“Darial Energy” LLC

Dariali Hydro Power Plant Construction and Operation Project

Environmental and Social Impact Assessment Report

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1 Introduction

1.1 General Overview

Georgia is rich in hydropower resources. According to the latest data, technical potential is estimated at 93,7 billion kWh/y., out of which only 11% is utilized and this cannot ensure a full coverage of thermal energy demand of the country. Nowadays, one of the main directions of the state policy is an optimal utilization of the country's hydropower potential – the government intends to utilize existing renewable energy sources properly (Georgia energy policy and State program – "Renewable Energy 2008"). A number of small, medium and large-sized hydro power plant construction projects are under consideration; Several (including cross-border) projects of power generation and transmission are underway or are under development. Implementation of such projects will contribute to the reduction of electricity imports and will provide an opportunity for Georgia to increase exports to neighboring countries.

Due to the economic situation of the country, only technically and economically effective hydropower resources can be utilized. It should also be noted that the land area of Georgia is small and construction of HPPs with large reservoirs is limited. Construction of Small and medium size run-of-river hydropower plants is more preferable, because, in this case, the risk of adverse environment effects is much less and their construction is carried out in a short period of time.

According to the preliminary estimation, carried out under consideration of geographical location and natural conditions, construction of the Dariali HPP on Tergi River is considered as one of the most promising projects and its implementation will greatly contribute to energy independence of the country. Construction of the power plant will be implemented according to the derivative scheme and it will work without a runoff regulation, in a natural flow regime, which, as it was noted, is very important from an environmental point of view. Based on the feasibility study, estimated installed capacity of HPP is 108 MW, which belongs to the category of medium capacity.

The project is fully in line with the European Energy Policy, adopted by European Commission in 2007 and with the UN Framework Convention on Climate Change (enacted by Kyoto Protocol in 2005), which calls on all countries to concentrate efforts on increasing the efficiency of energy consumption through increased utilization of renewable energy sources and reduction of environmental impact.

Socio-economic aspects of the project are also important. Construction of the HPP and additional power supply will contribute to the region's economic development, employment of the local population and improvement of their economic conditions.

Project implementation will assist the region to maintain existing jobs and businesses (including the service sector), which will contribute to the improvement of the living conditions of the employees. Besides, the local budget will receive taxes paid for water use and property tax as well as taxes paid by service provides delivering their services to the HPP.

1.2 Basis and Goals of Environmental and Social Impact Assessment Report

The Environmental and Social Impact Assessment Report is based on Georgian Law on "Environmental Permit". According to the article 4, paragraph 1, subparagraph "m", "location of a Hydro Power Plant (2 MW - less and higher capacity) and Thermal Power Plant (10 MW - and higher capacity) is subject to the ecological expertise. Therefore, construction and operation of the HPP in Kazbegi municipality is subject to the ecological expertise and its implementation should be based on ecological expertise.

Resolution of ecological expertise is issued by the Ministry of Environmental Protection on the basis of ecological expertise of ESIA report for the planned activities.

Implementation of the given project, along with positive impacts, will have some kind of negative impact on the region's natural environment and socio-economic conditions, which may result in loss of agricultural lands, destruction of biodiversity, damage to cultural heritage, emissions of harmful substances, change of hydrological, geological and hydro geological conditions, etc. The main goal of an ESIA is a quantitative assessment and a spatial scope determination of such negative impacts, including: collection of existing technical documentation of planned activities and information about the natural and social environment; determination of the expected environmental and social impacts (including residual and cumulative) on different phases of the project, on the basis of summing up and analyzing obtained information. The most important part of an ESIA is the identification of mitigation measures, adequate to specific negative impacts; establishment of environmental management and monitoring schemes, public awareness about the planned activities and their engagement.

Environmental impact assessment report for the construction and operation project of "Dariali HPP" has been prepared by the Scientific-Research Firm "Gamma" in compliance with the requirements of Georgian environmental law (Georgian Law on "Environmental Permit"-01.01.2008 and Regulation, "Environmental Impact Assessment" -09.03.2009) and environmental and social policies of EBRD (2008).

2 Legal-institutional framework

The main goal of the state policy of Georgian in power sector is to fully meet energy demand of industrial and domestic sector through sustainable use of the state energy resources, diversification of sources of imported energy, insurance of economic independence and energy security.

The main directions of the state policy in the energy sector are approved by the resolution of Georgian Parliament on June 7, 2006. The great attention is paid to the local renewable resources, including utilization of hydro-resources and alternative energy sources.

This chapter provides overview of current legislation, standard sand policy in force in Georgia and internationally, regulating environmental and social issues and associated with the planned activities. The review will be included in the environmental and social impact assessment report.

2.1 Georgian legislation and institutional framework

2.1.1 State policy objectives

After the declaration of independence, Georgia has completely changed its legislation and today a new national legislation is in force, including the environmental legislation. Georgian environmental legislation is mainly based on European legislation and the principles of sustainable development.

Due to the formation of a healthy environment and socio-economic development of the country, a variety of programs and plans have been developed and implemented. The most important among them are:

- Socio - economic recovery and economic growth program, approved in 2001 (Presidential Decree N89);

- Governmental Program of Georgia "United Georgia Without Poverty" (Parliament of Georgia, 2.07.2010, resolution № 3267);
- National Environmental Action Plan was adopted in 2000 (Presidential Decree N191), which has been expired in 2005. At present, a draft document is elaborated, which reflects new environmental priorities faced by the country;
- Biodiversity Strategy and Action Plan 2005 2005 (Resolution of the Government of Georgia N27).

In November 2006, "EU-Georgia Action Plan" was developed in the framework of "The European Neighbourhood Policy", which covers a time frame of five years. Since the adoption of the plan, its implementation and monitoring is carried out by means of special systems/mechanisms.

2.1.2 Regional and international cooperation

2.1.2.1 Regional cooperation

Regional cooperation by Georgia in environmental issues covers various fields at differant levels:

- Georgia is one of the six countries (Armenia, Azerbaijan, Caucasian part of the Russian Federation, North - Eastern Turkey and north - western part of Iran), which represent the Caucasus region and Ecoregion and which is historically and geographically considered as the region between the Black and Caspian Seas;
- Georgia is included in Black Sea countries and is involved in the activities related tothe protection of the Black Sea;
- In addition, Regional Environmental Centre Caucasus and Caucasus Environmental NGO Network are functioning in Georgia.

Figure 2.1.2.1.1. Georgia in the Caucasus region

2.1.2.2 International agreements

Georgia is signatory to many international conventions and agreements. Below are given those, which are important for the environmental and social impact assessment of HPP construction and operation project:

- **Protection of nature and biodiversity:**
  - The Convention on Biological Diversity, Rio de Janeiro, 1992;
  - The Convention on Wetlands of International Importance especially as Waterfowl Habitat Areas, Ramsar 1971;
  - The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), Washington, 1973;
  - The Convention on the Conservation of Migratory Species of Wild Animals, (Bonn Convention), 1983.
- **Climate Change:**
  - The UN Framework Convention on Climate Change, New York, 1994;
  - The Montreal Protocol on Substances that Deplete the Ozone Layer, Montreal, 1987. Georgia has signed this protocol in 1996;
  - The Vienna Convention for the Protection of the Ozone Layer, 1085;
  - Kyoto Protocol, Kyoto, 1997;
  - The United Nations Convention to Combat Desertification, Paris, 1994.
- **Pollution and environmental hazards:**
  - The European and Mediterranean Major Hazards Agreement, 1987.
- **Cultural heritage:**
  - Convention for the Protection of the Cultural Heritage of Europe;
  - Convention for the Protection of the Architectural Heritage of Europe.
- **Public information:**
  - Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters (Aarhus Convention, 1998).

2.1.3 Institutional Framework for Environmental Protection

According to the constitution of Georgia, legislative and executive branches of government are centralized.

The Parliament of Georgia is the main legislative body. Committee on Environment and Natural Resources is responsible for environmental matters. Legislative and normative acts may be adopted by the decree of the President of Georgia, by the resolution of the Government and normative order of the minister.

The MOE and Ministry of Energy and Natural Resources are main subjects of the executive powers, responsible for implementation of state policy in the field of environmental protection and rational use of natural resources in the country.

The most important objectives of the Ministry of Environment Protection of Georgia are: support of sustainable development; organizing of an environmental planning system; development and implementation of the state policy, purpose-oriented programs, sustainable development strategy for environmental protection, national actions program and management plans for the environmental protection field; protection and conservation of ambient air, water, land, fossils and biodiversity, country typical rare and endangered flora and fauna species, unique landscapes and ecosystems;

implementation of the state control (regulation, licensing, registration, supervision and control) functions in the field of waste and chemical substances management; implementation of international commitments and those set by the national legislation.

The Ministry of Environment Protection, in terms of public relations, ensures the access of public to environmental information, supports the public participation in environmental decision-making processes, as well as the environmental education and environmental awareness-raising.

Ministry of Environment Protection is headed by a Minister, Deputy Ministers, several departments and sub-agencies. The Department of Licenses and Permits is responsible for the environmental assessment of projects submitted by investors, for the preparation of an environmental assessment, as well as for the formulation and publication of the conclusions of ecological expertise.

As for the Ministry of Energy and Natural Resources, its objectives are:

- Maximum utilization of the existing energy resources and diversification of sources of imported energy supply;
- To satisfy the whole country's electricity demand by its own hydropower resources;
- Ensuring energy security, namely, complete re-equipment of technologically outdated and obsolete technology of the sector; construction of new power plants, electricity and natural gas transmission infrastructure; diversification of the imported energy carriers (natural gas, oil, electricity); formation of a commercially profitable economic model of the sector;
- Development of alternative energy sources;
- Promotion of the development of the East-West and North-South energy and transportation infrastructure, connecting Europe and Asia, and affiliation of Georgian energy sector to it;
- Commercialization of the energy sector and the economic recovery.

The following sectoral ministries and/or agencies will be potentially involved in the project implementation:

- The Ministry of Culture and Monument Protection of Georgia;
- The Ministry of Agriculture;
- Ministry of Labour, Health and Social Affairs;
- Ministry of Economy and Sustainable Development;
- Ministry of Refugees and Accommodation;
- Ministry of Justice (in charge of Land Management).

2.1.4 Environmental Legislation

Environmental legislation comprises the Constitution, environmental laws, international agreements, subordinate legislation, normative acts, presidential orders and governmental decrees, ministerial orders, instructions and regulations. Along with the national regulations Georgia is signatory of a number of international conventions, including those related to environmental protection.

The Constitution of Georgia (adopted in 1995, amended in 1999, 2000-2006, 2008) defines the legal framework, which guarantees public access to information about environmental conditions and the right to participate in public discussion on environmental issues. Though, the document does not directly address environmental issues.

Determines the right of all citizens to live in a healthy environment and enjoy the natural and cultural resources and at the same time, imposes an obligation to protect it. According to the article 37, part 5, everyone has the right to receive complete, unbiased and timely information about their working and

living environment. According to the Constitution, the Georgian Government is obliged to ensure the rational use of natural resources and to protect the environment.

In accordance with the Article 41, part 1, every citizen of Georgia must have access to information available in state institutions concerning their personal matters, as well as to official information if it is not confidential.

A list of major environmental laws of Georgia[1] are given in Table 2.1.4.1.

Table 2.1.4.1. The list of Environmental Laws and Regulations of Georgia

Year	Law / Regulation
1994	Law of Georgia on Soil Protection (amend.1997, 2002)
1995	Constitution of Georgia (amend. 1999, 2000-2006, 2008)
1996	Law of Georgia on the System of Protected Territories (amend.2003, 2004, 2005, 2006, 2007)
1996	Law of Georgia on Protection of Environment (amend. 2000, 2003, 2007)
1996	Law of Georgia on ownership of agricultural lands
1997	Law of Georgia on Wildlife (amend.2001, 2003, 2004)
1997	Law of Georgia on Tourism and Recreation
1997	Law of Georgia on Water (amend.2003, 2004, 2005, 2006)
1997	Law on Payment of Substitute Land Reclamation Cost and Damages in Allocating Farm Land for Non-Farming Purposes
1998	Law of Georgia on Pesticides and Agrochemicals
1999	Law of Georgia on State Complex Expertise and Approval of Construction Projects
1999	Law of Georgia on Protection of Ambient Air (amend. 2000, 2007)
1999	Forestry Code of Georgia (amend. 2000 2001, 2003, 2005, 2006)
1999	Law of Georgia on Seizure of Property Rights for Necessary Public Needs
2003	Law of Georgia on Red List and Red Book of Georgia (amend.2006)
2005	Law of Georgia on Licenses and Permits
2005	Law of Georgia on Fire Safety
2005	Law of Georgia on Privatization of State-owned Agricultural Land
2005	Law of Georgia on Registration of Rights to Real Estate
2006	Law of Georgia on Regulation and Engineering Protection of Sea and River Coasts of Georgia
2007	Law of Georgia on Cultural Heritage
2007	Law of Georgia on Status of Protected Areas
2007	Law of Georgia on Ecological Examination
2007	Law of Georgia on Environmental Impact Permit
2007	Law of Georgia on Public Health
2007	Law of Georgia on Entitlement of Ownership Rights to Lands Possessed (Employed) by Physical and Legal Persons of Private Law
2009	Law of Georgia on Notary

[1] As of 1 July, 2011

2.1.4.1 Overview of the key environmental legislation acts

Law of Georgia on Protection of Environment (enacted in 1996) - regulates legal relationship between the bodies of the state authority and physical persons/legal entities in the scope of environmental protection and consumption of natural resources on all Georgian territory including its territorial waters, airspace, continental shelf and special economic zones.

The law concerns environmental education, environmental management aspects, describes economic sanctions, licensing, standards, environmental impact assessment results. The law considers various aspects of ecosystem protection, protected areas, global and regional environmental management, protection of ozone layer, biodiversity and the Black Sea, as well as discusses international cooperation aspects.

The law covers certain aspects of waste management. Management, import, export, re-export and transit of waste is regulated according to the rules stated in Georgian legislation. Determines the ecological requirements regarding the waste, including toxic, radioactive and other hazardous waste disposal requirements and bans their uncontrolled disposal.

Law of Georgia on Environmental Impact Permit (2007) - The law defines a complete list of activities subject to mandatory ecological examination. According to the subparagraph "M" of paragraph 1, article 4, chapter 2 of the law, a construction and operation project of a HPP with over 2 MW capacity is subject to ecological examination. The law defines legal aspects for issuance of environmental permit, implementation of ecological examination, public awareness and public participation in this processes. According to the Law Environmental Impact Permit is issued by Georgian Ministry of Environment Protection and Natural Resources after examination of applicant's documents.

Law on Public Health (2007) – The law aims at: promoting health and a healthy lifestyle of the public; ensuring a safe environment for human health; promoting reproductive health care; prevention of communicable and noncommunicable diseases. The law defines the legal rights and obligations of the population and legal persons in the field of public health. In order to ensure a safe environment for the public health the Ministry sets the qualitative standards for air, water, soil, noise, vibration, electromagnetic fields, which include permissible concentrations and exposure standards. Adherence to the standards is obligatory.

According to the law, all people present on Georgian territory are liable to: refrain from any activity that creates the risk of spreading communicable and non communicable diseases, causes risks related to the health; maintain sanitary and epidemiological norms.

Law of Georgia on Licenses and Permits (2005) – The law regulates organized activities or actions concerning unlimited circle of persons, is characterized with increased hazard to human life or health, involves especially important state or public interests, or is connected to consumption of the state resources. The law deals with spheres regulated by licenses and permits, defines full list of licenses and permits, and sets rules for granting, amending and abolishing licenses and permits. According to the law, the state regulates an activity/action with a license or permit only when this activity/action is directly associated with increased hazard risks for human life or health, or they incorporate the state and public interests. The state regulates an activity/action with a license or permit only when the licensing/permit issuing can really reduce the mentioned hazards or they incorporate the state and public interests.

In compliance with this law, the license or permit issued by a foreign country under an international agreement or law can be recognized and have the status, similar to that granted to a license or permit issued based on Georgian legislation.
The law defines new principles for the license issuance. These are:

- "One-window" principle – a new concept adopted by the law, which obliges a licensing authority to ensure approval of additional licensing conditions by other authorities.
- "Silence gives consent" – a licensing administrative body is obliged to make a decision in due period of time after an application is submitted. Otherwise, if the decision is not announced by the end of this period, a license is deemed issued.
- "Umbrella principle" – a holder of the general license is not obliged to apply for specialized licenses.

Law of Georgia on Ecological Assessment (adopted in 2007) - The law makes an ecological expertise obligatory for issuance of environmental impact or construction permits. Ecological expertise aims to preserve ecological balance through incorporation of environmental requirements, sound use of natural resources and sustainable development principles. A positive conclusion of the ecological expertise is mandatory to obtain an environmental and/or construction permit. Ecological assessments are regulated by the Ministry of Environment Protection and Natural Resources.

Law of Georgia on Regulation and Engineering Protection of Sea and River Coasts of Georgia (2006) - The law establishes terms for complex and rational use of sea and river coastal zone of Georgia and ensures sustainability of coastal zone, as well as establishes state control over and liabilities for actions entailing erosive and abrasive processes.

Law of Georgia on Soil (1996) – The law defines status of soil, describes their use, and sets out the types of licenses and rights and obligations of the users. The law sets responsibilities to preserve lands from contamination and ensures conformity of agricultural activities with relevant legal requirements.

Law of Georgia on Water (adopted in 1997) – The law regulates major legal relations:

- between the state governmental bodies and physical/legal persons in the field of water protection, study and consumption;
- in the field of water conservation, restoration and consumption on land, underground, continental shelf, territorial water and especially active economic zones;
- in the sphere of commercial water production and international trade in water;
- defines competences of autonomous republics, local government and self-government in water related relations;
- in the sphere of groundwater protection, study and consumption consistent with requirements of the law of Georgia on "Natural Resources";
- in the field of aquatic life protection, study, reproduction and consumption, in compliance with the law of Georgia on Fauna;
- regarding consumption of fauna, flora, forest, land and other natural resources whilst water utilization.

Consistent with the legislation, water within the territory of Georgia is in the state ownership and can be provided only for consumption. Any actions directly or indirectly violating the state ownership rights for water are prohibited.

Law of Georgia on Soil Protection (1994) - The law aims at ensuring preservation of integrity and improve fertility of soil. It defines obligation and responsibility of land users and the state regarding provision of soil protection conditions and ecologically safe production. The law sets the maximum permissible concentrations of hazardous matter in soil.

The law restricts: the use of fertile soil for non-agricultural purposes; execution of any activity without striping and preservation of top soil; open quarry processing without subsequent recultivation of the site; terracing without preliminary survey of the area and approved design; overgrazing; wood cutting;

damage of soil protection facilities; any activity deteriorating soil quality (e.g. unauthorized chemicals/fertilizers, etc).

Law of Georgia on Protection of Atmospheric Air (1999) - The law regulates protection of the atmospheric air from adverse anthropogenic impact within whole Georgian territory. Adverse anthropogenic impact is any man-caused effect on atmospheric air causing or capable to cause deterioration of its quality.

Law of Georgia on System of Protected Areas (1997) - The law gives the definition of the protected areas (which includes the National Parks, state reserves, managed reserves, etc) and sets activities allowed in their boundaries. Activities are permitted considering purpose of the area, requirements set out in legislation and individual regulations, management plans of protected areas, as well as international agreements and conventions signed by Georgia. The law provides restrictions over use of natural resources in national parks and other protected areas. In general, in the protected territories are prohibited:

- To damage or modify natural ecosystems;
- Destruction of natural resources, due to exploitation or any other purposes;
- To seize, damage or disturb natural ecosystems and species;
- To pollute environment;
- To introduce and multiply alien and exotic species of living organisms;
- To import explosive or poisonous materials into the territory;
- To carry out any other activities, restricted by the management plan of the protected area.

Forest Code of Georgia (1999) – The law regulates spheres related to functions and use of forest, including protection, management of water catchment basin, wood production, etc. It allows for private ownership of forest and commercial woodcutting. According to the law, Forest Department of Georgia does not executed commercial woodcutting itself, but controls and manages these operations as grants this function to private enterprises. However, the Forest Department is carries responsibility over sanitary woodcutting and forest management. According to the Code, the Ministry of Environment Protection and Natural Resources delegated to the Department a right for issuance a woodcutting license. The Forest Code sets categories of protected forests, including those regulating soil and catchment basins, riparian and sub-alpine forest zones, floral species of the Red List, etc. The Forest Code is a framework law and requires execution of detailed regulations.

Civil Code of Georgia (26th June, 1997) – The law regulates private civil relations, determines rights of ownership, family and neighboring tenements and establishes inheritance rules. Ownership right enables the proprietor to freely manage or alienate owned assets. Paragraph 183 of the Code states, that purchasing of real estate shall be confirmed by a written agreement and ownership right of the buyer is registered in the public register. The Civil Code gives the proprietor right to alienate assets with right to build, usufruct or servitude. The Code defines rules for neighboring tenements. According to paragraph 180, if a land parcel does not have access to public roads and power, gas and water supply networks, the proprietor has right to request a neighbor to use his/her parcel to provide such communications and for this right he pays a one-off compensation. The Code also defines other rights of neighboring tenements regarding bordering facilities, plants, fences and disturbances.

Law of Georgia on Protection of Cultural Heritage (8th May, 2007) – The law sets legal principles for protection of cultural heritage in Georgia. It obliges the state to protect cultural heritage and makes all citizens responsible to care for and protect it. According to the law, cultural heritage is preserved and managed by the Ministry of Culture, Monuments Protection and Sports and local governmental bodies. Protection of cultural heritage is managed under the constitutional agreement made between the state and Georgian Orthodox Church.

For alienation of state owned monuments, objects having cultural value, or land parcels contained in the archaeological protection zone an agreement shall be made with the Ministry of Culture, Monuments Protection and Sports. The agreement shall stipulate protection of cultural heritage in compliance with Georgian legislation. Monuments recognized as World's Cultural Heritage cannot be alienated. Only usage rights can be transferred for them.

Law of Georgia on Notary (2009, 12. 04.) - The law provides a legal basis for notary arrangement and notary service in Georgia, as well as basic requirements to implementation of notary an do the related actions. On the basis of the Article 41 of the Law, in populated areas, where there is no notary, service rights are granted to the local self-government, in particular, the local Board(City Hall) head(representative); he has right to implement following notary actions: confirm Wills, protect inheritance rights, verify a copy of an original document, hand over a person's application and certificate to another person, attest a citizen's being alive, attest presence of a citizen on a certain location, receive a document in escrow, attest identify of a citizen with a person, depicted in a photo, verify a signature authenticity in a document. The notary service right is given to a local Board(City Hall) head(representative) only if an electronic notary register is available.

Law of Georgia on Privatization of State-owned Agricultural Land (8th June, 2005) - The law regulates privatization of state-owned agricultural lands. Based on this law, either leased or unleased state-owned agricultural land is subject to privatization. However, the categories of agricultural lands listed below are not subject to privatization:

- I - Grazing lands except grazing lands leased before enacting the law;
- II - Cattle-driving routes;
- III - First sub-zone (strict regime zone) of sanitary protection zone of water bodies utilized for water supply;
- IV - Forest fund land used for agricultural purposes;
- V - Recreation lands;
- VI - Lands allocated to historical, nature and religious monuments;
- VII - Land of protected areas;
- VIII- Agricultural lands being used by budgetary institutions and legal entities of public law in the form of usufruct.

Privatization of agricultural lands of categories II, III, IV and V is still allowed only for important projects and special decision upon privatization is to be made by Georgian Government if appealed by Georgian Ministry of Economic Development. Sanitary terms shall be adhered when privatizing lands of category III.

Law of Georgia on Agricultural Land Ownership (1996) - The law aims at rational land use, improvement of agrarian structure and prevention of land fragmentation. The law gives definition of an agricultural land, sets rules for its purchasing and alienation and role of the state to regulate relevant relationships.

The Law gives the ownership right to agricultural land to the state, citizen of Georgia, household and legal person registered in accordance with the legislation of Georgia. According to articles 6 and 8, acquisition of agricultural land is allowed on the basis of ordinary rules and general restrictions. Ordinary rule considers land alienation without any permits and other limitations, and general restrictions consider land alienation only on the basis of the consent of co-owner of shared property. If not covered by the given law, Civil Code of Georgia regulates land-related (ownership) relations and rights.

Law of Georgia on Entitlement of Ownership Rights to Lands Possessed (Employed) by Physical and Legal Persons of Private Law (7.07.2007) - The law regulates utilization of the state-owned lands and facilitates the development of land market via entitlement of legal ownership or utilization rights of physical and legal persons of private law, as well as other legal organized entities and squatters. The law defines general terms and procedures for entitlement of the land ownership right. Ownership rights cannot be entitled to the following lands:

Cattle-driving routes	Lands accommodating community infrastructure units (transport and underground utilities, water-supply, sewage, communication and power-supply systems);
Water field (stock);	Lands of special purpose (allocated for defense and mobilization);
Protected area;	Lands accommodating state-owned objects;
Recreation parks, forest-parks, squares and others;	Cemetery and pantheon;
Historical, nature and religious monuments;	Sanitary and protection zones;
Land parcel of public use (playground, street, passage, road, pavement, shore) and recreation sites (park, forest-parks, squares, alley, protected area);	Lands allocated for construction and operation of oil and gas mains, as well as associated structures and facilities.
Land containing water reservoir, hydraulic works and sanitary-protection zones of these objects;	

Law of Georgia on Registration of Rights to Real Estate (2005, December 28) – The law gives organizational and legal basis for registration of ownerships rights, encumbrance and mortgage on real estate, as well as liabilities of registration organs. Pursuant to the Law, ownership right to real property, mortgage, usufruct, servitude, lease, sub-lease, rent, sub-rent, lending are subject of registration in the Public Register (Article 13.2).

The Law of Georgia on Rules for Expropriation of Ownership for Necessary Public Needs (1999) – The law defines terms, rules and procedures for expropriation of assets for necessary public needs. Expropriation for essential public needs requires the Presidential decree and the court decision. Decision of the court shall give detailed description of confiscable property and due compensation to the owner.

The law lists the necessary public needs which may entail expropriation (article 2.2); these are construction/installation of:

- Roads and highways;
- Railways;
- oil, gas and oil product pipelines;
- Power transmission and distribution lines;
- Water supply, sewage and storm water drainage systems;
- Telephone lines;
- TV cables;
- Premises and objects of public needs;
- Works required for national defense;
- Mining and reserve development.

According to the law, after issuance of the Presidential decree a person seeking for expropriator's right announces in the central and local printed media about the project, its scope, area coverage and brief description of potentially confiscable property. All the owners also shall be informed about the dates of application to the court and action proceeding.

An expropriator is liable to obtain property in agreement with the owner. Prior to negotiation expropriator evaluates the property and determines estimated compensation sum or other property according to fair market price (articles 6.1). Agricultural lands shall be evaluated together with price of crops could be yielded by the owner throughout the current agricultural year.

Law of Georgia on Compensation of Land Substitute Costs and Damages due to Allocating Agricultural Land for Non-Agricultural Purposes (1997) - specifies requirements for compensating (a land replacement fee) the government and affected private landowners for degradation of land quality. Annex 1 of the law gives compensation sums of such damages. The law does not implicate remuneration due to damage of buildings, perennial plant or one-year crops.

2.1.4.2 Environmental Standards

Environmental standards set out the quality standards for the environment and determine the maximum permissible concentrations of hazardous substances for human health and the environment in water, air and soil.

Soil Quality Assessment criteria in Georgia are defined by the methodological guides on the "assessment of the level of soil pollution by chemical substances" (MG 2.1.7.004-02). Information about soil quality characteristics is given in Table 2.1.4.2.1.

Table 2.1.4.2.1. Soil quality characteristics

Compound	Units	Value
Metals and Miscellaneous		
Arsenic	mg/kg	2
Cadmium	mg/kg	2*
Copper	mg/kg	3-132*
Mercury	mg/kg	2.1
Nickel	mg/kg	4-80*
Lead	mg/kg	32-130*
Selenium	mg/kg	-
Zinc	mg/kg	23-220*
Total Petroleum Hydrocarbons	mg/kg	0.1
Cyanide	mg/kg	0,2
Volatile Organic Compounds		
Benzene	mg/kg	0.3
Toluene	mg/kg	0.3
Total xylenes	mg/kg	0.3
Semi Volatile Compounds		
Benzo(a)pyrene	mg/kg	0.02-0.2
Isopropylbenzene	mg/kg	0.5
Pesticides		
Atrazine	mg/kg	0.01-0.5
Lindane	mg/kg	0.1
DDT (and its metabolite)	mg/kg	0.1

*** Note**: Sodium and neutral (clay and clayey) pH >5.5 - No screening value available

Standards for groundwater quality are not set under Georgian law. Drinking water quality standards are commonly used instead as assessment criteria for groundwater.

Quality of drinking water is determined by the Technical Regulations for Drinking Water (approved by order №349/n of the Minister of Labor, Health and Social Affairs, 17.12.2007. Criteria for drinking water quality are given in Table 2.1.4.2.2.

Table 2.1.4.2.2. Criteria for drinking water quality

Compound	Units	Value
Metals and Miscellaneous		
Boron	mg/kg	0.5
Arsenic	mg/kg	0.01
Cadmium	mg/kg	0.003
Copper	mg/kg	2
Mercury	mg/kg	0.006
Nickel	mg/kg	0.07
Lead	mg/kg	0.01
Selenium	mg/kg	0.01
Zinc	mg/kg	3
Total Petroleum Hydrocarbons	mg/kg	0.1
Cyanide	mg/kg	0.07
Sulphate	mg/kg	250
Chloride	mg/kg	250
pH	pH value	6-9
Sodium	mg/kg	200

Quality of surface water is defined by order №130 on Protection of Georgian Surface Water by the Minister of Environmental Protection and Natural Resources of Georgia, 17 September 1996 and Sanitary Rules and Standards on Prevention of Surface Water Pollution approved by order №297/n on Approval of Environmental Qualitative Norms by Minister of Labor, health and Social Affairs, 16 August 2001. Some quantitative indicators of surface water quality are given in the table 2.1.4.2.3.

Table 2.1.4.2.3. Surface water quality characteristics

Investigated parameter	Units of measurement	MPC
pH		6.5-8.5
Na	mg/l	200
Chloride	mg/l	350
Cyanide (total)	mg/l	0,1[7]
Boron	mg/l	0.5[3]
COD	mg/l	30
BOD	mg/l	6
Total petroleum hydrocarbons	mg/l	0,3
As	mg/l	0.05[3]
Cr^{6+}	mg/l	0.05
Cu	mg/l	1,0[3]
Hg	mg/l	0.0005[3]
Ni	mg/l	0.1[3]
Pb	mg/l	0.03
Se	mg/l	0.01[3]

Zn	mg/l	1,0[3]
Phenols (total)	mg/l	0.001
Benzene	mg/l	0.5
Toluene	mg/l	0.5
Ethylbenzene	mg/l	0.01
Benzo(a)pyrene	mg/l	0.000005

Maximum permissible concentrations (MPC) for **air born** pollutants are set by the hygienic standards on Maximum Permissible Concentrations of Air Born Pollutants for Settlements (HN 2.1.6. 002-01). MPCs for some air pollutants are given in table 2.1.4.2.4.

Table 2.1.4.2.4. MPCs for Some Air Born Pollutants

Substance	Maximum permissible concentration (MPC), mg/m³	
	Maximum One-off	Average Daily
Asbestos containing dust	0	0.06
Silicon dioxide >70%	0.15	0.05
Silicon dioxide 70%-20%	0.3	0.1
Silicon dioxide <20%	0.5	0.15
Carbon Monoxide	5	3
Nitrogen Oxides	0.4	0.06
Nitrogen Dioxide	0.2	0.04
Sulphur Dioxide	0.5	0.05

Note: maximum one-off limit means an instantaneous concentration, which should not be exceeded.

The quotas for MPC of hazardous substances discharged into the water bodies are defined under the law of Georgia on Water. MPCs are set on a site specific basis. Water quality standards in Georgia comply with the WHO recommendations.

Noise

Acoustic background sanitary standards on Noise at Work Places, Residential and Public Buildings and Residential Territories (SRS 2.2.4/2.1.8 003/004-01, Georgian Information Bulletin №90, 24.08.2001, paragraph 647) is accepted in Georgia in order to prevent noise nuisance during the daytime and nighttime. According to this standard document, noise level of 55 dBA and 45 dBA are taken as limit at the border of residential area respectively for day-time (7:00 am – 7:00 pm) and night hours (7:00 pm – 7:00 am); permissible noise level within industrial area is 70 dBA.

Noise standard adopted in Georgia is consistent with the recommended values established by the World Health Organization (WHO[2]) and the International Financial Corporation (IFC[3]).

2.1.5 Environmental Impact Assessment Process in Georgia

"Environmental Impact Permit", as one of the type of the permit, is considered in Georgian Law on Licenses and Permits, in Volume II, Chapter VI, Clause 24, paragraph 4. Georgian law on Environmental Impact Permit in Clause 4 stipulates that if the activity, subjected to the ecological expertise, does not require a construction permit, the Ministry of Environment ("Ministry" herein) issues an Environmental Impact Permit based on the opinion of ecological expertise. Activities subjected to the ecological examination are defined by paragraphs 1 and 2 of the article 4 of Georgian law on Environmental Impact Permit.

According to Georgian law on "Environmental Impact Permit", article 4, paragraph 1, sub-paragraph "m" "arrangement of 2 MW and above capacity hydropower plant", and sub-paragraph "o" "arrangement of 10 000 m^3 and above capacity reservoir" requires ecological expertise. Considering that total capacity of the designed HPP cascades will be 110 MW, its construction and operation must be implemented on the basis of ecological expertise issued by the Ministry of Environment of Georgia.

Pursuant to Article 6 of the law, performer of the planned activities is obliged to organize public discussion of EIA prior to its submission to the administrative organ issuing the permit. For the arrangement of the public discussion, the performer of the planned activities is obliged to publish information about the planned activities in the central and regional newspapers. In a week after the publication of information about the activities, the administrative organ issuing the permit shall be provided with hard and soft copies of EIA. A public discussion shall be held within 50-60 days. Information (statement) about the activities shall include:

- Objectives, name and location of planned activities;
- Address where public representatives may have access to documents (including EIA report);
- Deadline for submitting comments;
- Time and place of the public discussion of EIA.

According to the Article 8, after arranging public discussion, documenting its outcomes and finalizing EIA, performer of the planned activities is authorized to apply to the permit issuing administrative body with:

- EIA report worked out in compliance with legislative norms (five hard and soft copies);
- Layout of an area of the planned activities (indicating distances);
- Volumes and types of expected emission - a technical inventory report on stationary pollution sources and emitted hazardous substances, as well as a standard document on maximum permissible emission/discharge of hazardous substances – 4 copies;
- Executive summary of the proposed activity (non-technical summary);
- Statement on confidential part of the submitted documents.

Article 9 of the law states that the Ministry decides upon the issuance of the Permit in 20 days from application, as prescribed by simple administration rules of Georgian General Administrative Code, volume VI and Georgian law on Licenses and Permits.

2.2 Environmental and Social Standards of International Financial Institutions

Environmental and Social Impact Assessment should be carried out in accordance with the following requirements:

- The EBRD's Environmental and Social Policy (2008) and its associated Performance Requirements, including compliance with relevant European Union directives (most prominently but not only the EU EIA directive);
- Requirements of other potential lenders, including the International Finance Corporation (IFC), the European Investment Bank (EIB), and commercial banks adhering to the Equator Principles;
- International conventions and protocols, related to the project.

The project related Lender Policies and Standards are given in section below.

2.2.1 Lender Policies and Standards

EBRD's 2008 Policy and standards approved by other International Financing Institutions (IFI) apply to the construction and operation project of Dariali HPP, namely:

- EBRD Environmental and Social Policy (2008) and its ten requirements for the project implementation, which is based on the relevant European Union directives (including directive on environment assessment and etc);
- "The Equator Principles".

2.2.1.1 EBRD Environmental and Social Policy, 2008

The Project has been given an 'A' categorization by EBRD. EBRD's environmental assessment requirements for Category A Projects are outlined in its 2008 Environmental and Social Policy. Of particular note, for category A projects EBRD requires:

- Preparation of an Environmental and Social Impact Assessment (ESIA).
- Compliance with its Performance Requirements (as applicable to category A projects) including:
    - PR1 - Environmental and social appraisal;
    - PR2 - Labor and working condition;
    - PR3 - Pollution prevention and abatement;
    - PR4 - Community health, safety and security;
    - PR5 - Land acquisition, involuntary resettlement and economic displacement;
    - PR6 - Biodiversity conservation and sustainable management of Living resources;
    - PR7 - Indigenous peoples (not applicable to this project);
    - PR8 - Cultural heritage;
    - PR9 - Financial intermediaries (not applicable to this project);
    - PR10 - Information disclosure and stakeholder engagement;
- Adherence to the UNECE Convention on Access to Information, Public Participation in Decision-Making and Access to Justice (Aarhus Convention).
- Compliance with good international environmental practice, such as:
    - EU standards; and
    - World Bank Group EHS Guidelines (where EU standards do not suffice).

The Project should also meet ILO core labor standards on:

- Forced labor (C105) [ratified by Georgia in 23.09.1996];
- Child Labor (C182) [ratified by Georgia in 24.07.2002];
- Discrimination (C111) [ratified by Georgia in 22.06.1993];
- Freedom of Association and the Right to Organize (C 87) [ratified by Georgia in 03.08.1999];
- Equal Remuneration (C100) [ratified by Georgia in 22.06.1993];
- Minimum Age (C138) [ratified by Georgia in 23.09.1996].

EBRD's requirements as prescribed in its Environmental and Social Policy and the underlying Performance Requirements which in turn reference compliance with numerous EU Directives, International Conventions and other sources of good practice represents a comprehensive suite of standards and principles for project finance. EBRD's requirements also capture the requirements of other financial institutions considering support to the project and are therefore adopted as the primary set of standards for this ESIA. Brief gap analysis of EBRD environmental and social policy and Georgia legislation is given in the table 2.2.1.1.1.

Table 2.2.1.1.1. Gap analysis of EBRD environmental and social policy and Georgia legislation

PR	Requirements	Equivalent national requirements	Gaps
1	**Environmental and social appraisal** Category A projects require a comprehensive environmental and/or social impact assessment, to identify and assess the potential future environmental and social impacts associated with the proposed project, identify potential improvement opportunities, and recommend any measures needed to avoid, or where avoidance is not possible, minimize and mitigate adverse impacts. This assessment will include an examination of alternatives. The ESIA shall meet PR 10 and any applicable requirements of national EIA law and other relevant laws. The environmental and social appraisal also requires: o Consideration of transboundary or global issues e.g. climate change adaptation; o Consideration of involuntary resettlement (and application of PR 5 below); o Cultural heritage and impact on indigenous peoples (if applicable); o Development of a Environmental and Social Action Plan (ESAP) which is often a standalone document; o Procedures for performance monitoring and review. The ESIA should also comply with the EU EIA Directive	The list of activities subject to EIA procedure under the Georgian legislation differs from the list of activities defined in EU Directive on EIA (Annex I and II), the list of EBRD's Category 'A' projects and the list provided in Aarhus convention (Annex 1). The Law of Georgia on Permit for Impact on the Environment provides a list of activities subject to EIA procedure. This Project is subject to Georgian EIA procedure. There is no official scoping stage in Georgia and consequently there are no requirements/practices for identifying possible stakeholders and ensuring their participation at the scoping stage; unlike the Aarhus convention, EU directive on ESIA, EBRD and the international bank requirements, public participation occurs only on the ESIA review stage. The public participation component is Implemented by developer itself. The developer publishes information on planned activity in central and local newspapers, ensures availability of EIA report for public consideration, holds public hearing meeting(s) and receives written comments from members of the public which are incorporated in the final version of the ESIA report. The Ministry of Environment Protection and Natural Resources of Georgia (decision-maker) does not communicate with public. There is no requirement for stakeholder engagement or a formal grievance mechanism in Georgia that would ensure that consultation, disclosure and community engagement continues throughout construction and operation of the project. Georgian ESIA process does not require consideration of climate change impacts and adaptation.	No provisions regarding scoping at the early stage of EIA preparation available. No requirements/practices for identifying possible stakeholders. The involvement of the public in the EIA processes is limited to the provision of information to them and consultation. No community participation at early stage of the ESIA process. No obligation for development of a grievance mechanism. No communication between the Ministry of Environment Protection and Natural Resources of Georgia (decision-maker) and stakeholders. No obligation to ensure engagement of stakeholders throughout construction and operation of the project.
2	**Labor and working conditions** EBRD policy requires that projects are complaint with applicable ILO conventions and certain EU requirements such that workers have fair terms of employment and rights and are provided with a safe working environment. In terms of the ESIA the key requirements of PR2 include:	Project-related labor and employment issues are associated with two laws: the Labor Code of Georgia and the Law" On Employment". The Labor Code of Georgia refers to almost all issues addressed by IFC performance standard 2, including: Labor and Working Conditions - working conditions and terms of employment; non-discrimination and equal opportunity;	There is no clear legislative definition or prohibition of forced labour. The minimum age for hazardous work is unclear. The Labour Code does not set out

	· Occupational Health and Safety · Training · Accommodation and other facilities · Retrenchment of workers (if collective dismissals are anticipated) · Supply chain management Workers must also have access to a grievance mechanism.	child labor; safe and healthy working conditions etc. Employees belonging to certain professions related to: transportation and driving safety; weapon possession; radioactive substances, reactive liquids; ionizing radiation and sources of electromagnetic fields; personnel working with high risk pathogenic biological agents and; all kinds of independent medical or nursing activities, are subject to periodic medical screening. The Employer is responsible for compensating any harm caused to the health of the employee where the employer is responsible for such harm. The law on compensation of harm caused by hazardous substances obliges the employer, regardless of fault, to compensate the damage to the human lives and the health, environment, cultural heritage, property and economic interests, caused by hazardous substances. Georgia is a member to ILO conventions including: Forced labor (C105); Child Labor (C182); Discrimination (C111); Freedom of Association and the Right to Organize (C 87); Equal Remuneration (C100); Minimum Age (C138).	any restrictions on types of work or working hours for children aged 14-16 years. There is no requirement for under-18s to undergo an appropriate risk assessment. Lack of legal protection for trade union members in the Labour Code discourages workers from organising and joining trade unions. Employers are given power to make unilateral changes in relation to certain working terms and conditions and may revoke collective agreements at will. Employers are not required to give notice of termination of employment (including retrenchment) to employees, although they are required to give 2 months' notice to trade unions. There is no obligation to consult or develop a plan to mitigate the adverse impacts. There are no specific provisions on worker accommodation. Non-employee workers: there are no specific provisions on non-employee workers. There is no requirement in Georgia for the purchaser to enquire into compliance of suppliers with legal requirements re labour and working conditions.

3	**Pollution prevention and abatement** The EBRD is a signatory to the European Principles of the Environment and requires compliance with EU environmental standards relating to industrial production, water and waste management, air and soil pollution, occupational health and protection of nature. The PR, amongst other objectives, promotes the reduction of greenhouse gas emissions. Key requirements of the PR are to: • Apply pollution prevention techniques and technology to minimize human and environmental harm whilst remaining technically and financially feasible); • Implement energy and resource efficiency measures; • Manage wastes following the principles of the waste management hierarchy, and use legitimate waste contractors where necessary; • Manage hazardous materials in a responsible manner where their use is unavoidable; • Develop suitable emergency response plans; • Monitor effluents and emissions on an ongoing basis; • Consider impact to ambient conditions, taking account of background pollutant concentrations and proximity to sensitive receptors, and promote strategies that will improve ambient conditions; • Report baseline and post construction GHG emissions (100,000 tones CO2 equivalent per year for the aggregate emissions of direct sources and indirect sources); • Pesticide use (if applicable).	Pollution prevention and abatement is regulated by Georgia legislation and regulatory documents. Such aspects as protection of atmospheric air, water, soil, use of natural resources, wildlife are covered (see list of laws and regulations in Section 2.1, National Legislation). Georgia is a member state of international conventions promoting protection of physical and biological environment, including those related to ozone layer protection: Vienna Convention on the Protection of the Ozone Layer, ratified by Georgia in 1996; Montreal Protocol on Substances That Deplete the Ozone Layer, 1987, joined by Georgia in 1996 with amendments; UN Framework Convention on Climate Change, New York 1994, ratified by Georgia in 1994; Kyoto Protocol on Greenhouse Gas Emission Reductions, 1997, ratified by Georgia in 2005; Geneva Convention on Long-Range Transboundary Air Pollution, 1979, ratified by Georgia in 1999, etc. Georgian environmental regulations support implementation of energy and resource efficiency measures; introduction of cleaner production approach and technologies; development of emergency response plans, etc. The draft environmental code is intended to bring together in a general framework law all environmental conventions ratified by Georgia along with new environmental legislation, with a view to introducing an innovative approach to harmonizing, systematizing, unifying and integrating existing and future environmental obligations.	Environmental regulations/legislation is being harmonized with EU; Article 43 of the Partnership and Cooperation Agreement between the European Union and Georgia provides that Georgia commits itself to harmonization of its legislation with that of the European Union. In accordance with 14 June 2001 Decree No.613 of President of Georgia "The Strategy of Harmonization of Georgian Legislation with that of the European Union" was developed and on 8 May 2004 Georgian government endorsed "National Program of Harmonization of Georgian Legislation with that of the European Union". However, there are some differences between EU and Georgian regulations. Air quality and emission standards, for some of the components are more stringent in Georgia than in Europe. Standards for groundwater quality are not set under Georgian law. Drinking water quality standards are commonly used instead as assessment criteria for groundwater. Georgian water legislation, unlike respective EU legislation does not provide for classification of water bodies in accordance with ecological status. The quotas for maximum permitted concentration (MPC) of hazardous substances discharged into the water bodies are defined under the law of Georgia on Water. MPCs are set on a Site specific basis. Water quality standards in Georgia are in accordance with the ISO recommendations.

			There are no published EU soil quality guidelines, while in Georgia the method for assessment of the level of chemical pollution of soil (MI 2.1.7.004-02), approved by the Ministry of Labor, Health and Social Affairs, and defines screening values for soil. There is no Georgian legislation on waste, except for household waste. There are no hazardous waste management plans in place.
4	**Community health, safety and security** Addresses a project's potential to increased community exposure to risks and impacts arising from temporary or permanent changes in population; transport of raw and finished materials; construction, operations and decommissioning; accidents, structural failures, and releases of hazardous materials. The PR requires that information concerning potential risks are disclosed and those risks are managed. Key requirements are that: • Equipment and infrastructure is designed to withstand natural phenomena (e.g. seismic events) and safety controls are place to protect communities where moving equipment and/or vehicles are involved; • Hazardous materials will be managed to prevent community exposure; • Impacts from natural hazards, such as flooding, should not be exacerbated; • Where necessary action plan shall be developed to prevent the spread of workforce induced communicable diseases; • Emergency preparedness plans, taking account major accident hazards and the protection of local communities, should be developed; • Security personnel will be hired, trained and monitoring in line with good international practice. This includes the principal of proportionality and conduct towards workers and members of the community. The port must investigate any allegations of abusive or unlawful acts by its security personnel.	Population health and safety is regulated by Georgian Law on Health Protection and the Law on Public Health. The objectives of these law are: • To promote healthy life style and health; • To ensure environment safe for human health; • To promote reproductive health; • To avoid spreading of contagious and non-contagious diseases. General measures for prevention of natural calamities, emergency situations and consequences thereof are addressed via the law of Georgia on Protection of Environment, whereas specific measures are set out in the law on Hazardous Industrial Objects.	No gaps has been identified.
5	**Land acquisition, involuntary resettlement and economic**	Compensation and ownership issues are regulated by:	The law does not allow for compensation to

	displacement In case of involuntary resettlement special requirements in PR 5 will also apply, where involuntary resettlement includes both physical and economic displacement. In cases where there has been displacement as a result of conflict, prior to the EBRD's involvement, this PR supports the application of the Guiding Principles on Internal Displacement: Office of the High Commissioner for Human Rights. A fundamental objective of PR5 is to avoid or at least minimize involuntary resettlement by exploring alternative project designs wherever possible. Where not possible, mitigation measures might include compensation for loss of assets at **full replacement cost** (emphasis added). Affected individuals' standard of living should be better or at least no worse off as a result of the project. Key requirements of PR5 include: • Consultation, including the opportunity to negotiate compensation packages and eligibility requirements • Grievance mechanism, including an impartial recourse mechanism, consistent with PR10 (below) • A census, where involuntary resettlement is unavoidable, to identify baseline conditions against a defined 'cut-off' date. • Development of either a Resettlement Action plan (RAP) where physical displacement occurs or a Livelihood Restoration Framework (LRF) where there is only economic displacement. A LRF is similar to a RAP except deals with economic displacement and therefore land take timeframes, valuation and appeal processes. Note. EBRD policy requires compensation for lost assets at 'full replacement cost' which can be defined as the market value of the asset plus transaction costs. It also recognizes the need to compensate those without legal title and the provision of special assistance to the poor and the vulnerable.	• Law of Georgia on Privatization of State-owned Agricultural Land (2005); • Law of Georgia on Ownership to Agricultural Land (1996); • Law of Georgia on Entitlement of Ownership Rights to Lands Possessed (Employed) by Physical and Legal Persons of Private Law (2007); • The Law of Georgia on Rules for Expropriation of Ownership for Necessary Public Needs (1999); • Law of Georgia on Compensation of Land Substitute Costs and Damages due to Allocating Agricultural Land for Non-Agricultural Purposes (1997). In case temporary or permanent right of use of private land is required the issue of compensation and terms of use are to be negotiated with the owners. If negotiations fail and obtaining the right of use is imminent public necessity lawful expropriation can occur (Law of Georgia on the Rules for Expropriation of Ownership for Imminent Public Necessity). The decision on expropriation can be made only through a Presidential Decree, while the final decision is made only by a Regional Court. Potential expropriator is obliged to inform land owners and to negotiate conditions of compensation. Compensation can be made in cash, reflecting the actual market value of the property. The law does not mention the possibility of suggesting choices among feasible resettlement options in case of physical displacement (the law does not specify/distinguish physical and economic displacement). All disputes are settled through court. During evaluation of the cost of the agricultural land, compensation is calculated with consideration of potential income expected through realization of the harvest, except for the cases when the land is cultivated after evaluation of the cost.	informal (illegal) tenants/land users. There is no obligation for development of grievance mechanism. The law provides for compensation at market value (rather than replacement costs).
6	**Biodiversity conservation and sustainable management of living resources.** The EBRD supports a precautionary approach to the management and conservation of biodiversity and is guided by applicable international law and conventions including:	Biodiversity conservation and sustainable management of living resources is regulated by environmental legislation of Georgia, such as: • Law on Wildlife (1997, amend. 2001, 2003, 2004);	Mechanisms of compensation/offset in case of unavoidable impact on critical habitats/protected areas are available in Georgia, but needs improvement.

	• Convention on Biological Diversity; • Convention on Wetlands of International Importance Especially as Waterfowl Habitat; • Convention on the Conservation of Migratory Species of Wild Animals; • Convention on the Protection of the Black Sea Against Pollution; • Council Directive 92/43/EEC May 1992 on the Conservation of Natural Habitats and of Wild Fauna and Flora, as amended; • Council Directive 79/409/EEC April 1979 on the Conservation of Birds. The client will need to identify measures to avoid, minimize or mitigate potentially adverse impacts and, where appropriate and as a last resort, propose compensatory measures, such as biodiversity offsets, to achieve no net loss or a net gain of the affected biodiversity.	• Law on System of Protected areas (1996, amend. 2003, 2004, 2005, 2006, 2007); • Law on Red List and Red Book of Georgia (2003, amend. 2006); • Law on Establishment and Management of Kolkheti Protecte; Areas (1998, amend. 1999, 2003, 2005, 2007); • Law on Status of Protected Areas, 2007; • Biodiversity Protection Strategy and Action Plan, 2005; • Red List, 2005. Georgia has ratified conventions including: o Convention on Biological Diversity; o Convention on Wetlands of International Importance Especially as Waterfowl Habitat; o Convention on the Conservation of Migratory Species of Wild Animals; o Convention on the Protection of the Black Sea Against Pollution.	
7	**Indigenous people**	Not applicable	
8	**Cultural heritage** EBRD requires that impact to irreplaceable cultural heritage is minimized consistent with the Convention Concerning the protection of the World Cultural and Natural Heritage and the Convention for the Safeguarding of Intangible Heritage. The EBRD therefore requires: • early identification (screening) of any cultural heritage objects or intangibles and where finds are identified, consultation notification of the relevant authorities; • Development of mitigation measures using international good practice, where avoidance is the preference; • Consultation with affected communities; • Development of a chance finds procedure, including the requirement to not disturb potential finds until an assessment has been made by a qualified specialist.	Georgia ratified UNESCO conventions of cultural heritage protection including the World Cultural and Natural Heritage and the Convention for the Safeguarding of Intangible Heritage. Furthermore cultural heritage issues are regulated by the law of Georgia on Protection of Cultural Heritage. According to the law protection and management of cultural heritage is responsibility of the Ministry of Culture and Monument Protection of Georgia and local authorities.	No significant gaps indentified
9	**Financial Intermediaries**	Not applicable	

10	**Information disclosure and stakeholder engagement** EBRD supports the approach of the UNECE Aarhus Convention and the right to 'meaningful consultation'. Key requirements in PR10 include: • Stakeholder identification and analysis, with special attention afforded to those that are disproportionately affected; • Stakeholder engagement at the scoping stage (for Category A projects); • Preparation of a Stakeholder Engagement Plan (SEP) with a grievance procedure, outlining consultation process and times/venues of meetings and other means of contacting the Project; • Ongoing engagement and disclosure of information (duration of activities, potential impacts etc.); • Disclosure of the ESIA, SEP, ESAP and Non Technical Summary; • A public disclosure period for the ESIA and other associated documents forming the disclosure package to be stay available in the public domain for a minimum of 60 days; • In case of involuntary resettlement special requirements in PR 5 will also apply; • Provision of periodic (no less than annually) reports to affected communities highlighting progress against the ESAP; • For projects to which involuntary resettlement (PR5) applies, the client will ensure that there is an independent, objective appeal mechanism.	The Project is categorized "A" per EBRD Environmental and Social Policy, entailing a full Environmental and Social Impact Assessment (ESIA), and a public disclosure period of 60 days as a minimum. Per Georgian requirements it is understood that the Project warrants an Environmental Impact Assessment (EIA) with associated public consultation and public disclosure (not more than 60 days). However, Georgian procedure does not specify the need for consultation at the scoping stage (as discussed earlier), a formal Stakeholder Engagement Plan with a grievance procedure, ongoing disclosure and engagement beyond the formal disclosure period, and disclosure of certain stand-alone documents required under EBRD Policy.	Under Georgian law there is no requirement/practice for identifying possible stakeholders. The involvement of the public in the EIA processes is limited to the provision of information to them and consultation. No community participation at early stage of the ESIA process. No obligation for development of grievance mechanism. No communication between the Ministry of Environment Protection (decision-maker) and stakeholders. No obligation to ensure engagement of stakeholders throughout construction and operation of the project.

2.2.1.2 International Financial Corporation Guidelines and Standards

Following **World Bank Group** Environmental Health and Safety Guidelines[2] are in compliance with the project:

- The General Environmental, Health and Safety (EHS) Guidelines;
- EHS Guidelines for electric power transmission and distribution projects.

Banks, which are guided by the "Equator Principles", also require the compliance with the following standards:

- the Equator Principles and the underlying IFC Performances Standards, 2006 including:
  - PS1 Social and Environmental Assessment and Management Systems;
  - PS2 Labor and Working Conditions;
  - PS3 Pollution Prevention and Abatement;
  - PS4 Community Health, Safety and Security;
  - PS5 Land Acquisition and Involuntary Resettlement;
  - PS6 Biodiversity Conservation and Sustainable Natural Resource Management;
  - PS8 Cultural Heritage.

“Requirements for the implementation of the projects” of EBRD includes the most part of the issues of the “ Standards for the Activities”.

3 Analysis of alternatives for the planned activities

Three basic alternatives have been discussed at the preliminary project stage:

1. No action alternative;
2. A seasonal regulation HPP construction alternative;
3. A riverbed type HPP construction alternative;
4. A diversion type HPP construction alternative.

Since the most rational option was selected, its additional alternatives have been considered as well. The general assessment and comparative analysis of these alternatives is given in the following chapters.

3.1 No Action Alternative

If the Dariali HPP Construction and Operation Project is not implemented, there will be no negative impacts on the natural and social environment caused by the construction works and power plant operation. This can be assessed positively.

Preliminary assessment of the planned activities, along with the expected negative impacts, revealed significant positive aspects that will not occur in case of the project failure.

The most notable positive results of the project implementation are socio-economic benefits, expected in the region during the plant construction and operation. Based on the environmental baseline study industrial infrastructure in Stepantsminda Municipality is underdeveloped. The main source of income for local residents is agriculture, particularly livestock. Recently, touristic importance of the

[2]EHS Guidelines applied because they are indicative of good international industry practice (GIIP).

municipality tends to grow as well. However this does not ensure a proper revenue growth. The population (especially young people) migration rate is high, which is basically caused by lack of jobs.

The power plant construction and operation will significantly contribute to the socio-economic status development in the region, particularly in Stepantsminda municipality. The revenue of the local budget will raise from a considerable amount of property taxes. It should be noted that there is a high probability of creating highly paid temporary and permanent jobs and employing local population. Based on the practice, only 5-10% of employees, hired during the power plant construction, are qualified specialists, invited from the capital and other regions. The remaining 90% of the staff (unqualified workers) will be selected among the local residents through competition. They will be provided with appropriate trainings.

In addition, the service infrastructure required for the planned activities (e.g. small manufacturers of building materials, transport services, public catering and so forth) will be developed, which in turn will create additional sources of income and improve the employment.

Dariali HPP construction is of notable importance for the improvement of the economic situation in the country. Georgian economy is on the rise in recent years and accordingly, demand on electricity for internal consumption is rapidly increasing. In addition, due to the worldwide high rate growth of energy shortages, leading countries are trying to fill the gap through energy imports from neighboring countries. Georgia has a very high hydro power generation potential and thus, construction and rehabilitation of power plants is one of the priorities for the state policy. After the Dariali HPP commissioning additional energy can be supplied to the power grid of Georgia – as for internal needs, as well as for increasing of energy exports to neighboring countries.
It can be concluded that if the project is not implemented, some low level environmental impacts could be avoided, though the development of the region's infrastructure and socio-economic condition will be impeded. Considering rational design decisions and appropriate mitigation measures, the power plant construction and operation will result in much more important socio-economic benefits, rather than the no-action alternative, hence, the latter was ignored.

3.2 A Seasonal Regulation HPP Construction Alternative

An alternative of seasonal regulation power plant was discussed at the preliminary stage of the project. Based on the visual audit results, a narrow gorge area, adjacent to Tsdo village (approximate coordinates: X = 470766, Y = 4726961) was considered to be the most appropriate site for the HPP dam construction. According to the alternative, the dam height is 40-60 m; taking into account the local terrain, it will create an up to 3 km long and averaged 800 m wide reservoir (water surface area approx. 1.8 km^2). The scheme of a seasonal regulation power plant alternative is given in Figure 3.2.1.

In case of the dam and reservoir construction in the mentioned area significant construction works will be required to be carried out for the road and, probably, also for the road tunnel.

Significant works will be required to be carried out for the reconstruction of the gas pipeline route as well. Pipelines in this section of gorge are located on the right bank of the river. In case of the dam and reservoir construction the pipelines should be necessarily relocated and due to the geological conditions, technically this will be very difficult to implement and will require significant costs. Besides, road and pipeline rehabilitation works will significantly increase the risk of adverse environmental impact.

Figure 3.2.1. The scheme of a seasonal regulation power plant alternative

The risk of developing hazardous geodynamic processes during the reservoir construction should be also considered. Namely: Intensification of erosion processes is expected due to the humidification of slope rock layers adjacent to the reservoir. According to the preliminary assessment, construction of the reservoir on the territory of Stephantsminda will not result in the development of dangerous geodynamic processes.

A significant drawback of the reservoir construction is a risk of an impact on the local climate. In addition, there is one more important issue, which should be taken into account: large land areas will be flooded and thus, economic activity of the local population throughout this areas will be limited - the area selected for the reservoir construction is used for pastures.

In terms of the impact on the biological environment the following issues has been revealed during the preliminary study:

- The area selected for the proposed reservoir is very poor in vegetation and presence of protected species is not expected. Accordingly, negative impact on vegetation will not be significant;
- If we consider the poor ecosystems of the areas that are likely to be flooded, existence of habitats of the protected animal species is unlikely. It should be noted that the boundaries of Kazbegi National Park is in the close vicinity to the study area and thus, there is a high risk that the protected species from National Park may occurre on the study area as well;
- Significant impact is expected on ichthyofauna, as the movement of fish towards the estuaries will be practically ceased due to the dam. It should be noted that in case of high dams the fish passage functioning is ineffective, and mitigation of these impacts is practically impossible.

As we know, technical maintenance of large reservoirs during their operation is related to very high costs. Permanent geological stability monitoring and periodical maintenance-preventive works on the reservoir slopes are necessary. Protection of safety measures around the reservoir perimeter is also related to high costs.

The fact that Dariali HPP will be a seasonal regulation power plant and energy generation on the Tergi River will be also available in low-water periods can be considered as an advantage of the high dam and reservoir construction alternative. However, the issue of maintaining the volume of water in the reservoir should also be taken under consideration. Given that Tergi and Chkheri Rivers are characterized by large volumes of solid sediments and often by mudflows, the reservoir will be filled with sediments in 2-3 years and the HPP will operate as run-of-the-river plant. Eventually, excessive amount of sediments will accumulate in Tergi riverbed, upstream of the reservoir. This may increase flood risks for adjacent areas, including Stepantsminda settlement. Just in contrary, lack of sediments will occur in the downstream, which will have an undesirable impact on hydrological regime of the river. Hence, in terms of power generation the dam construction is acceptable only for achieving the necessary gross head.

Description of this alternative has revealed that the construction of the reservoir would have far more negative consequences from the environmental point of view, than the construction of diversion type (run-of-the-river) HPP. In terms of energy generation, benefits are expected to be short term and may not reimburse the reservoir construction costs. Based on the above mentioned, the seasonal regulation HPP construction alternative is unacceptable.

3.3 A Riverbed Type HPP Construction Alternative

A riverbed type HPP construction alternative considers arrangement of a dam and reservoir on Tergi River, and construction of a power unit behind the dam. From the environmental and social point of view riverbed type HPPs have a significant advantage, as they do not require installation and operation of derivation systems and therefore there are no impacts associated with such facilities.

Based on the above mentioned, selection of riverbed type HPP construction alternative was possible, though it failed due to the local conditions, namely:

In order to achieve the desired electricity generation capacity, installation of a high dam (100-150 m) and a reservoir or hydropower cascade is required. In the first case negative impact risks, related to the reservoir operation would be very high (see chapter 3.2.); in the second case there are high negative impact risks, associated with construction and operation of several dams and small reservoirs.

Based on the above mentioned, riverbed type HPP cascade alternative was not considered acceptable.

3.4 Diversion type HPP construction alternatives

In order to utilize the hydro power potential of the proposed section of River Tergi, construction of two or single stage diversion type power plant may be considered. It is generally known that the construction and operation of derivation type HPPs is by far more acceptable in terms of environmental impacts, than of seasonal regulation power plants. This, of course, applies to the discussed project as well.

3.4.1 Two-stage run-of-the-river HPPs construction alternative

In case of the two-stage diversion type HPPs construction, the headwork of the first power plant should be preferably located in the section selected for a one-stage system. As for the power unit of the plant, it may be arranged in the section located between 1490-1510 m points, on the left bank of Tergi River. On this section of the left bank there is a relatively quiet area for the construction of powerhouse and substations. Approximately 450-500 meters away from the selected area river Tergi is crossed by gas pipelines, which further are located on the right bank of the river. Based on the above mentioned, construction of the second HPP headwork is recomended in the vicinity of the first HPP power unit. Otherwise, the arrangement of the headworks will be possible in 300-350 meters away from crossing point of 500 mm diameter pipeline (pipeline right of way zone, plus the influence zone of the second power plant dam) towards the river flow direction (near the Tergi River bridge), which is unacceptable in terms of power generation, since an important part of the river hydro power potential would be lost.

Proceeding from this, the headwork of the second power plant should be arranged in the section between 1490-1500 m elevation. Water intake facility, settling basin and diversion tunnel is recommended to be arranged on the right bank of the river, because, in this case, negative impact on the main gas pipelines and Gveleti village, as well as technical and environmental challenges related to the Devdoraki River crossing, will be avoided.

In case of constructing the headwork of the second power plant according to the mentioned scheme, the diversion tunnel would be arranged deep in the mountain along the right bank of the river, up to Khdistskali River surrounding areas, where the arrangement of a power unit is possible.

The scheme of the two-stage run-of-river HPPs construction alternative is given in Figure 3.4.1.1.

Figure 3.4.1.1. The scheme of the two-stage run-of-river HPPs construction alternative

In case of the two-stage HPP cascade construction the number of headworks (low threshold water outlet dam, water intake, settling facility), diversion systems, equalizing reservoirs, pressure pipelines, power plant buildings and substations to be installed will be doubled, which is likely to be the main disadvantage of the alternative.

Construction of two-stage HPP cascade requires a much greater scope of construction works to be carried out simultaneously in several sites, which increases the significance and quality of a negative environmental impact. Disadvantage of this alternative is obvious at the operational stage as well, which is mainly related to difficulty of technical maintenance services and associated costs.

Most importantly, even if the above-mentioned disadvantages will be neglected and the alternative will be accepted, significant growth of energy potential is not expected.

3.4.2 One-Stage Diversion HPP Construction Alternative

If the scheme of one-stage run-of-river HPPs will be implemented for the construction, arrangement of headquarters towards the direction of the river flow, downstream from the tributaries of the river Tergi and river Chkheri (1710-1725 m a.s.l.) is recommended for full utilization of hydropower potential; water intake facility should be arranged on the right bank of the river, from where water will be discharged into the diversion channel and afterwards into Diversion tunnel, which will pass under rocky ridge and will continue till the left bank of the Khdistskali river tributary. A place for the arrangement of powerhouse and substation can be found there.

The scheme of the one-stage run-of-river HPPs construction alternative is given in Figure 3.4.2.1.

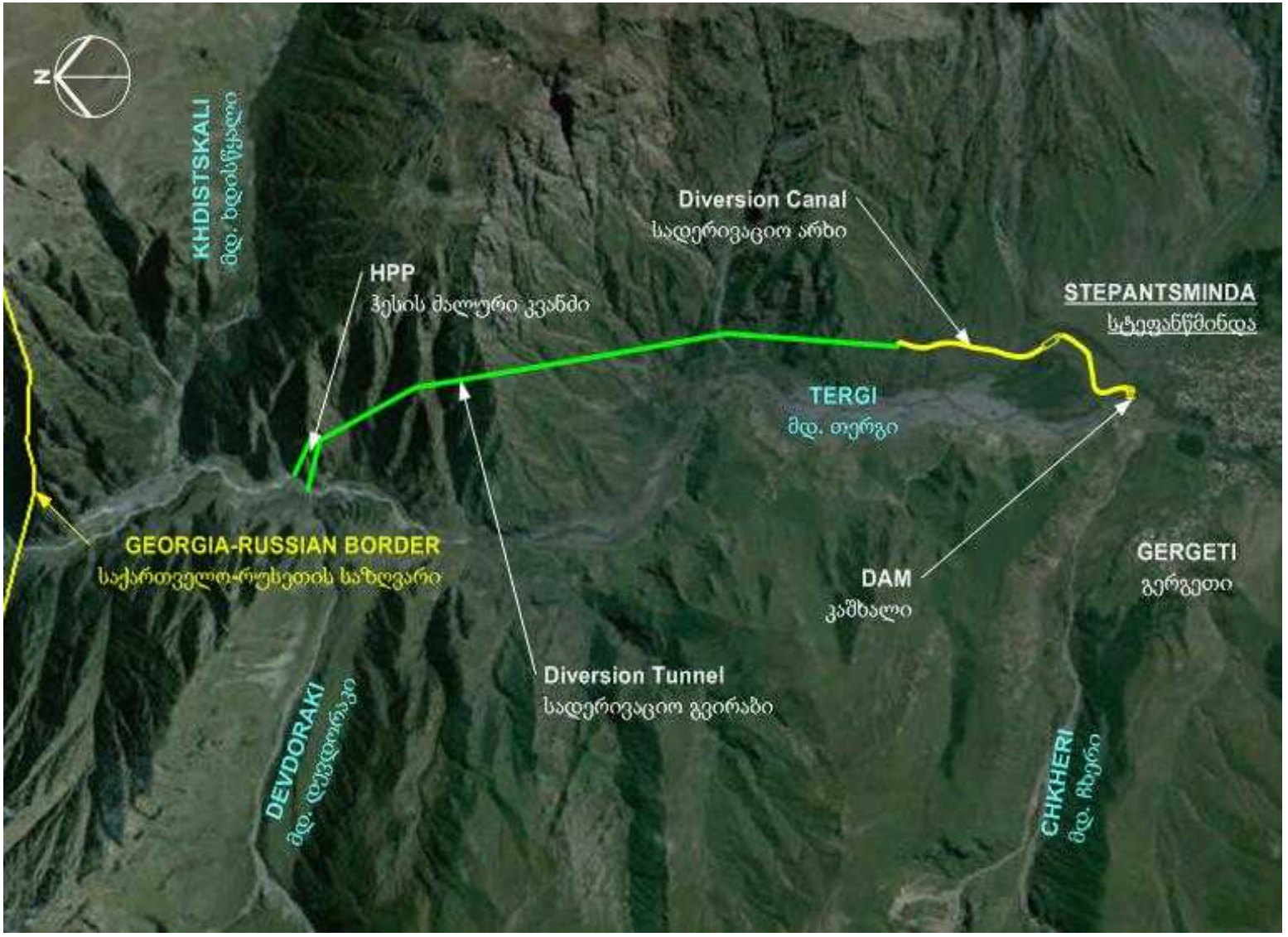
As noted in the previous sub-chapter, two main advantages of this alternative has been revealed according to the preliminary evaluation:

- A relatively small volume of construction works, which is important from both economic and environmental point of view;
- Simplicity of power plant operation.

Despite of the great advantages, one-stage run-of-river HPPs construction scheme has certain disadvantages, including:

- Diversion pipeline (approximately 2100 m) will pass through an unstable slope of the right bank of the river Tergi on which runs 2-3 mud flow type gorge. Accordingly, all potential geological risks should be considered during the preparation of structural design of pipeline;
- Diversion pipeline route will cross two main gas pipelines. Accordingly, an effective scheme of intersection of these two linear buildings should be worked out.

Figure 3.4.2.1. The scheme of the one-stage run-of-river HPPs construction alternative



Based on the above mentioned, the most rational decision has been made by the project organization and environmental group, namely: construction of one-stage diversion HPP on the proposed section of the river Tergi. Infrastructure deployment and major technological alternatives for the selected one-stage HPP alternative is represented in the following subsections.

3.4.2.1 Alternatives for Headworks

Construction of water intake facilities is considered about 1710-1725 m a.s.l. along the river Tergi, adjacent to the confluence of Chkheri and Kuro rivers.

In case of constructing dam in the head race from the selected section, it will be possible to increase pressure for several meters, which in turn will increase the hydropower potential usage coefficient. Though, the disadvantage of this alternative is unsatisfactory geological conditions (unstable rocks, relief) and dam's proximity to a densely populated area (Stepantsminda). In addition, the length of an open diversion pipeline increases as well.

As for the construction of dam in the tail race from the selected section, the main difficulty here is unfavorable characteristics of meandering of the river Tergi. Produced electricity is somehow decreased as well. Considering the above mentioned, the most appropriate adoption is the construction of dam at 1710-1725 m a.s.l., adjacent to the Tergi Chkheri river tributaries.

In addition to the above mentioned, headworks alternatives can be a subject of discussion, namely:

- Overflow dam and lateral water intake facility (proposed option);
- Gate dam.

The main advantages of the proposed option are: dam operation simplicity and small amount of mechanical equipment.

Layout of the headworks and positive and negative sides of technological alternatives are given in the table 3.4.2.1.1.

Table 3.4.2.1.1. Comparative analysis of headwork layouts and technological alternatives

Alternative	Advantage	Disadvantage
Layout alternatives		
Arrangement of headwork at 1710-1725 meters above sea level (proposed option).	• Flow and pressure gives possibility to produce designed capacity; • Proposed section for the construction of headworks is located in relatively accessible, which significantly reduces possible impact on environment; • Characteristics of meandering of the river Tergi, relief along the power unit route and rock specifics are favorable.	
Upstream or downstream of the proposed area	• Based on the general assessment, in case of arranging dam upstream from the proposed section, it will be possible to increase the pressure and produced electricity.	<u>Upstream from the proposed section:</u> • Unfavorable geological conditions and river meandering character; • Proximity of headworks to Stepantsminda; • Diversion pipeline length is prolonged, which increases negative impact on environment and risks related to population safety. <u>Downstream from the proposed section:</u> • The head will not be sufficient to obtain designed capacity
Technological Alternatives		
Overflow dam and lateral water intake facility (proposed option);	• Capability of automatic discharge of excess water flow; • Lack of mechanical equipment; • Simplicity of operation; • Sediments are not accumulated behind the dam and impact on sediments movement dynamics is not expected; • Headworks do not require constant supervision, daily check up is sufficient.	• Sufficient water is not collected upstream of the river and dam is working only with natural water flow of the river
Gate dam	• Minimal impact on hydraulic regime; • During flood period open shields of gate dam give possibility to keep natural riverbed processes; • Ensures free transportation of river drift in tailrace; • Ensure increasing of working efficiency of sedimentation tank with arranging threshold washing galleries.	• Flat gate opening capacity must be regulated during flooding flow; • A large number of mechanical devices and shields; • Operation complexity; • Periodical maintenance of metal structures; • Sufficient water volume does not reach upstream of the river, therefore dam is working only on natural river drift.

3.4.2.2 Diversion System alternatives

The following diversion system alternatives have been studied:

- Based on the local relief, the first section of diversion system will be arranged in the form of an underground diversion pipeline, and further the major part of the system will be represented as underground diversion tunnel. Two options have been considered during the design phase:

  I. Length of the diversion pipeline will be about 20073 m. Underground diversion tunnel will be arranged along the rest section of the system, which is about 5400-5800 meters long;
  II. Maximal deepening of water intake facility, which will shorten the length of the diversion pipeline and the major part of the diversion system will be represented by underground tunnel.
- Diversion pipeline alternatives (circular or horseshoe-shaped);
- Diversion pipeline construction method alternatives;
- Waste rock management alternatives, generated during the construction of diversion tunnel.

Baseline study of the diversion system deployment corridor has revealed that it is far more favorable to arrange the system mostly as underground diversion tunnel and to shorten the length of diversion pipeline to minimum. This has some notable advantages:

- Diversion system in the initial section crosses several mud flow type natural gorges. სისტემის Damage risk of underground tunnel during system operation is comparably low than it is in case of aboveground infrastructure.
- Arranging aboveground infrastructure on a big distance may hinder movement of local population and their agricultural activities. Diversion pipeline of less length considerably decreases scale of this type impact;
- The risks related to the population safety are low.

Based on the above mentioned it should be noted that the specificity of the local terrain gives the possibility to arrange 1700 m long diversion pipeline which afterward may be continued with underground diversion tunnel, which is the best solution for the current situation. Shortening the length of diversion pipeline and increasing length of tunnel is related to significant constructional difficulties (deepening water intake facility and tunnel construction) and additional financial expenses. . Partial compensation of the difficulties related to the diversion channel operation is possible by arranging a closed-type channel, which is discussed in Table 3.4.2.2.1, together with other alternatives of diversion system.

Table 3.4.2.1.1. Comparative analysis of diversion system alternatives

Alternative	Advantage	Disadvantage
Diversion pipeline and underground diversion tunnel length alternatives		
Length of diversion pipeline will be 2073 m and the length of diversion tunnel - 5400m (selected option)	• Relatively small volume of works and simple construction works; less financial expenses.	• High probability of system damage; • A relatively large area of land will be utilized and accordingly, agricultural activities will be limited and the risk of habitats fragmentation will be high; • Risks related to the population safety is high.
Prolongation of diversion tunnel by shortening diversion channel	• More protected from mechanical damage, vandalism and environmental impact; • Ensures the utilization of relatively small land areas which are used for pasturing and minimum hindrance of population and domestic animal movement ; • Risk of habitat fragmentation is relatively low; • Risks related to the population safety are rrelatively low.	• Complexity of construction works and significant financial expenses
Diversion channel alternatives		
Open diversion channel	• Relatively small volume of works and simple construction works; less financial expenses; • Simplicity of maintenance services during the operational phase (sludge removal, repairing of slopes and others).	• High probability of system failure and sludging; • Strict observance of safety rules during operation period (fencing of channel, arranging additional warning signes and so on); • Limited movement of the population and domestic animals.
Closed diversion channel (proposed design)	• More protected from mechanical damage, vandalism and environmental impact; • Risks related to the population safety are relatively low.	• Relatively large volume of construction works and additional financial expenses; • Relatively complicated maintenance services during the operational phase; • Limited movement of the population and domestic animals.
Diversion tunnel alternatives		
Circus or horseshoe-shaped	• From environmental point of view there is no big difference between these alternatives	
Diversion tunneling method alternatives		
Drilling and blasting	• Tunnel profile form does not create difficulties during the construction works. • Receiving of flat bottom is simple on which railway can be arranged. • Machinery damage risk is low.	• Dangerous, as works are connected with usage of explosive material; • Tunnel walls are not flat; • Tunneling takes a long time; • The risk of collapse; • problems related to the removal of materials, water drain and blockade has to be resolved.
Mechanical – using tunneling	• Capability of execution of tunneling and finishing works	• Relatively expensive;

machinery **(proposed option)**	simultaneously • Minimal volume of waste rock; • Ensure integrity of surrounding rocks; • Velocity and quality of tunneling works; • Complexity of works (tunneling, concreting); • If one tunneling machine will be used - arranging of construction shaft will not be necessary • Only two portals will be required (entrance and exit). Portals will be operating for a short time period. • Safe – explosive material will not be used	• During usage of tunneling machinery, tunnel ground must be leveled with cement, which requires additional time and expenses. • Stable abrasive rock may complicate working of cutters; • Working in weathered and fragmented rocks is difficult. • Efficient working time is reduced due to the damage and required maintenance (during working in hard rocks). Generally works 50% of the time (in worse case it is depended on rock characteristics). time is lost due to the required replacement of cutters; • Time is required for material disposal as well as for the solution of power supply, water drain and blockade problems; • Requires electricity; • Requires usage of water and drilling liquid; • Requires removal and management of secondary water (drilling liquid)
Ground Water Control Method Alternatives		
Water drain by gravity **(proposed option)**	• The simplest and cheapest method – gravity system.	• Pump usage will be required in exceptional cases; • Water discharge and treatment (cleaning, filtration) issues must be solved till discharging of surface water in the object. • If underground water horizon is water supply source water discharge may cause decrease of water volume necessary for water supply; • Drainage influences distribution of hydraulic pressure
Cementation	• In addition to the function of keeping underground water, decreases depression risk	• Expensive and time-consuming and is not completely safe even when it is arranged according to the all safety rules; • Requires cement and water.
Freezing	• Usually used while passing the tunnel, though it also can be used during tunneling works.	• Requires freezing agent.
Waterproofing with PVC	• No impact on ground water quality is anticipated during waterproofing	• Requires usage of insulation material and needs additional expenses (material and installation expenses).
Alternatives of waste rock removal from tunnel		
Railway transport	• Energy efficient and its usage is possible in case of different tunneling methods; • Can be used during the arrangement of any size tunnels; • Without emission.	• Requires arranging of railway and installing of switch to be used for several direction of one railway line.
Belt conveyor **(proposed option)**	• Constinuous removal of waste rock; • Without emission.	• Requires frequent maintenance/repair. • Requires usage of additional technical means
Truck	• Infrastructure is not required (e.g. railway or conveyor).	• with emission • Can be used only in big diameter tunnels.

Waste rock removal-disposal alternatives		
Disposal to landfill		• Requires corresponding area for temporary earth fill arrangement; • Transportation till final storage place (additional expense).
Usage for project goals **(proposed option)**	• Decrease of waste amount and useful usage.	• Requires corresponding temporary storage area; • Transportation till the place of usage;
Handing-over for usage of another factory	• Excluding transportation costs during handing-over to the "customer" on the place of production; • Can be assumed as a certain income source.	• Requires corresponding temporary storage area;

3.4.2.3 Penstock Alternatives

Two alternatives have been discussed: 1) aboveground or underground penstock; 2) different schemes of penstock.

Alternative	Advantage	Disadvantage
Aboveground or underground penstock		
Underground **(proposed design)**	• More protected from mechanical damage, vandalism and environmental impact (corrosion, freezing); • Minimal impact on fauna during operation phase; • Minimal impact on free movement of pedestrian and animal during operation phase; • Less impact of temperature, less possibility of compensators' usage; • Less probability of visual impact.	• Requires earthworks (with corresponding impact on environment); • Possible impact on ground water; • Requires usage of anticorrosive layer; • Operational difficulties in case of compensators' usage; • Less probability of visual maintenance; • Complicity of technical maintenance.
Aboveground	• Simplicity of monitoring during operation phase; • Earthworks are not required during construction and maintenance; • No underground water pollution risk;	• Less protected from environmental impact; • Requires usage of anticorrosive layer; • May hinder free movement of pedestrians/animals • Habitats may be fragmented; • Visual impact.
Different schemes of penstock		
Vertical and horizontal pipeline **(proposed design)**	• Enables to avoid construction of additional road in difficult geological and topographic sections; • Less impact on ground surface; • Minimal impact on vegetation; • Risk of habitat fragmentation; • Less visual impact.	• Unfavorable from economic point of view; • Requires hard work and time; • Risk of impact on ground water.
Bended pipeline	• Less duration of construction works; • Less costs required for construction works.	• Requires earthworks; • Impact on vegetation due to the earthworks; • Probability of temporary fragmentation of habitats; • Soil/slope stability failure risk.

3.4.2.4 Alternatives for Power Unit

Several alternatives should be discussed for the construction of power unit, among them: areas on the right and left bank of the river Khdistskali and construction of HPP in the depth of rocky mountain (underground building) on the left bank of the river. From the environmental point of view the best option from these alternatives is arranging the underground building, which is determined by the following factors:

- Communications of Department of Georgia Border Protection and Custom are located on the right bank of the river Khdistskali; construction of power unit on this territory might cause conflict situations. In addition, significant environmental and technical problem solutions will be required while crossing Khdistskali river ravine.
- Monastery complex construction is completing on the left bank of the riv. Khdistskali, therefore power unit must be arranged 300-350 m away from the complex. Hence, the power unit might be arranged on the right bank of the river, adjacent to the equipment yard. Locating power unit on this territory requires large-scale bank protection works;
- In case of constructiog underground power house, possible negative impacts on the environment will be reduced to minimum and the building itself will be protected from impact of external factors.

Considering all the above mentioned, construction of underground powerhouse may be considered as the best alternative.

3.5 Comparison of Alternatives

The table below provides differant types of the expected positive and negative impacts and comparison to other alternatives as during construction phase so for further operation period.

Symbols:

Construction phase -	**CP**
Operation phase -	**OP**
Positive impact -	
Negative impact -	
Impact is not expected -	
Impact scale and probability is low than in case of other alternatives -	**L**
Impact scale and probability is high than in case of other alternatives -	**H**

Table 3.4.1. Comparison of possible impact during construction and operation phases

Alternative / Impact receptor	Microclimate		Air				Soil				Water						Flora		Fauna (construction phase ichthyofauna)		Visual-landscape		Waste		Socio-economical Environment								Cultural heritage	
			Dust		Emissions		Quality		Stability (construction phase of geological structure)		Underground		Surface												Infrastructure		Land utilization		Employment and economical condition		electricity production			
													Quality		Regime																			
	CP	OP	CP	OP	CP	OP	CP	OP	CP	OP	CP	OP	CP	OP	CP	OP	CP	OP	CP	OP	CP	OP	CP	OP	CP	OP	CP	OP	CP	OP	CP	OP	CP	OP
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
No-action alternative	No impact on environment																																	
A seasonal regulation HPP construction alternative		H	H		H		H		H	H	H		H		H	H	H		H	H	H	H	H	H	H		H	H	H	H		H	H	H
A riverbed type HPP construction alternative		H	H		H		H		H		L		H		H		L		L		L		L		L		L		L	L		L	H	H
A diversion type HPP construction alternative			L		L		L		L	L	L		L		L	L	L		L	L	L	L	L	L	L		L	L	L	L		L	L	L
• Two-stage HPP cascade alternative			H		H		H		H	H	H		H	H	H	H	H		H	H	H	H	H	H	H		H	H	H	H			H	H
• One-stage HPP cascade alternative			L		L		L		L	L	L		L	L	L	L	L		L	L	L	L	L	L	L		L	L	L	L			L	L

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
o Alternatives for headworks:																																		
– Layout alternatives:																																		
1. 1727 m from sea level.			L		L				L	L					L	L				L	L	L									H		
2. In headrace from proposed section.			H		H				H	H					H	H				H	H	H									H		
3. In tailrace from proposed section.			L		L				H	H					L	L				L	L	L									L		
– Alternatives for headworks' type:																																		
1. Overflow dam.													L			H							L	L						L				
2. Gate dam.													H			L							H	H						H				
o Diversin system alternatives:																																		
– Channel and tunnel length alternatives:																																		
1. Channel length-1700 m, tunnel length-5400-5800 m.			H		H		H		H	H	L	L			H	H	H		H	H	H	H	L	H			H	H						
2. Channel length is less, tunnel length is bigger			L		L		L		L	L	H	H			L	L	L		L	L	L	L	H	L			L	L						
– Diversion tunnel alternatives:	From environmental point of view the shape of the tunnel is not significant																																	
– Tunneling methods alternatives:																																		
1. Drilling and blasting			H		H				H		H												H											
2. Using drilling machinery.			L		L				L		L												L											
– Underground water controlling alternatives:																																		
1. Water dain.											H																							
2. Cementation.											H																							
3. Freezing.											H																							
4. Waterproofing with PVC											L																							
– Waste rock removal method:																																		
1. Railway transport.									H																									
2. Conveyor.									L																									
3. Truck.									H																									
– Waste rock removal-disposal:																																		
1. Disposal to landfill			H		H																		H											
2. Usage for project target			L		L																		L											
3. Handing-over to use for another factory			H		H																		L											

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
o Panstock alternatives:																																		
– Underground or aboveground pipelines:																																		
1. Underground.			L		L				L	L	H	H											H									H		
2. Aboveground.			H		H				H	H	L	L											L											
– Pipeline scheme:																																		
1. Vertical and later on horizontal.											H	H											H									H		
2. Bended pipeline											L	L											L									L		
o Power unit alternatives:																																		
– Powerhouse location alternatives:																																		
1. On right bank of the river Khdistskali									H												L	L										L	L	
2. On left bank of the river Khdistskali									L												H	H										H	H	
– underground or aboveground power house:																																		
3. Underground.			L		L		L	L	L	L	H			L									H											
4. Aboveground.			H		H		H	H	H	H	L			H									L											
– Substation location alternatives.	No difference from environmental point of view																																	

3.6 Conclusion

Based on the results of comparative characterization of alternatives, in order to minimize potential negative environmental and social impacts priorities should be given to:

- One-stage diversion HPP project;
- Underground power station;
- Arrangement of headworks is recommended on Tergi river at 1725 m a.s.l.
- The best option for the arrangement of diversion system is steel pipe and tunnel.

4 HPP Construction and Operation Project Description

4.1 General Review of the Project

The present project considers construction of Hydropower Station within the frames of territory of Kazbegi Municipality, in close vicinity of Russia-Georgia border. Infrastructure object will be located on right slope of the river Tergi on 8 km length distance of the existing riv. Kuro and riv. Khdistskali. Low level dam construction is considered at the adjacent territory of Stepantsminda – 1725 m a.s.l. Arrangement of power unit is planned 1.2 km away from State Border Check-point of Dariali – 1340-1360 m a.s.l. of the river.

Table 4.1.1. Project data review of the selected alternative versions defined as per preliminary project decisions:

Table 4.1.1. Darial HPP general project data

Characteristics	Dimension unit	Significance
Headrace level	m	∇1725
Tailrace level	m	∇1345
HPP calculating water flow	m^3/sc	33.0
Calculating pressure (net)	m	370-380
HPP installed capacity	MW	108.0
50% of production	million kW/hour	510.0

HPP placement territory is 160 km away from Tbilisi, capital of Georgia. Georgia-Russian connecting motor way runs along the whole parameter of the project territory

According to design decision HPP is a diversion type without regulation, working on gravity. HPP facility includes: water intake, sedimentation diversion channel, tunnel entrance portal with spillway, diversion pipeline, surge shaft, underground pressure tunnel, dam underground building and open substation. Dariali HPP will be connected to power network via Dariali 110 kW power transmission line which connects Georgia and Russia power network (Stepantsminda – Vladikavkaz). Additionally, construction of new 220 or 500 kV transmission line construction is under consideration.

HPP communication scheme is given on the figures 4.1.1.-4.1.4.

Figure 4.1.1. Water Intake and Diversion Pipeline Placement Scheme

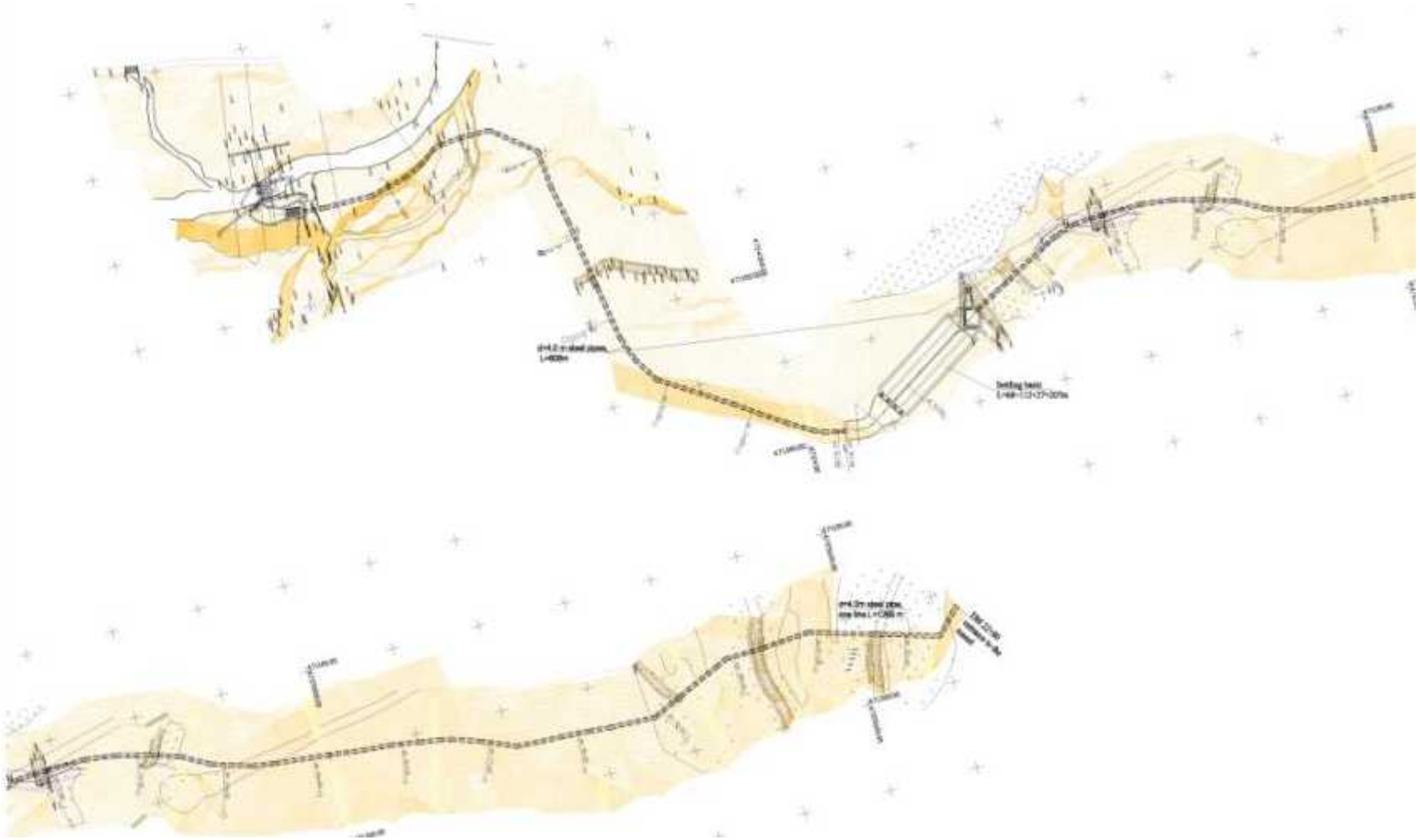


Figure 4.1.2. Diversion tunnel Arrangement Scheme

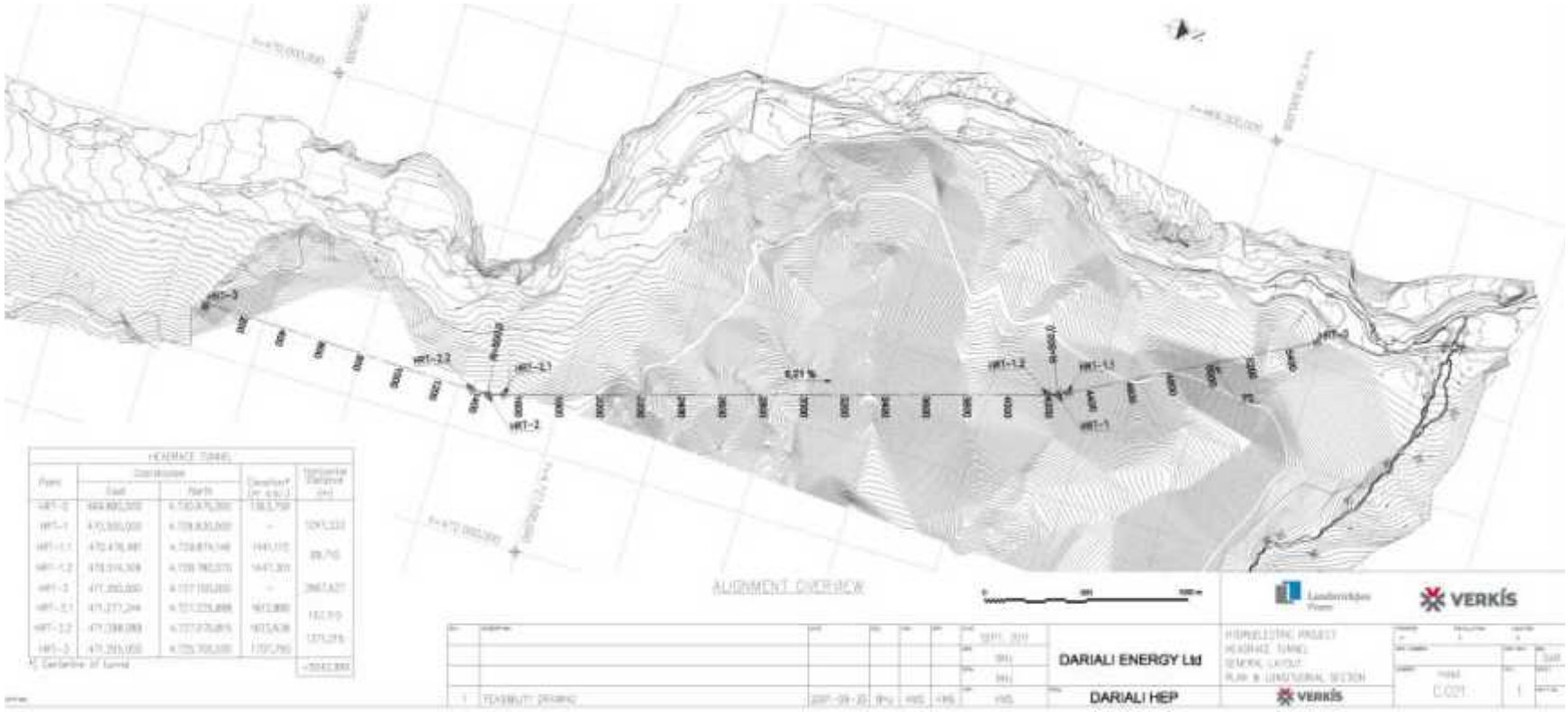


Figure 4.1.3. Diversion system's Section

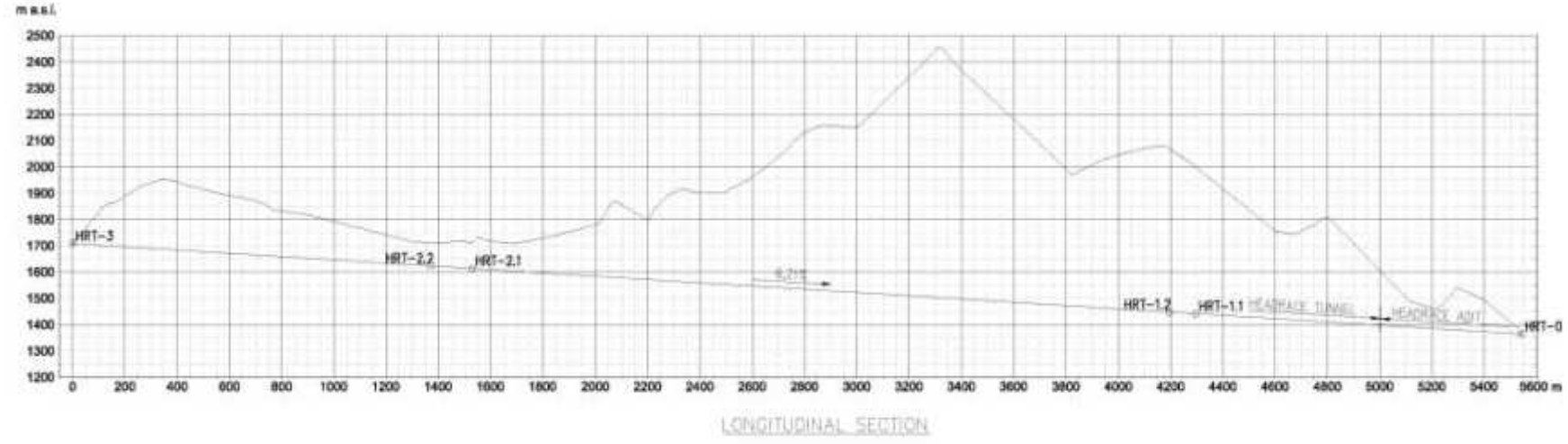
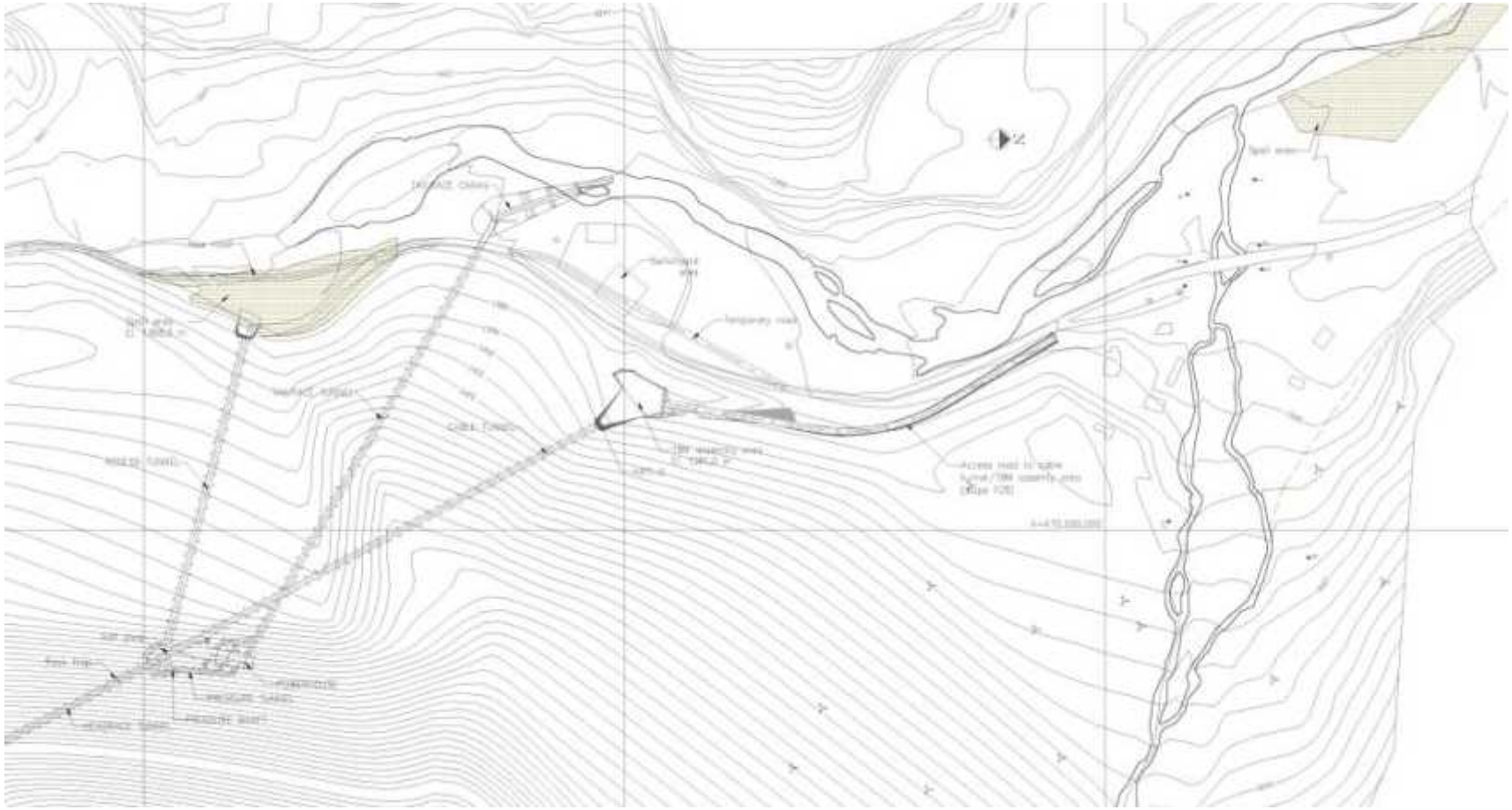


Figure 4.1.4. Power Unit Scheme



4.2 HPP Structure Description

4.2.1 Water Intake

Water intake facility includes the following: dam, water intake, settling basin.

4.2.1.1 Dam

HPP construction place (site) is alignment of the river Tergi with verge level ∇1727 m above sea in close vicinity of Kazbegi Hydropower Station. It will be arranged with rock fill with concrete walls. Dam parameters are given in the table 4.2.1.1.1 and dam scheme is given on the drawing 4.2.1.1.1. Dam height from the riverbed will be approximately 6 m; foundation width – 50-60 m. Considering dam height and structure water and solid residue will run easily to tailrace during flood time.

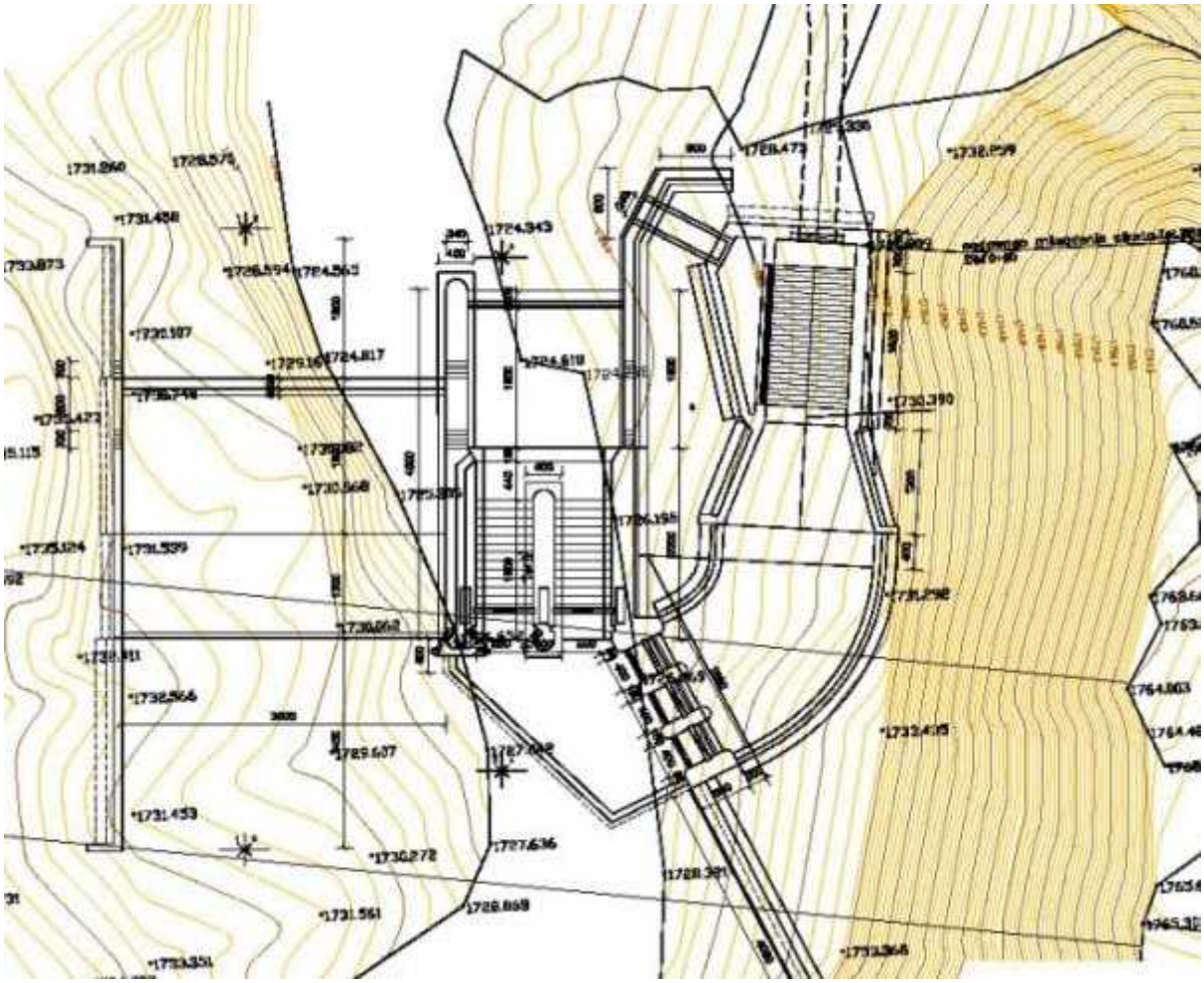
Environmental flow will permanently pass through tailrace via settling basin, fish way and spillway.

Concrete retaining wall construction is considered in headrace of dam on both banks of the river, which will prevent flooding of the boundaries and avoid erosion during flood ensuring maximum calculating flow run.

Table 4.2.1.1.1. Main Parameters of the Dam

Dam crest elevation	1729,3 m, sea level
Water level	1732,1 m, sea level
Dam foundation (bottom) level	1725 m, sea level
Stagnant water capacity	7000 m^3
Dam length	36 m
Washing sluice, 2 unit	6,0x6,0 m
Water discharge capacity	220 m^3/sec
Washing sluice capacity	280 m^3/sec
Water intake dimensions, 3 units	4,0x2,2 m
Garbage collector grid, 3 units	4,0x2.2 m
Headworks shut gate, 3 units	4,0x2,2 m

Figure 4.2.1.1.1. Project Dam Scheme



Lateral type headwork's which will be arranged on the right bank of the river in close vicinity to washing sluice, represents a simple concrete chamber with water intake locks and protective shelving. In order to avoid getting of heavy sediments and waste in headwork's, its entrance will be locked with two-line metal gratings.

4.2.1.2 Settling Basin

Construction of settling basin is planned 326 m away from headwork on the right slope of territory of the river Tergi. Water will run till settling basin via 4 m diameter metal diversion pipeline (see drawing 4.1.1.). Settling basin represents reinforced-concrete structure consisting of three sections. It is meant to catch suspended solid particles more than 0,2 mm diameter.

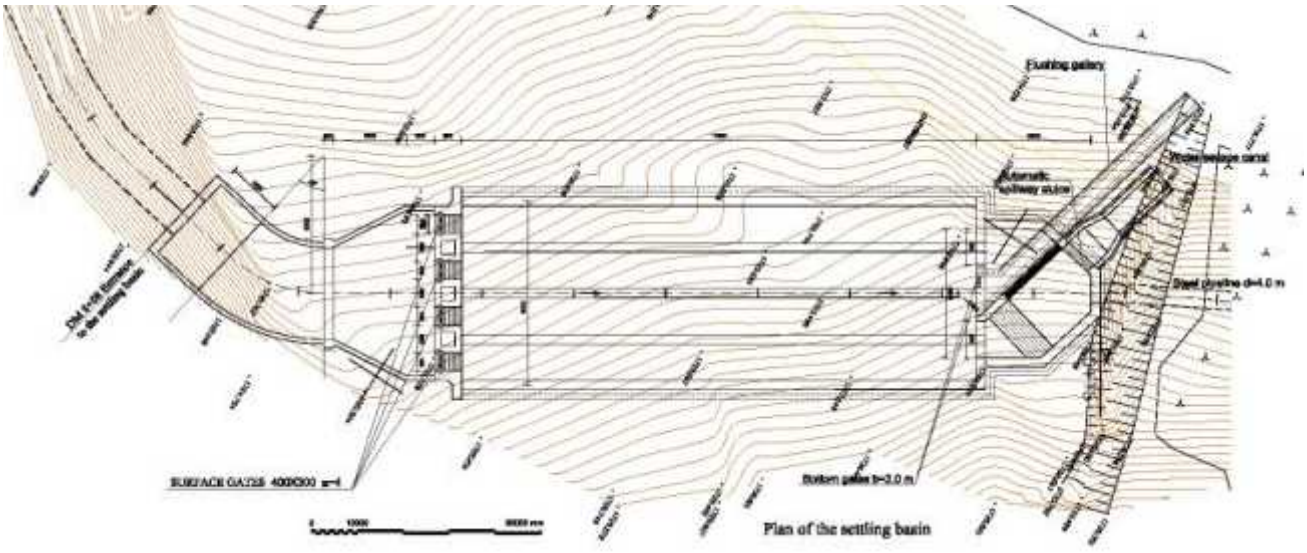
Length of the structure is 112 m, width – 40 m and height is 6 m. On each section entrance gates are arranged which ensures work regulation of settling basin sections.

Disposal of accumulated sediments during operation of settling basin will be done via bottom shield from where sedimentary water by means of washing sluice will be discharged to the riverbed. Spillway is arranged at the last point of settling basin, where from exceeded water amount will run to the river Tergi. After leaving settling basin water received from spillway and sedimentary water received from washing sluice will get into reinforced-concrete channel, which continues till riverbed of the river Tergi.

According to the project settling basin parameter will be fenced with wire fence. Proposed structure does not require systematic supervision; technical personnel will carry out daily check-up and in case of necessity its technical maintenance will take place.

Sedimentation scheme is given on the figure 4.2.1.2.1.

Figure 4.2.1.2.1.



4.2.1.3 Fishway

Fishway will be arranged on left bank of the river at the end of spillway. It will be 1 m wide concrete structure. In case if it is located close to rocky ground surface fish way will be of channel type.

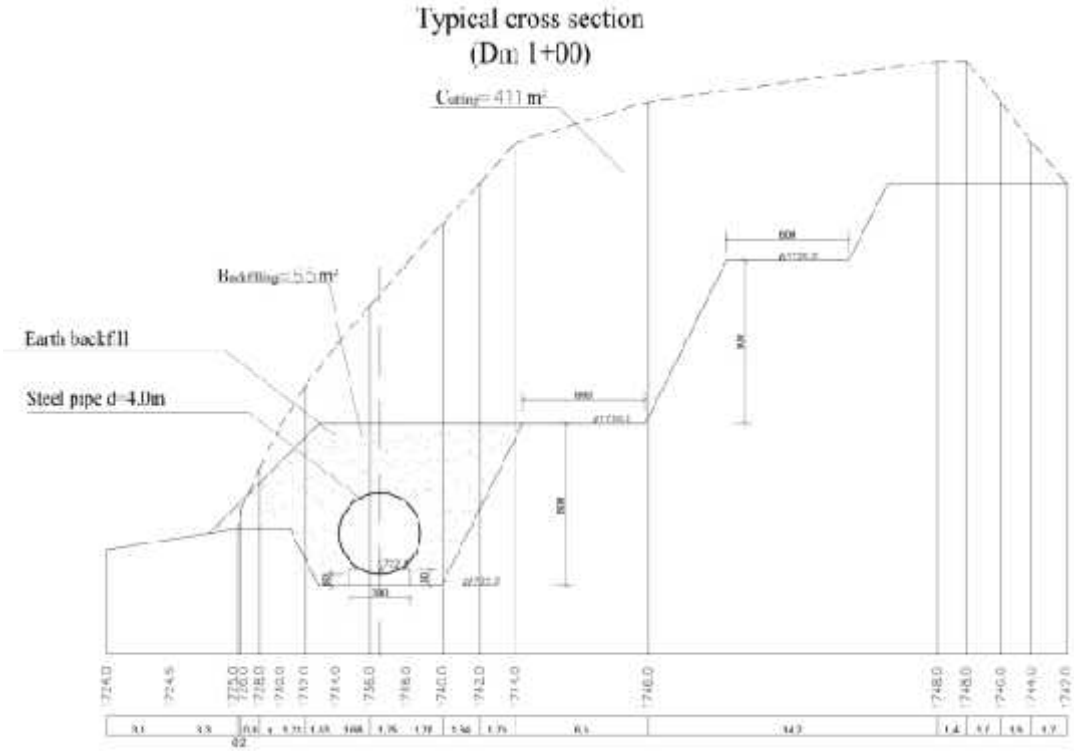
4.2.2 Diversion System

4.2.2.1 Diversion Pipeline

According to the feasibility study of Dariali HPP construction-operation project it was considered to construct closed type diversion pipeline of reinforced-concrete structure from headwork's till entrance portal of diversion pipeline(4 m x 4 m). During processing of detail-engineering project recommendations made during environmental and social impact assessment will be considered; so reinforced-concrete channel has been replaced with 4 m diameter metal pipeline. Pipeline will run underground and recultivation works will be implemented on surface.

Typical section of the designed pipeline is given on the figure 4.2.2.1.1.

Figure 4.2.2.2.1.



Complete length of the pipeline is 2100 m, consisting of two sections (see drawing 4.1.1.), namely: distance between headwork and settling basin is 326 m; distance between settling basin and entrance portal of diversion pipelines 1774 m.

Diversion pipeline will be located under river Kuro and other natural ravines and will be covered with reinforced-concrete protective structure; on the surface of the facility will be arranged a storm-overflow sewer of reinforced-concrete structure.

4.2.2.2 Diversion Tunnel

Diversion tunnel will connect to pressure diversion pipeline which diameter is 5.5. m. Upstream flow portal of the canal will be located on 1705 m level (with coordinates X=471265, Y=4725700), tailrace portal of the gallery on - 1361 m level (with coordinates: X=469890, Y=4730974). Parameters of the pressure tunnel are provided in the table 4.2.2.2.1.

Table 4.2.2.2.1. Parameters of the diversion pressure tunnel

Length	5040 m
Diameter	5,5 m
Inclination	6,21%
Nominal water speed	1,33 m/s

Tunnel construction is planned to be executed by firm "Robins" using TBM. The tunneling works will start from bottom benchmark and will continue till outlet portal. A special site will be arranged to build TBM on the slope of the right bank. For this purpose an access road will be arranged from the main highway.

Waste rock from the tunnel will be transported via belt conveyor and from the outlet portal to the temporary storage area will be delivered by vehicles. Basing on the technologies of the proposed tunneling water will flow using gravity system.

Idle spillway will be arranged close to the inlet portal. By means of spillway water will run from the channel to the river Tergi.

4.2.3 Power Unit Facility

Power unit facility will begin with surge shaft. At the end of surge shaft vertical pressure tunnel will be arranged. Horizontal part of the dam goes to turbine pipelines; storehouse of disk shutters will be arranged on the territory as well. Power unit facility includes the following: underground HPP building, cable duct, service channel, outgoing channel and outgoing tunnel and open substation. Power unit scheme is given on the figures 4.2.3.1. and 4.2.3.2., technical parameters are given in the table 4.2.3.1.

Figure 4.2.3.1. Power unit facility communication scheme

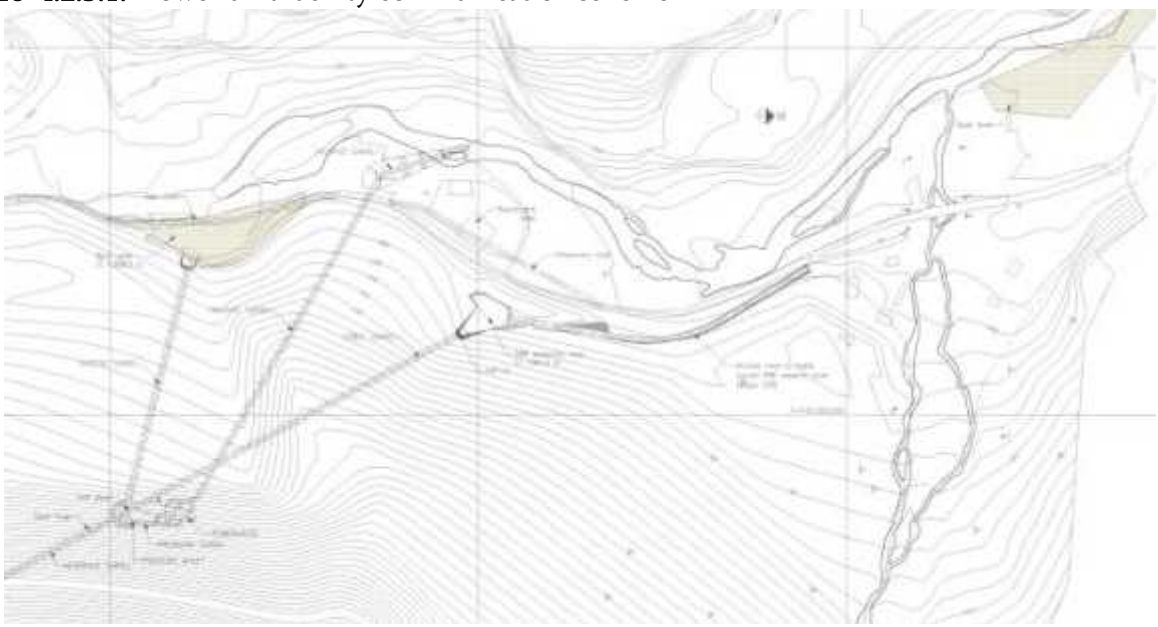


Figure 4.2.3.2. Power unit facility Principal scheme

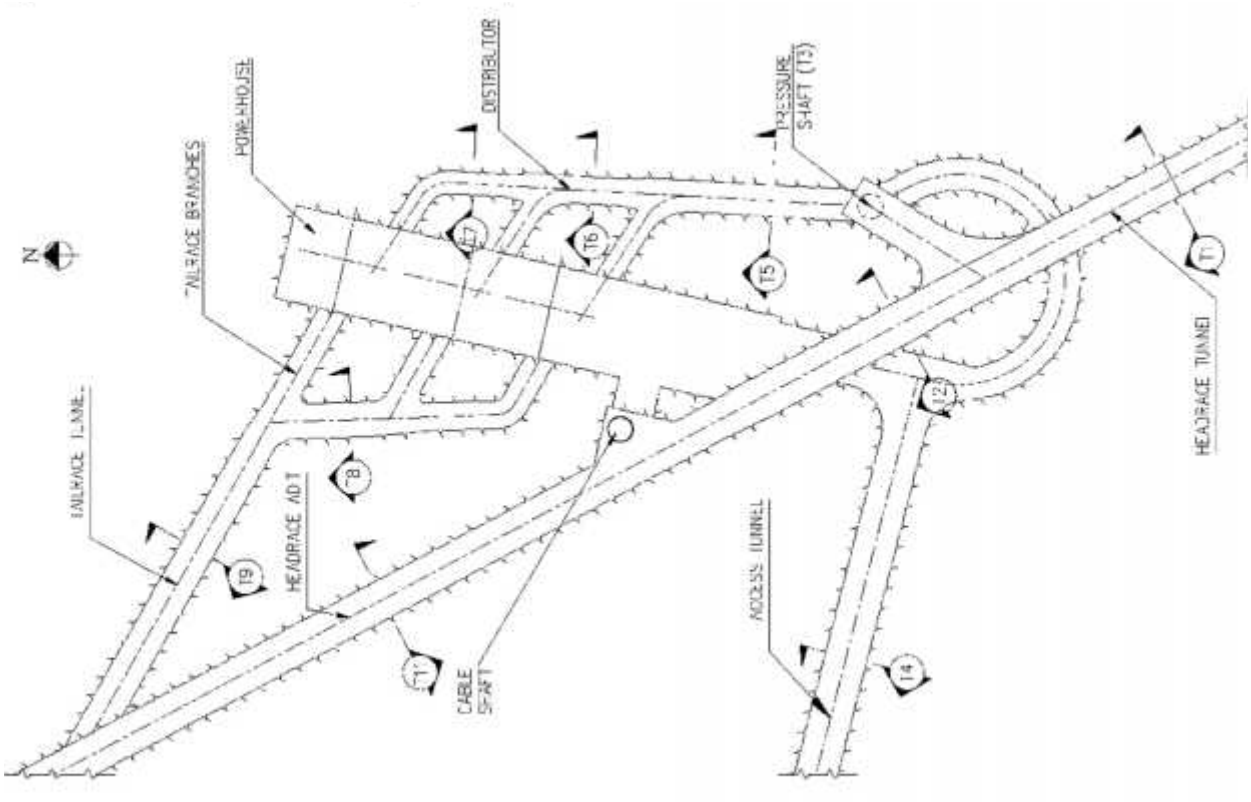


Table 4.2.3.1. Technical parameters of power unit communications.

Surge shaft	Diameter	3,5 m
	Down level	1420 m, sea level
	Upper level	1735 m, sea level
	Height	315 m
Pressure shaft	Length	55 m
	Metal casing length, including guiding apparatus	85 m
	Outgoing opening diameter	3,5 m
	Metal casing, diameter	2,9 m
HPP building	Turbine quantity and capacity	3×36 MW
	Type	Pelton vertical
	Nominal speed	375 turn/sec
	Generator nominal capacity	3×45 MW
	Building dimensions	13,5 x 71 x 28(h) m
HPP service tunnel	Length	330 m
	Width	5,5 m
	Height	6,0 m
	Cover	Asphalt
	Portal	Concrete
	Portal entrance	5,0 x 5,0 m
Cable duct	Length	510 m
	Diameter	5,5 m
	Cover	Gravelly
	Cable fastener	Cable staircase

Tailrace tunnel	Length	500 m
	Section, horseshoe-shaped	5,0 x 5,0 m
	Stop log gate	5,4 x 5,4 m
Tailrace canal	Length	125 m
	Bottom width	5,0 m
	Normal water level	1343,2 m, sea level
	Water maximal level	1346,4 m, sea level

4.2.3.1 Surge Shaft

Surge shaft is a continuation of pressure tunnel which will be connected to turbine pipeline. Internal part of surge shaft and pressure shaft will be covered with reinforced-concrete layer and afterwards with metal casing. Water from pressure shaft to turbines will be supplied via metal turbine pipeline; ball-valve will be installed on the pipeline.

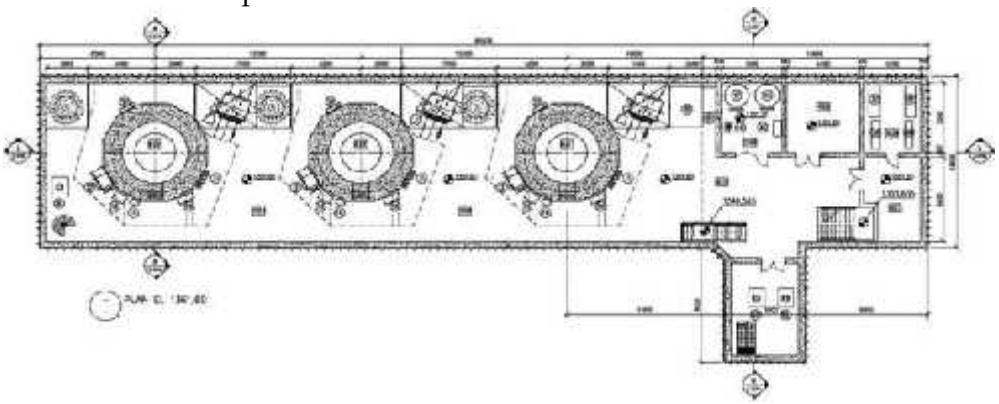
4.2.3.2 Power House

According to the design power house will be placed underground –in artificially arranged space. The following facilities will be installed here: bridge crane, three vertical hydraulic units ("Pelton" type) control units and additional electrical equipments. Project considers arranging of ventilation system for underground power house. Approximate dimension of power house: length - 71 m, width – 13.5 m, height - 28 m.

Air flow receiver will be arranged at the portal of access tunnel. Ventilator will be arranged on the same place. Air flow discharge will be installed at the gallery of tunnel of headrace (cabling tunnel portal). Smoke emission will take place through tailrace tunnel.

Oil storage reservoir with capacity of 10 m^3 for power house will be arranged.

Figure 4.2.3.2.1. Power house plan



4.2.3.3 Tailrace tunnel and channel

tailrace tunnel and channel of used water is also included in power unit complex with the following sizes: length about 500 m and diameter 5 x 5 m. Tailrace channel will last till the riverbed of the river Tergi under motorway route with the following parameters: length 125 m and bottom width 5 m.

4.2.3.4 Cable Duct and Service Tunnel

Parameters of service and cable duct are given in the table 4.2.3.1.

4.2.3.5 Open Substation

110/10 kW open substation will be arranged close to tunnel exit on the right bank of the river Tergi. 3 units of power transformer will be installed on the substation territory. Transformer will be installed on reinforced-concrete structure which will be equipped with oil-collector where from in emergency spillage case via pipelines oil will be discharged in underground oil-collector reservoir. Underground oil-collector reservoir capacity will be 33 m^3.

Installation of vacuum switches is planned on substation territory. For transmitting of generated electric energy 110 KW transmission line of Vladikavkaz-Stepantsminda will be used, which runs in close vicinity of the selected territory of substation. Additionally, construction of new 220 or 500 kV transmission lines is being considered. In case of project implementation the generated electricity will be delivered to the national grid via this line.

4.3 Description of Construction Works

4.3.1 Construction camp and Construction sites

4.3.1.1 Construction camp

Considering location place of HPP infrastructure it was decided to arrange one construction camp for construction. Adequate requirements have been considered during selecting places for construction camp namely:

- Arranging of construction camp close to construction site and easy access of the territory;
- Camp must be arranged on the territory where population disturbance due to pollutant substances emission in the air, noise propagation level and movement of machinery will be minimum;
- Selected territory must ensure minimum damage of ground and vegetation cover;
- Low risk of surface water pollution;
- Chosen territory and relief must be favorable for arranging infrastructure;
- Construction camp must be easily supplied with drinking and industrial water and must be ensured with power supply.

It is noteworthy that the region considered for construction of HPP is characterized with quite difficult relief and correspondingly there is no big choice of selecting territories for camp construction.

Considering above mentioned arranging of construction camp was planned close to power house location territory at the river Tergi, at the tributary of the river Khdistskali on right bank of the river. Area of the selected territory is 1 hectare (approximate dimensions: 150 x 70 m). Angle coordinates of the land are as follows:

A: X- 469762; Y - 4731641
B: X - 469729; Y - 4731813
C: X -469804; Y - 4731796
D: X -469824; Y - 4731651

The mentioned territory is 10-12 km away from Stepantsminda. It represents right terrace of river Khdistskali (it is 30 m away from active riverbed); surface is flat, slightly bended with the direction of river Khdistskali riverbed. Motor road to Dariali check-point runs to the West part of the territory. Area is completely free from vegetation cover, only insignificant amount of grass and bush is notable. Territory selected for construction camp is located in close vicinity of Communication of Customs and

Georgia State Border Defense Department. Considering the mentioned solution of power and water supply issues for the camp will be quite simple.

During arranging of construction camp territory must be cleaned from small vegetation cover; fertile layer must be removed and its storage works must be executed. For fuel reserve tank placement area embankment works with soil is considered and clay-type screen will be arranged for internal surface. Arranging of warning and directing signs is required around the parameter and in health hazard zones.

Main facilities required for construction will be located on construction camp, among them: concrete plant, crushing and screening plant, car park, car wash, joiners shop, mechanical shop, storage for construction and fuel-lubricate materials, administrative and residential camps and others.

Drinking-domestic water supply of the construction camp will be provided from local natural spring water; as for service water it will be supplied from the river Khdistskali. For industrial-fecal and storm waste water internal sewerage system and corresponding biological treatment facility will be arranged (water supply-sewerage issues are reviewed in sub-clause 4.3.4.).

Construction machinery-equipment required for construction works will move daily from construction camp to construction site and back.

Generally, if land ownership issue will be solved (land utilization issue must be agreed with Border Defense Department of Georgia) natural conditions of the territory chosen for arrangement of construction camp is quite satisfactory as from service simplicity so from environmental point of view.

4.3.1.2 Construction Sites

Implementation of HPP construction works requires arrangement of 4 main construction sites (1. headwork's (water intake facility), 2. entrance of diversion channel and diversion tunnel, 3. Exit of diversion tunnel, 4. surge shaft and power unit placement territory).

Small storage place will be arranged on the construction sites. Living camps will be arranged for the workers together with storage areas. Only heavy machinery will be placed on construction site; transport facility will daily go back to the car park of construction camp territory. Fuel supply for machinery-equipment on construction site will be provided by means of portable fuel station (special truck). Maintenance/repair works for transport facility will be provided on car service station on construction site territory.

Living camps for workers will not be arranged on construction sites; this kind of accommodation will be provided on construction camp territory.

4.3.1.3 Power Supply

Power supply for construction camp and construction sites is considered as from the existing network source so by means of diesel-generators. Usage of diesel-generators is considered for diversion pipeline and power unit places and for power supply of water intake construction site.

4.3.2 HPP Construction Works

4.3.2.1 General Provisions

From construction organization and implementation point of view, main power house facilities are: headwork's, diversion and power units.

Mobilization/preparation period include the following works: ensure power construction with permanent and temporary roads, with power and water supply, with compressed air and temporary building-facilities required for the construction.

Construction-installation works will be executed with shift method; with minimal manpower possessing two or more profession. 300 people will be employed in HPP construction process.

Total time period required for HPP construction is depended on time needed for construction of diversion tunnel. Tunneling works must be accomplished by tunneling machinery of the firm "Robins" and requires 3.5-4.0 year of construction. Due to difficult weather conditions HPP construction works will continue approximately 250 days.

Inert material (sand-gravel) for construction works will be provided from the river Tergi (in the section of village Kobi- Stepantsminda) existing source. Preliminary investigations must be carried out for utilization of inert materials (for clarifying inert material quality) and receiving corresponding license for production of inert materials. Waster rock usage issue during tunneling and underground HPP building construction works is quite notable. Tunnel construction is planned to take place in stable rocky layer; hence main part of disposed material can be used for several construction works.

Transportation of construction material will occur as per preliminary defined quantity and by trucks. Correspondingly temporary storage of big amount of construction material (metal structures, inert material and others) on construction camp and construction site territories will not take place. Main part of construction material will directly be delivered to the construction sites and used as per requirement.

4.3.2.2 Headwork

Before launching the construction operations access roads to the headwork's shall be laid. 150 m road section shall be rehabilitated from the main road till dam location place.

On the first stage will be constructed lateral water intake, settling well and stilling well, where hydro-mechanical structures and units will be used. On this stage a trench will be used to transfer water downstream; upper and lower temporary dykes will be provided to protect the dam's foundation pit from inundation.

On the second stage will be construction 6-7 m high concrete dam provided with a spillway. Its foundation pit will be protected by assembly concrete cubes or bulwark constructed up reach; water passage will be ensured through water intake.

Construction of the headwork's will take 5-9 months. It does not impact on the total duration of hydraulic works as constructed parallel to the other main facilities.

4.3.2.3 Diversion Pipeline

In parallel regime together with diversion pipeline new road will be constructed which will be used during channel construction and during operation phase for execution of maintenance works. Diversion pipeline territory comparing to other areas is characterized with a calm relief. Correspondingly construction of road and channel it is not connected with big volume of earth works.

Earth works mainly will be executed during deepening of pipeline channel for which excavator will be used.

Diversion pipeline will be covered with soil and recultivation works will be carried out.

4.3.2.4 Diversion Tunnel

The derivation tunnels will be constructed by the firm "Robins" TBM, with diameter of 5.5 m. Correspondingly tunnel diameter will be 5.5 m. Tunnel will be constructed from tailrace to headrace. In order to get designed tunnel level construction channel arrangement is considered, which afterwards will be used as cable outlet tunnel from HPP building (see figure 4.1.4.).

Disposal of waste rock from diversion tunnel will be conducted via belt conveyer and will be supplied to the bunker arranged at the end of construction tunnel. Afterwards it will be transported to the temporary location place.

Considering tunnel profile disposal of underground water is planned via gravity system. Settling pits will be arranged at the exit of construction tunnel which later on will be discharged to river Tergi.

4.3.2.5 Surge Shaft and Power House

Arrangement of pressure tunnel and power house will be executed via boring-explosive method. Waste rock disposal will be carried out by conveyor of construction channel.
Material transportation for finishing works is considered by trucks. Monolithic reinforced-concrete roof will be arranged for internal surface of HPP building and pressure tunnel.

4.3.3 Machinery Requirements for Construction Operations

Types and number of machinery required for construction operation are listed in Table 4.3.3.1.

Table 4.3.3.1. Type and number of machinery required for construction operations

№	Machinery	Headwork's	Tunnel gallery	Diversion pipeline Exit	Power House	Roads	Total
1	Tunneling machinery			1			1
2	Truck	3	3	2	2	2	12
3	Excavator	2	2			1	5
4	Bulldozer		1			1	2
5	Mobile crane	1			1		2
6	Concrete mixer	2	1	1	1		5
7	Concrete plant				1		1
8	Boring machine	1	1			1	3
9	Compressor	1	1	1	1		4
10	Ventilation installations	1		1	1		3
11	Drainage pumps	2		2	2		6

12	Concrete pumps	2	2	2	1		7
13	Diesel generators	1	1	1	1		4
14	Fuel tank				1		1 (20 m³)
15	Stationary tower crane				1		1
17	Watering car					1	1

4.3.4 Water Supply and Sanitation

4.3.4.1 Water Supply

During construction works water will be required for drinking, domestic and industrial purposes. Construction camp plan together with water consumption communications are given on the figure 4.3.4.1.

Figure 4.3.4.1. Construction camp plan

4.3.4.1.1 Drinking and Domestic Water Supply

Drinking and domestic requirement for water will be met through springs found nearby the construction grounds (the region and in particular the construction camp site is rich in high quality groundwater and spring water). Potable water supply will be kept in tanks intended for food products.

On the construction phase consumption of drinking and domestic water depends on number of laborers and water consumption per person. According to the feasibility study, maximum number of laborers will comprise of 300 people on the construction phase. As mentioned construction works will be of tunnelling type, correspondingly 200 people will be involved in construction works. Water consumption per laborer per day comprises 25 liters. If calculate this for 250 work days per annum, drinking and domestic water requirement should comprise:

$$300 * 25 * 250 = \mathbf{1250\ m^3/y,\ 5\ m^3/day}$$

From total number of employed people 35% will be constantly on site and other personnel will work on several construction site. Correspondingly drinking and domestic water consumption will be the

following: for construction camp: - **437,5 m³/y, 1,75 m³/day,** for the remaining construction sites: - **812,5 m³/y, 3,25 m³/day.**

20 people will be involved during dam construction phase. Here should be noted that personnel should not be permanently present at the headwork's and they only provide visual inspection of the site. Therefore, personnel do not consume water there and estimation of water consumption is not required. Water consumption per person will be 25 liter. During operation phase HPP will work in continuous regime, 365 days in a year. Hence, required amount of water during operation phase will be:

20 * 25 * 365 = **182,5 m³/y, 0,5 m³/day.**

4.3.4.1.2 Technical water supply

During construction works, technical water will mostly be utilized on territory of construction camp: for preparation of concrete mortar, crusher-grader shop and washing of transport vehicles. Technical water will be supplied form riv. Khdistskali via gravity pipeline.

The amount of water required for operation of the concrete facility depends of the volume of production. Based on the specific character of the construction works, capacity of the concrete factory shall be not less than 50 m³/h. The concrete factory shall operate in a single shift working schedule, with an average of 160 days per year. The volume of concrete produced shall be: 50 * 8 * 160 = 64 000 m³/year. The volume of water required for production of 1 m³ of concrete is 0.3 m³. Therefore the volume of water necessary for concrete factory shall be: 64 000 * 0,3 = **19 200 m³/year, 120 m³/d, 15 m³/h.**

A crusher-grader shop with an approximate capacity of 25 m³/h will also be arrange at the construction camp. The shop shall operate 200 days per annum, with 8 hour working schedule. The volume of construction materials produced shall be: 25 * 8 * 200 = 40 000 m³/year. According the characteristic of similar facilities, 3 m³ of water is required for production of 1 m³ of inert material. Therefore technical water consumption of the crusher-grader shop shall be 40 000 * 3 = **120 000 m³/year, 600 m³/day, 75 m³/h.**

Cars washes will be arranged on parking lot of the construction yard. It will be possible to wash 10-12 unit of construction machinery daily on each car wash. The volume of water required for washing of a single unit is 350 liters, taking into account that car washes shall operate 250 days per annum, the volume of required water shall be: 12 * 350 * 250 = **1050 m³/year, 4,2 m³/day, 0,53 m³/h.**

Based on the data shown above, the total approximate volume of technical water required at the construction camp shall be: **19 200 + 120 000 + 1050 = 140 250 m³/year.** Considering the 4 year construction period, approximately 561 000 m³ of technical water shall be utilized.

4.3.4.2 Household-fecal and industrial wastewater

4.3.4.2.1 Household-fecal wastewater

The volume of household-fecal wastewater id determined according to the volume of potable-household water consumed, minus 5% loss. Therefore, the approximate volume of household-fecal water during construction works shall be: **1187,5 m³/year, 4,75 m³/day.,** where:

- On construction camp - **415,6 m³/year, 1,663 m³/day.**

- Construction sites - **771.9 m³/year, 3,087 m³/day.**

Arrangement of "Biotal" type compact biologic treatment plant is envisaged for treatment of household-fecal wastewater formed on construction camp territory. Treated wastewater will be discharged into riv. Khdistskali. Industrial wastewater formed on the territory of construction sites will be collected in a 10-15 m^3 waterproof cesspool and later transported to the wastewater collector by a cesspool emptier and treated at a biologic treatment plant on construction camp territory. Based on the information given above, household-fecal wastewater will be discharged at a single point and the total approximate volume will be **1187,5 m³/year, 4,75 m³/day.**

During HPP operation primary source of household-fecal wastewater formation will be the powerhouse. The approximate volume shall be **173,4 m³/year, 0,475 m³/year.** Arrangement of a "Biotal" type biological treatment plant is envisaged on HPP.

4.3.4.2.2 Industrial wastewater

As stated above, technical water will be used only on construction camp, therefore it will be the only source of industrial wastewater. Due to the fact the water used in concrete production is fully consumed during the production process, industrial wastewater shall be formed at crusher-grader shop and the carwashes.

The volume of industrial wastewater formed on these sites shall be 95% (5% loss is expected due to evaporation etc.) of the total consumed amount. Therefore the volume of industrial wastewater shall be following:

- Crusher-grader shop - **114 000 m³/year, 570 m³/year, 71,3 m³/h.,**
- Car washes - **997,5 m³/year, 4 m³/year, 0,51 m³/h.**

The following scheme will be used for wastewater management of construction camp: a horizontal settling basin with a relevant capacity will be arranged for treatment of wastewater formed during operation of the crusher-grader shop, tank will hold the water to allow suspended particles to settle on the bottom. The wastewater will later be discharged into riv. Khdistskali via a channel. Arrangement of a compact oil catcher is planned for treatment of carwash wastewater. After flowing through the oil catcher, water will flow into the settling basin and later be discharged into riv. Khdistskali.

Formation of industrial wastewater on territory of construction sites is not expected. Only the drainage waters formed during the works on diversion channel shall be considered, as they could be polluted with suspended particles. Another fact worth mentioning is that area through the whole perimeter of the diversion channel is rocky, therefore significant pollution with suspended particles is not expected. Arrangement of settling ponds is planned, in order to avoid excessive turbidity during the discharge of drainage waters into the river. Due to the specific character of the planned works, it is impossible to estimate the volume of drainage water.

4.3.4.3 Wastewater treatment

Arrangement of "Biotal" type compact biological treatment plants is planned for treatment of household-fecal wastewater formed on construction camp and HPP.

According to technical documentation of the treatment plant, following quality of effluent will be ensured after treatment:

- Suspended particles - 60 mg/l;

- BOD - 6 mg/l;
- Ammonium nitrogen - 0,4 mg/l;
- Chlorides - up to 350 mg/l;
- Polyphosphates - 0,2 mg/l.

Arrangement of a compact treatment plant (oil catcher) is planned for treatment of industrial wastewater. The device is designed for use removal of suspended particles from industrial wastewater and oil products from water. According to the technical documentation, the content of oil and suspended particles in the effluent shall not exceed 0.3 mg/l and 60 mg/ respectively.

5 Baseline environmental condition of design work area

5.1 Overview

Territory where the HPP will be constructed is a part of the Kazbegi municipality, the latter is an administrative unit of Mtskheta-Mtianeti region.

Total area of Mtskheta-Mtianeti region is 6.8 thousand km^2, which is 9.2% of the whole county. The region is bordering with Tbilisi, Kakheti and Shida Kartli. Mtskheta-Mtianeti has a state border with Russian Federation. Administrative units of the region are: Mstkheta, Dusheti, Akhalgori, Tianeti and Kazbegi municipalities. Administrative center is the city of Mtskheta. Among the 285 populated areas in the region are: 2 cities (Mtskheta and Dusheti), 7 boroughs (Akhalgori, Jinvali, Fasanauri, Tianeti, Sioni, Stepantsminda) and 582 villages.

Kazbegi municipality is located in the northernmost part of the region with, Dusheti municipality is situated to south-west, Akhalgori municipality is to south, Java municipality is to West and Russian Federation is located to North. Total area is - 1081.7 km². 1 borough, 5 village communities and 45 villages are located within the municipality. Villages with population more than 5000 – 0, villages with population of 10 and less – 5; unpopulated villages 20.

Administrative center of the municipality is Stepantsminda borough (former Kazbegi). It is situated in the valley of riv. Tergi, at the foot of Mkinvartsveri. Elevation is 1750 m.a.s.l, distance from Tbilisi - 152 km.

Construction of the HPP is planned near Stepantsminda, on the section between riv. Tergi, Stepantsminda borough and Georgian state border.

A map of the construction region is shown in the fig. 5.1.1.

Following paragraphs provide detailed information on environmental and socio-economic condition of the project area (Mtskheta-Mtianeti region in general, Stepantsminda municipality, Kazbegi borough and the areas selected for construction of HPP infrastructure units). Presented information is based on literary and archive data together with the information supplied by the client and results of conducted field researches. Given information will be used for assessment of positive and negative impact of HPP construction.

Figure 5.1.1. Map of the project implementation area

5.2 Socio-economic environment

5.2.1 Demographic condition

According to the 2011 data, population of Mtskheta-Mtianeti is 109.3 thousand, which is 2.7% of the total population of Georgia. Density of population is 18.3 per square km (1/01-2006). Administrative unit with the biggest population is Mtskheta municipality, while Kazbegi municipality is the least populated.

Table 5.2.1.1. provides information on population in Mtskheta-Mtianeti region for 2002-2011 years.

Table 5.2.1.1. Population of Mtskheta-Mtianeti from 2002 to January 1 of 2011

Thousand people

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Geogia	**4,371.5**	**4342.6**	**4315.2**	**4321.5**	**4,401.3**	**4394.7**	**4382.1**	**4385.4**	**4436.4**	**4469.2**
Mtskheta-Mtianeti rergion	**125.4**	**124.6**	**122.5**	**122.5**	**124.5**	**124.1**	**105.2**	**105.2**	**108.8**	**109.3**
Akhalgori municipality	7.7	7.6	7.4	7.4	7.6	7.6	7.6	7.6	...	...
Dusheti municipality	33.6	33.4	33.0	32.8	33.4	33.3	33.1	33.1	33.8	34.0
Tianeti municipality	14.0	13.9	13.3	13.2	13.4	13.3	13.1	13.1	13.2	13.1
Mtskheta municipality	64.8	64.4	63.9	64.2	65.2	65.0	46.5	46.5	56.9	57.3
Kazbegi municipality	5.3	5.3	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9

Note: Population of the region has decreased by approximately 20 000 people after certain territories of Mstkheta region were joined with Tbilisi in 2008.

In 2007 the total population of Stepantsminda was 1.8 thousand people. Table 5.2.1.2. provides information on population of other populated areas in the project implementation area. The data is based on the census conducted by State Statistics department of Georgia in 2002.

Table 5.2.1.2. Population of the settlements in project implementation area

Settlement	Permanent population		
	Both genders	Both genders	Both genders
Stepantsminda borough community	29	11	18
Gveleti village	1	0	1
Tsdo village	28	11	17
Goristsikhe community	943	457	486
Goristsikhe village	283	128	155
Tkarsheti village	218	110	108
Pkhelshe village	184	87	97
Kanobi village	182	94	88
Khurtusi village	76	38	38
Kobi community	47	25	22
Kobi village	25	13	12
Almasiani village	13	6	7
Ukhati village	9	6	3
Sioni community	1463	719	744
Sioni village	384	187	197

Arsha village	565	281	284
Gaiboteni village	17	9	8
Garbani village	342	162	180
Vardisubani village	97	46	51
Fansheti village	58	34	24
Sno community	942	465	477
Sno village	418	204	214
Achkfoti village	251	127	124
Akhaltsikhe village	129	66	63
Karkucha village	82	38	44
Juta village	62	30	32

5.2.2 National and ethnic composition

97% of population in Kazbegi municipality is Georgians; 2.5% - Osetian; 0.3% - Russian; 0.1% Armenian. People with Georgian nationality are dominant in 22 villages, while Osetian population dominates in 3 villages.

There are 6 Georgian ethnic groups in the region: Khevsurian, Mtiulian, Gudamakarian, Tush, Mokhevian, and Pshavian.

Khevsurian ethnic group is mostly encountered in Khevsureti, on both sides of Caucasus, in Aragvi and Arghun basins. Due to intensive migration they have founded villages also in Khevi, Ertso-Tianeti, Kakheti (Shiraqi) and Kvemo Kartli (Gardabani). They speak Khevsurian dialect of Georgian language. They tend have maintained the details of traditional culture (clothes, multistory houses, weapons, customs and traditions, etc.) for a long period of time.

Mtiulians live mostly on territory of historical Mtiuleti, in the north-western part of Dusheti municipality, in the valley of riv. Aragvi.

Tushs are another ethnic group of Georgian highlanders, they live on Northern slope of Great Caucasus at the head of Gomtseri Alazani river, as well as in Kakheti (Akhmeta). Tush speak the Tush dialect of Georgian language, while one group – "Tsova Tushs" speak Batsb dialect.

Gudamakarians live mostly in Dusheti region, in the Valley of Gudamakari Aragvi River. They speak Mtiulian-Gudamakarian dialect of Georgian language, their religion is Christian. Gudamakarians are often confused with Mtiulians but they have some livelihood and cultural differences.

Mokhevians live mostly on territory of historic Khevi or modern day Stepantsminda municipality, as well as in villages of bordering Northern Osetia and Vladikavkaz. They speak mokhevian dialect of Georgian language.

Pshavs live mostly in Dusheti region, in the Basin of Pshavi Aragvi River. They can also be seen on territory of Ertso-Tianeti. They speak Pshav dialect of Georgian language.

5.2.3 Employment

Total employment resource of the Mtskheta-Mtianeti region is 55.5 thousand people (2005). 9000 people or 16% of the whole work force are unemployed.

A total of 46 500 people are employed, most of which (27 200) are self-employed, these are the people from rural areas that have a land plot more than 1 ha. Average monthly salary in the state sector is equivalent of approximately 65 US dollars, in private sector – 157.3 US dollars.

Majority of labor force in Kazbegi municipality as well as in project implementation area is self-employed. The primary sources of income are agriculture and tourism.

5.2.4 Economy

Economy of Mtskheta-Mtianeti region consists of following fields: Industry (56,1%), construction (28,9%), trade (13,3%), transport (1,3%) and communication (0,4%). The amount of enterprises registered in the last period has a tendency of growth. Number of enterprises registered in 2008 is 6 349 this is 7.7% more than previous year. In the first quarter of 2009 a total of 6 601 enterprises were registered.

5.2.4.1 Industry

There are three key industry fields in the region: processing, mining and electricity, natural gas and water production. Most significant enterprises are following:

- Mtskheta municipality
  - „Mina“ Jsc. – Glassware production, vill. Ksani;
  - “Auto 2011” Ltd. – Ready-mixed concrete production, Saguramo;
  - „Elguja Nozadze - Gantiadi “ – Mixed meat and egg production vill. Mukhrani;
  - “Nezloba” Ltd – sand and gravel quarry operations, adjacent to Mukhrani.
- Dusheti municipality:
  - “Georgian Military Road” Ltd. – road and airfield construction, Pasanauri borough;
  - “Center” Ltd. – Hotels and restaurants, Bazaleti community.
- Akhalgori borough:
  - “Lomisi” Ltd. – Beer production.
- Kazbegi municipality:
  - “Gudauri” Jsc - Hotels and restaurants, Gudauri.

Table 5.2.4.1.1. provides information on general parameters of the industrial enterprises in the region.

Table 5.2.4.1.1. General parameters of the industrial enterprises in the region. (2005)

Municipality	Small enterprises (up to 20 employees)			Medium enterprises (20-100 employees)			Large enterprises (more than 100 employees)			Total number of active enterprises	Production output (thousand GEL)
	Number of enterprises	Number of employees	Production output (thou. GEL)	Number of enterprises	Number of employees	Production output (thou. GEL)	Number of enterprises	Number of employees	Production output (thou. GEL)		
Mtskheta	63	213	1198,1	11	516	1947,3	1	291	12395,3	75	15540,7
Dusheti	20	54	627,4	4	125	360,9	1	168	3645,8	25	4634,4
Tianeti	11	43	103,6	1	22	191,1	-	-	-	12	269,1
Akhalgori	5	34	103,6	1	28	1,9	1	162	4916,2	7	5021,7
Stepantsminda	5	18	51,6	1	22	167,8	-	-	-	6	219,4
Total	104	362	2058,7	18	713	2669	3	621	20957,3	125	25685,3

There are no significant industrial enterprises near project implementation area.

5.2.4.2 Power resource

There are 7 active hydro power plants in the region:

- „Zahesi " – Mtskheta municipality;
- „Jinvali ", „Arkhoti ", „Shatili ", „Roshka" – Dusheti municipality;
- „Sioni "– Tianeti municipality;
- „Dariali "– Stepantsminda municipality.

5.2.4.3 Agriculture

Agriculture of Mtskheta-Mtianeti municipality is diversified. Leading fields are: fruit production, vinery, cereal crop (wheat, corn), bee-farming, poultry, livestock farming, fish breeding, vegetable gardening. Total area of agricultural land in Mtskheta-Mtianeti region is 291.1 ha. Including:

- Arable – 38,4 ha;
- Perennial plantations – 7,5 ha;
- Mowing land – 14,5 ha;
- Pastures – 229,3 ha;
- Residential and industrial buildings and facilities – 1,4 ha;
- Other – 17,6 ha.

Distribution of agricultural land among the municipalities is following (2007):

- Akhalgori municipality - 41477 ha;
- Dusheti municipality – 2482 ha;
- Tianeti municipality– 20083 ha;
- Mtskheta municipality - 4849 ha;
- Kazbegi municipality - 81712 ha.

Table 5.2.4.3.1. provides information on animal and poultry population in Mtskheta-Mtianeti region.

Table 5.2.4.3.1. Animal and poultry population in Mtskheta-Mtianeti region (2005-2006)

Municipalities	Cattle		Cow		Pig		Sheep and goat		Poultry	
	2005	2006	2005	2006	2005	2006	2005	2006	2005	2006
Akhalgori	6015	8595	5035	5210	1600	1360	8000	15632	11,9	5,1
Dusheti	25270	27111	19480	19840	12145	11677	16276	18069	50,3	60,1
Tianeti	10177	9527	7143	7679	6508	5922	3861	5371	28,0	25,8
Mtskheta	18011	18840	12400	12987	4813	2308	9584	9650	126,0	52,0
Stepantsminda	3592	3950	2355	2990	1870	2300	29108	33030	7,6	4,5
Total	63065	68023	46413	48706	26936	23567	66829	81752	223,8	147,5

The most developed field within the project implementation area is sheep breeding.

5.2.4.4 Technical infrastructure

Mtskheta-Mtianeti has motor and railway transport infrastructure. Automobile transport is the most widespread. A railway line crosses Mtskheta municipality. There also is a small airfield in Natakhtari.

Total length of roads of different categories in the region is 1769 km. 350 km (23.4% of total international highways in Georgia) are international highways. 197 km of roads were rehabilitated in 2004-2008. Rehabilitation works were ongoing on additional 29 km of road in 2009.

Total length of roads in Akhalgori municipality is:

- State roads – 45 km;
- Total length of internal roads – 234 km;
- State roads – 44 km;
- Big part of internal roads is in bad condition.

Length of motorways in Dusheti municipality is 754 km.
Tianeti region - 204 km (gravel surfaced roads).
Mtskheta region: railway - 35 km. Motorway - 420.0 km;
Kazbegi municipality: Motorway - 160 km. 60 km of which is State military road. 90% of these roads requires rehabilitation.

Internal and long distance telephone networks operate in the region. 70% of territory is within the coverage of mobile communication operators.

It is noteworthy that project implementation area represents a narrow rocky valley, with several linear structures (State military road, North-South gas supply mainline and Electric transmission lines). For implementation of HPP construction-operation project existence of motorway and main gas pipeline is significant.

5.2.5 Education

According to data of 2002 census, from the personnel engaged in economical activities in Mtskheta-mtianeti region 15338 have higher education, 20648 have Professional education and 32084 have full secondary (general) education.

Table 5.2.5.1. shows quantity and profile of educational-training facilities in Mtskheta-Mtianeti

Table 5.2.5.1. Quantity and profile of Educational-training Facilities

Municipality	Preschool	Primary	Basic 9- year	Complete General
Akhalgori	4	13	6	10
Dusheti	14	38	15	25
Tianeti	15	13	2	12
Mtskheta	22	16	10	24
Stepantsminda	7	3	2	5
Totally, in the region	62	83	35	76

5.2.6 Tourism Potential

Mtskheta-Mtianeti region has the biggest resources for development of mountain-ski tourism. Two tourism products are dominant:

- Resorts (Ananuri, Pasanauri, Sioni, Stepantsminda, Tskhvarichamia, Bazaleti lake);
- Winter resorts (Pasanauri, Gudauri);

For tourism development following places are significant: Gudauri, Bazaleti, Sioni, Khevsureti on both sided of great Caucasus, Truso gorge, Khado gorge, Caucasus peaks and others. One of quite important attraction for tourists is town of Mtskheta which due to its historical-architectural value is included in UNESCO world culture treasure list.

In Mtskheta-Mtianeti region we encounter so called “discovery tourism”, “cultural tourism” (nature and cultural heritage), mountain-ski tourism and others.

There are totally 5 health resorts and 25 resort venues in the region. In Dusheti and Kazbegi Municipalities there are balneal-climate and balneal type health resorts (table 5.2.6.1.).

Table 5.2.6.1. Mtskheta-Mtianeti region health resort list

Resort Name	Administrative unit	Resort type	Height m.a.s.l. and resort zone	Mineral water type	Profile
Vazha Spring	Dusheti	Balneal-climatic	1100	carbon	Gastroenterological
Sioni	Kazbegi	Climatic	1900	carbon	Pulmonological
Pasanauri	Dusheti	Climate- balneal	1050 m III-ð	carbon	Prophylactic pulmonological larthrological
Kanchaveti	Akhalgori	Balneal-climatic	960 m II-2-ð	sulphide	arthrological gynecological;
Stepantsminda	Kazbegi	Climatic-balneal	1744 m IV-ð	carbon	Prophylactic, pulmonological, gastro-enterologic(al)

There are totally 37 tourist-resort sites in Mtskheta-Mtianeti. During a year 12 hotels are operating, 20 private guest houses and 5 rest houses. Following hotels comply to the international standards: „Mtskheta Palace“, „Gudauri“, „Stepantsminda“, „Truso“, „ Hotel 7“, „Ozon“, „Shamo“, „Jvari Ugeltekhili“, „Panorama“, „Gudauri alpine hut“, Bazaleti lake resort complex.

5.2.7 Cultural and Historical Resources

On the territory of Mtskheta-Mtianeti region there are lots of natural, architectural and cultural monuments; among them most important ones are:

- City-museum Mtskheta;
- Ananuri Monastery;
- Zedazeni Monastery;
- Largvisi Monastery complex;
- Shiomgvime Monastery;
- Shatili (monument);
- And others.

Stephantsminda municipality is the most distinguished with number and diversity of cultural heritage monuments:

Gergeti Saint Trinity Church is located in Stepantsminda-Khevi eparchy, north to Stepantsminda on the right bank of the riv. Tergi tributary – Chkhera, 2200 meter above sea level. The church was constructed in XIV century, in the Georgian Church renaissance age. Monastery complex includes church tower and council court built next to South facade.

Sno fortress is quite significant among Georgian fortresses. It has all the elements which is characteristic for fortification. Fortress is built on the right bank of the river Snostskali, on separately standing rocky hill. Narrow ravine of the river after some kilometers connects to River Tergi. It is dated back to II half of XVI century or beginning of the next century.

Arshi fortress is located close to village Arshi on the bank of the river Tergi on the cliff. It is known as fortress with difficult protection system and also has very interesting artistic decoration. The fortress is biuly on the rocky hill of the riv. Snostskali right bank. Narrow gorge of this river conjoins with riv. Tergi gorge in several kilometers. Comparison with its analogs allows us to suggest that it was built either in second half of XVI century or in early ears of XVII century.

Arshi fortress is located adjacent to vil. Arshi. It is built on the bank of the riv. Tergi, on the steep slope. There is gate with complex security system on the North section of the fortress. Among the preserved structures the oldest is apseless church dated back to IX-X century. Fortress wall with embrasures is dated back to the end of XVI century or the beginning of XVII century.

Dariali fortress is located in Tergi gorge. This is the last check-point of North border of Georgia. Vakhtang Gorgasali is known as builder of the first fortress (V century), but current fortress had been built significantly earlier.

Other historical-cultural heritages of the Municipality are:

- Kazbegi Sioni church (IX-X century);
- Betlemi cave (VIII-XII century);
- Kazbegi Church (XVII-XIX century);
- Akhaltsikhe church of Ioane Natlismtsemeli;
- Church of Virgin Mary (IX century);
- Saint George church in Garbani village (IX-X century);
- Basil church in Pkhelshio village (IX century);
- Arch Angle church in Truso gorge (X-XI century);
- Truso gorge.

Al. Kazbegi and I. Kazalikashvili museums are in the Kazbegi municipality.

Picture 5.2.7.1. Al. Kazbegi Museum in Stepantsminda

Close to Dariali HPP infrastructure disposition territory quite noteworthy is Dariali fortress which is located on high rocky mountain of the left bank of the river Tergi. Considering that HPP infrastructure construction works will be executed only on right bank of the river, impact on historical heritage is not expected.

Besides the aforementioned, "Red Church" is located adjacent to the project territories (upstream from the confluence with the river Kuro); Ioane Natlismtsemeli alcove is located on left bank of the river Tergi (close vicinity to village Gveleti) and church of Ioane Natlismtsemeli is on the right bank of the river Tergi. It is noteworthy that all the mentioned cultural monuments are located far from the construction site.

Picture 5.2.7.2. Red church

In project region monument of so called "Gamuras Gamoqvabuli" (bat cave) is quite significant and Khada gorge which are included in red book. "Bat cave" is located on left hand of Dariali gorge upper part, north of Stepantsminda - 2 km away, at elevation 1550 m.a.s.l. Hence impact on natural monuments by the design HPP construction works, is hardly expected.

Khada gorge is located in river Khada valley, 1200-3400 m.a.s.l. Gorge is not populated and is located in North-East part of Dariali gorge.

5.2.8 Drinking Water Supply

Local spring waters are used as drinking water almost in all settlements of Kazbegi municipality.

Drinking-industrial water is supplied from ground waters to Stephantsminda borough. Headwork of water supply system is disposed South to the borough, on the right slope of the riv. Tergi. Headwork is distanced by 1800 meters from the design dam alignment to upstream of the river flow.

5.3 Physical- geographical environment

5.3.1 Climate and meteorological conditions

There is a moderate humid climate in lower zone (up to 2000) of Kazbegi municipality, with relatively dry, cold winters and long, cool summers. Stable snow cover lasts for 3-4 months.

Moderate humid climate is in the 2000-2600 m zone, with relative dry, cold winters and short summers. Average temperature of above 10^0C lasts 1-3 months, above 5^0C – 4-5 months. The temperature of the warmest month is 10-14^{0}C. Mountain winds are dominant. There are westerlies in the upper zone. Precipitations – 1000-1200 mm annually. Stable snow cover is observed during 5-7 months.

There is a moderate humid climate in the 2600-3600 m. No real summer, average temperature in January -11 - -15 ^{0}C. In July temperature everywhere in this zone is below 10^0C.

A highland, moderate humid climate above 3600 m, constant snow cover and glaciers. Average temperature in winter is -13 - -16 ^{0}C, in summer – positive temperatures. Snow is the main form of precipitation.

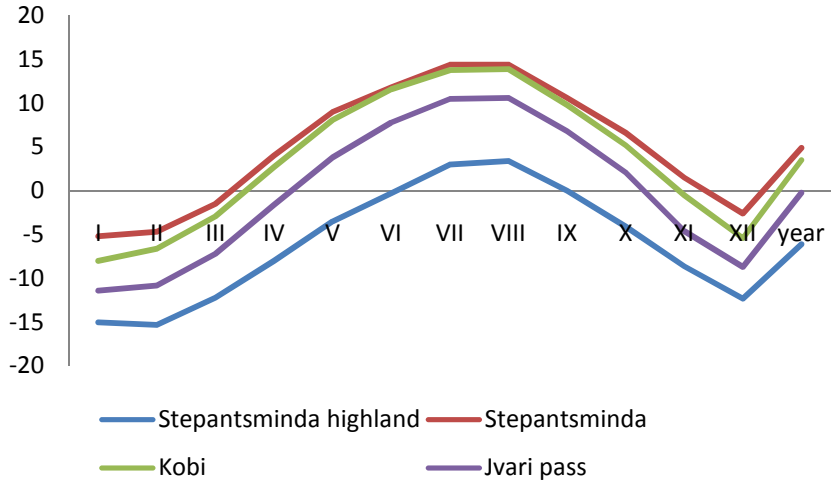
Tergi River basin up to the project section is located at the northern slope of Caucasus range, which is open to the Russian lowland; therefore, northern cold Arctic air masses enter here without any obstacles. Consequently this determines severe winters and relatively cool summers.

5.3.1.1 Temperature

One of the main formatting factor of dominant climate conditions of the region is air temperature. Data on average monthly and annual temperature in design section, based on long-term observation by meteorological stations located in riv. Tergi basin, are given in the table 5.3.1.1.1

Table 5.3.1.1.1. Average monthly and annual air temperatures, t^{0}C

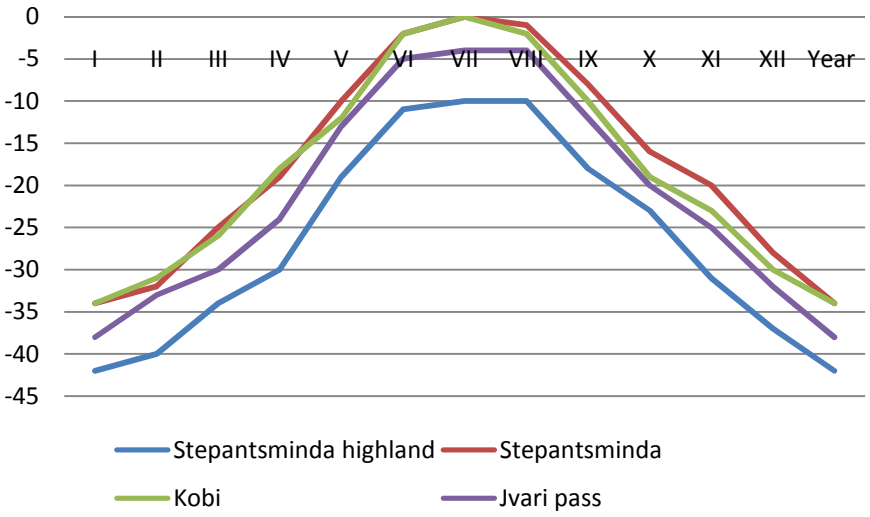
m/s	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	year
Stepantsminda highland	-15,0	-15,3	-12,2	-8,0	-3,5	-0,3	3,0	3,4	0,0	-4,1	-8,6	-12,3	-6,1
Stepantsminda	-5,2	-4,7	-1,5	4,0	9,0	11,8	14,4	14,4	10,6	6,6	1,5	-2,6	4,9
Kobi	-8,0	-6,6	-2,9	2,7	8,1	11,6	13,8	13,9	9,8	5,2	-0,5	-5,4	3,5
Jvari pass	-11,4	-10,8	-7,2	-1,6	3,8	7,8	10,5	10,6	6,8	2,1	-4,6	-8,7	-0,2



The absolute maximum air temperature of the region is recorded at Stepantsminda borough and is 32⁰. Absolute maximum air temperatures, based on long-observed data by meteorological stations, located in the Tergi River basin, are given below, in the table 5.3.1.1.2.

Table 5.3.1.1.2 Absolute maximum air temperatures, t⁰C

m/s	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Year
Stepantsminda highland	1	3	5	9	10	11	16	16	14	12	8	4	16
Stepantsminda	13	14	20	23	26	29	32	32	30	27	22	18	32
Kobi	10	12	18	20	24	26	27	28	27	24	19	16	28
Jvari pass	7	10	14	15	19	23	27	27	27	19	15	8	27

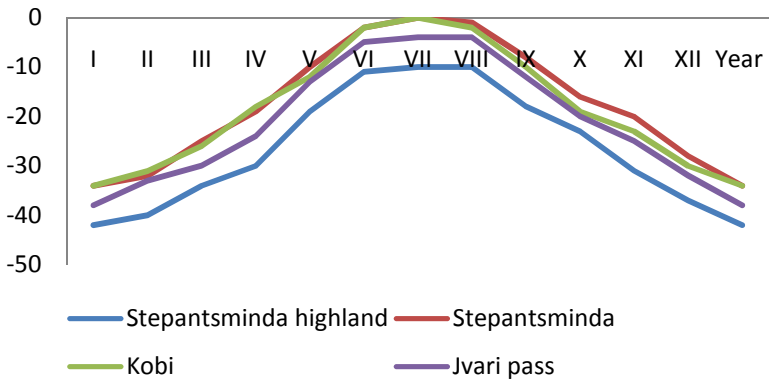


The absolute minimum temperature is measured at Stepantsminda highland meteo-station and was -42⁰C. Absolute minimum air temperatures, based on long-observed data by meteorological stations, are given below, in the table 5.3.1.1.3.

Table 5.3.1.1.3 Absolute maximum air temperatures, t⁰C

m/s	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Year
Stepantsminda highland	-42	-40	-34	-30	-19	-11	-10	-10	-18	-23	-31	-37	-42
Stepantsminda	-34	-32	-25	-19	-10	-2	0	-1	-8	-16	-20	-28	-34

Kobi	-34	-31	-26	-18	-12	-2	0	-2	-10	-19	-23	-30	-34
Jvari pass	-38	-33	-30	-24	-13	-5	-4	-4	-12	-20	-25	-32	-38



As we can see in the tables and diagrams above, the warmest month in the HPP design area is August, and the coldest – January.

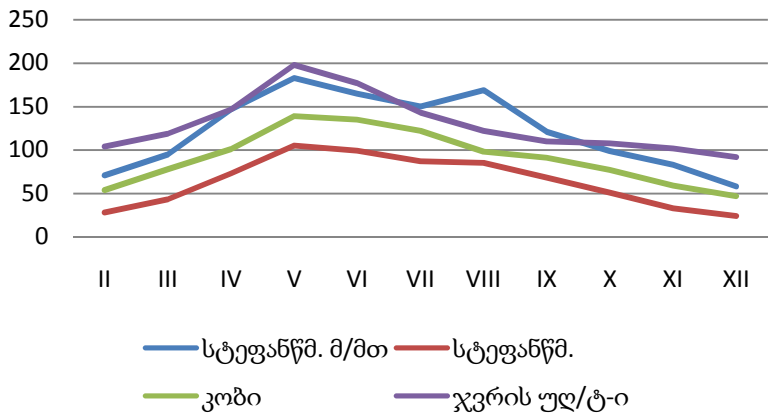
5.3.1.2 Volumes of precipitations

Annual value of precipitations in the survey area depends on hypsometric development of the Tergi River basin; therefore, the largest volumes of precipitations are measured at the stations, located at higher points. It is also noteworthy that annual dynamics of precipitations are characterized by maximums in warm periods of the year (IV-X) and minimums – in the cold period (XI-III).

Average monthly and total annual precipitation volumes, based on long-observed data by the meteorological stations, are given in the table 5.3.1.2.1.

Table 5.3.1.2.1. Average monthly and total annual precipitation volumes, mm

m/s	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Year
Stepantsminda highland	63	71	95	147	183	165	150	169	121	99	83	58	1404
Stepantsminda	22	28	43	73	105	99	87	85	68	51	33	24	718
Kobi	39	54	78	101	139	135	122	98	91	77	59	47	1040
Jvari pass	81	104	119	147	198	177	143	122	110	108	102	92	1503



The daily rate of atmospheric precipitations in the survey region is quite high. According to long-observed data of Kobi meteorological station, the daily precipitation rate of 21.10.1899 was 115 mm. The maximum daily precipitation was measured in Stepantsminda on 1.09.1965 and amounted to 111 mm.

5.3.1.3 Air humidity

In the survey region average annual rate of the water vapor tension (absolute humidity) is not high. Its value decreases with an increase in altitude. Annual dynamics of the absolute humidity and humidity deficit, practically match with the annual air temperature dynamics.

Average monthly and annual air humidity values, based on long-observed data by the meteorological stations, are given in the table 5.3.1.3.1.

Table 5.3.1.3.1 Air humidity

m/s	Humidity	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Year
Stepantsminda highland	absolute. mb	1,4	1,4	1,6	2,5	3,5	4,4	5,5	5,4	4,1	2,9	2,1	1,6	3,0
	relative. %	66	68	68	69	70	71	70	69	66	63	60	60	67
	deficit. mb	0,8	0,8	0,8	1,1	1,5	1,8	2,4	2,6	2,2	1,7	1,4	1,1	1,5
Stepantsminda Kobi	absolute. mb	2,8	3,0	3,7	5,6	8,0	10,0	12,1	11,6	9,1	6,2	4,5	3,3	6,7
	relative. %	62	63	66	69	70	71	74	72	72	67	64	61	68
	deficit. mb	2,0	2,0	2,2	3,2	4,0	4,8	5,1	5,6	4,5	4,0	3,1	2,4	3,6
Stepantsminda Kobi	absolute. mb	2,2	2,6	3,3	5,0	7,6	9,3	11,2	10,9	8,7	6,1	4,1	2,9	6,2
	relative. %	64	64	67	69	72	73	74	74	74	70	65	64	69
	deficit. mb	1,5	1,5	1,7	2,4	3,4	4,2	4,6	4,7	3,7	2,9	2,4	1,7	2,9
Stepantsminda	absolute. mb	2,3	2,5	3,1	4,6	6,4	8,5	10,5	10,2	8,1	5,5	3,8	2,8	5,7
	relative. %	78	80	84	80	82	82	83	83	86	82	79	75	81
	deficit. mb	0,7	0,6	0,7	1,1	1,6	2,1	2,4	2,5	1,7	1,5	1,1	1,0	1,4

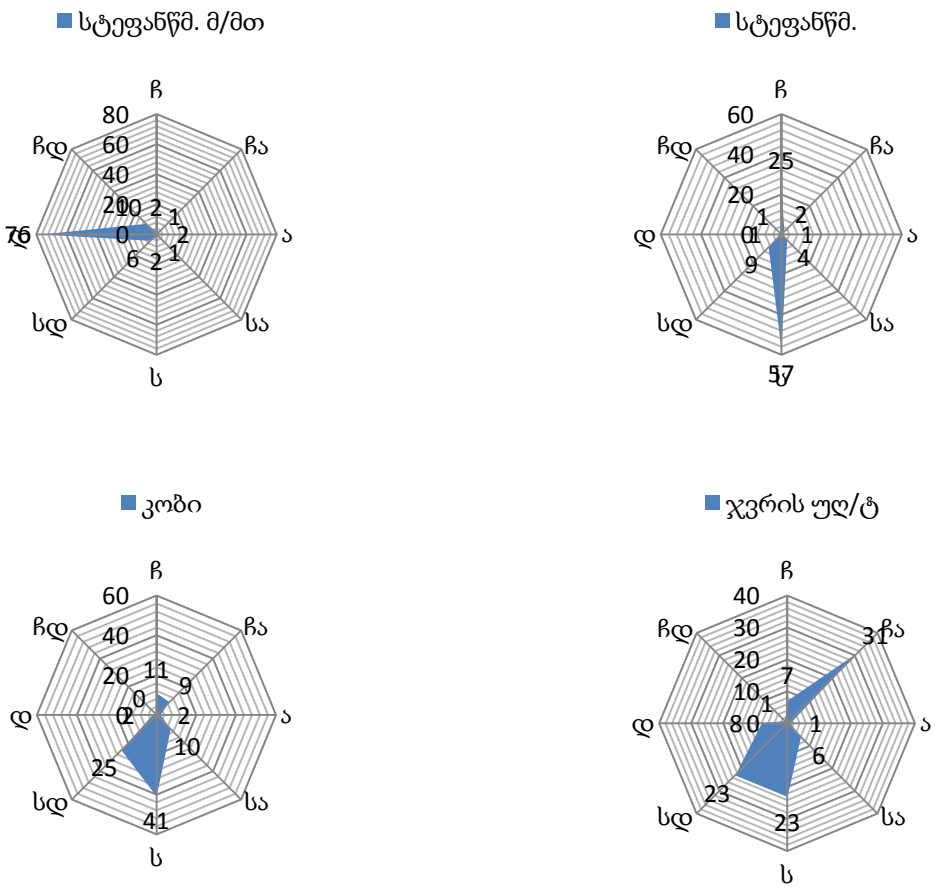
5.3.1.4 Wind data

Winds blow from all directions in the survey area, though at relatively low points of Tergi River Gorge (m/s Stepantsminda, Kobi) Southerly winds are dominant, at Stepantsminda highland m/s- Westerly winds, and at the Jvari Pass- NE and SW winds.

Repeatability of wind directions and numbers of calms as a % of annual, based on long-observed data by the meteorological stations, are given in the table 5.3.1.4.1.

Table 5.3.1.4.1. Repeatability of wind directions, and numbers of calms as a % of annual

m/s	N	NE	E	SE	S	SW	W	NW	Calm
Stepantsminda highland	2	1	2	1	2	6	76	10	38
Stepantsminda	25	2	1	4	57	9	1	1	30
Kobi	11	9	2	10	41	25	2	0	39
Jvari pass	7	31	1	6	23	23	8	1	38



The maximum average annual wind velocity is measured at the Stepantsminda highland weather station. At the Jvari Pass weather stations and at stations disposed in the gorge, the average annual wind velocity does not exceed 2.0 m/sec. Also maximum average monthly wind velocities are measured during the winter months, the minimum - in the summer.

Average monthly and annual wind velocities, based on long-observed data by the same meteorological stations, are given in the table 5.3.1.4.2.

Table 5.3.1.4.2 Average monthly and annual wind velocities, m/sec

m/s	Vane height, m	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Year
Stepantsminda highland	11	7,0	7,5	7,4	7,0	6,1	4,8	5,0	5,4	6,4	7,1	6,6	6,8	6,4
Stepantsminda	9	2,6	2,6	2,4	2,0	1,6	1,5	1,4	1,6	1,7	2,0	2,2	2,5	2,0
Kobi	10	1,7	1,9	1,9	1,3	1,4	1,3	1,5	1,4	1,6	1,5	1,9	1,7	1,6
Jvari pass	11	2,2	2,4	2,2	1,8	1,9	2,0	1,9	2,0	2,0	2,0	1,9	2,2	2,0

5.3.2 Geological Conditions

5.3.2.1 Geomorphology

Stepantsminda Municipality is characterised by high-mountain relief. Terrain is mostly rocky and difficult to access. Erosive, volcanic and ancient glacier terrain forms are developed here. Karst also occurs sporadically. The principle orographic unit is the region of Khevi, as well as three meridional ridges: Khuro, Shavana and Kidegani, and lateral ridge - khokhi.

Khevi is located on the northern slope of the Greater Caucasus mountains and comprises the upstream basin of Tergi River. Sliding rocks and effusion are observed. There are the following mountains there: Esikomi (3572 m), Sadzele (3307 m), Kvenamta (3152 m) and Kabarjina (3141 m). Jvari pass is the most significant mountain pass (2379 m), through which drifts the Military Highway of Georgia.

Shani ridge is a mountain in the Eastern Caucasus. It is a watershad meridional ridge of the right tributaries of the River Tergi – Khdistskali and Armkhi rivers. The largest part of Shani ridge is characterized by a complex and uneven landscape. Most of the peaks there are very steep and rocky and difficult to access. There are small glaciers on Shani ridge. Places free from glaciers are covered with gravel material and others.

Kuro ridge is one of the branching of the northern ridge of Caucasus, which separates river Tergi and Khde. The highest point of Kuro ridge is Kurostsveri (4091 m).

Kidegani ridge is bordering the Northern part of the Caucasus, Tusheti and Khevsureti regions. It is isolated from the main range at Sadzelisgheli pass and goes to North direction and within Ingusheti frames it borders with 375km length cuesta type rocky range.

Khokhi ridge is one of the great massifs of Caucasus lateral ridge. It is connected to the main ridge of the Caucasus through Truso ridge. It is the largest glaciated area in Eastern Georgia. The highest peak of the eastern Georgia - Mkinvartsveri (5047 m) is located there, which is characterized by extensive glaciations. It is considered to be extinct volcanic cones. Recently, warming has been observed in this region, which caused the reduction of glaciers.

Maili pass (4400 m) is the most important mountain pass, which is the highest pass in Georgia.

River Tergi within the Stepantsminda Municipality has two gorges - Dariali and Truso.

Dariali gorge, which is proposed for the construction of power plan, is the antecedent section of the River Tergi Ravine. It is cut in 1000 m depth in axial zone of the Caucasus Mountains and with rock corridor passes through the lateral ridge. The ravine begins from the estuary of the Chkheri River and ends to Zemo Larsi (length - 11 km.). The most rocky and narrow is the part between the month of the Rivers Kabakhi and Khda.

Truso gorge is located among the central watershed ridge of the Caucasus and the Khokhi ridge. It takes origin in Truso pass. Length of this gorge is 25 km. The lowest part of it is at 2000 m.

Elevation of the proposed locations for the basic facilities included in hydraulic units of the proposed project – headworks, diversion pipeline, tunnel, equalizing basin (surge shaft), pressure shaft and powerhouse – ranges between 1710.0-1333.0 meters.

5.3.2.2 Stratigraphy and Lithological Composition

Geological structure of Dariali ravine is composed of paleolithic (Pz2+3) granites of crystalline massifs of Dariali and Gveleti, granite-gneisses, on which phyllites of the lower Lias and chlorite schists are found. Quartz formation processes of adjacent rocks are observed; horizons of quartz schists and quartz-sericite schists are also formated there.

Rocks of the massif are cut by base rocks, mainly by seams of diabase and dikes. As a result of getting in contact with them, mylonites and cataclastic rocks are formated on the adjacent rocks. The surface of the Paleolithic rocks is highly fragmented and it is complex due to anisotropic cracks.

Strongly folded, asymmetric cystine rocks of sinemurian stage (J_1S_1) with the inclination towards the South direction are observed on eroded paleozoic surface. They are lithologically represented by graphite schists, quartzites, gravelites and sandstones. Thickness of the rocks of sinemurian age is 140-150 m.

Cystine rocks of sinemurian age are followed by the lower Pliensbachian Stage (J_1P_1), lithologically represented by middle layers of schists and quartz sandstones. Their total capacity is 350-400 m. In geological literature they are referred as sub-layers of Tsiklauri layers. The lower layer of the upper substage of Pliensbachian Stage ($J_1P_2^1$) is represented on the latter. It is represented by strongly folded, asymmetric schists and thin layers of allevrolites. They are followed by upper layers of Tsiklauri horizon ($J_1P_2^2$) rocks, lithologically represented by clay-schists and sandstone, as well as by beds of siltstone, often cut by diabase bodies. Slope: Az. 40°; inclination angle 80°. Actual capacity of this stage is up to 200m.

The main components of Kistinki and Tsiklauri horizons - Early Juristic ailtstone and pelitic schists – are extensively fractured throughout the power unit area. Weathered materials on slopes are not fixed and they are desintegrated.

Quaternary sediments (Q) are represented by alluvial (al), prolluvial (P), dealluvial (d), colluvial (C), fluvioglacial (f) and glacial (g) formations and are distributed as separated fragments.

Along with Quaternary sediments, volcanic sediments are also distributed there and lithologically they are represented by andesite, dacite and andesite-dacite rock.

Along with Dariali and Gveleti massives throughout the project area, there are diabase dikes with relatively small capacity (2-5m).

5.3.2.3 Tectonics and Structural Geology

The project area from geotectonic point of view belongs to the Greater Caucasus Range fold system. Tectonic zone is characterized by a strong deployed, asymmetric isoclinic folds. Structural units are crossed by the proposed diversion tunnel:

a) Dariali anticline fold, with steep slope from both sides and complicated with the secondary folds. Its North side is represented by the upper Pliensbachian Stage ($J_1P_2^1$) sediments, where parallel to Dariali anticline thick folds are developed. Their capacity varies between 100-500m.

b) Amalini syncline folds are located south to the Dariali anticline and are separated from it by a fracture, the so-called Amalini thrust fault, so that the arch-shaped part of the anticline is overthrusted on the north wing of syncline. The fracture falls steeply to the South in a 70° -80° angle.

c) Gveleti anticline fold, like Dariali fold, is a sub-latitudinal. From the West side it is complicated by Gveleti fracture; the width of the zone from the West to the East direction varies between 0.5 and 2.-2.5 km. Gveleti anticline axis plane has almost a vertical inclination. The steep flanks of the fold fall in a 60°-80° angle to the South and in a 50°-70° angle to the North. Gveleti massif

granitoids are widespread in the arch-shaped anticline, which are surrounded by the layers of kistinki sediments.

d) Gveleti syncline fold is located south to the Gveleti massif. Upper Paleozoic granitoids are thrusting into a Pliensbachian Stage, by the thrust fault of steep Gveleti, which separates Gveleti anticline fold from the syncline with 300-400m capacity.

5.3.2.4 Fractures (disjunctive dislocations)

Throughout the area proposed for the construction of HPP, Amali and Gveleti cleavages are to be noted among the disjunctive dislocations.

Amali (Dariali) cleavage is a sub-latitudinal. It covers Amali River gorge and further it is observed along the river Kistinka (Khde). In Tergi River gorge granitoids are overthrusted on the sediments of Kistinka suit. Kistinka suit is overthrusted on Dariali granitoids.

Vertical amplitude of of the West to East movement increases gradually and makes 250-300m, in Tergi river gorge – 500-550m; in Kistinka River Gorge - 700-750 m. The plane of the thrusting fault falls to the North; tilt angle is 65° -75°.

Gveleti cleavage runs almost parallel to the Dariali fracture. Gveleti massif granitoids in Dariali gorge and partly Kistinki suit is overthrusted on the formations of Tsiklauri. The vertical movement amplitude increases from the West to the East up to 400-600 m. The plane of the thrusting fault falls to the North with 60° angle. These fractures will be crossed by diversion tunnel and thus, implementation of a proper maintenance works will be required.

5.3.2.5 Dangerous Geological Processes

Dusheti municipal area is especially notable in terms of high-intensity of dangerous geological processes and activities in Mtskheta–Mtianeti region. Complex climatic and terrain conditions and geological structure contribute to activation of these processes. In case of relevant supporting conditions, activation of these processes in practically all the settlements, located in both White and Black Aragvi Gorges is to be expected.

The process activation is also anticipated in Pshavi and Khevsureti Aragvi basins. The same problems exis in Tianeti municipality. Banks are expected to be washed in the gorges of Rioni River and its tributaries near the Sioni reservoir.

Mtskheta Municipality is chatacterised by its mild morphological and geo-morphological structure and therefore, dangerous geological processes are less expected there. Landslide and mudflow processes, local flooding and offshore motion of sediments are observed within the municipality area.

As for the Kazbegi Municipality, there is a particular danger of mudflow formation, promoted by a significant terrain inclination and large amounts of erosive and exhausted materials, accumulated in the gorge sources.

Mudflows pose a threat to the local settlements and military roads, gas pipelines and village internal roads. Activation of mudflow processes is anticipated in Devdoraki-Amali, Kistinka, Kuro, Kabarjina, Bidara Trusso gorges. Activation of landslide processes is limited there.

Hydrologic characteristics of the proposed power plant area leads to a high risk of dangerous geodynamic processes and natural disasters, such as rock-avalanche, avalanche, erosion, landslide, stone fall, mudflow, flood, offshore motion of sediments, road and bridge damage, and more.

5.3.2.6 Seismic Conditions

According to Annex 1 of construction norms and rules on "seismically stable construction" (01. 01-09), the area selected for the proposed diversion system construction (Stepantsminda surroundings) is located in seismic hazard zone (9 points on the MSK-64 scale). The seismicity undimensional ratio A for the nearest populated area (Stepantsminda surroundings) is 0, 41.

5.3.2.7 Hydrogeology

According to the hydrogeological zoning of Georgia by I. Buachidze, there are three hydro geological areas between the municipality of Stepantsminda and Mtskheta:

1. Keli and Kazbegi lava flow groundwater district, belonging to the fractured zone pressure water district of the Great Caucasus southern slope;
2. Mestia-Tianeti fractured and fractured-karstic water pressured basin, belonging to the same hydrological region;
3. Porous, fractured and fractured-karstic artesian basin of Kartli, existing within the hydro geological region of artesian basins of Georgian belt.

The area selected for the proposed power plant belongs to the fractured groundwater hydrogeological region of Keli and Kazbegi lava flows. It is located in the Greater Caucasus axial (mountainous) areas. Effusive sediments have basically flow stratification and diverse sub-volcanic forms. They are located at different elevations, on denudation surfaces of lower and middle Jurassic age sand-clayish-shale and upper Jurassic and Cretaceous age carbonate sediments. In some places of Tergi River gorge effusive developments are located on the old quaternary fluvial-glacial and alluvial sediments. Effusives are represented by shale of andesite-dacite range, which are characterized by a cleft structure.

Water content of the mentioned sediments varies in wide ranges (0,2–200 l/sec), mainly in 5-10 l/sec. Relatively high water content is typical for large lava flows (Gudauri, Khorisari), which varies in ranges from several dozen l/sec to 1 m^3/sec. Groundwater flow module exceeds 30 l/sec per 1km^2. Springs flow out along the water-tight shale contacts, in deep gorges (Tetri (White) Aragvi gorge etc.)

and create waterfalls. The springs are also associated with sections of abrupt relief changes (Jvari Pass south slope etc.).

Chemical composition of waters are hydrocarbonate - calcium or calcium- sodium. Rarely calcic-magnesia, with slight chlorine ion content (14 mg/l). Mineralization varies between 0, 1 - 0, 2 g/l, rarely reaches 0.3 g/l. Temperature varies from 3 to 9 ^{0}C.

In some places CO2 water outlets are connected with effusive sediments (Sioni, Arasha etc.).

The total resources of the hydrogeological region is calculated based on the hydrograph analysis of perennial hydrological observations and reaches 6,5 m^3\sec.

The project area is located in the Tergi River grove. Geological formations have properties of water bearing layers here. It has been confirmed that the ground water level is near the rock surfaces.

5.3.2.8 Soil Cover

The soil cover throughout the municipality is quite diverse. Mainly gray forest soils are distributed in the forest and subalpine zones, particularly in gorges of Tergi River and its several tributaries; as well as in the river gorge bottoms; The lower zones are characterized by different types of forest soils; the layers developed on alluvial-prolluvial stratifications, forest-meadow transitional soils, mountain-meadow hummock soils (1100 -2600 m a.s.l.), And swampy peat soils are also found here.

Soil cover in the Alpine Zone consists mainly of medium and minor depth mountain-meadow hummock soils. Undeveloped skeleton soils are widely distributed in all zones of the municipality, especially in highlands, where the soil is poorly covered with woods.

Mainly mountain-meadow hummock soils are distributed within the area selected for the construction of diversion pipeline for the proposed power plant. Soils are characterized by low capacity, light mechanical structure and high skeleton.

Transitional mountain-forest-meadow soils are distributed in the diversion pipeline exit portal and within the HPP location area. The capacity of the soil is minor or medium; it is strongly graveled and exhausted, caused by the decomposition of rocks.

5.3.2.9 Detailed Engineering- Geological Survey

The study of hydraulic structures area will be conducted by arranging wells and pits and rock sampling for laboratory research on the selected area, based on which geotechnical characteristics of the soil will be determined. Geotechnical studies will be completed in the final stages of design. The provided geotechnical information is obtained as a result of the existing geological information study and field surveys of the engineering-geological conditions throughout the area. Geophysical surveys are considered to be carried out at the next stage of the researches.

5.3.2.9.1 Geotechnical survey of the headworks and settling basin

The headworks and settling basin, inlet and outlet facilities, as well as other proposed facilities, will be located on the right bank of River Tergi, between 1710-1725 m of absolute elevation (the profile varies).

Basic rocks throughout the are selected for the construction of headworks and settling basin are: Early Jurassic age rocks covered with alluvial, prolluvial and colluvial soils. The alluvial material is dominated by larger pebble mass. In the flow regulator section there is a material of granulometrically large gravel and stones, transported by unnamed right tributaries of Tergi River. Genetically the soil is a rock weathering product withdrawn on the Tergi riverbed and terrace by mudflows.

The soils of the same genesis and granulometric composition on the right bank of the river Tergi gorge create landfall cones. The project envisages the construction of structures on the described soils. Calculated soil resistivity (bearing capacity) of pebble-gravelly and stony-rocky soils is 4.5-6 kg/cm^2. In order to determine geological cross section, capacity and physical-mechanical properties of Quaternary soils, detailed engineering - geological studies should to be carried out throughout the study area. Soils will be excavated to a 2.5 m depth during the flow regulator installation; maximum inclination (vertical/horizontal) of the slope, created during this process, should be up to 2.0 m 1/0.75; up to 3 m 1/1.

If the boring based foundation surveys show that sediment development thickness is minor, those should be completely removed from the regulator location and the regulator should be installed on the foundation rock.

5.3.2.9.2 Diversion Pipeline

Diversion pipeline will be arranged in 2073 meters long section, on the right slope of river Tergi, on the second hypsometric terrace of the river floodplain, in the upper weathering zone of Jurassic age rocks. The basic rocks, Jurassic age clayish-shale and sandstones layers are covered with quaternary age delluvial, colluvial and alluvial materials and in terms of lythology they are represented by unconnected and unsorted layers of Jurassic and Paleozoic age crystal shale and effusive shale fragments, clayish-gravelly sediment materials are detected in their contacts.

Geodynamical situation in the diversion pipeline section is caused by strong inclination (<20°) of Tergi River right slope and erosion of rocks. The erosion products create several meters long landfall masses and stone-fall contours at the slope foot. According to the existing data, sandstone erosion velocity in this section is 0.1-0.15 kg/m^2 in year, and for slates it is - 0.15-0.34 kg/m^2.

In the diversion pipeline section Tergi River from the right side conjuncts with unnamed, mudflow type, periodically water-filled tributaries. Periodicity of stony-muddy and stony-watery flows is estimated at 1-2 per year, and the solid material onetime out-drifting volume - by hundreds and primary thousands of cubic meters.

Geotechnical survey of layers, existing under the upper and lower flow limiters, will be reasonable at the detailed design stage.

Figure 5.3.8.1. View of the Proposed Diversion Pipeline Corridor

5.3.2.9.3 Diversion Tunnel

Energy tunnel, through which Tergi River water will flow to the power plant, will have a circled cross-section. Geological mapping of the tunnel route was carried out on the 1:25000 scale topographic map. Since a lot of materials are available at the Georgian Geology Department, no boring based researches at the facility installation site, regarding its geological composition, have been carried out at the current construction phase. Based on visual inspections and available literature, geological units are likely to be crossed by each other during the tunnel installation.

Basic rocks at the diversion tunnel section are ranges of lower Jurassic and Paleozoic ages, complicated by tectonic dislocation of rocky shale forms as granitoid, crystal and clayish-shale, quartzite, sandstone and aleurolite. Diabases of 55°-70° vertical inclination are represented in the rocky shale range. Solidity - resistance of the mentioned rocks by a single axis compression varies in ranges of 50-200 Mp.

Paleozoic granitoid solidity by a single axis compression under water saturated conditions is 150-175 Mp, shale softening ratio - 0.96, which indicates that it is not emollient.

Four main types of cleft systems are detected in the rocky massif of the diversion pipeline section:

- Inclination azimuth (I.A) 80°. Tilt angle (T.A) _ 40°.
- I.A. 180°. T.A. 75-85°.
- I.A. 270°. T.A. 65-70° .
- I.A. 260-280°. T.A. 25-45°.

Clefts are more observed to the South. Distance between systemic clefts varies in ranges of 0.5-3.0 m. According to existed data, weathering zone in the massif extends up to 200 meters. Clefts are intensively represented in the upper zone with 20-25 m capacity. Capacity of the gravelly weathered zone is 3.0-3.5 m.

Tectonic rocks are represented within these systems. They are not open and do not contain fillings. Field study of rock surfaces has revealed that their RQD (Rock quality designation) is 70-90% (rock quality).

Based on the Protodiakonov rock classification, the diversion tunnel surrounding rocks belong to the categories II-III and IV solid rocks, which ensures the resilience of the energy tunnel. Accordingly, it will be enough to have system supporting fastened with screws (2.00-3.00 m on the ceiling and 1.5-2.0 m on the sides) + wires. In the sections of expected cleft and disjunctive split crossings contact and consolidation injections of pressured concrete should be done.

Waterproofness in the tunnel area should be achieved through the surface screening, concrete injections. Measures should be taken for drainage in tectonic split zones.

It is considered to be necessary to study surrounding rocks along the designed tunnel route (profile) during the project design, in terms of their classification and identification by Terzaghi, CSIR and Q systems.

5.3.2.9.4 Surge Shaft

The surge shaft will be opened in Dariali massif granite rocks. Based on the Protodiakonov rock classification, these rocks belong to the II-III categories of solid rocks, with hardness ratio of 12; the rocks are cracked on the surface, are stable and less water permeable.

5.3.2.9.5 Penstock

Penstock will be located in Dariali massif crystalline rocks γPz2+3, which are represented by granites, granite-gneiss, crystallized shale and quartzite alternation. They belong to the II and III categories of solid rocks; small cracks and plicate clefts are observed on the surface. Geotectonically they can be categorized as solid, stable rocks that do not require any surface (exhausted layer) removal. Although the rocks inclination <angle is high, there will be no problems in terms of stability and bearing capacity along the penstock route; Estimated profile is at 1729.0-1333.0 m hypsometric point.

We consider that it is necessary to study physical-mechanical properties of the rocks in the project design period.

5.3.2.9.6 Powerhouse Location Area

An underground power station will be constructed. Excavation height of its foundation will be around 1310.0-1330.0 m.

Geologically it is built up by Dariali massif crystalline rocks, which are covered by glacier - delluvial unsorted materials; lithologically it is represented by uncemented material of crystalline rocks and effusive rocks of different compositions.

We consider that it is necessary to carry out a detailed engineering-geological survey of the area at the design phase and determine mechanical properties of the soil.

Weathered zone of rocks, which may be represented on the surface of the HPP construction site, should be removed after the excavation works and filled with concrete. It is reasonable to use a 3/1(vertical/horizontal) excavation declination during the excavation.

Figure 5.3.2.9.6.1. Assumed location of the entrance portal of the proposed underground power station

5.3.2.9.7 Geological and geotechnical examinations that are required to be carried out at the final design stage

Detailed geological surveys of the surface were carried out during the Dariali HPP project studies under the field conditions. Below are given the further projects and geological studies that are required to be implemented before the construction works:

- Preparation of detailed geological maps of an acceptable scale (1 /1000) for the Dariali HPP project location.
- 3 foundation boreholes of sufficient depths will be arranged at the regulator's location and on the slopes in order to examine the depth of sediment formations. While in order to study the foundation rocks and stream beds, an additional borehole should be arranged in the vicinity of the Tergi HPP.
- Pressurized water should be examined in order to determine water permeability of the foundation drilling formations and to identify groundwater levels.
- So far, no foundation researches have been conducted for the power tunnel routes. First of all, boundaries of formations that will be crossed as part of the tunnel route sections should be determined and based on these studies geological cross-sections should be elaborated. The foundation should be checked in a way that they exceed the tunnel bottom profile at 5.00 m on the tunnel route, for detection of crossed layers and their water permeability, lythological, as well as geo-mechanical properties. Prior to the final design stage, based on the assessment of geological excavations, also water tests should be carried out through setting it under pressure – as a part of drilling. Laboratorial researches of mining waste samples should be conducted - in the form of local surveys- and so the information should be obtained about lythological and geo-technical properties of geological formations, crossing along the tunnel route. Also, the ground water level should be measured along the tunnel route during the tunneling works. In addition, laboratory analysis should be conducted in order to determine the retaining wall system of the mining formation sections during the tunnel opening.
- Lythological and geotechnical properties of the foundation and its formations should be studied through arranging one borehole where the sediments are stable.
- Lythological and geotechnical properties of the foundation and its formations should be studied through arranging four boreholes on the area selected for power station construction.

- Inclination (slope) stability analysis should be carried out in accordance with the results of laboratory studies of samples, extracted from sediment stability areas, penstock pipe and powerhouse.
- Laboratory analysis of samples taken from the given streams should be carried out with regard to the concrete aggregates, used in the Tergi hydropower project.
- Additional laboratory tests will be carried out on paleolithic granites of Dariali and Gveleti massifs, which are expected to be used as concrete aggregates in frames of the Tergi HPP project, as crushed granite rocks.
- Study and analysis of earthquake risks.

5.3.3 Hydrology

Kazbegi municipality hydrographical net is very dense. The municipality is rich in rivers, lakes, glaciers and mineral water springs. Rivers here are short (except for Tergi River), though they are quick flowing and clear. On some rivers quite high waterfalls are encountered.

Tergi River has three main tributaries (Chkheri, Devdoraki and Khdistskali rivers) in the design HPP construction area; these are glacial rivers, with large fall of stream, significant sedimentation drift (mainly rocks). Mudflow currents are also characteristic during heavy rain and snowmelt periods.

Also a lot of lakes are there in the municipality and they are located at quite high elevations above the sea level. The lakes have glacial or volcanic origins and are characterized by small areas and often – by significant depths. The largest lake in the municipality is Kelitsadi volcanic lake, its deepest point is at 13,9 m. Archvebi lake, issituated in Keli plateau, at 3078 m a. s. l., depth approximately 6 m. Aragvistavi 3 lakes are also noteworthy. The largest is Qvemo Aragvistavi Lake (area ca-0,07 km², max depth 4,5 m).

Glaciers are also widely represented in the municipality. Mkinvartsveri massive is characterized by the largest icing (area about 80 km²). Many glaciers descend from Mkinvartsveri, including the most important Devdoraki and Gergeti glaciers. Glaciers are characterized by melting, area reduction, splitting and etc. Some of them have transformed from valley type to cirque type glaciers.

Pic. 5.3.3.1. View of Khdistskali River

5.3.3.1 Hydrological description of Tergi River

Tergi River originates from the Caucasus Ridge, Northern slopes of Zilgakhokhi mountain (3856 m), at 3400 m a. s. l. and flows in Caspian Sea north to Agrakhan peninsula, Russian Federation.

River length from the source to the project, i.e. Dariali HPP section, is 49,0 km, elevation difference – 1677 m, average decline - 34 ‰. The basin area is 778 km^2, its average height - 2820 m. In this section the river conjuncts with 32 tributaries of the first order, with common length of 181 km. Important of them are: Snostskali, Baidara, Mnaisi, Suatisi, Gimara and Desimak rivers. Mnaisi, Suatisi and Desimak are rivers with mudflow risks. It's known that on 17.08.1953 and 6.08.1967 mentioned rivers and other tributaries of Tergi were overflowed by a mudflow, which barricaded the riverbed and as later the river broke through, a serious damage was suffered by Stepantsminda municipality.

Lower, Middle and Upper Jurassic shale, sandstones, limestone and marl are found in the basin geological composition. Notably distributed are also the newest (quaternary) effusive, calc-tuff sedimented by springs, travertine, glacier and river layers. Note that the young local volcanoes are situated on a mountainous, fragmented surface of erosive origins.

Basically alpine and subalpine meadows are distributed in the basin. Almost no forest is there. Deciduous shrubs are found here and there, mainly in lower parts of tributary gorges.

The basin soil cover is mainly represented by mountain-meadow hummock and mountain-forest-meadow soils, a certain part of which is washed down.

Glaciers are widely distributed in the basin, playing an important role by feeding the rivers. Relatively large glaciers are Suatisi, Mna and Ortsveri.

The river gorge from the estuary up to Resi village is V-shaped. Downwards to Okrokana village it widens and becomes box-shaped. In this section, where the gorge bottom width is 1-1,3 km, Tergi River gets branched and creates several islands. By Okrokana village the gorge narrows again along ca 2 km and then widens again.

The riverbed meanders moderately and branched in wide places. In Stepantsminda city the river is not branched and flows in one deeply embedded riverbed. The current depth changes from the source downwards from 0,5 to 1,5 m, its width - from 8-10 m to 15-20 m, and the speed - from 1-1,5 m/sec to 1,8-2,3 m/sec. The riverbed bottom in narrow places is uneven, rocky and stopped by large stones/rocks, and in wide places it is sandy-gravelly.

The river is fed by glacier, snow, rain and groundwater. Its water regime is characterized by spring-summer floods and instable low water levels in different periods of the year. The spring-summer floods, caused by snow and glacier melting and rains reaches its maximum in July and ends in September. Minimal water levels are observed in February.

Tergi River is not used for economic activities in Georgia.

5.3.3.1.1 Tergi River average annual flows

Average annual flows of Tergi River diverse provision values (given in the tables 5.3.3.1.1.2 and 5.3.3.1.1.3) were detected based on 47 years long(1928-1940, 1953-1986) variation range of Tergi River average annual flows, according to which Tergi River average annual flow values in Stepantsminda H/S section vary between 18,6 m^3/sec(1934) - 30,4 m^3/sec(1963) (see table 5.3.3.1.1.1).

Table 5.3.3.1.1.1. Tergi River annual average flows, F=778 km².

№	Years	Qm³/sec	Qm³/sec Rank.	$K = \frac{Q_i}{Q_0}$	$K-1$	$(K-1)^2$	P%
1	1928	24,1	30,4	1,26	0,26	0,0676	1,5
2	1929	28,1	28,8	1,19	0,19	0,0361	3,6
3	1930	21,8	28,5	1,18	0,18	0,0324	5,7
4	1931	26,4	28,4	1,17	0,17	0,0289	7,8
5	1932	25,9	28,2	1,16	0,16	0,0256	9,9
6	1933	21,1	28,1	1,16	0,16	0,0256	12,0
7	1934	18,6	27,9	1,15	0,15	0,0225	14,1
8	1935	21,2	27,5	1,14	0,14	0,0196	16,2
9	1936	23,4	27,1	1,12	0,12	0,0144	18,4
10	1937	28,4	27,0	1,12	0,12	0,0144	20,5
11	1938	24,2	26,9	1,11	0,11	0,0121	22,6
12	1939	27,1	26,9	1,11	0,11	0,0121	24,7
13	1940	27,5	26,7	1,10	0,10	0,0100	26,8
14	1953	22,8	26,5	1,10	0,10	0,0100	28,9
15	1954	20,5	26,4	1,09	0,09	0,0081	31,0
16	1955	19,5	25,9	1,07	0,07	0,0049	33,1
17	1956	22,1	25,8	1,07	0,07	0,0049	35,2
18	1957	20,7	25,8	1,07	0,07	0,0049	37,3
19	1958	21,2	25,4	1,05	0,05	0,0025	39,4
20	1959	23,2	24,9	1,03	0,03	0,0009	41,6
21	1960	25,8	24,7	1,02	0,02	0,0004	43,7
22	1961	24,6	24,6	1,02	0,02	0,0004	45,8
23	1962	20,3	24,3	1,00	0,00	0,0000	47,9
24	1963	30,4	24,2	1,00	0,00	0,0000	50,0
25	1964	28,8	24,2	1,00	0,00	0,0000	52,1
26	1965	22,7	24,1	1,00	0,00	0,0000	54,2
27	1966	27,0	23,4	0,97	-0,03	0,0009	56,3
28	1967	26,9	23,2	0,96	-0,04	0,0016	58,4
29	1968	24,9	23,1	0,95	-0,05	0,0025	60,5
30	1969	20,8	22,9	0,95	-0,05	0,0025	62,7
31	1970	24,3	22,8	0,94	-0,06	0,0036	64,8
32	1971	26,7	22,7	0,94	-0,06	0,0036	66,9
33	1972	22,9	22,6	0,93	-0,07	0,0049	69,0
34	1973	20,3	22,1	0,91	-0,09	0,0081	71,1
35	1974	20,7	21,8	0,90	-0,10	0,0100	73,2
36	1975	23,1	21,2	0,88	-0,12	0,0144	75,3
37	1976	26,5	21,2	0,88	-0,12	0,0144	77,4
38	1977	25,4	21,1	0,87	-0,13	0,0169	79,5
39	1978	28,5	20,8	0,86	-0,14	0,0196	81,6
40	1979	24,2	20,7	0,86	-0,14	0,0196	83,8
41	1980	28,2	20,7	0,86	-0,14	0,0196	85,9
42	1981	22,6	20,5	0,85	-0,15	0,0225	88,0
43	1982	27,9	20,3	0,84	-0,16	0,0256	90,1
44	1983	20,3	20,3	0,84	-0,16	0,0256	92,2
45	1984	26,9	20,3	0,84	-,016	0,0256	94,3
46	1985	24,7	19,5	0,80	-0,20	0,0400	96,4
47	1986	25,8	18,6	0,77	-0,23	0,0529	98,5
	Total	1139,0	1139,0	47,0	0,00	0,6927	-

	Average	24,2	24,2	-	-	-	-

Based on data given in the table 5.3.3.1.1.1 average annual flows of Tergi River diverse provisions were detected for Stepantsminda H/S section (see table 5.3.3.1.1.2.). Since the section of the mentioned H/S practically maths with the project section, average annual flow values are used as calculation values for the project section.

Table 5.3.3.3.1.2. Average annual flows of Tergi River diverse provisions, m^3/sec

Section	F km^2	Q_0 m^3/sec	Cv	Cs	Provision P%						
					10	25	50	75	80	90	95
Stepantsminda H/S	778	24,2	0,12	0,24	28,0	26,0	24,1	22,2	21,7	20,6	19,7

An intra-annual distribution of average annual flows of calculated provision (10%, 50% and 90%) per months in the project section (Stepantsminda H/S) was carried out synchronously with average perennial values of average monthly flows the 47 years long observation. Data given in the table 5.3.3.3.1.3.

Table 5.3.3.1.1.3. Intra-annual distribution of average annual flows in the project section m^3/sec

P%	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Year
10	9,85	9,20	9,35	15,9	40,3	63,8	66,5	46,7	29,0	19,9	14,1	11,4	28,0
50	8,48	7,92	8,09	13,7	34,7	54,9	57,2	40,2	25,0	17,1	12,1	9,81	24,1
90	7,25	6,77	6,92	11,7	29,7	46,9	48,9	34,4	21,4	14,6	10,3	8,36	20,6

5.3.3.1.2 Tergi River maximal flows

Hydrological station (H/S): the processed variation range of Tergi River maximal flows in Stepantsminda H/S section of a 47 years long period given in the table 5.3.3.1.2.1.

Table 5.3.3.1.2.1. Tergi River maximal flows, F=778 km^2.

№	Years	Q m^3/sec	Q m^3/sec ranking	$K = \frac{Q_i}{Q_0}$	$K-1$	$(K-1)^2$	P%
1	1928	159	481	3,76	2,76	7,6176	2,1
2	1929	183	312	2,44	1,44	2,0736	4,2
3	1930	82,4	295	2,30	1,30	1,6900	6,2
4	1931	211	211	1,65	0,65	0,4225	8,3
5	1932	139	183	1,43	0,43	0,1849	10,4
6	1933	68,4	183	1,43	0,43	0,1849	12,5
7	1934	106	173	1,35	0,35	0,1225	14,6
8	1935	91,0	159	1,24	0,24	0,0576	16,7
9	1936	116	155	1,21	0,21	0,0441	18,8
10	1937	312	144	1,12	0,12	0,0144	20,8
11	1938	86,5	139	1,09	0,09	0,0081	22,9
12	1939	108	137	1,07	0,07	0,0049	25,0
13	1940	134	135	1,05	0,05	0,0025	27,1
14	1953	295	134	1,05	0,05	0,0025	29,2
15	1954	93,8	128	1,00	0,00	0,0000	31,2
16	1955	78,5	126	0,98	-0,02	0,0004	33,3

17	1956	101	118	0,92	-0,08	0,0064	35,4
18	1957	72,7	118	0,92	-0,08	0,0064	37,5
19	1958	89,1	117	0,91	-0,09	0,0081	39,6
20	1959	183	116	0,91	-0,09	0,0081	41,7
21	1960	100	111	0,87	-0,13	0,0169	43,8
22	1961	155	110	0,86	-0,14	0,0196	45,8
23	1962	91,4	108	0,84	-0,16	0,0256	47,9
24	1963	126	107	0,84	-0,16	0,0256	50,0
25	1964	135	106	0,83	-0,17	0,0289	52,1
26	1965	101	106	0,83	-0,17	0,0289	54,2
27	1966	144	102	0,80	-0,20	0,0400	56,2
28	1967	481	101	0,79	-0,21	0,0441	58,3
29	1968	79,6	101	0,79	-0,21	0,0441	60,4
30	1969	67,5	100	0,78	-0,22	0,0484	62,5
31	1970	137	97,0	0,76	-0,24	0,0576	64,6
32	1971	118	93,8	0,73	-0,27	0,0729	66,7
33	1972	76,0	91,5	0,71	-0,29	0,0841	68,8
34	1973	68,0	91,4	0,71	-0,29	0,0841	70,8
35	1974	106	91,0	0,71	-0,29	0,0841	72,9
36	1975	107	89,1	0,70	-0,30	0,0900	75,0
37	1976	97,0	87,0	0,68	-0,32	0,1024	77,1
38	1977	102	86,5	0,68	-0,32	0,1024	79,2
39	1978	117	82,4	0,64	-0,36	0,1296	81,2
40	1979	110	79,6	0,62	-0,38	0,1444	83,3
41	1980	128	78,5	0,61	-0,39	0,1521	85,4
42	1981	91,5	76,0	0,59	-0,41	0,1681	87,5
43	1982	173	76,0	0,59	-0,41	0,1681	89,6
44	1983	76,0	72,7	0,57	-0,43	0,1849	91,7
45	1984	118	68,4	0,53	-0,47	0,2209	93,8
46	1985	87,0	68,0	0,53	-0,47	0,2209	95,8
47	1986	111	67,5	0,53	-0,47	0,2209	97,9
	Total	6012,4	6012,4	47,0	0,00	15,0691	-
	Average	128	128	-	-	-	-

Maximal flows of Tergi River diverse provisions are calculated by use of the Moments' Method, graphic-analytical and Gumbel distribution. Flows, detected by the graphic-analytical method, are used for maximal flows calculation in the project, i.e. Stepantsminda H/S section, as the theoretical curve reflected on the probability cellule gives the best match with empiric points of the maximal flows. Maximal flows of Tergi River diverse provisions in Stepantsminda H/S section, calculated by the three methods, are given in the table 5.3.3.1.2.2.

Table 5.3.3.1.2.2. Maximal flows of Tergi River diverse provisions, m^3/sec

Section	Method	Provision P%					
		0,1	1	3	5	10	20
Stepantsminda H/S (project)	Moments	615	390	300	265	215	170
	Graphic-analytical	**655**	**445**	**345**	**295**	**230**	**175**
	Gumbel distribution	530	385	-	280	235	_-

Pic. 5.3.3.1.2.1. View of Tergi River Gorge

5.3.3.1.3 Tergi River maximal flows

A processed 47 year long variation range of Tergi River minimal flows in Stepantsminda H/S section is given in the table 5.3.3.1.3.1.

Table 5.3.3.1.3.1. Tergi River minimal flows, F=778 km².

№	Years	Q m³/sec	Q m³/sec rank.	$K = \frac{Q_i}{Q_0}$	$K - 1$	$(K-1)^2$	P%
1	1928	6,50	9,85	1,43	0,43	0,1849	1,5
2	1929	7,80	9,80	1,42	0,42	0,1764	3,6
3	1930	6,20	9,50	1,38	0,38	0,1444	5,7
4	1931	6,00	9,32	1,35	0,35	0,1225	7,8
5	1932	7,00	9,12	1,32	0,32	0,1024	9,9
6	1933	7,60	8,30	1,20	0,20	0,0400	12,0
7	1934	7,00	8,00	1,16	0,16	0,0256	14,1
8	1935	6,10	8,00	1,16	0,16	0,0256	16,2
9	1936	4,60	7,80	1,13	0,13	0,0169	18,4
10	1937	5,70	7,80	1,13	0,13	0,0169	20,5
11	1938	4,00	7,70	1,12	0,12	0,0144	22,6
12	1939	5,00	7,67	1,11	0,11	0,0121	24,7
13	1940	4,85	7,60	1,10	0,10	0,0100	26,8
14	1953	5,00	7,60	1,10	0,10	0,0100	28,9
15	1954	5,90	7,50	1,09	0,09	0,0081	31,0
16	1955	5,94	7,25	1,05	0,05	0,0025	33,1
17	1956	6,31	7,25	1,05	0,05	0,0025	35,2
18	1957	6,68	7,19	1,04	0,04	0,0016	37,3
19	1958	5,80	7,02	1,02	0,02	0,0004	39,4
20	1959	6,88	7,00	1,01	0,01	0,0001	41,6
21	1960	6,60	7,00	1,01	0,01	0,0001	43,7

22	1961	6,31	7,00	1,01	0,01	0,0001	45,8
23	1962	6,40	7,00	1,01	0,01	0,0001	47,9
24	1963	6,00	6,88	1,00	0,00	0,0000	50,0
25	1964	7,70	6,75	0,98	-0,02	0,0004	52,1
26	1965	7,02	6,68	0,97	-0,03	0,0009	54,2
27	1966	6,17	6,60	0,96	-0,04	0,0016	56,3
28	1967	7,19	6,50	0,94	-0,06	0,0036	58,4
29	1968	8,00	6,50	0,94	-0,06	0,0036	60,5
30	1969	7,50	6,40	0,93	-0,07	0,0049	62,7
31	1970	6,50	6,31	0,91	-0,09	0,0081	64,8
32	1971	9,12	6,31	0,91	-0,09	0,0081	66,9
33	1972	9,32	6,20	0,90	-0,10	0,0100	69,0
34	1973	7,25	6,17	0,89	-0,11	0,0121	71,1
35	1974	7,25	6,10	0,88	-0,12	0,0144	73,2
36	1975	6,75	6,00	0,87	-0,13	0,0169	75,3
37	1976	7,00	6,00	0,87	-0,13	0,0169	77,4
38	1977	7,00	6,00	0,87	-0,13	0,0169	79,5
39	1978	8,00	5,94	0,86	-0,14	0,0196	81,6
40	1979	6,00	5,90	0,85	-0,15	0,0225	83,8
41	1980	9,85	5,80	0,84	-0,16	0,0256	85,9
42	1981	9,50	5,70	0,83	-0,17	0,0289	88,0
43	1982	7,67	5,00	0,72	-0,28	0,0784	90,1
44	1983	7,80	5,00	0,72	-0,28	0,0784	92,2
45	1984	7,60	4,85	0,70	-,030	0,0900	94,3
46	1985	8,30	4,60	0,67	-0,33	0,1089	96,4
47	1986	9,80	4,00	0,58	-0,42	0,1764	98,5
	total	324,46	324,46	47,0	0,00	1,6647	-
	average	6,90	6,90	-	-	-	-

Diverse provision indexes of Tergi River minimal flows in Stepantsminda section (see table 5.3.3.1.3.2.)are determined by means of data, given in the table 5.3.3.1.3.1.

Table 5.3.3.1.3.2. Average annual flows of Tergi River diverse provisions, m³/sec

Section	F km²	Q_0 m³/sec	Cv	Cs	Provision P%					
					75	80	90	95	97	99
Stepantsminda power plant(project)	778	6,90	0,19	0,38	5,97	5,78	5,28	4,90	4,66	4,22

5.3.3.1.4 Tergi River solid flow

In order to detect Tergi River solid inflow calculation values for the project section, Stepantsminda Hydrological Station observation data are used, including the timeframe of 1928-1940. The processed variation range is given in the table 5.3.3.1.4.1.

Table 5.3.3.1.4.1. Tergi River average annual solid flow, F=778 km².

№	Years	R kg/sec	R kg/sec Rank.	$K = \frac{R_i}{R_0}$	$K - 1$	$(K-1)^2$	$P\%$
1	1928	5,6	88	3,65	2,65	7,0225	7,7
2	1929	16	33	1,37	0,37	0,1369	15,4

3	1930	6,4	32	1,33	0,33	0,1089	23,1
4	1931	32	29	1,20	0,20	0,0400	30,8
5	1932	9,8	24	1,00	0,00	0,0000	38,5
6	1933	24	23	0,95	-0,05	0,0025	46,2
7	1934	5,9	17	0,70	-0,30	0,0900	53,8
8	1935	17	16	0,66	-0,34	0,1156	61,5
9	1936	29	9,8	0,41	-0,59	0,3481	69,2
10	1937	88	6,4	0,26	-0,74	0,5476	76,9
11	1939	23	5,9	0,24	-0,76	0,5776	84,6
12	1940	33	5,6	0,23	-0,77	0,5929	92,3
	Total	289,7	289,7	12	0,00	9,5826	-
	Average	24,1	24,1	-	-	-	-

Based on to data, given in the table 5.3.3.1.4.1, different provision values of Tergi River solid flowand relevant inflow values are detected for Stepantsminda H/S section (see table 5.3.3.1.4.2.).

Table 5.3.3.1.4.2. Different provision values of Tergi River solid flow

Provision P%	1	3	5	10	20	50	75	90
Solid flow R kg/sec	110	78	64	48	34	22	10	7
Solid flow inflow W thousand tones	3470	2460	2020	1520	1075	695	315	220
Bottom sediment flow R_I kg/sec	55	39	32	24	17	11	5	3
Bottom sediment inflow W_I thousand tones	1735	1230	1000	755	535	345	155	95
$\Sigma R + R_I$ kg/sec	165	117	96	72	51	33	15	10
$\Sigma W + W_I$ thousand tones	5200	3690	3020	2275	1610	1040	470	315

Note that detection methods for a bottom sedimentation inflow are poorly developed. This is mainly caused by insufficient level of currently existing measuring tools and difficulty of a sediment transportation survey. Therefore, bottom sedimentation of mountain rivers is assumed by theoretical calculations to be equal to 50% of the solid flow.

5.3.4 Main landscapes

Main landscape types in Kazbegi municipality area are:

- Forest and gray soils with medium mountains and pine-birch woods;
- Mountain-gorge landscapes with forest-meadow vegetation and alluvial soils;
- Subalpine shrubbery-meadow on mountain-meadow soils;
- Alpine meadow landscape on mountain meadow soils;
- High mountainous glacial landscape, subnival and nival zones;
- vegetation cover.

The project areas are located on rocky areas along Tergi River right bank. The diversion channel sector of the diversion system runs along erosive, steep slopes, which are covered with crumbled materials and therefore very poorly vegetated. Other facilities are located under the ground and so their construction and operation processes will cause minor changes of the landscape.

Pic. 5.3.4.1 Dariali Gorge view

5.3.5 Biological environment

5.3.5.1 Flora

Vegetation structure in Stepantsminda, geobotanical district of a historical gorge, is extraordinary and distinctively different from vegetations of other regions of Georgia. This is due to the location, relatively dry climate and other factors. The high magnitude of the anthropogenic impact on the natural vegetation should be noted, which has led to a significant transformation of the main vegetation. Due to high impacts pine and birch forests are destroyed in the most part of the municipality, and instead of them there are brushwood and steppes. There grow sea buckthorn bushes along with grasslands in Tergi River floodplain.

Special character of vegetation is reflected in relief through Zonality type of the Central-North Caucasian, represented by incomplete forest masses, subalpine, alpine and subnival zones.

Ravine forest belt is represented by pine and birch forest, remaining between 1000 and 1600-1850 m a.s.l., in the forms of small segments and fragments. Forest stands are of different ages and are often characterized by low frequency and sparseness. Several species of common aspen *(Populus tremula)*, Caucasian hornbeam *(Carpinus caucasica)*, Sessile oak *(Quercus petraea)* and others are mixed in stands. Among the common shrubs are Caucasian honeysuckle *(Lonicera caucasica*), Bird Cherry *(Padus racemosa*), Wayfaring tree *(Viburnum lantana*) and others. Grass cover dominated by cereals and carex.

Birch forests, the edifactor of which are three birch species, are represented by a birch seedling *(Betula pendula)*, dwarf forests of birch *(Betula litwinowii)* and endemic, black birch forest *(Betula radeana)*; they are mainly distributed on the north and north-west exposition slopes, with a small number of Caucasian rowan trees (*Sorbus caucasigena)* mixed in.

The subalnie zone includes a hypsometric line from 1600-1850m up to 2500m a.s.l. The subalpine vegetation cover is complex, developed by subalpine forests, bushwoods, high grasslands and meadows. Leading formations in the subalpine forest composition are pine woods *(Pinus sosnowskyi)* and

birches*(Betula pendula, Betulalitwinowii, Betula radeana.).* As for the subalpine pine forests, only several stands and fragments can be observed in Khevi area. Sparse and crooked subalpine birch forests are distributed over a large subalpine meadows in the form of small plots at 2500 m a.s.l. Frequently a subforest is created in birch woods by Caucasian rhododendron *(Rhododendron caucasicum)* and Common Bilberry *(Viccnium myrtillus)*. Birch wood stands are mainly mono-dominant, with several common aspen)*Populus tremula)* and Caucasian rowan tree (*Sorbus caucasigena)* mixed in.

Figure 5.3.5.1.1.

Among the bushwoods are met: Savin Juniper *(Juniperus depressa, J. sabina),* Sea-buckthorn *(Hippophae rhamnoides)*, *(Spiraea hypericifolia)*, European barberry *(Berberis vulgaris)*, Cotoneaster *(Cotoneaster racemiflora)*, Willow species *(Salix kazbekensis,Salix kuznetzowii*, *Salix paeudomedemii)*, Honeysuckle *(Lonicera caucasica)*, currant shrubs *(Ribes biebersteinii)*, Rose species *(Rosa sp.)* and a variety of other Cereals.

Subalpine tall grass vegetation is developed in gorges and dingles (humid areas) mainly in the form of smaller groups. Coenosis are polydominant. Leading species are: Aconite *(Aconitum nasutum, A. orientale)*, Sosnowskyi Hogweed *(Heracleum sosnovskyi)*, valerian *(Valeriana tillaefolia)*, monkshood *(Aconitum nasutum)*, *Heracleum asperum*, *Delphinium flexuasum and more.*

Subalpine meadows, occuping a large territory, typologically are rich and diverse. The following meadow groups are observed here: grass meadows, dense lawn meadows -*Glabrus glabriculmis* , fescue grass *(Festuca varia)* and graining-grass meadows.

The Alpine zone covers an area between 2500-3200 m a.s.l. Vegetation landscape here is mainly created by alpine meadows. On north exposition slopes there is developed Georgian Snow Rose *(Rhododendron caucasicum)*, represented in the form of complex groups: *Glabrus glabriculmis*, fescue grass *(Festuca varia)*, sedges *(Kobresia macrolepis, K. schoenoides)*, carex species and so on.

The subnival zone is developed over 3200 m a.s.l. Due to severe natural conditions (cold climate, substrate poor on real soil) vegetation is often represented by rare coenosis. There are locally met small groups and fragments of alpine meadows, which are created with participation of *Festuca sulcata*, *Bromus species* and other cereal and grass plant species.

The major goal of this study is to descrivbe plant species within the Kazbegi National Park, on the right bank of the Tergi River in Stepantsminda. Diversion pipeline will pass through this zone of the

National Park, the construction of which may have a negative impact on insignificant part of the plants there. This part of the area is located within the snow avalanche risk zone, where the vegetation is poor. Due to the steep slopes and narrow valley, coastal forests in Tergi River Gorge occupies a narrow strip of land. Therefore, the forests in this area is sparse. Our goal is to determine whether there are endemic and endangered plant species in the study area.

The following shrubwoods and other types of coniferous or deciduous plants are represented in pipeline right-of-way and its surrounding area: Caucasian pine (*Pinus sosnowskyi*) and Silver Birch (*Betula pendula*), Two species of juniper - Savin Juniper (*Juniperus sabina*) and common Juniper (*Juniperus depressa*), Sea-buckthorn (*Hippophae rhamnoides*), European barberry (*Berberis vulgaris*), Goat willow (*Salix caprea*), Caucasian rowan tree (*Sorbus caucasigena*), Dog rose (*Rosa canina.),* Caucasian honeysuckle (*Lonicera caucasica*), Raspberry (*Rubus idaeus).*

As for the other vulnerable types of birch (Litvinov and black) of the Red List of Georgia, they are not recorded on the area of study. Two species of Juniper are widly spread on the Greater Caucasus, Adjara - Imereti and Trialeti ridges. They are not vulnerable species included in the Red List.

It should be noted that bushwoods are widely spread here, where sea-buckthorn is dominating. The area is under a high anthropogenic influence. Therefore, the vegetation here is of secondary origin.

Table 5.3.5.1.1. Trees and shrubs spread over the project area

English name	Latin name	Status
Caucasian pine	*Pinus sosnowskyi*	endemic species of Georgia. A small, fragmented areas
Slver Birch	*Betula pendula*	Spread species
Goat Willow	*Salix caprea*	Widespread species
Caucasian rowan tree	*Sorbus caucasigena*	Caucasus endemic species. Categories for Rare Plants; Ketskhoveli 1977.
Sea-buckthorn	*Hippophae rhamnoides*	Red List of Georgia,1982. Medicinal plant
Savin Juniper	*Juniperus sabina*	Widespread species
common Juniper	*Juniperus depressa*	Widespread species
European barberry	*Berberis vulgaris*	Widespread species
Caucasian honeysuckle	*Lonicera caucasica*	Spread species

Dog rose	*Rosa canina*	Widespread species
Raspberry	*Rubus idaeus*	Widespread species

5.3.5.2 Fauna

Quite valuable species of fauna are represented in the municipality area. East Caucasian tur is found in the eastern half of the Greater Caucasus mountains. Chamois is also widespread there. Wild goats are met in Khevsureti border line. There is also a brown bear, fox, wolves, weasels, marten, squirrel, rabbit, wild cat, turkish hamster *(Mesocricetus brandti)* (golden hamster) and others.

Ornithic fauna is rich here. Birds, included in the Red List of Georgia, are present as well. for example: Eagles breeding on rocks, Caucasian black grouse, Caucasian snowcock, which flies up to 4000 m high and others. There are also vulture, mountain eagle, griffon, jay and others.

5.3.5.2.1 Animals, typical for the upstream parts of Tergi River basin

The study area is characterized by a number of animals: birds - Bearded Vulture *(Gypaetus barbatus),* Griffon Vulture *(Gyps fulvus),* Egyptian Vulture *(Neophron percnopterus),* Golden Eagle *(Aquila chrysaetus),* Booted Eagle *(Aquila pennatus),* Common Buzzard *(Buteo buteo),* Eurasian Sparrowhawk *(Accipiter nisus*), Northern Goshawk *(Accipiter gemtilis),* Common Kestrel (*Falco tinnunculus),* Eurasian Hobby *(Falco subbuteo)*, Common Wood Pigeon *(Columba palumbus),* Common Cuckoo *(Cuculus canorus),* Tawny Owl *(Strix aluco),* Eurasian Hoopoe *(Upupa epops),* European Green Woodpecker *(Picus viridis),* Great Spotted Woodpecker *(Dendrocopos major),* Eurasian Wryneck *(Jynx torquilla),* Wood Lark *(Lullula arborea),* Tree Pipit *(Anthus trivialis),* Dunnock *(Prunella modularis),* European Robin *(Erithacus rubecula),* Common Redstart *(Phoenicurus phoenicurus)*, Song Thrush *(Turdus philomelos)*, Common Blackbird *(Turdus merula),* Ring Ouzel *(Turdus torquatus),* Mistle Thrush *(Turdus viscivorus),* Barred Warbler *(Sylvia nisoria),* Garden Warbler *(Sylvia borin)*, Eurasian Blackcap *(Silvia atricapilla),* Common Whitethroat *(Sylvia communis),* Lesser Whitethroat *(Sylvia curruca),* Orphean Warbler *(Sylvia hortensis),* Common Chiffchaff *(Phylloscopus collybita),* Green Leaf Warbler *(Phylloscopus nitidus),* Eurasian Wren *(Troglodytes troglodytes),* Spotted Flycatcher *(Muscicapa striata)*, Great Tit *(Parus maior),* Coal Tit *(Parus ater),* Blue Tit *(Parus caeruleus),* Long-tailed Tit *(Aegithalos caudatus),* Goldcrest *(Regulus regulus),* Eurasian Nuthatch *(Sitta europaea),* Common Treecreeper *(Certhia familiaris),* Red-backed Shrike *(Lanius collurio),* Eurasian Jay *(Garrulus glandarius),* Golden Oriole *(Oriolus oriolus),* Common Chaffinch *(Fringilla coelebs),* Common Linnet *(Carduelis cannabina)*, Eurasian Siskin *(Carduelis spinus),* Twite *(Carduelis flavirostris),* Greenfinch *(Carduelis chloris),* Red-fronted Serin *(Serinus pusillus),* Eurasian Bullfinch *(Pyrrhula pyrrhula),* Common Rosefinch *(Carpodacus erythrinus),* Black Redstart *(Phoenicurus ochruros),* Common Redstart (*Phoenicurus phoenicurus),* Caucasian Great Rosefinch *(Carpodacus rubicilla)* and White-winged Redstart *(*Phoenicurus erythrogastrus*)*;

Among the mammals the following species should be noted: Caucasian shrew *(Sorex satunini),* Gueldenstaedt's shrew *(Crocidura gueldenstaedti),* whiskered bats *(Myotis mystacinus),* Natterer's bat *(Myotis nattereri)*, lesser noctule *(Nyctalus leisleri),* common pipistrelle *(Pipistrellus pipistellus),* soprano pipistrelle *(Pipistrellus pygmaeus),* brown long-eared bat *(Plecotus auritus),* yellow-bellied wood mice *(Sylvaemus fulvipectus),* pygmy wood mice *(Sylvaemus uralensis),* Caucasian Snow Vole *(Chionimys gud),* Caucasian moles *(Terricola daghestanicus),* common vole *(Microtus arvalis),* house mouse *(Mus musculus)* is met neer the populated areas.

Most frequently met reptiles are: Caucasian lizard *(Darevskia caucasica)* and Georgian Lizard *(Darevskia rudis)*, grass snake *(Natrix natrix)* and Dinnik's viper *(Vipera dinniki).* Frequently met amphibians are: green toads *(Bufo viridis)* and marsh frog *(Rana ridibunda)* and long-legged wood frog *(Rana macrocnemis).*

According to the information obtained from the local residents, as well as based on researches carried out by us and our colleagues, the following species are also rarely met in the study area: European otter *(Lutra lutra),* gray wolf *(Canis lupus),* brawn bear *(Ursus arctos).* The mostly frequent species are red foxes *(Vulpes vulpes)* and beech martens *(Martes foina).* Least weasel *(Mustela nivalis)* and stoat *(Mustela erminae)* are also met there.

Table 5.3.5.2.1.1. shows the the list of terrestrial vertebrate species, included in the Red List of Georgia, which have been observed in the upstream part of the Tergi River, the influence zone of the proposed HPP construction.

Table 5.3.5.2.1.1. Species protected by Georgian legislation and inhabiting the plant construction impact corridor

№	Latin name	Georgian name	English name	Status
		ძუძუმწოვრები		
1	Lutra lutra	წავი	Common Otter	VU
2	Ursus arctos	მურა დათვი	Braun Bear	VU
		ფრინველები		
2	Aquila chrysaetus	მთის არწივი	Imperial Eagle	VU
3	Aquila heliacal	ბეგობის არწივი	Golden Eagle	VU
4	Aquila clanga	მყივანი არწივი	Spotted Eagle	VU
5	Accipiter brevipes	ქორცქვიტა	Levant Sparrowhawk	VU
6	Falco biarmicus	წითურთავა ბარი	Lanner Falcon	VU
7	Falco cherrug	გავაზი	Saker Falcon	CR
8	Falco vespertinus	თვალშავი	Red-footed Falcon	EN
9	Gyps fulvus	ოები	Griffon Vulture	VU
10	Gypaetus barbatus	კრავიჭამია	Bearded Vulture	VU
11	Neophron percnopterus	ფასკუნჯი	Egyptian Vulture	VU
12	Buteo rufinus	ველის კაკაჩა	Long-legged Buzzard	VU
13	Buteo lagopus	ფეხებანჯგვლიანი კაკაჩა	Rough-legged Buzzard	VU
14	Tadorna ferruginea	წითელი იხვი	Ruddy Shelduck	EN
15	Carpodacus rubicilla	დიდი კოჭობა	Great Rosefinch	VU
16	***Phoenicurus erythrogastrus***	წითელმუცელა ბოლოცეცხლა	Güldenstädt's Redstart	VU
17	Tetrao mlokosiewiczi	კავკასიური როჭო	Caucasian Black Grouse	VU

Georgia has joined the Bonn Convention on Protection of Migratory Species and the Agreement on Protection of European Bats (EUROBATS). According to this agreement Georgia is obliged to protect 6 chiropteran species, detected in this area and its vicinity. The list of chiropterans, found within the study area and protected by the Bonn Convention is given in Table 5.3.5.2.1.2.

Table 5.3.5.2.1.2. Chiropteran species inhabiting in the upstream part of the Tergi River - protected by the Bonn Convention

№	Latin name	Georgian name	English name
1	Myotis mystacinus	ულვაშა მღამიობი	Whiskered Bat
2	Myotis nattereri	ტყის მღამიობი	Natterer's Bat
3	Nyctalus leisleri	მცირე მეღამურა	Lesser Noctule Bat

4	Pipistrellus pipistrellus	ჯუჯა ღამორი	Common Pipistrelle
5	Pipistrellus pygmaeus	პაწია ღამორი	Soprano Pipistrelle
6	Plecotus auritus	რუხი ყურა	Brown Big-eared Bat

5.3.5.2.2 Ichthyofauna of the upstream part of the Tergi River

Ichthyofauna of the Tergi River is not sufficiently studied (especially those species that are inhabiting in its small tributaries). Ichthyofauna of the Tergi River basin belongs to different ecological groups and its composition varies by zones, according to the water flow elevation and its hydrology- hydraulic regime. In addition, fish migrate during the period of high waters.

Generally, rheophilic fish species are presented in the upsteam part of the Tergi River. The following six fish species are observed here: River trout, Barbell, Gudgeon, Eastern ray-finned fish, Caucasian Chub, Nemacheilus (see Figures 5.3.5.2.2.1. - 5.3.5.2.2.6.).

Fig. 5.3.5.2.2.1. River trout

Fig. 5.3.5.2.2.2. Barbell of Tergi River

Fig. 5.3.5.2.2.3. Gudgeon

Fig. 5.3.5.2.2.4. Eastern ray-finned fish

Fig. 5.3.5.2.2.5. Caucasian Chub

Fig. 5.3.5.2.2.6. Nemacheilus

Diversity of ichthyofauna in different sections of Tergi River is conditioned by historical, ecological, landscape-natural and other causes. Ichthyofauna of Tergi River near its source and of those tributaries that enter the Tergi River at this section belongs to the arctic fauna and is adapted to quick, canyon type, cold river waters with stony-gravelly bottoms.

As we have already mentioned, rheophilic fish species are inhabiting upstream of the river. They are spawning or hiding their roes under the stones at the bottom of the reservoir. As for the trout, they build nests and hide spawned roes there. All of these fish species are characterized by portioned spawning, which is related to the lack of food resources and is a kind of adaptation to severe highland conditions, in order to save their breed.

Ichthyofauna of Tergi River highland zone is not characterised by a long distance migrations, though short distance spawning migrations have been observed. River trout normally inhabits permanent places, such as river and spring sources.

Only a river (spring) trout (included in the Red List of Georgia, Status - VU) is met within the area selected for the construction. It is known that barbells and other Cyprinidae are not met over 1000 m a.s.l.

Zonal distribution of fish is also notable. River trout is the only fish inhabiting in vertical zonality conditions. They occupy the highest areas, so called "trout sections", where they spawn and spend winter.

Two types of river trout inhabit Tergi River and its tributaries: "mountain" – inhabiting the sources of small inflowing rivers; and "foothills trout" – inhabiting the lower part of the "trout sections". "Mountain" trout permanently inhabits the sources of Tergi river tributaries, i. e. spawning zones, where the stream flows constantly. It undertakes only short feeding migrations. Climatic conditions for the river trout are especially severe in this zone; feed base is poor. These factors leads to a reduction in the growth rates and reflects on sexual maturation periods.

Due to severe climatic conditions, Qualitative indicators of plankton and benthos within the given zone of Tergi River and its tributaries are relatively low, though, specific groups are quite common in terms of quantity. This provides feed base development for fish, inhabiting this area. Therefore, the fish productivity of Tergi River and its tributaries has a high index - 30 kg/ha - relative to river trout. Gammaridae, insect larva, including chyronomidae serve as a food resource for fish.

Zooplankton of the reservoir is represented by: *Rotatoria, Ostracoda, Copepoda, Chironomidae*, floating in the river water layers.

Rotatoria class is represented by the following series: *Lacinularia, Asplanchna* და *Conochilus, Philodinidae* and *Colurellidae.* As for the Copepods *(Copepoda)*, they are represented by *Cyclops. Oligochaeta, Insecta, Chironomidae* larves*, Nirudinea, Gaminaridae* (namely one species - freshwater shrimp *(Rivulogammarus pulex*)) have been observed from Zoobenthos point of view.

Biomass of Zooplankton ranges from 100 to 130 mg/m; as for the benthic indicators, it ranges from 300 to 370 mg/m. Trout is mainly fed by *Chironomidae larva,* gammaridaea, insects and their larva (32,3 – 60,1%).

5.3.5.3 Protected Areas

The territory of Kazbegi Protected Areas is fragmented, with a total area of 8707 hectares. All of the Kazbegi National Park is mountainous. Its lowest part is located at 1400 m above sea level.

Kazbegi National Park is located on the northern slopes of Main Caucasus range, in the basin of the Tergi River in the Municipality of Stepantsminda; lower marker of its territory is at a height of 1400 m above sea level, and the upper one is within 300 - 4100 m. Establishing of Kazbegi National Park serves the purpose of protection of the high mountain ecosystems.

Its relief is complex, mountainous and very rugged. In Dariali gorge, and even to the south, everywhere, where the Tergi River has cut its way through the canyons, the slopes of the gorge are the perfect examples of the local geology. It is easy to see the basalt sec-tions and lava layers in the cliffs.

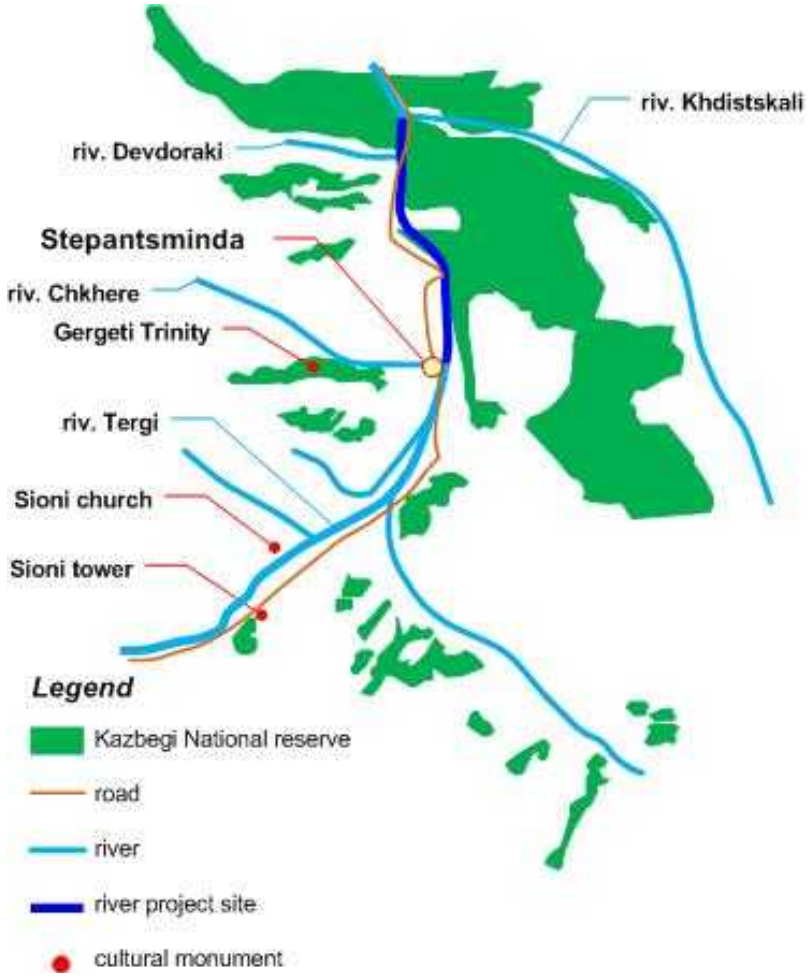
Vegetation cover of Kazbegi National Park is quite diverse. It is enclosed in the very part of the Kazbegi florist zone of the Greater Caucasus, which is distinguished by richness of endemic species. 1347 species of plants can be found in this florist zone, 26% out of them are endemic. The alpine, sub alpine, xerophyte and plants of other ecological communities can be found here.

The forests of Kazbegi National Park are located on the steep slopes. 105 species of wood plants can be found in the Strict Nature Reserve, though mainly there are Litvinov's birch (Betula litwinovi), Sosnovski's pine (Pinus sosnowskyi), junipers (Juniperus), Sea-buckthorn (Hippophae rhamnoides). It is remarkable that in Georgia there is a very rare large grove of Sea-buckthorn nearby the settlement of Stepantsminda, and the Caucasian rhododendron (Rhododendron caucasicum), Oriental beech and high-mountain oak are widespread in the vast areas.

Existence of diverse vegetation indicates to richness in fauna. And exactly in the Kazbegi Strict Nature Reserve can be found the Georgia's Red List species, such as East Caucasian tur (Carpa cylinricornis), chamois (Rupicarpa rupicarpa), wolf (Canis lupus), Pine Marten (Martes martes), and others. The Strict Nature Reserve is the best environment for birds of prey. Namely, here can be found the Golden eagle, griffon vulture, Bearded vulture, and others.

The issue regarding the distance between the area selected for the construction of HPP and Kazbegi National Park should also be noted. Namely: North-Eastern part of the National Park is directly bounded by Dariali Gorge, while the end part of the gorge (past Devdoraki River) is within the protected area (see Figure 5.3.5.3.1.). According to requirements of the law of Georgia on Protected Territories, any economic activity is prohibited within the protected area. Therefore, in the designing phase of HPP it will be necessary to set the boundaries between the communications of Kazbegi National Park and the HPP and to implement relevant organizational measures.

Figure 5.3.5.3.1. The general scheme of Kazbegi Nature Reserve



6 Environmental and Social Impact Assessment

This paragraph assesses potential impact on social and natural environment for phases of construction works, operation, technical maintenance and HPP liquidation/decommissioning.

Receptor \ Phase of planned activity	Construction	Operation	Maintenance	Suspension / Decommissioning
Air				
Soil				
Water				
Flora				
Fauna				
Protected Areas				
Landscape and Visual Impact				
Land Ownership				
Infrastructure				
Traffic Flow				
Cultural Heritage				
Socio-Economic Environment				

Negative

Positive

Table 6.1 gives information about sources, receptors and magnitude of environmental impact for construction and operation phases of the HPP.

Table 6.1. Potential Environmental and Social Impact of Project by Phases

Activity	Receptor	Impact Source	Description of Impact
Preparatory works • Arrangement of construction camps including water supply, sanitation and power supply • Parking of machinery and special equipment • Material delivery and stocking.	• Atmospheric air • Soil • Water • Flora • Fauna • Infrastructure • Cultural heritage • Population and personnel	• Traffic and building machinery • Diesel-generators • Personnel • Produced waste	• Emission of dust and exhaust due to transportation • Emissions of diesel-generators • Dust produced by ground works • Noise and vibration (machinery) • Noise (personnel) • Soil pollution (spilt fuel/oils, waste) • Soil tramping due to traffic • Damage of topsoil • Temporary change of land ownership type • Water pollution by split fuel/oils, sediments and waste (whenever construction operations occur next to surface waters) • Damage, clearance and tramping of vegetation (direct impact) • Damage of vegetation due to emissions, fuel/oil spills (indirect impact) • Fauna disturbance by personnel and machinery • Impact of electric transmission line /electromagnetic field on fauna and other receptors (personnel, population) • Impact on downstream ichtyofauna due to surface water pollution throughout construction operations • Impact of electric transmission line /electromagnetic field on fauna and other receptors (personnel, population) • Wastes – solid, liquid • Impact on traffic flow • Possible traumatism of personnel during works • Impact on infrastructure (e.g. road cover) • Visual-landscape changes
Road arrangement-rehabilitation	• Atmospheric air • Soil • Water • Flora • Fauna • Infrastructure • Cultural heritage • Population and personnel	• Vehicle and building machinery • Personnel • Produced waste • Vehicle and building machinery • Personnel • Produced waste	• Emission of dust and exhaust due to transportation • Emissions of diesel-generators • Dust produced by ground works • Noise and vibration (machinery) • Noise (personnel) • Soil pollution (spilt fuel/oils, waste) • Soil tramping due to traffic • Damage of topsoil • Soil (slope) stability risk • Change of land ownership type during construction of new roads

			• Water pollution by split fuel/oils, sediments and waste (whenever construction operations occur next to surface waters) • Damage, clearance and tramping of vegetation (direct impact) during construction of road segments • Damage, clearance and tramping of vegetation (direct impact) during construction of road segments • Damage of vegetation due to emissions, fuel/oil spills (indirect impact) • Fauna disturbance by personnel and machinery • Impact on traffic flow • Temporary restriction of traffic due to road rehabilitation activities • Possible traumatism of personnel during works • Disturbance due to landscape alteration • Impact on downstream ichtyofauna due to surface water pollution throughout construction operations • Opportunity to employ local population for construction operations or associated service (positive effect)
Construction phase	Atmospheric air	• Vehicle • Building machinery • Diesel-generators	• Dust and exhaust • Welding aerosols
	Soil	• Vehicle / building machinery • Diesel-generators • Ground works • Waste	• Soil tramping by traffic and building machinery • Soil pollution (split fuel/oils, wastes - including liquid ones) • Impact on soil stability • Topsoil damage • Temporary and permanent change of landownership type
	Water	• Vehicle / building machinery • Ground works • Waste	• Water pollution (split fuel/oils, wastes - including liquid ones) • Stream flow obstruction- alteration of hydrological regime
	Flora and Fauna	• Vehicle / building machinery • Personnel	• Direct impact (collision, disturbance) • Temporary and permanent fragmentation of habitats • Noise and vibration
	Population and personnel	Vehicle / building machinery	• Dust and exhaust • Noise • Disturbance due to landscape alternation • Possible traumatism of personnel during works • Opportunity to employ local population for construction operations or associated service (positive effect)

Operation	Soil	• Waste	• Soil pollution in case of improper waste management
	Water	• Waste	• Water pollution in case of improper waste management
	Flora	• Dam / water intake • Substation	• Impact on floodplain vegetation/fauna during floods or water shallowness • Cleaning of HPP area from vegetation cover during maintenance works
	Fauna	• Dam / water intake • HPP hydraulic units • Substation	• Possible impact on fish migration • Noise • Electromagnetic field
	Population and personnel	• HPP hydraulic units • Substation	• Noise • Electromagnetic field • Possible traumatism of personnel during works
Maintenance service / repairs	Impact of maintenance services /repairs will depend on specifics and volume of work and operation area. Possible impact of maintenance service will be similar to those of similar activities done during construction		
Decommissioning	There are two possible options: 1. Conservation – in this case all the existing structures are to be preserved. Territory should be enclosed and protected. 2. Decommissioning – in this case all the infrastructure and equipment should be dismantled, wastes removed/land filled, tunnel closed and territory recultivated. Though after lifespan period usually instead of liquidation the system is thoroughly rehabilitated and the object continues operation. In case of decommissioning proper acting plan should be worked out. Anticipated impact will be similar to the potential impact of construction. Special attention should be paid to waste management including hazardous wastes. Recultivation plan for the area should be designed.		

7 Environmental and Social Impact Assessment

7.1 General Principals of ESIA Methodology

This chapter includes expected environmental and social impact assessment during construction and operation process of HPP cascade. Methods used for impact assessment, as well as quantitative and qualitative criteria were developed to unify and standardize the assessment system, which ensures the objectivity of the assessment. Impact assessment methodology preparation was based on the recommendations of the World Bank and other International Financial Institutions (EBRD, IFC, ADB).

In the quantitative criteria are used environmental quality indicators introduced by Georgia, EU and IFC/WB for various environmental bodies (air, water, soil, etc). Wherever qualitative indicators are not preset for environmental factors (e.g. impact to ecosystems or population), the quantitative criteria are introduced analyzing the background data and considering value and sensitivity of impact recipients. If an impact cannot be estimated in quantitative terms, the qualitative criteria are developed envisaging international practices.

Impact on natural and social environment has been assessed in accordance with the determined criteria. During the assessment, special attention was paid to the impact which has been considered as significant in the given conditions.

EU directive 97/11: "during environmental impact assessment receptors which will be affected with the project should be considered".

In order to assess expected changes in natural and social environment, it is necessary to collect and analyze the information about the current situation in the project impact area. The volume of the expected changes is determined on the basis of obtained information, impact recipient objects – receptors would be identified and their sensitivity will be assessed, which is necessary for determining the importance of the impact. After determining the significance of the impact its acceptability is determined, alternative options with less negative impact, necessity of mitigation measures and mitigation measures themselves.

The following scheme will be used for environmental and social impact assessment of the planned activities:

Step I: Determination of basic impact types and research format

Determination of the impact based on general analysis of activities, which may be important for these types of projects.

Step II: Study of the environmental baseline – search and analysis of the existing information

Identification of the receptors, which are expected to be affected by the planned activities, determination of sensitivity of the receptors.

Step III: Characterization and assessment of the impact

Impact character, probability, significance other characteristic determination by considering the sensitive receptors, description of the expected changes in the environment and assessment of their significance.

Step IV: Determination of the mitigation measures

Significant impact mitigation, prevention or compensating measure determination.

Step V: Residual impact assessment
Determination of the expected value of change in the environment after implementation of the mitigation measures.

Step VI: Monitoring and management strategy development
Monitoring the effectiveness of the mitigation measures is needed to ensure, that the impact must not exceed the predetermined values, effectiveness of the mitigation measures must be confirmed, or the necessity of the corrective measures must be identified.

7.1.1 Impact Receptors and their Sensitivity

Implementation of the works may cause such qualitative and quantitative characteristic changes of physical and biological resources in the impact area, such as:

- Air quality and acoustic background of the environment;
- Soil stability and quality;
- Capacity and quality of surface and groundwater;
- Visual changes of the landscapes;
- Amount of habitats, flora and fauna;
- Historical-archaeological values of the study area;
- etc.

The population, which may be impacted by the planned activity, includes people living, working or involved in other activities (eg. vocation, travel) nearby the designed facility. Facility staff is considered as a potential sensitive receptor.

Receptor sensitivity is related to the impact volume and ability of the receptor to counteract the change or restore after the change, as well as with its relative ecological, social or economical value.

7.1.2 Impact Characterization

To estimate environmental impact major impact factors are identified for construction and operation Phases. Anticipated impact is assessed according to the following classification:

- Character – positive or negative, direct or indirect;
- Magnitude - insignificant, low, medium, high or very high;
- Likelihood – low, medium or high risk;
- Impact area – working site, project area or region;
- Duration – short-, mid- or long-term;
- Reversibility–reversible or irreversible.

That is, for the both project phases and for each potential impact has been determined anticipated alteration of environment and its character, area and duration of impact, reversibility and likelihood of occurrence; based on these information has been defined significance.

Some impact types were estimated quantitatively. Assessment of impact on environmental elements is based on relevant environmental quality standards, whenever appropriate. If qualitative assessment was impossible impact was estimated based on its characteristics and elaborated criteria

The criteria applied for environmental and social impact assessment is given below. They are developed only for those receptors which may experience significant changes.

7.2 Impact on Atmospheric Air Quality

7.2.1 Impact Assessment Methodology

This Section considers the potential air quality impacts associated with the construction and operation of the Dariali HPP Project (the 'Project'). Key potential emission sources of air pollutants which could affect the health of local receptors and amenity have been considered.

7.2.2 Impact Description

7.2.2.1 Construction Phase

Air quality impacts which may arise during the construction of the Project include:

- Emissions associated with stationary sources and vehicles – typically dust, sulphur dioxide (SO_2) and oxides of nitrogen (NO_x)
- Dust arising from construction works of weir, sediment trap, diversion channel, access roads, also transportation and disposal of wasterock and traffic;
- Emissions associated with the operation of construction equipment and vehicles

Combustion related emissions (such as NO_x, SO_2, CO, SO_2 and dust) will occur from stationary sources (concrete plant, inert material sorting workshop and etc) and vehicles; this can affect ambient air quality. But considering that works are temporary and the infrastructure facilities will be supplied with energy via existing networks, which will reduce the necessity of diesel-generators use to minimum, impact should not be significant.

Dust distribution will be related to construction activity and vehicles movement. Mechanical dust removal may take place by wind, or by temporary suspension of the vehicles. It may also arise from windy erosion of construction material piles, as well as during the waste rock removal-disposal.

7.2.2.2 Operation Phase

According to preliminary assessment the project will not cause significant long term impacts, since vehicular operations will be minimal.

Additionally, back-up power for the Project will be a diesel-generators. As these will only be in use under emergency conditions and for limited periods of time, no further consideration within this assessment is required. There are no potentially significant emission sources associated with other operational elements of the Project.

7.2.2.3 Decommission Phase

It is anticipated that the Project will have an operational life of 50 years. In the event of decommissioning of the Project, it is likely that any potential air quality impacts would be similar to those in the construction phase, as broadly similar activities would be required and therefore impacts on air quality associated with this phase are considered to be of a similar nature.

7.2.3 Impact Assessment

7.2.3.1 Sensitive Receptors

Impact is expected during arrangement of headworks and diversion channel and operation of construction camp. Emissions related to construction phase may affect population of Stepantsminda, while the sensitive receptors of construction camp operation are customs checkpoint and monastery complex.

Dust distribution:

Information regarding construction activities related to dust distribution is given in the Table 7.2.3.1.1.

Table 7.2.3.1.1. Dust emission-related activities

№	Stage Description	Generic Activity Description	Potential Dust Raising Activities	Dust Raising Potential
1	Site Preparation	Vegetation Clearance for Access Road construction Arrangement of construction site and construction camp	Earthmoving; Excavation works; Transport of materials; Re-suspension of dust on unpaved roads.	Medium
2	Arrangement of access roads and tunnel portals	Construction of access roads and tunnel portals	Excavation works; Transport and handling of soil/materials; Storage of soil /materials; Preparation of materials (cutting, etc.); Movement on unpaved roads; Concrete batching.	High
3	Weir construction	Weir construction Headwork construction	Excavation works; Transport and handling of soil/materials; Concrete batching.	Medium
4	Construction of an underground HPP	Arrangement of underground HPP communications	Excavation works; Preparation of materials (cutting, etc.); Transport and storing of soil/materials Concrete batching.	High

Magnitude of an expected impact, receptor sensitivity and overall value is provided in the table 7.2.3.1.2.

Table 7.2.3.1.2.

Site	Specific Activity Description	Impact Magnitude	Distance from Nearest Receptor to Activity	Receptor Sensitivity	Overall Significance
Construction camp	Concrete production; Procession of inert materials	Minor	Monastery complex 120 m	Average	Minor
Arrangement of headworks and diversion pipeline	Ground works for arrangement of headworks and diversion pipeline	Major	340-350 m	Medium	Moderate
Inlet portals of the tunnels	Wasterock removal and transportation to the disposal area	Moderate	1500 m	Low	Minor

The project will cause temporary 'moderate adverse' to 'minor adverse' impact without relevant mitigation measures in place. As a result of proposed mitigation measures it will be possible to avoid, or reduce dust impact.

7.2.3.2 Operation Phase

As discussed, vehicular access to these sites for maintenance and operational purposes will be minimal and hence emissions from such vehicles will be negligible and do not require assessment.

7.2.3.3 Decommission Phase

It is anticipated that the project will have an operational life of 50 years. In the event of decommissioning of the Schemes, it is likely that any potential air quality impacts would be similar to those in the construction phase, as broadly similar activities would be required. Similarly to the construction phase these are considered to be temporary 'moderate' to 'minor' adverse significance following implementation of appropriate mitigation measures.

There is some uncertainty in the potential presence of receptors, which depending on the time of any such decommissioning may have been introduced or removed from the site. Therefore the decommission plan should consider adequate minimisation of potential issues for receptors that could be affected.

7.2.4 Cumulative Impact

There are two Schemes under development which could cause a cumulative impact. These include:

- Larsi HPP;
- Kazbegi HPP;

It is expected that each of the projects will commence in 2012-2013 and construction is likely to continue for a further four years. Sharp increase of traffic flows is expected regarding the construction.

Due to location of the mentioned projects, cumulative impact associated with the construction dust distribution is not expected.

7.2.5 Mitigation Measures

The measures presented below are based on the potential impacts, the majority of which are temporary 'moderate adverse'. Relevant measures are as follows:

- Minimizing dust from material handling sources, such as conveyors and bins, by using covers and/or control equipment (eg. cyclone);
- Open sources, such as construction materials (sand, gravel and others) open storages must be fenced, preferable – covered (stall); periodically, especially during hot summer, raw material moistening with water is necessary, in order to minimize the dust formation and distribution risk;
- Reducing the dust formation associated with the construction equipment movement, by moistening the roads with water and vehicles speed reducing, especially within the populated territories;
- Combustion of solid waste on the territories of construction sites and camps is prohibited;

- Ground works, such as removal of topsoil and excess materials, location of haul roads, tips and stockpiles, and blasting shall be planned with due consideration to meteorological factors (e.g. precipitation, temperature, wind direction, and speed) and location of sensitive receptors;
- Raw material processing factories should be located in vicinity of their source, in order to reduce traffic and hence risk of dust emission;
- Dust emissions from drilling activities should be carried out by wet drilling, otherwise, an appropriate dust trap system should be arranged;
- Internal roads should be adequately compacted and periodically graded and maintained by the construction contractor;
- A speed limit for trucks should be determined;
- Water spraying and surface treatment (e.g. hygroscopic media, such as calcium chloride, and soil natural–chemical binding agents) of roadways and exposed stockpiles using a sprinkler system or a "water-mist cannon" should be implemented.

Measures to minimize dust distribution in the working area are given below:

- Applying water or non-toxic chemicals to minimise dust from vehicle movements (moisten of the road and construction sites surface);
- Prohibit of work without Personal Protective Equipment (masks, respirators) in the dusty work areas;
- Excavators, dumpers, dozers, wagon-drills, and other automated equipment should be equipped with air conditioned, dustproof, and soundproof cabs.

7.3 Noise Distribution

7.3.1 Impact Assessment Methodology

Georgia regulates noise levels with Sanitary Norm 2.2.4/2.1.8 003/004-01 "Noise at Work Places, Residential and Public Buildings and Residential Territories". Noise must not exceed standards set by the document.

Table 7.3.1.1. The noise related impact assessment criteria

Ranging	Category	Residential Area	For work, industrial or commercial zones
1	Very Low	Acoustic background increased by less than 3 dBA5, in residential zone <50 dBA in daytime and <45 dBA in nighttime	Acoustic background increased by less than 3 dBA and <70 dBA
2	Low	Acoustic background increased by 3–5dBA, in residential zone <55dBA in daytime and <45dBA in nighttime	Acoustic background increased by 3–5dBA and <70 dBA
3	Medium	Acoustic background increased by 6–10dBA at sensitive receptors, in residential zone >55dBA in daytime and >45dBA in nighttime	<70 dBA, acoustic background increased by 6–10dBA at sensitive receptors

4	**High**	Acoustic background increased more than 10dBA at sensitive receptors, in residential zone >70dBA in daytime and >45dBA in nighttime	>70 dBA, acoustic background increased more than 10dBA at sensitive receptors
5	**Very High**	Acoustic background increased more than 10dBA at sensitive receptors, in residential zone >70dBA in daytime and either impulsive or tonal noise present, >45dBA in nighttime	>70 dBA, either tonal or impulsive noise present

7.3.2 Impact Description

7.3.2.1 Construction Phase

Noise distribution assessment has been conducted for two sites:

- Construction camp territory - as residential areas are located quite far away noise distribution calculating point is considered personnel of Dariali border which is located to its close vicinity (distance to custom's offices – 140 m) and people living in monastery complex (distance 120 m).
- Construction site of headwork construction – calculating point of noise distribution is Stepantsminda settlement area, namely closest dwelling located to the south from construction area of headwork (distance equals to - 340 m).

As for noise distribution assessment on other construction areas (e.g noise at diversion pipelines, tunnel inlet portal and during construction works within power unit territory), in this case implementation of calculation may not be considered as a must, as distance between noise sources and closest receptors is quite big. Besides, local relief and high acoustic background considerably reduce possibility of noise reaching to dwellings which is mainly due to mountain river (river Tergi and its tributaries) flow in canyon gorge.

Octave level of the noise source is calculated according to the formula:

$$L = L_p - 15\lg r + 10\lg \Phi - \frac{_a r}{1000} - 10\lg \Omega,$$

where,

L_p – octave level of the noise source capacity;

Φ – noise source direction factor, non-dimensional, is determined through trial and changes from 1 to 8 (depends on spatial angle of sound radiation)

r – the distance from the source of the noise to the reference point;

Ω – spatial angle of sound radiation, which will be: $\Omega = 4\pi$-when located in the space; $\Omega = 2\pi$-when located on the surface of the territory; $\Omega = \pi$ - double ribbed angle; $\Omega = \pi/2$ – triple ribbed angle;

$_a$ – sound damping in the air (dBA/km) tabular description.

Average geometric frequencies of the octave lines, H Hz	63	125	250	500	1000	2000	4000	8000
$_a$dBA/km	0	0.3	1.1	2.8	5.2	9.6	25	83

Noise source levels on the noise-generating section are summarized in the formula:

$$10\lg\sum_{i=1}^{n}10^{0,1Lpi}$$

Where: L_{pi} – i-type noise source capacity.

Following assumptions are made to perform the calculation:

1) If distance between some noise sources, located on the same site, is less than distance until the reference point, sources are combined into one group. The total noise level is calculated with the following formula: ; $\sum_{=niLpi110}1010.\mathbf{lg}$

2) To assess total level of noise source distribution, their distance from geometric center is used as a distance to accounting point;

3) For simplicity, the calculations are performed for the sound equivalent levels (dBA) and average value of its octave indicator is taken as sound damping coefficient in the air β_{ave}=10.5 dBA/km;

The calculation was conducted in two conventional points, during the simultaneous operation of all the machinery-equipment on the selected site, considering the minimum screening of the noise (worst case scenario) (see Table 7.3.2.1.1.).

Table 7.3.2.1.1. Noise distribution calculation results

Area	Main Machinery	Equivalent Noise Level at Generation Point [dBA]	Distance to Nearest Receptor [m]	Equivalent Noise Level at Nearest Receptors [dBA]	Norm[3]
Construction camp territory	o Truck - 3, o Excavator o Crusher-sorting plant; o Concrete unit	98,8	120	49,4	Day time – 55 DBA, Night time – 45 DBA
Dam construct ion site	o Truck - 2, o Excavator o Bulldozer o Concrete mixer o Water pump	93,6	340	47	During day hours– 55 dBA, At night- 45 dBA

Calculations showed, that noise level at monastery complex may go up to 49,4 DBA. Considering that work will only be conducted during the day time, significant impact due to noise level will not occur. According to the results of calculation, noise level at customs communication may reach 69,4 dBA. Noise distribution levels may exceed at populated area at night hours (as per calculations it exceeds permissible norms at night hours by 2 dBA). Construction works will occur only at daytime which excludes simultaneous work of all machineries listed in the table above. Correspondingly possibility of negative impact of noise distribution on population is minimal.

Personnel employed on the construction (especially when working near the equipment causing significant noise), will be equipped with safety equipment (earmuffs).

[3]Sanitary Norms on Noise at Work Places, Public Premises, Residential Houses and Populated Areas

Impact caused by noise distribution will be significant for the local wildlife, which will be related to the migration of animal species to the other areas. But the impact is temporary and after completion of the construction works the majority of species will return to their old habitats.

7.3.2.2 Operation Phase

During the HPP operation main noise sources will be three hydro-turbines. According to passport data typical hydro-turbine produces 96 dBA noise. Total noise level for simultaneous operation of turbines will reach 101 dBA.

On the operation phase noise may be induced when routine or emergency incidents will require repair works and/or transportation operations. This "extra" impact will be short-term and will depend on volume and duration of works.

Noise impact on population will not take place during operation process of hydro-turbines, because of the following factors:

- Turbine house shall be located underground;
- Hydro-turbines shall be placed in a special case, which has a high rate of absorption;
- Distance from the turbine house till the nearest populated area is more than 10km.

Considering all of the above mentioned, it is possible to ignore the impact of noise on the population during the HPP operation and no mitigation measure is required.

As for the expected impact on the staff working in the HPP facility, some mitigation measures will be required, namely: personnel must be equipped with special ear protectors; in turbine house, operational office must be arranged with the special noise-insulation material.

7.3.3 Mitigation Measures

Implementation of the following mitigation measures are expedient, in order to minimize the noise and vibration distribution levels during the construction phase of the HPP:

- Technical functionality of the machinery-equipment;
- "Noisy" works only in daytime;
- Ensuring personnel with protection means (earmuffs);
- Staff instruction before starting the works and once every 6 months;
- In case of grievance entry, their recording/registration and appropriate action;
- Providing the special earmuffs for the personnel during the operation phase; In the turbine house, operational office must be arranged with the special noise non-conducting material.

7.3.4 Impact Assessment

Table 7.3.4.1. Noise impact summary

Description of Impact and Impact Sources	Impact Receptors	Impact Description and Assessment
Construction phase		
Noise distributionin the Air Sources – machinery and special equipment used during various construction works, as well as material and labor transportation	Residents of nearby settlements, the project workers, nearby inhabiting animals	õ=**General:** = Direct negative, temporary impact, the maximum distribution area – 1 km from the work z ne • **Impact on the nearby residents** The noise level caused by the HPP construction, will not 47 dBA exceed the determined values in the nearest populated area Significance: Medium **Significance:** medium, Considering mitigation measures impact will be very low • **Impact on customs' personnel** Noise level – up tp 69,4 dBA **Significance:** medium Considering mitigation measures residual impact will be low **Impact on Laborers** • **Impact on Laborers** Anticipated acoustic background for work sites comprises up to 98,8 dBA; on construction sites – up to 93,6 dBA **Significance:** high, Considering mitigation measures impact will be low or medium • **Impact on the Animals** Temporary disturbance of the animals is expected **Significance:** medium - Considering mitigation measures impact will be low or medium

Operation Phase		
Distribution of Noise in Ambient Air – Throughout exploitation of HPPs operation of hydraulic turbines – Throughout maintenance/ repairs used machinery and vehicle	Population in neighboring settlements, project labor, animals inhabiting in the area	**Impact on neighboring population throughout HPPs operations** In the nearest residential zone (450 m afar) acoustic background associated with the HPPs operations should comprise some 36 dBA • **Overall:** Direct negative long-term impact, maximum distribution area – 0,5 km km from operation zone **Impact on neighboring population throughout HPPs operations** • **Impact on neighboring population** Impact is less expected **Significance:** Very Low • **Impact on Laborers** Anticipated acoustic background for work sites comprises up to 101 dBA **Significance:** High - Considering mitigation measures impact will be low or medium • **Impact on the Animals** Temporary disturbance of the animals is expected during technical maintenance and repair works **Significance:** Low

7.4 Impact on Soil

7.4.1 Impact Assessment Methodology

Impact value on the soil, ground and bottom sediments quality is assessed by the following parameters:

- Impact intensity, area and duration;
- Towards changes of their sensitivity;
- Their ability to restore.

Table 7.4.1.1. Impact assessment criteria on soil, ground and bottom sediments

Ranging	Category	Destruction of the fertile soil layer	Soil/Ground Pollution	Bottom sediments Pollution
1	Very low	Less than 3% of the project area has been destroyed for ever	Soil/ground background conditions have changed unnoticeably	Bottom sediments background conditions have changed unnoticeably
2	Low	3%-10% of the project area has been destroyed for ever	The concentration of pollutants have increased by less than 25%, but less than the permitted value, 6 months will be needed for the soil/ground quality restoration	The concentration of pollutants have increased by less than 25%, 6 months will be needed for the quality restoration

3	**Medium**	10%-30% of the project area has been destroyed for ever	The concentration of pollutants have increased by 25-100%, but less than the permitted value, 6-12 months will be needed for the soil/ground quality restoration	The concentration of pollutants have increased by 25-100%, 6-12 months will be needed for the quality restoration
4	**High**	30-50% of the project area has been destroyed forever; small areas are damaged outside of the project area, recultivation of which is possible after completion of the construction works	The concentration of pollutants have increased by more than 100%, or exceeds the permitted value, 1-2 years will be needed for the soil/ground quality restoration	The concentration of pollutants have increased by more than 100%, 1-2 years will be needed for quality restoration
5	**Very High**	More that 50% of the project area has been damaged or destroyed; small areas are damaged outside of the project area, recultivation of which is possible after completion of the construction works	The concentration of pollutants have increased by more than 100%, or exceeds the permitted value, more than 2 years will be needed for the soil/ground quality restoration	The concentration of pollutants have increased by more than 100%, more than 2 years will be needed for the quality restoration

7.4.2 Impact Description

7.4.2.1 Construction Phase

During the HPPs cascade construction phase, in the project influence zone, the following impacts may have place on the soil and ground:

- Fertile soil layer destruction/damage, disorganization of the stability;
- Soil contamination.

During the project implementation, the fertile soil layer damage and disorganization of the stability is mainly expected during the preparatory and construction works, which will be related to the vehicle movement, land works and arrangement of permanent and temporary infrastructure on the dam placement territories.

During arrangement of the construction camps, an average depth of 0,2-0,3 m of the fertile soil layer should be removed from the selected territories and disposed on the pre-selected area before starting the construction works. In process of the fertile soil layer removal and temporary storage, soil erosion may occur, accordingly deterioration of the surface water quality is expected. In addition, fertile soil layer removal and transfer into the bund may cause loss of its certain amount, reduce soil fertility, impoverish seed stock, change pH and chemistry and structure of the surface layer.

Significant impact on fertile soil layer is expected during construction works (especially during works on slopes). During arrangement of permanent HPP infrastructure (diversion pipeline, water intake and etc.,) losing of small portion of lands is inevitable.

Soil contamination is anticipated during mobilization works and during construction works as well.

The incorrect waste (both solid and liquid) management may impact the soil quality, violation of rules of storage of the lubricants and construction materials, as well as accidental spill of fuel/lubricants from the construction machinery and vehicle means.

It is notable that within project implementation area (where construction machinery will work and earth works will be carried out) poor quality soil is developed, which is not characterized with a high productivity (territories are mainly used for pasture). As per mentioned and after implementation of above listed mitigation measures damage impact to fertile soil layer as well as to ground stability and quality will be insignificant.

As for the probability of contamination of the river bottom sediments. The mentioned is indirect impact – it is related to the negative impact on river water quality. Negative impact on the surface waters quality is discussed in the relevant section.

7.4.2.2 Operation phase

No impact on soil is expected during operation phase, except for the maintenance works. During implementation of repairing works mitigation measures and impact avoidance measures stipulated for the construction phase should be carried out.

7.4.3 Mitigation Measures

The following environmental requirements should be taken into account by the building contractor in order to prevent damage-pollution of the soil:

- Removal of the fertile soil layer and temporary disposal on the pre-selected areas. The soil must be placed on a separate landfill. Landfill must be protected from wind dispersal and atmospheric precipitation washing. The area selected for the soil disposal must be away from the water facility, at least by 50 m;
- Strict protection of the working site borders to avoid possible contamination of the "neighboring" areas, fertile soil layer damage and soil ramming;
- Protection of the roads intended for the vehicle movement (prohibition of passing of the road);
- Ensure functionality of equipment, in order to prevent soil pollution with fuel/oil spill;
- Waste collection and temporal storing on the special allocated area;
- Appropriate management of the industrial wastewater and agricultural-fecal wastewater formed in process of car washing on the territories of the construction camps. Arrangement of proper treatment facility and permanent monitoring of activities;
- Restriction of refueling/maintenance of the machinery/equipment on the construction sites. In case of urgent need, these activities should be carried out at least 50 m away from the water, with consideration of certain mitigation measures for preventing the spills (and consequently soil/water contamination);
- Restriction of machinery and equipment washing on the territory;
- In case of fuel/oil spill, localization of the spilled material and immediate cleaning of the contaminated area. Personnel should be provided with appropriate means (adsorbents, shovels, etc.) and personal security equipment;
- Contaminated soil and ground for further remediation should be taken out from the territory by the contractor holding an appropriate permit on these activities;
- Training of the personnel on environmental and safety issues, prior starting the work;
- Cleaning the territory and recultivation after completion of the construction works.

The following measures must be ensured by the operator company, in order to prevent pollution of soil on HPPs cascade operation phase:

- Waste management plan provides the systematic supervision of fulfilling the measures;
- Control of the fuel/oil storage and usage rules;
- In case of fuel/oil spill, cleaning of the territory and withdrawal of the contaminated soil and ground for further remediation;
- Disposal of the spill result liquidation means on the territories of substations and oil storages;
- Training of the personnel on environmental and safety issues during recruitment and then once a year;
- In process of repair works, implementation of the mitigation measures considered for the construction phase.

7.4.4 Impact Assessment

Table 7.4.4.1. Summarizing the impact on soil

Description of impact and impact sources	Impact receptors	Impact description and assessment
Construction Phase		
Impact on integrity and stability of the soil surface . **Lose/damage of fertile soil layer** - Vehicle and construction equipment movement - Land works, including access roads for construction of various facilities - Waste management	Local population, vegetation, wildlife	Direct negative, temporary impact. Approximately 3-10% of fertile soil layer of the project area will be destroyed **Significance:** Low Considering mitigation measures – very low
Contamination of soil – Oil or other chemical spill, pollution with waste – Siltation with sediment contaminated water	Vegetation, surface and ground water Local population	Direct negative, temporary impact. Distribution area depends on pollutants quantity and distribution way, but mainly small local spills are expected. Pollutants concentration would not increase by more than 25% of background concentration. **Significance:** Low Considering mitigation measures – very low

Operation phase		
Impact on integrity and stability of the soil – Vehicle and construction equipment movement for repair/maintenance and transport operations – Land works ***Soil contamination*** – Oil or other chemical substances (eg. paint, transformer oil) spill, pollution with waste	vegetation, groundwater, animals Local population,	• **General:** Direct negative, long-term impact. Distribution area depends on pollutants quantity and distribution way, but mainly small local spills are expected. Pollutants concentration would not increase by more than 25% of background concentration. Soil/ground background condition change will remain unnoticeable. Only during repairing / tech.maintenance process which will not exceed 3% of HPP infrastructure location territory, **Significance:** veryLow

7.5 The Risk of Dangerous Geodynamic Processes Development

7.5.1 Impact Assessment Methodology

Geological processes discuss gravitational processes on the Earth surface such as ravine formation, landslide, debris flow, rockslide, mudflow and others and which may be caused or activated as a result of project implementation. Increase of the geodynamic processes is associated with existing geologically hazardous areas which are sensitive to the certain impact. Accordingly, risks are assessed with consideration of receptor and project activity.

Table 7.5.1.1. Assessment criteria of the geodynamic processes development risks

Range	Category	Geo-hazardous (ravine formation, landslide, debris flow, rockslide, mudflow) risks
1	Very low	The project does not include any type of activities at geo-hazardous areas/zones; the project activities practically are not related to the geo-hazard causing risks.
2	Low	Preventative measures are considered during works in the geo-hazardous areas/zones that would effectively eliminate geological risks. Activities on the geologically safe areas do not cause erosion, or other changes, which may cause the geo-hazards. Geo-hazard management/effective plan of mitigation measures is developed and is being implemented.
3	Medium	Preventative measures are considered during works in the geo-hazardous areas/zones that would effectively eliminate geological risks. During implementation of the activities on geologically safe areas may cause development of such processes (eg, erosion) which may cause geo-hazards without effective management. Geo-hazard management/effective plan of mitigation measures is developed and is being implemented.

4	**High**	Despite the preventative measures on the geo-hazardous areas/zones there is a risk of geo-hazardous processes development, or implementation of the activities caused geo-hazardous processes on the geologically safe areas. Geo-hazard management/mitigation measures plan does not exist or is less effective
5	**Very High**	Despite the preventative measures on the geo-hazardous areas/zones there is a risk of geo-hazardous processes development, or implementation of the activities caused geo-hazardous processes on the geologically safe areas. Geo-hazard management/mitigation measures plan does not exist or is less effective.

7.5.2 Impact Description

7.5.2.1 Construction Phase

Given difficult relief conditions, activation of the geo-hazardous processes may be associated with the vehicle movement, construction of dams, temporary and operational roads arrangement and implementation of other works.

Significant geo-hazardous processes have not been identified on the designed dam arrangement territories and road placement corridors during the field surveys. But it should be noted, that the areas with potential risks would be identified in period of construction works, detailed assessment of which should be carried out immediately and necessary reinforcing measures should be conducted.

Activation of the geo-hazardous processes may be associated with the vehicle movement on the construction phase, construction of dams, temporary and operational roads arrangement and implementation of other works.

Dangerous geo-dynamic process development risk is expected during rehabilitation works of existing roads and their operation. Detail geotechnical conditions assessment is necessary in old landslide and rivers gulling places before commencement of construction works. Protective engineering buildings, and drainage systems and water drain channels must be arranged on the basis of assessment results.

Construction of underground tunnels is mainly considered with TBM, as given in paragraph 4; however powerhouse and diversion pipeline arrangement will be conducted via drilling-explosion method. Correspondingly possibilities of dangerous geological process development are expected which must be considered in detail geological engineering survey program.

Special attention during the cascade construction should be paid to the issues of constant operation status of water drain and draining facilities of the roads.

7.5.2.2 Operation Phase

Dangerous geo-hazardous processes development risk is minimal during HPP operation phase. Such events may occur in case of accidents (damage of diversion system).

7.5.3 Mitigation Measures

The following mitigation measures are necessary in order to minimize the risks of development of the geo-hazardous processes during construction of designed units and roads of HPP cascade:

- The formations in the active dynamic of the upper slopes should be removed and slopes must get stable corresponding deviation angle;
- Withdrawal of the surface and groundwater should be organized, under the condition, that it would not lead to the additional flooding of below existing slopes;
- In order to avoid deformation of the road embankment, gabions should be arranged if necessary;
- Arrangement of the concrete channels (cuvettes) along the project corridor is necessary to prevent development of the erosion and landslide processes in road construction period;
- Atmospheric and groundwater flow from the slopes of the channels arranged along the roads and diversion channels should be discharged in the adjacent natural ravines or in river Tergi;
- Recultivation of construction site and implementation of landscaping works is a must after completion of construction works.

7.5.4 Impact Description

Table 7.5.4.1. Summarizing the risks of development of the geodynamic processes

Description of impact and impact sources	Impact receptors	Impact description and assessment
Construction Phase		
Development/Activation of Geo-hazards, including landslide, erosion, avalanche, ravine formation - Construction and transportation operations, especially the use of heavy equipment o on the geologically hazardous areas o on the slopes - Un-reinstated or poorly reinstated sites	All the resources of land and on the land (plants, animals, water)	Direct negative, long-term impact **Significance:** Depends on the section, considering the local conditions and preventative/mitigation measures effectiveness may vary from low to high level impact. As a result of mitigation measures impact may be reduced from very low to low level impact.
Operation Phase		
Development/Activation of Geo-hazards, including landslide, erosion, avalanche, ravine formation –Maintenance/Repair works, the use of heavy equipment o on the geologically hazardous areas o on the slopes - Un-reinstated or poorly reinstated sites	All the resources of land and on the land (plants, animals, water)	Direct negative long-term impact **Significance:** Depends on the section, considering the local conditions and preventative/mitigation measures effectiveness, may vary from very low to low level impact

7.6 Impact on Surface Water

7.6.1 Impact Assessment Methodology

Impact on water environment includes:
- Impact on solid sediment movement of the river, river-bed dynamic and stability of the banks;
- Change of river water capacity;
- Deterioration of river water quality.

Impact is assessed with consideration of intensity, impact area and the sensitivity of river-bed/banks of the river.

Table 7.6.1.1. Surface water impact assessment criteria

Range	Category	Impact on sediment movement	Change of rivers water capacity	Deterioration of water quality of the river Tergi
1	Very Low	The change of the solid run-off is practically invisible, there is no impact on the river-bed or on the banks of the river	Change of the capacity is invisible, does not impact on the water habitat/Ichthyofauna. Water use has not changed	Background concentration of the substances and water turbidity has invisibly changed
2	Low	Solid run-off has changed by 1-5% in the tailrace/lower water intake flow along the whole length of the river or on its certain sections, which may cause some impact on sensitive areas, but the erosion processes has not been activated significantly.	The river capacity on certain sections has changed by 10%, impact is temporary (eg, will be restored after completion of construction works) or is seasonal (eg, there will be only shallowness), does not impact on water habitats/Ichthyofauna. Water use has changed temporary or slightly.	Concentration or turbidity of the water has changed by less than 50%, but does not exceed maximum permissible concentration
3	Medium	Solid run-off has changed by 5-10% in the tailrace/lower water intake flow along the whole length of the river or on its certain sections, which cause some impact on sensitive areas, significant activation of the erosion processes is expected, or development of the erosion processes on the erosion hazardous areas.	The river capacity on certain sections has changed by 10-30%, impact is temporary (will be restored after completion of construction works) or is seasonal (there will be only shallowness), certain impact on water habitats/Ichthyofauna is expected. Water use has changed temporary and slightly.	Concentration or turbidity of the water has changed by 50-100%, but does not exceed maximum permissible concentration
4	High	Solid run-off has changed by 10-15% in the tailrace/lower water intake flow along the whole length of the river or on its certain sections, which cause significant impact on sensitive areas, existing erosion processes has significantly activated or erosion is being developed on erosion hazardous areas.	The river capacity on certain sections has changed by 30-50%, which is irreversible by character, significantly impacts on water habitats, impact on Ichthyofauna is expected, visibly impacts on water use.	Concentration or turbidity of the water has changed by more than 100%, or exceeded maximum permissible

5	Very High	Solid run-off has changed by >15% in the tailrace/lower water intake flow along the whole length of the river or on its certain sections, which significantly impacts the lower flow of the river, including sensitive areas, existing erosion processes has significantly activated, erosion developed on erosion hazardous or on previously stable areas.	The river capacity on certain sections has changed by more than 50%, impact is irreversible, lack of flow significantly impacts on water habitats, there is an impact on Ichthyofauna, water use has significantly changed.	Concentration or turbidity of the water has changed by more than 200% and exceeded maximum permissible concentration

7.6.2 Impact Description

7.6.2.1 Construction Phase

Solid sediment movement limitation of the river in tailrace and change of the water capacity is short-term event. It depends on duration of the works to be done in active part of river-bed. In this period river water will run to tailrace through trench and correspondingly water flow in tailrace will be almost unchanged. During flood period when silt movement is most active no construction works will be carried out in river-bed.

The highest risk on the construction phase is contamination of the surface waters. Impact on water quality is expected during implementation of dam construction and other works near to the surface water facility. Surface water pollution risks include:

- Pollution from vehicles/equipment as a result of fuel/oil spill;
- Increase of turbidity of water in the river-bed or during works to its vicinity
- Pollution with construction and other wastes, including untreated wastewater;

Impact on water quality mainly considers: water intake facility construction and placement of construction camp. Drainage water management process must be as well considered during headrace tunnel and HPP building works. According to the mentioned contamination risks is highest for river Tergi and Khdistskali.

Surface water contamination risk on construction phase considerably depends on implementation of environmental management measures by building contractor as well as waste management and machinery maintenance quality. Soil protection from contamination is important as well.

7.6.2.2 Operation Phase

Cascade operation will have considerable impact on silt movement; on one hand this is important for the dynamic of river bed and stability of banks. HPP construction is planned to be implemented in high mountainous area. Selected area of riv. Tergi valley is a canyon, with insignificant terraces where hard rock is easily found. In such natural conditions reduction of silt in cascade tailrace will not change riverbed dynamics significantly.

It is notable that reservoir construction is not planned by the project. Low threshold dam with water discharge will be arranged on water intake, which carries more considerable advantage from this point

comparing to other alternatives, namely: possibility of automatic pass of high water flow and silt and small number of mechanical equipments.

Considering the average amount of water cost of the river Tergi, significant positive moment will be the pass of the sanitary cost. The following conditions will be taken into account for calculation of pass of the sanitary/environmental cost in the tailrace in process of operation of the designed dams:

- Pass of the necessary amount of water for the normal vitality of biological environment of the river;
- Pass of the necessary amount of water in the tailrace of the dam for implementation of activities of current water users.

According to the survey results, the only type of water usage in the tailraces of the designed dams is amateur fishing. Neither with literary sources, nor during the field works have been identified other types of water usage.

Considering the above mentioned, the necessary water cost to be passed in the tailraces of the dams must be calculated only by considering the capacity of the water necessary for vitality of biological environment of the river.

It is that there is no predetermined standard for calculation environmental flow, necessary to discharge to the downstream of the hydro-technical facility. According to implemented practice, for all dams functioning in the country, environmental flow is calculated as 10% of average multiannual flow for 50% provision of water flow.

For alignment, selected for dam disposition, 10% of average multiannual flow for 50% provision of water flow is 25.4 m^3/sec. Therefore ecological flow for Dariali HPP will be 2.54 m^3/sec.

Impact is reduced by the fact, that in 150-200 m from headwork riv. Kuro connects with riv. Tergi from right, which has definite stable flow, which on its behalf will reduce negative impact caused by the water deficit.

As about contamination of riv. Tergi water quality – compact biological water treatment facility will be arranged in HPP construction project for treating of agricultural-fecal wastewaters in power unit. Treated water will be discharged in riv. Tergi. Assignment of personnel shift is not planned on water intake facility and correspondingly there will not be any chance of waste water production.

No impact on water quality is expected during operation phase besides maintenance works in close vicinity of the object. Impact will be depended on volume of works to be done and their type. Impact mitigation measure during construction works will be similar to the expected one.

7.6.3 Mitigation Measures

7.6.3.1 Construction Phase

In order to reduce the negative impact on the surface waters, construction contractor shall ensure the following conditions

- Equipment to be placed at least 50 m away from the surface water facility (wherever it is possible; if it is not possible, constant control and security measures to prevent water pollution);
- Avoid the blocking of the river-bed during operating in or near the river-bed;
- Ensure the maintenance of the machinery/equipment, in order to reduce the risk of fuel/oil spill to the minimum;
- Material and waste right management;

- Segregative collection of the waste formed during the works and temporary warehousing on the special allocated areas, away from the water facility;
- Restriction of refuelling/maintenance of the machinery/equipment on the construction sites. If there is an urgent need, it should be done at least 50 m away from the water, by implementation the certain security measures of prevention of spill (and consequently soil and water pollution);
- In case of fuel/oil spill on the soil, localization of the spilled material and immediate cleaning of the contaminated area in order to prevent the getting of pollutant in the water;
- Restriction of the car-wash near the river-beds;
- Restriction of the wastewater discharge without treatment. This is most notable in process of construction camp functioning and during working out of underground works;
- Arrangement of the drainage system and temporary treatment depositing tanks for the surface run-off;
- Training of the personnel on environmental and safety issues.

7.6.3.2 Operation Phase

Implementation of the following mitigation measures is necessary, in order to minimize the impact on surface waters on HPPs cascade operation phase:

- Systematic control over implementation of measures considered by the waste management plan;
- Arrangement of the compact biological treatment facilities of the agricultural-fecal wastewaters for every power unit and control over effectiveness of their operation;
- Systematic supervision on fuel/oil storage and usage rules;
- In case of fuel/oil emergency spill, localization of the pollution and implementation of measures to prevent deterioration of the surface waters;
- Training personnel on environmental and safety issues.

7.6.4 Impact Assessment

Table 7.6.4.1. Summarizing the impact on surface waters

Description of impact and impact sources	Impact receptors	Impact description and assessment
Construction Phase		
Impact on sediment movement – Change of dynamic of the river-bed and stability disturbance of the banks	Residents o nearby settlements, infrastructure (road), river inhabitants	Direct negative temporary impact. Change of the solid run-off is practically invisible, there is no impact on river-bed or banks. **Significance:** Very Low
The change of river water flow	Residents of nearby settlements, river inhabitants	Direct negative temporary impact. Capacity change is invisible, does not impact on water habitats/Ichthyofauna. Water usage has not changed **Significance:** Very Low
Contamination of surface waters with weighted particles, with hydrocarbon and other substances – The source of pollution with weighted particles – industrial wastewater, contaminated surface run-off, inert materials run-off; – The source of pollution with hydrocarbon/chemical substances – discharge of the surface run-off contaminated as a result of spill, or their direct spill in water facility; – Other pollution source – construction and household solid/liquid sediments formed on the construction camps/sites.	Residents of nearby settlements, river inhabitants, agricultural lands which are irrigated with polluted water	Direct negative, temporary (≈4 years) impact. Distribution area depends on pollutants concentration and distribution way Concentration of harmful substances or turbidity in the river may increase by 50-100% during the construction works of the head building Significance: medium, considering the mitigation measures, impact will be low-quality

Operation Phase		
Impact on sediment movement – Change of dynamic of the river-bed and stability disturbance of the banks	Residents of nearby settlements, infrastructure (road), river inhabitants	Direct negative, long-term impact. The change of the solid run-off may cause a certain impact on the sensitive areas, though existing erosive processes are not significantly activated; **Significance:** Low
The change of river water flow	Residents of nearby settlements, river inhabitants	Direct negative, long-term impact. The impact is mainly seasonal (happens during the shallowness), certain impact is expected on the sensitive habitats/Ichthyofauna of the water, water usage conditions has slightly changed **Significance:** Medium
Contamination of surface waters with weighted particles, with hydrocarbon and other substances – The source of pollution with weighted particles: o Washing of hydraulic structure; o Surface run-off contaminated with solid sediments from non-cultivated sites of the HPPs – The source of pollution with hydrocarbon/chemical substances: o Pollution of HPP water with turbine oil o Discharge of the surface run-off contaminated as a result of spill, or their direct spill in water facility -Pollution with construction material; – Solid/liquid household waste, solid/liquid construction waste formed during the repair works	Residents of nearby settlements, river inhabitants	Direct negative, long-term impact. distribution area depends on the pollutants concentration and distribution way Concentration of the harmful substances or turbidity may increase by less than 50% in the water of river Tergi, but does not exceed maximum permissible concentration Significance: Low, considering the mitigation measures, impact will be very low-quality

7.7 Impact on Ground Water

7.7.1 Impact Assessment methodology

Table 7.7.1.1. Groundwater impact assessment criteria

Range	Category	The change of groundwater capacity	Deterioration of Ground water[4] Quality
1	Very Low	Capacity invisibly changed	Background concentration of the substances has changed invisibly

6 Georgian law does not regulate underground water quality, that is why standard for drinking water was used

7 EU directive 80/68/EEC, 1979, December 17, on „protection of groundwater from different hazardous substances“

2	**Low**	Groundwater level has significantly decreased, but has not influenced on the bore-hole water level or on spring water flow	II groups[5]substances concentration is less than the permissible
3	**Medium**	Groundwater level has significantly decreased, at the same time obtaining of water from the bore-holes has reduced, impacts on the springs flow	II group substances concentration is exceeding the permissible for the drinking water
4	**High**	Bore-holes are temporarily not working, uncharged has reduced in the surface water facilities, which leads to the seasonal drought and environmental impact	Concentration of harmful substances of I group are being identified
5	**Very High**	Bore-holes are dehumidified, there are no uncharged in the surface water facilities, there are major risks of drought and environmental impact	Concentration of harmful substances of I group exceed the permissible in the drinking water

7.7.2 Impact Description

7.7.2.1 Construction Phase

During infrastructure arrangement works, especially during underground works, there is a possibility of crossing of aquifer which may cause reduction of local ground water flow. Exact definition of this impact and its scale is difficult because of specification of the activity.

Contamination of the groundwater is expected during the works at the places, where the not-deep water horizons are identified. The impact on groundwater may be:

- Direct – eg. during the land works (drilling, foundation extraction and etc.) and
- Indirect – movement of the pollutants from the highly contaminated soils in the deep layers through the atmospheric waters, or because of the hydraulic connection between contaminated surface water and groundwater.

7.7.2.2 Operation Phase

Georgian law does not regulate underground water quality, that is why standard for drinking water was used. The risks of deterioration of groundwater quality and water flow change during operation phase is quite low. Reduce of impact probability is possible in conditions of proper environmental management.

7.7.3 Mitigation Measures

In order to reduce the contamination of the groundwater, ground and surface water quality protection measures must be implemented.

7.7.4 Impact Assessment

Table 7.7.4.1. Summarizing the impact on groundwater

Description of impact and impact sources	Impact Receptors	Impact description and Assessment
Construction Phase		
Change of groundwater capacity	Residents of nearby settlements, animals, surface waters with hydraulic connection with them	Direct negative, long-term impact Groundwater level may significantly decrease and influence the bore-hole water level or on spring water flow **Significance:** may vary from high to low impact
Deterioration of groundwater quality	Residents of nearby settlements, animals, surface waters with hydraulic connection with them	Direct or indirect negative, temporary impact. Exceeding maximum permissible concentration of the II group[6]substances is not expected. **Significance:** Low, considering the mitigation measures, very low
Operation Phase		
Change of groundwater capacity	Residents of nearby settlements, animals, surface waters with hydraulic connection with them	Direct negative, long-term impact. Noticeable change of groundwater capacity is not expected. **Significance:** Very Low
Deterioration of groundwater quality	Residents of nearby settlements, animals, surface waters with hydraulic connection with them	Direct or indirect negative, long-term impact. Noticeable change of background concentration of the substances is not expected **Significance:** Very Low

7.8 Impact on Terrestrial and Aquatic Ecology

7.8.1 Impact Assessment Methodology

For terrestrial and aquatic impact assessment qualitative criteria was introduced for the following categories:

- Habitat integrity, where expected loss or fragmentation, reduce of potential capacity of ecosystem and impact on natural corridor are expected;
- Behavior of species, where the changes due to visual impacts, noise and emissions are estimated, also, impact on reproduction, coupling, daily or seasonal migration, activity and mortality is assessed;
- Habitat/species recovery abilities;
- Protected habitats, protected areas, protected landscapes and nature sites.

For the assessment of importance of ecological impact following criteria was used:

- Probability, intensity, scope and duration of impact, which determines volume of impact;
- Sensitivity of habitats towards direct impacts or changes caused by impacts;
- Recovery ability of habitats and species;

[6]EU directive 80/68/EEC, 1979, December 17, on „protection of groundwater from different hazardous substances"

- Defensive and ecological value of impact receptors, such as species, populations, communities, habitats, landscapes and ecosystem;
- Impact on protected receptors are high impacts.

Established criteria for assessment of ecological system impacts are given in the table 7.8.1.1.

Table 7.8.1.1. Terrestrial and aquatic ecology impact assessment criteria

Range	Category	Impact on habitat integrity	Impact on behavior of species	Restoration ability of habitats/species	Impact on protected habitats
1	Very Low	Insignificant impact on habitat integrity	No changes in behavior, death of small mammal/fish species of no importance is anticipated, no danger of invasive specie spreading	Fully restored after recultivation works (<1 year)	No impact on protected areas of national or international importance
2	Low	Noticeable impact on low-value habitat integrity, including loss of 10-20 ha land habitat	Changes in behaviour can be detected using standard methods. Death of less valuable species of small mammals/fishes is expected. No danger of invasive species.	Restoration in 2 years after recultivation works	Temporary, short-term, small impact on protected areas of national or international importance, which will not cause long-term ecological integrity violation
3	Medium	Noticeable impact on integrity of habitats, reduction of valuable habitats, loss of less valuable lands (20-50 ha)	Changes in behaviour of valuable species can be detected using standard methods, death of less valuable species, invasive species are expected	Restoration in 2-5 years after recultivation works	Small impact on protected areas of national or international importance, but ecosystem will be restored within 3 years
4	High	Decrease of protected or locally important habitats, loss of 50-100 ha of less valuable habitats	Changes in behaviour of valuable species can be detected using standard methods, death of valuable animal species is expected, invasive species spread	Restoration in 5-10 years after recultivation works	Impact on protected areas of national or international importance is expected, mitigation measures will help to restore ecosystem, which will take around 5 years
5	Very Hugh	Decrease of protected or locally important habitats or loss of >100 ha of less valuable habitats	Changes in behaviour of valuable species can be detected using standard methods, death of valuable animal species is expected, invasive species spread	Restoration in more than 10 years after recultivation works	Impact on protected areas of national or international importance is expected.

7.8.2 Impact on Flora

7.8.2.1 Construction Phase

Impact on flora on the construction phase may be direct (damage, loss) and indirect (emission).

Infrastructure territories for of HPP and generally Stepantsminda adjacent territory is very poor especially with high production vegetation cover. The territories selected for arrangement of construction camp, water intake, diversion pipeline are rare bushy plant areas. Comparably thick vegetation cover is on the mountain where power unit must be arranged (pressure channel, HPP building and etc.), except substation which will be arranged underground. Substation construction is planned on the territory existing between military road and riv. Tergi; access roads will be arranged from military road. There is no vegetation cover on the proposed territory for communications.

As mentioned above, only small amount of bushy and grass plants (diversion pipeline corridor) will be destroyed during construction phase.

Determination of exact amount of vegetation cover under destruction and taxation characteristics will be possible after preparation of detail engineering design and after specifying borders of construction site, which requires execution of additional survey works on this stage.

Construction site borders will be strictly protected in order to avoid damage of vegetation cover and it will exclude additional damage to grass cover. Territory will be completely cleaned after completion of construction works and removed surface layer will be recovered. Vegetation cover will be restored. Vegetation cover will be lost only on permanent arrangement places of infrastructure (settling basin, substation and others).

Indirect impact (dust and exhaust impact) will be local, insignificant and time-limited.

Project related impact on flora can be reduced with right organization/management of the works and via implementing corresponding mitigation measures.

7.8.2.2 Operation Phase

Direct impact on flora during operation phase is less expected. Grass on substation territory will be periodically cut. Planting of cultural and decorative trees and plants on the adjacent territory of substation is considered which shall be assumed as important mitigation measure.

7.8.2.3 Mitigation Measures

- Strictly observe traffic routes and construction areas border in order to minimize risk of damaging vegetation cover at the adjacent territory of construction site;
- Instruction of personnel about protecting of vegetation cover before commencement of works.
- Cutting of trees-plants must be carried out by supervision of authorized department of Ministry of Environment and Natural Resources Protection;
- In case of detection of protected species their extraction from environment must be done in compliance with Georgian Law of “Georgian Red List and Red Book”, clause 24, sub-clause I, accordingly to v) sub-clause, on the basis of agreement with Ministry of Environment and Natural Resources Protection.
- Implementation of all measures to prevent contamination of ambient air and soil quality

- Planting of cultural and decorative trees-plants at the adjacent territory of the project to be implemented.

7.8.3 Impact on Fauna

7.8.3.1 Construction Phase

HPP construction is related to temporal disturbance of fauna and possible migration from areas of influence. Construction works may affect animal biodiversity as follows:

- Vibration and noise levels will increase during construction works, plants will be covered with dust, which will affect feeding base for vertebrate and invertebrate species;
- Concern factors will increase for birds and bats living near the road;
- Arranged trenches poses a risk to small animals. They might fall into the trench and get injured;
-
- Limitation of movements due to construction of temporary structures, temporary fragmentation of habitat
- Cutting plants on some locations will destroy whereabouts of animals, this will especially affect bats, which live mainly in trees near the forest. Destruction of such trees will cause decrease of number of bats; Though number of plants and trees within the project to be cut is not big;
- In case of pollution of water and soil with harmful substances fish, amphibians, water birds and otters will suffer; as well as animals living on place of spillage and its adjacent territory.

Having said that, direct (collision/damage, fragmentation of habitats and destruction) and indirect (migration due to noise/vibration, emissions and etc) impacts are expected. Sources of impacts are:

- Transport;
- Machinery and people;

On the construction phase animals/birds will not migrate on far distances. After completion of construction and "stop" of source of concern animals/birds will return to their original habitat, except reservoir areas, which will be permanently lost.

7.8.3.2 Operation Phase

Impact on fauna will not be significant considering the following: arrangement of HPP aggregates underground, noise loss characteristic from noise distribution source and animals adaptation conditions.

Approximately 2073 m long diversion pipeline will be arranged underground and correspondingly fragmentation of habitats will not be anticipated.

Impact on Ichthyofauna is especially important on this stage. As it was noted during environment background assessment at riv.Tergi headrace Ichthyofauna is generally represented rheophil fishes. Here we can find 6 species of fish: Spring trout, Tergi gobio, Tergi barbel, *Alburnoides fasciatus, Colchic borysthenicus,* Tergi*Loach*. On the planned construction territory we come across only with sea trout as it is known that more than 1000m above from sea level there are no barbell and other carps.

Spring trout can go up to the highest point in the river which 2000 – 2500 meter high creates "mountain type" trout population and is characterized with low growing up temper, lower fattening and late ripening.

HPP operation considers which considers discharge of main amount of the water in the diversion pipeline will have significant impact on sea trout population of the river Tergi and its tributary. Impact factors are: significant violation of hydrological regime (run-off deformation); elimination of roe, fry, mature in the water intake system (fish and fry kill on aggregates); lessening of fish food base; reducing of spawning areas.

Spring trout population damage due to operation phase consists of:

- Loss of river Tergi (that part of tributary which will loss water flow because of its discharge into diversion tunnel) fish productivity;
- Fish productivity reduction due to fish movement, reproduction, fattening and deterioration of wintering conditions;
- Death of fish of various development stage and food organism collapse on hydro aggregates (diversion pipeline, aggregates)

7.8.3.3 Mitigation Measures

Following mitigation measures must be conducted in order to minimize impact on fauna, namely:

- Strict protection of traffic movement routes and construction site borders;;
- Selection of optimal traffic speed to reduce direct impact possibility (accident);
- Implement measures in order to reduce dust during execution of the works;
- Implement measure against noise and vibration reduction during construction phase;
- Nest of protected bird species must be registered and access to them must be prohibit from April to July;
- Relevant waste management;
- Measures to restrict spillage of oil products and other conterminous substances on water and ground;
- Pits, trenches and other must be protected to prevent fall of animals. For large species – sharp-colored ribbon, for small animals – any flat material – tin, polyethylene and etc. Long boards or logs must be launched into trenches and pits, so that small animals could get out. Trenches must be inspected before filling them with soil;
- Instruction of personnel before commencement of the works;

Following measures must be implemented to minimize impact on Ichthyofauna

- Proper waste management in order to avoid water pollution;
- Take caution during working in close vicinity to water object in order to prevent increase of water turbidity
- Execution of water intake construction works in less "sensitive" period of bio-environment;

Implementation of proper mitigation measures is considered during operation phase in order to reduce impact on Ichthyofauna:

- Water intake facility will be equipped with fish way which will definitely affect impact quality due to limitation of fish migration;
- For energy generation during water intake environmental flow in the river is considered as ($2m^3$/sec) which will create definite conditions for fauna being depended on the river Tergi considering increasing of water flow in tailrace of the headwork's;

Besides the mentioned:

- During 5 years after operation of HPP twice in a year monitoring of Ichthyofauna must be implemented in order to evaluate fishway operation effectiveness and define additional mitigation measures;
- If as a result of monitoring it is clarified that fishway efficiency is not exceeding 60-70% arrangement and operation of river trout reproduction farm must be considered.

7.8.4 Impact Description on Protected Territories

HPP Construction territory and Kazbegi National Preserve location issue is quite noteworthy. According to HPP working draft design diversion pipeline, sedimentation basin and entrance portal of diversion pipeline will be located in Kazbegi National Park traditional usage territory. Area of the mentioned communications and access roads will be 2.64 hectare.

Besides the mentioned, indirect impact may take place, specifically animals may get from protected territory to construction site and it may result in their death or injury. Noise and vibration distribution impact may occur as well.

With a special land usage form 2.64 hectare of the land of Kazbegi National Park traditional usage zone where HPP infrastructure arrangement is considered, will be handed to "Darial Energy" LLC.

Project territory within traditional usage zone is quite poor from vegetation point of view and in case of civil works implementation significant impact on flora is not anticipated.

7.8.5 Impact Assessment

Table 7.8.5.1. Summary of impact on biological environment

Description of impact and impact sources	Impact Receptors	Impact description and assessment
Construction Phase		
Damage/Destruction of the Vegetation: Direct Impact: o Cutting down the plants for arrangement of the infrastructure and access roads; o Damage of the grass surface on the construction sites, camps and access roads. – Indirect impact: o Air pollution; o Water pollution; o Soil pollution and erosion.	Territories for HPP Infrastructure, acess roads	Direct and indirect negative, temporary impact. The area of distribution of the direct impact is within the territories of HPP infrastructure, construction camp and access roads. Indirect impact may exceed the project area **Significance**: Medium, considering mitigation measures very low

Impact on terrestrial fauna, including: – Direct impact sources: o Cutting down the vegetation for arrangement of the HPP infrastructure; o Construction works and transportation operations. Indirect impact sources: o Air pollution; o Change of the acoustic background; o Change of the illumination background at night; o Possible pollution of surface and ground waters; o Soil pollution and erosion; o Visual Impact.	The animal species inhabiting in the project implementation area	• **Overall:** Direct and indirect negative impact. Duration in some cases is within the duration of the project (eg, animal frighten/death); irreversibility of other impacts is longer (eg, habitat restoration). Duration in some cases is within the duration of the project (eg, animal frighten/death); irreversibility of other impacts is longer (e.g, habitat restoration). **-Impact on species behavior:** The death of single copies of some animal species is expected. Animal temporary migrations expected. **-Disturbance of habitat integrity:** Impact on locally valuable habitat integrity **Significance:** medium, considering mitigation measures, low
Impact on Ichthyofauna: - Direct impact sources: o River abstraction in order to arrange hydraulic structures; o Arrangement of the hydraulic structures; o Arrangement of the car gangway. - Indirect impact sources: o Pollution of waters; o Pollution of bottom sediments.		Direct and indirect negative, temporary impact. The death of single copies of the fish is expected. Impact on habitat integrity and temporary migration of the fish. **Significance:** low
Impact on Kazbegi State land	Disturbance of ecological integrity of protected territories	Indirect negative, temporary impact. Impact on protected areas of national or international importance is expected, which will cause long-term breakage of ecological integrity **Significance:** low

Operation Phase		
Destruction/damage of the Vegetation: - Direct impact sources: o Mow of the vegetation on substation territories; o Vegetation damage during repair and transportation operations. - Indirect impact sources: o Air pollution; o Surface and ground water pollution; o Soil pollution and erosion;	Territories, access roads intended for the HPPs infrastructure	Direct and indirect negative, long-term impact. Distribution area of the direct impact is within the substation and repair sites, as well as access roads. Restoration of the damaged plants will not need more than 2 years. Indirect impact will distribute on reservoirs and other facilities adjacent territories **Significance:** low
Impact on terrestrial fauna, including: - Direct impact sources: o vegetation cover control; o Repair works and transportation operations. - Indirect impact sources: o Air pollution; o Change of the acoustic background; o Change of the the illumination background at night; o Possible pollution of surface and ground waters; o Soil pollution and erosion; o Visual Impact.	Animal species inhabiting in the HPP communications deployment area	**Overall:** Direct and indirect negative, long-term impact. Distribution area is mainly within the territories of the power unit and access roads and repair site. Indirect impact may exceed the project area • **Impact on the species behaviour** The death of single copies of less valuable species is expected. Animal migration. • **Disturbance of habitat integrity** Due to arranging of diversion pipeline local habitats fragmentation is expected **Significance:** medium, considering mitigation measures low
Impact on riv. Tergi Ichthyofauna: - Direct impact sources: o Changes of river hydrological regime; o Operation of hydro aggregates; o Reservoir washing; o Arrangement of the car gangway; o Repair works performed in or near the river. o Accomplished repair works - Indirect impact sources: o Surface water pollution; o Bottom sediment pollution.	Riv. Tergi Bioenvironmental	Direct and indirect negative, long-term impact. Decrease of locally valuable habitats number. The death of single copies of less valuable species is expected. **Significance:** High, considering mitigation measures medium or low
Impact on Kazbegi State land	Disturbance of ecological integrity of protected territories	Indirect negative, long-term impact. Impact on protected areas of national or international importance is expected, which will cause disturbance of ecological integrity **Significance:** low

7.9 Waste

7.9.1 Impact Assessment Methodology

Impact on municipal landfills and sewage systems/treatment facilities as a result of project implementation is assessed here, which is connected to increase of their loading. The impact depends on the type and capacity of the formed wastes.

Table 7.9.1.1. Impact assessment criteria associated with the waste management

Range	Category	Solid Waste Management	Wastewater Management
1	Very low	Insignificant increase of load on the household/construction waste municipal landfill/waste recycling facility	Insignificant increase of load on municipal sewage systems/ treatment facilities
2	Low	Increase of load up to 10% on the household/construction waste municipal landfill/waste recycling facility	Increase of load up to 10% on municipal sewage systems/ treatment facilities
3	Medium	Increase of load from 10-50% on the household/construction waste municipal landfill/waste recycling facility, landfill expansion is not necessary	Increase of load up to 10-50% on municipal sewage systems/ treatment facilities
4	High	Increase of load from 50-100% on the household/construction waste municipal landfill/waste recycling facility, landfills expansion or arrangement of the new landfill may be necessary	Increase of load up to 50-100% on municipal sewage systems/ treatment facilities, may be necessary to increase their conductivity or arrangement of the new collector/treatment facilities
5	Very High	Increase of load with more than 100% on the household/construction waste municipal landfill/waste recycling facility, landfills expansion or arrangement of the new landfill is necessary	Increase of load with more than 100% on municipal sewage systems/ treatment facilities, it is necessary to increase their conductivity or arrangement of the new collector/treatment facilities

7.9.2 Impact Description

In process of HPP construction and operation each corresponding waste management measure must be implemented, in order to minimize generation of the waste during activities, increase their recycling and re-use to maximum and finally, to dispose waste ate appropriate locations. Responsible person should be appointed for implementation of these measures, who will control temporary and final waste disposal processes and will keep the register.

7.9.2.1 Construction Phase

Construction of the Dariali HPP may produce both non-hazardous inert waste and hazardous waste. Among non-hazardous waste the following are likely to be generated:

- Inert waste excavated during the construction of dams and HPPs buildings;
- Waste due to vegetation clearance;
- Polyethylene waste (packaging/sealing materials);
- Ferrous and non-ferrous scrap metal;
- Domestic waste, etc.

Generation of considerable quantities (approximately 200 thousand m^3) of waste is expected during construction of diversion pipeline, HPP building and other underground excavation works.

Waste rock generated during diversion pipeline excavation works will temporarily be stored at the adjacent territory of construction camp, between riv. Tergi and motor road, on approximately 4 hectare land plot. Same area will be used as temporary storage for waste rock excavated from tailrace channel. Waste rock generated due to access tunnel and substation excavation works will be stored on right bank of the riv. Tergi, close to access tunnel, in order to prevent portal of access tunnel from possible flooding, which is expected from the river flowing from the West. Public road rerouting might become necessary on that place.

It is noteworthy that 60% of waste rock material will be used for "Dariali HPP" construction works, for which waste will be recycled on construction camp territory. Construction of "Larsi HPP" is planned in the future and its design water intake facility will be located adjacent to this territory. Use of waste rock generated during "Dariali HPP" construction works for the implementation of the "Larsi HPP" project is being discussed, namely approximately 40% of waster rock, temporarily stored at the bank of Riv.Tergi will be used for "Larsi HPP" works, specifically for filling of trenches, formed due to excavation works for diversion pipeline, and covering its surfaces.

For waste rock storage area concrete wall must be arranged on river side which will prevent waste rock getting into the river. Water drain channels must be arranged on the perimeter in order to prevent flooding of the territory and washing away of waste rock. Implementation of recultivation works will be necessary after total volume of waster rock material is stored fully on the landfill area.

Wood material generated during vegetation removal for arrangement of construction sites and road corridors, will be used for construction activities and forestry waste, unsuitable for this activity will be given to the local population for as fire-woods.

The planned building operations should not generate numerous scrap metals. Upon accumulation they will be delivered to scrap metal collecting companies.

Household waste will be collected in adequately labeled lidded containers. Domestic waste form the construction site will be delivered to the domestic waster utilization landfill. Waste generated on construction camp will be delivered to Stepantsminda landfill. Throughout construction operations may be produced approximately 300*0,7=**210 m^3/y** Household waste (considering 4 years construction period **– 840 m^3**).

Generation of following types and volumes of hazardous waste is expected during implementation of construction works:

- Paint residues and cans under paints - 80-100 kg/y;
- Explosive material waste remained after arranging of HPP building's underground space and additional tunnels - 8-10kg

- Residues of fuels and lubricants - 120-150 kg/y;
- Out-of-date and damaged accumulators - 40-50 unit/y;
- Oil filters from building machinery and vehicle – 25-30 unit/y;
- Used rubber tires - 40-50 unit/y;
- Welding electrodes -60-70 kg/y;

Soil/ground polluted with petroleum hydrocarbons due to accidental oil spills – volume depends on spill scale.

Tunneling drilling and blasting operations will be executed by correspondingly licensed subcontractor. Blasting material will be kept in special facility arranged at the construction camp. Blasting material will be delivered on operation sites on a daily basis and residues will be returned to the storage facility.

Other hazardous wastes will be temporarily kept at the construction camp, in a special facility (20-25 m^2 area wagon-containers). The facility shall be provided with wash stand, as well as with shelves to place waste. Waste should be labeled.

Hazardous waste generated at construction grounds shall be transported to the temporary storage facility by waste management personnel of a building contractor using special vehicles (waste should be removed from construction grounds as accumulated, but at least once per three days interval). Final waste management measures (taking put of temporary storage, neutralization, utilization, disposal) should be carried out by correspondingly licensed contractor. Adoption of registering mechanism of such waste is a must.

Soil/ground polluted due to small oil spills (5-10 m^3) can be remediated on site (e.g. in situ bioremediation). In case of large spills removed contaminated soil/ground shall be taken out of the territory for remediation. Spill site shall be recultivated using clean ground. It is rational to transfer polluted soil/ground for remediation to an adequately licensed contractor.

Violation of rules of above mentioned waste management may cause a number of negative impacts on different environmental receptors, for example:

- Incorrect waste management (dumping into water, littering on the adjacent territory) may cause pollution of soil and water, as well as deterioration of sanitary conditions and negative visual changes;
- Disposition of construction waste and scrap metal on the improper area, may lead to a road barricading and negative impact on traffic flows and etc.

Therefore, it is necessary to implement waste management rules. Hazardous waste management measures are given in detail in appendix №1.

7.9.2.2 Operation Phase

On the operation phase considerable waste generation is not expected. Along with household waste hazardous waste such as waste listed below, will be generated:

- Waste turbine oil - 170-200 kg/y;
- Out-of-date and damaged accumulators - 2-3 unit/y;
- Oil filters from building machinery and vehicle - 2-3 unit/y;
- Used rubber tires - 8-10 unit/y;
- Welding electrodes -10-12 kg/y;

- Soil/ground polluted with petroleum hydrocarbons due to accidental oil spills – volume depends on spill scale;
- Ferrous and non-ferrous scrap metal - 30-40 kg/y;
- Luminescent lamp - 20-25 unit/y;
- Cartridges of laser printers – 4-5 unit/y;
- Solid waste produced from refining of transformer oil -10-15 kg/y;
- etc.

Hazardous waste disposal and their further management must be accomplished by adequately licensed contractor. Hazardous waste management rules are given in appendix №1.

Quantity of domestic waste depends on number of HPP operation personnel. 20 employees will be employed in HPP operation. Considering that approximate annual household waste equals to 0,7 m^3 per staff. Total number of household waste will be 14 m^3/year.

Domestic waste will be disposed from power house territory to Stepantsminda landfill; for intake facility special domestic waste utilization pits must be arranged.

7.9.3 Mitigation Measures

7.9.3.1 Construction Phase

On the HPP construction process, constructor-contractor is responsible to ensure implementation of the mitigation measures developed in waste management plan, including:

- Majority of waste rock accumulated during tunneling works will be used for project means after being recycled; remaining part will be temporarily stored in compliance with corresponding rules, on the right bank of the river Tergi, on 4 hectare land and afterwards will be used for “Larsi HPP” construction.
- After completion of waste rock storage works, landfill recultivation works must be carried out.
- Wall should be constructed from river Tergi side on the territory of waste rock temporary storage area, in order to exclude chances of waste wash-off;
- Reinforced concrete channel will be arranged for water drainage all along the landfill territory and water will be discharged into the river Tergi;
- Scrap metal must be delivered to corresponding service (or company);
- Wooden material must be handed-over to the local population as a fuel for winter;
- Domestic waste accumulated on the construction site must be disposed to Stepantsminda landfill; for construction site special utilization pits must be arranged for waste disposal;
- Explosive material waste will be removed from site by the company executing explosive works, having corresponding license.
- Special storage house must be arranged for temporary storage of hazardous waste; special labelled hermetic containers must be placed on construction site ;
- Waste management must be conducted my properly trained personnel who will undertake training periodically;
- Hazardous waste must be removed from construction site by the contractor having corresponding permission for the mentioned activity;
- Wastewater from construction sites must be discharged in surface water, only after treatment.

7.9.3.2 Operation Phase

During the HPP operation phase, special warehouse must be arranged for hazardous waste, which should be in compliance with environmental requirements, namely:

- Warehouse floor and walls must be surfaced with ceramic tiles;
- Warehouse ceiling must be painted with humidity-proof paint;
- Warehouse should be equipped with following facilities:
  - Exhaust ventilation system;
  - Wash-stand and tap to wash the territory;
  - Water-intake trap.
- Arrangement of shelves and racks are necessary for the waste disposal;
- Waste disposal is allowed only in hermetic packages, which must have proper labeling.

- Correspondingly trained personnel should be provided for the waste management, who will periodically undertake training and testing;
- Removal of the hazardous waste from the construction camps for the further management should be conducted by the contractor having special permit on these activities.

7.9.4 Impact Assessment

Table 7.9.4.1. Summarizing the impact associated with the waste management

Phase	Description of impact and impact sources	Receptors	Description and assessment of residual impact
Construction Phase			
	Impact on solid household waste landfill - Increase of the load on landfill ***Impact on the areas of the holes arranged for solid household waste disposal*** - Impact on soil and surface/ground waters - Visual impact, including pollution of the territory with waste ***Impact on the areas for temporary disposal of the solid waste*** - Impact on soil and surface/ground waters - Visual impact, including pollution of the territory with waste ***Impact on the areas for disposal of mining waste*** - Impact on water and soil by the waters generated on the bulk areas - Visual-landscape impact ***Impact on the drainage water discharge facilities*** - Change of turbidity and pH balance ***Impact on the areas where the liquid household waste is formed*** - Pollution of the area in case of leakage ***Impact on the liquid household waste discharge facilities*** Deterioration of the water quality -	The areas selected for the temporary/permanent disposal of the waste, solid household waste landfill, wastewater receiving water objects, soil	• **Overall:** Direct negative, temporary impact. Duration: within the construction phase • **Load of the local landfill:** Increase of the load on landfill will not be higher than 10% **Significance:** Low • **Load of municipal sewage systems:** Load of municipal sewage systems is not expected. **Significance:** Very Low • **The risk of pollution of environmental facilities (water, soil) with waste:** **Significance:** Medium, considering mitigation measures - low

Operation Phase			
	Impact on the areas for disposal of the solid household waste - Impact on soil and surface/ground waters - Visual impact, including pollution of the territory with waste *Impact on the areas for temporary disposal of the solid waste* - Impact on soil and surface/ground waters - Visual impact, including pollution of the territory with waste *Impact on the areas where the liquid household waste is formed* - Pollution of the area in case of leakage *Impact on the liquid household waste discharge facilities* - Deterioration of the water quality	The areas allocated for the temporary/permanent disposal of the waste, waste water receiving facilities, soil	• **Overall:** Direct negative, permanent impact • **Load of landfills/sewage systems:** Load on landfills or on sewage collectors is not expected **Significance:** Very low • **The risk of pollution of environmental facilities (water, soil) with waste:** **Significance:** Low considering mitigation measures - very low

7.10 Visual-Landscape Impact

7.10.1 Impact Assessment Methodology

Visual-landscape impact assessment is more or less subjective. Impact area and duration is used as assessment criteria, as well as relative ecological value of the landscape.

Table 7.10.1.1. Visual-landscape impact assessment criteria

Range	Category	Impact on visual receptors	Duration and spatial borders of the landscape change/landscape quality and value
1	Very low	Change of the view is invisible	Landscape change is invisible, or landscape is not valuable
2	Low	Some insignificant changes of the view are noticeable from some points, which is easily adaptable	Landscape change is insignificant, or landscape restoration needs 1-2 years
3	Medium	the view has significantly changed for many points of observation, but is easily adaptable	Separate section of landscape has changed, or landscape restoration needs 2-5 years
4	High	The view has changed significantly for most points of observation, but is adaptable	Natural or high-valued landscape has changed on a large area, or landscape restoration needs 5-10 years
5	Very High	The view has changed completely from all points, adaptable or hardly adaptable impact on receptors is expected	Natural or high-valued landscape has changed on a large area and landscape restoration is impossible

7.10.2 Impact Description

7.10.2.1 Construction Phase

During preliminary works, some landscape and visual impact will occur due to increased traffic, construction sites, presence of personnel and machinery, and constructing structures. Construction works will cause partial alteration of usual views and landscape.

Expected visual and landscape changes will be slightly perceptible for local population as infrastructural objects and construction sites of all the three HPPs are apart from residential zones. Potential receptors of these changes could be hunters, herdsmen, lumbermen and tourists. Some construction sites may be seen from the road, though considering distances it should not cause significant discomfort for passengers passing on the road.

After finishing the construction, all the personnel, machinery, building materials and waste will be moved out of construction sites. Temporary structures will be also dismantled and removed, and the territory will be recultivated. However, the power houses with their infrastructure, substations and access roads to all the HPPs will be left; road profiles will be changed at the water intake areas and access roads to the tunnel entrances will be rehabilitated. All these will cause some alteration of the landscape which are unavoidable for any such project.

7.10.2.2 Operation Phase

Through the operation phase main landscape/visual impact will be associated with the permanent buildings, though after a while local population may adapt to it. Some impact is also expected due to repair and rehabilitation works. This impact is similar to the one on the construction phase though much smaller. Impact significance may vary according to type and volume of works.

7.10.3 Mitigation Measures

Impact mitigation is possible through proper selection of building color and design; temporary structures, materials and waste must be stored in a way, which will be less noticeable for visual receptors.

7.10.4 Impact Assessment

Table 7.10.4.1. Visual-landscape impact assessment criteria

Range	Description of impact and impact sources	Impact receptors	Description and Assessment of Impact
Construction Phase	**Visual-landscape impact** - Tree and shrubbery grubbing within work sites and row - Construction sites and temporary structures - Waste rock disposal; - Construction and transportation operations	Local population, passengers, tourists, hunters, herdsmen, lumbermen, inhabiting animals.	Direct negative impact, Duration is within the construction phase The view will noticeably change from some points, which is easily adaptable. Landscape restoration needs 2-5 years. **Significance:** Medium, considering mitigation measures - low
Operation Phase	**Visual-landscape impact** - HPP infrastructure - Vegetation control - Repairing works		Direct negative long-term impact, though adaptable Spatial extension depends on local relief, i.e. visibility terms **Significance:** low

7.11 Impact on Cultural Heritage

7.11.1 Impact Assessment Methodology

Table 7.11.1.1. Cultural heritage impact assessment criteria

Range	Category	Damage/destruction of the cultural heritage
1	Very Low	The risk of impact is insignificant because of the large distance from the object or because of the used method of construction/operation
2	Low	1-10% of the insignificant object may be damaged/destroyed
3	Medium	10-25% of locally significant object may be damaged/destroyed
4	High	25-50% of locally significant object may be damaged/destroyed, or the object of regional significance may be damaged
5	Very High	50-100% of locally significant object may be damaged/destroyed, object of regional significance may be damaged, national or international significance protected object may be damaged

7.11.2 Impact Description

7.11.2.1 Construction Phase

Impact on cultural heritage is comparably high during construction phase. Within HPP construction ZoI, Dariali monastery complex is quite notable, as well as church of John the Baptist, which is located on the western slope of the cliff, where diversion pipeline must be constructed.

According to the audit results of the HPP infrastructure placement area, no historical, architectural or archaeological sites were found in the areas selected for building sites, access roads and power transmission lines. However some archaeological sites can be discovered later during ground works. In this case a building contractor is obliged to invite specialists from government agencies, authorized for the expertise by Georgian legislation, in order to assess significance of the site and make decision about renovation of works.

Most important is Dariali monastery complex as it is located close to construction camp and close to water intake construction site. Despite the mentioned vibration, caused by machinery shifting and construction works, damage to complex is less expected as complex represents modern structure and can withstand such impact.

As for church of John the Baptist - negative impact is reduced by large distance to construction areas (closest construction site – diversion pipeline is up to 2km away from it) and by construction methods (tunnel-boring machinery will be used for tunneling).

According to audit results of HPP infrastructure territories, within construction sites, as well as within access roads, no other historical-architectural monument had been detected. Though during ground works, late archaeological findings may occur.

7.11.2.2 Operation Phase

Indirect impact on cultural heritage is not expected during the operation phase. Reservoir construction is not considered – no local microclimate change will not occur, correspondingly humidity level will not increase for neither for region nor for cultural-historical monuments.

7.11.3 Mitigation Measures

If monument is discovered, construction process will be stopped. Finding will be studied by expert-archaeologists and in case of necessity finding will be a subject of conservation or transfer to storage. After obtaining permission works will continue.

7.11.4 Impact Assessment

Phase	Description of impact and impact sources	Impact Receptors	Impact description and assessment
Construction and Operation Phase	*Impact on Cultural Heritage* - Damage or destruction of the cultural heritage monuments	Objects of cultural heritage, population, touristic environment	Damage or destruction of monuments of the cultural heritage is not expected **Significance:** Very Low

7.12 Impact on Socio-Economic Environment

7.12.1 Impact Assessment Methodology

During socio-economic impact assessment both, negative and positive impacts are considered. Three-category scheme is used for assessment of such impacts – low impact, medium impact and high impact. See assessment criteria in table 7.12.1.1.

Table 7.12.1.1. Criteria for socio-economic impact assessment

Range	Category	Socio-economic impact
Positive		
1	**Low**	- Employment in local population increased by 0.1% - Average income of local population increased by 10% - Budget income of the region increased by 1% - Local infrastructure/power supply is slightly improved, resulting improved living/subsistence and economic environment for local population
2	**Medium**	- Employment in local population increased by 0.1-1% – Average income of local population increased by 10-50% – Budget income of the region increased by 1-5% – Noticeable improvement of infrastructure/power supply, resulting improved living/subsistence and economic environment for local population and development of regional economy
3	**High**	- Employment of local population increased by more than 1% - Average income of local population increased by more than 50% - Budget income of the region increased by more than 5% - Significant improvement of infrastructure/power supply, resulting significant improvement of living/subsistence environment and encouragement of regional/national economic development
Negative		
1	**Low**	-Short-term restriction of resources' and infrastructure accessibility, which will not affect income of local population; long-term negative impact on economic activity of local population also is not expected; - Short-term deterioration of living quality of local population, which will not result in long-term negative impact - No impact on health - Insignificant impact on safety - Long-term, although easy adoptable impact on environment; - Increase of local population by 10% due to migration
2	**Medium**	– Short-term restriction of resources' and infrastructure accessibility, which will affect lifestyle of population for a short period of time, although this will not have long-term negative impact on economic activity of local population; - Short-term deterioration of living quality, which will not result in long-term negative impact; - Certain impact on health is expected, but mortality risk will not increase; - Certain safety-related risks are expected ; - Complaints regarding some impacts are expected; - Increase of population by 10-30% due to migration

3	**High**	– Some resources and infrastructure becomes unavailable for local population, due to which they have to change their lifestyle and this brings by long term negative impact on their economic activity; – Significant deterioration of local population life quality; – Significant impact on health, resulting in high mortality risk; – Certain safety-related risks are expected – Corrupt deals regarding employment and nepotism are expected – Population constantly complains about impacts, resulting in conflict situations between population and staff – Local population increased by more than 30% due to migration, creating unacceptable cultural environment for local population, creation of new settlements is expected

7.12.2 Description of Impact

7.12.2.1 Health and Safety

During the activities (construction and operation) some health and safety-related risks (for population and personnel) are expected. Impacts could be:

- Direct (e.g.: accidents, power stroke, falling from heights, injuries from construction machinery, etc.); and
- Indirect (emissions, increased acoustic background, climate change, contamination of water and soil).

Social risks are also related to health and safety, namely risk of infectious diseases' spread (including AIDs and STDs). This risk is related to migration of personnel during construction and operation phases. Appropriate preventive measures must be implemented. Considering, that most of personnel will be local population, this risk is minimum.

Population health and safety risks related to movement of transport and construction machinery, will not be high, as for transportation operations only Georgian military road will be used. Transport will get to construction corridor of diversion pipeline through access road to dam.

7.12.2.2 Mitigation Measures

In order to prevent direct impact implementation of safety rules and permanent supervision is most important. Implementation the safety rules means:

- Instruction of personnel on health and safety issues during acceptance on the job and later, several times a year;
- While working on height personnel must be secured with special ropes and locking carabiners;
- Corresponding warning, prohibiting and directing sign-boards must be arranged at the construction areas for personnel and local population, for health and safety purpose;
- Standard medical kits must be delivered to construction sites at sections, potentially dangerous for health and safety;
- Trespassing or movement without special protective means of unauthorized individuals must be controlled and prohibited;
- Maximal implementation of safety rules during execution of transport operations;
- Roads, passing through settlements, must be restricted during transport operations as much as possible;

- Regular on-site risk assessment should be conducted in order to determine risk factors for population and to develop corresponding risk management plan;
- Personnel medical insurance;

Constructing contractor on construction phase and operating company on operation phase, are obliged to assign health and safety officers[7]. They will control level of compliance with safety requirements and will keep a special register for registration of acts, violating safety norms.

As for possibility of indirect impact on health of population and personnel – it is immediately related with preservation of environmental (ambient air, soil, water) qualitative norms, for which mitigation measures are given in corresponding paragraphs.

7.12.2.3 Resource Accessibility

As it was mentioned project site is a State property. After completion of construction activities, the territory used as construction site will be recultivated, but territories for reservoir and dams will be lost forever (water intake and diversion pipeline, substation).

The exact quantity of inert materials required for construction activities will only be known after the detailed engineering project is developed. As known to-date, the inert materials will be supplied from stocks in the middle body of the riv. Tergi (section between village Kobi and Stepantsminda borough), for which a special license must be obtained. It is noteworthy, that on the basis of proper lab research, waste rock from diversion tunnel may be used as inert materials, which will significantly reduce risks of expected impacts.

One of the most important environmental resources, used during the construction activities is water (technical, drinking-agricultural water). Technical water (140 124 m^3/year) should be taken from the river Khdistskali. Considering river flow and the fact that it connects with riv. Tergi in several meters from the point from where technical water will be collected, section of riverbed, where water deficit may oocur, will be too short.

Local spring waters will be used for drinking purposes, which may cause limited usage for local population. However, the project area is rich with drinking waters and impact on this resource will be insignificant.

One of the ways of impact reduction is registering of discontent and complaints and proper response on them.

7.12.2.4 Land Use and Ownership

Land selected for arrangement of headworks and diversion pipeline (right bank of the river Tergi) is meant for public use and is mainly used for pasturing. According to the project, diversion pipeline must be arranged underground; if recultivation works are implemented, territory will be restored to its initial condition after completion of works. Therefore, considering the aforementioned, impact as a result of loss of pasturing land and fragmentation will be temporary and will not be significant during operation phase.

[7]Health and Safety Officer - ჯანმრთელობისა და უსაფრთხოების ოფიცერი

Power unit infrastructure, except substation, will be arranged underground and correspondingly land use impact risk will be minimal.

Temporary impact is expected on the territory of waste rock temporary storage area (right bank of the tributary of the river Tergi.) According to the project, most of the waste rock will be used for civil works (production of inert material); remaining part will be used for vertical planning of diversion pipeline for Larsi HPP. Recultivation of the territory will be implemented after completion of works.

During environmental and social impact assessment no discontent and complaint was registered.

7.12.2.4.1 Mitigation Measures

- Strictly adhere boundaries of construction sites and transport routes, during construction works of headworks and diversion pipeline, which will minimize possible damage of the adjacent territory;
- Arrangement of protective accessories on the roofs of observation wells and arrangement of fence along the whole parameter;
- Implementation of recultivation works, after cleaning the territory of waste rock temporary storage and its restoration to initial condition;
- Registering of discontent/complaints and proper response.

7.12.2.5 Demographic Changes

The project does not aim at permanent housing estate construction for the workers, since basically local residents will be employed both for construction and maintenance. Correspondingly, no important demographic changes are expected at any stage of the project implementation.

7.12.2.6 Contribution to Economy

The implementation of the project of the HPP construction and operation will significantly contribute to socio-economic development of Kazbegi Municipality and Mtskheta-Mtianeti. During construction of the HPP, construction materials from local resources (region is rich with construction material reserves: tuff and marble, limestone, inert materials, granite, shale, andesite) will be used, which will encourage the activity of building material producers. The positive impact of local population employment is also noteworthy.

After the HPP is launched, the power system will get extra energy, which is extremely important for the country's power independence. Income growth of Stephantsminda municipality and the whole region is also expected, which will be an important positive impact in terms of social and economic development.

7.12.2.7 Employment

At the construction stage (for about 3-3.5 years) 300 people will be employed, while on operation stage - 20 people. Besides, activation of construction material producers and service providers (Hotels, Public food facilities and etc.) is expected, especially during construction phase, which is a guarantee of extra jobs.

This will be positive impact on the employment and social conditions of the local population, as for regional development – this may be considered as minor positive impact.

7.12.2.8 Road Damage, Traffic Load, Limited Movement

At present, the technical condition of roads is satisfying. Road damage is expected due to intense transport movement during construction phase.

Less impact is expected on operation phase, namely during repair-maintenance works, as traffic of heavy machinery will be less. To reduce the impact to minimum, proper planning of work sequences is important. During works and especially after, all damaged sections of roads must be rehabilitated and restored to their original condition.

It is quite considerable that during diversion pipeline construction, population may have temporary limited access to local sacred place of Stepantsminda – The church of John the Baptist. Considering that diversion pipeline will be covered on the whole perimeter, impact is meant to be temporary and it will not occur during operation phase.

It is noteworthy, that on initial stage of project implementation, construction of dam and a motorway on it is planned, which will terminate need to use internal roads of Stephantsminda borough for construction of sediment basin and diversion tunnel. On the operation stage, this new motorway will also be used by the local population.

A small increase of traffic is expected on construction phase, but considering that military road will be used for transport operations, most likely there will be no delay on road, and as for safety-related risks – they will insignificantly increase.

Mitigation measures will reduce the impact even more, namely: routes must be predefined, which will limit use of roads in settled areas (sections of Georgian military road, passing through settlements, are not considered).

Impacts on traffic flows on operation phase are very low and may be assessed as insignificant.

7.12.2.9 Mitigation Measures

Following mitigation measures must be implemented in order to minimize impact:

- Road rehabilitation during preparatory works – positive factor;
- Maximum limitation of caterpillar movement;
- All the damaged road objects must be rehabilitated after completion of works and it should restored to their initial condition;
- Ensure minimal disturbance of the population/passenger movement during road rehabilitation/construction;
- Selection of optimal bypass road to construction site;
- Ensure maximum limitation of machinery movement on public roads;
- Population will be informed about time and period of civil works execution;
- Registering of discontent/complaints if any and proper response.

7.12.3 Impact Assessment

Table 7. 12.3.1. Socio-Economic Impact

Impact and Impact Sources	Impact Recipients	Description and Assessment of Residual Impact
Construction Phase		
Health deterioration and safety risks: – Direct (e.g.: accidents, power stroke, falling from heights, traumatism, injuries from construction equipment, etc.); and – Indirect (emissions, increased acoustic background, climate change, contamination of water and soil).	Personnel and local population	Direct or indirect impact. Duration – construction phase Certain impact on health and safety-related risks **Significance:** Medium, considering implementation of mitigation measures - very low
Availability of resources: *In civil works* – Usage of construction materials; – usage of technical water; – usage of drinking-agricultural water	Local population lacking access to resources	Direct negative. Duration – construction phase. Availability of resources might be hindered, which will have no impact on incomes of local population. **Significance:** low
Impact on land ownership and use -Limitation in pasture use; -Impact on neighboring land owners – damage of any property and any kind of activities on their lands.	Local Population	Direct negative. Duration – construction phase. Complaints from population are expected. Though intensive conflict situations are not expected. **Significance:** Medium, considering implementation of mitigation measures - very low
Changes in demography: – Migration; – Construction of settlements and migration of foreigners.	Local Population	Direct negative. Increase of migration is not expected. **Significance:** low

Contribution to economy and employment - Stimulation/development of construction business and its satellites business activities - Establishment of work places - Increased budget receipts	Regional economics, including construction and other businesses, local population	Direct positive temporary impact A number of impacts will be long-term (e.g. improvement of infrastructure) Increase of employment, income and budget receipts. Improved infrastructure **Significance:** High
Damage of road cover -Movement of heavy machinery *Intensification of traffic* -Movement of any machinery - Limitation of movement - Blocking roads for safe works	Local Infrastructure, population	Direct negative, duration – construction phase Road infrastructure usage can be limited. Complaints expected from local population **Significance:** medium, considering implementation of mitigation measures - low
Operation phase		
Health deterioration and safety risks: – Direct (eg.: accidents, power stroke, falling from heights, traumatism, injuries from construction techniques, etc); and – Indirect (emissions, increased acoustic background, climate change, contamination of water and soil).	Mainly personnel involved in operation phase, as well as local population	Direct or indirect. Long-term impact. Impact on health is less expected. Safety-related risks are insignificant. **Significance: Low** considering implementation of mitigation measures – very low
Availability of resources: - usage of drinking-agricultural water during operation phase; -usage of Riv.Tergi water for energy targets;	Local population having poor access to resources	Direct negative, Long-term impact. Lessening of water flow is expected on some definite places of riv.Tergi, having no impact on local population income **Significance:** low

Impact on land ownership and use – Limitation in local pasture use; – Impact on neighboring land owners – damage of any property and any kind of activities on their lands.	Local Population	Direct negative, Long-term impact. These kind of impacts are less expected during operation phase as works are not intensive; mitigation measures will reduce impact risks **Significance:** low
Contribution to economy and employment - Stimulation/development of construction business and its satellite business activities - Creation of new job opportunities - Increased budgetary income.	State economic conditions, local production and population	Direct positive, temporary impact improvement of infrastructure and power supply which will improve living conditions for local population and promote country's economic development **Significance:** high 20 people will be employed during operation phase **Significance:** low
Damage of road cover - Movement of heavy machinery required for maintenance/repairing works *Intensification of traffic* - Movement of any machinery *Limitation of Movement* – Not anticipated	Local Infrastructure population	Direct negative, impact Due to arranging of diversion pipeline impact may be long-term. Otherwise impact duration is maintenance works **Significance:** low, considering implementation of mitigation measures – very low

7.13 Trans-boundary Impact

River Tergi is trans-boundary river. Upper body of the river is located on the territory of Georgia and remaining part of the river, passing through Dariali gorge flows on the territory of Russian Federation.

Considering trans-boundary impact of the planned activity the following aspect must be assessed:

- Hydrological changes of the river;
- Solid sediment flow;
- Deterioration of water quality; and
- Negative impact on water bio-environment.

Hydrological Regime: according to the previous report – hydrological regime change of the river during operation phase is expected only till headwork and tailrace channel confluence with the riv. Tergi, which in total equals approximately 8.5-9.0 km. Correspondingly, no impact is expected in downstream of the river.

Solid Sediment: Considering that design HPP is run-of-river type, impact on solid sediment flow is minimal. Project considers construction of low level dam with water discharge, in upstream of which a small impoundment will occur. Correspondingly, during heavy flow period, full volumw of solid sediments will be discharged to the downstream. Floating sediment left in sedimentation basin, will be washed back to the river via permanent washing system with full capacity. Hence, trans-boundary impact risk on solid sediment flow on construction-operation phase of HPP, is minimal.

Water quality: According to the assessment of surface water quality impact (paragraph 7.6.) riv. Tergi water quality deterioration risk is expected, during both construction and operation phases; but considering planned mitigation measures. impact level will not be high.

Ichtyofauna: Discussion of trans-boundary impact on ichthyofauna may be very important, as operation of dams will in any case restrict movement of fish to the upstream and therefore deteriorate natural conditions of their breeding and habitat. Negative impact on ichthyofauna is also expected due to trapping and dying in the water intake.

As it is stated in paragraph 7.8.3.2, fish passage will be arranged on dam and water intake will be equipped with fish protection equipment, which under proper environmental management conditions, will minimize negative impact.

During assessment of trans-boundary impact on ichthyofauna, it is important to discuss location of design HPP alignment, namely:

As it is known, on elevation 1000 m a.s.l. there are no barbell and other cyprinidae, species of fish characteristic to the riv. Tergi. Higher up, on designed dam level (1727 m a.s.l.) you may find “spring trout”, which forms so called “mountain trout” population on 2000 - 2500 m height. These species of fish are not characterized with migration process and is habitant only in local geographical area, in this specific case on the territory of Kazbegi Municipality (Possibly on the territory of Russian Federation, within the Dariali gorge) correspondingly negative impact on ichtyofauna is local and should not be considered as trans-boundary impact.

Considering all aforementioned, only deterioration of water quality may be considered as significant issue form trans-boundary point of view. This risk, in case of proper environmental management is minimal.

Considering these and some other objective reasons, conduct of trans-boundary impact assessment was considered unnecessary.

7.14 Cumulative Impact

“Dariali HPP” is one of those projects, which is planned under long-term governmental program on the territory of Kazbegi Municipality, including Dariali gorge. Besides Dariali HPP project, implementation of two other projects is planned (two-stage HPP on river Khdis Tskali, “Larsi HPP”).

All HPPs (design Dariali HPP, and two perspective projects) will be diversion type. Existing small HPP (Kazbegi HPP) with capacity 320 KW, is also diversion type. Project implementation is planned in a geographical area (Dariali gorge), which has quite complex terrain.

Cumulative impact of planned activities shall be considered according two main scenario, namely: a) existing Kazbegi HPP plus designed Dariali HPP, b) Existing Kazbegi HPP plus designed Dariali HPP impact and plus planned future projects (HPP cascades on riv. Khdistskali and "Larsi HPP"). Cumulative impact assessment should include physical, biological and socio-economic impact assessments.

According to the survey result, carried out during audit process, "Kazbegi HPP" has a very primitive structure and small capacity. Correspondingly environmental and social impact level is very small. In case of riv. Khdistskali HPP cascade project implementation Kazbegi HPP will cease functioning. Considering the aforementioned discussion of first scenario (existing Kazbegi HPP plus designed Dariali HPP) of cumulative impact assessment was not considered reasonable; cumulative impact assessment for construction-operation phases of the second scenario, are given below:

7.14.1 Construction phase

Nowadays the only ongoing construction object in Dariali gorge is construction of monastery complex, which is almost over. Construction of this complex is not related with important negative environmental and social impact; this issue will be discussed lately.

Construction processes of perspective HPPs in Dariali gorge will imply cumulative impact. Implementation deadlines of mentioned projects are not known nowadays, though it is quite possible that construction works of one of them may launch before the end of construction works of Dariali HPP.

Following potential cumulative impacts should be considered: atmospheric emissions (pollutant substances, including dust) waste, noise and vibration, flora, fauna, water environment, landscape, cultural heritage, land purchase, socio-economic issues and others.

According to the previous calculation results, impact caused by emission of polluting substances and noise will not be significant. Considering that communications of perspective HPPs will be quite distanced (minimum 9.0-10.0 km) from settlement, even in case of parallel construction works, health risks of the population will be minimal. Some definite impact is expected on bio-environment but the impact will be temporary and will result in temporary disturbance of the local wildlife.

Territories selected for designed Dariali HPP and perspective HPP construction is not characterized with biodiversity. From this point of view only territory where Khdistskali HPP cascade communication will be disposed is significant; part of this territory will remain within Kazbegi National Park area. Generally cumulative impact on bio-environment on construction phase will not be significant. Planned HPPs will be of diversion type and construction works for water basin will not require cleaning of the big territories from vegetation cover. Arrangment of small dams and creation of small impoundments in their upstream will not cause significant impact.

From cumulative impact types bioenvironmental impact of riv. Tergi and its tributary will be an exception, which will be related to water quality deterioration risks during construction phase. Reduction of impact is possible through proper environmental management and monitoring.

Significant cumulative impact on river's hydrological regime and on solid sediment movement is not expected during construction phase.

Socio-economic environment impact for designed Dariali HPP, as well as for perspective HPPs will be positive due to the following conditions:

- Territories of possible location of design HPP, as well as perspective HPPs belongs neither to state nor to Municipality. According to preliminary survey materials, private property will not get within any project impact zone;
- Among public lands only diversion pipeline territory is significant which is used by local population for pasturing. Impact will be temporary and after completion of the construction and recultivation works territory will be restored to its initial condition;
- Significant amount of job opportunities will be created for execution of construction works, where mainly local manpower will be employed (majority of low qualification manpower, which is in constructing Contractor's interest)
- HPP construction process will be related with intensification of some (production of construction material, trade and service field, production of food products and others) business activities ;
- Implementation of the project will increase budgetary income of the municipality; considering that municipality is on state donation up to now, significant positive impact is expected.

No significant negative impact is anticipated with regard to land use, during designed and perspective HPPs construction period, namely:

- Territories of possible location of design HPP, as well as perspective HPPs belong neither to state nor to Municipality. According to preliminary survey materials, private property will not get within any project impact zone;
- Among public lands only Diversion pipeline territory is significant which is used by local population for pasturing. Impact will be temporary and after completion of the construction and recultivation works territory will be restored to its initial condition;

It is noteworthy that population health and safety risks will not be significant, as construction sites are quite distanced from settlements; military road of Georgia will be used for transport operations.

Considering aforementioned, possible cumulative impact on physical and biological environment during construction phase will not be significant. Significant positive cumulative impact is expected on Municipality socio-economic environment.

7.14.2 Operation Phase

From the possible cumulative impact types on the designed HPPs operation phase significant ones will be: risk of deterioration of riv. Tergi and its riverbed water quality, impact on hydrological environment of the river (water and solid sediment flow); impact on ichtyofauna and on local and global climate.

According to feasibility study of the project and preliminary design solutions of perspective HPPs, all dams will be diversion type and correspondingly cumulative impact related with change of solid sediment movement, is not expected (planned low level dams in heavy flow period will completely discharge solid sediment flow). Correspondingly during HPP operation phase cumulative impact on solid sediment movement is not expected.

Hydrological changes of the river will take place in its downstream during operation phase. Considering that headworks of designed Dariali HPP and perspective Larsi HPP will be located on riv.Dariali, definite cumulative impact will occur during operation period, namely: significant hydrological changes are expected on section of the riv. Tergi, from Stepantsminda borough till state

border. Impact will be considerably high for Larsi HPP, as in some hundred meters from dam of Dariali HPP, rivers Chkheri and Kuro connect to Dariali river and as for Larsi HPP – there are no significant tributaries downstream the design headwork. Main mitigation measure for the mentioned cumulative impact is proper calculation of ecological flow and control on its systematic discharge. Otherwise significant negative impact on the river bio-environment will be inevitable.

Cumulative impact on designed and perspective HPPs during operation phase may be related to deterioration of river water quality. Contamination of water quality during operation phase, generally is associated with improper waste management or violation of fuel and oil storage/usage rules. Correspondingly reduction of this impact is possible with proper environment management and monitoring.

As mentioned, cumulative impact of design and perspective HPPs on Ichtyofauna is expected on operation phase. Existing of low level dam on riv. Tergi and riv. Khdistskali will seriously affect single fish specie inhabiting this region - spring trout which is enlisted in Georgian Red List. As it is stated in the present document, design dam will be equipped with fish ladder and water intake facility will have fish protection equipment; however number of dams will still have significant influence.

Mitigation of the mentioned impact on ichtyofauna is expected considering river trout species characteristics themselves, namely: spring trout is not a migratory fish and on high levels it creates “mountain type” trout population. According to the mentioned no significant impact is expected on spring trout population, considering possible cumulative impact background.

7.15 Summarization of Anticipated Impact

Component	Physical Environment													Biological Environment							Social Environment							
	Air				Water					Soil				Fauna				Flora											
Impact Source/Activity	Vibration	Microclimate	Noise	Air quality	Flow regime	Sediment transportation	River-bed integrity	Surface water quality	Ground waters	Seismicity	Soil integrity	Soil quality	Bank integrity	Fish	Birds	Mammals	Endangered species	Vegetation	Endangered species	Landscape/visual	Archeological sites	Protected areas	Traffic, Transportation network	Waste disposal	Agriculture	Health	Employment	Living conditions
Preliminary Works																												
Camp arrangement	-		--	-				-	-		-	-			-			-		-			-	-		-	+	+
Road arrangement	-		-	-				-			-	-			-	-		-		-			-	-	-	-	+	+
Construction area preparation, ground works	-		-	-					-		--	-			-	-		-		--	-				-	-	+	+
Construction Phase																												
Water intake	-		-	-	-	-	-	--			-	-	-	-	-			-		-						-	+	+
Diversion pipeline	-		-	-					-		-	-			-	-		-		-	-		-	-	-	-		
Headrace tunnel	-			-				-	--															--		-	+	+
Auxiliary tunnel	-		--	--				-	--															--		-		
Pressure shaft	-		-	-				-	-															-		-	+	+
Power house	-		--	--				-	--															--		-	+	+
Substation	-		-	-				-			-	-			-	-		-		-						-	+	+
Operation Phase																												
Maintenance service/ repairs	-		-	-	-			-	-		-	-		-	-	-		-						-	-	-	+	+
Operation			-		-	-	-	-					-	--	-					-						-	+	+

+++	High positive impact	-	Low negative impact
++	Medium positive impact	--	Medium negative impact
+	Low positive impact	---	High negative impact
			No impact

8 Mitigation Measures and Monitoring

Hierarchy of environmental measures looks as follows:

- Impact avoidance/prevention;
- Impact reduction;
- Impact mitigation;
- Damage compensation;

Impact can be avoided and risks reduced using best construction and operation practices. Designed project considers some of mitigation measures. However, as it is impossible to avoid all types of impacts, for maximum environmental protection, corresponding mitigation measures plan was developed for all stages of life cycle and all receptors.

The plan is "live" document and will be amended and adjusted on the basis of monitoring/observation. In case of any changes in works corresponding amendments have to be made in the mitigation measures plan. A person responsible for environmental issues of the company will be responsible to ensure environmental monitoring and management. Throughout the construction phase responsibility on environmental management is shared between the company and building contractor.

8.1 Mitigation Measures and Residual Impact

8.1.1 Construction Phase

Receptor/Impact	Impact	Mitigation Measures	Characteristics
Inorganic dust emission to the ambient air **significance:** low	• Dust generated due to ground works; • Dust generated due to transportation operations; • Dust generated due to handling of building materials;	• Ensure proper working conditions of machinery; • Ensure optimal transport movement speed (especially on gravel road); • Restrict use of motorways passing through populated areas as much as possible. • Implementation of appropriate preventive measures to avoid excessive dust emission during ground-works and handling of building materials (e.g. prohibition of material unloading from height during loading/unloading); • Implementation of appropriate measures for reduction of dust emission as needed (e.g. watering of construction area); • Equip personnel with proper protecting equipment (masks-respirators) as needed; • Instruct personnel before works are launched; • Ensure registration and appropriate response to complaints.	**Significance of residual impact:** very low **Responsible for implementation of mitigation measures:** Constructing contractor **Monitoring:** Technical inspection of machinery**;** Drivers' inspection during transportation operation **Responsible for monitoring:** Constructing contractor **Monitoring expenses:** No additional expenses **Expenses for implementation of mitigation measures:** Expenses for individual protection means for personnel; No additional expenses.
Emission of combustion products to ambient air **significance:** low	• Exhaust gases from vehicles, building machinery and domestic generators; • Welding aerosols	• Ensure proper working conditions of machinery; • Selection of optimal transport speed and routes; • When not being used, vehicle engines should be either turned off or maintained at lowest possible rotation. • Instruct personnel before works are launched; • Ensure registration and appropriate response to complaints.	**Significance of residual impact::** very low **Responsible for implementation of mitigation measures:** Constructing contractor **Monitoring:** Technical inspection of machinery**;** **Responsible for monitoring:** Constructing contractor **Monitoring expenses:** No additional expenses **Expenses for implementation of mitigation measures:** No additional expenses
Noise propagation to working or industrial zone **Significance:** fluctuating from average to high impact	• Noise and vibration generated due to transport operations; • Noise and vibration generated by construction machinery and equipment.	• Ensure proper working conditions of machinery; • Equip personnel with proper protecting equipment (ear-protectors) as needed; • Execute "noisy" works in daytime; • Ensure registration and appropriate response to complaints.	**Significance of residual impact:** low - average **Responsible for implementation of mitigation measures:** Constructing contractor **Monitoring:** Technical inspection of machinery **Responsible for monitoring:** Constructing contractor **Monitoring expenses:** No additional expenses

			Expenses for implementation of mitigation measures: Personnel individual protection means expenses; No additional expenses
Noise Propagation to settlement boundaries **significance:** low		• Ensure proper working conditions of machinery • Execute "noisy" works in daytime; • Instruct personnel before works are launched; • Ensure registration and appropriate response to complaints.	**Significance of residual impact:** very low **Responsible for implementation of mitigation measures:** Constructing contractor **Monitoring:** Technical inspection of machinery **Responsible for monitoring:** Constructing contractor **Monitoring expenses:** No additional expenses **Expenses for implementation of mitigation measures:** No additional expenses
Soil stability and destruction of fertile layer **significance:** low	• Risks of soil stability deterioration and destruction of fertile soil layer during construction works.	• Implementation of safety norms developed for design works; • Works should be implemented strictly within pre-determined road and construction site boundaries, in order to avoid excessive damage of soil; • Conduct reinforcement works if necessary; • Remove fertile soil layer (if necessary) and ensure safe temporary storage for further recultivation works; • Instruct personnel before works; • All potential risks must be determined timely and appropriate response must follow.	**Significance of residual impact:** very low **Responsible for implementation of mitigation measures:** Constructing contractor **Monitoring:** Ongoing observation **Responsible for monitoring:** Constructing contractor **Monitoring expenses:** No additional expenses **Expenses for implementation of mitigation measures:** Cost of reinforcement works depends on volume of work and market prices
Ground/soil pollution **significance:** low	• Soil pollution by waste • Soil pollution due to fuel/oil spill.	• Ensure proper working conditions of machinery to avoid fuel/oil spilling. Proper management of the fuel/oil materials; • Proper waste management; including separation and reusing as possible; placement of useless waste in special containers and disposal off site; • Timely localization of oil/fuel spill and treatment of polluted area; • Instruct personnel before works • Provide corresponding equipment (containers, spill catcher means, etc.); • Remove and dispose all potential pollutants when works are finished.	**Significance of residual impact:** very low **Responsible for implementation of mitigation measures** Constructing contractor **Monitoring:** Technical inspection of machinery; Waste management plan implementation control; Visual control of soil conditions; **Responsible for monitoring:** Constructing contractor **Expenses for implementation of mitigation measures:** No additional expenses **Expenses for implementation of mitigation measures:** Technique and inventory expenses in case of fuel/oil spillage
Risk of potential hazardous geological processes **significance:** may vary from low to	• Erosion and landslide process development during preparation of construction sites and	• Remove active landslide formations from upper parts of slopes and arrange appropriate gradient angle, ensuring stability; • Surface and groundwater drainage system should be arranged so that excessive moistening of lower slopes will be avoided. • Arrange timber gabions below road subgrades to prevent road deformation; • Concrete canals (culverts) should be arranged along roads to prevent	**Significance of residual impact:** low **Responsible for implementation of mitigation measures** Constructing contractor **Monitoring:** ongoing observation **Responsible for monitoring:** Employer and Constructing Contractor

high impact	construction of motorways.	erosion and landslides when constructing motorways. • Atmospheric precipitation and ground water from arranged culverts and nearby slopes must be discharged into the riv. Tergi and its tributaries. • Construction sites must be recultivated and greened after completion of construction works.	**Monitoring expenses:** No additional expenses **Expenses for implementation of mitigation measures:** Must be considered in design documentation
Hydrological regime – change of sediment and water flow **significance:** very low	• Change of river Tergi watercourse during construction works of headwork;	• The impact is not expected; • Mitigation measures are not required; • During construction of the dams the river will be temporarily diverted, however it will not alter the river's hydrological regime;	**Significance of residual impact:** very low **Responsible for implementation of mitigation measures:** Not considered **Monitoring:** not considered **Responsible for monitoring:** not considered
Pollution of surface water **Significance:** medium	• Pollution during ground works; • Pollution due to improper management of solid and liquid waste; • Contamination as a result of fuel/oil spill.	• Ensure proper working conditions of machinery to avoid fuel/oil spill; • If on-site machinery servicing is necessary, place selected must be fairly distanced from the water object; • Ensure proper waste management, including separation and reuse as much as possible; waste not appropriate for reuse in must be stored in special containers and taken out of the territory by the licensed Contractor; • Arrange settling pond for drainage water, produced during tunnel construction process; • Arrange wastewater sedimentation tank of corresponding capacity on construction camp territory; • Timely localization of oil/fuel spill and treatment of polluted area; • Instruct personnel before launch of works; • Equip with corresponding technical means and inventory (containers, spill catcher means and etc.,) • Remove all potential polluting materials after work completion;	**Significance of residual impact:** low **Responsible for implementation of mitigation measures:** Constructing contractor **Monitoring:** technical check-up and control of water treatment facility and other machinery and equipment; waste management plan accomplishment control; visual control of soil and waste water condition **Responsible for monitoring:** Constructing Contractor **Monitoring expenses:** No additional expenses **Expenses for implementation of mitigation measures:** Expenses of technical means and inventory, necessary to eliminate pollution due to fuel/oil spill. Sedimentation tank expenses, which does not require considerable financial expenses.
Change of ground water debit **significance:**	• Ground water horizons may be crossed and ground water regime may	• It is difficult to precisely estimate or determine types and scales of such impact due to characteristics of design activities, therefore no specific mitigation measures exist on this stage.	**Significance of residual waste:** low-high **Responsible for implementation of mitigation measures:** not considered

may vary from low to high impact	be deteriorated during arrangement of underground infrastructure.		**Monitoring:** not foreseen **Responsible for monitoring:** not considered
Pollution of ground water **significance:** low	• Quality deterioration with polluted surface water or soil; • During construction works,(especially during ground works) as a result of fuel/oil spill.	• Implement all the measures to prevent contamination of surface water (see corresponding section); • Implementation of all measures to avoid soil contamination (see corresponding section); • All pre-determined safety rules must be implemented during underground channel construction works in order to prevent ground water pollution	**Significance of residual waste:** very low **Responsible for implementation of mitigation measures:** Constructing Contractor **Monitoring:** Technical inspection of machinery; Control over implementation of waste management plan; Visual control of soil and water conditions; **Responsible for monitoring:** Constructing contractor **Monitoring expenses:** No additional expenses **Expenses for implementation of mitigation measures:** Expenses of technical means and inventory necessary to eliminate pollution due to fuel/oil spill. Other activities does not require any financial expenses.
Impact on vegetation cover **Significance:** medium	• Direct impact on vegetation cover • Indirect impact - dust, emission	• In order to avoid excessive damage of vegetation cover on the territories, adjacent to construction sites, it is necessary to precisely follow pre-determined boundaries of roads and construction sites. • Personnel instruction before works launch on protection of vegetation cover; • Removal of vegetation cover must be accomplished under supervision of government agency authorized by Ministry of Environment and Natural Resources • If protected species are found, they shall be extracted in compliance with Georgian Law on Georgian Red List and Red Book, paragraph 24, clause 1, sub-clause 'v', and it should be agreed with the Ministry of Environment Protection and Natural Resources. • Implement all measures in order to prevent pollution of ambient air and soil quality (see corresponding sections); • Before the launch of construction works, territory of Kazbegi National Park within the design area, must be granted o JSC Dariali Energy under special ownership form.	**Significance of residual impact:** very low **Responsible for implementation of mitigation measures:** Constructing Contractor **Monitoring:** Control of road and construction site boundaries; Technical inspection of machinery; **Responsible for implementation of mitigation measures:** Constructing Contractor **Monitoring expenses:** No additional expenses
Impact on terrestrial fauna **Significance:** medium	• Temporary disturbance of local fauna due to construction machinery/transport and population	• Control traffic routes and building site boundaries; • Define optimal transport movement speed to minimize dust emission; • Restrict use of noisy horns of transport and machinery in order to avoid fauna disturbance; • Ensure proper working conditions of machinery to reduce noise/vibration; • It is recommended to fence working sites during ground works to prevent	**Significance of residual impact:** low **Responsible for implementation of mitigation measures:** Building Contractor **Monitoring:** waste management control; equipment proper operation control; **Responsible for monitoring:** Building Contractor

	movement during construction works (direct impact – collision; indirect impact - dust emission)	small mammals from falling into pits; • Instruct personnel before works launch.	**Monitoring expenses:** No additional expenses **Responsible for implementation of mitigation measures:** during earth works expenses required for pit fencing, which is not connected with important financial expenses. Other measures are not connected with additional expenses
Impact on Ichthyofauna **Significance:** low	• Deterioration of surface water quality during ground works and construction period • Temporary alteration of the river Tergi watercourse during headwork construction works;	• Prevention of water pollution by proper waste management • Caution during working in close vicinity of water object in order to prevent water turbidity. • Construction of headwork must be conducted in period, less-sensitive for biological environment of the river.	**Significance of residual impact::** very low **Responsible for implementation of mitigation measures:** Constructing Contractor **Monitoring:** waste management control; Control of technical functionality of equipment. **Responsible for monitoring:** Constructing Contractor **Monitoring implementation expenses:** No additional expenses **Expenses for implementation of mitigation measures:** No additional expenses
Waste **Significance:** medium	• Construction waste; • Household waste.	• Majority of waste rock accumulated during channel construction works after its treatment will be used for project means. Remaining part will be temporarily stored on right hand side of the river Tergi, on 4 hectare land and afterwards will be used during construction of "Larsi HPP". • After storage of waste rock is finished, surface of landfill must be	**Significance of residual impact:** low **Responsible for implementation of mitigation measures:** Constructing Contractor **Monitoring:** waste disposal/management control; **Responsible for monitoring:** Constructing Contractor

		recultivated. • On the waste rock disposal site, on the side facing riv.Tergi, the wall must be constructed in order to avoid wash-off of the waste by the river. • Reinforced concrete channel for drainage water produced on the whole perimeter of the landfill territory must be arranged and this waste water should be discharged in river Tergi; • Deliver scrap metal to corresponding agency; • Waste wood shall be handed over to local population as firewood. • Household waste from the construction camp should be disposed at Stepantsminda landfill. • Waste of explosive materials must be taken out of the site by the contractor, holding corresponding license; • Special storage facility shall be provided at the camp site for temporary storage of hazardous waste. Construction grounds shall be provided with adequately labeled hermetic containers. • Properly trained personnel shall be assigned for waste management operations. They should be periodically trained and tested. • From construction camp hazardous waste shall be removed by correspondingly licensed contractor. • Waste water from construction camp territory must be discharged in surface water only after its treatment.	**Monitoring expenses:** No additional expenses

			Expenses for implementation of mitigation measures: • Expenses for arrangement of temporary disposal facility for hazardous waste and for hermetic containers; • Costs for arrangement and future recultivation of waste rock landfill; • Costs for arrangement of sedimentation tank for treatment of waste water; • Other measures does not require additional expenses.
Landscape-visual change **Significance:** medium	• Landscape-visual change due to water intake, diversion pipeline, substation construction and existing construction camp. • Visual change due to increased traffic flow	• "Visual" impact due to transport movement is unavoidable, though it is quite low and short-term; • After completing construction, landscape changes (due to presence of dams, power house and other permanent buildings) can be partially mitigated using natural materials and reasonable coloring for better merging with environment. • Clean and recultivate the territory after the end of the construction.	**Significance of residual impact:** low **Responsible for implementation of mitigation measures:** Constructing Contractor agreeing with the Employer **Monitoring:** Control of visual and sanitary-ecological conditions of the territory **Responsible for monitoring:** Constructing Contractor **Expenses for implementation of mitigation measures:** expenses for mitigation measures are defined as per selected material price. Expense/price will be clarified during development of draft design, considering market prices.
Historical/ archaeological monuments **Significance:** Very low	• Damage	• Cease works whenever any artifact is discovered. Ensure that artifact is examined by qualified archaeologists. Ensure its conservation or delivery to a vault if necessary. Continue works only after permission is obtained.	**Significance of residual impact:** very low **Responsible for implementation of mitigation measures:** Constructing Contractor together with the Employer **Monitoring:** observation **Responsible for monitoring:** Constructing Contractor
Safety risk of population and personnel safety **Significance:** medium	• Direct (transport accident and others) • Indirect (atmospheric emissions, increased acoustic background, water and soil pollution).	• Maximal implementation of safety rules for transport operations • Use of motorways, passing through settlements must be restricted as much as possible; • Install corresponding warning, directing and prohibiting signs in sections, potentially hazardous for health and safety; • Standard medical kits must be delivered to construction sites at sections, potentially dangerous for health and safety; • Trespassing or movement without special protective means of	**Significance of residual impact:** very low **Responsible for implementation of mitigation measures:** Constructing Contractor together with the Employer **Monitoring:** periodic control **Responsible for monitoring:** Constructing contractor should provide H&S officers, who will be in charge of safety rules' implementation. **Monitoring implementation expenses:** expenses related to employing additional personnel

		unauthorized individuals must be controlled and prohibited; • Regular on-site risk assessment should be conducted in order to determine risk factors for population and to develop corresponding risk management plan; • Employed personnel must be supplied with individual protective means. • During working on height, personnel must be insured by ropes and special locking carabiners; • Personnel should be trained in labor safety issues during acceptance on the job and afterwards several times a year. • Personnel medical insurance; • Implement all the measures to avoid deterioration of ambient air, water and soil quality (see corresponding clause);	**Responsible for implementation of mitigation measures:** • First medical aid inventory expenses • Personnel medical insurance expenses; • Personnel individual protection means expenses; • Expenses related to implementation of measures necessary to avoid deterioration of the quality of atmospheric air, water and ground
Accessibility to resources **Significance:** low	• Population may have restricted accessibility to local resources (water resources and others)	• Whenever submitted, complaints must be registered and responded correspondingly.	**Significance of residual impact:** low **Responsible for implementation of mitigation measures:** Constructing Contractor together with the Employer **Monitoring:** not required **Expenses for implementation of mitigation measures:** No additional expenses
Impact on land ownership and usage **Significance:** low	• Restricted accessibility to local pastures; • Impact on neighboring land owners;	• Arrangement of overpasses on dam and diversion pipeline, which will be used by the population; • Whenever submitted, complaints must be registered and responded correspondingly.	**Significance of residual impact:** low **Responsible for implementation of mitigation measures:** Constructing Contractor and Employer **Monitoring:** not required **Expenses for implementation of mitigation measures:** Expense for arranging overpasses on diversion pipeline (will be clarified after approving the detailed design).
Impact on transport infrastructure **Significance:** low	• Damage of road surface; • Overloading traffic flow; • Restricted movement.	• Road rehabilitation during preparatory works – positive impact; • Movement of caterpillar machinery must be restricted as much as possible; • All damaged road sections must be rehabilitated after completion of construction works and must be restored to its initial condition; • Ensure minimum restriction of population/passenger movement during construction/rehabilitation works; • Ensure selection of optimal, bypass roads to construction sites; • Ensure restriction of transport movement on public roads as much as possible; • Population must be supplied with information concerning time and period of works; • Whenever submitted, complaints must be registered and responded correspondingly.	**Significance of residual impact:** low **Responsible for implementation of mitigation measures:** Constructing Contractor together with the Employer **Monitoring:** Regular control **Responsible for monitoring:** Constructing Contractor **Monitoring costs** No additional expenses **Mitigation measures cost:** Costs for rehabilitation of damaged road sections

Due to similarities between construction works and works to be done for one of the HPPs suspension/decommissioning their environmental impacts are also similar. (Notice that after decommissioning the territory should be reinstated to the original state to the extent possible)

8.1.2 Operation Phase

8.1.2.1 Maintenance service/ Repairs

Operation Phase (Maintenance Service)	Timeline
o Inspection: seasonal, annual and once per 5-years; o Seasonal maintenance service for powerhouses and substations; o Daily service and inspection; o Monitoring of turbine conditions; o Repairs – e.g. replacing hydro-turbine rotor, repairing of generators (every 20-40 years); o Repairing/cleaning of headwork/water intakes whenever needed; o Oil changing in transformers, lubrication of mechanisms; o Maintenance of buildings, fences, gates, warning signs, lighting and territory – if necessary; o Cleaning of substations sites; testing and repairing of electrical equipment; o Periodical repairs/maintenance of equipment; o Maintaining access road (roads) in proper condition;	50 years (Min.) after its launch.

8.1.2.2 Water Intake

- Periodical inspection of dam equipment. Servicing (painting, cleaning) if necessary;
- Removal of sediments from the settling well;
- Walls and bottom of settling well must be repaired if necessary;
- If geoweb is used for slope protection, regular visual control and maintenance should be provided;
- Ecological (sanitary) flow downstream the dams – **1,97 m³/sec**
- Regular control of ecological (sanitary) flow downstream the dams.

8.1.2.3 Diversion pipeline

- Periodical inspection of diversion pipeline technical conditions. Timely detection and restoration of erosive sections;
- Control and periodical cleaning of vegetation cover across the pipeline perimeter;
- Control of technical conditions of mudflow channels arranged at sections of pipeline, crossing mudflow gorges. The bottom of the mudflow channel should be periodically cleaned from sediment.
- Detection of leak by comparing measurements of flow conducted at inlet and outlet portals.

8.1.2.4 Diversion tunnel

- Tunnel inspection (at the end of 1st and 3rd years of operation and once per 5-years afterwards), check-up (including geophysical study) and cementation if needed.

8.1.2.5 Pressure shaft

- Periodical (once per 5 years) ultrasound inspection of walls and welded joints. Servicing if necessary;
- Detection of leakage by comparing water flows measured at inlet and outlet.

8.1.2.6 Powerhouses and adjacent infrastructure

- Inspection and maintenance of main technologic (turbines, generators, etc.) and auxiliary (valves, sluices, cranes, pumps, etc.) units, if required.

8.1.2.7 Substations

- Visual monitoring of technical conditions of transformers and disconnecting switches – service and repairs if required;
- Visual monitoring of concrete basins under transformers. if required - repairs;
- Adding/changing oil in transformers;
- Maintenance of the territory – grass mowing, regular mechanical control of weeds along fence;
- Visual control of fence and repairing if necessary.

Some small and short-term environmental impact may occur due to repairs/maintenance service. Character of the impact is similar to the one expected on the construction phase. Impact significance depends on scale and time-frame of repairs/maintenance operations.

Mitigation measures and responsibility is defined considering specific work characteristics of rehabilitation/construction project.

8.2 Environmental and Social Monitoring Plan

Objectives of environmental monitoring are:

- Verification of potential impact assessment;
- Control/assurance of compliance with environmental and safety law and standards;
- Control of risks and ecological/social impacts;
- Supply of public/stakeholders with corresponding information;
- Determination of mitigation measures' efficiency and their adjustment if necessary;
- Control of environmental impacts and risks during construction and operation phases;

Monitoring involves visual observation and measurement (as needed) techniques. The monitoring plan considers monitoring parameters, monitoring time and frequency, collection and analysis of monitoring data. Monitoring frames depend on significance of anticipated impact and risks.

8.2.1 Monitoring Plan – Preparatory and Construction Phases

Object/Action of Monitoring	Control/Sampling Point	Method	Frequency/Time	Objective	Responsible for Monitoring
1	2	3	4	5	6
Air (emission of dust and exhaust)	• Construction sites; • Construction camps; • Construction site access roads; • Nearest receptor (populated area)	• Visual control • Technical inspection of machinery • Instrumental measuring	• During ground works and periodically in dry weather; • During construction works including road rehabilitation; • Technical inspection of machinery - before works; • During intensive transportation in dry weather; • Measuring if required and in case of complaints	• Ensure compliance with established quality norms • Minimize population disturbance • Ensure personnel safety • Minimize flora and fauna disturbance	• Constructing Contractor • Employer
Noise and vibration	• Construction sites • Commercial/industrial zone – Dariali Customs office communication disposition territory • Nearest receptor (populated area)	• Control conditions of buildings (to find damages caused by vibration) • Technical inspection of machinery; • Instrumental measuring	• Technical inspection of machinery - before works • Regular control – periodical measurement or in case of complaints.	• Ensure compliance with health and safety norms • Provide personnel with comfortable working conditions • Maintain buildings and facilities • Minimize fauna/population disturbance	• Constructing Contractor; • Employer
Soil	• Construction camps; • Construction sites; • Material and waste storage areas	• Regular control, supervision • Technical inspection of machinery • Lab control	• Regular inspection; • Inspection after completion of works. • Laboratory analysis – in case of pollutant spill	• Preserve soil stability and quality	• Constructing Contractor • Employer
Water	• Construction camps; • At construction sites – at sections adjacent to surface water (at water intake, roads)	• Visual control • Technical inspection of machinery • Solid waste management control • Waste water management control • Inspection of functionality of water treatment facility ; • Laboratory control.	• During preparation of construction sites (next to surface water bodies), especially after rain/snow. • Whenever construction works are carried out next to water bodies or in the river course. • During transportation/storage of solid waste; • Technical inspection of machinery - before works • Periodical inspection of treatment facilities	• Ensure protection of water quality • Minimization of potential impact on ichtyofauna	• Constructing Contractor • Employer

Object/Action of Monitoring	Control/Sampling Point	Method	Frequency/Time	Objective	Responsible for Monitoring
1	2	3	4	5	6
			• Provide laboratory analysis – after spillage of pollutant or after detection technical defects at treatment facilities.		
Vegetation cover	• Construction camps; • Working area of diversion pipeline and/or its adjacent territory • Rehabilitation and/or construction road corridors	• Visual control	• Quantitative and qualitative inspection of vegetation cover before works launch; • Control during working hours; unplanned control • Inspection and reinstatement of vegetation cover after completion of works	• Preserve Vegetation cover, minimize fauna/ population disturbance.	• Constructing Contractor • Employer
Waste	• Construction site and/or its adjacent territory; • Waste storage areas	• Visual control of the territory • Waste management control	• Periodically, especially in windy weather	• Preservation of soil and water quality	• Constructing Contractor • Employer
Labor safety	• Construction istes;	• Inspection • Periodical control of availability and functionality of personal protection equipment	• Regular control during works	• Ensure compliance with health and safety norms • Avoid/minimize traumatism	• Constructing Contractor – H&S office • Employer

8.2.2 Monitoring Plan – Operation Phase

Object/Action of Monitoring	Control/Sampling Point	Method	Frequency/Time	Objective	Responsible for Monitoring
Noise	• At the nearest receptor	• Ensure technical functionality of machinery; • Instrumental measurement.	• Periodical control • Instrumental measurement - in case of complaint submission or After repairs	• Ensure compliance with health and safety norms • Minimize population disturbance • Minimize impact on fauna	• HPP operator Company
Soil stability Risk of geological hazard development	• Control of slope protection means at the water intake • Within diversion pipeline corridor, especially at crossings with mudflow gorges.	• Inspection	• Periodical control • Inspection after heavy rain or snow	• Ensure safety of HPP infrastructure	• HPP operator Company
Soil quality	• Substation area • Water intake area • Waste storage areas	• Visual control • Provide laboratory analysis if necessary	• After transformer oil change/addition; • Lab test – in case of oil spill	• Preserve soil quality • Avoid surface water pollution by surface runoffs • Avoid ground water pollution	• HPP operator Company
Waste	• Water intake area • Power house/substation area • Waste storage areas	• Visual control of the territory • Waste management control	• Periodically	• Preserve soil and water quality	• HPP operator Company
Labor safety	• Construction sites	• Inspection • Regular control of availability and functionality of personal protection equipment	• Regular control during works	• Ensure compliance with health and safety norms • Avoid/minimize traumatism	• HPP operator Company
Biological environment - ichtyofauna	• upstream and downstream of the dam on the riv. Tergi.	• Ichthyofauna (trout) population study	• Twice a year – in spring and in autumn	• Preservation of existing population of Ichthyofauna	• HPP operator Company

No additional expenses are needed for the monitoring (except when laboratory analyses are needed).

For repairs/maintenance services monitoring is similar to the one for construction phase. Frequency and duration of the monitoring depends on volume and duration of repairs/maintenance service.

9 Residual Impact

Residual impact will be low if mitigation measures, proper environmental management and best construction and operation practices are implemented. In Table 9.1 „-“ means that residual impact is not expected or it is insignificant; „✓“ means that after mitigation measures some residual impact is expected.

Table 9.1. Residual Impact

Impact	Residual Impact Construction Phase	Residual Impact Operation Phase	Residual Impact Suspension/Decommissioning
Deterioration of air quality	-	-	-
Noise and vibration	-	-	-
Water quality	-	-	-
Change of hydrological regime	-	✓ (moderate risk at riv.Tergi ≈8 km section)	-
Deterioration of soil quality	-	-	-
Deterioration of soil stability	-	-	-
Development of geological hazards	-	-	-
Impact on flora/vegetation cover	✓ Removal of vegetation cover from HPP communication (main diversion pipeline and access road) disposition territory	-	-
Impact on fauna – birds	✓ (noise propagation, short-term)	✓ (Impact related to electromagnetic field)	-
Impact on fauna – ichthyofauna	-	✓ (Small risk due to hydraulic units)	-
Landscape and visual alteration	✓ (Landscape changes due to construction of diversion pipeline and access roads)	✓	-

10 Potential Emergency Situations

Following emergency situations may be expected:

Emergency situation	Impact and Response
Construction Phase	
Soil destabilization	• Risks associated with construction of water intakes, diversion pipeline and access roads are analogous to those expected for similar construction works; • During construction of diversion pipeline along the motorway, rocks may be damaged and erosion processes may be provoked; • Before starting works, constructing contractor should consider all potential emergency situations and develop corresponding action plan; • Regular monitoring and proper response (if necessary); • Personnel training.
Oil/lubricant spill	• Soil/water may be polluted due to oil/lubricant spill if machinery is not properly maintained. To avoid this, machinery should be regularly inspected and spills should be properly managed (polluted areas must be cleaned and remediated); • Regular monitoring of the territory and proper response (if necessary); • Personnel training.
Fire	• For fire prevention all safety norms should be implemented; • Personnel training.
Traumatism	• Traumatism risk may be increased if labor safety norms are violated; • Personnel should be instructed on first aid and labor safety issues; • Personnel should be provided with individual protection equipment; • Implementation of safety norms should be ensured/controlled; • Medical insurance of personnel;
Operation phase	
Fire	• If fire outbreaks at the substation, atmospheric air can be polluted by combustion products; • For fire prevention all safety norms should be implemented, in particular facilities should be provided with automatic fire alarm system, indoor and outdoor firefighting systems should in proper working condition, evacuation plan should to be developed; • Labor safety norms should be fully implemented; • Personnel training;
Oil/lubricant spill	• Soil/water may be polluted due to oil/lubricant spill if machinery is not properly maintained. To avoid this, machinery should be regularly inspected and spills should be properly managed (polluted areas must be cleaned and remediated); • In case of transformer or turbine oil spill to downstream special technical means should be used in order to minimize propagation (e.g. containment boom); • Daily registration of turbine oil consumption; • Labor safety norms should be fully implemented; • Regular monitoring should be provided; • Personnel training.
Turbine and transformer oil spill	• For spill prevention all oil-containing units (e.g. transformers) should be regularly inspected and serviced as needed; • In case of spill polluted ground should be removed and treated; • Tank for emergency oil emptying should be arranged at the substation area; • Large scale spills should be localized and cleaned up; • Labor safety norms should be fully implemented; • Regular monitoring should be provided; • Personnel training.
Emergency damage	• In case of emergency damage of hydrological structures during operation phase,

of hydraulic structures	local wash-off of top soil layer and ground may occur; • The territory may be flooded; • Damage of the pressure tunnel may cause soil destabilization; • Risks of emergency development may be reduced by regular monitoring and implementation of proper responsive measures; • Labor safety norms should be fully implemented; • Personnel training.
Traumatism	• Traumatism risk may be increased if labor safety norms are violated; • Labor safety norms should be fully implemented to avoid casualties; • Personnel should be instructed; • Personnel should have medical insurance.

Emergency response will be determined in corresponding instructions. HPP must have evacuation plan, technical means/equipment necessary for handling small-scale emergency situations, protective and communication means (phone, fax machine) for personnel to protect themselves and call for corresponding emergency services (fire-fighting squad, ambulance).

Every accident will be registered and its causes will be investigated. If necessary, remediation will be ensured.

The HPPs will be provided with first aid means and firefighting equipment. Personnel will be periodically instructed/trained regarding operation and safety issues.

11 Environmental and Social Action Plan

(Except construction phase, which will be executed by constructing contractor)

No	Action	Target	Legislative Requirement/ Best Practices	Need for Investment, Resources, Responsibility	Deadline
1	Development of Emergency Response Plan	Response to emergency situations; Ensure maximum protection of environment and personnel; Quick and effective response to accidents	Best practice - obligatory	Own resources; Some invited consultants may be involved;	Before operation phase launch
2	Schedule maintenance services and technical inspection for each unit	Ensure effective and safe operation of the HPP and infrastructure;	Best practice	Own resources; Some invited consultants may be involved;	Before operation phase launch
3	Development and implementation of Environmental Management System	Minimize environmental and social impacts	Best practice - optional	Own resources; Some invited consultants may be involved; Corresponding expenses should be estimated; Assign personnel responsible for implementation	Before operation phase launch
4	Develop and implement Personnel Training Plan	Train/instruct personnel on labor safety, first aid and environmental issues; If considered reasonable - provide also trainings on monitoring, accident response and other issues	Best practice - obligatory	Own resources; Some invited consultants may be involved; Corresponding expenses should be estimated;	Before operation phase launch
5	Develop and implement Public Relations and Public Involvement Systems	Establish links to public and stakeholders; Develop information exchange format; Develop and adopt discontent management system;	Best practice - obligatory	Own resources; Some invited consultants may be involved; Corresponding expenses should be estimated; Assign personnel responsible for accomplishment	Before operation phase launch

12 Public awareness and participation in the ESIA process

At the initial phase of the environmental and social impact assessment stakeholders (those potentially affected by the project) have been identified, summary of the planned activities and questionnaire forms have been prepared. The summary was prepared in Georgian.

The program, which ensures the involvement of public and all potential stackeholders in the assessment process has been developed. The procedures, volume and format of the provided information, schedule, feedback mechanisms, required resources and personnel have been determined for each group. Information about the measures required at the different stages of the project is given in Table 12.1.

Table 12.1

Phase	Involvement Procedure/Method	Provided information, format
Project planning phase	Interviews with state officials; Interviews and consultations with experts and environmental services; Meetings with personnel, environmental experts.	Press releases and public information via mass media; Technical documentation; Presentation; Public engagement;
Environmental and social impact assessment phase	Interviews with stakeholders; Questioners; Public meetings (population, nongovernmental organizations, etc.);	Nontechnical documentation; Project summary; Public engagement
Construction and operation phase	"Open Door" principle; Complaint Mechanism	Feedback

12.1. Schedule

The frequency and mechanism of stakeholders' engagement in the process have been determined on the basis of risks and impact assessment, sensitivity of environmental receptors and public interests.

At the initial stage of the project, the local government, decision makers and licensing agencies have been informed and consulted. Information has been provided through private meetings, consultations and mass media. The schedule of the consultations is given in Table 12.1.1.

Table 12.1.1

Activities/month (week)	*I month*				*II month*				*III month*				*IV month*	
	1	2	3	4	1	2	3	4	1	2	3	4	1	2
Meetings with participation of "Darial Energy"ltd. (Ltd "Feri", Company Landsvirkjun power) and Scientific Research Firm Gamma: *Identification of stakeholders and other potentially impacted people*														
Meetings with government authorities: *providing information and consultations in order to obtain their support.*														
Mass media advertisements							●	●						
Presenting of draft ESIA report to the Ministry of Environment Protection and Natural Resources, information disclosure to public									●					
Communication with the Ministry of Environment Protection and Natural Resources, local government and environmental experts														
Audit of the project area, meeting with stakeholders – *audit of the territory, identification of stakeholders*														

Stakeholders' analysis, *interviewing in order to determine their opinion about the planned activities.*													
Getting information from public *(deadline – 50 days after advertisement)*													
Public discussion in compliance with Georgian legislation *(no earlier than 50 days and no later than 60 days after advertisement)*													●

During the audit, conducted in July-August 2011, information has been collected and interviews have been held with potentially affected stackeholders.

Information on the planned activities, as well as the date and place of public discussion has been published in"24 Hours" (August 5, 2011 edition). Meetings with stakeholders about the Environmental and Social Impact Assessment of Dariali HPP construction-operation project was held on August 12, 2011, at 13:00 in Administrative building of Stepantsminda Municipality.

Public discussion on Environmental and Social Impact Assessment of Dariali HPP construction-operation project was held on 8 November, 2011 at 14:00 in Administrative Building on Kazbegi Municipality (address: Stepantsminda, #1 A.Kazbegi street). Information about public discussion appointment was published in "24 hours" (September 8, 2011 edition). Information about the notes and proposals received during public discussion process is given in paragraph 12.2.

12.2. Information regarding Comments and Suggestions Received during Public Discussions

#	Authors of comments and suggestions	Content of comments and suggestions	Reply
1	Ministry of Environment Protection of Georgia	EIA report must include general plan of the HPP (including mapping of emission sources); also, parameters of the hydro aggregates, industrial tunnels and other buildings and equipments.	Comment considered. See chapter 4 "Description of HPP Construction and OPeration Project". General plan with indication of emission sources is provided in the technical report on stationary sources of emission and inventory of hazardous substations.
2	„_____„	In order to be able to make relevant decisions in case of geo-ecological complications monitoring plan must be developed for mudflow slopes and potentially hazardous landslide slopes, as for construction phase, so for operation stage of the project.	Comment considered. See chapter 8.2. "Environmental and Social Monitoring Plan"
3	„_____„	Since the selected alternative for diversion channel and underground diversion tunnel lengths includes higher risk in terms of habitat fragmentation, an alternative with less risk for biodiversity should be selected.	Comment considered. In the EIA process a reinforced concrete channel was replaced by a metal underground pipeline with a diameter of 4 m. this will reduce risk of habitat fragmentation to minimum. Also, less sensitive corridor has been selected for proposed pipeline.
4	„_____„	EIA report states, that "activation/generation of hazardous geodynamical processes on the selected areas for HPP stem from hydrological conditions of the territory". This statement needs specification, since development of hazardous geological processes depend on tension of the mountain massif, energy of the relief, existence of rocky layers and high quality of their disintegration.	Comment considered.
5	„_____„	EIA indicates, that "diversion tunnel section has system of four gaps, which include azimuth and tilt angles." It is recommended to discuss the openness of the gaps and the character of the filler material, which determines stability of water absorption by the rocks and filtration of the gap fillers.	According to engineer-geological study results magma rock and tectonic gaps are present within the system. They are not open and have no filling. See paragraph 5.3.2.9.3.

6	„————————„	EIA report needs to specify allocation of inert material storages on the construction phase and date of the emissions.	Comment considered. See chapter 7.3. "Impact on Ambient Air Quality"
7	„————————„	EIA report must fully review flow of technical and drainage water.	Comment considered. See paragraph 4.3.4.1.2. "Technical Water Supply". The document also provides information regarding management conditions of drainage water. Namely: runoff generated during ground works and water from tunnels will be discharged into sediment pits after purification.
8	„————————„	Page 74 of the document states, that "water from the riv. Khdistskali will we used for technical water supply. For abstraction of industrial-fecal and drainage wastewater arrangement of inner sewage system and compact biological facility is considered." General plan of the facility with indication of water intake, industrial-fecal and drainage wastewater and purification facility must be presented, also it must include situational scheme of objects location with mapping of wastewater discharge points.	Comment considered. See paragraph 4.3.4. „Water Supply and Sewage"
9	„————————„	Given, that generated industrial-fecal wastewater will be purified by the "Biotal" compact biological treatment facility, after which the water will be discharged into the riv. Khdistskali, it is important to develop maximum permissible discharge standard and to agree it with the Ministry of Environment Protection.	Comment considered.
10	„————————„	§4.3.4.2.2 states, that "due to specification of works the approximate amount of drainage water cannot be pre-determined. However, in order to prevent turbidity increase of the water during discharge into rivers arrangement of sediment pits is considered." Therefore, qualitative value of the drainage water must not exceed the baseline levels of the suspended particles of the rivers.	Comment considered.
11	„————————„	It is recommended to calculate inert material and cement dust separately in the harmful substance emission report, because maximum permissible concentration of cement dust is more severe than that of inert material dust.	Code of inert material dust was adopted by Silica content 20-70% (2908), which is the same for cement dust.

12	„————————„	It is reasonable to add computer print of the initial parameters of the emissions to the harmful substance emission maps. This would allow to determine exactly which source is responsible for emission.	Comment considered. See EIA report, appendix #1
13	„————————„	According to the law on Air Protection, every legal or private person who has sources of harmful substance emission must develop and agree with the MOE the "technical report on stationary sources of emissions and inventory of the harmful materials".	Comment considered.
14	„————————„	Sub-paragraph 7.9.2.1. (construction phase) states, that "household waste gathered on construction sites will be collected in the utilization pits." It should be noted, that according to the legislation that the household waste must be disposed in the legal landfill. Therefore, generated household waste must be gathered in the relevant containers and removed to the solid waste polygon basing on the agreement with the local municipality.	Comment considered.
15	„————————„	Works to be implemented in the live section of the riv. Tergi lead to significant impacts on the Ichthyofauna of the river, especially on the "Red List" specie – Trout. Hence, we believe it is necessary to have a more effective mitigation and avoidance measures, with a relevant justification of acceptable results. Compensatory actions must be carried out, if necessary.	Given features of the river (spring) trout, namely the short range of migration and ability to create micro population in the tributaries of the river – impact caused by the dam construction should not be significant. However, periodical monitoring should be carried out during 5 years after beginning of construction and if necessary, a fish reproduction plant must be arranged (see paragraph 8.2.2.).
16	„————————„	The report must reflect types of the possible impacts on the "Red List" plant species, as well as number and locations of plants that may be cut/destroyed in case of project implementation. If any risk exists (cut/destruction of the "Red List" specie), actions should be carried out in accordance with requirements of the law on "Red List and Red Book".	According to the results of studies carried out on the territory of the project HPP communication territories no protected species have been recorded. Additional study of the vegetation cover is planned prior to construction works. Relevant recordings are provided in the plan of mitigation measures and recommendations.

17	„————————————„	EIA must define animal species listed in the "Red List" of Georgia, as well as their locations that can be affected due to project implementation. If any, relevant mitigation and avoidance measures should be determined.	Comment considered. The project territory is habitat for only one "Red List" specie – river (spring) trout and relevant mitigation measures are considered. Mitigation Measure Plan also considers mitigation measures for cases if protected animal species accidently enter the project zone form the Kazbegi National Park.
18	„————————————„	2,64 hectares of design HPP gets within the territory of Kazbegi National Partk traditional use area. According to article 8, paragraph 2 of "Temprary regulation norm for Kazbegi National Park": only following is permitted in traditional use area: **a)** Protection, care, restoration and monitoring of wild animals and vegetation of ecosystems located on the territory; **b)** Protection of forres ecosystem, care and restoration; **c)** Non-municipal and municipal scientific research and monitoring; **d)** Educational activities; **e)** Collection of collective invertebrates and herbs in restricted quantities, for educational and scientific activities. **f)** Establishment and arrangement of protective, tourism and recreational infrastructure; **g)** For implementation of restoration measures: arrangement of permanent and temporary orchards and arrangement of aviaries for restoration of animal wildlife; **h)** Movement with automatic and aerial transport means on the territory of traditional use area, in order to carry out corresponding duties during natural hazards, catastrophes, state of emergency and restoration works; **i)** Implementation of cadaster works; **j)** Registration of natural resources; **k**) Transport movement on roads; **l)** Movement of visitors; **m**) maintenance of roads and arrangement-maintenance of pathways; **n)** Population of adjacent settlements are permitted to use non-timber	The note was taken into account. 2,64 hectare territory of Kazbegi National Park, where diversion pipeline of design HPP will be allocated, will be handed to Dariali Energy LTD under special terms of land use, in accordance with Georgian Legislation.

		forest resources, fruits of timber plants, secondary wood materials, also to graft wild timber plants, pasture animals (on non-forest areas), mow, arrange bee farms, where number of bee families should not exceed 300, collect mushrooms and berry and to conduct other activities, permitted by Georgian legislation." It is noteworthy, that for implementation of this project land plot should be granted to the company under special terms of use, which is permitted on the traditional use are of National Park, Considering abovementioned, assignment of land plot under special terms of use needs clarifying.	
19	Zaza Tsiklauri, local resident	Where will be located South portal of the tunnel?	Portal will be in front of former customs office territory, above confluence of rivers Tergi and Khdistskali, on the right bank of the riv. Tergi.
20	„————————„	From which side will the tunneling start? Maybe from the both sides?	Tunneling will be conducted using tunnel-boring machinery, from the side of exit portal.
21	Khulelidze Vaja – Leading specialist of municipality in transport issues	What is the diameter of tunnel-boring machine?	The diameter of tunnel-boring machine is 5.5 m.
22	„————————„	Will existing motorway route be altered?	Existing motorway route will not be altered
23	Zaza Tsiklauri, local resident	Where will the tailrace tunnel pass in regard with the road?	Tailrace tunnel will pass through the depth of mountain on the right bank of riv. Tergi and therefore will not have anything to do with the road.
24	Roland Kobaidze – Cheief of municipality Information Department	Who made these assessments, including assessment of negative impacts?	Environmental and Social Impact Assessment of planned activity was conducted by independent consulting companies – Scientific-research Company "Gamma" and "Stucky Caucasus" LTD. Ecological Expertise Conclusion will be issued by The Ministry of Environment of Georgia on the basis of assessments, made by independent experts.

25	„_____"	Will any kind of negative impact be propagated to the Russian Federation territory?	ESIA report includes trans-boundary impact assessment, according to which on the section of the riv. Tergi, located on the territory of neighboring state, propagation of any significant impact is not expected.
26		Considering small distance with the border, how safe will be design unit, from let's say terrorist attack?	This issue is subject of political and state analysis and requires more deep discussion, which exceeds the limits of ESIA. Generally we may state, that development of infrastructure and increase of production potential in frontier regions should be considered as significant act for strengthening internal security.
27	Zaza Tsiklauri, local resident	As for sediment flow – you said that it will be fully discharged. How will it be done according to the project?	Project considers arrangement of low dam with a spillway, which will ensure full discharge of surplus water and solid sediment to the downstream. The dam will have locking shields, which could even discharge catastrophic flow of the riv. Tergi, including solid sedimets. In case of any other design solution, it will be impossible to operate the HPP.
28	„_____"	"Exit" (term used by locals describing high water period) of rivers Kuro, Tergi and Chkhera does not coincide, so how will this affect sediment movement? I'm interested whether it will be necessary to transport sediment mechanically, i.e. by transport, or not?	Sediment flow is characteristic to high-water periods, where volume of water ensures sediment transportation. Therefore need of artificial involvement in sediment movment is not expected.
29	Besik Sujashvili – Member of City Council, Representative of "Stephantsminda" NGO	I would like to draw your attention to socio-economic field. According to my information, taxes of large companies go to the central budget, and you state that these fund will flow to local budget. Please clarify this issue.	Local budget will get property tax, which will significantly exceed million GEL. Even if we neglect other incomes, property tax will be very significant for budget of Kazbegi.
30	„_____"	How many person will be employed on construction and operation phases?	As it is known, construction works will be conducted by the contractor, selected through the tender. Dariali Energy LTD will oblige this contractor (under contract terms), to hire 90% of inexperienced workforce from local settlers. Local population, no less than 80 person will be employed on all stages of construction. Minimal daily wage will be 20 GEL.

31	„————————„	Is training of local employees taken into consideration?	Company considers training of local personnel both on construction and operation stages. Training will be conducted on site, but it is possible that some personnel may be assigned to other regions of the country or even sent abroad.
32	„————————„	Socio-economic side of this project is not very impressive. It is obvious that no benefits are considered for local population.	In agreement with local municipality, the company Dariali Energy LTD will participate in implementation of different social programs. As for reduction of electricity tariff, it is beyond competence of investor company.
33	„————————„	What will be the total number of employed personnel?	Total of 300 person will be employed on construction phase, including administrative personnel and workers of investor company and different contractors.
34	NGOs “Green Alternative” and “Stephantsminda” „————————„	Notes of non-governmental organizations and comments of EIA group is given in appendix of Public Discussion Protocol.	

13 Conclusions and Recommendations

Throughout the environmental and social impact assessment for the HPP construction and operation on Tergi River following conclusions and recommendations are made:

Conclusions:

- According to the feasibility study, one-stage run-of-river HPP will be constructed and operated on Tergi River. According to survey results conducted during development of present document, no significant environmental impact is foreseen during construction and operation phases of HPP, namely:
- Construction of low level, small dam and lateral water intakes is planned at the headworks. They will ensure full discharge of extra water and solid sediments to the downstream. Therefore there is a minimum risk of negative impact on hydrology and bank stability of Tergi River
- Fish ladder will be arranged at the dam and fish protection structure at intake, which will minimize negative impact on ichtyofauna;
- Structure of the headworks requires arrangement of only small size impoundment in upstream of the dam, which will not cause negative impact on regional climate and meteorological conditions and will significantly reduce risks of geological hazard development;
- According to the project, headwork should ensure environment flow (10% of 50% average multiannual flow), which (in some hundred meters from the dam river Tergi connects to the river Kuro, small tributaries and afterwards river Devdokari) will create some reasonable conditions for Tergi River ichthyofauna;
- Majority of HPP communications: diversion pipeline, diversion tunnel, power house, headrace channel, will be arranged underground; besides there will be recultivation works. All these factors combined, significantly reduce impact on regional bio-environment as well as visual-landscape impact risks;
- Considerable amount (approximately 60%) of waste rock produced during HPP construction phase will be used during construction of HPP infrastructure (as construction material). Main part of waste rock will be stored on right side of the riv.Tergi with purpose to use them during construction phase of “Larsi HPP” diversion pipeline; unused waste rock will be used for maintenance-rehabilitation of local Municipality roads.
- Construction site will be arranged on the territory without any vegetation cover; after completion of works, project considers recultivation works of the used territory; no significant bio-environment impact is expected;
- Considering that construction works will be conducted on a reasonable distance from settlements, impact from air quality deterioration will be insignificant;
- According to the estimations given in the report noise impact will be insignificant during construction and operation phases. Certain impact on fauna is anticipated; however, this disturbance will be short-term and disturbed specimens should return to their native habitats right after construction;
- In case of proper environmental management and implementation of designed mitigation measures impact on aquatic environment should not be significant neither on construction nor on operation phases;
- Due to reasonable distance between power transmission lines and residential zones no measures are required to mitigate impact of electric field.
- Considering that construction site will be located on a reasonable distance from settlements and that traffic routes selected for transportation (only military road of Georgia will be used for transportation purposes), no increase of traffic flows are expected;

- Only state and municipal lands will be used during HPP construction-operation phase; so there is no risks of property loss;
- Considering planned mitigation measures during HPP construction and operation phase, trans-boundary and cumulative impact will not be significant;
- The HPP implementation project will cause positive impacts, such as:
  - On the construction and operation phases local population will be employed for a number of temporary and later permanent jobs at the HPP infrastructure, which is extremely important for local population employment; (as per social policy of "Darial Energy" 80% on low qualification working places employed staff will be local)
  - The HPP construction and operation project includes rehabilitation of local roads which should be assumed as a positive impact on local population;
  - The HPP construction and operation project will positively affect Kazbegi Municipality as well as socio-economic development of Mtskheta-Mtianeti region.

Besides:

- Considerable anthropogenic load due to construction works will cause serious impact on local wildlife. Though it is noteworthy that the impact will be a short-term and animal species will return to their habitats right after construction;
- Some significant impact is anticipated due to fragmentation of habitats due to construction of diversion pipeline and access roads, which may be reduced with corresponding mitigation measures, namely: completion of civil works in short period of time; arrange temporary crossings above pipeline channel during construction period;
- The HPP construction may limit free transportation of population and some agricultural activities; but this will be a short-term impact which will last till completion of civil works.
- Expected hydrological changes (water deficit) in the riverbed of Tergi river in upstream of the dam during HPP operation phase, can be considered as significant impact; permanent negative impact on river ichthyofauna may be evaluated similarly significant.

Recommendations:

- Construction Company is liable to control and ensure implementation of mitigation measures specified in the environmental and social impact assessment report and the environmental management plan;
- Temporary storage for hazardous waste must be arranged on construction site during construction phase and on the HPP territory during operation phase;
- Removal and further management of hazardous waste formed on construction and operation phases must be carried out by contractors with appropriate permits;
- Electro-gas and vacuum switch should be mounted at every substation;
- Hydrological parameters of the Tergi River should be regularly recorded in the HPP alignment. Establish control on sanitary flow in dam downstream;
- To optimize compliance with oil storage and handling standards throughout the HPP operation, special warehouse are must be arranged, which will be equipped with anti-spill facilities;
- For transformers, reinforced-concrete tanks and underground reservoirs must be arranged, which will prevent spilled oil leakage outside the territory;
- On the territories of substations and oil storage areas spill control kits must be located;
- In every case of oil spill the administration must conduct pollution prevention measures and inform the ministry of Environment Protection;
- For wastewater purification compact biological treatment facility must be arranged on HPP territory;

- Wherever protected species are found during clearance works, they shall be extracted in compliance with Georgian Law on Georgian Red List and Red Book, paragraph 24, clause 1, sub clause 'v',
- During first 5 years of HPP operation monitoring of ichthyofauna condition of the river Tergi will be provided in order to define fish ladder effectiveness and if required arranging and operation of trout reproduction farm must be considered.
- Before commencement of civil works 2.64 hectare of Kazbegi National Park zone where diversion channel, sedimentation basin and diversion pipeline must be located is to be handed-over to Project implementation Company.
- The HPP personnel training and testing (every 6 months) on environmental and occupational safety issues for staff – is a must;
- Organization of medical insurance for staff is desirable;
- To minimize geo-hazards formation throughout construction of HPP infrastructure and access roads the following mitigation/ prevention measures are to be executed:
    - Remove upper layer of landslide formations of upper slopes and ensure deviation angles for slope stability;
    - Remove upper layer of landslide formations of upper slopes and ensure deviation angles for slope stability;
    - Organized withdrawal of surface and groundwater, with a condition that this will not lead to moisturizing of lower slopes;
    - Arrangement of (timber and stone type) gabions to avoid deformation of road sub-grade;
    - To prevent erosions and landslide processes during construction of roads, concrete canals (ditches), must be arranged along the project roads;
    - Groundwater from channels arranged along the roads must be discharged into the riv. Tergi and its tributaries;
    - After completing construction works, construction sites must be recultivated and vegetated;
    - Special attention is to be paid to landfill of worked out slope during HPP construction period as well as to water drain and water discharge systems proper operation for motor road.
    - During HPP operation phase monitoring of hazardous geological process development must be provided and in case of necessity corresponding prevention measures must be implemented.
- If extraction of inert materials from riv. Tergi floodplains is necessary, these works must be conducted under corresponding license for resource mining.

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15 Appendices

15.1 Annex №1 Waste Storage Conditions and Movement Scheme during Power Plant Construction-Operation

№	Description of waste	Waste management	Safety conditions during storage and transportation	Waste processing, burial or utilization conditions
1	2	3	4	5
1. Domestic waste				
1.1.	Domestic and food waste	• **Waste collection and delivery to domestic solid waste landfill** • Collection and disposition of waste – in special containers placed in operation sites. • Removal from operation grounds by municipal trucks under agreement. **DSWL=domestic solid waste landfill**	• Prohibited is to put in solid domestic containers waste of 1, 2 and 3 hazard class waste, including luminescent tubes, oily waste and others, those are not allowed for disposal to domestic solid waste landfill. • To disposal site waste shall be transported by special vehicles to avoid pollution of environment.	Landfilling: according to sanitary rules and domestic solid waste landfill operation rules **Responsibility:** contractor
1.2.	Waste paper, card-board, plastic bags			
1.3.	Broken glass, plastic and rubber waste, faulty bulbs			
1.4.	Swept waste, dead leafs			
2. Hazardous class 3 and 4 waste allowed for disposal to domestic waste landfill				
2.1.	Broken roofing slates, asbestos-cement waste	**Waste collection and delivery to domestic solid waste landfill** Collection and disposal: • broken roofing tiles, asbestos waste – to be packed in plastic bags and kept in enclosed open-air sites. • paronite, plastic and rubber pipes, glass fiber, foam plastic waste – within bounded open ground. • wood waste, chips – under shed or areas covered with plastic • Delivery to domestic solid waste landfill using the FIZ transport	• Prohibited is placement of industrial waste in containers allocated for domestic solid waste. • Removal of 3 and 4 hazard class is done only following consent from the landfill management and availability of relevant 'control slip' • During transportation safety measures required to avoid pollution of environment must be put in place.	Landfilling: according to sanitary rules and domestic solid waste landfill operation rules **Responsibility** contractor
2.2.	Paronite, plastic and rubber waste			
2.3.	Paper and wooden packaging waste			
2.4.	Wood waste, chips			
2.5.	Plastic pipes, glass fiber, sandpaper, abrasive dust waste			
3. Industrial waste prohibited for disposal to domestic waste landfill				
3.1. **Mercury containing waste and materials:**				
3.1.1.	Luminescent tubes	**Accumulation – removal to storage**	Burned out luminescent tubes are replaced and	• Shall be delivered to

		Collection on operation grounds: • Placement in dry, integer packaging, which exclude the risk of any damage during transportation; • damaged or broken lamps must be placed in plastic bags, tied up and placed in cardboard boxes. Premises – ventilated. • Accumulation of this type of waste on operation ground is prohibited. • to the temporary storage facility is done on the FIZ vehicles in compliance with the completed document.	collected by adequately trained staff. Prohibited is: • storage in the open air ; • storage in open premises; • storage unpacked; • piling; • placement on the ground; • handing over to organization not authorized for processing of this type of waste. • During transportation safety measures required to avoid pollution of environment must be put in place.	temporary storage facility. • Handed over authorized contractor for subsequent utilization.
3.1.2.	Mercury thermometers waste	**Accumulation – removal to storage** • Accumulation – in tight plastic bags placed in wooden boxes. • Accumulation on the spot of generation is prohibited • Removal – to temporary storage in compliance with the completed document	Prohibited is: • placement of mercury thermometers in containers allocated for domestic solid waste disposal. • storage in the open air and without packaging. • litter around. • In case of damage and spillage of mercury treatment/neutralisation of premises must be carried put.	Is subject to removal to temporary storage facility. Handed over authorized contractor for subsequent utilization.
3.2. Waste chemicals				
3.2.1	Residues of liquid chemicals Expired medical supplies	**Accumulation – removal to storage** • accumulation – in plastic bags placed in cardboard boxes, properly labelled: name, quantity, date. • accumulation – in storage, equipped with changing ventilation system, in special registration book, indicating corresponding data. • storage in compliance with the completed document.	Prohibited is: • placement of chemical solutions in containers allocated for domestic waste disposal • storage in the open area and without packing • scattering around • During transportation of chemical solution waste all safety rules must be observed to prevent environment pollution.	Is subject to removal to temporary storage facility. Handed over authorized contractor for subsequent utilization.
3.3. **Lead containing waste**				
3.3.1	Waste lead accumulators (drained of accumulator acid)	**Accumulation- removal to storage** • accumulation – on vehicle ground, in ventilated premises. • Storage in ventilated premises, in wooden boxes based on metal supports	Prohibited is: • placement of accumulators waste in containers allocated for domestic waste disposal • disposal of accumulator acid into sewer.	Is subject to removal to temporary storage facility. Handed over authorized contractor for subsequent utilization.

		• storage in compliance with the completed document.	• mechanical processing of accumulators. long-term storage on the spot of generation (>1 week).	
3.4. Waste slightly contaminated with oil (oil content <15%)				
3.4.1	Oily rags	**Accumulation – removal for utilization** • accumulation – in special labelled container, on the spot of generation. • removal for utilization (incineration) under agreement with contractor.	Prohibited is: • placement of oily waste in containers allocated for domestic waste disposal • scattering around • during transportation safety measures required to avoid pollution of environment must be put in place.	Handed over authorized contractor for subsequent utilization.
3.4.2	Used oil filters	**Accumulation - removal to waste storage** • accumulation – on the spot of generation, in plastic bags placed in cardboard boxes • removal to waste storage in compliance with the completed document.	Prohibited is: • placement of oily waste in containers allocated for domestic waste disposal • scattering around • during transportation safety measures required to avoid pollution of environment must be put in place.	Is subject to removal to temporary storage facility. Handed over authorized contractor for subsequent utilization.
3.5. **Waste oil and petroleum products**				
3.5.1	Used industrial oils and lubricants	**Accumulation – removal to waste storage** • accumulation - on the spot of generation, in closed plastic or metal containers. • removal to waste storage in compliance with the completed document.	Prohibited is: • spillage of oil. • disposal into industrial-storm water drainage system, pouring on soil or disposal into water body.	Is subject to removal to temporary storage facility. Handed over authorized contractor for subsequent utilization.
3.5.2	Used transformer (no POPs, eg. PCB containing) oil	**Accumulation – removal to waste storage** • accumulation – on the spot of generation, in closed plastic or metal containers. • removal to waste storage in compliance with the completed document.	Prohibited is: • spillage of oil. • disposal into industrial-storm water drainage system, pouring on soil or disposal into water body. • transportation of oil together with other materials or waste.	Is subject to removal to temporary storage facility. Handed over authorized contractor for subsequent utilization.
3.6. Plastic and rubber waste				
3.6.1	Waste tyres	**Accumulation – removal to waste storage** • collection – on the spot of generation, • accumulation- not recommended. • removal to waste storage in compliance with the completed document.	Burning of rubber articles is strictly prohibited.	
3.6.2	Waste laser printer cartridges	**Collection –removal to solid domestic waste landfill**	• Prohibited is disposal of cartridges in containers allocated for domestic waste	Landfilling: according to sanitary rules and

		• collection – in plastic packages, on the spot of generation. • accumulation – in long-term storage. • removal – by licensed contractor *SDW –solid domestic waste	• Waste can be disposed only following consent from the landfill management and availability of relevant 'control slip' • During transportation safety measures required to avoid pollution of environment must be put in place.	domestic solid waste landfill operation rules • **Responsibility** Organization contractor
3.7. **Medical waste**				
3.7.1	Used cotton wool and syringes.	**Collection- removal for utilization** • in plastic bags, on the site of generation. • Removal for utilization (incineration) under agreement with contractor	Prohibited is disposal of medical waste in containers allocated for domestic waste or scattering around.	Handed over authorized contractor for subsequent utilization.
3.7.2	Expired medical supplies			
3.8. Waste paint and paint cans		**Accumulation – removal of waste to the storage** • collection – in wooden boxes, on the spot of generation. • accumulation – on the spot of generation, in closed premise or under a shed on solid base, until completion of works. • removal - to long-term waste storage facility based on relevant documents.	Prohibited is: • placement of paint and metal drums in containers allocated for domestic waste disposal. • scattering/spilling around.	Is subject to removal to temporary storage of contaminated soil. Handed over authorized contractor for subsequent utilization.
3.9. Scrap metal				
3.9.1	Ferrous and non-ferrous scrap metal	**Accumulation – removal of waste to the storage** • collection – within specially allocated area on the spot of generation. • accumulation - within specially allocated area on the spot of generation. The area must be sloped towards industrial-storm water collector well. • removal – to waste storage based on relevant documents.	Prohibited is: • placement of metal waste in containers allocated for domestic waste.	Is subject to removal to temporary storage of contaminated soil. Handed over authorized contractor for subsequent utilization.
3.9.2	Waste welding electrodes	**Accumulation – removal of waste to the storage** • collection – on the spot of generation. • accumulation – in metal drums or wooden boxes, on the spot of generation up to completion of maintenance works. • removal – to waste storage based on relevant documents.	Prohibited is: • placement of metal waste in containers allocated for domestic waste.	Is subject to removal to temporary storage facility. Handed over authorized contractor for subsequent utilization
3.10. **Wood waste**				
3.10.1	Wooden pieces	**Accumulation – removal by private persons** • collection – in situ, at certain places • removal – delivery to pre-agreed place using	Prohibited is: • placement of wood waste in domestic waste containers	Handed over private persons on contractual basis or terms established by the company

		the company's or rented vehicles		
3.11. **Waste heavily contaminated with oil**				
3.11.1	Contaminated soil and sand	**Accumulation – removal of petroleum-contaminated soil to temporary storage** • collection – in metal tanks (on the spot of generation). • accumulation - on the site of generation is not recommended. • placement – in temporary storage of petroleum-contaminated soil, based on relevant documents.	Prohibited is: • placement of unpacked waste on soil or open ground. • discharge into the water body. • During transportation –spill prevention measures put in place.	• Is subject to removal to temporary storage of contaminated soil. • Handed over authorized contractor for subsequent utilization.