Draft Environmental and Social Impact Assessment – Part 1

Project Number: 47919
June 2013

GEO: Adjaristsqali Hydropower Project

Prepared by Mott MacDonald for Adjaristsqali Georgia LLC



Adjaristsqali Hydropower Cascade Project

ESIA - Volume I Non Technical Summary

October 2012

Adjaristsqali Georgia LLC

Clean Energy Group

Mott MacDonald

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1. Abashidze Street 6, 6010 Batumi, Georgia

Issue and revision record

Revision	Date	Originator	Checker	Approver	Description
A	07.02.12	J. Glass	V. Hovland	L. Chapman	Draft for Client approval
B	19.03.2012	J. Glass	V. Hovland	L. Chapman	Draft for Disclosure
C	30.03.2012	V. Hovland	V. Hovland	L. Chapman	Final draft disclosure
D	30.10.2012	V. Hovland	V. Hovland	L. Chapman	Final Report

Content

1. Introduction

1.1 Overview

This non-technical summary (NTS) presents the main findings and conclusions of the Environmental and Social Impact Assessment (ESIA) undertaken for the construction, operation and decommissioning of the Adjaristsqali Hydropower Cascade (the Project).

Adjaristsqali Georgia LLC (hereafter referred to as AGL) is undertaking the development of the Adjaristsqali Hydropower Cascade Project (the Project) in the Autonomous Republic of Ajara, Georgia. The Project is expected to have a total installed capacity of 400 MW of renewable energy.

The Project is comprised of three separate hydropower schemes operating in cascade along the Adjaristsqali River. Each scheme consists of a combination of dams and weirs, reservoirs, headrace and transfer tunnels, powerhouse, power evacuation, and access roads. .

AGL has commissioned Mott MacDonald Ltd as their International Environmental Consultant to undertake the Environmental and Social Impact Assessment (ESIA) and Environmental and Social Management Plan (ESMP) of the Project in compliance with national permitting requirements as well as international finance requirements. Supporting Mott MacDonald are local consultants Gamma Consulting Limited (hereafter referred to as Gamma) who have undertaken baseline studies, local consultation activities, and development of documentation required in accordance with national permitting requirements.

1.2 Who is Adjaristsqali Georgia LLC (AGL)?

Clean Energy Group (CEG) has been set up to develop greenfield hydropower projects in countries with an untapped hydro potential and a sustainable energy framework. Adjaristsqali Georgia LLC (AGL), part of CEG, has been set up as a special purpose vehicle (SPV) to develop the hydro potential in the Adjaristsqali River and its tributaries. AGL is developing the Project in cooperation with the International Finance Corporation's (IFC) InfraVentures, an early stage project development fund launched by IFC, a member of the World Bank Group. The IFC is currently the key financial institution whom AGL have approached to provide funding. It is anticipated that the European Bank for Reconstruction and Development (EBRD) will also be approached by AGL.

1.3 Where Can I Find More Information About the Project?

A dedicated website (www.adjaristsqali.com) has been generated for the Project where information about the Project background, progress, and additional sources of Project related information can be accessed. Table 1.1 sets out the contact details for enquires on this ESIA.

Table 1.1: Project Contact Details (Head Office)

Project Proponent	Information
Name of Company	Adjaristsqali Georgia LLC (AGL)
Address	I. Abashidze Street 6, 6010 Batumi, Georgia
Telephone	+995 599 715125
E-mail	info@adjaristsqali.com
Website	www.adjaristsqali.com

2. The Project

2.1 Where is the Project?

The Project is located within the Autonomous Republic of Adjara (hereafter referred to as Adjara) situated on the Black Sea littoral in the south-west of Georgia, as shown in Figure 2.1. The status of Adjara as an autonomous republic was confirmed by the Constitutional Law of Georgia on 20 April 2000. Adjara remains part of Georgia and is governed in accordance with the principles of the national constitution.

Adjara is bordered by Turkey to the south, the Meskheti mountain range to the north; the Arsiani mountain range to the east and the Black Sea to the west. The area comprises 2,900 km^2 and constitutes 4.2% of the whole territory of Georgia. Adjara is made up of five administrative units (municipalities) – Kobuleti, Khelvachauri, Keda, Shuakhevi and Khulo. The Project has a direct influence (although to greater and lesser extent depending on the scheme) on all five municipalities. The Project area of influence is illustrated in Figure 2.2.

Figure 2.1: Project Location within Georgia

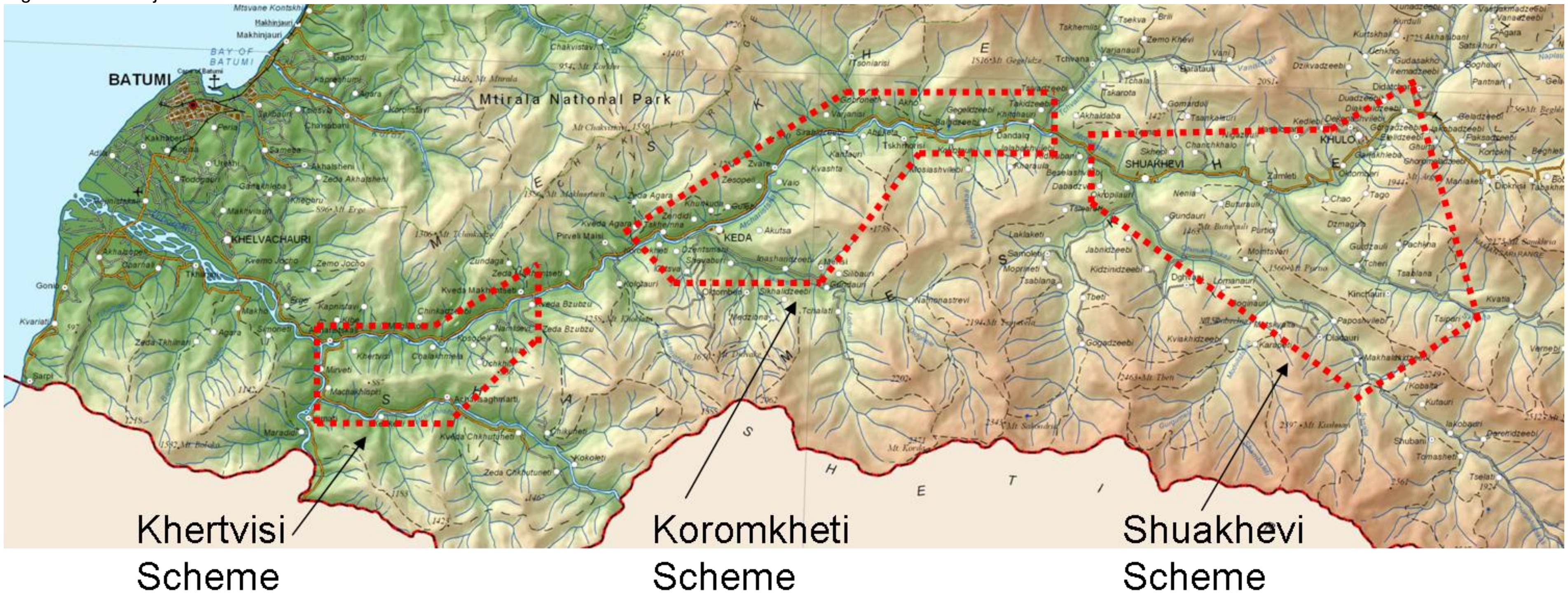
Source: Mott MacDonald Ltd

The municipalities are mostly rural with a total population of approximately 176,000. Ethnic Georgians (largely of Christian Orthodox and Muslim denomination) represent the majority of the local population. Depending on the altitude the main income source for the local population consists of growing vegetables (potatoes and tomatoes among others), fruits, tobacco, grapes, and cattle farming.

The region as a whole is highly sensitive to various natural hazards including mudflows, erosion and landslides. The Adjaristsqali River originates from the western part of the Arsiani mountain range, 2435 m above sea level. The total length of the river is 90 km, total fall – 2397 m, average inclination – 26.6%. The catchment area is 1540 km^2 with an average height of 1400 m. The river joins the Chorokhi River from the right side some 17 km from the outfall of the Chorokhi River into the Black Sea.

Most of the area is covered by the forests. In the downstream area, 1000-1200 m, leaf bearing forest is present, at 1200 - 2000 m elevation conifer forest is present and above 2000m only Alpine valleys are present and make up only 15-20% of total basin area. The Adjaristsqali River inflows are provided by snow, rain and ground water. The primary input is rainfall which is the main source of river water inflow (44%); groundwater and snow respectively contribute 30% and 26%. There are no glaciers in the catchment.

Figure 2.2: Project Area of Influence



Source: Mott MacDonald Ltd

2.2 What is the Project?

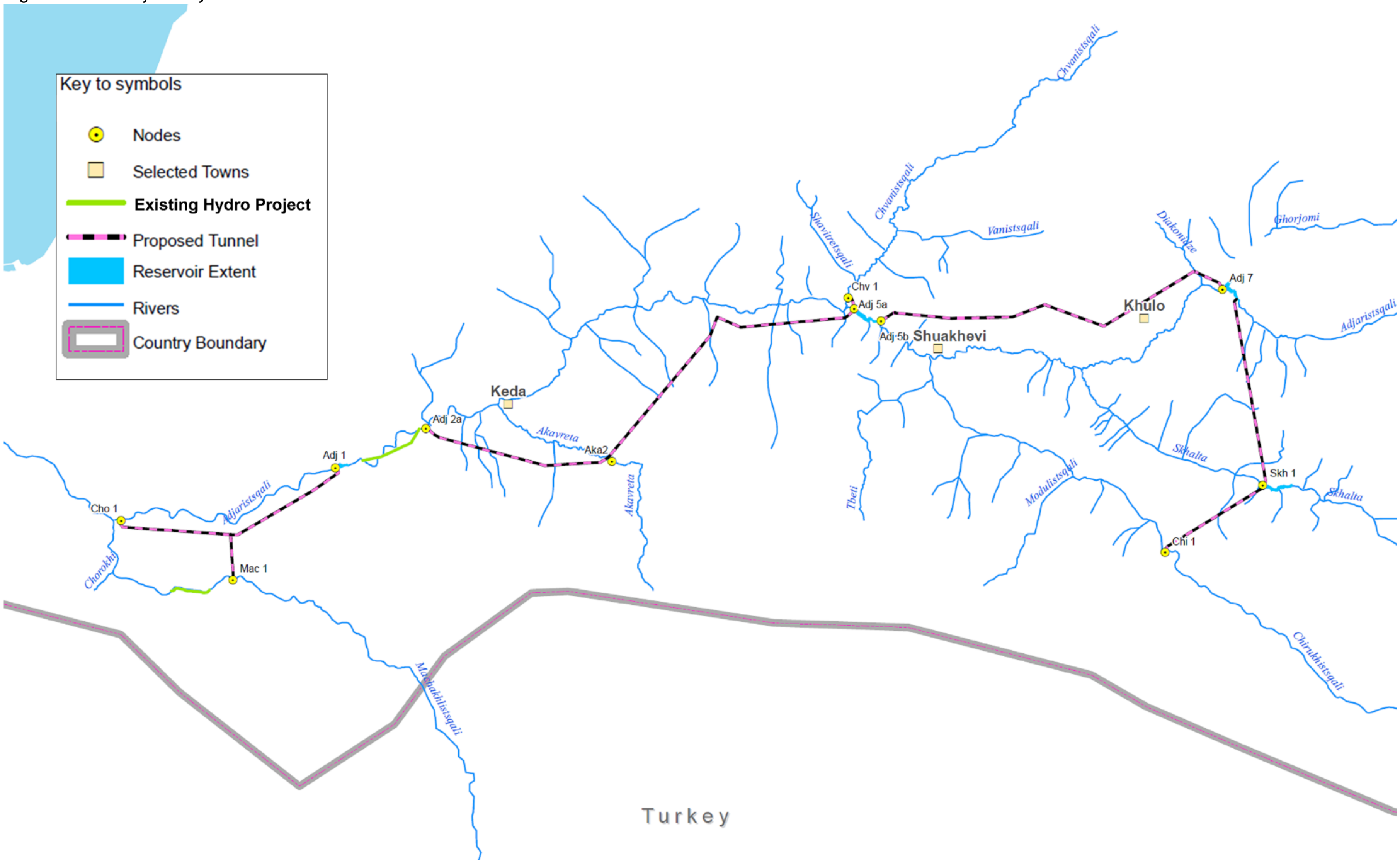
The Project consists of three cascade schemes, Shuakhevi 185 MW, Koromkheti 150 MW, and Khertvisi 65 MW. This would be an annual average production of between 500 and 1200 GWh of renewable electricity depending on whether one or all three schemes are constructed. The Project is expected to supply the Georgian and Turkish power systems. The Project will also enable Georgia to use more of its energy resources to meet electricity demand during the winter months of December, January and February. The Project will require transmissions lines for transporting the generated electricity to substations for eventual use by consumers. Details of the individual cascade schemes are:

- **Shuakhevi Scheme** – will have installed capacity of 185 MW and is comprised of two dams with reservoirs and one weir on the Adjaristsqali, Skhalta and Chirukhistsqali Rivers respectively. A series of transfer and headrace tunnels connect the reservoirs to the Shuakhevi Powerhouse to be located just upstream of the Adjaristsqali and Chvanistsqali confluence. The majority of the installed capacity will be at the main powerhouse, however an additional 10 MW of installed capacity is provided at the Skhalta dam where a small turbine will be installed to take advantage of transfer from the Chirukhistsqali River.
- **Koromkheti Scheme** – will have an installed capacity of 150 MW and is comprised of one large dam and reservoir on the Adjaristsqali River (immediately downstream of the Shuakhevi powerhouse), one low dam on the Chvanistsqali River, and a weir on the Akavreta River. The project includes transfer tunnels from the dam to the powerhouse located downstream on the Adjaristsqali River.
- **Khertvisi Scheme** - will have an installed capacity of 65 MW scheme and is comprised of one dam and reservoir on the Adjaristsqali River as well as a weir on the Machakhlistsqali River. A headrace tunnel from the main dam to the Khertvisi powerhouse located just upstream of the confluence of the Chorokhi and Adjaristsqali Rivers, with a transfer tunnel from the Machakhlistsqali River.

See Figure 2.3 for an overview of the project layout components.

The Project under consideration does not include for the development of transmission lines to export power generated to the national grid. The transmission line is part of an overall transmission line expansion for Georgia and will be the subject of a separate ESIA to be developed by the Government of Georgia on behalf of the Georgian State Electro System LLC (GSE) in accordance with national requirements. Initial studies for the development of the transmission line are already underway and contracts under negotiation for full studies and development. Construction of the transmission line will take approximately two years with commissioning planned in April 2016.

Figure 2.3: Project Layout



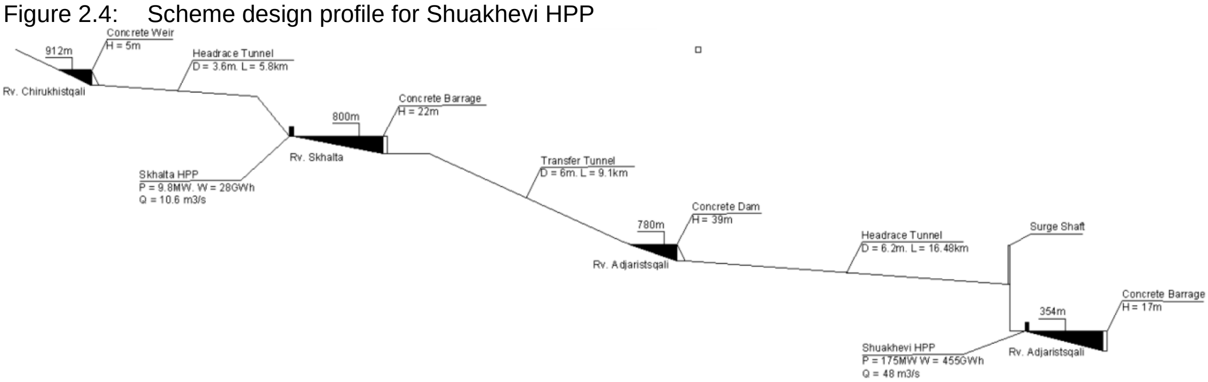
The Shuakhevi scheme will be based on diverting water from the Chirukhistsqali and Skhalta Rivers into a reservoir on the Adjaristsqali River which will provide mainly diurnal storage and from which a head race tunnel on the right bank will take water to a powerhouse downstream from the Shuakhevi village on the Adjaristsqali River (Figure 2.4). Additional storage will be provided on the Skhalta River at the Chirukhistsqali outfall and before the Skhalta to Adjaristsqali transfer. A small powerhouse will be built at the Chirukhistsqali outfall to generate from the head differential of over 100 m. The key components of the scheme are detailed in **Error! Reference source not found.** and illustrated in Figure 2.4

Table 2.1: Shuakhevi Scheme Key components

Node Figure Reference	Description	Key Parameters
Chi 1	Weir, sediment trap and run-of-river intake on Chirukhistsqali to transfer / headrace to Skhalta River	Level: 912 m
Chi 1 to Skh 1	Transfer / headrace tunnel to Skhalta Reservoir / Skhalta Powerhouse	Lining type: Unlined Length: 5.8km, Diameter: 3.6 m Design capacity: 10.6 m^3/s
Skh 1	Powerhouse	Type: Surface Units: 9.8 MW (2 x 4.9 MW) Pelton
Skh 1	Dam and Skhalta Reservoir	Type: Concrete barrage Height: 22 m Approx. reservoir capacity: 493,000 m^3 Approx. surface area: 194,000 m^2
SKh 1	Intake to Transfer Tunnel	Operating levels: 790 to 800m
Skh 1 to Adj 7	Skhalta to Didachara Transfer Tunnel	Lining type: Unlined Length: 9.1km Diameter: 6.0m Design capacity: 25 m^3/s
Adj 7	Didachara Dam and Storage Reservoir	Type: Concrete dam Height: 39m Approx. reservoir capacity: 623,000 m^3 Approx. surface area: 169,000 m^2
Adj 7	Intake to Headrace Tunnel	Operating levels: 770 to 780m
Adj 7 to Adj 5b	Headrace Tunnel Intake to Surge Shaft	Lining type: Unlined Length: 16.48km Span and Height: 6.2m Design capacity: 48 m^3/s
	Surge Shaft	Lining type: Unlined Height: 154.9m (CL to GL) Diameter: 12.0m
	Headrace Tunnel Surge Shaft to Pressure Shaft	Lining type: Unlined Length: 0.05km Span and Height: 6.2m Design capacity: 48 m^3/s
	Pressure Shaft	Lining type: Unlined Height: 370.7m Diameter: 6.2m

Node Figure Reference	Description	Key Parameters
	Pressure Tunnel Unlined	Lining type: Unlined Length: 0.48 km Span and Height: 6.2m Design capacity: 48 m^3/s
	Pressure Tunnel Steel Lined - Single	Lining type: Steel Lining Length: 0.75km Diameter: 4.5m Design capacity: 48 m^3/s
	Pressure Tunnel Steel Lined - Bifurcation (Surface)	Lining type: Steel Lining Length: 17m (Along Chainage) Diameter: 3.2m Design capacity: 48 m^3/s (2 x 24 m^3/s)
Adj 5b	Shuakhevi Powerhouse	Type: Surface Units: 175 MW (2 x 87.5 MW) Francis

Figure 2.4: Scheme design profile for Shuakhevi HPP



Source: Mott Macdonald

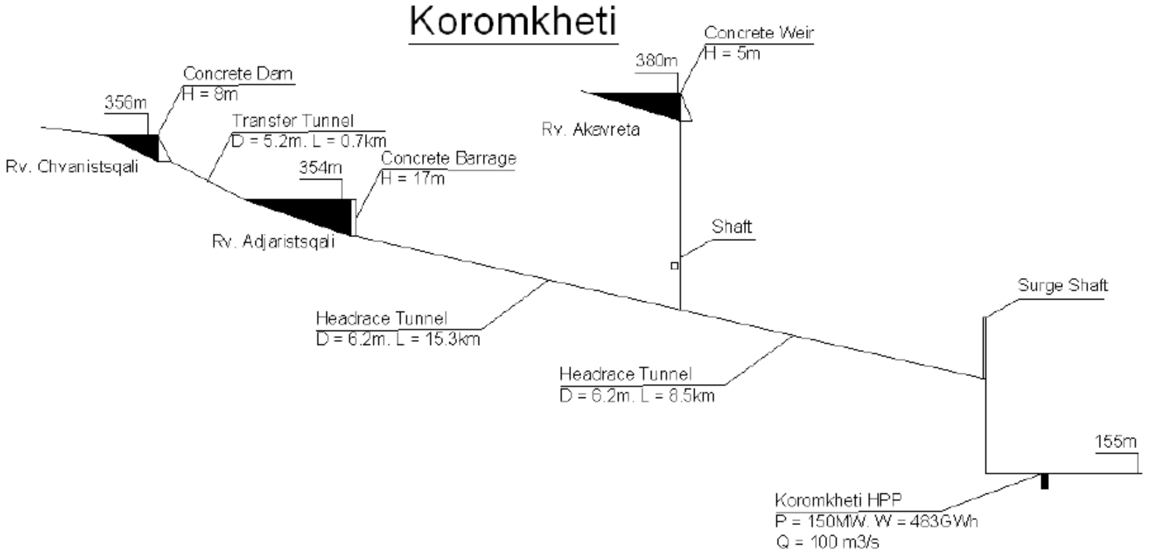
The Koromkheti Scheme will be taking water discharged from the Shuakhevi Scheme plus water flowing into the Adjaristsqali, Skhalta and Chirukhistsqali Rivers downstream from the Shuakhevi intake together with flow diverted from the Chvanistsqali River through the small Khichauri Reservoir, which will provide some additional diurnal storage into the headrace tunnel which will be located on the left bank to the Koromkheti powerhouse below the village of Keda on the Adjaristsqali River and just above the existing Atsi hydropower scheme. The key components of the scheme are detailed in Table 2.2 and in Figure 2.5 below.

Table 2.2: Koromkheti Scheme Key Components

Node Figure Reference	Description	Key Parameters
Chv 1	Run-of-river weir and sediment trap on Chvanistsqali River with intake into transfer to Khichauri Reservoir	Level: 356m
Chv 1 to Adj 5a	Transfer to Khichauri Reservoir	Lining type: Unlined Length: 0.67 km Diameter: 5.2 m Design capacity: 25 m3/s
Adj 5a	Khichauri Dam and Storage Reservoir	Type: Concrete barrage Height: 19m Approx. reservoir capacity: 577,000 m3 Approx. surface area: 187,000 m2
Adj 5a	Intake to Headrace Tunnel	Operating levels: 349 to 354m
Adj 5a to Aka 2	Headrace Tunnel Intake to Akavreta	Lining type: Concrete lined Length: 15.32 km Diameter: 6.2 m Design capacity: 100 m3/s
Aka 2	Weir, sediment trap and intake on Akavreta River	Level: 380 m Capacity: 18 m3/s
	Akavreta Intake Shaft	Lining type: Concrete lined Height: 35.4m Diameter: 4m Capacity: 18 m3/s
	Akavreta Intake Tunnel	Lining type: Concrete lined Length: 0.29km Diameter: 6.2m Capacity: 18 m3/s
Aka 2 to Adj 2a	Headrace Tunnel Akavreta to Surge Shaft	Lining type: Concrete lined Length: 8.54 km Diameter: 6.2 m Design capacity: 100 m3/s
	Surge Shaft	Lining type: Concrete lined Height: 110.8m (CL to GL) Diameter: 20.0m
	Headrace Tunnel Surge Shaft to Pressure Shaft	Lining type: Concrete lined Length: 0.097km Diameter: 6.2m Design capacity: 100 m3/s
	Pressure Shaft	Lining type: Concrete lined

Node Figure Reference	Description	Key Parameters
		Height: 141.1m Diameter: 6.0m
	Pressure Tunnel Concrete Lined	Lining type: Concrete lined Length: 0.48km Diameter: 6.2m Design capacity: 100 m3/s
	Pressure Tunnel Steel Lined - single	Lining type: Steel lined Length: 7m Diameter: 5m Design capacity: 100 m3/s
	Pressure Tunnel Steel Lined - Bifurcation	Lining type: Steel lined Length: 18m (Along Chainage) Diameter: 3.5 m Design capacity: 100 m3/s (2 x 50 m3/s)
Adj 2a	Koromkheti Powerhouse	Units: 150 MW (2 x 75 MW) Francis

Figure 2.5: Scheme design profile of Koromkheti HPP



Source: Mott Macdonald

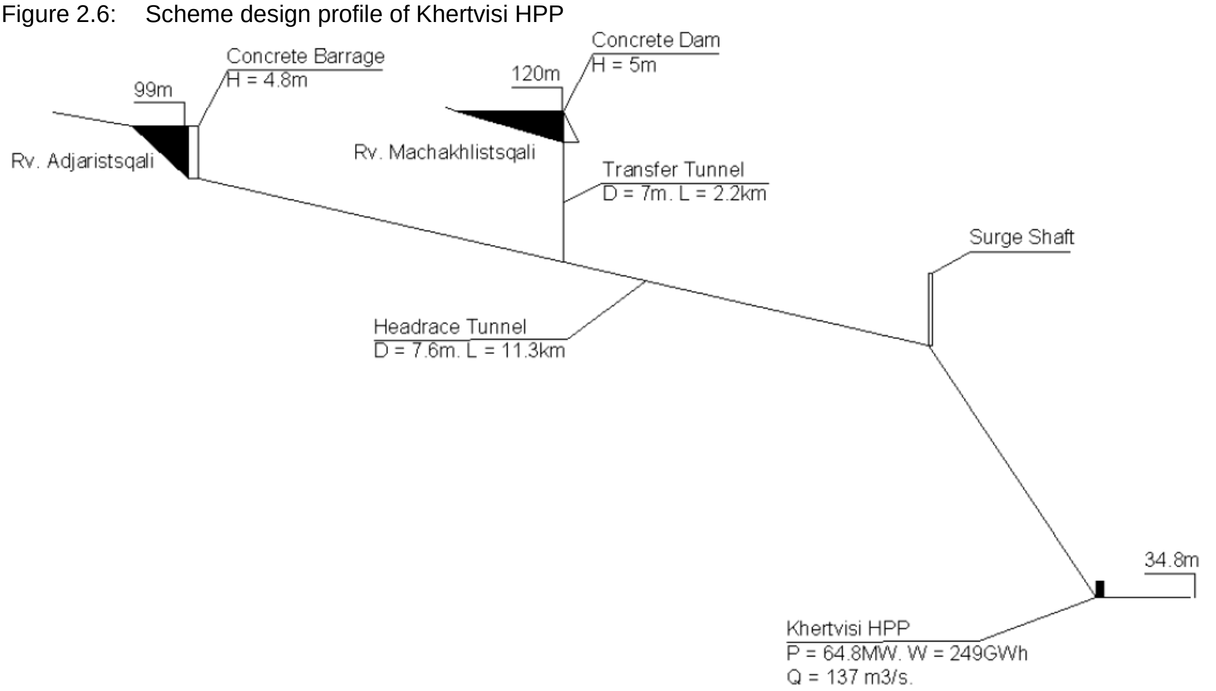
The Khertvisi scheme is located just downstream of the existing Atsi HPP and utilises the remaining head available to the downstream limit of AGL's concession at the confluence of the Adjaristsqali River with the Chorokhi River. A small reservoir providing limited diurnal storage will be located at the intake point of the Khertvisi Dam, discharging into the Adjaristsqali River at the Khertvisi powerhouse. The headrace tunnel will be located on the left bank primarily to enable an intermediate intake into the headrace from the Machakhlistsqali River. The key components of the scheme are detailed in Table 2.3 and illustrated in Figure 2.6 below.

Table 2.3: Khertvisi Scheme Key Components

Node Figure Reference	Description	Key Parameters
Adj 1	Barrage with sediment trap Khertvisi Reservoir	Type: Concrete barrage Height: 4.8 m Approx. reservoir capacity: 150,000 m3 Approx. surface area: 93,000 m2
Adj 1	Intake to headrace tunnel	Operating levels: 97 to 99 m
Adj 1 to Cho 1	Headrace Tunnel Intake to Connection at Ch 958	Lining type: Concrete lined Length: 0.96 km Span and height: 7m Design capacity: 137 m3/s
	Headrace Tunnel Connection at Ch 958 to Connection at Mac	Lining type: Segmental lining Length: 5.20km Diameter: 7.6m Design capacity: 137 m3/s
Mac 1	Run-of-river weir and sediment trap with intake on Machakhlistsqali River into connecting headrace	Level: 120 m
Mac 1 to Adj 1/Cho 1	Machakhlistsqali Transfer Tunnel	Lining type: Concrete lined Length: 2.16km Diameter: 7m Design capacity: 37 m3/s
	Headrace Tunnel Connection at Mac to Surge Shaft	Lining type: Segmental lining Length: 5.25km Diameter: 7.6m Design capacity: 137 m3/s
	Surge Shaft	Lining type: Concrete lined Height: 75.4m (CL to GL) Diameter: 26.0m
	Headrace Tunnel Surge Shaft to Pressure Tunnel	Lining type: Concrete lining Length: 0.03km Diameter: 7.0m Design capacity: 137 m3/s
	Pressure Tunnel Concrete Lined	Lining type: Concrete lining Length: 0.07km Diameter: 7.0m Design capacity: 137 m3/s
	Pressure Tunnel Steel Lined - Single	Lining type: Steel lining Length: 0.15km

Node Figure Reference	Description	Key Parameters
		Diameter: 6.5m Design capacity: 137 m3/s
	Pressure Tunnel Steel Lined – Bifurcation (Surface)	Lining type: Steel lining (Bifurcation) Length: 17m (Along Chainage) Diameter: 3.5m Design capacity: 68.5 m3/s
Cho 1	Khertvisi Powerhouse	Units: 64.8 MW (2 x 32.4 MW) Francis

Figure 2.6: Scheme design profile of Khertvisi HPP



Source: Mott Macdonald

2.3 Why is the Project needed and what are the benefits?

The Project is part of Government of Georgia's (GoG) energy policy to achieve economic independence and sustainability of the sector as well as provision of energy security through domestic resources and diversification of imported energy carriers. In addition Georgia considers electric power to be an export commodity and is aiming to develop this potential.

Georgia's Energy Policy

According to the state energy policy, Georgia's priorities are the "preferential utilization of renewables and alternative resources and the attraction of foreign investments in the energy sector." As part of achieving this goal the Renewable Energy Policy" was adopted in 2008[1].

The Project meets a number of the priority areas outlined in the Renewable Energy Policy, 2008. Some of these priority areas include:

- The main objective of the long-term energy policy is to attract foreign investments for the construction of new power plants.
- To maximise the utilisation of abundant hydro-resources.
- To achieve complete self sufficiency of the country's energy demand with its own resources, the long-term objective is to replace thermal generation.
- To meet energy policy objectives the following key activities are required:
  - Identification of hydropower projects and tender award
  - Rehabilitation of the infrastructure connecting to the neighbour countries' energy systems;
  - Construction of new transmission lines and substations; and
  - The export of surplus power generated in new and existing power plants.

The GoG initiated a competitive tender for the hydro power concession through an expression of interest in March 2010. CEG was one of three bidders (Limak and Kolin) who submitted competitive bids for the license in April 2010. Being the successful bidder, CEG were awarded the concession in May 2010 and signed the implementation agreement for project (approved by Cabinet of Ministers Georgia) in June 2011.

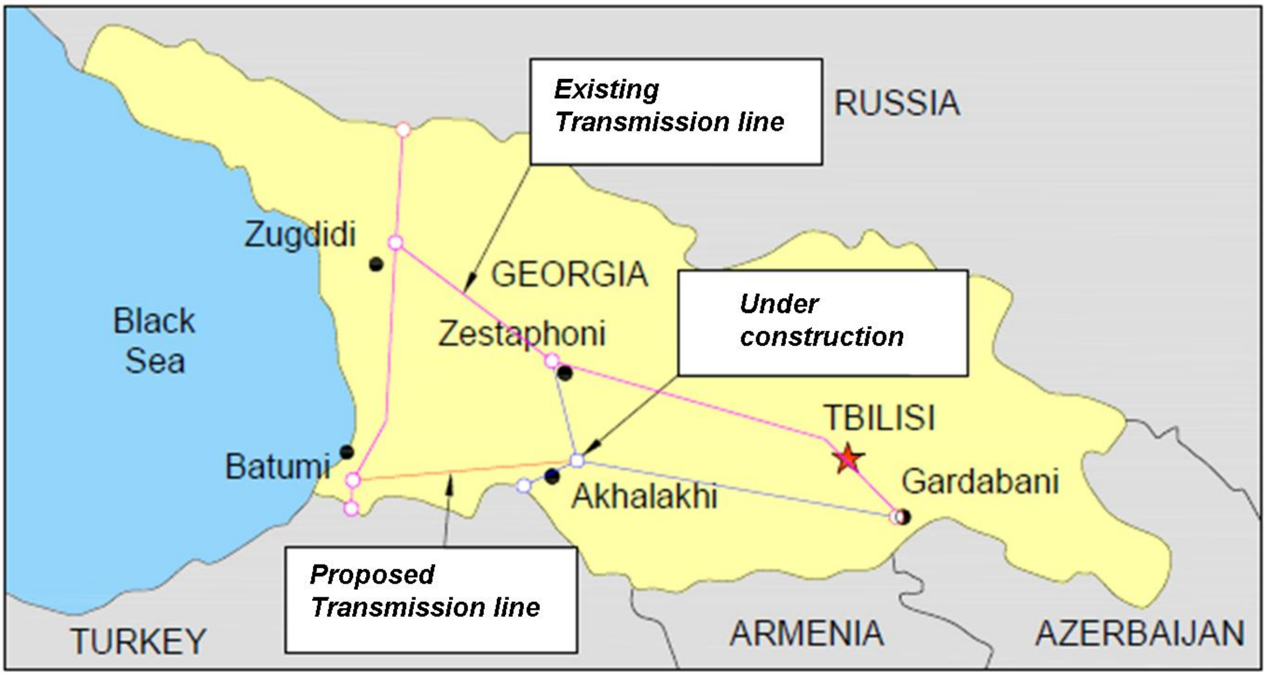
Improved Grid Connection

The Georgian Government is currently constructing a 500/400 kV high-voltage transmission line (Black Sea Regional Transmission Line, Akahalakhi to Turkey see Figure 2.4 below) which connects Turkey and Georgia and is being financed by International Financial Institutions (such as KFW, EBRD, and EIB). The Transmission line is planned to be commissioned in May, 2012 and fully operational by January 1, 2013. It should be noted, that the priority for usage of the new transmission line will be given to newly constructed plants. In addition, there are plans to construct a 500 kV transmission line connecting Azerbaijan and Georgia, and the 400 kV line connecting Georgia and Armenia. Georgia intend to position themselves as a major energy hub for the region. The overall objective is to expand and refurbish its transmission network to increase reliability and improve export and import opportunities.

The construction of a 220kV transmission line from Batumi to Akahalakhi would provide significant benefits to Batumi by improving current connection weaknesses to the national grid and supporting projected increased development and demand. Developing the Project in the region provides the opportunity and incentive to develop a direct connection from Batumi to the new Akhalakhi substation and thus strengthening of the grid connection.

[1] Additional information on Georgia's Energy Policy objectives can be found at the website of the Ministry of Energy and Natural Resources of Georgia, http://www.menr.gov.ge/en/4364.

Figure 2.7: Georgian Transmission System Situation Plan



Source: GEG

Local municipality tax income benefits

The tax system in Georgia provides a mechanism through which a form of monetary benefits sharing can be realised by local municipalities. The project will be required to pay a yearly property tax to each of the municipalities based on 1% of the value of their assets. An indicative estimate of the income that each municipality affected by the project could receive, compared to their existing budgets is presented in Table 2.4.

Table 2.4: Estimated municipality tax income

	Shuakhevi Scheme	Koromkheti Scheme	Khertvisi Scheme
Total Project Investment Cost GEL million	495	495	330
Commencement of operation	2016	2019	2020
Share of tax income per municipality			
Khulo Municipality	35%		
Shuakhevi Municipality	65%	10%	
Keda Municipality		90%	30%
Khelvachauri Municipality			70%
Indicative high level estimate of property tax GEL m/year**			
Khulo	1.7		
Shuakhevi	3.2	0.5	
Keda		4.5	1.0
Khelvachauri			2.3

Source: AGL

In the case of Shuakhevi and Keda municipalities, the increase could be significant whereas for Khulo and Khelvachauri the increase is less significant but still important when compared to existing budget levels (see table 2.5). It is important to bear in mind however that these projects will be realised over 10 year period and therefore it is not possible at this time to compare directly increases in budget compared to existing 2012 budgets.

Table 2.5: Existing 2012 Budgets

GEL million/year	2012 budgets
Khulo	6.0 million GEL
Shuakhevi	4.6 million GEL
Keda	4.5 million GEL
Khelvachauri	7.9 million GEL

Local community skills development and employment

According to statistics and information provided by local municipalities, the unemployment rate in the Project area of influence is higher than that in Batumi and the coastal resort areas. According to information provided by the municipal authority in Shuakhevi the unemployment rate varies from 25% to as high as 75% (these unemployment figures are likely to include those dependent on subsistence farming). Similar situations of high unemployment are observed in Keda and Khulo municipalities, with the majority of the working age population being employed in schools, local administration offices, medical stations or shops.

It is expected that the Project will bring benefits to the local community through skills training and employment opportunities. During the peak of Shuakhevi scheme construction phase, the Civil Contractor may have up to at total of 800 workers both skilled and unskilled on site, where possible the majority of unskilled workers will be drawn from the villages closest to each of the construction sites subject to availability of suitable candidates. It is anticipated that the project may be able to draw a large number of the unskilled workforce from the local area, but this will depend at least in part on the extent to which the contractors appointed bring an greater or lesser external workforce with them.

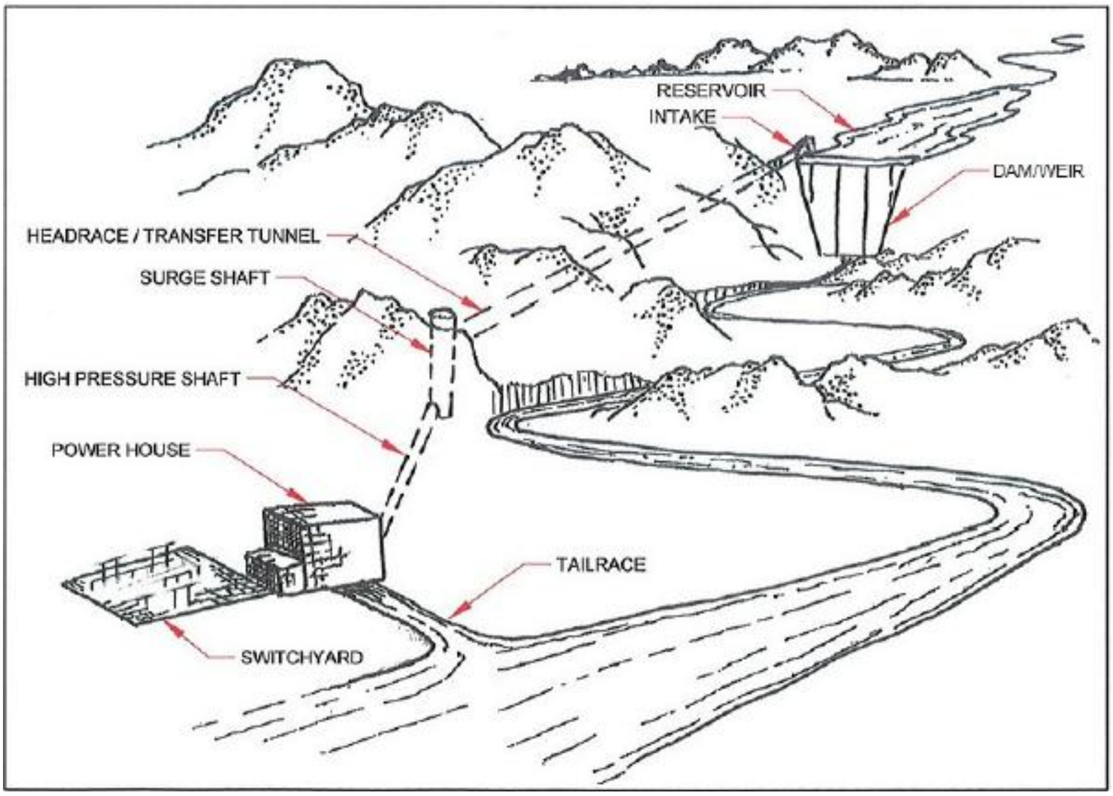
Sector	Types of Roles	Estimated workforce
Site Management	Project Manager, Site Manager, accountant, translators, health, safety and environment (EHS) team	55
Civil	Drivers, tunnelling operatives, concrete mixers, engineers, geologist, metal workers, general labourers	600
Mechanical and Electrical	Engineers, riggers/slingers, fitters, welders, crane operators, technicians	60
Secondary Support Staff	Medics, security guards, firemen, emergency response team, caterers, cleaners	70
Total		**785**

The availability of alternative sources of employment within the project area at present are minimal and the project therefore provides opportunities that are unlikely to have been realised in the short-term, and will enable a number of people to gain skills and experience which will extend beyond the life of the Project.

2.4 What do the Schemes consist of?

Each of the Schemes consists of at least one dam and reservoir with diurnal storage, weir, tunnels, powerhouse, and switchyard. This Section provides an overview of the key project components and construction methods. Figure 2.8 below provides an illustration of the key components which make up each Scheme.

Figure 2.8: Hydropower Key Components



Source: Mott MacDonald Ltd

Dams and Hydraulic Structures

Dams and Weirs

There are two main types of hydropower projects, reservoir storage schemes and run of river schemes. Run of river schemes rely on having a good difference in elevation (gross head) between an area suitable for the intake upstream and an area suitable for the powerhouse downstream and a good sized catchment area (watershed) from which water will drain into the river. The Project is considered to be a run of river scheme with diurnal storage where the dams create a hydraulic head in the river to divert some portion of the river flows but have only limited daily storage capacity. Conversely reservoir storage schemes create large impoundments to capture seasonal and annual storage and also regulation of the river, which is not the case for this Project.

Dams are defined as large if they are 15 m in height or greater from their foundations, or between 5 and 15 m in height and also have a reservoir volume of greater than 3 million m^3 (ICOLD[2] definition). The Project consists of several different types of dams and weirs depending on the in-situ geological conditions and design requirements. All the dams in the scheme have been designed based on results of dam safety analysis and requirements for sediment management arrangements. The following types of weirs and dams are included within the Project design:

- Concrete barrage dam – this type of dam consists of a series of large gates that can be opened or closed to control the amount of water passing the dam.
- Mass concrete gravity dam – conventional concreting, i.e. with the concrete being placed in blocks and lifts or as roller compacted concrete (RCC), it is possible to include low level gates at the bottom of this type of dam to pass floods and flush sediments.
- Embankment dam – this can have either a central impermeable zone and gravel shoulder zones or a concrete faced rockfill dam (CFRD); a spillway is required to pass floods over this type of dam.
- Concrete weir – low concrete weirs, designed to pass floods over the top of the structure.

All dams need to be “waterproofed” and prevent water from seeping underneath them and damaging stability of foundations, therefore depending on the in-situ geological conditions, grouting curtains may be required below and to the side of the dams. Grouting consists of pumping a mixture of cement and water under pressure into the ground to seal fissures in the rock foundations.

The programming of construction for the dams, weirs and intake structures has been timed to benefit from periods of low flow in the rivers (generally in June). The highest flow period generally occurs during the period from early April to the end of May. There are two general construction methods which will be employed to construct the dams and weirs of the Project:

- coffer dams and diversion tunnels which allows for the entire dam to be constructed in dry by diverting the river through a tunnel (required at some sites where there is insufficient space to create a diversion channel).
- diversion channel on either side of the river to enable the dam on the opposite side to be constructed.

[2] International Commission on Large Dams

Figure 2.9: Existing Machakhlistsqali HPP Concrete Weir

Source: Mott MacDonald

Reservoir

As the Project is a run of river scheme with diurnal storage, the storage available within each of the schemes is to enable the project to take advantage of daily peaking prices. Diurnal storage means that the reservoirs only have sufficient storage to respond to fluctuations in daily energy demands as opposed to storage schemes where reservoirs can store water in the summer, which can then be used to generate electricity in the winter. The following dams have reservoirs and daily storage capacities, Skhalta, Didachara, Khichauri, and Khertvisi (see Tables 2.1 to 2.3 for details of reservoir volumes). The waters within the reservoir are unlikely to be deep enough to be impacted by thermal stratification (where very cold water remains at bottom of reservoir and warm water at the top) due to the daily fluctuations in water levels due to draw down for generation. The water levels in the reservoirs will go up and down by approximately 2 to 10 m everyday depending on the scheme.

Intakes

Intakes are situated behind a dam or weir which is used to create enough water storage to allow the intake channel/pipe to have sufficient water and head before entering the headrace/transfer tunnel. Depending on the intake design, construction may require a coffer dam to be built to protect the construction area.

Sediment Basin

In some parts of the scheme a sediment basin/trap is required at the intake to prevent sediment passing into the transfer tunnel that may otherwise settle within the tunnel and/or pass through the turbines. The traps (basins) are designed to slow the water to velocities below that which will occur in the tunnel, for sufficient time to remove sand and gravel. These are relatively unobtrusive structures but they can have a large footprint as they need to be large enough to slow down the flow of water from the river. Figure 2.10 provides an example of the sediment basin from an existing hydropower plant on the Adjaristsqali River, Asti HPP.

Figure 2.10: Existing Asti HPP Sediment Basin

Source: Mott MacDonald Ltd

Spillway, flushing gates and diversion tunnels

All dam structures are required to have a system which enables them to pass a controlled release of flows over or around the dam in the event of a flood or during maintenance/stoppage of the hydropower plant to prevent flows damaging the dam. This is achieved either through a spillway structure, gates designed within the dam, or diversion tunnel which takes water around the dam through the mountain/hillside and back into the river.

Fish Passes

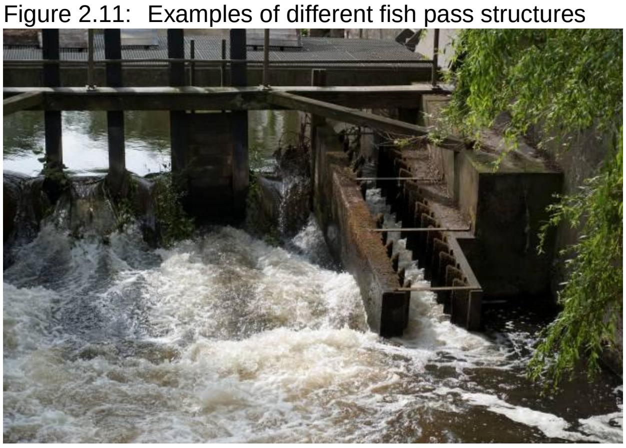
The construction of a large dam will create a physical barrier in the river to the movement of fish species. Where species found in the river are migratory this can have potentially significant effects on populations. The Project has made an assessment for each of the dam structure to identify the requirement for a fish pass based on the presence of migratory species and risk of fragmenting breeding populations, as part of the detailed design the most suitable type of fish pass will be defined for each dam.

There are a number of types of fish passes that have been developed to allow passage of fish through dam obstructions, the main ones are listed below (see Figure 2.11 for examples of fish passes):

- Pool and traverse pass
- Baffled pass
- Fish locks and lifts
- Pre-barrages / ponds.

Fish passes have been included on all the Project dams and weirs apart from the Didachara and Skhalta dams which are located at a higher elevations in the catchment and have dam heights of over 20 m and with less of an impact on short range migration. Any impacts that may result can be mitigated through stocking of fish into water courses above and below the dams if necessary.

Figure 2.11: Examples of different fish pass structures



Source: Stockphotos

Tunnels and Underground Works

Hydroelectric power stations generate power from water flowing from a high level to a lower level. For this project the water transfer will occur in underground tunnels. For low head schemes the tunnel can slope directly from the high to the low point, but in higher head schemes (as is the case for the Project) this can require additional strengthening of tunnels to withstand higher pressures at the downstream end of the scheme. As part of this project, the majority of the tunnels required will be underground low pressure tunnels carrying water from the intakes to the powerhouse and are referred to as either transfer tunnels or headrace tunnels. All of the tunnels in the project will be underground structures, apart from the surge shaft (see Figure 2.12) which will surface element consisting of a 20 m diameter opening to air.

There are two main methods available for constructing tunnels, conventional drill and blast (D&B) method and tunnel boring machine (TBM) method.

Figure 2.12: Example of surge shaft

Source: Mott MacDonald Ltd

Access Portals and Adits

Both temporary and permanent access portals and adits will be required for the Project, initially to construct surge shafts, pressure shafts, transfer and headrace tunnels etc. and subsequently during operation for ongoing maintenance purposes. Where D&B methods are used for tunnelling, adits will be used to allow a greater number of construction faces from which to progress tunnelling and therefore reduce construction times and risks. Construction method for development of access portals will depend on the in-situ ground conditions, either D&B or mechanical excavation will be used. It will be necessary to excavate into the slope to create a vertical face for the tunnel drive.

Where access tunnels are designed to only provide temporary access during construction, the tunnel will be sealed permanently with a concrete plug. Where permanent access is required the access tunnels will be sealed with a concrete plug with a built in door enabling future access for inspection and maintenance of the tunnels.

Figure 2.13: Example of Tunnel and Portal Construction

Source: Mott MacDonald Ltd

Powerhouse and civil works

Powerhouse

The powerhouse contains the turbines and generators for the production of electrical power as well as ancillary equipment. The structure can be located either above ground or underground. The Shuakhevi and Khertvisi schemes will have an above ground surface powerhouse as illustrated in Figure 2.14 below, approximate footprint of surface powerhouse proposed at Shuakhevi and Khertvisi is 0.5 ha. Koromkheti will have an underground powerhouse with only a small switchyard visible on the surface.

Figure 2.14: Existing Asti HPP Surface Powerhouse

Source: Mott MacDonald Ltd

Figure 2.15: Existing Asti HPP Tailrace

Source: Mott MacDonald Ltd

Tailrace

The tailrace is the outlet of the powerhouse, returning waters back to the river once the water has been through the turbines (see Figure 2.15).

Power Evacuation

Transformer and Switchyards

To export the electricity generated at the powerhouse, it will have to be stepped up (increased in voltage) using a transformer and switchyard to allow the powerhouse to connect into a new proposed 220 kV transmission line. Transformers can be located either above ground or below ground, Shuakhevi and Khertvisi are both above ground structures with a footprint of approximately 1.4 ha each.

Figure 2.16: Example of Transformer and Switchyard location

Source: Mott MacDonald Ltd

Transmission line

Power will need to be exported from the area to the wider national grid as well as connected to the grid for export to Turkey. The Project will be connected to a double circuit 220 kV transmission line which will be constructed connecting Batumi to a new grid connection currently under construction at Akhaltsikhe. In accordance with IFCs Performance Standards, the transmission line is considered as an associated facility, however as it is being developed by the Government of Georgia, no details are available at this time on routing of the transmission line. From a high level review of the most direct route (see Figure 2.7), it is unlikely that any proposed or existing protected areas will be affected by a new transmission line. The Project connection requirements are the subject of a separate study, routing and design will also undergo an environmental assessment in accordance with national.

Figure 2.17: Existing 110 kV transmission line

Source: Mott MacDonald Ltd

Figure 2.18: Existing 110 kV transmission line

Source: Mott MacDonald Ltd

Associated Activities

To support the main works the following activities are identified as key to the construction phase operations and on-going maintenance requirements:

- Land acquisition associated with temporary and permanent structures
- Development of borrow pits to provide aggregate for road building
- Temporary workers accommodation
- Temporary storage and work sites at dam and powerhouse locations
- Spoil disposal locations required for significant amounts of material to be excavated from tunnels
- Batching plants for the production of concrete to support foundation works
- Upgrade to existing access roads to support delivery of equipment to site
- New permanent access / maintenance roads
- Construction of temporary access roads.

2.5 When will the Project happen?

Activity	Duration	Start/Completion date
Feasibility Study		May 2011 / February 2012
Tender Preparation and Contract Award	12 months	February 2012 / February 2013
Shuakhevi Construction	36 months	January 2013 / January 2016
Koromkheti	54 months	January 2015 / January 2019
Khertvisi	36 months	January 2017/ January 2020
Operation	45 yrs (each scheme)	January 2020 / January 2065

2.6 What alternatives were considered in developing the project?

A number of studies have been undertaken in the development of the Project that is assessed within this Report, including pre-feasibility assessment, initial optimisation, and final feasibility study. The development of this ESIA and the Feasibility Study have been undertaken concurrently, as such the Project has been developed with consideration of environmental and social constraints with the aim of mitigating the most significant impacts through an iterative design process.

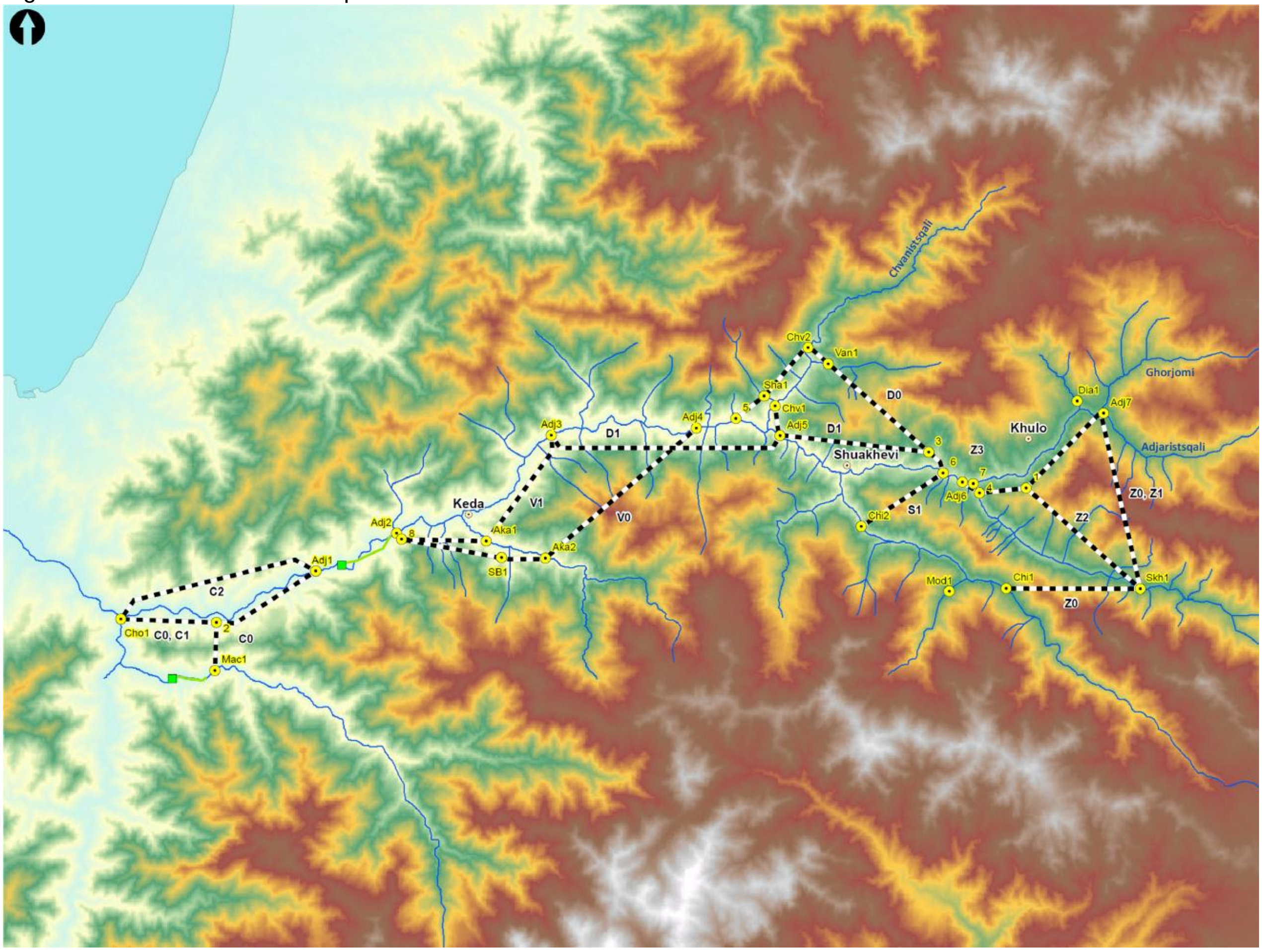
The feasibility study identified a number of potential intakes and alternative layouts for four different schemes, with six options initially identified for each scheme. Of these options one was finally chosen and subsequently optimised. Figure 2.19 provides an illustration of the number of intakes and structures initially considered, most of which have been significantly simplified in the final design layout.

The following considerations and constraints were applicable to all schemes in determining the above options:

- existing hydropower schemes
- avoidance of historic bridges and known cultural heritage features
- avoidance of villages and associated areas used for agriculture
- avoidance of landslides.

In addition to the above the final option chosen was able to reduce the number of intakes and structures on the Adjaristsqali River and its tributaries. A number of intakes were dropped in favour of choosing a combined scheme, which lead to reduction in physical footprint of the project. During the optimisation process, the key factor which drove the design was the geological conditions and avoidance of landslides. As a result the number of options available was significantly reduced, but resulted in benefits such as dropping the intake on the Modulistsqali River and a number of intakes higher up on the Chvanistsqali River and its tributaries. The intakes initially proposed on Diakonidze River and Goderzitsqali River were also dropped to provide additional flow contributions.

Figure 2.19: All initial scheme options considered



Source: Mott MacDonald

3. Managing Environmental and Social Impacts

3.1 What are the Project activities that could affect the environment and people?

It is recognised that a project of this scale and duration has the potential to impact the environment and the community, both in a positive and negative way. The activities that could cause the most important effects include:

- Social impacts associated with:
  - Employment generation
  - Workers skills and well-being
  - Community health, safety and well being
  - Land allocation / re-allocation
  - Community investment
- Direct and indirect impacts on ecology
- Impacts on water resources and water quality
- Materials and waste management
- Impacts to ground conditions
- Noise and vibration effects
- Traffic and transportation impacts
- Landscape and visual effects
- Air quality impacts
- Greenhouse gases emissions
- Impacts to cultural heritage and archaeology

3.2 How the Project was assessed and what were the findings?

A thorough appraisal has been undertaken for potential impacts arising from the Project development, including the above issues; the appraisal has included a detailed Social Impact Assessment and Environmental Impact Assessment (collectively presented as an ESIA). The assessment included:

- Establishment of the baseline to understand current conditions at and around the proposed Project sites;
- Prediction of impacts, using, where relevant, advanced modelling tools; and
- Identification of mitigation measures to be included in the design, procedures, development and management of the Project.

The appraisal process was supported by local consultation undertaken to ensure that AGL understands and has incorporated the concerns of local people from the surrounding communities into the process.

The significance of an impact is described based on sensitivity of project affected persons / environment and magnitude of impacts. Where possible, impact magnitude and sensitivity are described with reference to legal requirements, accepted scientific standards, and/or accepted impact assessment practice and/or social acceptability. Where the ESIA found that the project could cause moderate to substantially significant impacts then actions or procedures (referred to as mitigation measures) have been developed to avoid, reduce or otherwise mitigate the effects and reduce their significance. A great number of potential impacts can either be avoided or reduced through mitigation; however, some residual environmental impacts may be unavoidable. Each chapter of the ESIA has assessed whether residual impacts, either beneficial or adverse, remain after mitigation. A summary of the key findings of the appraisal process, the residual impact and the main mitigation measures identified for each significant impact social and environmental impact is summarised in section 3.2.1 below.

3.2.1 Summary of Environmental and Social Impacts and Mitigation

3.2.1.1 Social Impacts and Mitigation

Table 3.1: Summary of Social Impacts and Mitigation Measures Applicable to all Schemes

Activity	Potential Impact	Sensitivity Score	Magnitude Score	Impact Significance	Mitigation & Enhancement	Residual Significance
Construction						
Construction works	Employment generation	Medium	Moderate	Moderate beneficial	Skills mapping and training for local jobseekers. Disclosure of Recruitment Policy. Localised disclosure of need for staff and labourers in advance of opportunities arising.	**Moderate to Major beneficial**
Construction works	Induced development, population changes and the potential for cultural tension	Medium	Minor	Minor adverse	Modifications to procurement practices. Training of all international workers in cultural sensitivities.	**Minor beneficial (combined with mitigations specified for employment generation)**
Land acquisition	Negotiated settlement or potential involuntary resettlement of affected persons	High	Minor	Moderate adverse	Transactions to be carried out on the basis of negotiated settlement in accordance with AGL's Land Acquisition and Resettlement Framework. Consultation to be carried out with people engaged in informal livelihood activities affected by the Project in order to find alternatives and/or identify the need for compensation or assistance.	**Insignificant to Minor beneficial**
Operational works	Employment generation	Low-negligible	Minor	Minor beneficial	Skills mapping and training for local jobseekers. Disclosure of Recruitment Policy. Localised disclosure of need for staff and labourers in advance of opportunities arising.	**Moderate beneficial**
Infrastructure works (roads and bridges)	Improved possibilities for tourism and other economic development	Medium	Moderate	Moderate beneficial	Road maintenance to leave a useful asset for communities after the construction phase.	**Moderate beneficial**

Activity	Potential Impact	Sensitivity Score	Magnitude Score	Impact Significance	Mitigation & Enhancement	Residual Significance
Payment of municipality taxes	Additional revenues for municipality budgets likely to benefit local communities.	Moderate	Moderate (dependent on what the revenue is spent on).	Moderate beneficial	AGL will support communities in identifying social improvement programmes that benefit by supporting establishment of a committee and provision of organisational assistance.	**Moderate to Major beneficial**

3.2.1.2 Environmental Impacts and mitigation

Table 3.2: Summary of General Environmental Impacts and Mitigation Measures applicable to All Schemes

Phase	Activity/Feature	Potential Impact	Sensitivity Score (Conservation value) / Sensitivity of visual receptors	Magnitude Score	Impact Significance	Mitigation & Enhancement	Residual Significance
Ecology and Biodiversity							
Construction	Oak forest Liana Rich mixed deciduous forest with mixed species Degraded spruce forest with mixed species	Habitat loss and felling for road access and construction laydown areas.	Medium to High	Minor to Moderate	Moderate adverse	Avoidance measures, minimisation of construction laydown, habitat reinstatement, plant genetic conservation.	**Minor adverse**
Construction	Aquatic Ecology: Chirukhistsqali River, Skhalta River, Chvanistsqali River, Akavreta River, Adjaristsqali River	Sediment release, changes in water quality, temporary interruption and change in river course within construction area, resulting in habitat loss..	Medium	Moderate	Moderate adverse	Minimise working areas timing of in river construction activities during low flows, pollution prevention measures, sediment control. Ban on fishing by construction workers.	**Minor adverse**

Phase	Activity/Feature	Potential Impact	Sensitivity Score (Conservation value) / Sensitivity of visual receptors	Magnitude Score	Impact Significance	Mitigation & Enhancement	Residual Significance
Construction	Aquatic Ecology: Machakhlistsqali River	Sediment release, changes in water quality, temporary interruption and change in river course within construction area, resulting in habitat loss.	High	Moderate	Major adverse	Minimise in river construction activities and avoid all interruption of flow during salmon migration and spawning period.	**Moderate adverse**
Construction	Pontic rhododendron scrub	Habitat loss and felling for road access, and construction laydown areas	High	Minor	Moderate adverse	Avoidance measures minimise working areas, habitat reinstatement.	**Minor adverse**
Construction	Cyclamen, Hartvisian oak	Habitat loss and felling for road access, work compounds	Medium	Moderate	Moderate adverse	Avoidance measures, minimum working areas, species translocation, plant genetic conservation.	**Minor adverse**
Construction	European otter	Barriers during construction, noise disturbance, food shortage, sediment release, habitat loss	High	Moderate	Major adverse	Minimum working areas, sediment control and habitat reinstatement.	**Moderate adverse**
Construction	Brown bear, European lynx, wild cat	Habitat loss, noise disturbance, hunting	Medium	Moderate	Moderate adverse	Avoidance of natural habitat loss, hunting ban, good working practices	**Minor adverse**
Construction	Bats (all species)	Habitat loss, light and noise disturbance	High	Moderate	Major adverse	Avoidance of natural habitat loss, habitat instatement	**Moderate adverse**
Construction	Little owl, Bird assemblages	Habitat loss, light and noise disturbance	Low to Medium	Moderate	Moderate adverse	Minimise habitat loss, ban on hunting, pre-construction checks for nesting birds	**Minor adverse**

Phase	Activity/Feature	Potential Impact	Sensitivity Score (Conservation value) / Sensitivity of visual receptors	Magnitude Score	Impact Significance	Mitigation & Enhancement	Residual Significance
Construction	Clark's lizard Caucasus viper Caucasian salamander	Habitat loss, accidental killing and injury	High to Very high	Minor	Moderate adverse	Minimise area of habitat loss, pre-construction checks in sensitive areas/suitable habitats, relocation of animals if found, staff awareness.	**Minor adverse**
Operation	Aquatic Ecology: Chirukhistsqali River, Skhalta River, Akavreta River, Adjaristsqali River	Long term reductions in flows, loss of habitats, barriers to fish movement, potential impact on vulnerable fish species (Colchic kharmulya and Brown trout).	Medium	Moderate	Major to Moderate adverse	Phase II assessment, hydrological and ecological surveys to inform further development of adaptive management approach to environmental flows, incorporation fish pass, and habitat reinstatement. Potential requirement for fish re-stocking.	**Moderate to Minor adverse**
Operation	Aquatic Ecology: Machakhlistsqali River	Long term reductions in flows, loss of habitats, barriers to fish movement, potential impact on endangered Black Sea Salmon	High	Major	Critical adverse	Phase II assessment, hydrological and ecological surveys to inform further development of adaptive management approach to environmental flows, incorporation fish pass, and habitat reinstatement.	**Moderate adverse with potential to reduce to minor through offsetting measures.**
Operation	Aquatic Ecology: Chvanistsqali River	Reductions in flows over only very minimal reach, barrier to fish movement upstream and downstream of dam.	Medium	Moderate	Moderate adverse	Phase II assessment, hydrological and ecological surveys to inform further development of adaptive management approach to environmental flows and incorporation of fish pass.	**Minor adverse**
Operation	Cyclamen	Permanent habitat loss from inundation and infrastructure	Medium	Moderate	Moderate adverse	Minimisation of construction laydown areas & plant translocation	**Minor adverse**

Phase	Activity/Feature	Potential Impact	Sensitivity Score (Conservation value) / Sensitivity of visual receptors	Magnitude Score	Impact Significance	Mitigation & Enhancement	Residual Significance
Operation	European otter	Physical barriers preventing movement of species, reduced riverine habitat, reduce food availability along rivers, changes in water quality, increase disturbance.	High	Major	Major adverse	Habitat reinstatements, stocking of reservoirs with fish.	**Moderate adverse**
Operation	Brown bear	Habitat loss, noise disturbance, hunting	Medium	Minor	Minor to moderate adverse	Hunting ban and enforcement measures, minimise habitat loss and reinstatement where possible, staff awareness	**Minor adverse**
Operation	Bats (all species)	Habitat loss, reduced area for roosting, increased disturbance and light pollution.	Medium	Moderate	Moderate adverse	Erection of bat boxes to compensate for loss of roost sites, reservoir open water habitats creating new foraging areas.	**Minor adverse**
Operation	Clark's lizard Caucasus viper Caucasian Salamander	Habitat loss, accidental killing and injury	High to Very high	Minor	Moderate adverse	Reduced operating areas, habitat creation, staff awareness of ecological issues	**Minor adverse**
Operation	Oak forest Liana-rich mixed deciduous forest with mixed spruce Degraded Spruce forest with mixed species	Permanent habitat loss from inundation and infrastructure	High to medium	Minor to Moderate	Moderate adverse	Minimise footprint and siting of permanent office structures and reforestation scheme including habitat reinstatement.	**Minor adverse**
Water Resources and Water Quality							
Construction	Dams	Increase sediment load	Medium	Minor	Minor Adverse	Good practice construction	**Minor adverse to Insignificant**

Phase	Activity/Feature	Potential Impact	Sensitivity Score (Conservation value) / Sensitivity of visual receptors	Magnitude Score	Impact Significance	Mitigation & Enhancement	Residual Significance
Construction	Tunnels	Spoil disposal	Medium	Moderate	Moderate Adverse	Ensure sediment load in river system not increased beyond transport capacity and that risk of downstream and upstream flooding does not impact sensitive receptors	**Minor adverse to Insignificant**
		Disturb spring sources	Low	Moderate	Moderate Adverse	Grout/line tunnel sections as needed to seal against groundwater flow	**Minor adverse to insignificant**
Operation	Operate diversion (All diversions except Mac1)	Changed/lowered flow regime	Low - Medium	Minor to Moderate	Moderate to Minor Adverse	Negotiate buy-out of existing HPP on Machakhlistsqali. Provide alternative supply or compensation to any small scale affected users	**Minor adverse to insignificant**
Operation	Operate diversion (Mac1)	Changed/lowered flow regime	High	Major	Critical Adverse	Negotiate buy-out of existing HPP on Machakhlistsqali. Provide alternative supply or compensation to any small scale affected users	**Minor adverse to insignificant**
Operation	Operate dam	Changed/lowered flow regime	Medium	Moderate	Moderate Adverse	Environmental flows and closure days for sediment flushing Provide alternative supply or compensation to any small scale affected users	**Moderate to Minor adverse**
Geology, Landslides and Seismic Risks							

Phase	Activity/Feature	Potential Impact	Sensitivity Score (Conservation value) / Sensitivity of visual receptors	Magnitude Score	Impact Significance	Mitigation & Enhancement	Residual Significance
Construction	Blasting of tunnels	The spoil may be placed according to good engineering practice and design at the toe areas of vulnerable slopes in order to improve stability and used as a source of local aggregate source	Low - Medium	Moderate	Minor - Moderate beneficial	n/a	**Minor beneficial**
Construction	Cuttings for road construction	Seismic event causing damage and failure of structures due to liquefaction or ground failure, potentially causing flooding downstream of the dam location / overtopping of the dam causing large scale destruction and casualties.	High	Minor	Moderate adverse	Design for seismic conditions, potential to increase dam freeboard etc. Ongoing monitoring of micro seismic network	**Minor adverse to Insignificant**
Operation	During normal operation the flow in the sections of river between the dam and the powerhouse will be reduced	A reduction in erosion of areas where the river is currently undercutting the slopes.	Minor	Moderate	Minor beneficial	n/a	**Minor beneficial**
Decommissioning	Removal of the reservoir	If this area is to be farmed / built upon it is weaker ground and this combined with the erosion by the river in the normally consolidated materials may cause mudslides	High	Minor	Moderate	Landuse restrictions	**Minor Adverse**

Phase	Activity/Feature	Potential Impact	Sensitivity Score (Conservation value) / Sensitivity of visual receptors	Magnitude Score	Impact Significance	Mitigation & Enhancement	Residual Significance
Decommissioning	Removal of the reservoir	Cause lowering of the groundwater table and decrease in porewater pressures so an increase in slope stability.	Positive Low	Positive Minor	Positive Minor	n/a	**Minor beneficial**
Materials and Waste Management							
Construction	Spoil material handling and disposal	Displacement of flood waters, increasing flood risks to some users.	Medium	Minor to Moderate	Moderate adverse	Detailed in situ checks of proposed disposal areas to confirm avoidance of flood risks during tender design, design of spoil disposal reinstatement to minimise any risk of flooding.	**Minor adverse**
Construction / operation / decommissioning	Waste Generation, handling and storage	The use of landfill, where waste re-use or recovery is not feasible, which is a finite resource.	Medium	Moderate	Moderate adverse	Construction phase waste management plan, which will form part of the construction phase ESMP, will be developed Waste management procedure for the operational phase will be developed and will form part of an overall Environmental and Social Management System. The waste management procedure will include a SWMP. Development of site waste management plan incorporating measures to characterise waste stream, seek to minimise waste production and where waste streams are unavoidable, highlight potential re-use, recycling and recovery (in that order) opportunities according to current good industry practice.	**Minor adverse**
Traffic and Transportation							

Phase	Activity/Feature	Potential Impact	Sensitivity Score (Conservation value) / Sensitivity of visual receptors	Magnitude Score	Impact Significance	Mitigation & Enhancement	Residual Significance
		Increase in general traffic (cars and trucks) volumes causing delays on the local highway network	Low	Major	Moderate adverse	Re-use of excavated materials on site TMP Construction of personnel accommodation on site Provision of bus/minibus services for personnel living in nearby settlements	**Minor adverse**
Construction		Increase in general traffic (cars and trucks) volumes causing conflicts with vulnerable road users (pedestrians and cyclists) on the local highway network	High	Major	Major adverse	Develop traffic management plan to manage construction traffic impact on local traffic. Construction of personnel accommodation on site Provision of bus/minibus services for personnel living in nearby settlements	**Moderate adverse**
Construction		Physical effects (wear and tear) of trucks (including abnormal loads) on local highway infrastructure.	Medium	Moderate	Moderate adverse	TMP Pre-construction road survey, road improvements.	**Minor Adverse**
Noise and Vibration							

Phase	Activity/Feature	Potential Impact	Sensitivity Score (Conservation value) / Sensitivity of visual receptors	Magnitude Score	Impact Significance	Mitigation & Enhancement	Residual Significance
Construction	General construction activities, such as traffic, blasting, excavation, drilling, crushing plant, batching plant.	Potential impacts include; • Nuisance to local residents • Ecological disturbance There are two locations where a change in noise is likely to result in an increase in noise over 3 dB. These are; • Link Ref. I. Khertvisi Construction Phase from Route S-45 to the Project site (3.2dB) • Link Ref. M. Shuakhevi Construction Phase from Route S-1 at Zomoleti to the Project site (3.4dB)	Medium	Moderate	Moderate adverse	Noise mitigation measures are likely to include the following: • Maintaining equipment in good working order and fitting with appropriate noise control at all times • Keep haul routes well maintained • Ensure deliveries arrive and depart so as not to disturb residents at inconvenient times • A regime of noise monitoring where appropriate	**Moderate to Minor adverse**

Phase	Activity/Feature	Potential Impact	Sensitivity Score (Conservation value) / Sensitivity of visual receptors	Magnitude Score	Impact Significance	Mitigation & Enhancement	Residual Significance
Construction	Construction traffic noise	Potential impacts include; • Nuisance to local residents • Ecological disturbance There are two locations where a change in noise is likely to result in an increase in noise over 3 dB. These are; • Link Ref. I. Khertvisi Construction Phase from Route S-45 to the Project site (3.2dB) • Link Ref. M. Shuakhevi Construction Phase from Route S-1 at Zomoleti to the Project site (3.4dB)	Medium	Moderate	Moderate adverse	Noise mitigation measures are likely to include the following: • Maintaining equipment in good working order and fitting with appropriate noise control at all times • Keep haul routes well maintained • Ensure deliveries arrive and depart so as not to disturb residents at inconvenient times • A regime of noise monitoring where appropriate	**Moderate to Minor adverse**
Cultural Heritage and Archaeology							

Phase	Activity/Feature	Potential Impact	Sensitivity Score (Conservation value) / Sensitivity of visual receptors	Magnitude Score	Impact Significance	Mitigation & Enhancement	Residual Significance
Construction	Road widening / Dam Construction / Reservoir construction/area submergence/ Tunnel and adit excavation / Construction facilities area including new industrial and residential buildings / Construction of project headquarters (located in Koromkheti Phase II area)	Disturbance or damage to previously unrecorded and or buried cultural heritage assets.	Medium	Medium	Moderate adverse	A chance find strategy will be in action across the scheme during all groundworks, with the exception of tunnelling involving drill and blast or TBM methods. Any archaeological finds and sites will be reported immediately to the Georgian National Cultural Heritage Agency and to the Cultural Heritage Preservation Agency of Adjara. The two stone bridges will be assessed for date and cultural heritage significance prior to any rehabilitation. Should they be significant the rehabilitation will either be conducted in keeping with the stone structures or an alternative route will be sought.	**Minor adverse**
Construction	Provision of utilities including, telecommunications, water and electricity, possibly requiring the excavation of small service trenches	Disturbance or damage to previously unrecorded and or buried cultural heritage assets.	Medium	Major	Major adverse		**Minor adverse**
Construction	Quarry excavation	Disturbance or damage to potentially previously unrecorded cultural heritage assets	Medium	Minor	Minor adverse		**Minor adverse**

Phase	Activity/Feature	Potential Impact	Sensitivity Score (Conservation value) / Sensitivity of visual receptors	Magnitude Score	Impact Significance	Mitigation & Enhancement	Residual Significance
Construction	Stone bridge rehabilitation	Disturbance or damage to potentially previously unrecorded cultural heritage assets	Medium	Minor	Minor adverse	The two stone bridges will be assessed for date and cultural heritage significance prior to any rehabilitation. Should they be significant the rehabilitation will either be conducted in keeping with the stone structures or an alternative route will be sought.	**Minor adverse**
Landscape and Visual Amenity							
Construction	Visibility of workers, plant and operations	High – medium dependent on location	Minor adverse	Low to high	Moderate adverse	Construction sites to be kept tidy. Clause in contractual documentation passing responsibility onto Contractors.	**Minor adverse**
Construction	Cutting mountainside for roads, tunnels and adits resulting in loss of vegetation, visible rock faces and earth	High – medium dependent on location	Moderate adverse	Low to high	Major adverse	Clearing of vegetation around construction sites to be minimised. Landscape planting strategy to identify appropriate re-vegetation.	**Moderate adverse**
Operation of Khertvisi, Akavreta, Chirukhistsqali, and Machakhlistsqali weir	Visible weir, loss of vegetation near weir	High	Minor adverse	Sensitive receptors will be limited in number, low to medium sensitivity	Moderate adverse	Landscape planting strategy with appropriate re-vegetation	**Minor adverse**
Operation of Skhalta, Didachara, Khichauri and Chvanistsqali dam and reservoir	Visible dam and reservoir, loss of vegetation in reservoir, exposure of dry river margins or stretches.	High	Moderate adverse	Sensitive receptors will be limited in number, low to medium sensitivity	Major adverse	Landscape planting strategy with appropriate re-vegetation	**Moderate adverse**

3.3 Cumulative Impacts with Other Projects

Cumulative impacts are those that may result from the combined effects of several activities, either existing or planned, in a project's zone of influence. While a single activity may itself result in an insignificant impact, it may, when combined with other impacts (significant or insignificant) in the same geographical area and occurring at the same time, result in a cumulative impact that is significant.

The Project ESIA process included, where relevant, consideration of the cumulative impact of the Project with other present and planned developments in the zone of influence. The developments included in the cumulative impact assessment are shown in Table 3.3

Table 3.3: Existing and proposed developments in project area of influence

Existing Projects or Planned Development	Socio-economics	Ecology and Biodiversity	Water Resources and Water Quality	Materials and Waste Management	Ground Conditions	Noise and Vibration	Traffic and Transportation	Landscape and Visual Amenity	Air Quality	Carbon
Existing Asti Hydropower plant (HPP)	✓	✓	✓							
Existing Machakhlistsqali Hydropower plant (HPP)	✓		✓							
Chirukhistsqali HPP under construction	✓							✓		
Proposed Chorokhi hydropower cascade project		✓	✓				✓	✓	✓	
Local tree felling				✓	✓					
Ski Resort on the Chvanistsqali Valley	✓							✓		
Goderdzi Pass Ski Resort (Khulo Municipality)							✓		✓	
Gomarduli Ski Resort (Shuakhevi Municipality, Gomarduli Village)							✓		✓	
Goma Mountain Ski Resort (Shuakhevi and Keda Municipalities)							✓		✓	

No cumulative impacts were assessed as being significant for any of environmental or social aspect as a result of interaction of other existing or planned developments with the Project.

3.4 How will AGL manage environmental and social impacts?

AGL will implement an Environmental and Social Management Plan (ESMP) that draws upon the management and mitigation measures which have been defined within the ESIA. The ESMP is presented as Volume IV of the ESIA documentation. The primary objective of an ESMP is to safeguard the environment, site staff and the local population from site activity that may cause harm or nuisance. The management plan, which also covers monitoring, is the basis of the environmental and social protection measures to be implemented by AGL and its contractors.

In addition to the ESMP, a number of complimentary framework plans, policies and procedures have been developed including the following:

- Construction Environmental Management Plan (which includes a number of sub plans and procedures relevant to the construction phase, such as waste management plan, labour accommodation plan, adaptive management plan etc);
- Stakeholder Engagement Plan;
- Biodiversity Action Plan; and
  Land Acquisition and Livelihood Restoration Framework.

Responsibilities for implementation are outlined in the ESMP and fall to either AGL or the various contractors. The implementation of the ESMP ensures EHS performance is in accordance with international standards (including the relevant EBRD and IFC EHS standards and guidelines) and best practice.

Moving into the operational phase, AGL will develop an environmental and social management system (ESMS), to cover all Project components. This will ensure best practices with regards to environmental and social management are imbedded into the operational philosophy of the Project.

4. Summary of Project Significance

The Environmental and Social Impact Assessment assessed the potential impacts associated with the construction and operation of the Project on all the key environmental and social aspects within the project area of influence. Whilst many of the impacts were assessed to be minor or insignificant and therefore not significant, there remained a number of impacts that were assessed as being major or moderate adverse and therefore significant.

In all cases where impacts were assessed to be significant, mitigation measures were adopted to reduce impact significance from major to either moderate or minor. This has been achieved through a combination of adopting measures in line with international and national standards, particular IFC guidelines and Georgian regulations, industry good practice measures and the development of specific plans or enhancement measures to reinstate or rehabilitate aspects where damage is predicted to occur, which in many cases reduced these impacts to non-significant impacts. This was the case in relation to disturbance to a range of ecological features which, as a result of measures such as reducing the construction footprint, habitat reinstatement, pre-construction surveys and translocation, forestry plan etc, it has been possible to reduce the impacts to non-significant.

A number of significant beneficial impacts were identified, principally in relation to high levels of employment creation in the project area, which is known to suffer from high unemployment, and economic benefits to the local municipalities as a result of substantial property taxes payable by the project to each municipality in which project infrastructure is located. There will also be a residual benefit in the form of significant improvements to local roads and bridges as a result of upgrade works the project will implement.

There remained however a number of residual adverse impacts that have been assessed, at this stage, to be significant including the following;

- Certain construction activities that could lead to sediment release, changes in water quality, habitat loss and disturbance could have a moderate impact on some aquatic species on the Machakhlistsqali River for the duration of those activities. Measures such as minimising in-river construction activities and avoiding interruption of flow during salmon migration and spawning are anticipated to restrict the duration of these impacts. Construction impacts are however temporary and in the longer term unlikely to be significant, although operational impacts remain potentially significant to the existing population of Black Sea Salmon within the Machakhlistsqali River.

- Habitat loss and light and noise disturbance during the construction phase could adversely impact a number of bat species. Minimisation of the area of habitat lost, pre-construction surveys and reinstatement post-construction is however anticipated to reduce to the longer term significance of the impact.

- European otter could be affected by the creation of barriers during construction, noise disturbance, food shortage, sediment release and habitat loss. Minimising the working areas, implementing sediment control and post construction habitat reinstatement is however anticipated to reduce the longer term impact. The potential for fish restocking would also serve to overcome any food shortage issues that may arise.

- The change in flow regime leading to long term reductions in flow, most significantly noted on certain river stretches immediately downstream of the main dam or weir river diversions, are predicted to impact on a range of fish species (e.g. Colchic kharmulya and Brown trout) potentially affecting spawning habitats, juvenile feeding areas and adult habitats. At this stage a minimum environmental flow release of 10% of annual average flow has been assessed to determine the potential impacts, whilst also taking into account the needs of the river and its users based on current data. To mitigate the impact as far as possible an adaptive management approach to environmental flows, incorporation of fish passes, habitat reinstatement/enhancement and the potential for fish re-stocking have been identified as appropriate. To fully develop the adaptive management approach however, a second phase of hydrological and ecological surveys will be carried out during 2012 to enhance the survey information already gathered and allow the development of more targeted environmental flow releases more closely matched to the needs of certain stretches of river at certain key times of year. Combining this approach with specific habitat enhancements is anticipated this will reduce the overall impact of the schemes on this environmental aspect. Further consultation with relevant NGOs will also be undertaken as part of refining the mitigation measures to be adopted.

- Construction traffic has also been identified as having a potentially significant impact due to the scale of the change in traffic volumes compared to the very low flows currently experienced on the roads leading the project construction areas. Upgrades will be undertaken to many of the roads in the project area to facilitate movement of construction vehicles thereby increasing the capacity of the roads to a level that can take the traffic flows predicted. It will be important however to implement robust traffic management plans in order to manage the potential conflict between vulnerable road users such as pedestrians and cyclists and construction traffic. The duration of the impact will be time limited and after completion of construction the local road network will have been significantly improved so the longer term impact is not anticipated to be significant.

- Construction of project infrastructure such as dams, roads and powerhouses is assessed to have a significant impact on the landscape and visual receptors. The impact will be most significant when wooded areas are cleared for roads and for the construction of the larger dams and power houses. Adoption of a planting and landscaping strategy should however reduce the significant impact seen during construction and early in operation associated with most of the project infrastructure, allowing it to blend more easily into the surrounding landscape within five years of completion. The presence of three large dams (Didachara, Skhalta and Kichauri) will result in permanent structures visible from a number of viewpoints but in the longer term it is considered that these structures would become an accepted part of the landscape, particularly given the presence of the diurnal storage reservoirs that will form lakes along the valley bottoms.

Monitoring will be adopted as part of construction and operational environmental management in order to ensure that impacts will be maintained at or below the predicted level of impact. Information/data gathered from further survey work will be used to refine the environmental flow regime to prove more targeted releases to meet the downstream ecological needs of the affected river stretches. This approach, coupled with focused habitat enhancement, is expected to further reduce the most significant residual impact relating to flow changes. All construction impacts will be temporary and in the longer term will not result in a significant residual impact.