance of vegetation cover during camp construction - Potential damage of topsoil - Contamination related to fuel storage and fuelling operations - Sewerage related contamination	camp site	Camp will not be arranged closer than 500m to the villages and closer than 100m to the r. Iori; Water and power supply will be organized in a way not to impact local village supply; Proper waste management - install waste bins for domestic waste; - organize area for temporary storage of waste; - contract specialized companies providing waste management services; - collect separately used oil, oily rags, fuel contaminated pads, residual paints and other hazardous wastes. Organize hazardous waste storage sites (impermeable	Construction period	Constructing Contractor	RDMRDI Inspectorate of MoE

<ul style="list-style-type: none"> - Waste management - nuisance and social impacts on closest villages 		<p>pallets/trays or secondary containment vessels); Subcontract Sanitary Ltd or other licensed hazardous waste operator;</p> <p>Arrange accommodation of personnel in villages. In case if large camp will be constructed for the workers accommodation, organize sewerage according standards.</p> <p>Organization of fueling sites: bunded areas on a top of a sealed plastic sheet. All refueling operations on the working sites will use absorbent pads and/or straw to minimize spills, which will be put in place prior to the commencement of refueling operations. Polluted ground will be removed immediately. Soiled ground and absorbents will be removed, stored and treated as hazardous waste. Refueling will always be carried out with the correct equipment (i.e. nozzles of the appropriate size), and only by suitably trained and experienced Refueling Operators.</p> <p>Proper storage of topsoil. Reinstatement of the site after completion of works</p>			
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8.4.3 Mitigation Measures to be Implemented During the Operation Phase

Impacts	Sites	Mitigation Measures	Timeframe	Responsibility for Implementation	Responsibility for Monitoring and Enforcement
Geohazard risks (Landslides; debrisflows)	km 0 +200 Landslide. km 4+ 200 mudflow gully km 4+200 small landslide km 5+000 - km 7+000 r. Orville (flashfloods and debrisflows) km 8+100 landslide km 10+000 - km 12+000 The river Sajinobos Khevi prone to debris-flow	Permanent monitoring; Antierosion measures and maintenance of anti-erosion structures; Road rehabilitation and maintenance works; Cleaning of road from stones;	Throughout operation	RDMRDI in long-term perspective	RDMRDI
Soil and water contamination by fuel and lubricants alongside the highway; Increased sediment load on watercourses	whole alignment	Install oil traps at large bridges (bridge No 1 and 2); Facilitate installation of standard refueling stations and repair shops along the highway Monitoring of water quality near the bridges during 12 months after the road enters in operations; Improve antierosion measures and drainage system in case of increased turbidity of drainage water;	after completion of construction	RDMRDI	RDMRDI
Air pollution from vehicle operation, in populated areas traversed by the highway, notably metropolitan areas or densely settled rural areas. Local dust.	v. Sasadilo, Bochorma, Kudro, Orkhevi etc.	<ul style="list-style-type: none"> - Monitoring of air quality and traffic related emissions (including inspection of vehicle emissions) - Development of policy and regulations limiting traffic related emissions (regulations on fuel quality etc.) - Require adherence to engine maintenance schedules and standards (or use alternative fuels) to reduce air pollution. - Plant trees along the roadside to screen and smoothen emission impacts on the close located villages 	Throughout operation	MoE RDMRDI in long-term perspective	MoE
Emission from Construction Vehicles & Equipments causing air pollution – during road maintenance works	whole alignment	<ul style="list-style-type: none"> - Emission levels of all construction vehicles & equipment will conform to Georgian emission standards. - All vehicles and plants shall be maintained so that their emissions do not cause nuisance to workers or local people. 	During Maintenance Works	RDMRDI supervising works and Maintenance Contractor	RDMRDI

		<ul style="list-style-type: none"> - Vehicle refueling will be undertaken so as to avoid fugitive emissions of volatile organic compounds through the use of fuel nozzles and pumps and enclosed tanks (no open containers will be used to stored fuel). 			
Noise pollution from vehicle operation, in populated areas traversed by the highway, notably metropolitan areas or densely settled rural areas. Noise related to maintenance works;	v. Sasadilo, Bochorma, Kudro, Orkhevi etc.	<ul style="list-style-type: none"> - Require adherence to engine maintenance schedules and standards - Keep green plantations along the roadside to mitigate noise impacts on the close located villages - Enhance public transportation and traffic management capability 	Throughout operation	Maintenance contractor RDMRDI in long-term perspective	MoE
Roadside litter	whole alignment	<ul style="list-style-type: none"> - Provide for disposal facilities. - Encourage anti-littering laws and regulations. 	Throughout operation	Local Government authorities and RDMRDI provide facilities	RDMRDI Inspectorate of MoE
Accident risks associated with vehicular traffic that may result in spills of toxic materials injuries or loss of life.	whole alignment	<p>Facilitate development of legislation and enforcement system regulating transportation of hazardous materials. Facilitate emergency preparedness and development and implementation of the sectoral (RDMRDI) and National Emergency Response Plan related to Natural and Technogenic Hazards (developed by the ministry of Interior in 2006);</p> <ul style="list-style-type: none"> • 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. 	Throughout operation	MoE MoI RDMRDI	RDMRDI MoE MoI

8.5 Environmental Monitoring Plan (Matrix)

Construction Phase

Phase	What? (parameter is to be monitored)	Where? (is the parameter to be monitored)	How? (is the parameter to be monitored /type of monitoring equipment/?)	When? (is the parameter to be monitored – frequency of measurement or continuously)	Why? (is the parameter to be monitored (reply is not obligatory))	Cost	Responsible Institution
Material supply	Possession of official approval or valid operating license	Supplier of materials (asphalt, cement and gravel)	Inspection	Before an agreement for the supply of materials is formalized	Assure compliance with HSE requirements	N/a	Plant operator; Constructing Contractor Supervising Agency (SA) hired by RDMRDI
Material transport according to the schedule and routes defined for deliveries	Truck loads covered/ wetted Air pollution due to the dust and fumes related to the Material Transport	Construction site and access road	Supervision	Unannounced inspections during work hours	Assure compliance with HSE requirements. Ensure safety, and minimize traffic disruption.	Minimal Included in supervision contracts	Constructing Contractor; SA hired by RDMRDI
Top-soil stripping stage. Final reinstatement.	Top-soil storage. Reinstatement. Erosion control. Landscape destruction; Visual impacts;	Construction site	Supervision	Periodic (Unannounced inspections during work hours); From top-soil stripping – to completion of the works.	Assure compliance with, construction standards, environmental norms and EMP provisions;	Minimal Included in supervision contracts	Constructing Contractor SA hired by RDMRD
Construction work	Noise levels; Equipment;	Construction site	Inspection; compliance monitoring (engine maintenance, usage of mufflers, night time work limitations and other provisions of EMP.) noise measuring	Periodic (average once per month); Only in case of complaints	Assure compliance with HSE requirements. Good condition of standard construction machinery and limiting the works near settlements to the site-related works is the only way for efficient noise control	Minimal Included in supervision contracts	Constructing Contractor SA hired by RDMRD MoE

Phase	What? <i>(parameter is to be monitored)</i>	Where? <i>(is the parameter to be monitored)</i>	How? <i>(is the parameter to be monitored /type of monitoring equipment/?)</i>	When? <i>(is the parameter to be monitored – frequency of measurement or continuously)</i>	Why? <i>(is the parameter to be monitored (reply is not obligatory))</i>	Cost	Responsible Institution
Construction work	Vibration	Construction site	Supervision	Unannounced inspections; following complaints	Assure compliance with HSE requirements.	Minimal Included in supervision contracts	Constructing Contractor SA hired by RDMRD
Construction work	Dust and Air pollution (solid particles, suspended solids, flying heavy metal particles)	At or near construction site	Visually	During material delivery and periodically in dry periods during construction	Assure compliance with HSE requirement, Assure compliance with, environmental norms and EMP provisions.	Minimal Included in supervision contracts	Constructing Contractor SA hired by RDMRD
Whole construction period.	Traffic safety/ Vehicle/ pedestrian access Visibility/ appropriate signs	Construction site	Observation	Once per week in the evening	Assure compliance	Minimal Included in supervision contracts	Constructing Contractor; SA hired by RDMRD
Whole construction period.	Material and waste storage, handling, use Water and soil quality (suspended solids, oils, etc)	Material and waste storage sites; Run off from site; material storage areas; wash down areas	Observation	During material delivery and periodically during construction (average 1/week), especially during precipitation (rain/ snow/ etc).	Assure pollution abatement; Assure compliance with, construction standards, environmental norms and EMP provisions;	Minimal Included in supervision contracts	Constructing Contractor; SA hired by RDMRD
Whole construction period.	Waste Management	All construction sites; Camps;	Observation	Once per week	Assure pollution abatement; Assure compliance with, construction standards, environmental norms and EMP provisions	Minimal Included in supervision contracts	Constructing Contractor; SA hired by RDMRD
Whole construction period.	Equipment maintenance and fuelling Water and soil quality (suspended solids, oils, fuel, etc)	Refueling and equipment maintenance facilities; Run off from site; material storage areas	Observation	During material delivery and periodically during construction (average 1/week), especially during precipitation (rain/ snow/ etc).	Assure pollution abatement	Minimal Included in supervision contracts	Constructing Contractor; SA hired by RDMRD

Whole construction period.	Impacts on archaeological sites and remnants	All earthwork sites	Observation	Permanent/daily	Assure cultural heritage protection	Minimal	CAS represent. Constructing Contractor; SA
Phase	What? (parameter is to be monitored)	Where? (is the parameter to be monitored)	How? (is the parameter to be monitored /type of monitoring equipment/?)	When? (is the parameter to be monitored – frequency of measurement or continuously)	Why? (is the parameter to be monitored (reply is not obligatory))	Cost	Responsible Institution
Whole construction period	biological recontamination during earthworks near pest-holes of soil infections (e.g. anthrax);	All earthwork sites	Observation	Permanent/daily	Assure health protection	Minimal Included in supervision contracts	Construction Field officer; SA hired by RDMRD Veterinary Department of the NSFSVPP
Whole construction period	Protection of infrastructure elements	Crossings of power lines, pipelines;	Observation	During construction activities at the sites of concern	Assure infrastructure protection	Minimal Included in supervision contracts	Constructing Contractor SA hired by RDMRD
During Construction period	offset tree planting Program	Sites adjacent to the MSZ 5	Observation	During Construction period	Assure offset of damage to flora and landscape	Minimal Included in supervision contracts	Constructing Contractor; SA hired by RDMRDMoE
During Construction period	Reinstatement of work sites	work sites, road alignment, used quarries, camp sites	Observation	During Construction period, after completion of works at concrete site	Reinstatement of work sites not taken by RoW		Constructing Contractor; SA hired by RDMRD
During Construction period	Disposal of construction wastes	work sites, road alignment, used quarries, camp sites	Observation	During Construction period, after completion of works at concrete site	Ensure pollution prevention and landscape protection;		Constructing Contractor; SA hired by RDMRD
Whole construction period	Personal Protective equipment. HSE issues Organization of traffic by-pass	Construction site	Inspection	Unannounced inspections during works	Assure compliance with HSE requirements	Minimal Included in supervision contracts	Constructing Contractor; SA hired by

							RDMRD
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Operation Phase

Phase	What? <i>(parameter is to be monitored)</i>	Where? <i>(is the parameter to be monitored)</i>	How? <i>(is the parameter to be monitored /type of monitoring equipment/?)</i>	When? <i>(is the parameter to be monitored – frequency of measurement or continuously)</i>	Why? <i>(is the parameter to be monitored (reply is not obligatory))</i>	Cost	Responsible Institution
Whole operation period	Lon-term degradation of natural landscape at land strips and slopes adjacent to highway. Development of landslides, rockfalls and other natural hazardous processes. Visual impacts. Change of drainage patterns, erosion, degradation of vegetation	Whole alignment	Observation	Quarterly	Assure erosion protection, reinstatement and mitigation of visual impacts	N/a	RDMRDI personal responsible for engineering and environmental monitoring ;
Whole operation period	Increased suspended sediment in streams affected by erosion	Near rivers	Observation	Quarterly	Assure water protection	Minimal	RDMRDI Field officer;
During maintenance works	Air pollution from equipment and machinery during maintenance works.	Whole alignment	Observation; Checking technical compliance of plant	Once during start up of maintenance works	Pollution abatement	Minimal	
Whole operation period	Routine waste and pollution management; Roadside litter and minor fuel contaminations;	Whole alignment	Observation	Monthly	Waste management and pollution abatement	Minimal	RDMRDI Field officer
Whole operation period	Air pollution from vehicle operation	Near settlements	Observation; Sampling/analysis	Quarterly/Annually	Pollution abatement	Minimal	MoE
Whole operation period	Noise pollution from vehicle operation	Near settlements		Quarterly/Annually	Noise protection and compliance with HSE requirements	Minimal	MoE
Whole operation period	Emergency preparedness	Emergency team offices; Simulation trainings	Simulation trainings	Annually	Emergency preparedness; Rescue and salvage operations; Pollution abatement	Minimal	MoE; MoI RDMRDI

Minutes of Public Consultation Meeting

**Ministry of Regional Development and Infrastructure of Georgia
Roads Department**

**Kakheti Regional Roads Improvement Project (KRRIP)
Rehabilitation of Sasadilo Sioni Road
Minute of the Public Meeting for Environmental Impact Assessment**

Public meeting for environmental impact assessment for rehabilitation of 27 km road section of the secondary road Sasadilo-Sioni was held at the Gamgeoba of Sioni of Tianeti Municipality on August 15, 2013. The meeting was aimed at raising the awareness of the local population on the essence, deadlines, expected temporary difficulties caused to the population as a result of the construction process and the activities for mitigation of negative impacts. The representatives of the local population asked questions and expressed their opinions to be taken into consideration in the process of preparation of the plans.

The Roads Department of Georgia was represented by the Deputy Head of Resettlement and Environmental Protection Division Gia Sopadze and a Main Specialist of the Environmental Management Unit Ms. Luiza Bubashvili.

The meeting was attended by the representatives of daba Sioni population.

The meeting was opened by Mr. Gia Sopadze. Mr. Sopadze informed the population on the rehabilitation works planned on the territory of the Municipality. The importance of rehabilitation of the secondary road for the development of Georgian Economy was also discussed during the meeting.

The Consultant Mr. Medgar Chelidze talked about the rehabilitation of Sasadilo-Sioni 27 km road section, the expected environmental and health impacts caused by the rehabilitation works and discussed the mitigation measures to minimize the negative impacts during the construction and operation of the road.

Deputy Chairman
Irakli Litanishvili

Deputy Head of Resettlement and Environmental Protection Division
Gia Sopadze

Main Specialist of the Environmental Management Unit
Ms. Luiza Bubashvili.

1) Գրքի համար	Նախ քան որ	Լ. Գրքի
2) Գրքի բնույթը	Երկրի	Յ. Գրքի
3) Գրքի հեղինակը	Երկրի	Յ. Գրքի
4) Գրքի թվականը	Երկրի	Յ. Գրքի
5) Գրքի թվականը	Երկրի	Յ. Գրքի
6) Գրքի թվականը	Երկրի	Յ. Գրքի
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15) Գրքի թվականը	Երկրի	Յ. Գրքի
16) Գրքի թվականը	Երկրի	Յ. Գրքի
17) Գրքի թվականը	Երկրի	Յ. Գրքի
18) Գրքի թվականը	Երկրի	Յ. Գրքի



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