Technical Assistance for Preparation of the Zemo Samgori Irrigation Project, Georgia

Environmental and Social Impact Assessment (ESIA) Report

European Investment Bank (EIB)

September 2022

AA-010475-001 – Framework Agreement to support EIB Advisory Services (EIBAS) activities inside and outside EU-28 Lot 1: Environment

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Client signoff

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Acronyms and Abbreviations

AA	Association Agreement
ADB	Asian Development Bank
Ac	Accession
ACT	Analysis and Consulting Team
AET	Actual Evapotranspiration
AFD	French Development Agency
AFFS	Agriculture Food Forestry Systems
AgERA5	FAO's Global Weather for Agriculture - dataset based on the hourly ECMWF ERA5 data at surface level
AIOJSC	Azerbaijan's Amelioration Irrigation Open Joint Stock Company
AIRB	Alzani-Iori River Basin
AoI	Area of Influence
AP	Airport
Ap	Approval
APS	Agricultural Production Support
ARDA	Agriculture and Rural Development Agency
ASCI	Areas of Special Conservation Interest
BC	Before Christ
BOD	Biological Oxygen Demand
BPfA	Beijing Declaration and Platform for Action
CatchX	Global web-based catchment hydrological information platform
CBO	Community Based Organisation
CDC	British International Investment
CESMP	Construction ESMP
CEDAW	Convention on the Elimination of all Forms of Discrimination against Women
CMS	Conservation of Migratory Species
COD	Chemical Oxygen Demand
CROPWAT	FAO's Crop Water Requirement calculation Software
CSO	Civil Society Organisations
EA	Environmental Assessment
EAC	Environmental Assessment Code of Georgia
EBA	Endemic Bird Area
EBRD	European Bank for Reconstruction and Development
EFR	Environmental Flow Requirement
EIA	Environmental Impact Assessment
EIB	European Investment Bank

EIEC	Environmental Information and Education Centre
EIF	Entry into Force
ENP	EU's European Neighbourhood Policy
EPE	European Principles for the Environment
EPRP	Emergency Preparedness and Response Plan
E&S	Environmental and Social
ES	Environmental Study
ESIA	Environmental and Social Impact Assessment
ESAP	Environmental and Social Action Plan
ESMP	Environmental and Social Management Plan
ESMS	Environmental and Social Management System
ESP	Environmental and Social Policy
EEC / EC / EU	European Economic Community / European Commission / European Union
EUR / €	Euro currency
FAO	Food and Agricultural Organisation
F-ESMP	Framework ESMP
FGD	Focus Group Discussion
FPIC	Free Prior Informed Consent
FS	Feasibility Study
GA	Georgian Amelioration
GBVH	Gender-based violence and harassment
GDP	Gross domestic product
GEC	Equality Council of the Parliament of Georgia
GEL	Georgian Lari
GeoStat	National Statistics Office of Georgia
GFDRR	Global Facility for Disaster Reduction and Recovery
GHG	Greenhouse gas
GIIP	Good International Industry Practice
GIP	Good International Practice
GIS	Geographical Information System
GN	Guidance Note
Gn	nth number of secondary canal
GNERC	Georgian National Energy and Water Supply Regulatory Commission
GoG	Government of Georgia
GPS	Global Positioning System
GRM	Grievance Redress Mechanism
GSM	Global System for Mobile communication
GWP	Georgian Water and Power

HDV	Heavy Duty Vehicles
HGV	Heavy Goods Vehicle
HH	House Holds
HIV / AIDS	Human Immunodeficiency Virus / Acquired Immunodeficiency Syndrome
HPP	Hydro Power Plant
HR	Human Resources
HR SAP	Human Rights Strategy and Action Plans
HSE	Health, Safety, Environment
IAQM	Institute of Air Quality Management
IBA	Important Bird Areas
ICT	Information and Communication Technology
IDP	Internally Displaced People
IE	Irrigation Efficiency
IFAD	International Fund for Agricultural Development
IFC	International Finance Corporation
IFM	Integrated Farm Management
ILO	International Labour Organization
IPDP	Indigenous Peoples Development Plan
IPM	Integrated Pest Management
ISO	International Organisation for Standardisation
IUCN	International Union for Conservation of Nature
IWRM	Integrated Water Resources Management
IZ	Irrigation Zone
KII	Ky Informant Interview
km	kilometre
KSIS	Kvemo Samgori Irrigation System
LAP	Livelihood Action Plan
LRP	Livelihood Restoration Plan
LARP	Land Acquisition and Resettlement Framework Plan
LEPL	Legal Entity under Public Law
LMC	Lower Main Canal
LMMC	Lilo Martkopi Main Canal
MAD	Maximum Admissible Discharge
MPC	Maximum Permissible Concentrations
MEPA	Ministry of Environmental Protection and Agriculture
MESD	Ministry of Economy and Sustainable Development
MOF	Ministry of Finance
MP	Management Plan

MRDI	Ministry of Regional Development and Infrastructure
MSW	Municipal Solid Waste
NAPR	National Agency for Public Registry
NEA	National Environmental Agency
NGO	Non-Governmental Organisation
NPK	Nitrogen-Phosphorous-Potassium
NSR	Noise Sensitive Receptor
NTS	Non-Technical Summary
OESMP	Operation and Maintenance ESMP
O&M	Operation and Maintenance
OHS	Occupational Health and Safety
OMM	Operation Maintenance and Management
ORIO	Netherlands' Facility for Infrastructure Development
P	Precipitation / Rainfall
PDO	Public Defender's Office of Georgia
PET	Potential Evapotranspiration
PHW	Paldo Headworks
PMU/PIU	Project Management Unit / Project Implementation Unit
PPE	Personal Protective Equipment
PPV	Peak Particle Velocity
PRs	Performance Requirements
PWD	Person with Disability
RAP	Resettlement Action Plan
RBMP	River Basin Management Plan
RCC	Reinforced Cement Concrete
RCP	Representative Concentration Pathway
RPF	Replacement Policy Framework
Rt	Ratification
RVO	Netherlands Enterprise Agency
SCADA	Supervisory control and data acquisition
SEA	Strategic Environmental Assessment
SEP	Stakeholder Engagement Plan
SMHI	Swedish Meteorological and Hydrological INstitute
SMS	Short Message Service
SOGI	Sexual Orientation and Gender Identity
SSR	Self Sufficiency Ratio
STD	Sexually Transmitted Disease
STI	Sexually Transmitted Infections

SU	Secondary Unit
TA	Technical Assistance
ToR	Terms of Reference
TPH	Total Petroleum Hydrocarbons
TSP	Total Suspended Particles
TU	Tertiary Unit
TUDA	Transport and Urban Development Authority
TV	Television
UMC	Upper Main Canal
UN ECE	United Nations Economic Commission for Europe
UNFCCC	United Nations Framework Convention on Climate Change
USAID	Unites States Agency for International Development
USD	United States Dollar
UWSC	United Water Supply Company
WB	World Bank
WEEE	Waste Electrical and Electronic Equipment recycling
WHO	World Health Organisation
WUG	Water User Group
WUO	Water Users Organisation
WUO-PF	Water Users Organisation – Planning and Formation
WWF	Wordl Wide Fund for Nature
ZSIS	Zemo Samgori Irrigation Scheme
2/4WD	Two/Four Wheel Drive

Executive Summary

Introduction

The Zemo Samgori Irrigation System (ZSIS) is located to the east of the capital Tbilisi, in the Mtkvari (Kura) river basin and its sub-basin, the Iori river. It was originally designed to irrigate 41,000 ha and was constructed in two phases, Phase 1 being completed in 1954 and the remainder of the scheme in 1964. Upon completion the ZSIS was the largest irrigation system in Georgia. The ZSIS is being currently operated and maintained by the Georgian Amelioration Ltd (GA), a state-owned limited liability company managed under the Ministry of Environmental Protection and Agriculture (MEPA).

Figure 0-1. Project Location

The Government of Georgia wants to revive the irrigation system with the support of the European Investment Bank (EIB). The EIB appointed Atkins as consultants to update previous work undertaken on the Project, including a Site Investigation Report prepared by the GA in 2016 and an Environmental and Social Impact Assessment (ESIA) and associated Feasibility Study (FS) prepared by Eptisa in 2018.

The Atkins 2022 FS (September 2022) covers the following:

- Feasibility Report
- Baseline Report
- Conceptual Design Report
- Cost Model
- Economic and Financial Analysis tables as appendices

It also covers this ESIA Report which was prepared by Atkins. The ESIA Report forms one of several documents prepared to meet EIB environmental and social requirements as follows:

- Environmental and Social Management Plan (ESMP)
- Resettlement Policy Framework (RPF)

The primary objective of the ESIA is to identify the environmental and social risks, impacts and benefits of the Project and to inform the technical and financial decision making of the FS.

This ESIA has been prepared based primarily on the 2018 Eptisa ESIA Report, supplemented by additional desk-based study, site walkover, and further detailed hydrological, agricultural and technical analysis as part of the 2022 FS review. No additional detailed site surveys have been undertaken.

Project Description

The ZSIS was predominantly developed as a large open canal network designed to serve six large collective farms (kolkhozes). Irrigation distribution was mainly by flood and furrow irrigation, but also included some pressurised pipe distribution. The control equipment, mainly simple sluice gates, was basic and rudimentary and overall the system was inefficient.

The original structural elements of the ZSIS include (see also Figures 0-2 and 0-3):

- The Sioni dam and reservoir across the Iori river, a tributary of the Mtkvari river.
- The Paldo headworks (PHW) which comprise the main intake where water from the Iori is diverted into the Upper Main Canal (UMC).
- The UMC which services the upstream half of the ZSIS, estimated at about 12,000 ha[1]. The UMC's main secondary canal is the Lilo Martkopi Main Canal (LMMC), providing irrigation water to a design command area of about 2,600 ha. There are four hydro-power plants (HPP) installed in the UMC, once recently constructed. The UMC drains into the Tbilisi Sea.
- The Tbilisi Sea stores water from the UMC and the LMMC (not functioning now), as well as water from the Zhinvali Reservoir on the Aragvi river. It also has its own small catchment. Water from Tbilisi Sea serves the Lower Main Canal (LMC), while water from the Zhinvali Reservoir serves as drinking water[2] for the city of Tbilisi and its surroundings.
- The LMC receives water from the Tbilisi Sea, Chumatkhevi creek, Lochini River and a transfer from the UMC to the LMC via a 1000 m steel pipe. It is also supplemented by water pumped from the Mtkvari River (up to 6 m^3/s using two pump stations)[3], which are no longer functional[4]. The LMC services the downstream half of the ZSIS, estimated at 13,000 ha.
- Secondary canals branch off from the UMC, LMMC and LMC and convey irrigation water to the different Tertiary Units (TUs) where the farms are located.
- Drainage canals, which mainly build on the existing natural drains and streams that are part of the watershed of the Iori River, the Mtkvari River and the Tbilisi Sea.

[1] Site investigation report (2016), p.41 states 15,000 ha; field notes by GA state 12,000 ha.
[2] ZSIS ESIA Report, Eptisa (2018). P.227
[3] ZSIS ESIA Report, Eptisa (2018), p.227 and pp. 240-242; also site investigation report (p.15/16)
[4] These elements do not form part of the 2022 FS.

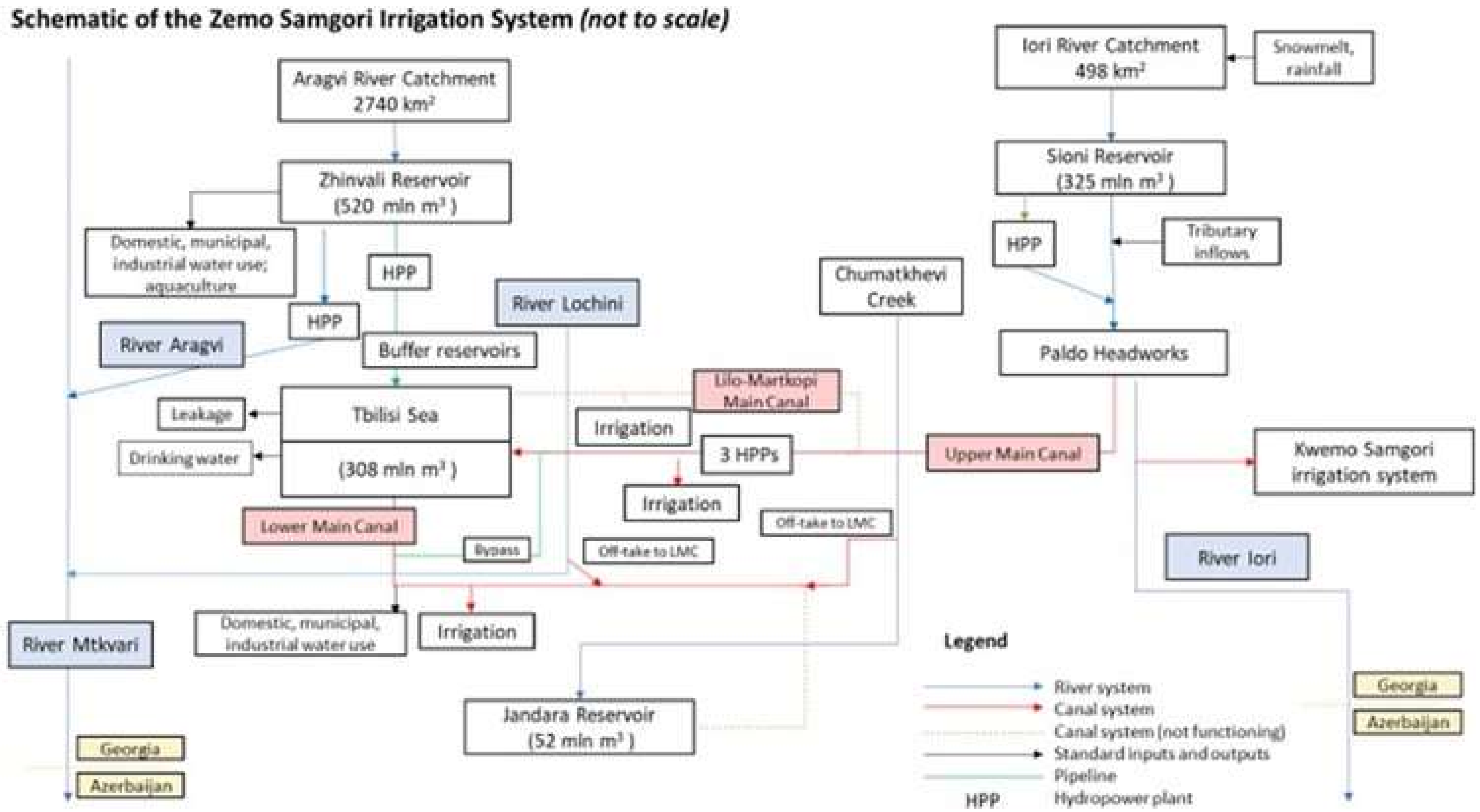


Figure 0-2. Schematic representation of the Zemo Samgori Irrigation System

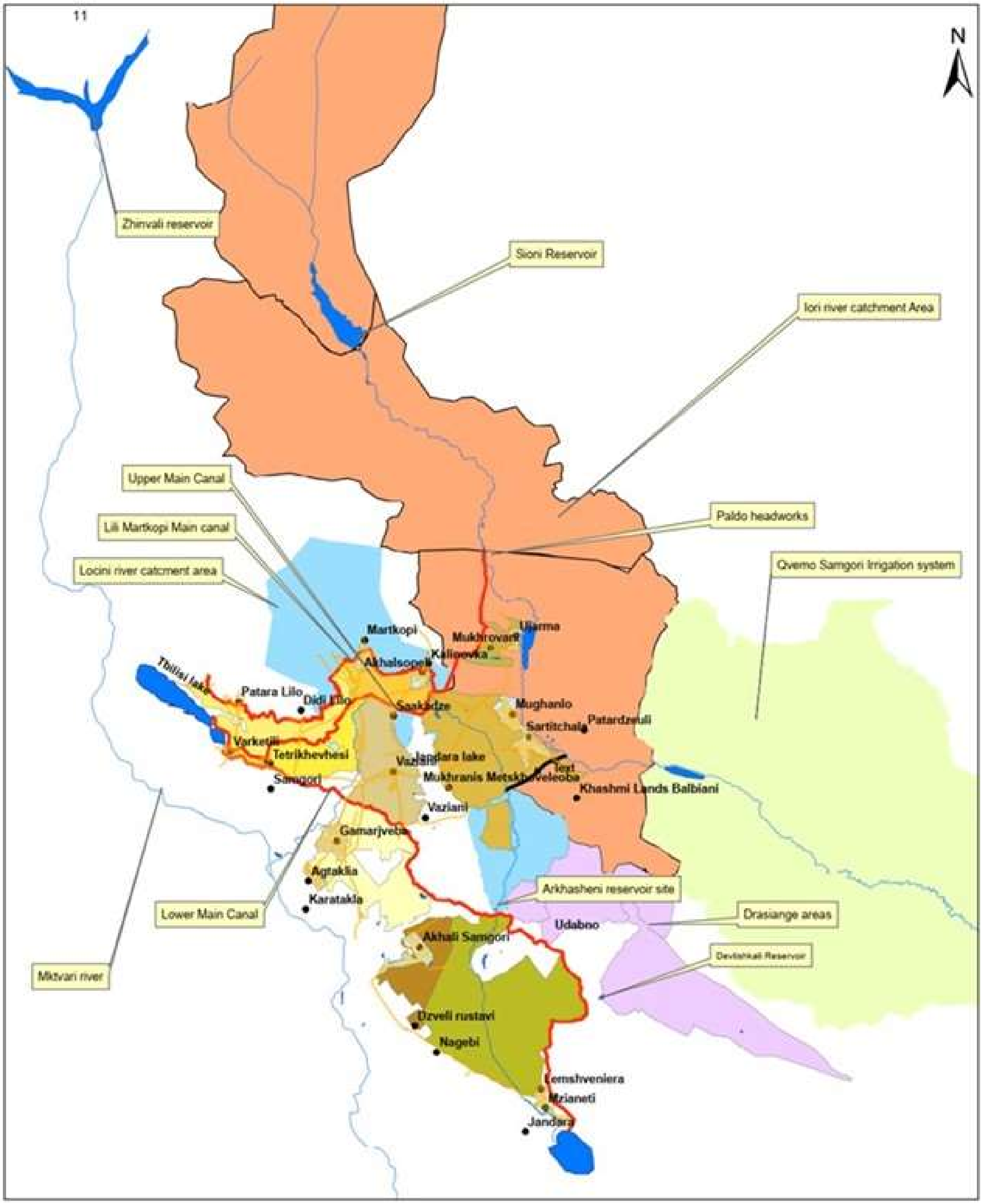


Figure 0-3. Zemo-Samgori Irrigation Scheme Catchments and Command Area

Command Area Assessment

The Geographic Information System (GIS) for the ZSIS command area, prepared during the 2018 FS was used together with strategies, plans, literature and field observations to assess the suitability of lands for agricultural production today and in the future. The results show that an estimated 19,129 ha is available for agriculture, following the exclusion of (a) lands in use for roads and canals, (b) non-suitable lands for agriculture, (c) build-up areas in villages, (d) industrial complexes and commercial enterprises as well as (e) lands currently undergoing or planned to undergo urban development, etc. (Table 0-1).

Currently nearly 18,500 ha of the Tertiary Units (TU) with agricultural potential are registered. Corresponding to the land area assessed for agricultural suitability, the number of TUs identified in the ZSIS command area with lands potentially fully suitable for irrigated agriculture is reduced from 342 TUs to 242 TUs, of which 184 TUs are fully included and lands of 58 TUs are partially included, of which 41 village TUs; as such lands of 100 TUs are fully excluded from the 2016 command area.

In 2020 and 2021, only 6,404 ha and 5,320 ha, respectively, were irrigated after signing an agreement for irrigation water supply with Georgian Amelioration Limited (GA), which is less than one-third of the potential irrigable area. Analysis of the land area being irrigated under contracts between GA and farmers in 2020 and 2021 shows that irrigation water is also provided to plots of land that are located outside the area identified in 2018 FS as the original command area of the ZSIS. These lands are irrigated by pumps installed or canal extensions dug by farmers[5].

Table 0-1. Initial classification of land use suitability in the ZSIS command area (ha)

Irrigation Zones	Design Command Area	Roads, canals and non-suitable lands within TUs	Build-up area in villages	Non-suitable TUs	Potential Irrigable Area		Annual Net Potential Irrigated Area
					Total	Of which: annual fallow	
IZ-1: Paldo Headworks UMC-G1 to UMC-G5	588.7	33.5	21.2	211.0	323.0	32.3	290.7
IZ-2: UMC-G06 to UMC-G09 and LMMC to Martkopi	7,394.8	602.7	461.0	445.5	5,885.5	588.6	5,296.9
IZ-3: UMC-G10 to UMC-G29	4,096.0	101.8	80.6	2,917.0	996.6	99.7	896.9
IZ-4: LMC-G04 to LMC-G20	10,501.6	833.3	455.1	1,258.2	7,955.1	795.5	7,159.6
IZ-5: LMC-G21 to LMC-G28	5,298.3	426.5	130.8	771.8	3,969.2	396.9	3,572.3
IZ-6: LMMC after Martkopi	2,114.8	0.0	0.0	2,114.8	0.0	0.0	0.0
TOTAL	**29,994.2**	**1,997.9**	**1,148.7**	**7,718.2**	**19,129.4**	**1,912.9**	**17,216.4**

In consideration of the results of the land suitability analysis, including considerations for the distribution of the land plots supplied with irrigation water under contracts signed with GA, the identified IZ-2 (UMC-G06 to UMC-

[5] For more details, see Conceptual Design report section 2.2 “project command area”.

G09 and LMMC to Martkopi village), IZ-4 (LMC-G05 to LMC-G20), and IZ-5 (LMC-G21 to LMC-G28) as the most relevant areas for the ZSIS modernisation investment project[6].

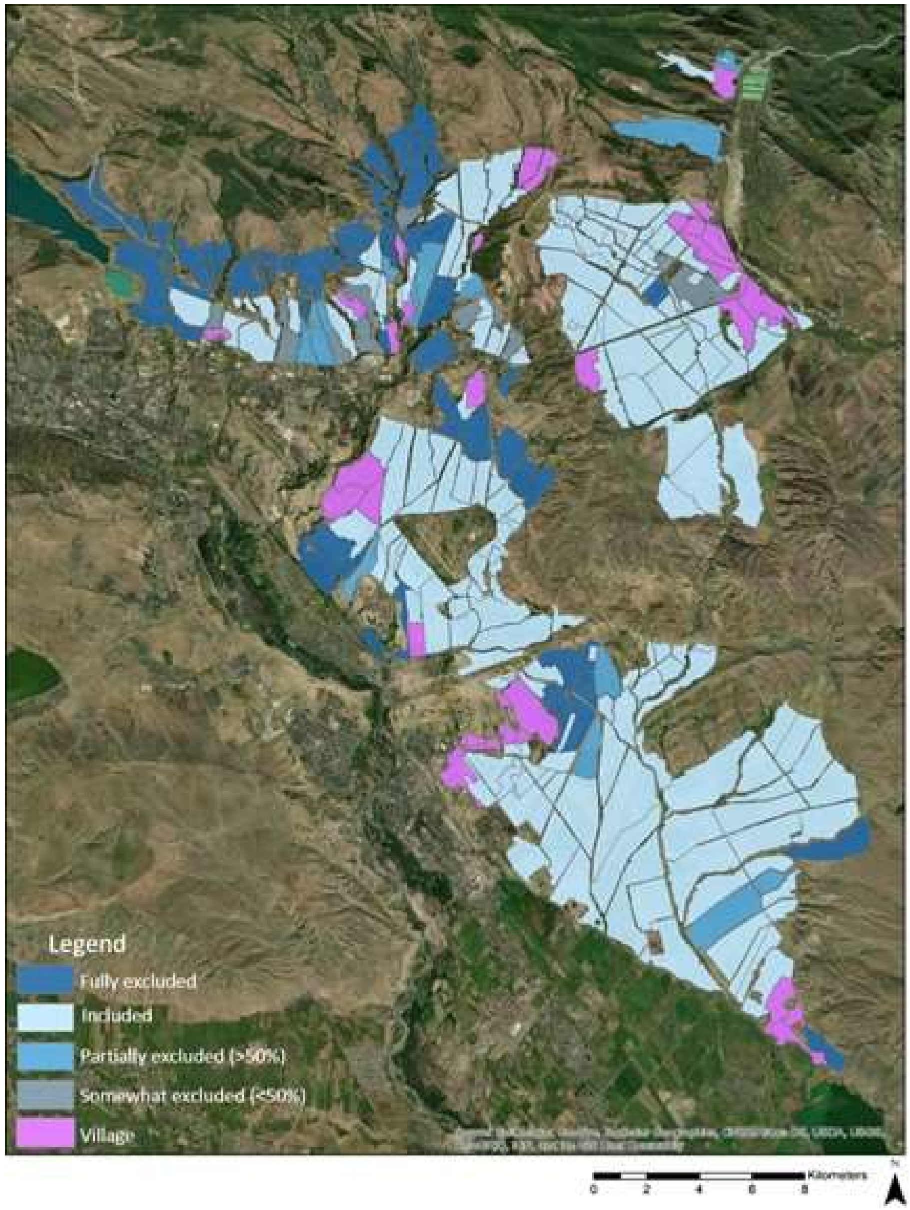


Figure 0-4. Spatial view of potential irrigable TUs in the ZSIS command area

Water Resources Assessment

The actual irrigated areas of ZSIS, in 2020 and 2021, are 6,404 ha and 5,317 ha respectively and the corresponding irrigation supply, at Paldo Headworks, are 24,024 m^3/ha and 19,934 m^3/ha. Irrigation use at present is more than double the amount of theoretical demand and the losses are due to (a) unregulated supply (b) overuse by farmers (c) poor irrigation infrastructure and (d) illegal tapping.

A monthly water balance model was developed to simulate historic flows in the Iori basin using rainfall-runoff modelling, monthly demand profiles and considering infrastructure capacities. Iori river supplies water to ZSIS, Kvemo Samgori Irrigation System (KSIS), Khashmi and Patanjeuli irrigation schemes. The latter two are minor irrigation schemes with a total command area of 300 ha. The area considered for annual irrigation in the ZSIS and KSIS are 19,129 ha and 21,500 ha respectively, out of which the areas considered for annual irrigation are

[6] During detailed design, alternative considerations may be given to selection of priority canals for modernization investments.

17,216 ha and 19,350 ha respectively. The model was run with three selected climate change scenarios (Hot Wet, Warm and Hot Dry). The water balance model assumes 20% of the long-term average monthly flow to be reserved as environmental flow[7], to ensure mimicking seasonal variation in river flow, including spring peak flows, in support of natural ecological processes and aquatic biodiversity.

The results of water balance modelling show that under the different climate scenarios used, the amount of runoff from the Georgian catchment remaining in the Iori river after irrigation and other water use abstractions are considered is on average 41%, exceeding the historic volume for 1990-2014 (30.8%), a result achieved by the reduced supply to irrigation from improved irrigation water delivery and use.

In summary, the water available from the Iori river could irrigate 97.4% (average of three climate scenarios) of the total potential ZSIS and KSIS command area of 36,566 ha in the first decade (2022-2031), reducing to 92.3% in the third decade (2042-2051). Three possible development pathways were identified:

a. The command area – of either ZSIS or KSIS, or both - could be proportionally reduced to match with 100% of water availability.
b. Irrigation requirement per ha could be reduced by introducing more sprinkler and drip irrigation systems, which is possible in case of further promoting the adoption of high-value agricultural cropping systems, including orchard trees, greenhouse crops, etc.
c. Cultivating less water demanding crops.

In conclusion, the FS Design Concept Report assumes that development pathway (b) and (c) will be the preferred options, meaning that modernisation of the ZSIS will allow to irrigate 100% of the command area in the next 30 years, made possible by promoting a combination of one or several of the following measures:

- Encouraging farmers to grow crops under sprinkler and drip systems;
- Adopting highly monitored and controlled irrigation scheduling and delivery;
- Encouraging farmers to grow less water intensive crops;
- Linking irrigation fees with volumetric irrigation water delivery to encourage farmers to grow more crop per unit of water;
- Proper operation and maintenance of irrigation infrastructure through Water Users Organisations (WUOs) to reduce the water wastages along the distribution network.

Proposed Project Modernisation Approach

The conceptual design of the irrigation system follows the approach defined in the Eptisa 2018 FS, updated in areas where a change in the conceptual design is deemed appropriate. The major changes, compared to previous study, are:

- The irrigation command area is reduced from 29,994 ha to 19,129 ha with a net annual potential irrigated area in use for agricultural production set at 17,216 ha. Correspondingly the number of TUs is reduced from 342 TUs to 242 TUs fully or partly included, with 100 TUs fully excluded from the command area. Among the 242 TUs, 184 TUs are fully included, while within 17 TUs a land area of more than 50% (10 TUs) or less than 50% (7 TUs) is excluded, while within 41 TUs with villages 50% of the land area is excluded;
- The schematic diagram is updated and revised, indicating the potential for TUs for agricultural potential;
- The LMMC beyond the village of Martkopi is not included for investments;
- No investments are considered in the internal water distribution network within the village TUs;
- While contracts for irrigation water supply to lands outside the 2016 command area have been signed, investments for modernisation of water distribution are exclusively considered within the 2016 ZSIS command area;

[7] As the current 10% of **minimum annual flow** accepted in Georgia as ecological flow is not in line with international views on ecological flows, Atkins opts to use 20% of the **long-term average monthly flow** as ecological flow, to allow for water abstraction while maintaining seasonal variation in river flow, including a mimic of spring peak flows, in support of maintaining aquatic biodiversity. The 20% is an estimation, as ecological flows are river-specific, commonly determined based on in-depth integrated research of hydrologists and ecologists. The EFR varies internationally from as low as 10% to 90% of the monthly flow depending on the season, weather zone and water requirement for the habitats. The EFR could be revised in the future depending on based on the methodology for the assessment of environmental flow in rivers to be adopted by the Ministerial Order.

- A number of additional works necessary have been identified and costed, such as an inlet from Chumatkhevi creek into the LMC, and minor works at the PHW. These works were not considered in the earlier FS;
- Illegal taps, especially in the main canals, have been identified. If an illegal tap is in use to support agricultural production and is in use to provide water to the fields of a group of farmers, the tap will be legalised and an appropriate outlet will be included in the investment project.

Design and Modernisation Requirements

The water balance study showed that the **carrying capacity of the UMC is adequate** to meet the ZSIS irrigation demand for agricultural production in 17,216 ha net annual potential irrigated area but only if the Tbilisi Sea serves as an intermediary storage basin, to ensure that in parallel the peak demand for irrigation water in both the UMC and the LMC during June-August can be met.

The **water level in the UMC and LMC has to be maintained at all flow levels** in order to deliver the planned flow rate constantly through the offtakes. Installing duckbill or long crested weirs, with a sediment excluder at the bottom, along the canal is the solution to maintain the water level in the canal.

In order to **maintain the specified flow rate at all times in the offtakes,** wherever the water level cannot be maintained in the canal, an automated undershot gate or modular gates may be chosen; the specific choice can be decided upon during detailed design.

All the networks up to the tertiary units (i.e. main and secondary open lined distribution canals[8]) must be sized to deliver uniform and constant flow for 24 hours. Within TUs, the flow rate within tertiary may be designed on a rotational basis (six days cycle at seven days interval). The canals within the tertiary units will have manual gates and shall be operated by the Water User Groups as per schedule.

Suggested modernisation requirements are as follows; the exact volumes of works will be identified during the detailed design:

<u>Paldo Headworks</u>

- Repair of settling basins of UMC regulator;
- Repair works to hoists at the UMC regulator point;
- Provision for a monitoring system to measure flow and sedimentation level in the settling basins.

<u>Upper Main Canal</u>

- Repair of lining works;
- Minor repairs to tunnels, siphons and drain overpasses;
- Additional duckbill or cross regulators to maintain the flow levels, as required;
- Repair works of LMMC regulator and addition of a distribution structure at UMC-G09;
- Improvement of existing outlets from UMC to secondary and TU distribution canal network, including introduction of new outlets (under specific conditions as described in section 6.2 “modernization approach”), including to villages, as appropriate;
- Establishment of monitoring and control devices;
- Minor repair works to the service roads;
- Repair works to the UMC-LMC connecting pipeline;

<u>Lower Main Canal</u>

- Repair of existing lined sections of LMC;
- Lining of 5.5km of unlined section of the LMC;
- Cross regulators to maintain the flow levels;

[8] Depending on the soil type, topography/slopes, etc., tertiary canals of the secondary distribution system (e.g. UMC-G5-1) will be designed either as open canals or closed pipeline. The specific choices will be determined during the detailed design stage.

- Improvement of outlets from LMC to secondary and TU distribution canal network, including introduction of new outlets (under specific conditions as described in section 6.2 “modernization approach”), including to villages, as appropriate;
- Establishment of monitoring and control devices;
- Repair works to the service roads;
- Inlet works from Chumatkhevi creek to the LMC;
- Minor repairs to the Lochini river inlet

Secondary distribution network

- Repair of existing lined canals;
- Reshaping and lining of secondary open canal distribution network[9];
- Establishment of new secondary and sub-secondary canals / pipelines wherever it is feasible without major land acquisition. The decision will be taken during the detailed design stage;
- Provision of proportional division structures at branches of secondary distribution canal network;
- Cross regulators to maintain the flow levels;
- Improvement of outlets from secondary distribution canal network to TU distribution canal network, including introduction of new outlets (under specific conditions as described in section 6.2 “modernization approach”) , including to villages, as appropriate;
- Establishment of monitoring and control devices;
- Repair works to the service roads.

Control and Monitoring

A simple SCADA system is proposed.

Other Works

Budget provision has been made for 55km of drainage improvements works (28km UMC and 27km LMC) and repair works to access and service roads.

Operation and Maintenance

Currently there are no Water User Organisations (WUOs) and so a well-developed WUO institutional structure will be useful for the development and implementation of efficient water distribution system and continuous maintenance in the future.

The organisational structure proposed for the ZSIS O&M is presented in Figure 0-5, while the comparison between the current and proposed operation, maintenance and management (OMM) is presented in Table 0-2 below.

[9] Depending on the soil type, topography/slopes, etc., tertiary canals of the secondary distribution system (e.g. UMC-G5-1) will be designed either as open canals or closed pipeline. The specific choices will be determined during the detailed design stage.

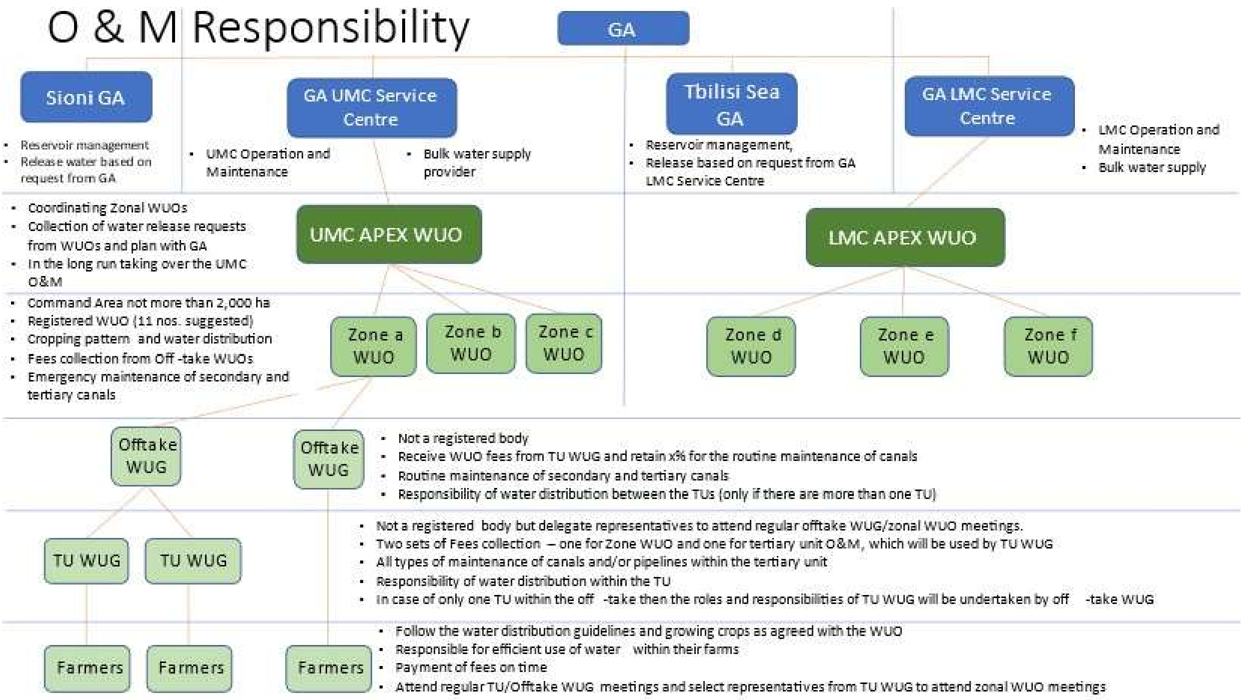


Figure 0-5. Proposed organisation structure for the O&M of ZSIS

Table 0-2. Summary of current and proposed O&M arrangement

	Description	Current management responsibility	Proposed future management arrangement
1	Operational system	Continuous flow with no scheduling and water distributed on ad-hoc basis	Irrigation schedule based on rotational water distribution system as per prior identified cropping pattern
2	OMM of Sioni Reservoir and Tbilisi Sea	GA	GA
3.	OMM of UMC, LMC and LMMC	GA Service Centre for ZSIS	Prior to WUO establishment: GA Service Centre; to be transferred to / reorganised into Apex WUO organisation(s)
4	OMM of Secondary and Tertiary Distribution Systems	GA Service Centre	Prior to WUO establishment: GA Service Centre; to be transferred to / reorganised into Zonal WUOs
4.1	Head and Tail end regulator operations of UMC and LMC	Head and Tail end regulator operations by GA	Head and Tail end regulator operations by GA
4.2	Offtakes at main canals	Gate Operators mostly engaged by GA	Prior to WUO establishment: GA Service Centre; to be transferred to / reorganised into WUOs
4.3	Offtakes at secondary / tertiary canals	Gate Operators mostly engaged by GA	Prior to WUO establishment: GA Service Centre; to be transferred to / reorganised into WUO's Off-take WUGs
4.4	Gate Structure and water distribution at TUs	Gate Operators mostly engaged by GA	Members of the benefiting Water User Group (WUG) or Gate Operator

	Description	Current management responsibility	Proposed future management arrangement
			engaged and paid by the Offtake WUG or TU WUG
4.5	Emergency maintenance of secondary and tertiary canals	GA Service Centre	Prior to WUO establishment: GA Service Centre; to be transferred to / reorganised into Zonal WUOs
4.6	Regular maintenance of secondary and tertiary canals	GA Service Centre	Prior to WUO establishment: GA Service Centre; to be transferred to / reorganised into WUO's Offtake WUGs
4.7	OMM of TUs	Farmers but in reality very minimal activities	TU WUGs
5	Financing of OMM	Government allocation which is not based on needs nor any clear performance indicator	To be financed from irrigation fees but with initial subsidy (to be decided during implementation) which is be phased-out over 5 years
5.1	Estimated OMM Cost/hectare/annum	NA	GEL 215 (to be updated during project implementation)
5.2	Irrigation Fee/ha/annum	GEL 75	To be gradually raised[10]

Project Management Unit

To guide the implementation of the project, a dedicated Project Management Unit will be established and staffed with relevant operational and technical experts. A budget of €2.43million is allocated for PMU staff salary and expenses to be financed from the loan. It is envisaged that the PMU can be become operational under the umbrella of the existing MEPA PMU, as the MEPA PMU is managing the current IFAD and WB funded irrigation projects.

Technical Assistance

The Project needs support from the experts, with experiences in various sectors such as hydrology, water resources, infrastructure, agriculture, environment and sociology, for pre-, post- and during implementation stages. The 2022 FS identifies five technical assistance packages.

Analysis of Alternatives

The analysis of alternatives helps identify the most appropriate method of developing a project and can help identify the option(s) with the least environmental and social impacts.

The 'no project' alternative considers the outcomes should the Project not go ahead. The 'no project' alternative would mean a continuation of existing operations, whereby less than 7,000 ha (6,404 ha and 5,320 ha in 2020 and 2021, respectively) of the original 30,000 ha command area are annually irrigated.

Possibilities of alternative water usage were considered to determine whether the objectives of the Project could be met by alternative means. Given that the system was developed to utilise surface water, this is considered the preferred water resource option for the Project.

The location of the Project has been driven by the existence of the ZSIS since the 1960s. Utilising the existing command area is therefore the preferred option. The ZSIS is one of the larger irrigation areas in the country and, as it is close to Tbilisi, offers the biggest opportunity to increase crop production within Georgia. For this reason, the existing ZSIS and its existing command area has been chosen for development.

Three alternatives were considered in the Eptisa 2018 FS and Eptisa 2018 ESIA. A detailed analysis of these options is presented in the previous work. The 2022 FS has approached the identification of the areas suitable for irrigation through a consideration of land constraints and water resource availability, through which a preferred land area has been identified. This has reduced the area for irrigation identified in the previous studies.

[10] The tariffs for primary water user services are defined by the Georgian National Energy and Water Supply Regulatory Commission, new tariffs are presumably approved by 2024.

The 2022 FS proposes two apex WUOs established at the level of a main canal, then 11 WUOs established at a zonal level, around 50 WUGs established around a separate offtake directly from the LMC, UMC or LMMC, and around 128 Water User Groups (WUGs) established at the level of a Tertiary Unit (TU). This approach enables Operation and Maintenance (O&M) to be implemented through various hierarchical WUOs. This will however be developed further under the guidance of the proposed WUO Planning and Formation Technical Assistance programme.

The process and operational alternatives look at the technological or equipment alternatives. Options such as irrigation methods, water management techniques, crop management techniques and soil management techniques will be discussed as the Project moves forward, a number of these options may be employed as relevant to maximise the benefits of the Project.

Institutional, Policy and Legal Framework

The EIB Environmental and Social Standards require that projects comply with all national legislation and international conventions and agreements ratified by the host Country, as well as with the provisions of the following treaties and conventions:

- UN ECE Aarhus Convention;
- United Nations Convention on Biological;
- United Nation Framework Convention on Climate Change and its UNFCCC's Kyoto Protocol and EC Policy on Climate change addressing both mitigation and adaptation responses;
- United Nations Hyogo Framework for Action Programme (2005-2015) and the Community approach on the prevention of natural and man-made disasters.

The key government organisation in relation to the environmental and social aspects of the Project is the Ministry of Environmental Protection and Agriculture (MEPA), the main institution in charge of issues related to environmental protection, the use of national resources (except minerals, oil and gas), and agricultural development including land improvement (amelioration). MEPA's subordinated structural units, subordinated entities and Legal Entities of Public Law are also described, including the Environmental Assessment Department, the National Environmental Agency (NEA), the Environmental Information and Education Centre.

Key National Environmental and Social Policies and Strategies include the Climate Change Strategy for 2030, Environmental Protection and Rural Development – 2030, the Social Economic Development Strategy of Georgia as well as the Association Agreement between the EU and Georgia.

Key National Environmental and Social Legislation includes the Constitution of Georgia, the Law of Georgia on Protection of Environment, the Law of Georgia on Energy and Water Supply, the Law on Water, and others. The Law of Georgia on Protection of Environment (adopted in 1996, last amended in 2021) regulates the legal relations between the bodies of the state authority and physical persons/legal entities in the scope of environmental protection and consumption of natural resources throughout Georgia. The Environmental Assessment Code 2020 sets the legal basis for issuance of an environmental decision, including implementation examination process, public consult

ations and community involvement in the processes.

The Environmental Assessment Code was adopted on June 1, 2017. The Code was elaborated with the aim to align the national EIA procedures with the EU directives. The code will enter into the force from January 1, 2018. According to the new Code, subject to EIA are the projects listed in Annex I and those projects listed in Annex 2, which become subject to EIA based on the screening decision in accordance with Article 7 of this Code.

According to the Environmental Assessment Code, construction and operation of irrigations systems is an Annex II activity and therefore is subject to screening, which is also confirmed by liaison with the EA Department of MEPA (December 2021). Consequently a screening report should be submitted to the MEPA to confirm the need for an EIA. In the case that an EIA is required, the MEPA is responsible for EIA reports, disclosure and arrangement of public consultation meetings at the scoping stage and further after submission on EIA before issuance of Environmental Decision on the Project.

Irrigation Water Management Framework

The Agriculture and Rural Development Strategy aims for competitive agricultural and non-agricultural sectors, sustainable use of natural resources, retaining the ecosystem, adaptation to climate change, effective food/feed safety systems, and veterinary and plant protection. The Irrigation Strategy for Georgia 2017-2025 specifically aims to rehabilitate decayed irrigation infrastructure and develop a modern data-based professional and participatory irrigation management capacity. By 2025, 200,000 hectares will be equipped for irrigation through evaluating and prioritising more than 100 potential projects.

Legislation relevant to irrigation management includes the Law on Water covering issues related to water protection and use, the draft Law on Water Resources Management aiming for water resources management based on river basin management principles and aligned to five EU Directives, as well as the Law on Water User Organisations elaborating the foundation for the establishment of WUOs in Georgia, describing the use of irrigation infrastructure, main principles of irrigation services provided by WUOs and primary water users, and state control of WUOs.

The key national stakeholders in irrigation water management include the MEPA and subordinate authorities, including the Hydromelioration and Land Management Department, the Environment and Climate Change Department, NEA. Specifically, Georgian Amelioration (GA) is the sole provider of irrigation and drainage services in the country. Responsibilities of GA include the construction, reconstruction and rehabilitation of infrastructure and its safe management, observance of water use rules established, and calculation and collection or irrigation service fees (GEL 75 per hectare).

ESIA Approach and Methodology

The key stages of the ESIA process have covered the following:

- Project Inception
- Policy, legal and institutional review
- Baseline conditions
- Stakeholder engagement
- Impact assessment and mitigation measures
- Cumulative impacts
- Preparation of the ESIA report, ESMP and RPF.

As requested in the Terms of Reference, this Assignment is focused on an update of the ESIA prepared for the Project by Eptisa dated August 2018. The Eptisa ESIA has therefore been supplemented by further analysis of the hydrological, water balance and agricultural impacts and reflects the updated Project as set forth in the 2022 2022 FS.

Environmental Baseline

The geology of the command area of the ZSIS is characterised by Quaternary continental molasse with volcanic rocks and Neogene terrigenous with volcanic rocks. There are three sub-types of soil: Chromic cambisols, Meadow chromic cambisols and Vertisols. These soils provide a good potential for growing two crops per year but they are also susceptible to erosion, secondary salinisation and poor drainage. Vertisols have a poor water retention capacity during the dry summer.

The UMC and LMC command area is divided into five zones considering their distinct topographic, climatic, soil and agricultural characteristics. This excludes Zone 6 which was not considered suitable for development. The crop details for each of the zones are presented below.

Table 1-3. Crops in the ZSIS command area

Zone	Crop Suitability
Zone 1 - Paldo Headworks UMC-G1 to UMC-G5	Dominant crops are grain maize and alfalfa. Grapes and fruits are not suitable as hail is quite frequent as well as early/late freezing
Zone 2 - UMC-G6 to UMC-G09 and LMMC to Martkopi	Corn maize is the dominant crop in this zone along with fruit and grape orchards on large scale farms. It is also suitable for a variety of crops including vegetables, wheat and barley.
Zone 3 - UMC-G10 to UMC-G29	The cropping pattern in this zone is mostly based on grapes, berries, fruits and other perennial crops. Maize and alfalfa are produced on smaller pieces of land compared to other zones. Farmers are using drip irrigation for newly established orchards (e.g., berries) and furrow irrigation for older crops (e.g. grapes).
Zone 4 - LMC-G04 to LMC-G20	Cropping patterns in this zone comprise of grasses, alfalfa, berries, vegetables (e.g. tomatoes) and fruit/nut orchards. Water shortages and poor infrastructure lead to relatively undeveloped agricultural sector in the area. Farmers mainly focus on grasses and other annual crops.
Zone 5 - LMC-G21 to LMC-G28	Cropping patterns in this zone are limited to grasslands with natural vegetation for winter pastures, silage maize and alfalfa.

Natural hazards include earthquakes, severe storms triggering floods and landslides, extreme heat, hurricanes, tornadoes, and wildfires. Other hazards include wind erosion and hydraulic erosion. In the irrigation area, extensive damage can also be caused by leaking irrigation infrastructure that leads to landslides.

The National Environmental Agency has two observation points for water quality in the Iori Basin, at Sasadilo and Sartichala, within the ZSIS. The water quality of Iori river is within the maximum permissible concentrations (MPC) as specified by the Government of Georgia’s regulations. However, the water quality in the canals shows enhanced concentrations of E-Coli, iron and ammonia due to untreated sewage and effluent discharges into the canals.

The air quality in the project area is affected by the presence of cement and construction material production and thermal power plants. However only for 11% of the year did it show poor air quality. The main sources of noise pollution are the E60 motorway and the Tbilisi bypass road.

There are a number of protected areas in and around the study area, including the Caucasus Endemic Bird Area (EBA)[11] covering Georgia, Armenia, Azerbaijan, Iran, and Turkey and the northern part of the ZSIS; and three Important Bird Areas (IBAs) just to the south of the ZSIS: Jandara Lake IBA; Iori IBA; and the Lower Kura Valley IBA.

The Emerald Network is an ecological network made up of Areas of Special Conservation Interest. In accordance with obligations under the Bern Convention on the Conservation of European Wildlife and Natural Habitats, and the EU-Georgia Association Agreement, Georgia officially nominates candidate Emerald Sites. At present, there are 66 Emerald Sites in Georgia, from which 46 are designated sites, four candidate sites and 16 proposed sites. The Lower Kura Valley IBA coincides with the Gardabani Nature Reserve, which is an Emerald Network ‘Candidate Site’. The sites closest the ZSIS are the Saguramo Emerald Site, the Gombori proposed Emerald Site and the Jandara Lake proposed Emerald Site.

Also, downstream of the study area the Iori Managed Reserve is located adjacent the Iori river, in the Sighnaghi municipality of the Kakheti region; the Gardabani Managed Reserve is located on the Mtkvari river in the Gardabani municipality and Marneuli municipality in the Kvemo Kartli region, near the Azerbaijan border; and the Gardabani Wildlife Refuge is located along the Mtkvari river to the west of the project area.

The ZSIS crosses several habitats, all of which are strongly affected by anthropogenic factors. Rare and endemic plant species occur in fragments of riparian forest and xerophyllous shrubbery located in the dry gorges of areas surrounding the ZSIS and the broadleaf forest of Paldo-Mukhrovani, outside the current project area. Some tree species, included in the Red List of Georgia (*Pyrus demetrii, Juglans regia, Ulmus minor*) were recorded near canals during the surveys of the Eptisa 2018 FS. Fauna within the ZSIS is not very diverse since

[11] Most bird species are quite widespread and have large ranges. However, over 2,500 are restricted to an area smaller than 50,000 km^2, and they are said to be endemic to it. BirdLife International has identified regions of the world where the distributions of two or more of these restricted-range species overlap to form Endemic Bird Areas.

the natural landscape has been modified by agriculture over a long period and the area is densely populated. There are a number of small water bodies allocated across the ZSIS.

According to the Cultural Heritage Database and literature review, there are around 40 monuments in the ZSIS area. Some archaeological sites dated from the Bronze Age to the Middle Ages are reported in the northern and central sections of the ZSIS, in the areas of Martkopi, Satskhenisi, Norio, Lilo and Gamarjveba. The 2021 engagement with farmers also indicated the presence of tombs and a cemetery within the command area, and therefore there may be more local features present close to proposed works that should be confirmed during detailed design.

Socio-economic Baseline

Administratively the command area of the ZSIS is mostly located in the Kvemo Kartli region of Georgia, in the municipality of Gardabani, while smaller parts are located in the Samgori district of Tbilisi and the Kakhati region, municipality of Sagarejo. In total 25 villages were intended to benefit from the scheme. The population has been relatively stable in both municipalities between 2019 and 2021, although it decreased compared to earlier years. According to Geostat data for Georgia in 2020, the population was growing in Kvemo Kartli region but declining in the Kakheti region, though this trend has slowed since 2019.

For Georgia as a whole, the share of men and women to the total population as of 1st January 2021 equals, respectively, 48.2% and 51.8%. The 2014 census indicates that a total population in the ZSIS villages were 48,669, of which 49% were male and 51% were female. Eighty five percent of the ZSIS area population are ethnic Georgians, while 13% are Azerbaijani and 1.7 belong to other nationalities. Georgian is a native language for the 85% of the ZSIS project area population, while Azerbaijani language is native for the 13%.

Georgia is a small market economy of 3.7 million people with a per capita Gross Domestic Product (GDP) of $4,691.2 and an unemployment rate of nearly 17.6% in 2019 (before the COVID-19 pandemic). Services contribute the most to GDP (58.57%), followed by industry (21.63%). Agriculture provides around 7.37% of GDP (2020). Although the GDP has been growing through the last 10 years, agricultural output has increased only slightly. Overall, the business sector ‘Agriculture, forestry and fishing’ is 0.08%, 4% and 6% of all economic activities in Tbilisi, Kvemo Kartli and Kakheti, respectively.

About two-thirds of the workforce is considered self-employed, predominantly as subsistence farmers. However, according to GEOSTAT’s updated methodology on employment, as of 2020, the Georgian agriculture sector employs about 19.8% of the population.

The active labour force in the three project regions is highest in Tbilisi and lowest in Kakheti. In all cases, the majority of the labour force is in hired employment. The unemployment rate is highest in Kvemo Kartli and lowest in Kakheti.

The average monthly per capita income is highest in Tbilisi (324.2 GEL), then Kakheti (288.7 GEL), then Kvemo Kartli (256.4 GEL); and the per capita expenditure is also highest in Tbilisi (256.3), then Kakheti (246.2 GEL) then Kvemo Kartli (190.5 GEL). Average monthly salaries are 1394.4, 759.4 and 998.4 GEL, respectively. In 2020, the share of income derived from the sales of agricultural production in Georgia as a whole constituted only 5.3% of the total household income, which indicates that agriculture production is largely oriented towards self-consumption. According to the Eptisa 2018 ESIA Report, the population of the villages in ZSIS area are mainly self-employed in the agricultural sector. 79% of households interviewed in the villages by Eptisa reported agricultural production as their main income, while only a half of interviewed urban inhabitants participate in agricultural activities (49%). The main source of income of the local people is selling of agricultural products to the local markets. The exception is the residents of Samgori district villages, who are mostly employed in Tbilisi.

Available data from GEOSTAT according to the last agricultural census (2014) shows that across the Project regions, the majority of the lands are operated and owned lands, with a much smaller number renting land.

In the Kvemo Kartli region, in 2020 the share of agricultural holdings oriented mainly on crop production was 49.2%. In addition, in 2020 the share of agricultural holdings mainly engaged in livestock farming was 22.6%, while 28.2% of the agricultural holdings was engaged equally in mixed crop and livestock production. In the Kakheti Region, in 2020 the share of agricultural holdings oriented mainly on crop production was 66.6%, while the share of holdings oriented on livestock farming was 5.6% and of those engaged equally in crop and livestock production was 27.8%.

As part of the 2022 FS, the 2021 plot registration database was classified by plot size class as well as TU land suitability for agricultural production. The 2021 distribution of farm plots is skewed towards small farms (<0.25 ha) which account for 50% of the plots but only 5.7% of the total area, with plots >10 ha accounting for 2% of plots but the majority of the total area at 63%. This is similar, though with a slight reduction in number of small plots, to the findings of the previous census in the 2016 work that indicated that small plots (<0.25 ha) accounted for 63% of the total number of plots but only 11% of the total area and large farm plots (> 10 ha) accounted for 1% of total plots but 58% of the total area. There has therefore been a slight increase in larger farms since the previous work.

Analysis of the water supply contracts database managed by GA shows that for 2020 and 2021 a total of 4,298 contracts were signed, with 2,462 and 1,836 contracts signed in 2020 and 2021, respectively. It is noted that specifically in 2020, in response to the covid impacts, the GoG cancelled the annual fee for irrigation (flat fee of 75 GEL/ha), resulting in more farmers signing contracts. In 2021 such "subsidy" was not offered by the GoG and this may be one of the reasons for less contracts in 2021.

Most of the irrigation contracts are signed on rented/leased lands – 76.6% and 67.5% respectively in 2020 and 2021 showing 9.1% increase within owners. Another interesting fact is that contracts are mostly signed with physical persons rather than legal entities (94.9% and 90.5%). Additionally, most of the contract signees are male 90.37% and 93.37% in 2020 and 2021.

The main crops cultivated in the general area are wheat, barley, fruits, alfalfa, maize, grape and vegetables and within the ZSIS, annual crops such as maize, grass and alfalfa dominate. However, the area of perennial crops has increased from 4.8% in 2020 up to 10.4% in 2021 mostly from newly established intensive orchards co-funded from state program “Plant the future”.

According to the census data in the Eptisa 2018 ESIA, 35% of rural inhabitants reported having domestic animals. Bulls and cows are the most common domestic animals in the ZSIS villages (71%). 44% of interviewed households in rural areas stated an intention to have domestic animals, if irrigation water becomes available after the system rehabilitation. They mainly named cows / bulls (72%), pigs (53%) and hens (41%) as desired livestock.

In 2020 19.7% of the population in Georgia was under 60% of median consumption, while 7% was under 40% of median consumption, and 21.3% was under the absolute poverty line. Relative and absolute poverty indicators are higher in rural areas as compared to urban areas. From the ZSIS regions, absolute poverty is highest in the Kvemo Kartli region and lowest in Tbilisi.

Although the unemployment rate is higher for men, women’s economic inactivity rate is approximately 1.5 times greater than men’s – yet this is obviously related to women’s overrepresentation in unpaid work. A recent report from the Food and Agricultural Organisation (FAO) (2018)[12] indicated that there are still gender norms and stereotypes that severely hinder women’s development in rural areas in Georgia.

Stakeholder Engagement

A stakeholder engagement plan (SEP) was prepared as part of the Eptisa 2018 ESIA. The SEP is a ‘living document’ and therefore the existing SEP should be developed in more detail by the GA, the Detailed Design Technical Assistance team and, during construction, the Construction Contractor(s), to reinforce both ownership and execution of the Plan in the future Project stages. The SEP is intended to be a document that responds to the specific and unexpected circumstances and challenges that may arise in the Project Area about which stakeholders need to be informed and consulted with if they are or will be potentially affected.

During the 2022 FS, engagement has been ongoing with the GA to agree the Project concept. Engagement was also undertaken with the Georgian Water and Power and the Kvemo Samgori Irrigation System (KSIS) Project team to discuss irrigation demand and planning in their scheme. A farmer survey was also undertaken with representative farmers in the ZSIS in 2021. This engagement comprised a questionnaire related to household/organisation statistics, crops grown, crops interested in growing, animals owned, income, expenses and environmental and social challenges.

This chapter also provides a summary for proposed future engagement on the Project.

Impacts and Mitigation

Overall, the conclusion of the ESIA is that the impacts of the Project are manageable, and construction and operation of the Project will not result in irreversible, unacceptable risks to people or the environment. However, the findings of this report should be reviewed as the Project progresses and further details on the design emerge.

The main benefits of the Project are to modernise the ZSIS, which was the largest irrigation scheme in the country and the closest scheme to Tbilisi, in order to enable the recovery of the agricultural sector. It will also provide a more reliable water source, over a wider area, whilst maintaining downstream water user

[12] FAO. 2018. Gender, agriculture and rural development in Georgia – Country Gender Assessment Series. Rome, pp. 80 Licence: CC BY-NC-SA 3.0 IGO.

requirements and ecological flow requirements. In so doing, it provides an opportunity to increase subsistence and commercial farming, with positive knock-on effects in the economy and livelihoods from demand for agricultural products and sales.

The GA has overall responsibility for delivery of the Project and will be assisted in this role by the Technical Assistance programme, and the Project Management Unit (PMU).

During design

It is anticipated that the Project will be subject to further detailed design engaged by the GA. The ESIA and ESMP prepared for this work should form part of the tender documentation for the detailed design consultant. The detailed design consultant will be expected to address the measures proposed in this ESIA and the accompanying ESMP to avoid and minimise adverse environmental and social impacts wherever possible.

During this stage, further assessment of critical habitats based on the final design should also be undertaken. Based on the screening exercise for critical habitats, there is potential for the upgrade of the irrigation system to have moderate adverse effects on the site integrity of the neighbouring EBA and IBAs (Lower Kura Valley IBA, also known as the Gardabani Managed Reserve and a Candidate Emerald Network site; and Jandara Lake IBA), for example through noise and changes to offtake of surface or groundwater water. A more detailed assessment once the design is progressed will assist in determining whether there are significant adverse effects that require mitigation, for example, through the adoption of a Biodiversity Management Plan.

During construction

A Construction Contractor will be appointed to construct the Project. The ESIA and ESMP updated during the detailed design phase should form part of the tender documentation for the Construction Contractor. The Construction Contractor shall provide sufficient staffing to manage the environmental and social (E&S) performance of the Project and E&S staff to be approved by the GA/PMU.

With appropriate mitigation in place through a Project Environmental and Social Management System (ESMS) and ESMP, the majority of the adverse effects are anticipated to be reduced to Minor Adverse to Negligible and are, for the most part, temporary i.e., occurring for the period of the construction works only.

The following beneficial effects are predicted:

- Employment opportunities including increased direct earning opportunities for local working age unemployed and underemployed persons and increased expenditure on local goods and services resulting in further indirect employment and increased short-term disposable income and wellbeing among beneficiaries.
- Local economy effects through construction employee expenditure on transport, assets, hard goods and consumables. This will be further enhanced locally through any direct demand by the main Contractor for project materials, provisions and services.
- Construction employment opportunities that will have a positive impact on incomes and therefore livelihoods. Construction of the Project could also provide temporary workers with the opportunity to up-skill during the period of employment.
- Improved labour and working conditions, including Occupational Health and Safety (OHS), due to compliance with national and international standards; with the potential for positive directly and indirectly generated professional and casual employment opportunities for women.
- The following significant adverse effects (i.e. moderate or major adverse effects) however are predicted to remain following mitigation:
- Increase in dust emissions and particulate matter arising from dust generating construction activities leading to an increase in dust soiling at sensitive receptors such as individual properties, farmers and local communities. These effects will be short term, for construction works period only.
- Noise impacts arising from construction activities due to noise-generating equipment/items of plant including noise from construction associated traffic, on nearby Noise Sensitive Receptors within 200 m e.g., residential properties. These effects will be short term, for construction works period only.
- Community Health, Safety and Security risks such as public injuries as a result of, for example; movement of construction vehicles including HGVs, use of equipment, open excavated areas, construction materials and equipment being dropped; and machinery or operator loss of control; construction related accidents and pollution incidences; and 'local influx' potentially resulting in rapid changes in local demographics and pressure on social structures and local services, increase disturbance and increased risk of GBVH and the prevalence of STIs.

During operation

One of the principals underlying drivers for the Project is to modernise the ZSIS to increase agricultural production and improve food security and livelihoods.

During operation, therefore, the Project will have a direct and indirect positive impact on the national, regional, and local economy. The following beneficial effects are predicted:

- Improvements in food security, agricultural output (increasing both subsistence and commercial farming) and economic development. Improving the condition of irrigation structure will decrease water shortages and contribute to farmers' adaptation to climate change. This is particularly beneficial for those groups who are disproportionally affected by the impacts of climate change, such as women.
- Economic revenue from the expanded irrigated area, as well as related economic benefits of improved food security and knock-on demand for agricultural and other goods (as wages increase) in the local economy.
- Employment opportunities within the agricultural space will depend on the nature of the farm plots and whether they are all developed for farming. Given the area of land that can be irrigated will double, it is not unreasonable to assume that this will provide some employment opportunities directly to households that farm on these plots, within larger companies that may rent or buy land, as well as a seasonal demand for labour during harvest periods both on smaller and larger commercial farms. Mechanisation however may favour seasonal rather than full time employment.
- Operation of the Project is not expected to generate significant job opportunities at the local level, though it can be expected that the maintenance of the Project will generate some job opportunities such as routine maintenance of canals and structures which may provide limited local job opportunities.
- Improvements in livelihoods due to provision of more irrigated land. The main impacts to stem from this are an increase the sustainability of existing agrarian livelihoods through increased local employment and income generating opportunities, and through improved local food security. These impacts are especially pronounced in the context of household farmers, especially those that are vulnerable, who may lack the capital or adaptive means to establish alternative livelihoods. However, medium/larger farms are more likely to be able to maximise the benefits of the Project more rapidly. Improved livelihoods and access to subsistence crops as a result of the Project, for those that have access, can be expected to have a positive effect on the wellbeing of farmers and their households, including those working full time and part time on farms.
- Project packages may encourage economically vulnerable households to keep their lands and benefit from the Project. Also, as irrigation becomes more available and incentives for farming activities are more evident, it is expected that there will be a shift from livestock to crop farming. This could provide new opportunities for households previously solely dependent on a limited number of livestock.
- Improvements in relation to previous entry barriers to irrigated land through incentives and support.
- Health improvements in relation to improving the flow of stagnant or semi-stagnant waters in the existing irrigation canals, which can serve as breeding sites for vector borne diseases. Improved flow of water could result in some minor improvements to farmer health and the local communities in the ZSIS.
- Health, safety and security benefits in relation to various aspects such as training in the use of pesticide, fertilisers and herbicide; training in the use of dangerous farm machinery; and improved management of water resources having a positive effect on wellbeing and security through more equitable distribution of water.
- Improved labour and working conditions, including OHS, due to compliance with national and international standards; with the potential for positive directly and indirectly generated professional and casual employment opportunities for women.
- With targeted intervention, improvements in women's (and other vulnerable persons) access and participation within and ability to benefit from the Project. The Project provides an opportunity to promote greater economic inclusion for women and other vulnerable groups. The irrigation development of the area has also potential to contribute to the skills development and training of local communities.

The following significant impacts (i.e. moderate or major adverse effects) however are predicted to remain following mitigation:

- Water availability within the ZSIS will have an impact on the area of land that can be irrigation as part of the ZSIS. As identified above, using the averaged water balance across the three climate, the model indicates that water is available to irrigate more than 90% of the combined command area of ZSIS (and the KSIS and other demands) in the next three decades (resulting in a potential residual effect of moderate adverse). The 2022 FS proposes measures in place to address this. These assumptions are based on modelled data and obviously actual impacts will depend on actual climate change that occurs.

- Hydraulic erosion may still result in moderate adverse effects given the types of soils in the ZSIS and rainfall conditions. Whilst the modernisation should reduce this risk significantly, it may not be possible to completely eradicate this risk. Hydraulic erosion may result in loss of productive topsoil, reduced water availability in the soil, reduced soil nutrients, and pollution of waterways.
- Irrigated agriculture is a significant source of soil and water contamination, emanating from agro-chemicals (fertilisers, pesticides, and herbicides) application, spillages from farm machineries and poor quality of irrigation water. This may affect soils by: Altering its physiochemical properties and increasing the concentrations of some pollutants, with knock-on effects for nutrification and eutrophication of water bodies; and food and animal safety. Depending on final methods use on farms, this could result in a moderate adverse effect on soil quality and fertility especially as the Project will not be able to control what is undertaken on each farm plot.

Additional Project Implementation Recommendations

In addition to the specific environmental and social measures discussed under construction and operation impacts above, and the implementation approach set out in the 2022 FS Report, the following measures are proposed to be put in place to ensure successful Project implementation:

Project Management Unit (PMU)

It is recommended that within the PMU that will be set up for the Project, the following personnel are appointed:

- Environmental and Social Expert
- Community Liaison Officer / Stakeholder Specialist
- Gender specialist

Water User Organisations

It is recommended that a template contract for provision of irrigation water supply services from state irrigation systems to WUOs is developed, as well as developing a new template contract for the supply of irrigation water from WUOs to farmers. A unified automated billing system for should be developed in the GA including development of reserve funds in WUOs, an introduction of an insurance system for farmers against crop failures, including those caused by water scarcity in sources and other force majeure circumstances, etc. as mechanisms to protect the financial and economic interests of all key stakeholders of the irrigation sector.

Asset Management

It is recommended that an inventory of the irrigation infrastructure is undertaken by the GA, including all necessary documentation (technical datasheets, Acts of Asset Transfer, etc.) and that the GA/PMU assists the new WUOs in the registration of the ownership rights to the transferred irrigation systems. Such assistance shall at the very least include consultations for WUOs on the legal and procedural aspects of registration.

Training and Capacity Building

Both technical and non-technical training will need to be delivered for personnel from GA, as well as WUOs, and beneficiary farmers - including women and vulnerable persons - on irrigation, cropping, soil management and associated practices, improved water management practices, business management, markets and decision making around water and agriculture. It is recommended that a training needs assessment system is introduced as well as developing annual capacity building programs in all the GA divisions and WUOs.

In addition to standalone training, it will be necessary to ensure there are ongoing advisory services available for staff, especially for women who may not have had the same access to historical training.

Gender

During the design and planning stage, there are significant opportunities for gender inclusion. It is recommended to use opportunities to develop awareness on providing equal opportunities for all, regardless of gender. Ideally, gender-transformative approaches should be implemented to sensitise the implementing bodies on the importance and benefits of working towards gender equality in the sector (e.g.: reducing the gender gap) and tackling the unconscious bias that limit women’s participation.

Environmental and Social Management Plan

The environmental and social impacts of the Project will be managed through a Project Environmental and Social Management System (ESMS) to be developed by the GA/PMU, which will include updating this 2022 ESIA Report (where applicable), Framework ESMP and the Eptisa SEP. The GA/PMU may also need to develop a Resettlement Action Plan (RAP) and/or Livelihoods Restoration Plan (LRP), depending on the final design and displacement impacts of the Project. The Construction Contractor, likewise, will need to develop, GA/PMU approval, and implement a detailed Construction ESMP and SEP. The performance of the Contractor during construction will be overseen by the GA/PMU. During operation, an Operation and Maintenance (O&M) ESMP will be prepared, and its implementation will be managed by the GA and the WUOs.

1. Introduction

1.1. Background

Georgia is one of the upper middle-income countries[13] that gained independence from the Soviet Union in 1991. The contribution of agriculture, forestry and fishing to the Gross Domestic Product (GDP) was 6.5% in 2019 and was 8.4% in 2020[14].

Georgia's once vibrant irrigation systems, with more than 500,000 hectares (ha) of command area, was reduced to less than 50,000 ha by 2015 due to poor operation and maintenance, lack of investment and increased energy costs for pumped irrigation systems. Over the years Georgia has become a net importer of food. The Government of Georgia (GoG) has ambitious plans to develop the agricultural sector through its Strategy of Agricultural Development of Georgia for 2012-2022, Rural Development Strategy for 2017-2020, Agricultural and Rural Development Strategy for 2021-2027, Irrigation Strategy for Georgia 2017-2025 and Action Plan 2021-2023.

Georgia is now part of the European Union's (EU) European Neighbourhood Policy and Eastern Partnership Framework, which helps with overall development of the country including economic and social development and engagement with civil society. In addition, the EU and Georgia signed an Association Agreement (AA) in June 2014 to improve the country's institutional capacity among other objectives. Georgia, as part of Paris Climate Agreement, highlighted the need to address both climate change adaptation and mitigation. All these objectives are included in the revised Association Agenda 2017-2020. The European Investment Bank (EIB) is supporting the AA objectives in the areas of socio-economic development by investing in vital and enabling infrastructure, private sector development and climate action.

The Zemo Samgori Irrigation System (ZSIS), located to the east of Tbilisi, was developed in the 1950s with an original design command area of 41,000 ha and was in use until 1991, but currently is in a deteriorated condition (**Error! Reference source not found.**). The GoG wants to revive the irrigation system and has indicated that this particular project has been identified as a key enabling project for the recovery of the agricultural sector and to boost the economy. The improvement of ZSIS is strategically aligned with the objectives of various GoG strategies and the EU and EIB's agreements with the GoG.

Figure 1-1. Project Location

[13] The World Bank data @ [Agriculture, forestry, and fishing, value added (% of GDP) - Georgia | Data (worldbank.org)]
[14] Agriculture of Georgia 2020. National Statistics Office of Georgia. Available at: https://www.geostat.ge/en/single-archive/3357

The Dutch Government through the Netherlands Enterprise Agency (RVO) provided a grant to the GoG for the development of a Feasibility Study (FS) including an Environmental and Social Impact Assessment (ESIA) of the modernisation of the ZSIS. These were prepared by an international consulting firm in accordance with the International Finance Corporation (IFC) standards between 2015 and 2018 and are referred to herein as the Eptisa 2018 FS and Eptisa 2018 ESIA. The Dutch financing of the project did not materialise and since then, the GoG has requested a framework loan from the EIB for the modernisation of the ZSIS.

1.2. Feasibility Study

The EIB has appointed WS Atkins Limited (the Consultant) to undertake a Technical Assistance Assignment, comprising the update of the Eptisa 2018 FS and Eptisa 2018 ESIA of the ZSIS, which were prepared with the support of the Netherlands Government, to align with EIB standards and requirements.

The overall objectives of the Project are:

- To modernise the ZSIS to respond to the irrigation service needs of current agricultural producers; and
- To increase the resource-efficient production of quality agricultural produce, thus increasing availability and access to food by local populations and increasing the competitiveness of Georgian produce on regional markets.

The main objectives of the Technical Assistance Assignment are:

- To review and update the FS and the ESIA in line with the EIB standards;
- To prepare an Environmental and Social Management Plan (ESMP) and a Resettlement Framework Policy (RFP); and
- To prepare Terms of Reference (ToR) for consultancy services for detailed design and to engage farmers in the modernisation process.

The main results to be achieved under the Assignment are an updated FS report, including ESIA report, and series of plans, manuals and recommendations, notably:

- A review of the previous studies including site investigation report, ESIA report (including detailing relevant water supply-demand balances) and financial and economic study report;
- ToRs for consultancy services to produce detailed engineering design and tender documentation for modernisation of the ZSIS;
- Feasibility assessment and refined Project scope meeting EIB's standards;
- ESMP and RFP established according to EIB requirements and operationalised by the Promoter;
- Project implementation structure and manuals outlining procedures standardised according to EIB requirements and operationalised by the Promoter including the preparation of a Project Procurement Plan;
- ToRs to engage a service provider to conduct a new round of consultations with all project stakeholders to present the proposed Project as well as to discuss their views on the adoption of new on-farm irrigation technologies and anticipated changes to cropping patterns.

The 2022 FS is presented as a series of reports:

Feasibility Report

- Baseline Report
- Conceptual Design Report
- Cost Model
- Economic and Financial Analysis tables

1.3. Purpose and Scope of this Report

As part of the Techncial Assistance Assignment, the EIB requires that the previous ESIA prepared for the Project is updated in line with EIB Environmental and Social Standards (2018).

The primary objective of the ESIA is to identify the environmental and social risks, impacts and benefits of the Project and to inform the technical and financial decision making of the FS.

The ESIA has been prepared based on the previous ESIA Report, supplemented by additional desk-based study, site walkover, and further detailed hydrological, agricultural and technical analysis as part of the 2022 FS review. No additional detailed site surveys have been undertaken.

1.4. Content of this Report

This report is structured as follows:

- Section 1 introduces the Project and the purpose of this ESIA.
- Section 2 provides a description of the Project.
- Section 3 sets out an analysis of alternatives considered.
- Section 4 describes the institutional, legal and policy context within which this Project will be managed.
- Section 5 provides the approach and methodology for this ESIA.
- Section 6 identifies the baseline environmental conditions in the Study Area, as well as any gaps in available data.
- Section 7 identifies the baseline social conditions in the Study Area, as well as any gaps in available data.
- Section 8 summarises the stakeholder engagement to date and proposed future engagement as the Project progresses.
- Section 9 describes the potential environmental and social impacts of the Project, and recommended mitigation measures and future actions.
- Section 10 considers the cumulative impacts.
- Section 11 sets out proposed additional design stage implementation recommendations.
- Section 12 provides a summary of the Environmental and Social Management System and Plans for the Project.
- Section 13 provides a summary conclusion.

2. Project Description

The Ministry of Environmental Protection and Agriculture (MEPA) is the Promoter of the Technical Assistance Assignment and the Georgian Amelioration (GA) Limited, the government entity responsible for irrigation development and management in the country, is the Beneficiary. The sections below provide the irrigation context in Georgia followed by a description of the proposed Project as identified through the 2022 FS review.

2.1. Irrigation Context

The majority of irrigation infrastructure historically was built and operated in the eastern part of Georgia, specifically in the Kakheti and Kvemo Kartli regions, where the significant portion of arable land is located. In total, around 500,000 ha was irrigated until the early 1990s. As a result of the economic downturn and chronic lack of funds that followed the collapse of the Soviet Union in 1991, irrigation infrastructure fell in disrepair, which consequently led to a drastic decline in irrigated land area until 2012. In 2012 the water supplied area was 45,000 ha and drained area 14,000 ha. As of the end of 2020 water was being supplied up to 134,051 ha, while drainage services were provided to 43,229 ha (Figure 2-1).

Figure 2-1. Water supplied and drained area[15]

2.2. Water Management in Georgia

The key national stakeholders in irrigation water management include the MEPA and subordinate authorities, including the Hydromelioration and Land Management Department, the Environment and Climate Change Department and the Water Service Unit. Specifically, GA is the sole provider of irrigation and drainage services in the country. Responsibilities of GA include the construction, reconstruction and rehabilitation of infrastructure and its safe management, observance of water use rules established, and calculation and collection or irrigation service fees. Water management organisations are described in turn below.

2.2.1. Ministry of Environmental Protection and Agriculture (MEPA)

MEPA is the key state institution that defines the state strategy for the irrigation sector. It facilitates the establishment of Water User Organisations (WUOs) and supports their development, drafts template for their charter, develops and maintains the WUO register. The Ministry also defines conditions of agreements between the first level water users (Legal Person of Public Law or Judicial Person partially established by the State) and WUOs concerning the provision of irrigation service.

The ***Hydromelioration and Land Management Department*** of MEPA is in charge of development of the policy and respective legislation for hydromelioration and is also responsible for the monitoring of their implementation. Within its competences, the department defines the policy of land use and management and

[15] Source: web-site of GA

develops the respective policy and legislation. The Department is also engaged in the planning of measures that aim at improving the management of hydromelioration systems, as well as land management. The Department includes the Hydromelioration Unit. The Department cooperates with GA closely to support the effective implementation of the irrigation policy.

The ***Environment and Climate Change Department*** is responsible for the development and implementation of the state policy in respect to water resources management and drafting respective legal acts. In particular, this function is being carried out by the **Water Service Unit**. The Unit is responsible for the identification of indicators of qualitative and quantitative assessment of surface water resources. The Water Service is also collecting and aggregating data on water uses annually in close cooperation with the GeoStat. As envisaged by a new draft *Law on Water Resources Management*, the Water Service will also be responsible for the coordination of development of *the National Water Strategy and the National Action Plans.*

Annually the Water Service Unit collects information on water abstraction and consumption from all key water users, including the GA. For preparation of the State of Environment Report issued by MEPA once every 4 years, the GA prepares for the MEPA information on: water withdrawal by the irrigation system, including water intake for irrigation purposes; water loss during transportation in the distribution system and irrigated land area, as well as information about rehabilitation/construction of the irrigation systems and planned activities, along with the map of the melioration network. It must be also noted that the provision of information is not standardized, which makes it difficult to extract needed information without additional clarifications and communications with GA. Given the complexity of water intake by the irrigation system for various purposes (hydropower, fishery, enterprises, as well as for ensuring environmental flow), having a standardized reporting format on water abstraction, use and loss, would benefit the data collection process and increase the reliability of water use data.

2.2.2. Georgian Amelioration (GA) Limited

The GA is a state-owned limited liability company managed by MEPA. The power to dispose shares of the Company rests with the Legal Entities of Public Law (LEPL) National Agency of State Property that is part of the Ministry of Economy and Sustainable Development (MESD). The GA is the sole provider of irrigation and drainage services in the country. As defined by the Statute of the company, the GA is responsible for:

- construction, reconstruction and rehabilitation of amelioration infrastructure;
- provision of priority services to land users (irrigation water and drainage services) and provision of water to other water users (Hydro Power Plants (HPPs), ponds, manufacturing facilities, etc.);
- safe management of infrastructure and reduction of risks of environmental impact through planning and implementation of risk reduction measures;
- calculating the service fee for the use of amelioration infrastructure and water in line with the law. Participation in setting service tariffs within its competence; and
- control of observance of the water use rules within its competence.

In addition, the GA collects fees from the amelioration system's users through its regional offices. GA manages the main and secondary irrigation canals and related infrastructure. It concludes contracts with individuals and legal entities for sub-contracted works for water supply, removal of excess water and other services. GA is also responsible for training its staff and developing their qualifications, as well as participation in conferences, seminars and other events.

The GA is managed by General Director who is appointed by the Minister of Environmental Protection and Agriculture. The General Director runs the company with support of four Directors in charge of finances & procurement, administration & logistics, operations management and technical support. The company has undergone several restructurings processes during last years. The last restructuring was carried out in 2021.

The GA is one of the largest public companies in terms of assets and staff. Currently the staff of the company includes 1,049 positions. Table 2-1 provides further breakdown of the staff by regional services and service centres.

Table 2-1. Breakdown of the number of posts under the Operations Department's Regional Service

Operations Department's Regional Service and its Centres	Number of Posts
Kvemo Kartli Regional Service	12
Kvemo Kartli Regional Service Centres	159
Shida Kartli and Samtskhe-Javakheti Regional Service	20
Shida Kartli and Samtskhe-Javakheti Regional Centre	211
Ckakheti Regional Service	13
Kakheti Regional Service Centre	131
West Regional Service	20
West regional Service Sector	135
Total	**701**

2.2.3. Water User Organisations (WUO)

Although currently there are no WUOs in the command area, the Law of Georgia on Water User Organisations (2019) creates a legal ground for the foundation and development of WUOs to become a legal entity of public law that are established for purpose of maintenance and operation of the local water supply and irrigation infrastructure on territory defined by MEPA. Within three months after the establishment of WUO, MEPA transfers to WUO the assigned irrigation infrastructure that exists on the territory of the WUO.

The key functions of WUO is to include: management, maintenance and operation of irrigation infrastructure of the secondary/tertiary canals (major and minor distributary canals and field channels), local irrigation systems, hydraulic units within their service area; provision of services to the members of WUOs in accordance with the charter, as well as provision of services to other water users on the basis of a contract; metering of water at the point of delivery and its rational distribution; collection of irrigation fee and payment to the GA (first level water supplier).

Within the area assigned to WUO, irrigation water is supplied only by the WUO. WUO will have an annual general meeting, where members of the WUO participate in decision making by voting. To be eligible to vote, a person must be a member of the WUO and he/she must not be indebted to the WUO. Votes are weighted according to the size of the area owned/used by the member. Agreement on provision of services is signed between GA and WUOs and covers period of 10 years. Payment for services is made by WUOs to the GA. The system of irrigation fee payment is explained in Figure 2-2.

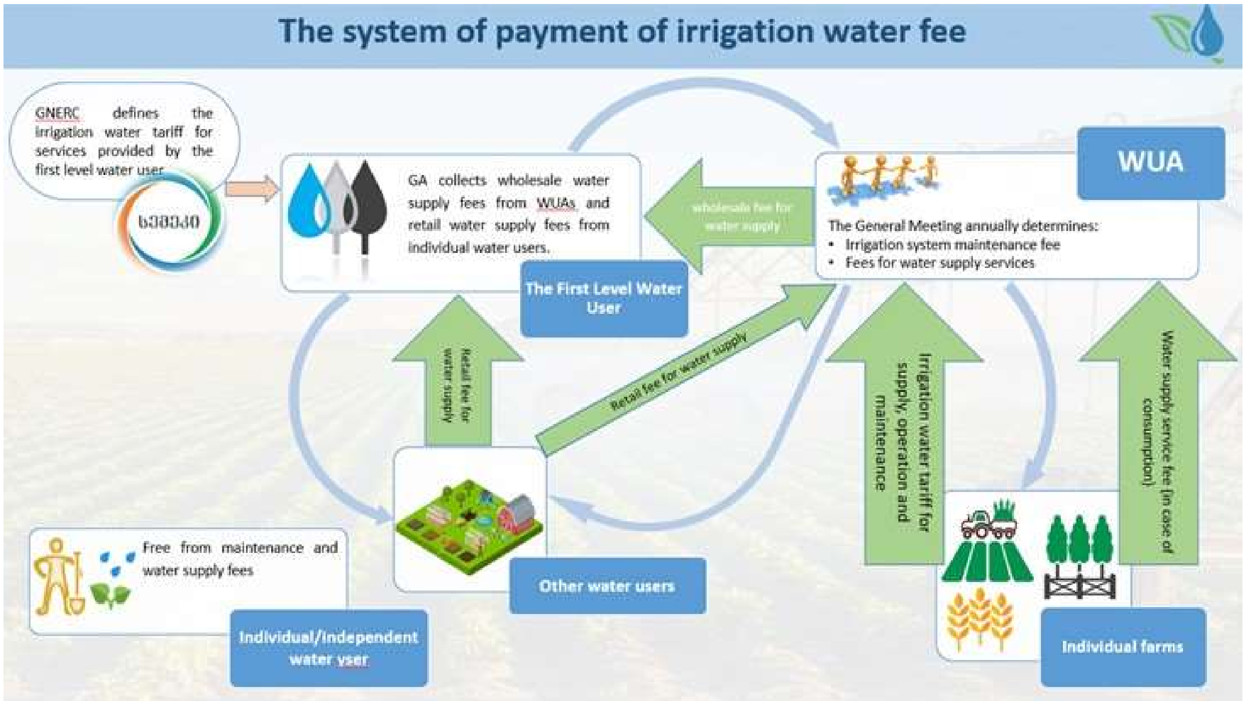


Figure 2-2. The system of irrigation water tariff payment[16]

2.2.4. Georgian Water and Power (GWP)

Georgian Water and Power (GWP) is a private company and is part of the Georgia Global Utilities. GWP is in charge of operation of the Tbilisi reservoir. The company operates 4,000 km of water and sewerage networks consisting of main lines, distribution networks, clean water tunnels and aqueducts. GWP serves more than 507,400 customers in the capital, and 500 million m^3 of drinking water is supplied annually from water extraction facilities. The Central Chemical-Microbiological and Headquarters Laboratories of GWP are accredited according to SST ISO/IEC 17025:2018. GWP rehabilitated and operates the Gardabani wastewater treatment plant. Here wastewater from Tbilisi and Rustavi undergoes full cycle treatment. The capacity of the station is 480,000 m^3 per day. The regular monitoring and control of drinking water quality is carried out by GWP both at the source and in the network. The water quality is tested for 53 parameters.

2.2.5. National Energy and Water Supply Regulatory Commission (GNERC)

The Georgian National Energy and Water Supply Regulatory Commission (GNERC) establishes terms and conditions for licensing the generation, transmission, dispatch and distribution of electricity and the transportation and distribution of natural gas; and is responsible for developing a methodology for tariff calculation (including for irrigation water[17]) and setting irrigation tariffs. It reviews and endorses/rejects tariffs proposed by service providers.

The GNERC is also responsible for promoting water efficiency. For this purpose, it applies such tool as setting targets for water losses (technical and commercial losses) for license holders and by determining the norms for drinking water use in general. So far, this function has been only applied in respect to drinking water supply. The GNERC will also be in charge of dispute settlement between irrigation water providers and WUOs once the methodology for calculating irrigation water tariff is approved and new irrigation tariffs are set (after 2024).

The GNERC is also in charge of dispute settlement between irrigation water providers and WUOs once the methodology for calculating irrigation water tariff is approved and new irrigation tariffs are set (after 2024).

2.2.6. United Water Supply Company (UWSC)

The United Water Supply Company (UWSC) Limited is a public enterprise under the Ministry of Regional Development and Infrastructure (MRDI) and provides water service (drinking water supply and sanitation) to 57

[16] Chelidze, G. Presentation at National Policy Dialogue, March 2020
[17] The responsibility for developing methodology for irrigation water tariff calculation will be enacted from June 2024.

cities and 315 villages throughout whole Georgia with the exception of Tbilisi, Mtskheta, Rustavi, the Gardabani municipalities and the Ajara Autonomous Republic. The company is one of the largest employers. It employs 2,700 persons. Main activities of the company include water abstraction, treatment and supply, design, construction, maintenance and operation of water supply and wastewater networks. The company provides services to over 306 000 domestic customers, and up to 19,000 non-domestic customers. The UWSC is responsible to ensure the provision of drinking water of adequate quality in regions of Georgia.

2.3. The Zemo Samgori Irrigation System (ZSIS)

The ZSIS is an irrigation and drainage system which was constructed in two phases. Phase 1 was completed in 1954 and the remainder of the scheme in 1964. Upon completion the ZSIS was the largest irrigation system in Georgia. The ZSIS was in use until the early 1990s, but in the post-soviet era (after the independence in 1991) the system deteriorated progressively, its pumping stations stopped working and most metallic pipelines and control structures were vandalised. Of the very original design command area of 41,000 ha which was designed to benefit 25 villages in 2020 and 2021, only 6,404 ha and 5,320 ha, respectively, were irrigated after signing an agreement for irrigation water supply with GA. This is less than one-third of the potential irrigable area. The area under irrigation in the last couple of years also includes lands outside the 2016 ZSIS command area.

The ZSIS is currently operated and maintained by the GA, the state-owned limited liability company managed by the Minister of MEPA. The power to dispose shares of the Company rests with the LEPL National Agency of State Property that is part of the Ministry of Economy and Sustainable Development (MESD). GA owns all main system irrigation-related infrastructure and provides irrigation and drainage services to contracting farmers within the command areas of its systems.

The ZSIS was originally designed as a continuous flow system with rotation by farmers at the tertiary level. No clear content of the rotation was stated but no reason could be adduced for disregarding the rotation. Currently there is no proper scheduling and water is distributed on an *ad hoc* basis just by opening the gates at the request of farmers and on signing of contract between the GA and farmers to release water for a fixed per-hectare irrigation fee.

The operation of gates is at present carried out by the gate operators engaged by the GA and sometimes by farmers. Most of the secondary and tertiary canal gates are not functioning efficiently. Lack of knowledge of irrigation scheduling is the most important constraint for farmers followed by poor coordination among the farmers of tertiary system and between farmers and GA. Farmers need extension advice to increase yields and water use efficiency. So long as farmers receive irrigation, irrespective of wastage, they believe that the management is delivering a good service. This is the case at the ZSIS because the offtakes are kept permanently open (mostly damaged). There are complaints from the farmers that during the irrigation season, some plots are submerged due to poor drainage.

2.3.1. ZSIS Setting

The ZSIS is located to the east of the capital Tbilisi, in the Mtkvari (Kura) river basin and its sub-basin, the Iori River. Administratively, the command area of the ZSIS is mostly located in the municipality of Gardabani in the Kvemo Kartli region of Georgia, with much smaller sections located in the Samgori district of Tbilisi region and the municipality of Sagarejo in the Kakheti region to the east of Tbilisi (Figure 2-3).

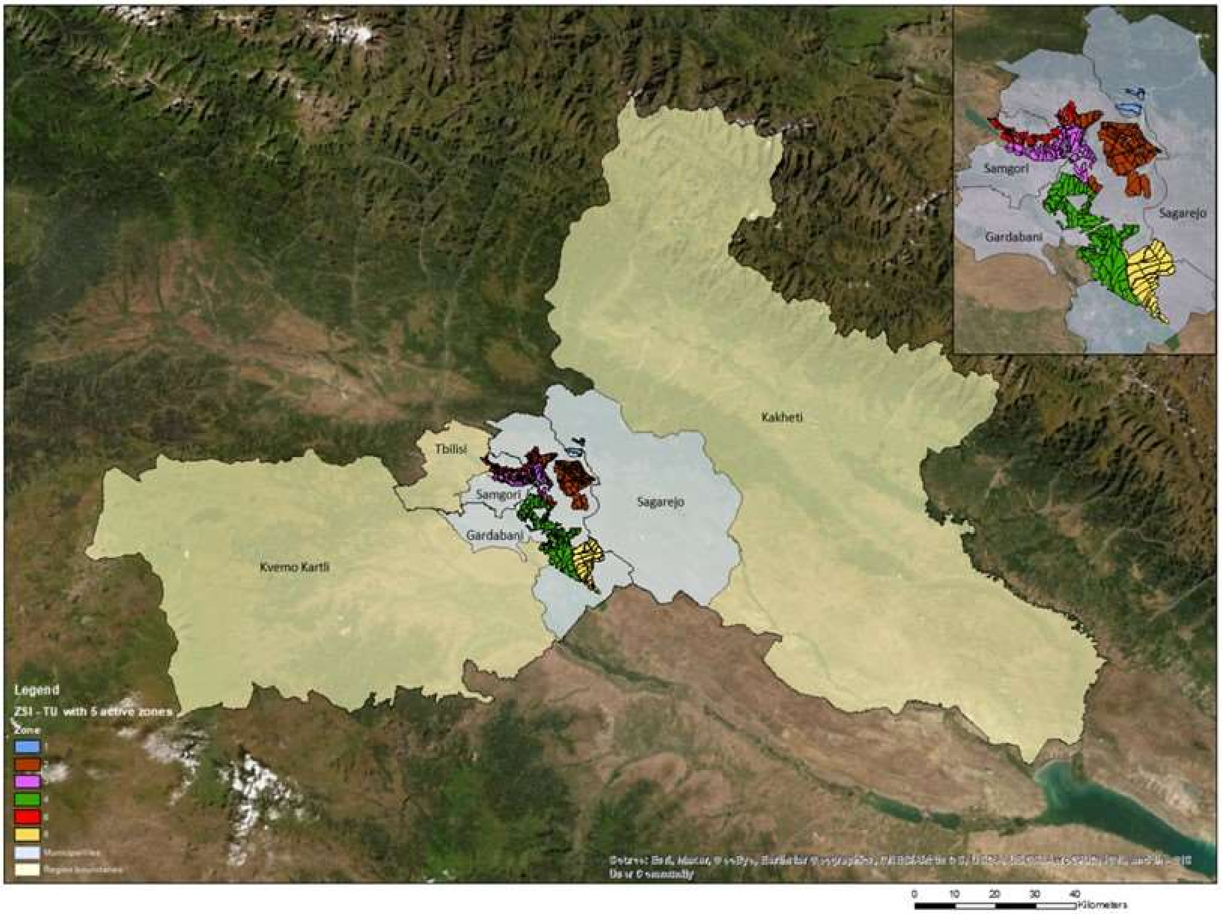


Figure 2-3. The Zemo Samgori Irrigation Scheme and administrative areas of Georgia

2.3.2. ZSIS Management

The ZSIS, main and secondary canals, is currently operated and maintained by the GA through its Zemo Samgori Service Centre, located near the Tbilisi Sea, as well as operational stations at the Sioni reservoir and Paldo Headworks.

The previous ESIA report indicated that towards the end of Soviet era, there were 37 water users, of which the seven cooperatives, operating as mixed farms, each with the order of 3,000 ha, occupied most of the land. The water users cooperatives were dismantled and to date there is not alternative mechanism established so there are currently no WUOs in the ZSIS.

2.3.3. ZSIS General Layout

The ZSIS was predominantly developed as a large open canal network designed to serve six large collective farms (kolkhozes). Irrigation distribution was mainly by flood and furrow irrigation, but also included some pressurised pipe distribution. The control equipment, mainly simple sluice gates, was basic and rudimentary and overall the system was inefficient. The general spatial layout of the ZSIS is

shown in

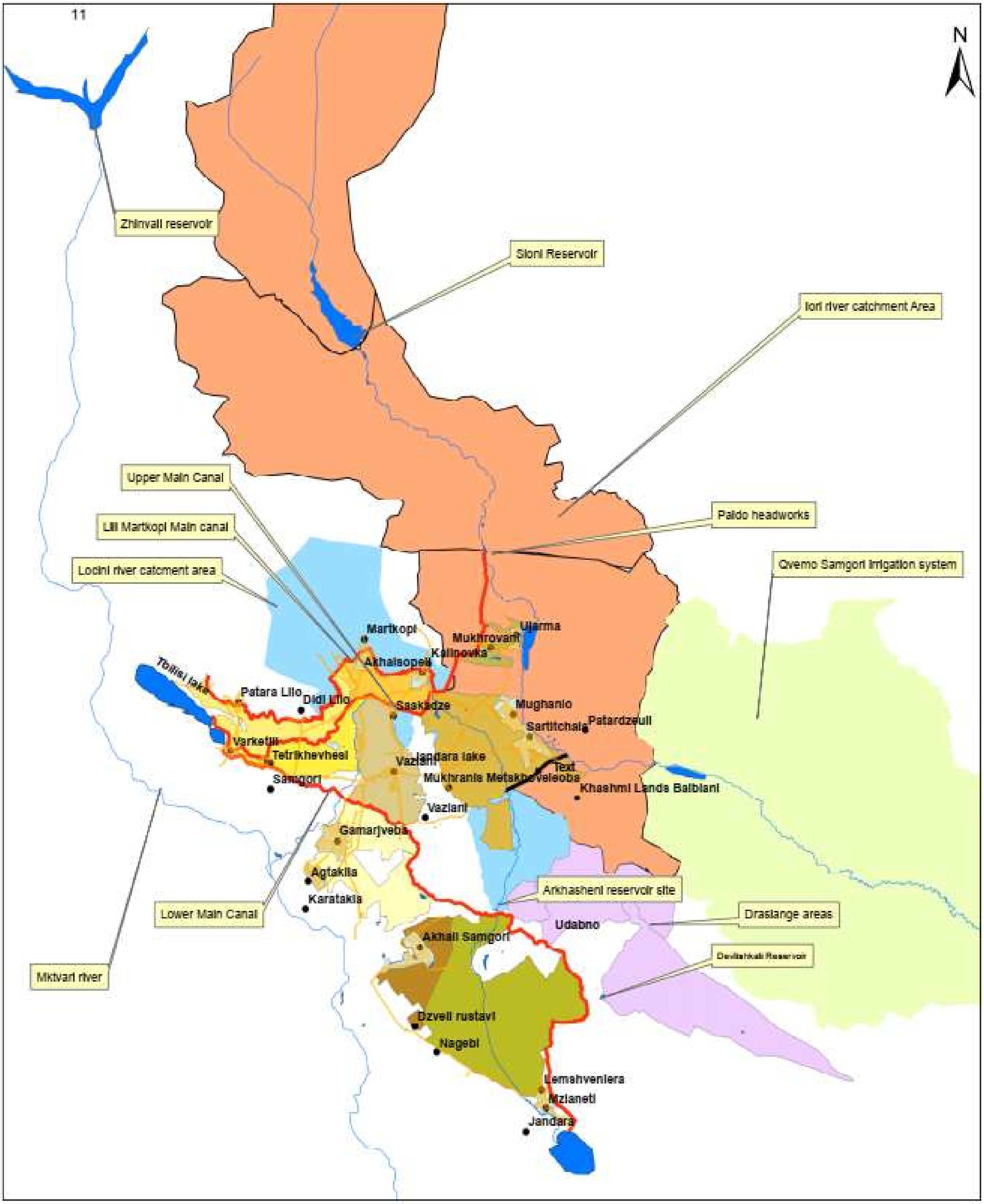


Figure 2-4.

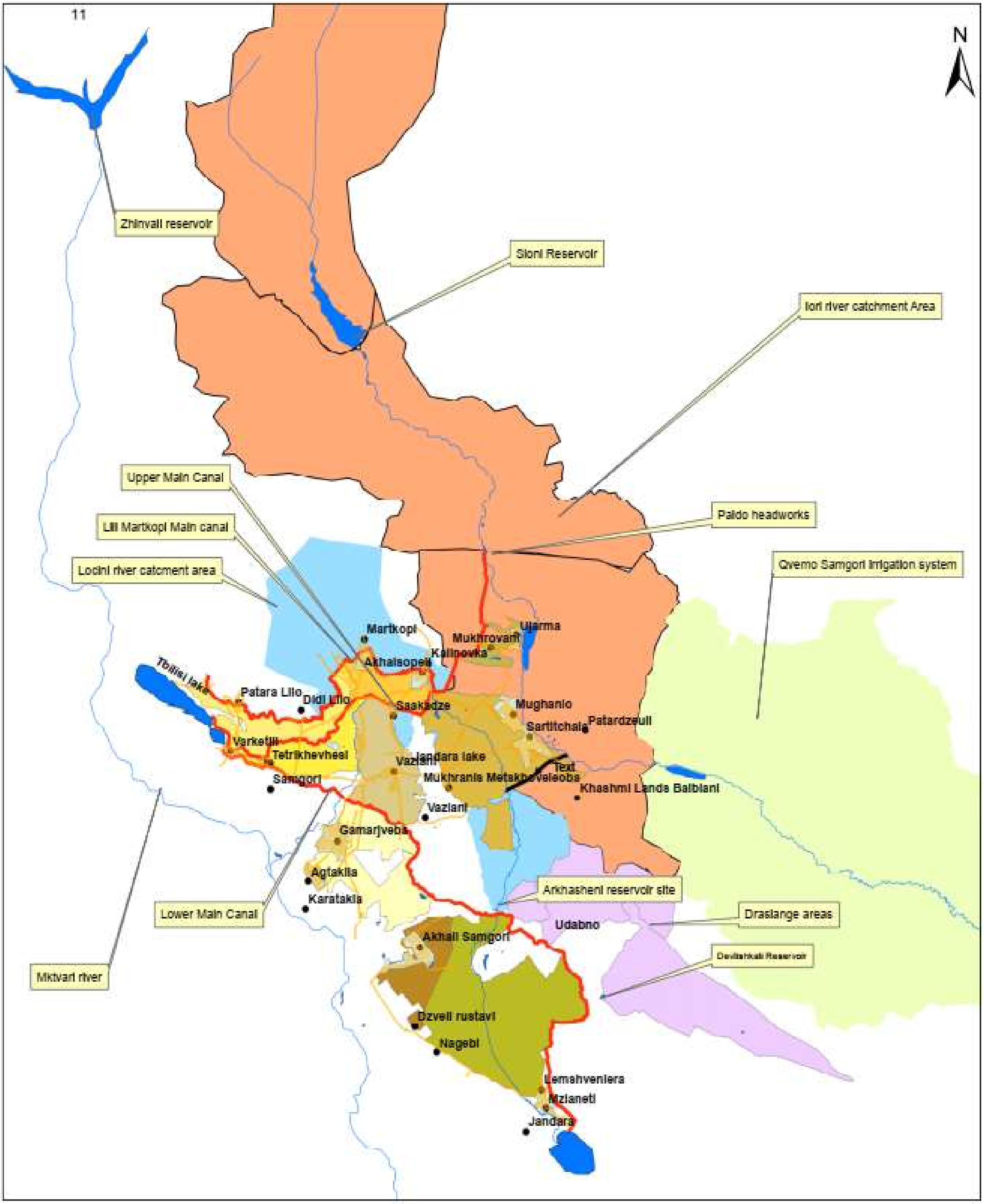


Figure 2-4. Zemo-Samgori Irrigation Scheme Catchments and Command Area[18]

[18] Source: Eptisa 2018 ESIA

The original structural elements of the ZSIS are shown in Figure 2-5 below and include:

- The Sioni dam and reservoir across the Iori river, a tributary of the Mtkvari river.
- The Paldo headworks which comprise the main intake where water from the Iori is diverted into the Upper Main Canal (UMC).
- The UMC which services the upstream half of the ZSIS, estimated at about 12,000 ha.[19] The UMC's main secondary canal is the Lilo Martkopi Main Canal (LMMC), providing irrigation water to a design command area of about 2,600 ha. There are four hydro-power plants (HPP) installed in the UMC, once recently constructed. The UMC drains into the Tbilisi Sea.
- The Tbilisi Sea stores water from the UMC and the LMMC (not functioning now), as well as water from the Zhinvali Reservoir on the Aragvi river. It also has its own small catchment. Water from Tbilisi Sea serves the Lower Main Canal (LMC), while water from the Zhinvali Reservoir serves as drinking water[20] for the city of Tbilisi and its surroundings.
- The LMC receives water from the Tbilisi Sea, Chumatkhevi creek, Lochini River and a transfer from the UMC to the LMC via a 1000 m steel pipe. It is also supplemented by water pumped from the Mtkvari River (up to 6 m^3/s using two pump stations)[21], which are no longer functional.[22] The LMC services the downstream half of the ZSIS, estimated at 13,000 ha.
- Secondary canals branch off from the UMC, LMMC and LMC and convey irrigation water to the different Tertiary Units (TUs) where the farms are located.
- Drainage canals, which mainly build on the existing natural drains and streams that are part of the watershed of the Iori River, the Mtkvari River and the Tbilisi Sea.

The Project covers only the distribution network modernisation.

[19] Site investigation report (2016), p.41 states 15,000 ha; field notes by GA state 12,000 ha.
[20] ZSIS ESIA Report, Eptisa (2018). P.227
[21] ZSIS ESIA Report, Eptisa (2018), p.227 and pp. 240-242; also site investigation report (p.15/16)
[22] These elements do not form part of the 2022 FS.

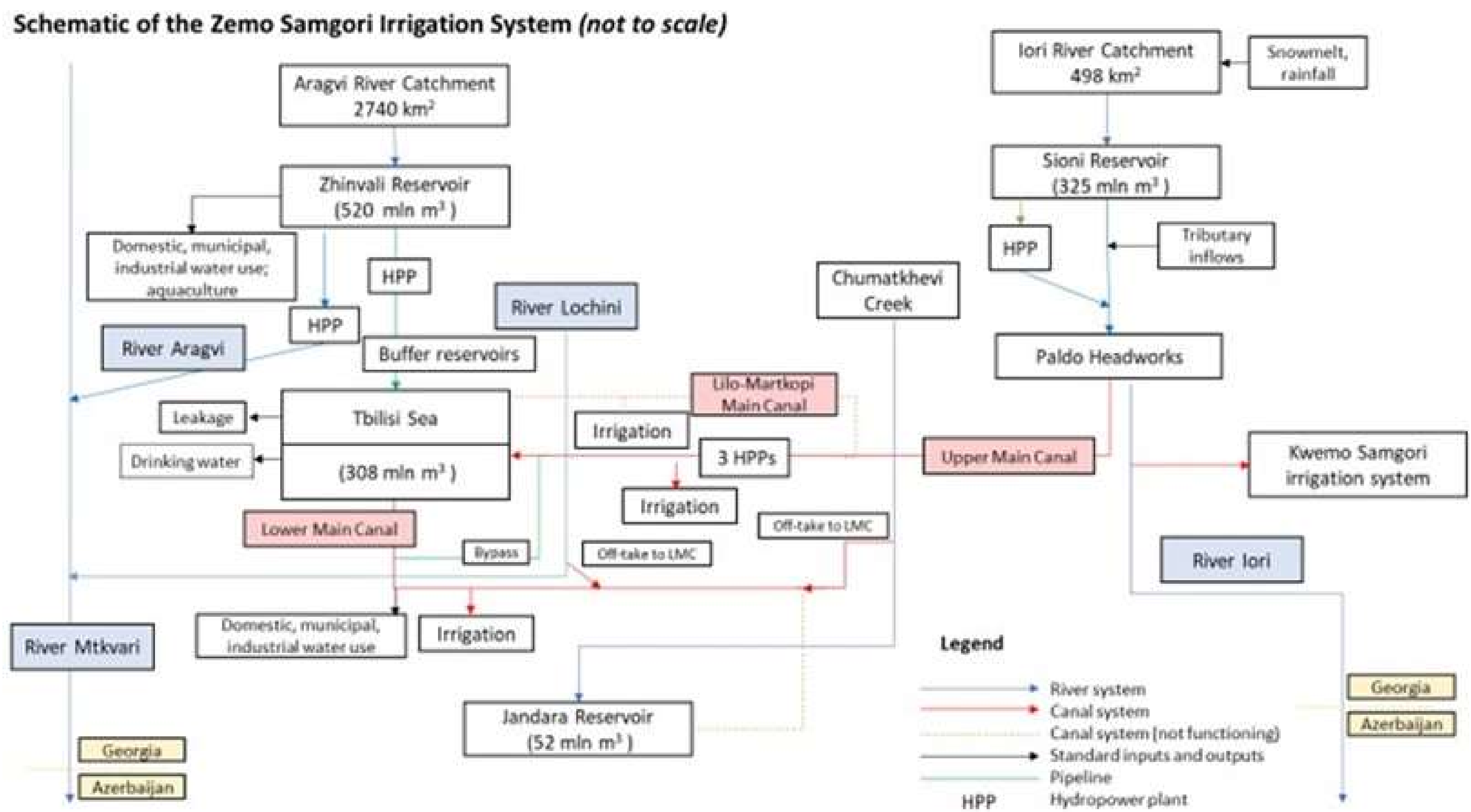


Figure 2-5. Schematic representation of the Zemo Samgori Irrigation System

2.4. Existing Infrastructure

2.4.1. Sioni Reservoir

Built in the 1950s on the Iori River, the Sioni reservoir is located close to the homonymous village in the Tianeti municipality, 70 km north-east of Tbilisi city (Coord.: 41°59'16.63"N; 45° 0'57.53"E). The reservoir is formed by a rock fill dam, 84.8 m high and with 850 m long crest. The crest top is at 1,074 m asl. Water storage is 433 million metres cubed (Mm^3) including the dead volume of 10 Mm^3. The historical minimum of 45 Mm^3 was observed in February 2021 and the minimum storage continued to the beginning of the irrigation season from April 2021. The 25 m^3/s outflow is controlled from the inlet tower on the left side, close to the village.

The principal purpose of the Sioni reservoir is for supplying water to the ZSIS and the Kvemo Samgori Irrigation System (KSIS), as well as to supply the Tbilisi Sea during the winter season. Water from the Sioni reservoir is also used for hydroelectric production. The dam is managed by GA.

Figure 2-6. Sioni dam and reservoir

In August 2021 the works on the Sioni dam, financed by the World Bank, were completed. The work consisted mainly of the installation of safety instrumentation such as piezometers and inclinometers as well as a meteorological station, flow meter devices on the main canal with remote control systems for monitoring connected by a Global System for Mobile Communication (GSM) to the GA premises in Tbilisi.

The discharge, released from the Sioni reservoir through a HPP, reaches the Paldo headworks, which is 25 km downstream. The intake work of the UMC on the right riverbank diverts 11.5 m^3/s design flow. A further 30 km downstream an additional 11.5 m^3/s is diverted to supply the KSIS on the left riverbank. In total an estimated nominal flow of 24 m^3/s is the design peak flow diverted from the upper course of the Iori River for irrigation purposes during the dry season and a maximum flow of 12.5 m^3/s during the winter months to fill the Tbilisi Sea only when it is needed for water supply and irrigation needs.

2.4.2. Tbilisi Sea

- The Tbilisi Sea is an artificial reservoir, formed over natural lakes, in operation since 1953 for irrigation and drinking water supply purposes, as well as providing a recreational destination for the population of Tbilisi capital city. Due to the small catchment area the Tbilisi Sea is fed mainly by water released from the Sioni reservoir and conveyed by the UMC as well as from the Zhinvali reservoir on the Aragvi River via a pipeline. The Tbilisi Sea has two sections, of which the smaller south-eastern part supports irrigation. The intake tower of the LMC canal is located close to the embankment of the dam. The connection between the two parts is open.

Tbilisi sea water management is complicated by different sources, different operators and seasonal dynamics. Georgia Water and Power (GWP), a private operator, could not support GA’s request for additional irrigation water supply during summer period due to the high turbidity of the Aragvi river. The characteristic levels and volumes of the Tbilisi Sea is presented in the table below.

Table 2-2. Tbilisi Sea Levels and Volumes

No	Description	Elevation (m MSL)	Storage Volume (Mm^3)
1	Design maximum water level	550.00	329.18
2	Maximum operating water level	548.00	307.25
3	Currently applied maximum water level*	539.60	217.96

No	Description	Elevation (m MSL)	Storage Volume (Mm^3)
4	Currently applied lowest limited by the suction level of the GWP sewerage pump station	535.33	176.46
5	Dead storage level	532.75	
6	Maximum available storage (2-4) but subject to significant leakages		130.79
7	Minimum available storage (3-4)		41.50

* - beyond which significant leakage losses are observed.

Source: Eptisa 2018 ESIA Report

2.4.3. ZSIS Distribution System

The ZSIS distribution system is shown in Figure 2-7, and is composed of:

- Paldo headworks;
- UMC: from Paldo headworks to Tbilisi Sea;
- LMMC canal: from UMC it serves the belt bordered by the two canals; and
- LMC canal: from the Tbilisi Sea to the southeastern part of the Tbilisi plain.

A summary of the current main canal structures is provided in the table below; further details are provided in the following sections.

Table 2-3. Current Main Canal Structures of the ZSIS

Structure	UMC	LMC	LMMC
Total canal length	39.8km	42km	30km
Open canal sections	18 reaches – 29km	18 reaches – 39.7km	12 reaches – 25km
Tunnels	11– 9.6km	5– 920m	2– 2.4km
Inverted siphons	5– 1.2km	6– 1,324km	8– 2.8km
Canal bridges	3– 192m	One aqueduct - 1.323km	-
Max carrying capacity	12.5 m^3/s	12 m^3/s	-
Secondary canal off-takes*	34	50	19

** - there are many illegal off-takes in these canals*

Figure 2-7. The ZSIS distribution network

2.4.4. Paldo Headworks

Paldo headworks are located in Kartli Region, Sagarejo district, 25 km downstream of the Sioni dam (Coordinates 41°50'48.24"N; 45° 8'8.88"E). The design flow diverted into the UMC is 12.5 m^3/s. The barrage section of Paldo headworks is composed of a 75 m long river barrage with four radial gates of 12 m each one. The UMC intake is equipped with three sluice gates controlling the inlet of the following settling basins 40 m long and 6 m width.

In 2005, some repair works were undertaken with World Bank finance as it was affected by the 2004 floods. The (former) Ministry of Agriculture carried out some repairs on the electro-mechanical equipment with the ORIO's funds in 2014.

The structures, the barrage and the intake need further repair works starting from the intake structure and its equipment. The electro-mechanical hoists to move the de-silting stop-logs at the ending section of the three settling basins have been out of order for 10 years and, consequently, two of the settling basins are covered with sediment. The flow meter on the UMC canal, downstream of the settling basin, also needs to be repaired.

Paldo barrage on the Iori River

Settling basins

Figure 2-8. Paldo Headworks

2.4.5. Upper Main Canal (UMC)

The UMC is 39.8 km long from the Paldo headworks to the Tbilisi Sea. This canal is designed to transfer Iori river water to the Tbilisi Sea during the winter season and to feed the irrigation networks, including the LMMC. Three HPPs are located along its course, utilising elevation drops and a fourth one was constructed recently on the outlet of the canal in the Tbilisi Sea.

The UMC is composed of:

- 18 reaches of open canal sections with a total length of 29 km;
- 11 tunnels with a total length of 9.6 km;
- 5 inverted siphons with a total length of 1.2 km and;
- 3 canal bridges with a total length of 192 m.

Due to the fact the design winter flow and irrigation peak flow of 12.5 m^3/s is constant along the full length of the channel, the open canal reach has a constant trapezoidal cross section with a freeboard of 0.5 m.

The entire channel is concrete lined, with a thickness of around 10-15 cm. The concrete lining is the original, constructed in the 1960s, and it is still in an acceptable condition for the most part. Due to the fact the rubber seal of the joints is natural rubber, they appear still in good condition despite almost 60 years of life.

The original scheme lay-out had 22 off-takes serving the secondary canal networks with a total length of 146 km. However, due to the agricultural reform carried out in the 1990s, the GA to increase this number to 34 off-takes. More than 40 pipes, with different diameters from a few millimetres up to 400 mm, withdraw water from the canal, most unauthorized. The off-takes are composed of a concrete structure supporting a steel sluice gate that served the downstream distribution network formed by open canals, mainly not lined. Most of the off-takes of the distribution network do not have gates.

UMC downstream of the settling basins

UMC G6 and G7 offtakes

G6 secondary canal

G7 canal tertiary offtake

Figure 2-9. Upper Main Canal

In the last few years, due to the shortage of water and urbanisation, the number of off-takes (both gated and piped), and difficulties to control the water flow along the entire length of the canal, only the upper off-takes from G5 to G16 (see Figure 2-9 above) are served by the GA and the remaining off-takes from G17 up to G29 are permanently closed.

Among the irrigation units served by the UMC, only G6 and G8 were rehabilitated between the years 2014-16. No works were undertaken at tertiary and quarterly levels. In general the condition of the distribution system is in a very bad state, with channels appearing like natural streams than artificial channels. Large water loses are expected both from seepage along the unlined sections of the canals and the night-time flows remaining unutilized and drained away.

The eastern part of the UMC command area, in Sartichala, covering irrigation units G6, G7, G8 and G9 with an area of 4,400 ha, is more developed in terms of in-farm mechanized irrigation systems such as pivots and hose reels, and even automatic drip irrigation networks for orchards and vineyards. However, the distribution networks of G7 and G9 are in a bad state with high losses of water flowing along unlined open channels crossing the permeable soils that characterizes this area. To cope with this chronic lack of water the additional natural flow of the Chumatkhevi creek is diverted into the G7 canal close of the crossing of the railway line.

At the out-let of tunnel 5, the UMC enters into the plain, changing its direction toward south-west. G6 and G7 off-takes are located on this right bend, upstream of an unauthorized pumping station on the left bank. A rudimentary weir is visible in the canal to increase the back water tail to guaranty the withdrawals even for low flows. The G6 secondary canal, already rehabilitated in 2016, needs to be checked because some damages have been noticed during the 2021 surveys.

G7 secondary canal originates on the left side of the UMC canal from the off-take controlled by two sluice gates, with a length of 17 km. It serves a group of larger farms (such as Chirina Poultry Farm); its condition is poor.

The G10 off-take is located upstream of the first HPP. The canal has a total length of around 9 km. The first reach, concrete lined, with a trapezoidal cross section, has a winding route crossing the hilly and forested area before proceeding south-east, dominating the plain.

The G11 secondary canal originates 5 km downstream of the first HPP, though only the first reach of 1 km up to the village of Saakadze is partially working, which is used for the cattle. The next 4 km is out of order with no water requests from farmers.

The G12 off-take, just 20 m downstream of G11, presently serves only the reservoir of the Chirina Poultry complex.

The G13, G14 and G15 Secondary Units have small areas, between 15 ha and 30 ha. The unlined canals are in bad condition. Only a few contracts for water are signed in this area.

Along the UMC canal the only visible flow control structures are the three doubled sluice gates at the inlet of the penstocks/by-pass chutes of the HPPs. The canal discharges and water levels are not regulated currently. This is the main reason why the off-takes, legal or illegal, utilize a rudimentary stone weir downstream of the intake to maintain a steady profile of the tail water.

Along the UMC there are four hydropower plants:

- Satskhenisi hydropower plant – installed capacity 14.0 MW.
- Martkopi hydropower plant – installed capacity 3.9 MW.
- Tetrikhevi hydropower plant – installed capacity 13.6 MW.
- A fourth HPP has been recently constructed at the UMC outlet in the Tbilisi Sea.

2.4.6. Lilo Martkopi Main Canal (LMMC)

The LMMC is 30 km long and originates from the bifurcation node at chainage 12+820 of the UMC at an elevation of 850 m asl (Coordinates 41°45’2.17”N; 45° 5’18.40”E). It runs halfway along the northern chain of hills bordering the downstream plain of Tbilisi, passing through the villages of Akhalsopeli, Markopi, Norio, Didi Lilo and Patara Lilo, before ending in a stream flowing into the Tbilisi Sea. Its northern alignment runs almost in parallel to the UMC, serving around 2,600 ha bordering between LMMC and UMC.

The LMMC is composed of:

- 12 reaches of open canals in earth and concrete lined sections as well as pre-casted flumes, with a total length of 25 km;
- 2 tunnels with a total length of 2.4 km; and
- 8 inverted siphons with a total length of 2.8 km.

Along its course there are 19 off-takes for secondary canals, on the left side of the UMC canal. The entire canal systems are damaged and the steel components, both for gates and frames, are removed. The LMMC gate at the intake opening was partially clogged with stones and sand p by GA due to the shortage of water.

Due to its poor condition, the GA dies not distribute water in this area. Restoration of the canal networks is considered too costly by GA. The ratio between the 2,115 ha of the command area and the canal length of 30 km gives an average of 70 ha only served by 1 km of primary canal.

The 2021 site visit has confirmed that the entire system is out of order. Despite this condition some water can flow in the canal only when the level in the UMC is very high, as was observed during the visit (06/11/2021) when the flow in the UMC was 9 m^3/s (for testing the 4^{th} HPP).

LMMC offtake from the UMC

LMMC canal

Figure 2-10. Lilo Martkopi Main Canal

2.4.7. Lower Main Canal (LMC)

The water required for irrigation in the command area of the LMC is provided via four pathways: (a) transfer through Chumatkhevi creek, (b) steel pipeline, (c) via Tbilisi Sea and (d) transfer from Lochini river.

The canal length is around 42 km, with an average 376 ha served by 1 km of primary canal.

The LMC is composed of:

- 18 reaches of open canal sections with a total length of 39.7 km (94%);
- Five short tunnels with a total length of 920 m;
- Six inverted siphons with a total length of 1.323 km; and
- One aqueduct with a total length of 90 m.

The LMC supplies water to 50 off-takes feeding the secondary canals with a total length of more than 120 km. The longest secondary canal, 14 km long, is the G28 at the tail end of the main canal and discharging into the Jandara lake, though is presently silted and out of order. This lake is shared with neighbouring Azerbaijan. No water is distributed in this irrigation unit and, as no flow reaches the lake, an international agreement was signed with Azerbaijan to realise water in Jandara lake. An alternative to this flow is presently supplied from the Mtkvari/Kura river through the Gavdabani canal.

LMC tower in Tbilisi Sea

LMC 1o reach

LMC G5 secondary canal lined in 2014-16

LMC unlined 2° reach

Figure 2-11. Lower Main Canal

The LMC was designed for a maximum flow of 12 m³/s, currently only 6 m³/s can be provided due to the deformation of the concrete lining and the shortage of water in the Tbilisi Sea.

The LMC canal can be divided in 6 reaches:

Table 2-4. Reaches of the LMC

<table>
<tr><th>Reach</th><th>Description</th></tr>
<tr><td>Reach 1 : from the origin up to Lochini creek crossing: 11 km long, concrete lined in medium-good condition</td><td>With south direction, a 450 m long tunnel reaches the outlet where the LMC canal originates. This is inside the GA Service centre area. The canal flow is measured by a flow meter located on the pedestrian bridge. From this site, the first 11 km reach of the LMC crosses the urban suburbs and industrial area of Tbilisi city, reaching up to the Lochini sub-river crossing. This first reach up to the sub-river crossing is concrete lined, in good condition, with only small parts to be repaired. Due to the urbanization and industrialization of Tbilisi city, no irrigation areas are now present and only G3 off-take (41°40’57.70”N; 44°59’18.11”E) feeds a poultry farm. Small portion of land could be served by G4, but currently there are no requests for water by farmers. The Lochini creek is crossed with a 260 m inverted siphon.</td></tr>
<tr><td>Reach 2: from d/s Lochini siphon outlet at pk. 12+930 to G9.3 off-take at pk. 21+431, unlined for 8500 m. The first 4,6 km will be concrete lined in the next year 2022. Tendered launched in Sep.2021</td><td>The second LMC canal reach starts from the siphon outlet (41°40'35.90"N; 45° 0’17.24”E), and is 9 km long, with no lining from the G5 off-take at chainage 12+930 up to off-take G11 at chainage 21+430. This reach has an estimated 60% of water leakage/infiltration losses, with a high concentration of contaminants from sewerage and industrial waste pipe discharges and from discharges from the military bases and Vaiani town. The irrigation services reach G15/16 upstream only. In September 2021 the GA launched the construction tender for profiling and concrete lining the first 4.6 km of this reach from pk 12+930 to pk. 17+530.

Along the unlined reach there are 21 off-takes. All secondary canals are earth canals without any lining or concrete pre-casted flumes. Only G5, G5.1 and G6 have been re-profiled and concrete lined in 2016 with national resources.
<table>
<tr><th>Off-take</th><th>Sec. canal</th><th>Sec. (m)</th></tr>
<tr><td>G5</td><td>Rehabilitated 2014-16</td><td>n. 1 6,250</td></tr>
<tr><td>G5.1</td><td>Rehabilitated 2014-16</td><td>n. 2: 2,500</td></tr>
<tr><td>G5.2</td><td>Unlined open canal</td><td>n. 1: 1,570</td></tr>
<tr><td>G5.3</td><td>Unlined open canal</td><td>n. 1: 1,850</td></tr>
<tr><td>G5.4</td><td>Unlined open canal</td><td>n. 1: 5,850</td></tr>
</table></td></tr>
</table>

Reach	Description
	G5.5 | Piped & Unlined | n. 2: 5,800 G6 | Rehabilitated 2014-16 | n.1: 3,080 G6.1 | Unlined open canal | n. 5: 8,600 G.7 | Pipe DN 400 | n. 1: 3,000 G.7.1 | Unlined open canal | n.1: 1,980 G8 | Unlined open canal | n. 2: 4,100 G.8.1 | Unlined open canal | n.1:750 G8.2 | Unlined open canal | n.1: 1,650 G8.3 | Unlined open canal | n.2: 3,100 G8.4 | Unlined open canal | n.1: 3,100 G8.5 | Unlined open canal | n.2: 2475 G8.6 | Unlined open canal | n. 1. 1,100 G9 | Unlined open canal | n. 1: 1,150 G9.1 | Unlined open canal | n. 1: 1,240 G9.2 | Unlined open canal | n.2: 1,450 G9.3 | Unlined open canal | n.1: 950
Reach 3: from pk. 21+431 to G15/16: 6,600 m long concrete lined in good condition, recently (2016?) renovated with shot-concrete layer	This reach is 6,587 m long, of which 6,216 m in open trapezoidal canal, 64 m of pipes; 82 m of open chute, 100 m of tunnel and 125 m of inverted siphon. The open canal sections were concrete lined and in 2016 renovated with a final layer of concrete. Along this reach there are 10 off-takes, on the right side, composed by a steel sluice gate. All the secondary canals are unlined except for G15/16 that have been concrete lined in 2016. Off-take | Sec. canal | Sec. n.: Le (m) G10 | Unlined open canal | n.3: 2650 G11 | Unlined open canal | n.1: 2,700 G12 | Unlined open canal | n. 3: 4,510m G12.1 | Unlined open canal | n. 2: 4,160 G12.2 | Pipe to Akali S. Village | 5,000 DN600-200 G13 | Unlined open canal | n.2: 2.200 G13.1 | Pipe to G15 | 1,500 DN800-500 G14 | Rehabilitated 2014-16 | n. 2: 2,000 G14.1 | Unlined open canal | n.2: 2,200 G15/16 | Rehabilitated 2014-16 | n. 2: 16,230
Reach 4: from G15/16 to Arkhashenl river: 3,510 m long concrete lined in good condition, recently (2016?) renovated with	This reach is 3,510 m long of which 2,745 m in open trapezoidal canal and 412 m of inverted siphons (2 nos). The open canal sections were concrete lined and in 2016 renovated with a final layer of shot concrete. Along this reach there are 6 off-takes, on the right side, composed by a steel sluice gate. All the secondary canals are unlined. Due to the shortage of water, these canals are not provided with water and are in very poor condition. Off-take | Sec. canal | n. Sec.: m G14.2 | Unlined open canal | n.2: 650

Reach	Description		
shot-concrete layer	G17	Unlined open canal	n.1: 1,350
	G17.1	Unlined open canal	n.1: 950
	G17.2	Unlined open canal	n. 1: 650
	G17.3	Unlined open canal	n.1: 700
	G18	Unlined open canal	n.1: 1,425
Reach 5: from to Arkhashenl siphon to the end of the canal: 12 km long concrete lined in medium-low condition	This reach is 12,000 m long of which 11,229 m is open trapezoidal canal, 408 m is one inverted siphon and 363 m is tunnel. The open canal sections still have the original concrete lining from the 1950s. Along this reach there are 22 off-takes, on the right side, composed by a simple steel sluice gate. All the secondary canals are unlined. Water does not reach this area, instead water is diverted from the Arkhasheln River directly into the canal. The average river flow during the summer is around 3 m^3/s, largely insufficient to serve the downstream area. This river flow has a heavy bed load movement due to the active erosion which has consequences on both the hydraulic efficiency of the canal and the high O&M costs for removing sediments.		
	Off-take	**Sec. canal**	**n. Sec. : m**
	G19	Unlined open canal	n.1: 1200
	G20	Unlined open canal	n.1: 400
	G21	Unlined open canal	n.2: 3,700
	G21.1	Unlined open canal	n.1: 6,300
	G21.2	Unlined open canal	n.1: 1,500
	G21.3	Unlined open canal	n.1: 1,300
	G22	Unlined open canal	n.3: 3,700
	G22.1	Unlined open canal	No areas
	G22.1	Unlined open canal	n. 1: 6,200
	G23	Unlined open canal	n.1: 6,500
	G23.1	Unlined open canal	n.1: 4,500
	G23.2	Unlined open canal	n.2: 5,000
	G23.3	Unlined open canal	n.1: 1,500
	G23.4	Unlined open canal	n.2: 2,600
	G23.5	Unlined open canal	n.2: 4,500
	G24	Unlined open canal	n.2: 3,600
	G24.3	Unlined open canal	n.1: 800
	G24.4	Unlined open canal	n.1: 2,200
	G24.5	Unlined open canal	n.1: 2,500
	G24.6	Unlined open canal	n.2: 1,600
	G25	Unlined open canal	n.1: 8,000
	G26	Unlined open canal	n.1: 7,800
Reach 6: the 14 km long secondary canal of the I.U. G28	Irrigation unit G28 has an extension of 1,800 ha at the tail of the LMC canal. This area was served by a long secondary canal with a length of 14 km flowing into the Jandara lake. Nowadays nothing remains of the secondary and tertiary canals, the canal sections are totally silted. Due to the presence of abundant alluvial pebbles and		

Reach	Description
flowing into the Jandari lake, completely silted and out of order	stones, this area may not be suitable for intensive agriculture and irrigation but mainly for open pastures for cattle.

In summary, the canals are in different conditions varying from requiring minor repairs to complete reconstruction. The off-takes are not designed to deliver the required amount of water and sometimes farmers raise the water level in the canal with temporary blockages at the downstream of their off-takes. The main observations are:

- Infrastructure limitations for example the carrying capacity of the UMC cannot be increased in a cost-efficient manner as there are tunnels and HPPs.
- Land areas outside the 2018 command area are being served by GA.
- There are no flow requirement calculations for the offtakes and canals.
- There are no control structures to provide constant supply of water.
- Poor deliveries and losses in the system due to poor canal alignment and shapes in the unlined areas.
- Poor or no maintenance leading to erosion and sedimentation.
- No water in the tail end of LMC.

2.4.8. Water Management Control Structures

2.4.8.1. Main Canals

Control of the Primary Canals

There is an absence of any control structure along the primary canals excepting a few cross structures equipped with simple sluice gates. The presence of rudimentary stone weirs downstream of almost each off-take to increase the level on the bottom opening, demonstrate the necessity to control the water level in the canal especially when flows are lower. The simplest way to maintain the level in an open channel is to insert several long-crested weirs (duck bill weir).

Control of the Secondary Off-Take

The off-takes are original and are equipped with a sluice gate only. This system was chosen because:

- The number of the off-takes were relatively little serving the large Kolkhoz surfaces;
- In the collective system the number of workers to regulate the openings was high;
- The water availability was not a serious concern in those times.
- The above are not adaptable for managing a large irrigation system.

2.4.8.2. Secondary and Tertiary Channels

Sizing, Slope and Velocity

The 2021 visits have confirmed the poor condition of the secondary canals and these canals are unlined. For these reasons the high velocity of the current causes high erosion of the canal section.

Pressurized Network

The three main canals UMC, LMMC and LMC dominate the command areas toward the low plains. It is possible to serve large portions of lands with pressurized networks. The limit for reconverting the open canal systems into a pressurized piped network could be fixed by the hydrostatic head of 50-60 m above the ground elevation of the lot, depending on the irrigation method to be chosen (sprinkler or localized ones). Two solutions are presented in the FS:

(a) Maintaining a rotation shift for the water delivery at the hydrants, and

(b) Adopting an “on-demand” distribution, leaving free the farmers to watering their plots when they prefer and without limitation of time.

For both solutions, a reservoir is proposed.

2.4.9. Control System

There are no control structures along the main canals except a few cross structures, which are equipped with simple sluice gates and without applying any proper control and operating procedures. There are temporary stone weirs downstream of each off-take to control the water level in the canal especially when the flows are lower.

2.4.10. Additional Water Sources

2.4.10.1. Lochini River

The Lochini River is a tributary of the Mtkvari River, with a length of 30 km and a river basin area of 207 km^2. There is an inlet (feeder canal) from the Locini River to the LMC. To increase the flow of the LMC canal an additional inflow comes from the existing diversion weir with an intake work on the left bank (41°41'41.1"N 45° 1'02.4"E). This conveys around 1.2 m^3/s through a 2,700 m long open canal of a Reinforced Cement Concrete (RCC) pre-casted flume, ending in the out-let section of the LMC siphon of Lochini creek crossing. This intake structure does not have a scouring/desilting basin and for this reason most of the bed load movement settles into the canal.

Lochini Feeder Canal (2,700 m)

Lochini Feeder Canal

Figure 2-12. Lochini River

2.4.10.2. Chumatkhevi Creek

Chumatkhevi Creek starts at the outlet from the UMC. It receives water from its own catchment, from the irrigation return water from Zone 2, and supply let from UMC through the creek. The creek also collects groundwater as it flows downstream. Part of the water from the creek is taken out at the LMC intake, the rest goes towards Jandara Lake. Along its route, water is extracted by pumps and at least one gravity canal from private initiatives of farmers.

Note that the lower reach of the Chumatkhevi creek, according to maps, is called the Arkhasheni River. A new dam was constructed on his part of the river just downstream of the existing provisional diversion embankment, with a rudimentary offtake to the LMC. The reservoir however was never filled as it is located on military land. Due to this dam being on military land, it is not suitable for consideration within the ZSIS.

Chumatkhevi Creek entry point to the LMC

Chumatkhevi Creek upstream

Figure 2-13. Chumatkhevi Creek

2.4.10.3. Devlshkhall Reservoir and Dam

Built in the Soviet era, this reservoir is located close to the tail of the LMC canal at 512 m asl and was fed mainly by an additional pumping station from the Kura River through a long main pipe. The dam (41°32'27.91"N; 45°14'24.70"E) is an earth fill embankment, approximately 25 m high and 950 m long, with the crest at 521 m asl[23], probably a zoned dam due to the use of gravel and pebbles for the dam's construction. This is outside the scope of this Project due to pumping requirement.

Devlshkhall reservoir catchment area

Upstream course of the stream

Figure 2-14**. Devlshkhall Reservoir and Dam**

2.4.11. Irrigation Contracts Signed

[23] These approximate elevations were kept with a portable GPS device, and not so reliable.

Table 2-5 sets out the current contracts signed for water irrigation supply in the command area. As can be seen, the percent of land with signed contracts is low overall, with only Zones 2 and 5 reaching almost 50%.

Table 2-5. Contracts signed for irrigation water supply per command area zone

	Irrigated Area with signed contracts (hectare; max for 2020/2021)	Number of signed contracts (max for 2020/2021)	Average hectares per contract	% of potential land with signed contracts
Zone 1 - Paldo Headworks UMC-G1 to UMC-G5	39.04	20	1.95	11.64%
Zone 2 - UMC-G6 to UMC-G09 and LMMC to Martkopi	2,890.78	1,659	1.74	47.96%
Zone 3 - UMC-G10 to UMC-G29	448.79	155	2.90	19.88%
Zone 4 - LMC-G04 to LMC-G20	2,170.15	532	4.08	26.04%
Zone 5 - LMC-G21 to LMC-G28	2,016.48	184	10.96	47.28%
Zone 6 - LMMC after Martkopi	0.00	0	n/a	0.00%
TOTAL	**7,565.24**	**2,550**	**2.97**	

2.5. The Project

2.5.1. Need for the Project

Irrigation services throughout Georgia, including that of Zemo Samgori, have deteriorated significantly following the disintegration of the Soviet Union in the 1990s. The main reasons for this include:

- Lack of funds. Irrigation budget decreases;
- Weak institutional framework. The management of the irrigation system was transferred to several different entities in the past 20 years, with a range of organizational and financing structures proposed and implemented as a consequence;
- Weak users' organization and confidence. In parallel with the changes in the institutional framework, modalities of farmer co-operation (Amelioration Associations, AA's) were developed in 2004-2006. At present, however, AA's are not operational anymore while the fee recovery is slow and cumbersome. Farmers, however, have informal contacts with the irrigation authorities but the mutual relation has been damaged due to many years of unreliable irrigation supply;
- Poor technical state of the irrigation and drainage system. Physical deterioration of the greater part of the system has made it increasingly difficult to turn the trend around. Virtually no maintenance or regular repair has been undertaken on the system for years, leading to complete failure of almost 100% of the pumped irrigation and 80% of the gravity irrigation; and
- Limited ability of farmers to pay fees. As water supply to farms has become unreliable, farmers have increasingly taken to livestock farming and cultivation of rain-fed crops. Payment of irrigation fees has become too large a burden for small farmers, resulting in a very low level of income for the irrigation authorities, which in their turn were unable to invest in the improvement of the infrastructure.

Other constraints that need addressing within the system include:

- Land areas outside the command area are currently being served with irrigation water by GA;
- Most of the existing control systems are obsolete and constant supply of water is not possible;
- Poor or no maintenance leading to erosion and sedimentation;
- Poor deliveries and losses in the system due to poor operation and maintenance; and
- No water in the tail end of the LMC.

As mentioned in Section 1, the GoG has ambitious plans to develop the agricultural sector through its Strategy of Agricultural Development of Georgia for 2012-2022, Rural Development Strategy for 2017-2020, Agricultural and Rural Development Strategy for 2021-2027, Irrigation Strategy for Georgia 2017-2025 and Action Plan 2021-2023.

The ZSIS is the largest scheme in the country and the closest scheme to Tbilisi in terms of production of food. The Project will meet the requirements of these plans, the modernisation providing a more reliable water source, over a wider area, whilst maintaining downstream ecological flows. It provides an opportunity to increase subsistence and commercial farming, with knock-on effects in the economy from demand for agricultural products and sales.

2.5.2. Project Investment Principles

2.5.2.1. General Principles for Modernisation of ZSIS

The objective of modernisation of the ZSIS is to achieve the distribution of the required quantities of water to the required locations in the right time in a socially, economically and environmentally sustainable way during the entire production cycle of any crops across the ZSIS command area. In order to achieve this, the conceptual design takes note of:

a) Original design of the ZSIS, the present technical state of its infrastructure, and the shortcomings of its water management operations in view of the changed socio-economic context of the agricultural production system specifically, and the society of Georgia at large;

b) Physical features of lands in the ZSIS command area, including altitude, slope, soil types, climate conditions, and the resulting overall agricultural suitability, in order to inform detailed design, including the introduction/expansion of pressurized irrigation waters supply and use;

c) The scheme re-design, in particularly downstream of the secondary distribution network off-takes (i.e. in tertiary units (TUs)), in order to improve the water distribution system, the introduction/expansion of pressurized irrigation, and the necessity to replace TU water distribution from earthen canals to lined open canals and pressurized pipelines, as feasible (to be further elaborated during detailed design), to support the planned introduction of WUOs and to simplify the Operation and Maintenance (O&M) of the system through controlling the flows along the network and saving water.

d) Water availability, including reservoir storage capacity and constraints, seasonal variations, climate change impacts and demand from other users;

e) Social features, including farmers' interest in (alternative) crops, production technologies and irrigation techniques, farm economics and agricultural marketing constraints (i.e., processing and storage, production costs and price risks, etc.), demographic, urbanisation and job market developments;

f) Environmental features, current and after modernisation, including soil salinization risks, limitations and impacts from poor water quality, ecological and heritage constraints, etc.;

g) Legal, institutional and operational management settings, including laws and regulations in place and envisioned, institutions and governance arrangements, government, non-governmental, civil and private sector stakeholders, etc.

2.5.2.2. Irrigation Water Management Principles

In order to deliver irrigation water from the PHW to individual farmers' plots, the conceptual design and modernisation proposal is based on the following water distribution principles:

- **Adequacy** – Water adequacy is central to maximise agricultural production in any irrigation scheme. The adequacy refers to whether water is supplied as required in the right volume to any section in the irrigation scheme at the right time during the whole growing season. Water availability will be a main boundary condition for crop production in the ZSIS, currently and in the future, and hence crop planning and irrigation scheduling is important to avoid water shortages in space and/or time during the irrigation season. Irrigation infrastructure modernisation, with a designated control and monitoring mechanism in place, will ensure adequate and equitable supply of water to the entire ZSIS command area. Modernisation of the ZSIS will resolve the currently observed huge adequacy and equity gap between water delivery at the head and tail end of the ZSIS.
- **Reliability –** The supply system should function reliably at all time so that water is delivered to the farmers as planned.
- **Efficiency** – Water availability is going to be an issue in the future, hence the system should be modernised to reduce water losses, while provisions should be promoted for farmers to use efficient methods of irrigation such as sprinkler and drip irrigation systems. A control mechanism, with proper operational procedures, is important to reduce the loss of water during night irrigation and during non-peak

seasons when the water requirement is quite low. The efficiency is achievable with crop planning and irrigation scheduling, control and monitoring system and irrigation application at farm level.

- **Equitable water supply** – The system should have provisions to deliver water equitably to all the farm plots, depending on the area, cropping pattern and as per planned and agreed water delivery schedule. The delivery should have an agreed duration of supply, cycle and interval at primary, secondary, tertiary and quaternary canal level. This may be combined with equity goals as below.
- **Social equity** – The social equity goal in irrigation management refers to the equitable access of water to various types of water users - mainly between small- and large-scale farmers, as there is a huge disparity between small-scale holders and large-scale individual/corporate farms in the ZSIS. For example, during years with low water availability, the priority may be given to provide irrigation water to small scale farmers compared to large scale farms.
- **Demand based supply** – Water supply will be based on contracts signed between GA and farmers. The contract should have an agreed cropping pattern and water delivery schedule.
- **Controlled and monitored supply** – The irrigation water distribution system should have facilities to control the flow of water, so that the water is delivered as planned and thus reducing water losses and increasing water use efficiency.
- **Adaptability** – The system should be designed to deliver water to individuals, if needed, outside the irrigation season (for example, greenhouses may require water throughout the year), without any wastages on the way. The delivery system, including irrigation infrastructure, irrigation plan and scheduling, should also be adaptable to cater to the various types of use(r)s such as small and large farmers, the use of open canals or pressurised systems, etc.
- **Coordinated operation** – The efficiency of operations and effectiveness of implementation of operation and maintenance depends on a coordination of management responsibilities between GA and WUOs. These roles and responsibilities have to be clearly divided at all levels. The operation of main canals should remain with GA while operation of the lower-level distribution system may be designated to the WUOs. The individual farmers should not be allowed to operate any of the canal gates.
- **Transparency** – There should be transparency between GA, WUOs and its farmer stakeholders in the water availability, crop planning, irrigation scheduling, operation and maintenance procedures, responsibilities in Operation and Maintenance (O&M), fees and fund management. Appropriate and commonly used information channels (bulletin boards, social media, etc.) shall be used to make information on decisions taken publicly available and easily accessible for farmers and other stakeholders. There should not be any favouritism to any individual or group of farmers.
- **Safety** – the proposed structures should be safe enough for operations and for the public. Some of the safety measures may include installing fences wherever there is a movement of people along the canal and/or water depth is more than 1.5m. The safety should also be considered for the structures from damages by water movement or anthropogenic activities.

2.5.2.3. Water Control and Monitoring Principles

One of the main objectives of canal system modernisation is to provide better irrigation services to farmers, to improve the management (including for collection of water tariff payments) of the system, and to reduce water losses in the distribution system. Provision of a canal monitoring and control system, with either manual or automated system or a mixture of both, would enable to achieve the water use efficiency goal. The proposed water monitoring and control system is based mainly on the principles of:

1. Supply the required water timely and at right place through a monitored canal system;
2. Establish an operating procedure for irrigation water management;
3. Build the capacity of the operators, both GA and WUOs;
4. Control the losses through manually operated gates and cross regulators.

Canal operational procedures should meet changing water-use requirements by precisely measuring water level and flow data at cross-regulators and outlets, to allow the operators to make precise flow rate adjustments in response to the data.

An autonomous system is not suggested here as (a) it requires energy supply, (b) the safety of the equipment needs to be ensured; and (c) such system is costly. Instead of an autonomous operational system of gates, a monitoring system with Remote Transmitting Unit connected with the flow/water level measurement in the main canals is proposed.

2.5.2.4. Water Management Organisation Principles

The efficiency of water management depends on its level of adoption level by the beneficiaries. A participatory water governance[24] approach is needed to operate and maintain the canals systems. Good governance requires formulating and providing an appropriate enabling environment that includes facilitating collective decision making, effective institutions and suitable policy, legal and political frameworks. There is however no blueprint for effective water governance. The Global Water Partnership has however identified ten criteria for effective water governance that were further refined by the World Water Assessment Programme into eight principles of good governance, and this has been further modified for the purposes of this Project:

- **Participation**: All citizens, both men and women, should have a voice-directly or through intermediate organizations— representing their interests in policy- and decision- making. Establish management organizations at appropriate levels. To facilitate such broad participation the capacity of all stakeholders have to be built on water management and environmental protection administrations as well as address training needs (including training of trainers) and facilitating knowledge and expertise exchange at all levels.
- **Transparency**: Information (including those from collecting and monitoring water data, using indicators that adhere to international standards) should flow freely within a society; processes and decisions should be transparent and open for public scrutiny.
- **Equity**: All groups in society, both men and women, should have equal opportunities to improve their wellbeing and to establish and support fair and socially sensitive valuation and cost recovery.
- **Accountability**: Governments, the private sector and civil society organizations should be accountable to the public or the interests they are representing. Support the media to play a more systematic and constructive communication role on water issues and increase citizen awareness of water's value and culture.
- **Coherence**: Because of the increasing complexity of water issues, policies and actions must be coherent, consistent and easily understood. Support water research and link research outcomes with policy development, application and monitoring.
- **Responsiveness**: Institutions and processes should serve all stakeholders and respond properly to preferences, changes in demand or other new circumstances and challenges.
- **Integration**: Water governance should enhance and promote integrated and holistic approaches. Integrate policies in all water categories, including groundwater, coastal water and transboundary waters.
- **Ethics**: Water governance must be based on the ethical principles of the society where it functions—for example, by respecting traditional water rights.

2.5.3. Proposed Command Area

2.5.3.1. Command Area Review

As part of the 2022 FS, an initial analysis was undertaken including a review of the 2018 FS, a review of strategies, plans and literature as well as field observations and discussions with various stakeholders. This has indicated that there may be (i) limitations in water resources available for agricultural production; (ii) anticipated impacts on water resources availability and crop water demand from forecasted climate change; (iii) ongoing development processes that compete with agriculture for available land resources, specifically ongoing and envisioned future urbanisation, industrialization and small and medium enterprise development; all of which impact on the availability of land for agriculture in the ZSIS command area.

In response, the Consultant reviewed the features and extent of land use in the ZSIS command area as identified in the 2018 FS, to assess the potential of the ZSIS command area for agricultural production today and in the future. In the review a number of environmental factors were also considered, including soil quality and salinity, terrain topography, pollution and others. The review process specifically aimed at identifying those land areas that can be confidently considered as having potential for agricultural production and as such can be prioritized for inclusion in the irrigation modernisation investment project for the ZSIS.

The basis for identifying areas prioritised for investment is the tertiary unit (TU) of land plots. TUs are grouped in accordance with the quantity of irrigation supplied to them by means of a common Secondary Canal (SC) to

[24] Water governance guides, directs, enables and enhances effective and sustainable water management and provision. Effective water governance becomes more important as water becomes scarcer; it must ensure that all sectors of society have equitable, reliable and sustainable access to water and are using water efficiently.

form Secondary Units (SU) of land plots. For reasons of consolidation, TUs supplied with irrigation directly from the main canal, whether the UMC or LMC, were affiliated with their geographically nearest upstream SC (e.g., TUs supplied with water from the LMC-G05.2 are merged with UMC-G05, etc.). SUs can also be considered to be used for the selection of priority investment packages, if for financial reasons (insufficient budget) or water availability reasons (not enough water available) only part of the command area of the ZSIS can be included in the investment project.

Using the GIS system designed as part of the previous FS, in total, 342 TUs (UMC: 168, LMC: 130, LMMC: 44) were identified, which were grouped into 58 SUs (UMC: 29; LMC: 28, LMMC: 1).

The SUs identified were grouped using a geographic clustering approach, which identified six individual Irrigation Zones (IZ) in the ZSIS command area, the total land areas of which were quantified using the GIS system prepared during the previous FS (Table 2-6 and Figure 2-15).

Table 2-6. Description and area of Irrigation Zones identified

Irrigation Zone	Area (ha)
IZ-1: TUs and SUs located in the north-eastern area of the ZSIS command area, closest to the Paldo headworks and water intake into the UMC; secondary canals UMC-G01 to UMC-G05.	588.7
IZ-2: TUs and SUs located in the eastern area of the ZSIS command area; secondary canals UMC-G06 to UMC-G09 and TUs of the LMMC to Martkopi.	7,349.8
IZ-3: TUs and SUs located in the central-western area of the ZSIS command area; secondary canals UMC-G10 to UMC-G29.	4,096.0
IZ-4: TUs and SUs located in the central-southern area of the ZSIS command area; secondary canals LMC-G04 to LMC-G20.	10,501.6
IZ-5: TUs and SUs located in the south-eastern area of the ZSIS command area; secondary canals LMC-G21 to LMC-G28.	5,298.3
IZ-6: LMMC after Martkopi, located in the northern part of the ZSIS command area, currently out of order.	2,114.8
TOTAL	**29,994.2**

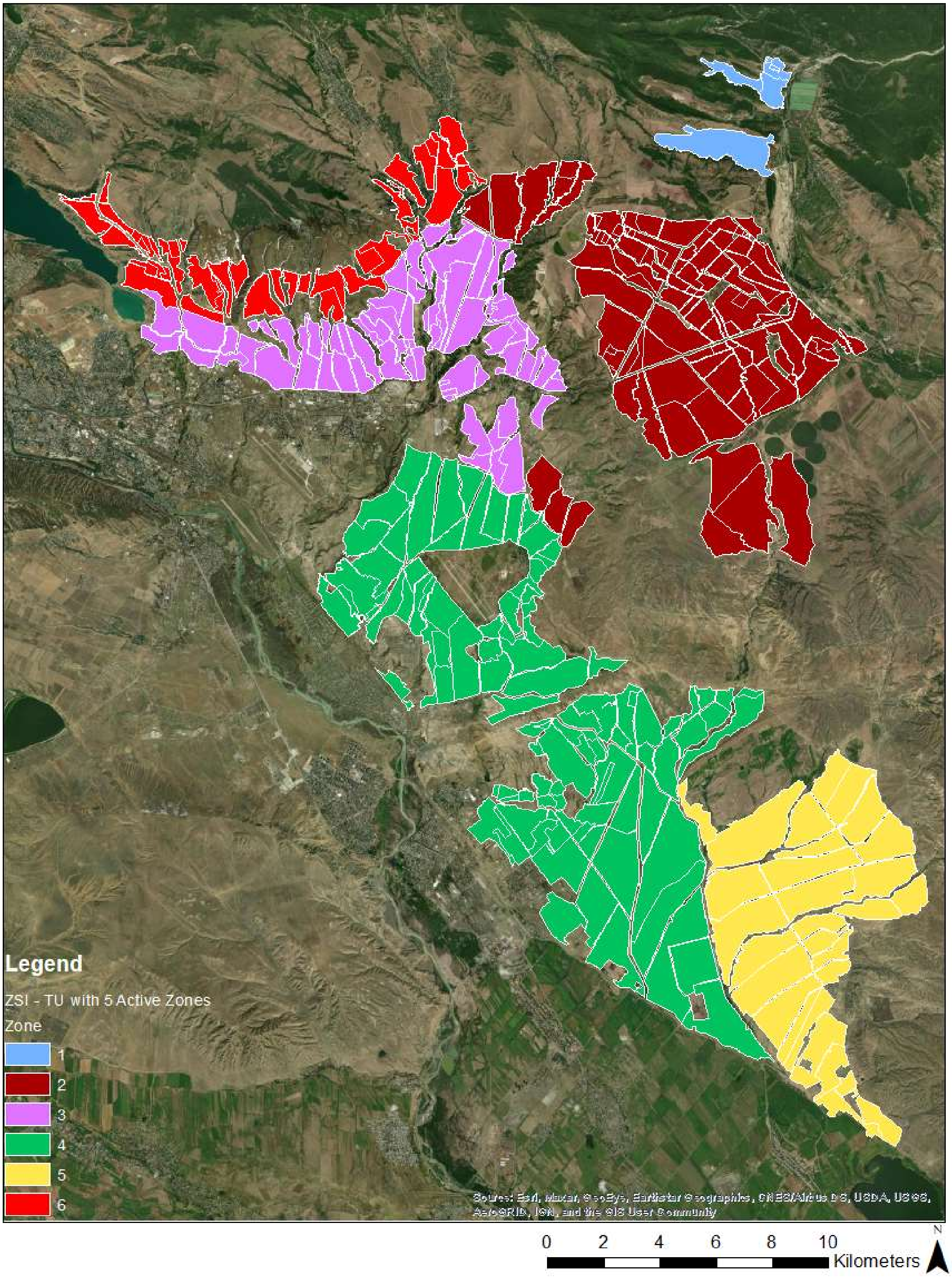


Figure 2-15. Irrigation zones identified in the command area of the ZSIS

In order to assess the potential of TUs for agricultural production and as such inclusion in the current irrigation modernisation investment project, a set of relevant parameters, described in Table 2-7, were analysed. Using the GIS maps with boundaries of TUs and a variety of google maps available on different platforms, a visual characterization approach to assess each TU against the criteria formulated was adopted.

Table 2-7. Parameters for potential irrigable command area identification

Parameter	Discussion
Pumping needs	TUs that needs pumping will be discarded as it is uneconomical. For example, nearly 6,500 ha of ZSIS, which during the Soviet era was irrigated through pumping water from Mtkvari river, are/will be excluded.
Agricultural land use	Land areas in TUs actual available for agricultural production[25]. Land areas in TUs supplied with water under contracts signed between GA and farmers[26]. Land areas in TUs in non-ZSIS command area[27]. Visual estimation of land in use for (irrigated) arable farming.
Urbanisation	Presence or urbanized areas, i.e., city districts, industries, or villages with home-gardens, will be excluded from the investment project. Specifically: (i) TUs identified as villages predominantly occupied by houses with gardens and/or household plots[28]; (ii) TUs occupied by existing urbanized areas, including districts of Tbilisi, or based on visual inspection showing expansion of urbanization, industrial or enterprise development[29].
Land registration and plot size	Command areas with more than 50% unregistered and/or unknown land ownership will not be considered for development. Priority will be given to areas with a high percentage of medium and large farms (> 1 ha).
Conditions of irrigation infrastructure	TUs provided with water by canals which are completely destroyed, need complete reconstruction, for which the reconstruction may require a significant acquisition of land or resettlement of people, or which are located at the tail end of a SC which requires significant costs for reconstruction compared to land area restored will be considered only if they are economically viable, socially acceptable and water availability is not a concern.
Landscape features	Landscape features affecting the land potential for irrigation, including factors such as soil type, terrain condition (e.g., gullies, adverse topography), high groundwater table, environmental issues (e.g., pollution, solid waste storage), road development, and social acceptability will also be considered before finalising the command area.

[25] Data on the geographic location of land plots in TUs of the ZSIS as provided by the NAPR show that not all land inside a TU is available for agriculture. Instead, some land area is in use for e.g. roads, canals, pipelines, wind breaks, etc. An analysis was undertaken that showed on average 85% of the land area inside any TU is available for agriculture, while 10% of the land is used for other purposes, and 5% is estimated as non-registered lands with potential for agriculture.

[26] Analysis of the water supply contracts database managed by GA shows for 2020 and 2021 a total of 4,298 contracts signed, with 2,462 and 1,836 contracts signed in 2020 and 2021, respectively. It was noted that the land area actually in use for irrigated agriculture, as defined by contracts signed between GA and farmers, is much less than the potential irrigated land area identified by the Consultant for each IZ.

[27] Analysis of the data provided by GA on the contracts signed in 2020 and 2021 with farmers for the supply of irrigation water to their fields shows that irrigation water is provided to land plots inside the ZSIS command area as defined in 2016, but also to some land plots beyond the command area. In total 2,383.6 ha of land plots were identified to be under signed contracts, equal to a net area of 1,013.0 ha irrigated with water using the ZSIS water distribution system, in either 2020 or 2021, or in both years.

[28] Analysis of the ZSIS command area as identified during the 2018 FS showed the presence of in total 41 TU that wholly or partly include villages with home-gardens, in total covering 2,297.4 ha. Based on a visual inspection of the land use characteristics of villages, to determine the occurrence of home-gardens and build-up areas, using google maps the consultant adopted the estimation that on average 50% of the area of any village TU is available for agricultural production (i.e. 1,148.7 ha).

[29] Analysis of the Tbilisi Master Plan (2019) showed envisioned expansion of build area to the east of Tbilisi Sea, and recreational zones to the north-east. The Consultant was informed that overall around 800 ha of the ZSIS command area has been re-categorised already as part of the Tbilisi Urban Development Plan. In the downstream section of the UMC, visual inspections also showed the ongoing expansion of the road network as well as enterprise development in the Lilo area east of Tbilisi.

Parameter	Discussion
Water availability	Sustainable water availability from various sources after considering climate change scenarios, competition of water and canal (tunnel) restrictions / limitation.

The reorganisation of the TUs and SUs will be addressed during the detailed design stage after conducting a detailed topographic survey and participatory walk-through survey.

2.5.3.2. Proposed Command Area

The resulting summary assessment table of the ZSIS command area is presented in Table 2-8. The geographic distribution of the categories "Potentially Irrigable Area", "villages" and defined categories of "non-suitable area" is presented in Figure 2-16.

Table 2-8. Initial classification of land use suitability in the ZSIS command area (ha)

Irrigation Zones	Design Command Area	Roads, canals and non-suitable lands within TUs	Build-up area in villages	Non-suitable TUs	Potential Irrigable Area		Annual Net Potential Irrigated Area
					Total	Of which: annual fallow	
IZ-1: PHW, UMC-G1 to UMC-G5	588.7	33.5	21.2	211.0	323.0	32.3	290.7
IZ-2: UMC-G06 to UMC-G09 and LMMC to Martkopi	7,394.8	602.7	461.0	445.5	5,885.5	588.6	5,296.9
IZ-3: UMC-G10 to UMC-G29	4,096.0	101.8	80.6	2,917.0	996.6	99.7	896.9
IZ-4: LMC-G04 to LMC-G20	10,501.6	833.3	455.1	1,258.2	7,955.1	795.5	7,159.6
IZ-5: LMC-G21 to LMC-G28	5,298.3	426.5	130.8	771.8	3,969.2	396.9	3,572.3
IZ-6: LMMC after Martkopi	2,114.8	0.0	0.0	2,114.8	0.0	0.0	0.0
TOTAL	**29,994.2**	**1,997.9**	**1,148.7**	**7,718.2**	**19,129.4**	**1,912.9**	**17,216.4**

Table 2-8 shows that the land marked as potentially available for agriculture inside the 2018 FS ZSIS command area is estimated as being 19,129.4 ha, following the exclusion of lands in use for wind breaks and roads, currently non-registered lands, and build-up areas in villages, of industrial complexes and commercial enterprises as well as lands currently undergoing or planned to undergo urban development.

Taking into account that, of the land potentially available for agriculture, an estimated 10% is considered to be annually left fallow, equal to 1,912.9 ha, a corrective annual net potential irrigated area for crop production of 17,216.4 ha will be applied in the water resources and agro-economic analyses as being the basis for crop production and income generation.

In consideration of the results of the land suitability analysis, including considerations for the area supplied with irrigation water under contracts signed with GA, the identified IZ-2 (UMC-G06 to UMC-G09 and LMMC to Martkopi village), IZ-4 (LMC-G05 to LMC-G20), and IZ-5 (LMC-G21 to LMC-G28) as the most relevant areas for the ZSIS modernisation investment project[30]. The prioritised selection of TUs and SUs in designated IZs is the Project that has been taken forward and therefore is addressed in this ESIA.

[30] During detailed design, alternative considerations may be given to selection of priority canals for modernization investments

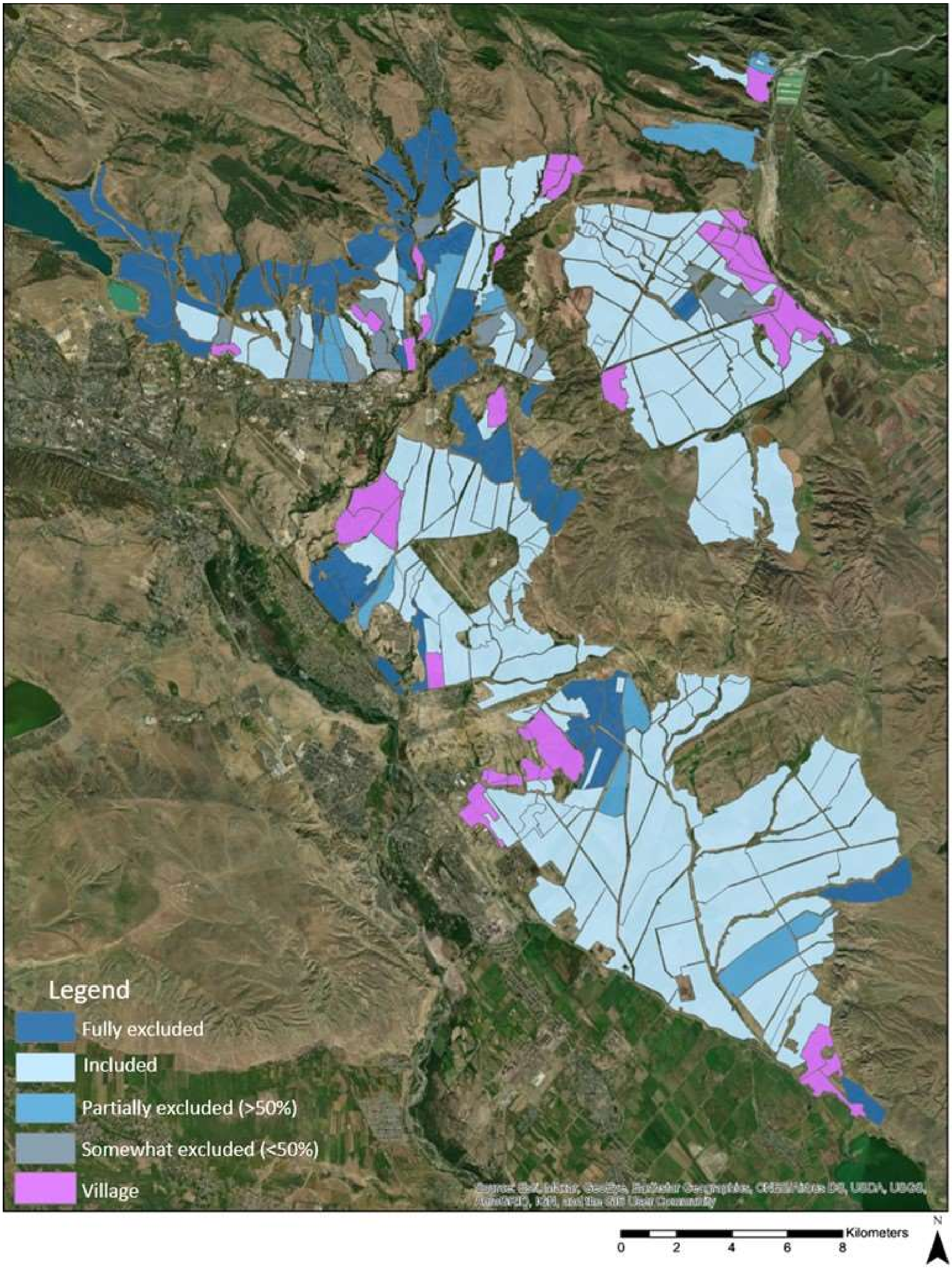


Figure 2-16. Spatial view of potential irrigable TUs in the ZSIS command area

Based on the review of the agricultural production potential of TUs based on the parameters selected, as described above, the following summary observations can be made separately for the IZs identified:

Table 2-9. IZ observations

Irrigation Zone	Command Area	TUs	Contract signed
IZ-1	IZ-1 has the smallest command area per original design (2.0%) and contributes the least to the potential irrigable area of the ZSIS (323.0 ha; 1.7%). Also, the potentially irrigable area is relatively small (52.0%) compared to the design command area of IZ-1, the remaining lands being either occupied by windbreaks, roads or municipal infrastructure, or is identified as not suitable for irrigation, largely due to unfavourable relief and soil conditions in the zone's mountain foothills.	IZ-1 includes 6 TUs, including the village of Ujarma.	For 2020-2021, on average 14 contracts were signed for the supply of irrigation water to only 8.6% of the potential irrigable area of IZ-1, the lowest among all zones.
IZ-2	IZ-2 ranks second in its contribution to the command area per original design (24.7%) and contributes 29.1% to the identified potential irrigable area (5,885.5 ha). IZ-2 has the relative largest area potentially available for irrigation (75.5%), with only 24.5% preliminary identified as unsuitable, occupied by windbreaks, transport or municipal infrastructure, as well as TUs with established agro-industrial enterprises. Also several TUs are located at the end of the long feeder canal UMC-G09, and as the benefits from agricultural production may insufficiently outweigh the relative high investment costs for the modernisation of water supply to these remote TUs, these TUs are excluded from the investment project.	In total, IZ-2 includes 99 TUs provided with irrigation water by 4 secondary canals. In addition, 18 TUs consist of lands of the villages Mughanlo, Sartichala and Mukhanis Metskhoveleoba.	For 2020-2021, on average 1,465 contracts were signed for the supply of irrigation water to 50.6% of the identified potential irrigable area in IZ-2, the highest relative area of all irrigation zones.
IZ-3	IZ-3 ranks fourth in its contribution to the command area per original design (13.7%) and contributes 5.2% (996.6 ha) to the potential irrigable area of the ZSIS. Only almost half (48.4%) of the design command area of IZ-3 is identified as potentially irrigable area. Main reasons include the more frequent occurrence of adverse relief features in TUs (slopes, gullies in foothills), the expansion of housing and urbanization, development of small and medium enterprises and road infrastructure, and long-term abandonment of farming practices, possibly caused by the relative vicinity of the capital city of Tbilisi, offering better access to alternative employment opportunities beyond farming. Also a number of TUs were observed to be located at the tail-end of long (transit) feeder canal UMC-G10. Such TUs were identified as unsuitable, as the benefits from agricultural production after modernisation of water supply may	In total, IZ-3 includes 74 TUs, including 7 TUs of the villages Brotseula, Nasaguri and some others, as well as the suburbs of Tbilisi, provided with irrigation water by 20 secondary canals.	In 2020-2021, on average 145 contracts for irrigation water supply were signed, for crop production on 5.9% of the identified potentially irrigable area of IZ-3. Exclusively contracts were signed for lands supplied with water from secondary canals UMC-G10 to UMC-G15; no contracts were signed for lands served by the secondary canals UMC-G16 to UMC-G29.

Irrigation Zone	Command Area	TUs	Contract signed
	insufficiently outweigh the relative high investment costs.		
IZ-4	IZ-4 provides the largest land contribution to the command area per original design (10,501.6 ha, 35.0%), and contributes 41.6% (7,955.1 ha) to the potential irrigable area of the ZSIS. Of IZ-4, 71.8% is preliminary assessed as potential irrigable area. Accordingly, a relatively small land area was assessed as non-suitable, for reasons of wind breaks, road and municipal infrastructure, adverse land and relief conditions (slopes and gullies, land degradation, soil salinity, etc.), and environmental issues (solid waste and industrial pollution). In addition, a number of TUs were observed to be located at the tail-end of long (transit) feeder canals LMC-G05 and LMC-G06. Such TUs were assessed as non-suitable, as the benefits from agricultural production after modernisation of water supply may insufficiently outweigh the relative high investment costs.	In total, IZ-4 consist of 102 TUs, of which 13 TUs are related to the villages Gamarjveba, Poladaantkari, Akhali Samgoris, Akhali Samgori as well as the outskirts of the city of Rustavi, provided with irrigation water by 17 secondary canals.	In 2020-2021, on average 380 contracts for irrigation water supply were signed, for crop production on 20.7% of the identified irrigable area of IZ-4.
IZ-5	IZ-5 covers 17.7% (5,969.2 ha) of the command area per original design and contributes 20.7% (3,756.0 ha) to the potential irrigable area of the ZSIS. Overall, 70.9% of IZ-5 is assessed as potential irrigable area, the remaining area is assessed as non-suitable, largely for reasons of the former irrigation infrastructure being completely destroyed and no dryland farming having taken place in the last decade.	In addition, IZ-5 includes 4 TUs related to the villages Lemshveniera and Mzianeti. In total, IZ-5 consists of 31 TUs provided with irrigation water by 8 secondary canals.	In 2020-2021, on average 103 contracts for irrigation water supply were signed, for crop production on 34.5% of the identified irrigable area of IZ-5.
IZ-6	IZ-6 covers 7.1% (2,114.8 ha) of the command area per original design, of which 0.0% (0 ha) are assessed as potential irrigable area. After consultations with the irrigation engineers and GA senior management as well as field observations, it was concluded that the modernisation of the LMMC after Martkopi is to be considered relatively very costly compared to the expected benefits from agricultural production after modernisation of the water supply, as such IZ-6 is proposed to be excluded from further detailed analyses.	-	-

2.5.4. Proposed Investment Project

The conceptual design of the irrigation system follows the approach defined in the Eptisa 2018 FS, updated in areas where a change was deemed appropriate. Based on the analyses of the ZSIS command area in the 2018 FS against parameters and observations discussed, and in consultation with the GA, a number of decisions were agreed upon which are taken into account is the 2022 conceptual design of the ZSIS investment project:

- The irrigation command area is reduced from 29,994.2 ha to 19,129.4 ha, with a net annual potential irrigated area in use for agricultural production set at 17,216.4 ha assuming that 10% is each year left fallow.[31] Correspondingly the number of TUs is reduced from 342 TUs identified in the previous FS (2018) to 184 TUs with 100% of their lands included, 7 TUs with >50% of their lands included, 10 TUs with <50% of their lands included, and 41 village TUs. As such, lands of 100 TUs were fully excluded from the previous command area.

- The LMMC beyond the village of Martkopi is not included for investments[32].
- The ZSIS modernisation investment project shall focus on the main, secondary and tertiary canals in 2016 command area; no consideration shall be given to invest in infrastructure to provide water to land plots beyond the 2016 command area.
- All TUs will be rehabilitated, either with open earthen or lined canal or pressurised distribution system, to deliver required water to the farmland;
- No investments are considered in internal water distribution network within the village TUs, while outlets for possible village water supply are provided for in the secondary distribution system[33].
- A number of additional works necessary have been identified and costed, such as erosion control measures along the banks of the Chumatkhevi creek between the intake point from the UMC and the crossing of Chumatkhevi creek with the Kakheti highway, over an estimated length of about 7 km, as well as for an inlet from Chumatkhevi creek into the LMC, and minor works at the Paldo Headworks. These works were not considered in the earlier FS.
- Illegal taps, especially in the main canals, have been identified. If an illegal tap is in use to support agricultural production and is in use to provide water to the fields of a group of farmers, the tap will be legalised and an appropriate outlet will be included in the investment project. Illegal taps for non-agricultural purposes will be closed.
- Establishment of WUO institutions as per the laws in the country.

2.5.5. Proposed Modernisation Works

The Project will be subject to detailed design. This includes, as relevant, any additional pre-construction surveys required such as topographic survey.

The following modernisation works have been proposed, the exact volumes of works will be identified during the detailed design:

Paldo Headworks

- Repair of settling basins of UMC regulator;
- Repair works to hoists at the UMC regulator point; and
- Provision for a monitoring system to measure flow and sedimentation level in the settling basins.

Tbilisi Sea

- No work is planned at Tbilisi Sea under this investment project.

Upper Main Canal

- Repair of lining works;
- Minor repairs to tunnels, siphons and drain overpasses;
- Additional duckbill or cross regulators to maintain the flow levels, as required;
- Repair works of LMMC regulator and addition of a distribution structure at UMC-G09;

[31] This area has been determined through the review of the TUs suitability for agriculture as discussed above (and not water availability which is discussed further on in this Report).

[32] Assessment showed that modernization of the whole LMMC would be a significant additional cost, considering the very poor to destroyed state of the LMMC. Also the unit cost per hectare for modernization is assessed as much higher than for the canals in other parts of the ZSIS command area, due to the elongated narrow shape of the relative small LMMC command area, and more unfavourable terrain features (more gullies, steeper slopes, smaller plots). Taking into account also the constrained water resources availability, it was agreed with GA during the preparation of the Conceptual Design to only include the LMMC to Martkopi.

[33] The ZSIS modernization project considers investment in water outlets from the secondary distribution network to allow villages to connect and receive water from the Iori river for their (agricultural) needs, the needs of which were considered in the water balance model. The ZSIS project, however, does not include investment in the water distribution network to agricultural (household) plots inside villages.

- Improvement of existing outlets from UMC to secondary and TU distribution canal network, including introduction of new outlets (under specific conditions as described in section 2.5.4), including to villages, as appropriate;
- Establishment of monitoring and control devices;
- Minor repair works to the service roads; and
- Repair works to the UMC-LMC connecting pipeline.

Lower Main Canal

- Repair of existing lined sections of LMC ;
- Lining of 5.5 km length of the LMC
- Cross regulators to maintain the flow levels;
- Improvement of outlets from LMC to secondary and TU distribution canal network, including introduction of new outlets (under specific conditions as described in section 2.5.4), including to villages, as appropriate;
- Establishment of monitoring and control devices;
- Repair works to the service road;
- Headworks and conveyance canal from Chumatkhevi creek to the LMC; and
- Minor repairs to the Locini river inlet.

Secondary distribution network

- Repair of existing lined canals.
- Reshaping and lining of the secondary open canal distribution network[34].
- Establishment of new secondary and sub-secondary canals / pipelines wherever it is feasible without major land acquisition. The decision will be taken during the detailed design stage.
- Provision of proportional division structures at branch secondary distribution network canals.
- Cross regulators to maintain the flow levels.
- Improvement of outlets including introduction of new outlets (under specific conditions as described in section 2.5.4.) including to villages, as appropriate.
- Establishment of monitoring and control devices.
- Repair works to the service road.

Offtakes

- There are 94 direct offtakes from both UMC and LMC and several offtakes/outlets in the secondary distribution canal network. The majority of offtakes are in poor condition and therefore it is proposed to replace all the offtakes on the main canals with either manual and self-regulated offtakes.
- Secondary and tertiary canal offtakes will be either repaired or replaced and new ones could be added as required.

The offtakes at the distribution system should be simple, reliable, flexible, deliver a constant and accurately measured flow rate and volume, and be manually operable for easy management by both WUOs and WUGs. The material (aluminium, steel or stainless steel) of the offtakes could be evaluated during the detailed design stage.

Tertiary Unit Development

There are 242 TUs (184 fully included, 58 partially included of which 41 are village TUs) identified within the ZSIS command area. They are grouped mainly based on hydraulics, taking into account that the land within one TU can be irrigated by means of one or two outlets from the secondary distribution canals or, occasionally, directly from the LMC or UMC. The land in some of the TUs are owned by single large farmers, while in other TUs the land is owned by several to many small farmers. The water distribution within the TUs will be comprised of either an open canal system or a pressurised pipeline system. Investment financing is considered for the development of the tertiary water distribution in all the TUs.

[34] Depending on the soil type, topography/slopes, etc., tertiary canals of the secondary distribution system (e.g. UMC-G5-1) will be designed either as open canals or closed pipeline. The specific choices will be determined during the detailed design stage.

Control and Monitoring

A simple SCADA system is proposed.

Drainage system

In general, the command area has enough slope to drain water naturally. No swamps or marshes have been noted or reported during the field visits. However, there are manmade drainage canals to drain excess water from the command area. Farmers have reported excess and uncontrolled applications of water in upstream command area that led to floods on their land. Provision has been made to repair 28 km and 27 km of the existing drains in the UMC and LMC command areas respectively. The proposed work is mainly to clean and reshape the drains to the design.

Water Regulation

The cumulative water required, for irrigation through secondary and direct tertiary canals as well as non-irrigation purposes, has to be supplied through regulated flows in the main canals.

The regulators for the UMC, in addition to the existing regulators, are required at:

- Paldo Headworks where water flow can be measured at the level of the weir crests at the end of the sand catcher;
- The adjustable weirs at the head of all three power stations;
- The additional adjustable weir provided for UMC-G10;
- Three additional regulators which are double duckbill weirs combined with sediment excluder gates. However, the specific number and location may be decided during the detailed design;
- The new head regulator at the Junction of the UMC with the LMMC.

For the LMC, the following regulators are required:

- The head regulator;
- Three additional regulators which are double duckbill weirs combined with sediment excluder gates;
- Three additional double duckbill weirs to maintain water levels;
- The cross regulators at siphons and waste ways.

The secondary distribution network is envisioned to provide for a 24 hours continuous supply and should deliver the cumulative water required for TUs at various nodes. The tertiary canals, only if they supply to more than one TU, should deliver the cumulative water required for TUs below the tertiary canals.

The flows of these canals will be regulated by (to be decided during detailed design):

- A modular outlet on the main canal of which the flow rate adjustable in steps of 25 or 50 l/s for a 2.5 cm wide segment or a 5 cm wide segment respectively;
- Long crested control structures at outlets to TUs in combination with baffled modular outlets;
- A single baffled modular outlet to large farms;
- Division boxes with modular outlets to branches, maximum flow being a proportional flow distribution;
- A tail structure presented as a long-crested structure with remote water level measurement allowing deriving the flow.

Each TU will receive its water supply continuously and the water will be distributed on a rotation basis to the farms / blocks. The TUs will have several tertiary distribution system canals, connected through division boxes and each farmgate will receive its water supply according the distribution schedule agreed with WUO/GA. The distribution schedule will vary in peak and slack seasons.

The TU headworks consist of pre-cast concrete units containing gates and concrete measuring flumes.

There are two types of tertiary supply: open lined channel system and pressurised system. In case of open lined channel system, the TU headworks and turnouts are designed to allow excess water flow over the gates and continue via the tail escapes into the drainage system.

Access and Service Roads

The roads inside the irrigation units are in poor condition. For (several) years, large parts of the UMC and LMC command areas are uncultivated and abandoned. Consequently, the road network suffered from a lack of maintenance as well as from erosion due to runoff, wind, snow etc. The UMC and its bigger secondary canals, like the UMC-G07, UMC-G08 and UMC-G09, have a side service road in good or medium condition. The LMC service road is utilized by the Army too.

A provision has been made in the cost estimate for repairing the internal roads in order to facilitate the link with the national roads for reaching the markets and to do not compromise the agriculture production driving along bumpy roads.

2.5.6. Technical Assistance

The FS has identified the TA support required for the Project, as outlined below:

Table 2-10. Technical Assistance Packages

TA	Scope
Detailed Design	• Detailed engineering designs of infrastructure, bill of quantities and cost estimates; • Preparation of technical specifications; • Preparation of site-specific ESMP; • Preparation of complete set of bidding and contract documents. Duration: 18 months
WUO Planning and Formation (WUO PF)	This WUO PF TA includes two sub-sets of TA: Farmers Engagement and Consultation Process The main results to be achieved by the Service Provider under this Assignment are a series of awareness programmes for the farmers and a tender document for WUO formation, notably: • Awareness programmes for farmers about the project • Contract documents for WUO formation Duration 6 months
	WUO Planning and Formation • Preparation of WUO institutions formation plan and formation; • Presentation of the proposed project to farmers covering technical aspects, cropping pattern and cost benefits to beneficiaries; • Preparation of complete set of bidding and contract documents; • Ensure participation of women and vulnerable farmers in this process; • Prepare plans to ensure beneficiaries are contributing to the infrastructure investment especially in the tertiary unit on farm development activities; • Capacity building of WUO. Duration 30 months
Project Management Unit Support Consultant	• Providing technical, contracts and management support to the MEPA / GA PMU; • Providing supervision support to the PMU; • Providing design support to TUs; • Developing an O&M manual and training program • Ensure ESMP is implemented as per Plan during the implementation. Duration 42 months
WUO Strengthening and Sustainability Support	Scope Strengthening of WUOs, once formed, through building their capacities in the areas of organisation management, developing long term sustainable goals, establishment of monitoring system, fee collection procedures and maintenance of their sections of the rehabilitated scheme. Activities • Series of training programmes on i. WUO organisation management ii. WUO financial management

TA	Scope
	iii. WUO monitoring system • Subsidies to WUOs initially for their management. • Study tour for farmers and GA to a country where WUOs are functioning effectively Duration: 36 months after completion of WUO-PF TA or Parallel once the first set of WUO's are formed.
Agricultural Production Support	Scope • Increase the productivity through adoption of best cultivation practices, with a focus on water use efficiency improvement. • Support GA in preparation of annual cropping pattern and irrigation scheduling • Activities • Preparation of a detailed implementation plan for training and awareness raising activities; • Preparation of capacity building materials: publications, demonstration plots, demonstration technical materials, etc.; • Selective subsidies on pilot scale to support farmers on agricultural production equipment and water saving technologies • Implementation of capacity building campaign; Duration: 24 months

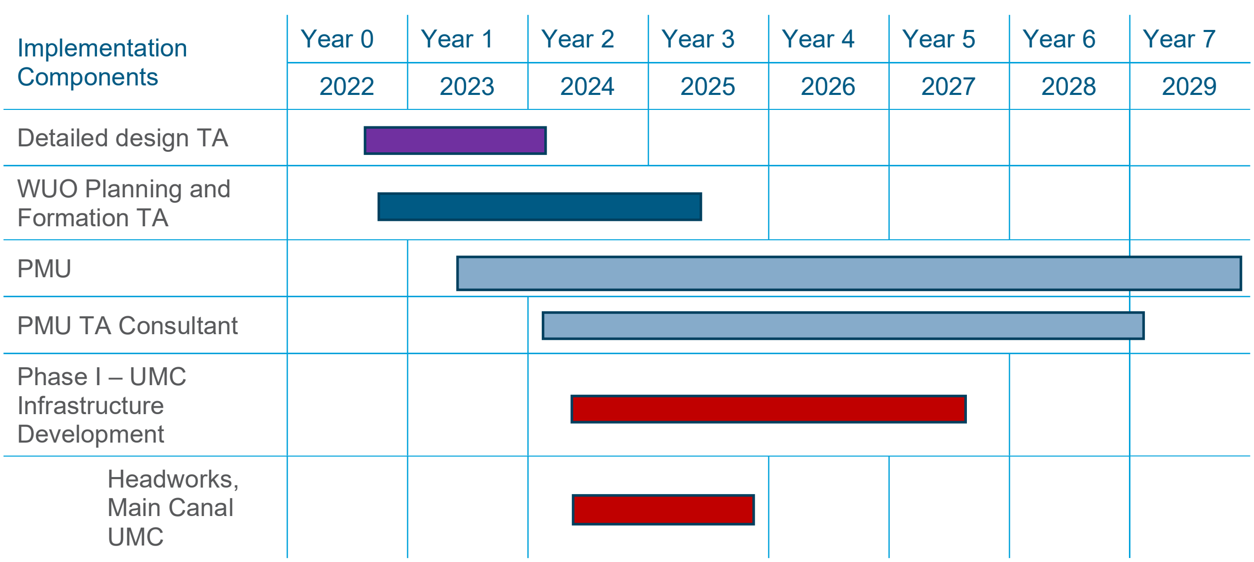
2.6. Project Phases

2.6.1. Implementation Plan

The proposed implementation plan is presented in the figure below. The overall project implementation will be seven years from 2022.

The work components are proposed for implementation in two Phases:

- Phase 1: UMC command area – PHW, main canal, secondary distribution network, tertiary development and associated drainage, road networks and control and monitoring structures;
- Phase 2: LMC command area – main canal, secondary distribution network, tertiary development and associated drainage, road networks and control and monitoring structures.



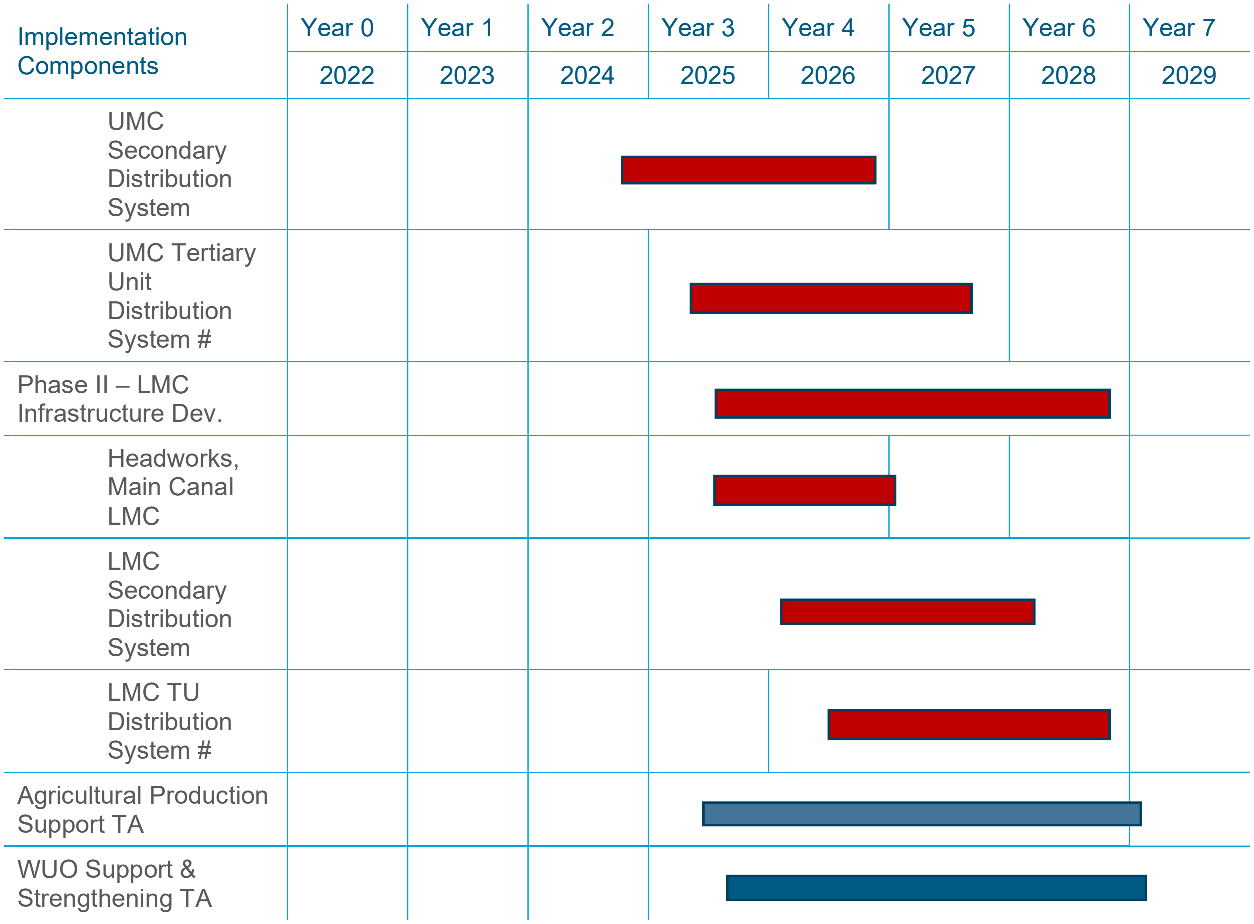


Figure 2-17. Implementation schedule

2.6.2. Detailed Design

As identified above, the next stage of works will be the detailed design of the Project. The WUO Planning and Formation TA will run in parallel with the detailed design as the design is expected to follow a participatory design process. On completion of detailed design, the packages related to headworks, main canals and secondary distribution systems will be implemented with the support of PMU TA.

From an environmental and social perspective, a detailed assessment of the detailed design may be required to meet Lender requirements. Additional surveys as proposed for mitigation in this ESIA Report should be undertaken to inform the detailed design. As identified in Chapter 4 of this ESIA, an EIA screening of the project should be undertaken to confirm that a national EIA is not required, given its elements of modernisation and not purely rehabilitation.

2.6.3. Construction

The initial stage of construction will involve the clearance of vegetation, fencing, removal of existing infrastructure to be replaced, where applicable, levelling of the site, and earthworks. Site access roads may need to be improved or constructed to assist the movement of heavy plant during the construction phase. Construction methods for road access and upgrades have yet to be determined as they will depend on the nature of the upgrades that are required at each site.

The sourcing of materials will be required, such as intake structures, cement, concrete, water, etc. These materials are likely to be sourced locally, nationally and internationally.

Emissions will be associated with construction vehicles and equipment such as generators.

Major waste streams will be the disposal of surplus spoil from sites where excavation is required, as well as general domestic waste from the accommodation camps including sanitary and food waste, office waste, organic material, small volumes of wastes arising from mobile plant, chiefly waste lubricating oil and packing materials (e.g. crates). Modernisation will also result in old infrastructure wastes.

The requirement for construction camps and laydown areas will be determined and the need for wastewater treatment plants will be determined. Given the short distance to Tbilisi it is not expected that workers' camps will be built for the construction staff, however, this would need to be confirmed by the Construction Contractor(s).

It is anticipated that around 75 people at any one time will be required for the construction phase, with total construction personnel not expected to exceed 300 people. For the works, it is likely that teams of 10-20 would be required for individual works. Larger numbers may be required for clearing activities.

It is anticipated that construction would take around 4 years.

2.6.4. Operation and Maintenance

During operation, activities will include the abstraction of water; water conveyance; distribution of water to and within agricultural land; control and treatment of water runoff from these areas and development of WUOs (see section 2.7.2.1 below).

2.6.4.1. Overall Management

The Project will be managed and operated by the GA. At present, the revenue to the GA comes from irrigation fees on a per area basis and an arbitrary budget allocation from GoG. The flat rate charge is GEL 75 per ha per annum.

A summary of prevailing and proposed O&M arrangements are presented in the table below. There are two sections specifically for O&M of UMC and LMC. Each section has one head and two permanent operators with an option to hire additional four temporary operators during the irrigation season.

Table 2-11. Summary of Current and Proposed O&M Arrangements

	Description	Current management responsibility	Proposed future management arrangement
1	Operational system	Continuous flow with no scheduling and water distributed on ad-hoc basis	Irrigation schedule based on rotational water distribution system as per prior identified cropping pattern
2	OMM of Sioni Reservoir and Tbilisi Sea	GA	GA
3.	OMM of UMC, LMC and LMMC	GA Service Centre for ZSIS	Prior to WUO establishment: GA Service Centre; to be transferred to / reorganised into Apex WUO organisation(s)
4	OMM of Secondary and Tertiary Distribution Systems	GA Service Centre	Prior to WUO establishment: GA Service Centre; to be transferred to / reorganised into Zonal WUOs
4.1	Head and Tail end regulator operations of UMC and LMC	Head and Tail end regulator operations by GA	Head and Tail end regulator operations by GA
4.2	Offtakes at main canals	Gate Operators mostly engaged by GA	Prior to WUO establishment: GA Service Centre; to be transferred to / reorganised into WUOs
4.3	Offtakes at secondary / tertiary canals	Gate Operators mostly engaged by GA	Prior to WUO establishment: GA Service Centre; to be transferred to / reorganised into WUO's Off-take WUGs
4.4	Gate Structure and water distribution at TUs	Gate Operators mostly engaged by GA	Members of the benefiting Water User Group (WUG) or Gate Operator engaged and paid by the Offtake WUG or TU WUG

	Description	Current management responsibility	Proposed future management arrangement
4.5	Emergency maintenance of secondary and tertiary canals	GA Service Centre	Prior to WUO establishment: GA Service Centre; to be transferred to / reorganised into Zonal WUOs
4.6	Regular maintenance of secondary and tertiary canals	GA Service Centre	Prior to WUO establishment: GA Service Centre; to be transferred to / reorganised into WUO's Offtake WUGs
4.7	OMM of TUs	Farmers but in reality very minimal activities	TU WUGs
5	Financing of OMM	Government allocation which is not based on needs nor any clear performance indicator	To be financed from irrigation fees but with initial subsidy (to be decided during implementation) which is be phased-out over 5 years
5.1	Estimated OMM Cost/hectare/annum	NA	GEL 215 (to be updated during project implementation)
5.2	Irrigation Fee/ha/annum	GEL 75	To be gradually raised

2.6.4.2. Approach to WUO Development

2.6.4.2.1. Approach to Participatory Irrigation Management (PIM)

Participatory Irrigation Management (PIM) is aimed at enhancing capacity building or local empowerment of the irrigation users and also promotes the sustainable management of irrigation systems. It requires an institutionalised arrangement by establishing a formal mechanism for interaction between farmers and the irrigation agency. This has to be done in an organised manner through the use of WUOs. Once established WUOs will discuss, negotiate, participate in decision-making and mobilise resources for O&M with powers devolved from the irrigation agency.

Major decisions regarding irrigation management can be taken by the irrigation organisation composed of farmers' representatives who should be formally elected by members on the basis of a hydrological boundary and for a definite tenure. The WUO should have the characteristics of (a) direct involvement of the irrigators, (b) effective monitoring and sanctioning, and (c) holding officials accountable. The WUO will become self-regulating, self-supporting, and self-governing on issues concerning irrigation management. The irrigation agency will play a regulatory role, and the WUO becomes responsible for all day-to-day O&M.

PIM helps in promoting self-reliance, social justice, people's organisation and capacity building on irrigation management issues.

The changes brought about by the introduction of PIM are as follows:

a. Providing a forum for defining local irrigation management problems more effectively;
b. Assisting irrigation users to access information and facilitate understanding on issues that fall outside the scientific realm;
c. Creating opportunity for identifying alternative management solutions that are economically viable, and socially acceptable to the irrigation users;
d. Creating a sense of ownership, mutual respect, individualism for planning and / or implementing the required management solutions. This will facilitate total commitment of both initiators and beneficiaries through consensual implementation;
e. Empowering farmers to share risks and uncertainties. This would accompany reallocation of power or authority to users especially when they become partners with the irrigation agency;
f. Facilitating an understanding of legal mandates through group responsibilities, thereby creating a strong and formal institutional backing for immediate action on management responsibilities.

2.6.4.2.2. Proposed Approach to the Introduction of PIM at ZSIS

In order to introduce PIM for the ZSIS it is proposed to implement a WUO Planning and Formulation (WUO-PF) TA programme at ZSIS, the main objectives of which are as follows:

a. To develop the farmer-based WUOs institutional approach, capable of managing O&M including collection of irrigation service fees and / or water tariffs to fund the work and generally managing water distribution;
a. To promote the formation and operations of WUGs;
b. To improve both the efficiency and equity of water distribution; and
c. To convert government-managed irrigation into a jointly managed scheme.

The roles and responsibilities of the WUO-PF TA should include:

a. Motivation and facilitation for formation of WUOs through building farmers' and authorities' interests in PIM;
b. Building confidence of both individuals and the group;
c. Organising and building WUG and WUO capacity;
d. Promoting gender equality;
e. Documenting and reporting;
f. Providing technical advice and direction in an informal context;
g. Assisting WUOs with modernisation works.

2.6.4.2.3. WUO Development Programme

A WUO Planning and Formation team is suggested to support GA's established WUO Support Unit by developing and managing the WUO development programme under the overall co-ordination of the PMU in Tbilisi. A PMU currently exists under the aegis of MEPA. It is currently managing IFAD, WB and ADB funded irrigation projects in the country. It is proposed that the PMU for the Project is embedded in the existing MEPA-PMU.

The team will be responsible for managing the WUO programme and hence the development of WUOs through the development phases - detailed design (if the WUO Planning and Formation team is established prior/during detailed design phase) and implementation of the works.

It is envisaged that a 30 month programme will be required to achieve sustainability and a full ToR and tender documents for implementation of the ZSIS WPF TA will be prepared during the next stage of the Project.

On completion of WUO formation, a new TA for WUO Strengthening and Sustainability Support may be contracted to support the implementation of tertiary units, irrigation management transfer to operate, maintain and manage ZSIS and strengthening of WUOs.

WUO Structure and organisation

The WUO infrastructure is envisaged to be developed for the 19,129.4 ha command area under the following four-tier structure:

- A Water User Group (WUGs) is established at the level of a TU; Preliminary the total number of TU WUGs identified is about 242;
- An Offtake WUG is formed around a separate offtake directly from the LMC, UMC and LMMC, as such the preliminary identified total number of offtake WUGs is about 50;
- A registered zonal WUO is established at a zonal level, with its envisioned irrigated area not exceeded 2,000 ha. Accordingly, in total 11 zonal WUOs are proposed:
    i. Irrigation Zone 1 – 323 ha – one zonal WUO;
    ii. Irrigation Zone 2 – 5,885.5 ha – three zonal WUOs;
    iii. Irrigation Zone 3 – 996.6 ha – one zonal WUO;
    iv. Irrigation Zone 4 – 7,955.1 ha – four zonal WUOs;
    v. Irrigation Zone 5 – 3,969.2 ha – two zonal WUOs.
- Apex WUOs with representatives from all WUOs is established at the level of a main canal; accordingly, two Apex WUOs are envisioned – one for the UMC and one for the LMC.

The zonal WUO will be responsible for overseeing all O&M activities below the main canals and collection of irrigation service fees from members for remitting into account of the General Assembly of the WUOs. The Apex WUO will be responsible for O&M of main canal in the future once the WUO institutions are well organised and trained.

Each offtake WUG and TU WUG will be developed on the basis of hydrological boundary of the SC or the TU as appropriate. Owners and/or farmers that own land, not tenants will be members of the offset WUG and TU WUG. Members must participate at group meetings, operation and maintenance activities, and relevant activities that can be resolved by participation of members in the Project.

The above numbers are only for consideration at this stage of the project, amendments may be decided by the WUO-PF TA based on other parameters such as TU and SC configurations and hydrological boundaries, distance, topography, village boundaries, farmers interest and management capacity.

The organisational structure proposed for the ZSIS O&M is presented below.

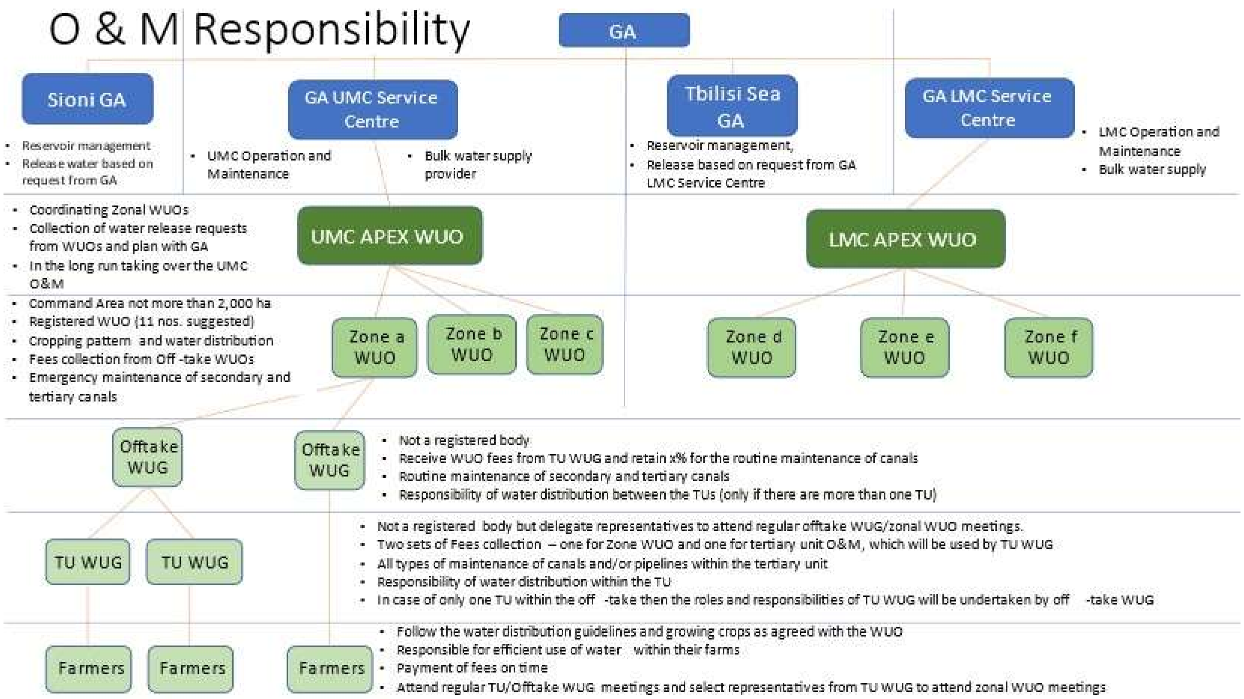


Figure 2-18. Proposed organisation structure for the O&M of ZSIS

Main Components of the WUO Planning and Formation TA

The approach of the WUO-PF TA should be based on participatory development techniques to ensure rapid sensitisation of the farming community. The emphasis of the WUO-PF TA will essentially be upon supporting the GA WUO Support Unit and specially-trained community liaison specialists, to provide them with the support necessary to achieve their main goal – the development of a sustainable WUO infrastructure.

The GA, MEPA and GOG will be required to actively support the sub-project(s) of the WUO-PF TA through close cooperation and involvement of traditional leaders and encouragement of farmers. Municipal Governments may also be required to periodically promulgate additional legislation specifically designed to recognise participatory irrigation management and WUO roles and responsibilities.

Land registration and ownership mapping should form part of the sub-project so that membership can be fully documented and details of hydrological boundaries can be assessed in relation to land ownership. The approach would be to use community organisation activities to gradually develop ownership mapping for the whole of ZSIS during the two-year tenure of the sub-project. The mapping should be GIS based using hand held GPS's for identifying plot boundaries supported by any relevant web-based remote sensing that can be used.

The main components of the sub-project(s) will therefore be:

- Training of staff and field facilitators of the WUO Support Unit of GA;
- Development of a detailed understanding of ZSIS system design (from main canals to TUs and WUG configuration) and performance, and its impact on farmers grouped in WUG and WUOs situated in different parts of the scheme;
- Formation and development of WUO institutions (apex WUOs, zonal WUOs, offtake WUGs, TU WUGs);
- Training of farmers and WUO administrators in irrigation O&M, management of accounts, dispute resolution and so on;

- Development of extension messages for farmers; and
- Participatory land ownership mapping.

WUO Development Strategy

The WUO Development activity will be based on community-driven approach with strong emphasis on users' participation in O&M, and, if possible, contributing to the infrastructure capital investment. Farmers will be organized into WUGs that will be guided through an intensive process of group formation and decision making using a range of participative techniques. Workshops will be provided to help in achieving the desired results through intensive awareness presentation.

WUO Training Strategy

A WUO training strategy will be implemented in six stages (a) conceptual design, formulation and inception; (b) preparation - prior to WUO formation; (c) WUO formation - establishment; (d) WUO formation -operation (single-purpose); (e) WUO formalisation; and (f) WUO multi-purpose. The strategy is based on a participatory approach.

Intensive capacity building will be encouraged through training and retraining in various areas of decentralizing O&M activities, user mobilization and organizing water users' into adopting a community-driven approach. Farmers' skills will be developed to ensure change in the mode of management, in the relationship with agency staff, and in believing that the project is theirs. They will be trained in revenue generation and conflict management for project productivity including sharing of responsibilities at various levels.

Staffing Approach

During field visits and agricultural survey, farmers have identified substantial support needs beyond those directly related to irrigation operation and maintenance.

The WUO-PF TA essentially engages facilitators from a variety of technical backgrounds which across the group will cover all the areas in which farmers need assistance. The 2022 FS therefore proposes a variety of technical specialists who can be called upon to provide extension messages which can be delivered direct to farmers but reinforced by the either PMU or GA's WUO Support Unit or by WUO-PF TA directly. A training specialist will ensure that the training delivered is compatible with farmers' needs using a consistent approach to maximising returns to water and other inputs. Training can be delivered initially by the training specialist but it would be expected that the field staff would be trained by the relevant training specialist so that they can deliver both the basic training as well as the follow up support. Training can be expected to take place in community buildings.

2.6.4.3. General Operation and Maintenance Requirements

The main objectives of the operation and maintenance of a large irrigation scheme are to:

- Distribute the available water equitably and timely to the farmers and at the same time ensuring maximum production with less water; and
- Maintain the system to enable the distribution system function effectively.

The main requirements to achieve the above objectives are:

- A hydrologic model to plan the cropping pattern;
- Well-developed operational procedures;
- A functioning control and monitoring system;
- A well-maintained water distribution system; and
- Well-trained and coordinated system operators, in GA as well as WUOs.

Maintenance will include activities such as clearing and maintaining water distribution and storage systems and servicing mechanical components. The main wastes during operation will be associated with maintenance activities; no other regular wastes are envisaged.

A O&M manual to cover the above objectives and requirements is proposed to be developed as part of PMU Technical Assistance.

2.6.4.4. Irrigation Duration, Cycle and Interval

The original UMC and LMC of the ZSIS was designed for 24-hour continuous flow with control at the head end of the system. The secondary distribution network was also designed for 24-hour irrigation. Only below the secondary distribution network, water is distributed to the fields within TUs, in cycles[35]. Based on interaction with the GA service centre and some farmers, it is proposed to continue to use the same six-days irrigation cycle of seven-day interval as the basis for design, with rotation within TUs. The design will also assume different rest days for different units so that the secondary and main canals flow continuously, throughout the week despite the six-day cycle, seven-day interval for each block within the TUs.

2.6.4.5. Peak Design Flows

The irrigation season in Georgia is mainly between April and September. The peak requirement is in July. The peak water demand calculation takes into consideration cultivated crops, soil types, topography, irrigation methods and climate conditions. The peak design flows calculation varies for main, secondary and tertiary canals. The peak design flow calculations for typical tertiary unit canals are presented in Section **Error! Reference source not found.** of CDR. The secondary distribution canals are designed as a cumulative water demand at various nodes and the same will be followed for the main canals. Most of the main canals are designed and constructed as well as in rather good technical condition, and therefore it is not suggested to make any changes to the maximum carrying capacity of the main canals.

2.6.4.6. On Farm Development

Farmers are expected to develop their field with their own funds. The farm level investment costs for various systems are as follows:

- Furrow irrigation (including hired workers) is 1000 GEL per ha;
- Pivot systems for large scale (25 ha to 100 ha) farms is GEL 7,000 per ha;
- Sprinkler irrigation systems for small farms is GEL 8,000 per ha;
- Drip irrigation for walnut trees is around GEL 3,500 per ha, GEL 4,500-5,00 per ha for almonds, GEL 6,000 – 6,500 per ha for vegetables, and GEL 5,500-6,000 per ha for raspberry;
- Cost of establishment of heated greenhouse is 80 – 120 GEL/m^2; and
- Cost of establishment of greenhouse without heating system is 50-60 GEL/m^2.

In addition to strengthen on-farm agricultural production, a targeted Agricultural Production Support (APS) activities are suggested, to support farmers and farmers' organizations in strengthening their production systems. APS activities may focus on strengthening knowledge and practical capacities on best practices for (i) surface irrigation (land levelling, furrow preparation, irrigation scheduling, crop water requirements, etc.); (ii) pressurized irrigation approaches (drip, sprinklers technologies); (iii) smart farming solutions, using digital data technologies (remote and ground-based sensors for weather, soil water, soil carbon, etc. monitoring); and (iv) Integrated Farm Management (IFM), promoting the adaptive management of e.g. soil fertility, crop and animal health, pollution control, water and energy efficiency, etc. to achieve more cost-effective farming with a higher productivity and a lower environmental impact.

APS activities are envisioned to be implemented by state organizations with designated responsibilities for providing agricultural extension services to farmers, like the Agriculture and Rural Development Agency (ARDA) or the Information and Consultation Centres, both under the MEPA. Alternatively, or in parallel, support to the APS activities could be provided by dedicated NGOs with specific relevant knowledge and hands-on experiences, like the Georgian Farmers Association.

2.6.5. Decommissioning

The proposed Project will have a lifespan of around 30 years. There is currently no agreement in place which defines what will happen to the facility at the end of its lifecycle but it is anticipated that the Project will be rehabilitated as appropriate.

[35] Depending on the soil type, topography/slopes, etc., tertiary canals of the secondary distribution system (e.g. UMC-G5-1) will be designed either as open canals or closed pipeline. The specific choices will be determined during the detailed design stage.

3. Analysis of Alternatives

3.1. Introduction

The analysis of alternatives helps identify the most appropriate method of developing a project and can help identify the option(s) with the least environmental and social impacts.

Alternatives include consideration of different means to meet the purpose and requirements of project activities, and may include alternatives to:

- The type of activity to be undertaken – this requires a change in the nature of the proposed activity; this includes the ‘do nothing’ or ‘no project’ option i.e. the option of not implementing the activity;
- The site location – alternative locations for the entire project proposal, or for components of the project proposal; and
- The process and operational aspects of the activity – also referred to as technological or equipment alternatives.
- The main alternatives in the context of this Project are considered below.

No pumped irrigation will be included in the investment project and therefore alternatives for power related to irrigation are not discussed below.

3.2. Project Alternatives

3.2.1. The ‘No Project’ Alternative

The ‘no project’ alternative considers the outcomes should the Project not go ahead.

The ‘no project’ alternative would mean a continuation of existing operations, whereby less than 7,000 ha (6,404 ha and 5,320 ha in 2020 and 2021, respectively) of the original 30,000 ha command area are currently irrigated.

The current poor condition of irrigation structures leads to high water losses and water shortages are reported by all farmers. This situation will likely be exacerbated over time given the risk of water shortage as a result of climate change.

Overall, the ‘no project’ alternative would result in a reduction - over time - of the existing irrigated areas and, therefore, in a reduction of agricultural output and contribution to subsistence, local, regional and national economy. It would also mean that Georgia would remain a net importer of food, making it less resilient to external shocks. This option would not meet the objectives of the GoG to (i) modernise the Zemo Samgori irrigation scheme to respond to the irrigation service needs of current agricultural producers; and (ii) to increase the resource efficient production of quality agricultural produce, thus increasing availability and access to food by local populations and increasing the competitiveness of Georgian produce.

3.2.2. Alternative Water Options

Possibilities of alternative water usage were considered in the 2018 FS and 2022 FS to determine whether the objectives of the Project could be met by alternative means. This included consideration of the following:

3.2.2.1. Surface Water

Georgia has extensive surface water resources however challenges include connecting the resource to the areas suitable for agricultural use; and the potential impact of climate change on availability of the resource. The command area that is irrigated currently receives water from the Iori river in the upper area and the Tbilisi Sea in the lower area. Given that the system was developed to utilise surface water, this is considered the preferred water resource option for the Project; however, the purpose of the Project is to determine the amount of surface water available to be viable, now and in the future.

3.2.2.2. Groundwater Use

Groundwater is a potential alternative instead of surface water. Known resources in the Study Area include groundwater from modern alluvial sediments of the River Aragvi floodplain terraces. Groundwater is not well developed, with the single exception of two centre-pivot schemes 8 km southeast of Akhali Samgori.

Groundwater is mainly used for drinking water supply and therefore its use for irrigation as well could only be justified if there were either untapped reserves and/or the rate of groundwater recharge was sufficient to meet demand. As the majority of deep groundwater has increased mineralization, it would also risk contributing to soil salinization.

To use groundwater supplies, pumping systems would be required to extract the water which entails significant cost. For this reason, this does not meet the objectives of the project and therefore has not been considered further.

Overall, groundwater was not considered as a viable option to surface water resources due to concerns over water quality and additional specific studies that would be required to assess groundwater availability, which currently is prioritised for drinking water supply.

3.2.2.3. Water Use Efficiency

The use of water efficient methods in agriculture could be used to reduce inefficient use of water and therefore decrease demand for current irrigated lands and enable larger areas of land to be irrigated. However, overall, the volume of water saved by these methods is unlikely to be able to deliver a project of the size proposed. The implementation of such methods is also likely to increase the cost of the water supplied and may therefore become unaffordable to farmers. On its own, it is not considered that water efficiency measures would provide sufficient water to expand the irrigable lands proposed by the Project. However, the Project does propose implementation of water use efficiency measures to maximise the benefits of the Project.

3.2.2.4. Treated Water Use

Treated wastewater can also be considered as an alternative irrigation solution. However, given the low level of sewage in the country, it is unlikely that this would provide sufficient water. Furthermore, sewage that is discharged is often done without the required level of treatment and therefore would require potentially significant infrastructure investment. Finally, legislative structures would need to be in place to support the use of treated water in agriculture.

3.2.3. Analysis of Site Locations

The location of the Project has been driven by the existence of the ZSIS since the 1960s. Utilising the existing command area is therefore the preferred option. The ZSIS is one of the larger irrigation areas in the country and, as it is close to Tbilisi, offers the biggest opportunity to increase crop production within Georgia.

For this reason, the existing ZSIS and its existing command area has been chosen for development.

3.2.4. Analysis of Design Options

The 2022 FS has sought to identify the area available and associated design of the Project on the basis of the available water. This analysis has been initiated following concerns over available water for the area proposed for irrigation in the 2018 FS.

Three alternatives were considered in the Eptisa 2018 FS and reported in the Eptisa 2018 ESIA, as follows:

- **Alternative 1:** The “general modernisation” which aimed at the provision of irrigation water with traditional irrigation methods to the whole irrigation area but, as there is insufficient water to irrigate the whole area, farmers could irrigate only 70% (17,800 ha) of their plots.
- **Alternative 2:** The “least cost alternative” with a proposed project area rounded to 18,000 ha which aimed at limiting investments to the areas for which there is sufficient water applying traditional irrigation methods for the expected preferred cropping pattern, excluding areas which require high investments for the modernisation. Areas such as downstream of the Norio siphon on the LMC would be excluded. It was considered socially unacceptable but served the purpose of demonstrating the impact on project profitability.
- **Alternative 3:** The “highest efficiency alternative”. Under this alternative, the transition would be made towards modern irrigation techniques through gravity pressurized systems where possible and buried pipe systems replace the concrete canals and gutters of Alternative 1. Water would be used more economically, and this would allow irrigation to the entire area of the scheme. 25,836 ha would be irrigated.

A detailed analysis of these options is presented in the Eptisa 2018 ESIA. In summary, the previous study concluded that:

Alternative 1 allows farmers to irrigate using surface irrigation methods which do not require much on-farm investment. For farmers who have no other activities it allows them to use idle time for productive purposes and to generate income. It allows farmers to profit from wetter years when more water is available, and less irrigation is needed but they may have to accept deficit irrigation in drier years. The alternative would however have high maintenance costs as relatively longer canals have to be maintained per unit productive area. There is insufficient water for a full irrigation of this whole area, with water being available to irrigate 17,800 ha only if the expected cropping patterns were applied.

Alternative 2 aims at restoring the functionality of the system but only in areas where there is sufficient water for surface irrigation methods. 30% of the net irrigation area could not be cropped due to the total absence of irrigation water and would end up under permanent fallow. The advantage of alternative 2 is that minimal infrastructure is required to use all the available water and it requires the use of traditional methods with little on farm investment. This results in a more efficient water use than under alternative 1 as there are less canals, less structures and less farmers and less hectares. This alternative allows farmers of rehabilitated area to produce crops with the least on-farm investment, thus allowing them to use their available time for irrigated crop production, the irrigation ensuring that they get a harvest each time. Farmers of the excluded areas would be left without water. However, Alternative 2 was the least acceptable of the alternatives for the stakeholders.

Alternative 3 was aimed at the highest water efficiency, obtained by adapting the proposed irrigation system to the local conditions. Under this alternative, the farmers must invest in irrigation equipment. It would be up to landowners to decide whether they want to get involved in crop production or not. Some additional measures are required such as: a mixed cropping pattern (not one single crop with high water demand occupying the irrigation area), wind breaks. The 2018 FS identified that the main concern to address is whether the water source is sufficient. Whether there is enough water or not depends on which crops the farmers will grow and how they will grow them. Overall, it was determined that Alternative 3 has an advantage with lesser investment per ha and maintenance costs at tertiary level but requires substantial on-farm investment which can only be justified if the farmers engage in high-value crops with high-input cultivation practices and proper outlets to the value chains.

Alternative 3 was considered as the preferred option in the 2018 FS. The reasons were that piped systems with filters offer many advantages over open canals systems. The majority of the stakeholders were also reported to have opted for this option, but concerns were expressed by smallholders regarding the financing of the on-farm systems.

Following a review of the 2018 FS, concerns were raised about the availability of water for the proposed alternatives. The current study was therefore commissioned to review this in further detail. In terms of the aims of the 2022 FS, Alternative 3 discussed above is similar to the 2022 FS approach, in that the preferred design options were to provide modernised system with greater efficiencies. However, the key approach to the 2022 FS has been to identify the preferred design through consideration of a number of key constraints, rather than compare various alternatives.

Within the ZSIS, as part of the 2022 FS an analysis was undertaken of the available command area using GIS. Details on the suitability of land within the command area is presented in detail in the 2022 FS and is summarised in section 2.5.3 of this report. Following consideration of land in use for wind breaks and roads, currently non-registered lands, and build-up areas in villages, of industrial complexes and commercial enterprises as well as lands currently undergoing or planned to undergo urban development, etc. a total area of 19,129.4 ha was estimated as available for agriculture inside the 2018 ZSIS command area, as presented in Figure 2-16. This is compared to the 25,836 ha in the preferred Alternative 3 put forward in the 2018 FS, for which it is not considered there is sufficient suitable land. The main area that would be excluded in the current study is the area beyond the village of Martkopi (Irrigation zone 6) which covers an area of (2,114.8 ha), though 0 ha are assessed as potential irrigable area.

Taking into account that, of the land potentially available for agriculture, an estimated 10% is considered to be annually left fallow, a corrective annual command area for crop production of 17,216.4 ha has been taken forward in the 2022 FS. Details on the analysis of the availability of water are presented in detail in the FS and are summarised in section 6.7 of this report. The water balance study showed that the carrying capacity of the UMC is adequate to meet the ZSIS irrigation demand for agricultural production in 17,216.4 ha net annual potential irrigated area but only if the Tbilisi Sea serves as an intermediary storage basin to ensure that i both the peak demand for irrigation water in the UMC and LMC during June-August can be met in parallel and also adopted water saving techniques at the farm level.

The preferred Project design within the command area has therefore been determined on the basis of the above analysis. Specific alternatives will be determined at an onfarm level, which will be determined by each farmer with support from a targeted Agricultural Production Support (APS) TA. Options include:

- Furrow irrigation;
- Pivot systems for large scale;

- Sprinkler irrigation systems for small farms;
- Drip irrigation for walnut trees, almonds, vegetables, and raspberry;
- Heated greenhouses; and
- Greenhouse without heating systems.

3.2.5. Alternative Organisational Structures

The 2018 FS proposed that the main canals would be operated by GA while the secondary units would be operated by WUOs, and the tertiary and quaternary units would be operated by the farmers group of the tertiary unit. 24 WUOs were proposed.

The 2022 FS proposes two apex WUOs established at the level of a main canal, then 11 WUOs established at a zonal level, around 50 WUGs established around a separate offtake directly from the LMC, UMC or LMMC, and around 242 WUGs established at the level of a TU.

This seemingly more complicated structure has been proposed as it enables a PIM approach at different levels of farmer access, based on hydrologic boundaries. It enables O&M to be implemented through various hierarchical WUOs. The proposal comprises around 11 registered WUOs, the remainder would not be registered but would be part of the WUOs to undertake specific activities.

This will however be developed further under the guidance of the proposed WUO Planning and Formation (WUO-PF) TA programme.

3.2.6. Process and Operational Alternatives

The process and operational alternatives looks at the technological or equipment alternatives. These options are discussed below and as the Project moves forward, a number of these options may be employed as relevant to maximise the benefits of the Project.

3.2.6.1. Irrigation Methods

The traditional, and still most common, irrigation method in the command area is gravity furrow and flood irrigation, with in recent years also farmers investing in drip and sprinkler irrigation systems. The main advantage of furrow irrigation is the absence of electricity (or fuel) consumption for water supply. However, with furrow irrigation soil erosion can be significant.

Surface irrigation methods such as furrow irrigation and flooding require labour throughout the season and the skill to evenly distribute water over the plot. Control over flooding is often limited and may result in erosion. Furrow irrigation is the cheapest.

Centre pivot systems allow a prescribed volume of water to be applied that matches crop water requirements. Reported application efficiencies for new well designed machines are generally in the 80-95% range, compared to 50-90% for surface irrigation systems. Labour requirements are generally lower than surface irrigation but depends on the system and/or the degree of automation of the machine. However, the systems have a relatively high capital cost compared to surface irrigation systems and they require some form of energy source.

Sprinkler irrigation systems allow application of water under high pressure with the help of a pump. They can be suitable for undulating lands and lack of water availability. They can eliminate water conveyance channels, thereby reducing conveyance loss, provide water efficiencies up to 30% - 50% and reduce labour costs. Sprinkler irrigation systems are the costliest.

Drip irrigation systems can be complex to install, advantages are that it allows more topical water provision and water efficiencies (drip irrigation in comparison to other conventional methods of watering, for instance, sprinklers, make use of 30% to 50% less water), and is less labour is required. Drip irrigation does not expose a large area of the soil surface to water and therefore, soil erosion can be minimised. Costs will depend on the crop but are more expensive than furrow systems.

Ultimately, farmers are expected to develop their field with their own funds.

3.2.6.2. Water Management Techniques

Water management techniques including field water distribution system, irrigation turns, outlets, drainage system improvement and return water management. It is likely that a range of soil management techniques will be required. For example, sprinkling and drip methods are optimal in cases of water shortage. If there is enough water, and it is cheap, then a furrows method can be used.

3.2.6.3. Crops

The current irrigated area is dominated by maize production (53%) followed by alfalfa (20%). Maize production is prevalent in Zones 1 and 2, while both maize and alfalfa are the main crops in Zones 3 and 4. Berries, grapes and fruit/nut trees are also grown, particularly in Zones 2, 3 and 4, while grassland (mainly partially irrigated) accounts for 80% of the cropped area in Zone 5 where water shortages are widespread. Based on interviews with small and large farmers, with regard to the future 'with project' cropping patterns, it is anticipated that there would be a significant increase in the area of fruit and nut trees due to the easy application of modern technologies, market availability, profitability (higher market prices and increasing availability of storage and processing facilities. Furthermore, increases in the proportion of maize (from 53% to 55%) and berries (from 5% to 8%) are anticipated, but the proportions of alfalfa and grass within the overall cropping patterns are expected to fall.

3.2.6.4. Crop Management Techniques

Crop management techniques include selection of crop varieties in relation to soil suitability, climate conditions, and water availability prior to the cropping season, market availability and further value chain development to increase the indirect benefits of the agricultural activities induced by the irrigation facilities. These techniques should be applied to maximise water efficiencies.

Crops that require less water include:

- Amongst the annual crops, maize requires most water while winter cereals require no irrigation at all in average to wet years so cropping pattern with more cereals will require less water. There are however economic reasons and marketing reasons why maize is more interesting.
- Some farmers grow a perennial protein crop which has deep roots that do not need much irrigation, called Sainfoin or locally known as epsarcet. Substituting alfalfa for this crop will reduce the demand for water for farmers with deep soils.
- Perennial crops require more water than annual crops and it was determined that a cropping pattern which would only consist of fruit trees, it would require about 17% more water than required for the typical cropping pattern of small holders.
- In the case of fruit trees and grapes, preventing the establishment of the grass cover will reduce the water requirement in the order of 20-25% depending on conditions.

3.2.6.5. Soil Management Techniques

Soil management techniques include measures to reduce deep percolation losses, reducing evaporation losses through soil mulching and practicing conservation agriculture to reduce soil and nutrient erosion. It is likely that a range of soil management techniques will be required.

4. Institutional, Policy and Legal Framework

4.1. Introduction

The EIB Environmental and Social Standards require that projects comply with all national legislation and international conventions and agreements ratified by the host Country, as well as with the provisions of the following treaties and conventions:

- UN ECE Aarhus Convention, with the requirements related to access to information, public participation in decision-making and access to justice in environmental matters;
- United Nations Convention on Biological Diversity focusing on the assessment of the significant adverse effects of projects on biological diversity, contributing to attaining the EU objective set in the Biodiversity Strategy of halting biodiversity loss and the degradation of ecosystem services by 2020 and restoring them where feasible;
- United Nation Framework Convention on Climate Change and its UNFCCC's Kyoto Protocol and EC Policy on Climate change addressing both mitigation and adaptation responses; and
- United Nations Hyogo Framework for Action Programme (2005-2015) and the Community approach on the prevention of natural and man-made disasters which stresses the need to put in place procedures for assessment of the disaster risk implications of major infrastructure projects.
- The relevant national and EIB requirements are set out below.

4.2. National Framework

4.2.1. Environmental and Social Institutional Framework

The key government organisations in relation to the environmental and social aspects of the Project are as follows:

Ministries

4.2.1.1. Ministry of Environmental Protection and Agriculture

The Ministry of Environment Protection and Agriculture (MEPA) is the main institution that is in charge of issues related to environmental protection, the use of national resources (except for minerals, oil and gas) and agricultural development. MEPA also plays a major role in issuing and enforcing the environmental permits, implementing state control functions, performing environmental monitoring, raising public awareness and training its staff and disseminating environmental information. These functions are implemented through the subordinated structural units, subordinated entities and Legal Entities of Public Law (LEPL).

The ***Environmental Assessment Department*** executes procedures related to the Environmental Impact Assessment (EIA) and Strategic Environmental Assessment (SEA) (see section 4.2.3).

4.2.1.2. Ministry of Regional Development and Infrastructure

The Ministry of Regional Development and Infrastructure (MRDI) has a complex set of responsibilities that, amongst others, include the responsibility for developing necessary infrastructure for drinking water supply to all settlements in Georgia. Provision of drinking water supply service in some cases involves the intake of water from water reservoirs. All matters related to provision of drinking water to settlements is handled by the LLC "United Water Supply Company of Georgia" (UWSCG) with 100% of shares owned by the state. The Company provides water supply and sanitation services to urban-type settlements throughout the country, except for Tbilisi, Mtskheta, Rustavi, Gardabani Municipality, and Adjara Autonomous Republic.

Under the MRDI operates the ***Municipal Development Fund***, which channels both public and donor funds for the investments in the local infrastructure and services, including projects related to drinking water supply.

4.2.1.3. Ministry of Culture, Sports and Youth of Georgia

The Ministry of Culture, Sports and Youth, amongst other responsibilities, is in charge of the conservation/ restoration of tangible and intangible cultural heritage, immovable and movable cultural monuments and objects of cultural heritage and other cultural values; it is responsible for supervising the construction activities to protect archaeological heritage. If construction is to be carried out in historic sites or zones of cultural heritage, consent of the Ministry is required before issue of a construction permit. If during construction artefacts of a potential archaeological value has been found, the project proponent shall contact the Ministry and seek guidance on the course of action. All action has to be put on hold until direction from the Ministry is formally issued. The project proponent is obligated to allow sufficient time and provide favourable conditions for undertaking works necessary for excavation, removal of artefacts from the site, and conservation. Works may resume only upon formal consent of the Ministry. In rare cases, the Ministry may require changes in the project design to bypass the site of exceptional importance and historical value.

4.2.1.4. The Ministry of Internally Displaced Persons from the Occupied Territories, Labour, Health and Social Affairs

This Ministry establishes environmental quality standards, including those for drinking water, bathing water groundwater and coastal waters.

National Agencies

4.2.1.5. National Environmental Agency (NEA)

The National Environmental Agency (NEA) is the main state institution that is in charge of organizing and carrying out environmental monitoring, including the observation and analysis of the qualitative and quantitative state of water resources of Georgia. This function for surface waters, which is the main focus of the current study, is carried out by: the Hydro-metrology Department and the Environmental Pollution and Monitoring Department. The Hydro-meteorology Department carries out the observation of hydrological parameters of water bodies, glacial and marine processes, as well as short-, medium- and long-term forecasting; processes hydro-meteorological data and transposes information in the GIS format, develops hydrological cadastre.

Historically Georgia had 149 hydrological monitoring stations, part of which became obsolete and damaged during the economic recession of the 1990s. Currently the hydrological observation network consists of 54 hydrological stations. Observation stations measure mainly water level, flow and discharge. Some stations also monitor snow parameters and precipitation. The majority of stations are automatic and have been equipped with automatic observation systems that send the data via GSM. With the support of funding from the Green Climate Fund the hydrological monitoring network will be further extended and improved by 2027.

By the end of 2020, surface water quality monitoring was carried out at 176 monitoring points in 94 rivers and 47 groundwater wells. This is carried out by the Environmental Pollution and Monitoring Department. Water quality assessment looks at the basic physicochemical parameters, nutrients, heavy metals, oil products, pesticides, detergents and several specific organic compounds macroinvertebrates, microbiological parameters. After the drastic reduction of monitoring points in 1990s, the number of quality monitoring points is bouncing back; during 2013-2020 the number of monitoring points of surface water increased fourfold.

4.2.1.6. The National Agency for Public Registry (NAPR)

The National Agency for Public Registry (NAPR) registers all legal entities in Georgia. This includes government and non-government bodies (including the private sector). The agency is responsible for geodesic surveys, topographic mapping, cadastre, land registration, and the National Spatial Data Infrastructure. The main goal of the NAPR is to establish a unified, modern, and customer-oriented public registry; to ensure transparency of registration and protection against conflict of interests.

4.2.1.7. Environmental Information and Education Centre

The Environmental Information and Education Centre (EIEC), that is a legal entity under public law (LEPL) and operates under the MEPA, is a key state institution that facilitates the public hearings on environmental legislation and state policies/programmes. The Centre has the Information Technology Unit that develops a common centralized database of the MEPA and facilitates the implementation of respective reporting. The Centre also implements activities focusing on environmental awareness raising and capacity building of the staff of MEPA and other state institutions.

Municipalities

The municipalities are in charge of spatial and territorial planning of the municipality and approving urban planning documents, including the general plan of land use. They issue construction permits for small scale infrastructure projects. Municipalities are also authorised to exercise control over construction works. Municipalities are mandated to manage public property and natural resources (e.g., land and forest) owned by them. In some cases, they are responsible for water supply (including technical water supply) and provision of a sewerage system, development of the local melioration system. Local municipalities will play an important role is designating and allocating sites for the arrangement of construction camps and will have crucial function in the grievance redress mechanism, functioning as interlocutors between local communities, construction contractor, technical supervisor and the GA.

4.2.1.8. Tbilisi Transport and Urban Development Agency

The Transport and Urban Development Agency (TUDA) is a Legal Entity under Public Law of Tbilisi municipality. The TUDA defines and implements the capital's transport and urban policy, conducts relevant research and analytical activities, and manages public transport processes within the administrative-territorial boundaries of Tbilisi. In respect to urban development the Agency is responsible for the management and control of urban development processes; it prepares draft decisions and conclusions concerning the approval of urban planning/construction documents; carries out planning activities; facilitates development of the land use master plan and its implementation; facilitates the development of areas; updates GIS databases and implements related measures; prepares an urban planning position regarding the management of Tbilisi-owned property; and participates in decision making on issues conserving the change of functional zone and special zonal agreement.

4.2.2. Key National Policies and Strategies

The following environmental and social policies and strategies are relevant to the Project:

Environmental and Social

4.2.2.1. 2030 Climate Change Strategy

Georgia’s 2030 Climate Change Strategy was adopted in 2021. It encourages the development of climate-smart agriculture to address UN Sustainable goals. The strategy considers regulating irrigation practices a priority direction as there is an absence of quality requirements for irrigation water in Georgia. Further, a significant amount of irrigation water is lost during transportation via old or malfunctioning ditches and channels. Therefore, future action focuses on the improvement of transportation channels and regulating the use of irrigation water. For this direction, Georgia seeks and relies on international support.

4.2.2.2. Environmental Protection and Rural Development – 2030

Key objectives of this strategic document are self-sufficiency ratio enhancement for food safety; environmental and natural resources protection; ensuring sustainable development; fostering greater utilization of export potential for Georgia’s agro-production; and development of crucial institutional capacity for enhancing sustainable and competitive agriculture. Hydro-amelioration is considered to be an infrastructural enhancement.[36]

Water Resources Policies and Strategies

4.2.2.3. Agriculture and Rural Development Strategy of Georgia 2021 – 2027

The Agriculture and Rural Development Strategy is a national sectoral strategy. Its main goals are competitive agricultural and non-agricultural sectors, sustainable use of natural resources, retaining the ecosystem, adaptation to climate change, effective food/feed safety systems, and veterinary and plant protection. In addition, the strategy aims to make agriculture, forestry and fisheries more productive and sustainable. To this end, it is planning to disseminate climate-smart and environmentally adapted agricultural practices; to support the development of ecotourism; sustainable usage of forest resources; to support the implementation of energy-efficient and renewable energy technologies and practices, and to maintain agro-biodiversity. The responsible agency for strategy implementation is the MEPA.

Strategy goals are:

1. Competitive agricultural and non-agricultural sectors;
2. Sustainable usage of natural resources, retaining the ecosystem, adaptation to climate change;
3. Effective systems of food/feed safety, veterinary and plant protection.

One of the objectives of the strategy is to improve irrigation and drainage systems. It’s planned that from 2021 to 2023, MEPA and GA will rehabilitate amelioration systems and purchase the equipment to increase the area of the regularly irrigated land. In addition, mentioned entities will develop a digital database of water resources users, which will support around 108,000 users until 2023.

[36] Strategic documents | Ministry of Environmental Protection and Agriculture of Georgia (mepa.gov.ge)

4.2.2.4. Irrigation Strategy for Georgia 2017-2025 developed

This strategy, developed with the support of the Water Partnership Program and World Bank's "Georgia Irrigation and Land Market Development Project" funding, intends to guide irrigation development and management in Georgia for the coming ten years. It encompasses both the modernisation of decayed irrigation infrastructure and the development of a modern data-based professional and participatory irrigation management capacity.

According to the strategy, Georgia will equip 200,000 ha of land for irrigation by 2025, increasing around 112,000 ha over 2015 levels. Most of the increase will result from the modernisation of existing gravity irrigation schemes. The considerable unexploited potential of groundwater will be studied, and measures devised to enhance private groundwater development for irrigation, particularly in conjunction with drip irrigation technology, which is expected to expand to cover as much as 10% of irrigated area by 2025. GA will evaluate and prioritise more than 100 potential projects on hydrologic, economic, and financial grounds, creating a high-quality list of prequalified projects for possible financing. The estimated $361 million required for the modernisation work will come from funds allocated by GoG and international assistance agencies. Modernisation investments to improve system management will target improved water measurement systems, control structures, and upgraded management information systems. A new unit will be established to mobilise farmers and facilitate consultation and dialogue. Local level modernisation design will be conducted in close cooperation with farmers, with WUO development proceeding in tandem with the modernisation process.

Agricultural lands to be irrigated after modernisation of the ZSIS are located in the Gardabani Municipality (Kvemo Kartli Region) and Tbilisi municipality.

4.2.2.5. Kvemo Kartli Regional Development Strategy (2014-2021)

The strategy, adopted by the Government of Georgia in 2013 (Decree of GoG#1365, dated September 17, 2013) considers the agriculture sector as one of the crucial parts of the economy of Kvemo Kartli, contributing 19% to the added value generated in the region. The climate is especially favourable for agricultural production. Harvest can be 2-3 times a year, leading to Kvemo Kartli's highly competitiveness compared to other regions. Proximity to the capital city Tbilisi and neighbouring countries creates a favourable environment for agricultural markets. However, lack of agricultural machinery and irrigation system disorders prevents land cultivation. Internal irrigation systems are damaged and require serious repair in the whole region. Consequently, one of the strategic objectives is to support the development of the agriculture sector through the modernisation of irrigation systems.

4.2.2.6. Tbilisi Land Use Master Plan

The Tbilisi Land Use Master Plan[37] is an urban planning document that defines the main parameters of land use and development, spatial and territorial conditions for the protection of the environment and immovable cultural heritage, spatial aspects of transport, engineering and social infrastructure and economic development, as well as territorial distribution issues.

The Tbilisi Land Use Master Plan takes into account the country's social and economic development trends. Specifically, regional development is regarded as an essential and irreversible process. According to the Master Plan, the development of the country's territories will lead to territorial decentralization of production, increase of local employment and stabilization of housing conditions in Tbilisi. In the foreseeable future, a significant increase in the population of Tbilisi Municipality and its agglomeration is not expected.

The Tbilisi Land Use Master Plan is based on the following conceptual ideas: compact city; green city; well-connected city; and resilient city. Functional zoning defines the priority functions of the territories of the capital and sets the directions for their development. Structural zoning reflects the different areas of concentration of interests in the city. Restricted zones, layers and contours represent an unavoidable obstacle to the development of the area. The development contour envisaged by the Master Plan is the boundary between the developed and non-developed areas in the city and is defined as a direct condition for limiting the urban construction development in the areas outside of it.

Further, the Tbilisi Land Use Master Plan provides a framework for development of residential areas, public-business areas and industrial areas, social-economic development, protection and development of the natural environment and the landscapes, historic and cultural heritage, transport, engineering infrastructure, water supply and wastewater collection, stormwater drainage, power supply, communication, internet and natural gas supply.

[37] Approved by Tbilisi Municipality Council Resolution #39-18 of 15 March 2019

4.2.2.7. River Basin Management Plans

The new draft Law on Water Resources Management assigns the MEPA the responsibility to introduce and implement River Basin Management Systems in the country that among other requirements, envisages the development and implementation of River Basin Management Plans (RBMPs). With the support of donor organizations, draft RBMPs have been prepared for several river basins, that will be approved by the Ministry once the Law is adopted. RBMPs have been developed for three out of six basin districts – including *the* Alazani/Iori river basin, where the large part of the ZSIS is located. No RBMP is available for the Mtkvari (Kura) Basin District, under which falls part of the ZSIS. It is important to note that the draft Alazani/Iori RBMP includes measures to be implemented on both the ZSIS and KSIS.

4.2.2.8. Gender

The GoG has adopted instruments that include aspects related to gender equality, such as the 2014-2020 Human Rights Strategy and the short-term Action Plans (HR SAP) for the periods 2014-2016, 2016-2017 and 2018- 2020. The 2018-2020 NAP was developed by the Inter-Agency Commission on Gender Equality, Violence against Women and Domestic Violence, a commission formed as a result of the 2016-2017 NAP[38]. This NAP focuses aspects related to sexual orientation and gender identity (SOGI) and it is aimed at combating hate-motivated crimes and awareness raising.

There are also relevant international instruments in place such as: 1) the Beijing Declaration and Platform for Action (BPfA), adopted by UN Member States in 1995, which defines areas of concern in regard to women's empowerment and gender equality; and 2) the Convention on the Elimination of All Forms of Discrimination against Women (CEDAW), adopted in 1981. Georgia's ratification of the CEDAW without reservations in 1994 obliged the Country to implement its provisions such as ensuring the implementation of laws about gender equality and to eliminate all forms of discrimination.

4.2.3. Key National Environmental and Social Legislation

Georgian legislation comprises the Constitution, environmental laws, international agreements, subordinate legislation, normative acts, instructions and regulations.

4.2.3.1. The Constitution, 1995

The basic legal document is the Constitution of Georgia, which was adopted in 1995. The Constitution lays down the legal framework that guarantees environmental protection and public access to information with regard to environmental conditions. Key articles are:

Article 29 – right to environmental protection, paragraph 1 states that "*everyone has the right to live in a healthy environment, enjoy the natural environment and public space. Everyone has the right to receive full information about the state of the environment in a timely manner. Everyone has the right to care for the protection of the environment. The right to participate in the adoption of decisions related to the environment shall be ensured by law".* According to paragraph 2, "*environmental protection and the rational use of natural resources shall be ensured by law, taking into account the interests of current and future generations".*

Article 18, Paragraph 2 states that *"everyone has the right to be familiarised with information about him/her, or other information, or an official document that exists in public institutions in accordance with the procedures established by law, unless this information or document contains commercial or professional secrets, or is acknowledged as a state secret by law or in accordance with the procedures established by law as necessary in a democratic society to ensure national security or public safety or to protect the interests of legal proceedings".*

4.2.3.2. Law of Georgia on Protection of Environment (1986, last amended in 2021)

The Law of Georgia on Protection of Environment regulates legal relations between the bodies of the state authority and physical persons/legal entities in the scope of environmental protection and consumption of natural resources throughout Georgia, including its territorial waters, airspace, continental shelf and exclusive economic zones.

4.2.3.3. Law on Water (1997, last amended in 2020)

The Law on Water covers issues related to water protection and use. The main objectives of the law are to:

- ensure pursuance of the uniform State policy in the sphere of water protection and use;

[38] See more here Georgia – 1325 National Action Plans (peacewomen.org)

- protect water bodies and use rationally water resources with due regard to the interests of the present and future generations and the principles of sustainable development;
- meet the demands of the population for drinking water as a priority task;
- sustainability and sustainable use of water fauna;
- prevent adverse impact on water and eliminate the consequences effectively; ensure protection of State interests of Georgia in the sphere of water protection, regulate use and international trade in water;
- ensure the compliance of commercial production of water with international principles and standards;
- protect lawful rights and interests of natural and legal persons in the sphere of water protection and use.

The Law on Water contains a number of references to irrigation and the use of water for agricultural purposes. Article 53 recognizes the use of water for agricultural purposes as a type of "special water use" and sets out a number of general conditions for such uses.

Abstraction of groundwater (for the purposes other than non-commercial, individual drinking, household and other) is subject to licensing. Use of surface water (abstraction of surface water and discharge into surface water) is regulated under the environmental impact assessment legislation and the technical environmental regulations.

4.2.3.4. Law on Water Resources Management

A new Law on Water Resources Management has been drafted, but it has not been adopted yet. The purpose of drafting the new law is to harmonize Georgian legislation to the five EU Directives, including EU Water Framework Directive (Directive 2000/60/EC); Floods Directive (2007/60/EC); Urban Wastewater Treatment Directive (91/271/EEC); Drinking Water Directive (2020/2184); and Nitrates Directive (91/676/EEC). The new Draft Water Law establishes water resources management based on river basin management principles. The MEPA will be responsible for development and implementation of state policy of water resources management and establishment of river basin management along with issuing water use permits; implementing the state control on water protection and water use; water quality, hydrological and hydromorphological monitoring; identification of nitrate-sensitive zones and implementation of good agricultural practices etc.; as well as for development and implementation of state policy in the field of irrigation and drainage (Article 6).

The new Draft Law introduces permits for "special water use". Special water use means water use by means of structures and technical equipment that substantially affect the water condition. This includes: a) abstraction of water with the amount of more than 10 m^3 per 24 hours; b) discharge of wastewater containing pollutant substances into a water body. Specifically, there will be three types of permits: a) permit for abstraction from a surface water body; b) permit for discharge into a surface water body; c) combined permit for use of a surface water body that includes both, abstraction and discharge. To the permits will not be subject activities that require environmental impact assessment according to the Environmental Assessment Code of Georgia (Article 16). Generally, permits for special water use will be issued for no longer than 5 years. While, special water use permits for irrigation water supply purposes will be issued for no longer than 15 year (Article 21). Finally, the Draft Law on Water envisages reintroduction of water abstraction fees for water abstraction for special water uses. The amount of the fee and the payment procedure will be defined by the Law on Fees for Natural Resources Use. Such fees, if applied to GA, will need to be taken into account in the irrigation tariff-setting process.

In addition, according to the Draft Law, abstraction of water from rivers, construction and operation of hydrotechnical and industrial facilities, construction and operation of irrigation systems and water abstraction for other purposes will be prohibited without consideration of environmental flow (Article 31). Permits for special water use will be issued with consideration of environmental flow based on the methodology for the assessment of environmental flow in rivers to be adopted by the Ministerial Order (Article 17). Currently, there are no pre-set rules in Georgia for the maintenance of environmental flows in rivers. Environmental and sanitary flows are taken to be 10% of annual average river flow. This value is based on a practice inherited from the Soviet era. At this time, the general concept of environmental flows is under review by MEPA.

4.2.3.5. Law of Georgia on Water User Organisations (2019)

The Law of Georgia on Water User Organisations (2019) creates a legal ground for the foundation and development of WUOs; regulates issues related to the use of irrigation infrastructure by a WUO; determines the main principles of irrigation services provided by a WUO and a primary water user; and ensures state control of the activities of a WUO (Article 2).

According to the law, a primary water user that may be a legal entity of public law or a legal entity created by equity participation, manages, stores and maintains main irrigation infrastructure and provides a WUO and the other water users with irrigation services (Article 4). The tariffs for primary water user services are defined by the Georgian National Energy and Water Supply Regulatory Commission (Article 5). A WUO is a membership based legal entity of public law, which is created on a WUO service area determined by the Ministry of Environmental Protection and Agriculture for the purposes of the provision of irrigation water to the WUO service area and storage and maintenance, as well as the utilization of irrigation infrastructure (Article 6). A WUO is founded by a decision of a majority of owners/users of land parcels, the total area of which exceeds 50% of the total service area of the WUO, within the WUO service area as determined by the Ministry. Upon verifying the accuracy of submitted documents on a corresponding decision, the Ministry registers a WUO in the registry (Article 7). A WUO manages, stores, maintains and utilizes the irrigation infrastructure in its service area – secondary and tertiary canals, the local irrigation system and hydrotechnical unit and provides irrigation services; collects water use fees and ensures settlement with a primary water user (Article 10). The members of a WUO shall pay the storage and maintenance costs of the irrigation system annually, and the fees for supplied water in case they use water. Amount of annual fees as well as fees for water supply are determined by the General Assembly of a WUO on the basis of a tariff set for primary water user services (Article 22).

4.2.3.6. Other Relevant Agricultural Legislation

In relation to land tenure, according to **Government Resolution #48** dated by January 18, 1992 (amendments #128 and 290, 1992), up to 1.25 ha of agricultural land was given to citizens of Georgia free of charge. In 1995, the Constitution of Georgia was adopted, which strengthened the right to land property and gave citizens the right to inherit the land. According to the legislation of Georgia (**law on Private Ownership of Agricultural Lands, law on Land Registration, Civil Code**) land may be sold, leased or mortgaged if it is registered in a public registry as a private property. The problems related to the land registration process caused adoption of new **Law on Special Rule for Systematic and Sporadic Registration of Land Rights within the State Project and Improvement of Cadastral Data** in June 2016 by the parliament of Georgia, as well as launching of new State Programme on Land Registration, which facilitates and simplifies the registration of landownership.

4.2.3.7. Summary of all Relevant Legislation

A summary of all potentially relevant environmental and social legislation is provided in Table 4-1.

Table 4-1. Summary of relevant environmental and social legislation

Legislation	Description
Environmental framework legislation and EIA	
Constitution of Georgia (adopted in 1995, last amended in 2020)	Lays down the legal framework that guarantees environmental protection and public access to information with regard to environmental conditions as well as public participation in decisions related to the Environment.
Law of Georgia on Protection of Environment (adopted in 1996, last amended in 2021)	The law addresses broad spectrum of issues, like education and scientific research in the scope of environment, environmental governance, economic levers, environmental monitoring and access to the information, licensing, standards, EIA and permitting, waste management. It considers different aspects on protection of natural ecosystems and biodiversity, protected areas, protection of ozone layer, protection of Black Sea and international cooperation aspects. According to the law, state authorities as well as physical and legal entities are obliged to be guided by the principles of environmental protection while planning and implementation of activities. The Law forms the basis to establish the environmental qualitative standards and the admissible limit for emission of harmful substances and microorganisms. Qualitative standards include maximum admissible levels of concentration of harmful substances and microorganisms in air, water and soil. Environmental qualitative standards must be redefined every five years.
Law of Georgia on Licenses and Permits (adopted in 2005, last amended in 2020)	The law sets forth fields regulated by licenses and permits, gives a full list of licenses and permits, and defines rules for issuing, amending and cancellation of licenses and permits.

Legislation	Description
Environmental Assessment Code of Georgia (adopted in 2017, last amended in 2020)	The Environmental Assessment Code sets the legal basis for issuance of an environmental decision, including implementation examination process, public consultations and community involvement in the processes. The main purpose of the Code is protection of the environment, human life and health which may have a significant impact on the environment, human life and health. Annexes of the Code provide a list of activities that are or may be subject to the EIA procedure.
Water Management	
Law on Water (adopted 1997, last amended in 2020)	The Law provides general framework for water protection and water use in Georgia. It defines rights and obligations for the water users. According to this Law, water users have the right: • To file a claim for compensation of damages against natural or legal person whose action was resulted in water pollution, littering and depletion. • To file an appeal against a decision of executive bodies and officials that violate their rights to water use. The law forms the basis to define and establish water protection areas along the rivers, around lakes and other water bodies to protect them from pollution, littering and depletion. Width of the river protection areas depends on the length of river and varies between 10-50 m. Several activities including waste disposal is prohibited in these areas (Article 20). According to the law, water protection and water use norms are established to ensure adequate quality of the environment, such as: a) water quality norms; b) maximum admissible norms of emission (discharge) of substances (including microorganisms) into water bodies; c) standards of load on water bodies (Article 84).
Law ``On Water Resources Management`` is drafted, but it has not been adopted yet.	Drafting the new law is to harmonize Georgian legislation to the five EU Water Framework Directives (Directive 2000/60/EC, Directive 2007/60/EC, Directive 91/271/EEC, Directive 2020/2184 and Directive 91/676/EEC). The main novelty introduced by the draft law is the establishment of river basin management systems and decentralization of governance in the water sector, as follows: • Special permits for water discharge and water use will be required. • Fees will be introduced for water use and discharge. • River basin management plans, elaborated according to the new law, will be adopted by the Government of Georgia and will be legally bounded. • Limits for water use for each river basin will be established by management plans.
Water protection and quality	
Resolution #425 of 31 December 2013 of the Georgian Government on Approval of the Technical Regulation on Protection of Surface Waters of Georgia from Pollution	Defines the quality norms and the maximum allowable concentrations of pollutants according to different water use types for the surface waters in Georgia and sets the requirements for protection of water from pollution caused by different economic activities. According to the regulation, water users are obliged to observe the established rules and conditions for discharge of pollutant substances into surface waters and implement necessary measures to protect water and to avoid pollution.
Resolution #58 of 15 January 2014 of the Georgian Government on	Defines sanitary norms for drinking water that is safe for human health.

Legislation	Description
Approval of the Technical Regulation on Drinking Water	
Resolution #414 of 31 December 2013 of the Georgian Government on Approval of the Technical Regulation on calculation of maximum admissible discharge (MAD) standards of pollutants discharged into the surface water bodies together with effluents	Defines rules for calculation of maximum admissible discharge norms for pollutants discharged into the surface water bodies taking into consideration background concentrations, water use category, maximum allowable concentrations of substances in a surface water body and their assimilation capacity (Article 2). Establishment of MAD norms is necessary for activities subject to environmental impact assessment that discharge wastewater (including industrial, urban wastewater, stormwater, drainage or wastewater from amelioration systems) into surface water bodies (Article 1). MAD norms for each water user are approved by MEPA for 5 years.
Resolution #17 of January 3, 2014 of the Georgian Government on Approval of the Technical Environmental Regulations	Activities that are not subject to EIA, have to comply with the Technical Environmental Regulations. Technical Regulation on Abstraction of Water from a Surface Water Body obliges a water user to develop a 5-year water abstraction plan to be approved by the MEPA. Technical Regulation on Discharge of Wastewater of Industrial and Non-industrial Facilities into Surface Water Bodies defines standard maximum admissible concentrations of pollutant substances in the discharged wastewater.
Soils	
Law of Georgia on the Protection of Soil (adopted in 1994, last amended in 2020)	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 topsoil; open quarry processing without subsequent re-cultivation of the site; terracing without preliminary survey of the area and approved design; overgrazing; windbreaks cutting; damage of soil protection facilities; any activity deteriorating soil quality (e.g. unauthorized chemicals/fertilizers, etc.). Based on the requirements of the law, it is necessary to implement topsoil removal-storage works during the construction stage of the project. In addition, according to the requirements of the law, any activity during the construction and operation phases should be carried out so as to minimize the possible contamination of soil.
Law on Soil Conservation and Improvement (adopted in 2003, last amended in 2020)	Aims at ensuring conservation and improvement of soil in the territory of Georgia, and defines the legal principles, measures, limitations and prohibitions to that end. The Law defines soil conservation and fertility restoration improvement measures. It prohibits unregulated grazing, logging of windbreaks, application of non-registered fertilizers or other substances, soil contamination and any activity, which results in deterioration of soil properties and facilitates desertification, swamping, salinization, etc.
Resolution #424 of December 31 of the Georgian Government on Approval of the Technical regulation for removal, storage, utilization and re-cultivation of topsoil	The purpose of the regulation is to determine the rules for the removal and disposal of fertile, productive layers (Topsoil) and rocks during various earthworks, for their intended purposeful use in specially designated areas. Subject to the requirements of the regulations, any activity that causes soil disturbance or degradation is liable to compensate and to ensure the integrity of the soil cover and its productivity to its nearest state.

Legislation	Description
Protected areas	
Law on the System of the Protected Areas (1996, last amended in 2020)	Establishes the legal status of the protected territories and declares the State's exclusive ownership rights on all territories including natural resources (lands, forests, waters, animals and etc.) located within the borders of State Nature Reserves, National Parks and Natural Monument and Managed Reserves. The Law allows different forms of ownership on the natural resources located within the Protected Landscape and Multiple Use Area, as well as within the traditional use zones of the national parks and several areas of the managed reserve. According to the law, all kinds of economic and entrepreneurship activities are admissible in the support zone provided they do not hamper the functioning of the protected areas.
Biodiversity, Flora and Fauna	
Forest Code of Georgia (2020, last amended in 2021)	The code determines the main principles of forest management. It aims to conserve the biodiversity of forest of Georgia, to preserve and improve the quantitative and qualitative characteristics of forest resources; to preserve the original natural and cultural environment of forest, including the vegetation cover and animal world, and natural and cultural property located in forest, and rare and endangered plant species and other assets for future generations; and to ensure targeted and rational use of forest resources and other natural potential of forest.
Law on Wildlife (1996, last amended in 2020)	According to the law, the impact on wild animals should be assessed and mitigation measures determined through the EIA process of the planned activity. Protection of the important habitats for wild animals should be envisaged while designing and construction of enterprises and other activities.
Law on Red List and Red Book (2003, last amended in 2021)	Prohibits any action which could lead to reduction of endangered species, their habitats and living conditions. Possible negative impacts of the planned activity on the endangered species should be taken into account during the EIA process. The Red List of Georgia was approved by the Presidential Decree No. 303 'On approving the Red List of Georgia' (May 2, 2006). Later, the Decree of Government #190, February 20, 2014 adopted the same list.
Air quality, noise, greenhouse gases and climate change	
Law on Ambient Air Protection (adopted in 1999, last amended in 2021)	Regulates protection of ambient air from harmful anthropogenic impacts in the territory of Georgia and defines state control on recording and permissible emissions. For activities subject to EIA, the Law requires development of the document on Maximum Admissible Limits of Pollutants into the atmospheric air which should be submitted to the Ministry of Environment Protection and Agriculture together with EIA report, if the project includes a stationary source of pollution. Elaboration of the mentioned document will be required at construction phase of project implementation, if project will include operation of cement-concrete mixing plant (rather than purchasing these materials from other providers).
Resolution #408 of December 31, 2013 of the Georgian Government on Approval of the Technical regulation for calculation of the maximum permissible	Defines the methodology for calculation of the maximum permissible emission rates of harmful substances in ambient air. Maximum permissible emission norms are established for stationary emission source facilities that are subject to environmental impact assessment. Emission norms approved by MEPA are established for 5 years for each emission source and each pollutant substance (Article 4).

Legislation	Description
emission rates of harmful substances in ambient air	
Resolution #17 of January 3, 2014 of the Georgian Government on Approval of the Technical Environmental Regulations	Stationary emission sources that are not subject to EIA, have to comply with the Technical Regulation defining standard emission limit values for pollutant substances.
Noise	
Order #297/n of the Minister of Labour, Health and Social Affairs, August 16, 2001 on approval of the environmental quality standards	Defines noise norms at workplaces (while noise norms for residential and public spaces are replaced by Resolution #398 below).
Resolution #398 of 15 August 2017 on Approval of the Technical Regulation on Acoustic noise norms in residential houses and public/state premises and their surrounding territories	Defines admissible norms of acoustic noise in residential and public buildings and surrounding areas during the day, evening and night-time.
Cultural heritage	
Law of Georgia on Cultural Heritage (2007, last amended in 2021)	Establishes buffer zones for the protection of cultural heritage. The goals for the establishment of buffer zones are the protection of cultural heritage within their borders, including the protection of cultural properties, urban fabric with cultural value and individual buildings and structures, and historical developments, street networks, planning structures, historical landscapes and objects of archaeological interest, from undesirable influence; the conservation of the natural, historical, aesthetic, and ecological environment of cultural heritage, their authentic elements, historically evolved views and panoramas within their borders, as well as the preservation of their social, economic and cultural context, which will support the protection and sustainable development of cultural properties and their environment and will preserve the role of cultural properties as objects of historical witness. According to the law, if a natural or legal person identifies or discovers cultural heritage or has reasonable grounds to presume that cultural heritage is being identified or discovered during activities which, if continued, may damage, destroy or pose a threat of damaging or destroying cultural heritage, the person conducting the activities shall immediately terminate such activities and inform the Ministry of Culture in writing.
Waste management	
Waste Management Code (adopted in 2014, last amended 2020)	Aims at creating a legal base in the field of waste management for the implementation of measures which would promote the prevention of generation of wastes and increase their reuse, processing of wastes in a safe for the environment manner (recycling and separation of salvage, generation of power from wastes, safe disposal of wastes). According to the Waste Management Code, *“the individuals and legal entities, whose activities result in the generation of over 200 tonnes of non-hazardous waste or any amount of hazardous waste annually or, individuals who annually produce more than 1000 tonnes of inert waste, or legal entities who annually produce more than 400 tonnes of inert waste, are liable to develop a company waste management plan.”* The Waste Management Plan is updated every 3 years, or in case of

Legislation	Description
	any substantial changes in waste types, volumes and treatment processes. Since generating of significant amount of waste (including construction waste generated during the demolition and construction works) is expected during the implementation of the planned activities, a Waste Management Plan should be developed. The Waste Management Plan should include: a) information about waste generated (in particular about its origin, and types, composition and amount of waste determined in the List of Waste); b) information on the measures to be taken for the prevention of generation of waste, especially of generation of hazardous waste, and waste recovery; c) a description of the method for separation of waste generated, in particular of hazardous waste, from the other waste; d) methods and conditions for the temporary storage of waste; e) waste treatment methods applied and/or information on persons to whom waste is transferred for further treatment.
Resolution #145 of 29 March 2016 of the Government of Georgia on Approval of the Technical Regulation on Special Requirements for Hazardous Waste Collection and Treatment	Defines specific rules for collection, treatment and temporary storage of hazardous waste.
Agricultural land	
Law on Determination of the Designated Purpose of Land and on Sustainable Management of Agricultural Land (adopted in 2019)	Regulates issues related to the designated purpose of land, including the change of the designated purpose of a plot of land, determines the categories of agricultural land and the procedure for changing such categories, as well as the principles of sustainable management of agricultural land.
Resolution #396, 1 July 2020 of the Georgian Government on approval of the “Rules and Conditions for Payment and Exemption from Payment of Compensation for Changing the Designated Purpose of a Plot of Agricultural Land, as well as the Rules and Conditions for Changing the Category of a Plot of Agricultural Land”	Defines the amount of compensation to be paid for changing the designated purpose of agricultural land as well as the rules and conditions for payment and exemption from payment. The regulation also defines the rules and conditions for changing the category of agricultural land.
Land Use and Acquisition	
Law of Georgia on State Property (adopted in 2010, last amended in 2021)	Regulates relations concerning the management, administration and transfer into use of the state property of Georgia.
Organic Law on Private Ownership of Agricultural lands (adopted in 2019)	Defines the ownership rights for agricultural land.
Law of Georgia on Recognition of the Property Ownership Rights Regarding the Land Plots	Defines general terms and procedures for entitlement of the right to land ownership. Although ownership rights cannot be bestowed onto the following lands: cattle-driving routes; cemetery and pantheon; water field (stock); sanitary and protection zones; protected areas;

Legislation	Description
Owned (Used) by Physical Persons or Legal entities (adopted in 2007, last amended in 2020)	historical, nature and religious monuments; recreation parks, forest-parks, squares and others; land containing water reservoir, hydraulic works and sanitary-protection zones of these objects; lands of special purpose (allocated for defence and mobilisation); lands accommodating community infrastructure units (transport and underground utilities, water-supply, sewage, communication and power supply systems); land parcel of public use (playground, street, passage, road, pavement, shore) and recreation sites (park, forest-parks, squares, alley, protected area); lands accommodating state-owned objects, including parcels which contain state property not subjected to privatization according to Georgian Law on Privatization of State Property; lands allocated for construction and operation of oil and gas mains, as well as any associated over- and under-ground structures and facilities.
Law of Georgia on Public Registry (adopted in 2008, last amended in 2021)	Provides an organizational and legal basis for the registration of ownerships rights, encumbrance and mortgage on real estate, as well as the liabilities of the registration authority. Pursuant to this Law, ownership rights related to real property, mortgage, usufruct, servitude, lease, sub-lease, rent, sub-rent, lending are subject to registration in the Public Register.
Law on Special Rule for Systematic and Sporadic Registration of Land Rights and Improvement of Cadastral Data (adopted in 2016, last amended in 2021	Establishes special procedures for the systematic and sporadic registration of rights to plots of land, the legal framework for such registration, and the rights and obligations of parties participating in administrative proceedings.
Law on Rules for Expropriation of Ownership for Necessary Public Needs" (adopted in 1999, last amended in 2020)	The state has the constitutional power to seize any property by means of expropriation for projects of imminent public necessity. According to the law the expropriator has to make every reasonable effort to acquire property by negotiation and is required to value the property in accordance with the fair market value before negotiations.
Social, labour and gender equality	
Constitution of Georgia (adopted in 1995, last amended in 2020)	Article 11 ensures the right to equality of all persons and prohibits discrimination based on sex and gender39. It also obliges the state to provide equal rights and opportunities for men and women, and to develop mechanisms to eliminate inequality. In 2014, the Country adopted the Anti-Discrimination Law, which stablishes the prohibition of discrimination, and included aspects and principles that are relevant to the promotion of gender equality. This Law also expanded the mandate of the Public Defender's Office of Georgia (PDO) in this regard.
Labor Code of Georgia (adopted in 2010, last amended 2021)	Governs the rights of the employees in all enterprises, institutions and organizations. This law establishes the requirements regarding human rights and creation of safe and healthy working environment including health and safety conditions, social security and insurance. However, there are no established norms and standards related to the workers accommodation.
Organic Law of Georgia on Occupational Safety	Defines the general requirements and the general principles of preventive measures related to occupational safety at work place, existing and potential hazards, avoidance of accidents and

[39] UNWOMEN (2020) Country Gender Equality Profile of Georgia. Available at: https://georgia.unwomen.org/sites/default/files/Field%20Office%20Georgia/Attachments/Publications/2020/Country%20Gender%20Equality%20Profile%20of%20Georgia.pdf

Legislation	Description
(adopted in 2019, last amended in 2020)	occupational diseases, training of employees, providing to them information and consulting, and ensuring equal participation of employees in the matters of occupational safety and health.
Gender Equality Law (adopted 2010)	This sets equality principles between men and women for social, economic, political, and cultural life. This Law converted the Gender Equality Council of the Parliament of Georgia (GEC) into a standing body responsible for developing legislation in the field of gender equality. Despite the law represents a significant milestone towards gender equality, some reports consider the Law as highly declarative and its enforcement and monitoring lagging[40].

4.2.4. National Environmental and Social Permits

The ***Environmental Assessment (EA) Department*** of MEPA executes procedures related to Environmental Impact Assessment (EIA). The EA Department is also in charge of decisions concerning the exemption of planned activities from the EIA process.

The main national permit in relation to EIA is the Environmental Decision, the need for which is determined in the Environmental Assessment Code 2017. The Code contains two annexes, both list activities that have significant effect on the environment. Activities listed in Annex I are subject to mandatory EIA, while Activities listed in Annex II are subject to screening.

According to the Code, construction and operation of irrigations systems is an Annex II activity and therefore is subject to screening, which is also confirmed by liaison with the EA Department of MEPA (December 2021). However, the Code does not refer to modernisation of irrigation systems. It would therefore be prudent for the Project to seek clarification with MEPA once a detailed design is available, to confirm the Project should be subject to screening.

A summary of environmental and social permits is provided in the table below. It is possible that an EIA Permit and a Construction permit may be required for the ZSIS.

Table 4-2. Summary of relevant environmental and social permits

Topic	Permit Type	Issuing body
Environmental Impact Assessment (EIA)	Environmental Decision - an act that is a mandatory precondition for implementing activities that are subject to an environmental impact assessment.	Ministry of Environmental Protection and Agriculture
Construction	Construction permit, except for facilities of special importance, nuclear or radioactive facilities	Municipality Executive Body or a legal entity of public law established by a municipality
Construction	Permit to construct facilities of special importance, except for nuclear or radioactive facilities	Technical and Construction Supervision Agency, Ministry of Economy and Sustainable Development
Construction	Permit to construct nuclear or radioactive facilities	Technical and Construction Supervision Agency, Ministry of Economy and Sustainable Development
Works on a cultural heritage monument	Permit to carry out works on monuments of cultural heritage	Ministry of Culture, Sports and Youth of Georgia
Archaeological works	Permit for archaeological works	Ministry of Culture, Sports and Youth of Georgia

[40] USAID (2018) Gender equality in Georgia: Barriers and Recommendations. Available at: http://ewmi-prolog.org/images/files/9896ENG-Vol1_GenderEqualityinGeorgia_BarriersandRecommendations_Final.pdf

Topic	Permit Type	Issuing body
Aquaculture	Permit for intensive aquaculture	National Environmental Agency (Ministry of Environmental Protection and Agriculture)
Extraction of minerals, including groundwater	Mineral extraction license (license to use)	National Agency of Mines (Ministry of Economy and Sustainable Development)
Fishing	Fishing license (license to use)	Ministry of Environmental Protection and Agriculture
Water supply	Water supply license (license to operate)	Georgian National Energy and Water Supply Regulatory Commission

4.2.5. National Standards

The environmental quality standards and norms define the admissible levels of pollutants in the environment, including surface waters, and measures of their protection including the zones of sanitary protection, the maximum admissible levels of discharge into water, atmospheric air pollution and noise, as well as rules for topsoil protection. Relevant standards are provided in Table 4-3.

Table 4-3. National Standards

Name of Legal Act	Brief Description
Water	
Technical regulation for protection of surface waters from pollution (Resolution #425 of GoG of December 31, 2013)	The technical regulation regulates various types of entrepreneurial activities that can adversely affect the condition of surface waters and contamination of surface water bodies from point and diffusion sources. Water quality norms for water bodies are determined according to separate categories of water use, such as A) drinking water use; B) agricultural-household water use; C) fishery water use, which is divided into higher, first and second categories. The limits of pollutants for maximum permissible discharge are given in the technical regulation.
On the approval of environmental technical regulations – Annex I - Technical regulation for discharging effluent from industrial and non-industrial facilities into surface water bodies (Resolution #17 of GoG of January 3, 2014 on "Approval of Environmental technical regulations")	Technical regulation applies to all industrial and non-industrial facilities that discharge wastewater into surface water bodies and whose activities are not subject to the environmental decision. The Technical regulation establishes the maximum permissible concentration of the relevant ingredient in the wastewater. The table of limits are given in regulation.
On the approval of environmental technical regulations – Annex II - Technical regulation for water extraction from surface water bodies (Resolution #17 of GoG of January 3, 2014 on "Approval of Environmental technical regulations")	For each water abstraction from surface water bodies, a separate water user - physical or legal person, whose activities are not subject to environmental impact assessment, is obliged to develop draft technical conditions for water abstraction from a surface water body. In some cases, the obligation to agree on technical requirements also applies to the person holding the environmental decision. The technical conditions for water extraction from the surface water shall not exceed 5 years. The form of technical requirements for removing water from a surface water body is defined in Annex №4.
On approval of the environmental quality standards (Order #297/n of the Minister of	The order approves the following relevant norms and rules: Sanitary rules and norms for protection against surface water pollution (Annex 2);

Name of Legal Act	Brief Description
Labour, Health and Social Affairs, August 16, 2001)	Hygienic requirements for decentralized water supply water quality. Sanitary protection of springs (Annex 3); Sanitary Rules for Protection of Groundwater Pollution (Annex 4).
Technical regulation for conditions for the discharge and collection of wastewater in the sewer system and limit pollution standards (Resolution of GoG #431, August 8, 2018)	The technical regulation establishes the procedure and control mechanisms for discharging/collecting; wastewater in the sewerage system. It defines the maximum permissible norms (concentrations) of pollutants in the wastewater (sewage) system. Compliance with the regulatory requirements is mandatory for all users who generate wastewater and discharge it into the sewerage system.
Technical regulation on water protection zones (Resolution of GoG #440, December 31, 2013)	The technical regulation defines the boundaries of the water protection zones of surface water bodies, regulates the mode of operation to protect water resources in this zone from pollution, sludging and drought. It is mandatory for state bodies, individuals, and legal entities. Water protection zones include shores of rivers, lakes, reservoirs, alienation zones of central and other canals, and other zones provided by law. The technical regulations impose prohibitions on what can be done within the water protection zone.
Technical regulation on water protection zones for small rivers (Resolution of GoG #445, December 31, 2013)	Defines the boundaries of the water protection zones for small rivers (with the length of less than 75 km) and sets special requirements and restrictions to be observed within the protection zones.
Technical regulation for sanitary specification for water sampling (Resolution of GoG #26, January 3, 2014)	Sanitary regulations set requirements for the sampling, transportation, storage, and conservation of water samples to determine water's physical properties, chemical composition, microbiological, parasitological and radiological parameters. It determines the location and frequency of sampling different types of water, the rules for preparing utensils, and the selection of equipment. The rules contain sampling methods, processing, storage and conservation, requirements for the compilation and statistical processing of sampling results, the rules for their acceptance in the laboratory, and the observance of safety rules during sampling.
Technical regulation for the calculation of limit values for emissions of pollutants discharged into the surface water bodies (Resolution of GoG #414, December 31, 2013)	Values for emissions of pollutants discharged into the surface water bodies is set for each control indicator taking into account the background concentration, the category of water use, the maximum permissible concentrations of substances in the water body and its assimilation capacity. The norms are being developed for separate water use facilities to meet the water protection requirements set for them: A) drinking water use; B) agricultural-household water use; C) Fishery water use, which in turn is divided into higher, first and second categories.
Technical regulation on drinking water (Decree of the GoG #58, 15 December 2014)	Technical regulation considers the regional peculiarities of the country and climatic-geographical conditions and sets the sanitary norms of human health safety for drinking water. The requirements set apply to natural or treated water used for drinking, food preparation and other household purposes, regardless of the method of origin and supply (supply through distribution network, tank and cistern, bottle or container); For water intended for the production of food or food products.
Air	
On the approval of environmental technical regulations – Annex III -	For activities that pollute the air with harmful substances, which are carried out through a stationary facility and which are not subject to an environmental decision, it is mandatory to prepare a "Technical Report

Name of Legal Act	Brief Description
Technical regulation for atmospheric air pollution activities with hazardous substances (Resolution #17 of GoG of January 3, 2014	on Inventory of Stationary Sources of Air Pollution and Emissions." The value of the maximum concentration of the harmful substance is given in the form of a table.
Technical regulation for an inventory of stationary sources of atmospheric air pollution (Resolution #42 of GoG of January 6, 2014)	An inventory is mandatory for all activities that pollute the air with a stationary facility, except for the activities subject to the environmental decision and the actions specified in Article 41 of the same Technical Regulation. Each source of air pollution and each harmful substance are subject to inventory at the stationary pollution facility. The inventory is carried out once in 5 years, and the results of the obtained materials are reflected in the technical report.
Technical regulation for self-monitoring and reporting on emissions from stationary sources of pollution (Resolution #413 of GoG of December 31, 2013)	The subject of activity is obliged to ensure proper self-monitoring of emissions of harmful substances from stationary sources of pollution. Self-monitoring of emissions of harmful substances from stationary sources of pollution includes: A) emission measurement (assessment); B) emissions accounting; C) Emission reporting.
Technical regulation Methods of calculation of maximum permissible emission of hazardous substances into ambient air (order #408 of the Government of Georgia December 31, 2013)	Technical regulation identifies qualitative and quantitative features of hazardous substance emissions emitted into the ambient air from stationary sources of air pollution.
Soil	
Technical regulation for removal, storage, utilization and re-cultivation of topsoil (Resolution #424 of GoG of December 31, 2013)	The regulation defines rules for removal and disposal of topsoil, productive layers and rocks during the implementation of earthworks, as well as rules for disposal of the material mentioned above to the specially allocated areas for further usage;
Noise	
Acoustic noise norms in residential houses and public/state premises and their surrounding territories (Governmental Decree #398 15.08.2017)	The technical regulation sets the permissible norms of acoustic noise in the residential houses and public/public institutions and the development area to protect people from the adverse effects of noise.
Order #297/n of the Minister of Labour, Health and Social Affairs, August 16, 2001 on approval of the environmental quality standards	Defines noise norms at workplaces (while noise norms for residential and public spaces are replaced by Resolution #398).
Other Relevant Secondary Legislation	
The Technical Regulation on Adoption the Methods to Estimate Damage to Environment (the Decree of the Government #54, January 14, 2014)	Defines rules to estimate and compensate environmental damage if mitigation is impossible even through planning and realizing the preventive measures. Stationary sources of air pollution.

4.2.6. Relevant International Conventions

Georgia is signatory of a number of international conventions, including those related to environmental protection.

Table 4-4. Relevant international conventions

Convention	Date of ratification (Rt), accession (Ac), approval (Ap), adoption (At) entry into force (EIF)	Summary
Aarhus Convention on access to information, public participation in decision-making and access to justice on environmental issues (2001)	07/04/1999 (Rt) 30/10/2021 (EIF)	The Aarhus Convention establishes several rights of the public (individuals and their associations) concerning the environment. This Convention provides for: • Access to environmental information. The right of everyone to receive environmental information that is held by public authorities. Applicants are entitled to obtain this information within one month of the request without saying why they require it. In addition, public authorities are obliged to disseminate environmental information in their possession actively; • Public participation in environmental decision-making. The right to participate in environmental decision-making. Arrangements are to be made by public authorities to enable the public affected and environmental non-governmental organisations to comment on, for example, proposals for projects affecting the environment, or plans and programmes relating to the environment. These comments to be taken into due account in decision-making, and information to be provided on the final decisions and the reasons for it; • Access to justice. The right to review procedures to challenge public decisions that have been made without respecting the two aforementioned rights or environmental law in general.
Bern Convention on the Conservation of European Wildlife and Natural Habitats (1982)	30/12/2008 (Rt) 01/03/2010 (EIF)	The Convention aims to ensure conservation of wild flora and fauna species and their habitats. Special attention is given to endangered and vulnerable species, including endangered and vulnerable migratory species specified in appendices. The Parties undertake to take all appropriate measures to ensure the conservation of the habitats of the wild flora and fauna species. Such measures should be included in the Parties planning and development policies and pollution control, with particular attention to the conservation of wild flora and fauna. The Parties undertake to promote education and disseminate general information concerning the need to conserve species of wild flora and fauna and their habitats.
Convention on Wetlands of International Importance Especially as	07.06.1997 (EIF)	This is an intergovernmental treaty that provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources. The Convention's mission is "*the conservation and wise use of all wetlands through local and national actions and*

Convention	Date of ratification (Rt), accession (Ac), approval (Ap), adoption (At) entry into force (EIF)	Summary
Waterfowl Habitat (RAMSAR) (1975)		*international cooperation, as a contribution towards achieving sustainable development throughout the world".* Under the "three pillars" of the Convention, the Contracting Parties commit to work towards the wise use of all their wetlands; designate suitable wetlands for the list of Wetlands of International Importance (the "Ramsar List") and ensure their effective management; cooperate internationally on transboundary wetlands, shared wetland systems and shared species.
Convention on the Conservation of Migratory Species of Wild Animals (CMS) (1979)	01/06/2000 (EIF)	This Convention is an environmental treaty under the aegis of the United Nations Environment Programme. It provides a global platform for the conservation and sustainable use of migratory animals and their habitats. CMS is the only global and UN-based intergovernmental organisation established exclusively for the conservation and management of terrestrial, aquatic and avian migratory species throughout their range. Migratory species that need or would significantly benefit from international co-operation are listed in Appendix II of the Convention.
Convention on Biological Diversity (1992)	02/06/1994 (Rt) 31/08/1994 (EIF)	The Convention has three main objectives: • The conservation of biological diversity • The sustainable use of the components of biological diversity • The fair and equitable sharing of the benefits arising out of the utilisation of genetic resources Its overall objective is to encourage actions, which will lead to a sustainable future. The Convention covers biodiversity at all levels: ecosystems, species and genetic resources. It also covers biotechnology, including through the Cartagena Protocol on Biosafety.
Cartagena Protocol on Biosafety (2003)	08/11/2008 (Ac) 02/02/2009 (EIF)	The Cartagena Protocol on Biosafety to the Convention on Biological Diversity is an international agreement which aims to ensure the safe handling, transport and use of living modified organisms resulting from modern biotechnology that may have adverse effects on biological diversity, taking also into account risks to human health.
United Nations Framework Convention on Climate Change (UNFCCC) (1994)	29.07.1994 (Rt)	The UNFCCC's ultimate objective is to achieve the stabilisation of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous interference with the climate system.
Kyoto Protocol (2005)	19/07/1994 (Rt)	The Kyoto Protocol operationalises the UNFCCC by committing industrialised countries and economies in transition to limit and reduce greenhouse gases (GHG) emissions per agreed individual targets. The Convention itself asks those countries to adopt policies and measures on mitigation and to report periodically. One important element of the Kyoto Protocol was the establishment of flexible market mechanisms based on

Convention	Date of ratification (Rt), accession (Ac), approval (Ap), adoption (At) entry into force (EIF)	Summary
		the trade of emissions permits. Under the Protocol, countries must meet their targets primarily through national measures. The Protocol also offers them an additional means to meet their targets by way of three market-based mechanisms: • International Emissions Trading • Clean Development Mechanism (CDM) • Joint implementation (JI)
Paris Agreement (2016)	08/05/2017 (Rt) 07/06/2017 (EIF)	The goal of the Paris Agreement is to limit global warming to well below 2, preferably to 1.5 degrees Celsius, compared to pre-industrial levels. To achieve this long-term temperature goal, countries aim to reach global peaking of greenhouse gas emissions as soon as possible to achieve a climate-neutral world by mid-century. Implementation requires economic and social transformation based on the best available science. The Paris Agreement works on a 5- year cycle of increasingly ambitious climate action carried out by countries. Parties should submit their plans for climate action known as nationally determined contributions (NDCs).
The United Nations Convention to Combat Desertification in Those Countries Experiencing Serious Drought and/or Desertification, Particularly in Africa (UNCCD) (1996)	23/07/1999 (Rt)	The Convention addresses specifically the arid, semi-arid and dry sub-humid areas, known as the drylands, where some of the most vulnerable ecosystems and peoples can be found. Parties work together to improve people's living conditions in drylands, maintain and restore land and soil productivity, and mitigate the effects of drought. The UNCCD is particularly committed to a bottom-up approach, encouraging the participation of local people in combating desertification and land degradation. The UNCCD secretariat facilitates co-operation between developed and developing countries, particularly around knowledge and technology transfer for sustainable land management.
Stockholm Convention on Persistent Organic Pollutants	04/10/2006 (Rt) 02/01/2007 (EIF)	The Stockholm Convention on Persistent Organic Pollutants is a global treaty to protect human health and the environment from chemicals that remain intact in the environment for long periods, become widely distributed geographically, accumulate in the fatty tissue of humans and wildlife, and have harmful impacts on human health or the environment.

4.3. EIB Requirements

4.3.1. Performance Standards

All EIB-financed operations are required to comply with EIB's Environmental and Social Standards (see section 4.3.1). The Bank operates within the framework of the European Principles for the Environment (EPE), which conforms to the environmental principles and the practices of the EC Treaty and all standards of EU environmental legislation; with the safeguard policies based on the EU approach to environmental sustainability.

The EPE cover projects located in the EU Member States, the European Economic Area countries, the EU Accession, Candidate and potential Candidate Countries. In the Neighbourhood and Partner Countries, projects should comply with the appropriate EU environmental principles, practices and standards, subject to local conditions. For projects in these regions, the EPE will be applied with reference to local circumstances.

All projects financed by the Bank are the subject of an Environmental Assessment (EA) to assess the requirements for an Environmental Impact Assessment (EIA) according to the EU requirements (se e section 4.3.2). Projects are screened into four categories based on these directives:

- Category A – those for which an EIA is mandatory (Annex 1 of the EU Directive);
- Category B – those for which the competent authority determines the need for an EIA according to specified criteria (Annex II of the Directive, with ref. to Annex III);
- Category C – for which a limited environmental assessment is required according to any likely adverse environmental impacts of the project (projects outside the scope of the Directive); and
- Category D – no environmental assessment required.

An ESIA has been requested by the EIB for this Project.

4.3.2. Performance Standards

The Project must comply with the EIB's Environmental and Social Standards, which are summarised in Table 4-5.

Table 4-5. EIB Performance Standards

No	Standard	Objectives and Scope	Key topics covered
1	Assessment and Management of Environmental and Social Impacts and Risks	Objectives: The overall objective of this Standard is to outline the promoter's responsibilities in the process of assessing, managing and monitoring environmental and social impacts and risks associated with the operations, specifically: • Policy commitment; • Assessment; • Management; and • Stakeholder Engagement. Scope: This Standard applies to all operations likely to have significant and material environmental and social impacts and risks.	Identification of Significant Impacts and Risks Assessment Area Comprehensive Environmental and Social Assessment Study Environmental and Social Assessment Environmental and Social Management Plans Organisation Capacity and Competencies Emergency Prevention, Preparedness and Response Activities Performance Management and Review Corporate Loans
2	Pollution Prevention and Abatement	Objectives: The objectives of this Standard are: • Avoidance of any deterioration in the quality of human health or the environment, and any loss of biodiversity; • Support to the EU aims of reducing greenhouse GHG and enhancing resource efficiency; • Promotion of an integrated approach to prevention and control of emissions into air, water and soil, to waste management, to energy efficiency and to accident prevention. Scope:	Pollution Prevention, Energy and Resource Efficiency Emissions of Atmospheric Pollution, to Water and Soil Noise Emissions Ambient Conditions and Environmental Quality Standards Waste Management Sound Management of Chemicals and Dangerous Substances Emergency Prevention, Preparedness and Response

No	Standard	Objectives and Scope	Key topics covered
		The Standard applies during the environmental and social impacts and risks identification process.	Pesticide Use and Management
3	Biodiversity and Ecosystems	Objectives: • Maintain the integrity of areas important for biodiversity. Scope and rationale: The rationale is that for any given environment, it is possible to compare current biodiversity values with those that would occur in an ideal state of conservation. All projects should seek to contribute towards this state, avoid or minimise further losses and finally compensate for any residual impact.	Natural, semi-natural and urban habitats Critical habitats Analysis of alternatives Ecosystem services Cumulative impact assessment Minimisation hierarchy Assessment of supply chains Stakeholder engagement Biodiversity management plan Invasive alien species
4	EIB Climate-related Standards	Climate change considerations should be taken into account at all stages of the project cycle, in particular during the pre-appraisal and appraisal stage.	Climate change Adjusted Economic and Financial Rates of Return (GHG) Carbon footprint assessment Climate change vulnerability assessment Carbon credit potential assessment
5	Cultural Heritage	Objectives: The objective of this Standard is to outline the promoter's responsibilities in terms of cultural heritage management, involving the actions taken to identify, assess, decide and enact decisions regarding the impact on cultural heritage associated with operations supported by the EIB, specifically: • To support the conservation of cultural heritage; • To protect cultural heritage from adverse impacts of project activities; • To promote the equitable sharing of benefits from the use of cultural heritage in project activities; • To promote the awareness of and appreciation of cultural heritage. Scope: The applicability of this Standard is established during the environmental and social impacts and risks identification process if, as an outcome of the process, it is identified that, during the project life-cycle, the project is likely to affect irreplaceable cultural heritage.	Screening for Risks or Impacts on Cultural Heritage Assessing and Mitigating the Impact Chance Find Procedures Consultation with Affected Communities Project's Use of Cultural Heritage
6	Involuntary Resettlement	Objectives: The key objectives of this Standard are to:	Census, Baseline Data and Cut-Off Date

No	Standard	Objectives and Scope	Key topics covered
		• Avoid or, at least minimise, project-induced resettlement whenever feasible by exploring alternative project designs; • Avoid and/or prevent forced evictions and provide effective remedy to minimise their negative impacts should prevention fail; • Ensure that any eviction respects the rights to life, dignity, liberty and security of those affected who must have access to an effective remedy against arbitrary evictions. Scope: This Standard applies to all components of operations financed by the EIB, including associated facilities, which result in *involuntary resettlement*.	Eligibility Criteria Relocation Sites Compensation and Income Restoration Resettlement Assistance Consultation Grievance Mechanism Forced Evictions Screening and Appraisal Planning Tools Implementation and Monitoring
7	Rights and Interests of Vulnerable Groups	Objectives: Key objectives are to: • Affirm, respect, and protect the rights and interests of vulnerable individuals and groups; • Adopt a gender-sensitive approach to the management of environmental and social impacts; • Identify and avoid adverse impacts of EIB operations on the lives and livelihoods of vulnerable individuals and groups. Scope: This Standard is to be applied in synergy and cross-reference with EIB's other Standards, as relevant.	Social assessment Public Consultation and Participation Monitoring Indigenous Peoples Development Plan (IPDP) Free Prior Informed Consent (FPIC) Indigenous Peoples Planning Framework
8	Labour Standards	Objectives: The key specific objectives of these standards are to: • Foster and realise non-discrimination and fair and equal treatment and opportunity at work; • Promote the freedom of association and collective bargaining; • Ensure, develop and maintain a sound worker-management relationship. Scope: This Standard applies in full to all workers directly engaged by the promoter throughout the project life cycle.	Exploitation of Child Labour Forced Labour Migrant Workers Non-Discrimination and Equality of Opportunity and Treatment Human Resources Policy and Access to Information Association and Collective Bargaining Collective Dismissals Grievance Mechanism Labour Assessment Monitoring and Evaluation Labour Audit
9	Occupational and Public Health, Safety and Security	Objectives: Key specific objectives under this Standard amount to the following:	Information Dissemination and Consultation Health and Safety Management Plans and Systems

No	Standard	Objectives and Scope	Key topics covered
		• Promote and protect the health and safety of employees at work throughout the project life cycle; • Ensure that promoters duly anticipate, avoid or minimise, and effectively mitigate risks and adverse impacts to the health and safety of host communities; • Help promote public health and safety across the project's area of influence. Scope: Standard 9 applies to all sectors of activity, both public and private. In the light of the nature of the activities and size of the projects, the extent of applicability of the requirements described in Standard 9 will be flagged in discussions between the promoter and the EIB.	Reporting Grievance Mechanism Working Environment Safety Training for Workers Essential Sanitary Facilities and Living Quarters Risks Associated with Project Activities Risks Associated with the Influx of Project Workers Promoting Public Health and Safety Security Management
10	Stakeholder engagement	Objectives: Key specific objectives arising therefrom for the promoter amount to: • Establish and maintain a constructive dialogue between the promoter, the affected communities and other interested parties throughout the project life cycle; • Ensure that all stakeholders are properly identified and engaged; • Engage stakeholders in the disclosure process, engagement and consultations in an appropriate and effective manner throughout the project lifecycle. Scope: The nature and extent of stakeholder engagement will reflect the nature and complexity of the project and its stakeholders, the project risks and potential adverse impacts on individuals, communities and other impacted stakeholders, and the sector.	Stakeholder Identification and Analysis Engagement Planning Information Disclosure Public Consultation Free Prior Informed Consent (FPIC) Grievance Mechanism Monitoring and Reporting

4.3.3. Relevant EU Directives

All operations located in the EU, Candidate and potential Candidate countries, which are likely to have significant effects on the environment, human health and well-being and may interfere with human rights, will be subjected to an assessment according to the EU EIA Directive 2011/92/EU. Projects outside of the EU, such as this Project, are subject to an Environmental and Social impact assessment (ESIA) procedure if they are likely to have significant and material impacts and risks on the environment, human health and well-being and interfere with human rights. The ESIA must be consistent with the principles contained in the EU EIA Directive and best international practice. Where EU standards are more stringent than national standards, the higher EU standards are required, if practical and feasible, taking local conditions into account. In such cases the EIB will agree the applicable requirements with the promoter on a project-by-project basis.

The relevant EU Directives are summarised below:

4.3.3.1. Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment, amended in 2014 by Directive 2014/52/EU

The most relevant EU Directive in relation to the Project is EU Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment, as amended by 2014/52/EU (the EIA Directive). This Directive improves the level of environmental protection, with a view to making business decisions on public and private investments more sound, predictable and sustainable in the longer term. EIA is required for all projects in Annex I and for Annex II projects, national authorities have to decide whether an EIA is needed. It also strengthens the need for effective public participation in decision-making, protection and promotion of cultural heritage and strengthen public access to information.

A review against the EIA Directive requirements has been undertaken, to assess whether the Project (all schemes) are listed in Annex I or II of the EIA Directive. The following is applicable in Annex II:

“Water management projects for agriculture, including irrigation and land drainage projects” (Annex II, Article 4(2), Paragraph 1”).

It is considered that the Project falls under Annex II, which implies a case-by-case examination to determine whether an EIA is required taking into account characteristics of the Project and its likely significant effects on the environment.

4.3.3.2. EU Directive 2000/60/EU Water Framework Directive

The objective of this Directive is to establish a framework for protection of inland surface waters (rivers and lakes), transitional waters (estuaries), coastal waters and groundwater. Inter alia, it is aimed at an effective use of water resources and will ensure that all aquatic ecosystems and, with regard to their water needs, terrestrial ecosystems and wetlands meet 'good status' by 2015.

4.3.3.3. Nitrates Directive (91/676/EEC)

The Nitrates Directive (91/676/EEC) aims to improve water quality by protecting water against pollution caused by nitrates from agricultural sources. In particular, it is about promoting better management of animal manures, chemical nitrogen fertilisers and other nitrogen-containing materials spread onto land. It forms an integral part of the Water Framework Directive and is one of the key instruments in the protection of waters against agricultural pressures.

4.3.3.4. Sustainable Use of Pesticides Directive (2009/128/EC)

This Directive aims to achieve a sustainable use of pesticides in the EU by reducing the risks and impacts of pesticide use on human health and the environment and promoting the use of Integrated Pest Management (IPM) and of alternative approaches or techniques, such as non-chemical alternatives to pesticides. The main actions relate to training of users, advisors and distributors of pesticides, inspection of pesticide application equipment, the prohibition of aerial spraying, limitation of pesticide use in sensitive areas, and information and awareness raising about pesticide risks.

4.3.3.5. EU Directive on the Conservation of Wild Birds (2009/147/EC)

The EU Directive on the conservation of wild birds (2009/147/EC), referred to as the Birds Directive, is relevant. Article 1 applies the Directive to the conservation of all species of naturally occurring birds in the wild state in the European territory of the Member States to which the Treaty applies. It covers the protection, management and control of these species and lays down rules for their exploitation; and applies to birds, their eggs, nests and habitats. Article 5 requires the protection of nests and eggs and prohibits deliberate disturbance of these birds particularly during the period of breeding and rearing, in so far as disturbance would be significant having regard to the objectives of this Directive.

4.3.3.6. Council Directive on the conservation of natural habitats and of wild fauna and flora (92/43/EEC of 21 May 1992)

The EU Directive on the conservation of natural habitats and of wild fauna and flora, referred to as the Habitats Directive, aims to promote the maintenance of biodiversity, taking account of economic, social, cultural and regional requirements. It establishes the EU wide Natura 2000 ecological network of protected areas, safeguarded against potentially damaging developments. Animal and plant species listed in the Directive's annexes are protected in various ways.

4.3.3.7. Directive 2003/4/EC of the European Parliament and of the Council of 28 January 2003 on Public Access to Environmental Information

The purpose of the Directive is to ensure that environmental information is systematically available and distributed to the public. The Directive requires Member States to ensure that public authorities are required to make the environmental information they hold available to any legal or natural person on request.

4.3.3.8. Directive 2003/4/EC of the European Parliament and of the Council of 28 January 2003 on Public Access to Environmental Information

The purpose of the Directive is to ensure that environmental information is systematically available and distributed to the public. The Directive requires Member States to ensure that public authorities are required to make the environmental information they hold available to any legal or natural person on request.

4.3.3.9. EU Waste Framework Directive

Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain Directives sets the basic concepts and definitions related to waste management, such as definitions of waste, recycling, recovery. It explains when waste ceases to be waste and becomes a secondary raw material (so called end-of-waste criteria), and how to distinguish between waste and by-products. The Directive lays down some basic waste management principles: it requires that waste be managed without endangering human health and harming the environment, and in particular without risk to water, air, soil, plants or animals, without causing a nuisance through noise or odours, and without adversely affecting the countryside or places of special interest. Waste legislation and policy of the EU Member States shall apply as a priority order the following waste management hierarchy: Prevention, Preparing for re-use, recycling, recovery, disposal. The Directive introduces the "polluter pays principle" and the "extended producer responsibility".

4.4. Gap Analysis

Table 4-6 provides a summary of the main differences between EIB requirements and those set out in national legislation.

Table 4-6. Comparison of National and EIB ESIA requirements

Environmental assessment step	Georgia	EIB
Legislative Sources	Environmental Assessment Code of Georgia (EAC).	EIB Environmental and Social Policy. EU Directives.
Projects requiring EIA	List of projects requiring mandatory EIA and list of projects subject to screening are included respectively in Annex I and Annex II of the EAC.	Set out in Annex I and II of the EU EIA Directive.
Sensitivity of the Project/ Categorization	Not foreseen by the Georgian legislation, however depending on the final project may trigger: Annex II 9. Infrastructure projects: 9.7 Construction of inland waterways;	Annex II: "Water management projects for agriculture, including irrigation and land drainage projects' (Annex II, Article 4(2), Paragraph 1").
Documents to be provided	The EAC Article 10, paragraph 4, defines a list of documents and information to be attached to an EIA report.	ESIA Report
Environmental and Social Management Plan	Not required by the EAC (Article 10 – requirements to an EIA report). In addition, the scope and requirements to an EIA report is defined by a scoping opinion.	Required

Environmental assessment step	Georgia	EIB
Public Consultation and Disclosure	Public participation is part of the EIA procedure (outlined in the EAC).	An EIA process requires appropriate public consultation and information disclosure. Verification that this has been/will be undertaken forms an integral part of the Bank's due diligence process.
Summary Document	Non-technical summary of EIA needs to be enclosed in an EIA report (EAC, article 10).	A non-technical summary is required.
Land Acquisition and Resettlement (LAR)	Not covered in the EIA legislation. Law on Rules for Expropriation of Ownership for Necessary Public Needs	A Resettlement Action Plan or Framework is required.

5. ESIA Approach and Methodology

This Assignment request the update of the previous ESIA prepared for the Project by Eptisa dated August 2018. The Eptisa 2018 ESIA has therefore been supplemented by further analysis of the hydrological, water balance and agricultural impacts and reflects the updated Project as set forth in the updated FS.

The key stages of the ESIA process have covered the following:

- Project Inception
- Policy, legal and institutional review
- Baseline conditions
- Stakeholder engagement
- Impact assessment and mitigation measures
- Cumulative impacts
- Preparation of the ESIA report, ESMP and RPF.

These are discussed in turn below.

5.1. Project Inception

A virtual pre-kick-off meeting was held on 4th August 2021 to start the assignment by understanding the clients' needs and the approach proposed by the consultants to achieve the objectives. The kick-off meeting was attended by:

European Investment Bank

- Aleksandr Bakhtamyan, TA Officer, Consultant Procurement and Contract Management Division
- Giovanni Munoz, Senior Engineer, Projects Directorate
- Maximilian Hagemes, Loan Office, public sector lending operations in Georgia
- Nato Peitrishvili, TA Specialist

Government of Georgia

- Gizo Chelidze, Head of the Hydro-melioration and Land Management Department of Ministry of Environmental Protection and Agriculture of Georgia (MEPA)
- Levan Tabatadze, Head of Projects Management Department of Georgian Amelioration Limited (GA)
- Mikheil Margvelashvili, Head of Donor Organizations Projects Coordination Office of GA

Atkins

- Duraisaminathan Visvanathan, Team Leader
- Pamela Paul, Project Director
- Steven Wade, Hydrology and Climate Change Lead
- George Davies, Assistant Project Manager
- Harald Leummens, Deputy Team Leader
- Adriano de Vito, KE 2 – International Irrigation Engineer
- Katie Prebble, KE 3 – Environmental & Social Lead
- John Roe, KE 4 – Agricultural Economist
- Khatuna Gogaladze, Local Project Coordinator GEO

5.2. Site Reconnaissance

Reconnaissance field surveys have taken place as part of the ESIA work to pre-selected sites to familiarise the ESIA Team with key site locations.

Dates of the reconnaissance surveys and early surveys were as follows:

- 23 October 2021
- 12 December 2021
- 14 December 2021

- 16 December 2021
- 18 December 2021

5.3. Policy, Legal and Institutional Review

The policy, legal and institutional framework review for this Project is described in Section 4 of this report. This covers EIB and national requirements. Understanding the legal and policy framework ensures that the Project has been assessed, as far as possible, against relevant existing environmental and social regulations and guidelines.

5.4. Baseline Conditions

Baseline data has been obtained from the Eptisa 2018 ESIA and has been supplemented where possible with updated statistical data to characterise the existing environmental and social receptors and conditions in the Study Area and is described in Section 5 of this report.

Data requests were made to the following institutions:

- United Water Supply Company of Georgia
- National Environmental Agency, Ministry of Environmental Protection and Agriculture
- National Agency of Mines, Ministry of Economy and Sustainable Development
- National Statistics Office of Georgia
- Relevant literature reviewed is listed below:
- Zemo Samgori FS, Jacobs, December 2007
- Site investigation report – June 2016 (Deliverable 1)
- Conceptual design report – May 2018
- ORIO Application Call for Proposals, Appendix 1: Project description, 2013
- 2nd Advice on the Scoping Report by NCEA – October 2016
- ESIA Report, Eptisa – August 2018 (Deliverable 2)
- Economic and Financial Analysis, Eptisa – Aug 2018 (Deliverable 3)
- Irrigation Strategy for Georgia (2017-2025) – 2017
- 3rd Advisory Review of the ESIA for the rehabilitation of the Zemo-Samgori Irrigation Project, by NCEA – October 2018
- Zemo Samgori Irrigation System Rehabilitation Project – Project plan – May 2018
- Agriculture and Rural Development Strategy of Georgia 2021 – 2027 – December 2019

5.5. Impact Assessment and Mitigation Measures

The purpose of the impact assessment is to identify and evaluate the likely significance of the potential impacts on identified receptors and resources according to defined assessment criteria, to develop and describe measures that will be taken to avoid, minimize, reduce or compensate for any potential adverse environmental effects, and to report the significance of the residual impacts that remain following mitigation.

The assessment presented in this report is commensurate to the level of detail of the options under review as part of the FS.

5.5.1. Technical Scope

The technical scope refers to the range of topics to be addressed in the ESIA. Annex IV, Paragraph 4 of the EIA Directive provides a list of topics to be included in an EIA as *"...population, human health, biodiversity (for example flora and fauna), land (for example, land take), soil (for example organic matter, erosion, compaction, sealing), water (for example hydromorphological changes, quality and quantity), air, climate (for example greenhouse gas emissions, impacts relevant to adaptation), material assets, cultural heritage, including architectural and archaeological aspects, and landscape".*

Table 5-1 summarises the technical topics considered in this ESIA, as identified through the inception phase and confirmed during the impact assessment.

Table 5-1. Technical scope of the ESIA

ESIA Topic	Construction phase	Operation phase
Hydrology and water resources	✓	✓
Aquatic biodiversity and riparian habitats	✓	✓
Terrestrial biodiversity, flora and fauna	✓	✓
Air quality and Greenhouse gases (GHG)	✓	✓
Noise and vibration	✓	✓
Soils	✓	✓
Groundwater resources	✓	×
Water quality	✓	✓
Materials use	✓	×
Waste	✓	✓
Land use, tenure and displacement	✓	×
Cultural heritage	✓	×
Economy, Employment and livelihoods	✓	✓
Community health, safety, and security	✓	✓
Labour and working conditions	✓	✓
Occupational Health and Safety (OHS)	✓	✓
Gender	✓	✓

5.5.2. Temporal Scope

The temporal scope of the ESIA has considered the effects arising from the pre-construction, construction and operation and maintenance (O&M) phases of the Project. Expected timescales for decommissioning are so far into the future that there is insufficient certainty about the likelihood, type or scale of activities to determine the potential effects, and therefore these impacts are considered at a high level only.

5.5.3. Spatial Scope

The spatial scope of the ESIA is described by the geographical area potentially affected by the Project.

The ***Project or Study Area*** refers to the spatial area within which environmental and social data have been collected to assess the effects of the Project. The Project Area covers the Kvemo Kartli and Kakheti regions and Tbilisi City.

The ***Project Footprint*** refers to the total physical area required by the Project. The Project Footprint is taken therefore as the area to be included within the command area for the project (see Figure 2-16 in Section 2).

Additional land may be required temporarily for construction purposes, such as laydown areas, construction workers' accommodation camp, if used, etc., however the location and dimension of these are not currently known.

The ***Area of Influence (AoI)*** is used to describe the extent over which the Project impacts will be realised. The AoI assessed can vary depending upon the type of impact being considered and the attributes of the potentially affected receptors and may also extend across administrative or national boundaries; and therefore, is described in each topic assessment in Section 9 of this report.

Associated facilities are the facilities or activities that are not funded as part of the project and that would not have been constructed or expanded if the project did not exist, and that are essential for the successful operation of the project. This may include access roads.

5.5.4. Identification of Impacts and Assessment of Effects

The purpose of impact assessment is to identify and evaluate the likely significance of the potential impacts on identified receptors and resources according to defined assessment criteria, to develop and describe measures that will be taken to avoid, minimize, reduce or compensate for any potential adverse environmental effects, and to report the significance of the residual impacts that remain following mitigation.

The term ***receptors*** or ***resources*** has been used to describe features of the environment such as water resources, habitats and species which are valued by society for their intrinsic worth and/or their social or economic contribution; and social groups such as individuals and communities that may be affected by the Project.

An environmental or social ***impact*** is defined as any change, potential or actual, to (i) the physical, natural, or cultural environment, and (ii) impacts on surrounding community and workers, resulting from the business activity to be supported.

An ***effect*** is defined as the consequences of change (or impact) acting on the resources and receptors of particular value or sensitivity. Effects are typically described in terms of their significance.

The significance of an effect is determined taking into account the following:

- Receptor: the human/natural environment/economic/social which is potentially going to receive and have to cope with an impact.
- Sensitivity: ability to cope with an impact and/or its importance to Georgia. Criteria which broadly define sensitivity are provided in Table 5-2.
- Magnitude: the size of the potential impact. Impacts may be short term / long term and considered low magnitude (e.g. noise or temporary reduction of income during a short construction project) or high magnitude (e.g. the poor disposal of large quantities of hazardous waste into a water course). Indicative criteria which define magnitude are provided in Table 5-3.

Table 5-2. Illustrative example for determining receptor sensitivity

Importance/ Sensitivity of Receptor	Example of importance of receptors	Example of sensitivity of receptors
Very High	An attribute with a high quality and rarity on an international, regional or national scale with little or no potential for substitution.	Sensitive area or receptor with little resilience to imposed stresses.
High	An attribute with a high quality and rarity on an international or national scale with little or no potential for substitution.	
Medium	An attribute with a medium quality or rarity on a regional scale with limited potential for substitution, or an attribute of low quality and rarity on a regional or national scale.	The receiving environment or receptor has a moderate natural resilience to imposed stresses.
Low	An attribute of low quality and rarity on a local scale (town, site) with potential for substitution locally.	The receiving environment or receptor has a high natural resilience to imposed stresses.

Table 5-3. Illustrative example for determining magnitude

Magnitude	Impact type	Illustrative description
High	Adverse	Loss of resource and/or quality and integrity of resource; impact extends to national or international level.
	Beneficial	Large scale or major improvement to resource quality; enhancement; impact extends to national or international level.
Medium	Adverse	Measurable change in resource quality/integrity; medium loss of key characteristics or features; impact extents to regional level.

Magnitude	Impact type	Illustrative description
	Beneficial	Medium benefit to or addition of key characteristics or features; impact extents to regional level.
Low	Adverse	Minor loss or detrimental alteration to one or more characteristics or features; impact extends to the local level or immediate area.
	Beneficial	Minor benefit or addition of key characteristics or features; impact extends to the local level or immediate area.
Very low / No change	N/A	No change to the current situation.

Once the sensitivity of receptors and magnitude of impacts have been established, potential significant effects have been classified using the following matrix (see Figure 5-1). Assessing the likely significant effects of the road considers the direct and indirect effects, secondary, cumulative and whether the effect is adverse or beneficial. In general, those effects identified as Major or Moderate are considered significant.

		Receptor/resource sensitivity/importance			
		Very high	High	Medium	Low
Magnitude of impact	High	Major	Major	Major	Moderate
	Medium	Major	Major	Moderate	Minor
	Low	Major	Moderate	Minor	Negligible
	Very Low	Moderate	Minor	Negligible	Negligible

Figure 5-1. Impact significance matrix

5.5.5. Mitigation of Effects

For Major and Moderate adverse effects (significant effects) identified through the ESIA, mitigation measures will be proposed that can be practicably implemented to prevent or reduce any significant effects on the environment, to satisfy EIB requirements. The identification of such measures will be undertaken in parallel with the design process so that measures can be incorporated into the Project wherever feasible. Mitigation measures will be considered in line with the following hierarchy:

- **Avoid** - making changes to a project's design or location to avoid adverse effects on an environmental feature.
- **Minimise** - reduction of adverse effects through sensitive environmental treatments/design.
- **Restore** - measures taken during or after construction to repair/reinstate and return a site to the situation prior to occurrence of impacts.
- **Compensate/offset** - where avoidance or reduction measures are not available, it may be appropriate to provide compensatory/offsetting measures. It should be noted that compensatory measures do not eliminate the original adverse effect, they merely seek to offset it with a comparable positive one.
- **Improvement measures** - projects can have positive effects as well as negative ones, and the project preparation stage presents an opportunity to enhance these positive features through innovative design.

Mitigation measures are identified in Section 9.

5.5.6. Residual Effects

The residual significance is the potential effect that remains following mitigation. This more accurately describes the effects of the Project as it is anticipated and forms the basis for the development of the stand-alone ESMP that should be followed so that impacts are satisfactorily mitigated.

5.5.7. Cumulative Impacts

The EIB Environmental and Social Standards and EU EIA Directive require the consideration of cumulative impacts. The cumulative impacts of an action or activity can be viewed as the total effects on a resource, ecosystem, or human community of that action and all other activities affecting that resource. Cumulative impacts may arise as a result of:

- Impacts of interrelationships within the same project on a single receptor; and
- Impacts on a resource, ecosystem, or human community of that action arising from the Project in combination with other existing, planned or reasonably defined developments.

Cumulative impacts are summarised in Section 10.

5.5.8. Reporting

This document presents the ESIA Report for the Project. It forms one of several documents prepared to meet the Assignment requirements:

- **ESMP** – this provides a framework for managing (and avoiding) potential environmental and social risks and impacts for the Project. It comprises of a set of management, mitigation and monitoring measures to be taken during construction and O&M phases to manage key potential environmental and social impacts. It outlines the generic approach (and control processes) to be applied for to the Project in the development and implementation of a more detailed ESMP for Project implementation.
- **RPF** – a Resettlement Policy Framework has been prepared which sets out the framework for addressing potential economic displacement and, if it arises, any potential physical displacement, as a result of the Project.

5.6. Limitations

This ESIA has not included detailed surveys on site e.g. supplementary social surveys or ornithological surveys. As such, it is based at this stage on secondary data sources and a site walkover.

6. Environmental Baseline

This Section presents the baseline environmental conditions in the Project Area. Data sources include:

- Feasibility Study for Rehabilitation of Zemo Samgori Irrigation System, Final Report, Jacobs UK Ltd, December 2007
- Rehabilitation of the Zemo Samgori Irrigation System ESIA, Eptisa, August 2018
- Site reconnaissance survey
- SMHI (Swedish Meteorological and Hydrological Institute) – an exert agency under the Ministry of the Environment in Sweden, which holds data on meteorology, hydrology, oceanography and climatology for locations globally
- CatchX – a platform that provides access to the latest scientific hydrology data with data for each river catchment globally
- National Environmental Agency
- Runoff map of Georgia, Hydrological modelling of water balance, Stein Beldring (Ed.), 2017
- National Environmental Agency
- Secondary data sources on the internet, as referenced
- Social baseline conditions are presented in Section 7.

6.1. General Setting and Topography

The ZSIS is located to the east and south of the Tbilisi City, eastern Georgia, in the South Caucasus[41], a geographical region on the border of Eastern Europe and Western Asia, straddling the southern Caucasus Mountains. Figure 6-1 shows the general topography of the study area.

To the north of Tbilisi City and the study area is the Saguramo Range, to the east and south-east the Iori Plain, and to the south and west various sub-ranges of the Trialeti Range. The Iori river is to the east of Tbilisi and the command area, on the southern slopes of the Central Caucasus, flowing between the Kakheti and Kartli ridges.

The highest point of the ZSIS is at Sioni reservoir, which is 3,236 m asl. The irrigation area of the ZSIS is at elevations between 865 m asl at PHW to 310 m asl at Lemschveniera in the south of the command area.

Figure 6-1. Mountain ranges around the ZSIS

[41] The South Caucasus roughly corresponds to modern Armenia, Georgia, and Azerbaijan.

There are distinct topographies across the command area. The difference in elevation is significant for crop production as crops are planted about 10 days later in the higher elevations compared to the lower ones mainly due to differences in temperature and precipitation, with the higher elevations receiving more rainfall. A broad summary is provided in Table 6-1 covering the five zones that are considered part of the FS (Zone 6 is not included in modernisation due to the heavy investment required).

Table 6-1. Topography of the command area

Command area	Topography
Zone 1 – North-eastern area of the ZSIS command area, closest to the PHW and water intake into the UMC; secondary canals UMC-G01 to UMC-G05	The potentially irrigable area is relatively small, largely due to unfavourable relief and soil conditions in the zone's mountain foothills.
Zone 2 - Eastern area of the ZSIS command area; secondary canals UMC-G06 to UMC-G09 and TUs of the LMMC to Martkopi	Eastern part of terrain between Gamarjeva and Lemshveniera - foothills and intersected slopes along which the main canal was built. The canal has a bed slope of 0.7 m per km but has two chute sections with a total drop of about 25 m. Ujarma - flat, relatively small valleys of the River Lori. Sartichala - Gently rolling terrain intersected with natural drains.
Zone 3 - Central-western area of the ZSIS command area; secondary canals UMC-G10 to UMC-G29	Around Lilo Martkopi, a series of minor plateaus intersected by deep gorges. The surface of the plateaus has a general main slope of about 4% in a southern direction. Around Vaziani, sloping to mildly sloping terrain intersected by natural drains in a southwestern direction ending in flat terrain with a gentle slope in a south eastern direction, east of Gamarjveba.
Zone 4 - Central-southern area of the ZSIS command area; secondary canals LMC-G04 to LMC-G20	Gently undulating terrain with a general sloping of 1-2% in a southwestern direction delimited by steep slopes ending on river terraces of the River Mtkvari. The terrain slopes down in a southern direction and connects with the ridge of Akhali Samgori, oriented in east west direct and which has a steep slope on its northern side. Vartekeli - Undulating terrain created by the incision of natural drains in terrain with a general slope in a southwestern direction. The terrain is incised by deep gullies with the River Lochini as the most important gorge. Akhali Samgori - The ridge consists of a narrow plateau with a slight general slope in a western direction. The slope is gradually decreasing in a southern direction to end in near level terrain dissected by natural drains extending all the way to Lemschveniera.
Zone 5 - South-eastern area of the ZSIS command area; secondary canals LMC-G21 to LMC-G28	This area is defined by terrain with a very gentle slope. Natural drains incised about 10 m into the terrain and connected to Jandara Lake.

6.2. Climate

Georgia exhibits a diverse climate of perennial snow and glaciers in the Greater Caucasus high mountain zone in the north, humid subtropical climate in the west near the Black Sea, and steppe-continental climate in eastern Georgia.

6.2.1. Precipitation and Evaporation

Maps of mean annual precipitation and evaporation of Georgia are presented in Figure 6-2. An irrigation and drainage development study of Georgia identified four climatic stations as being representative of the different agro-climatic zones (Table 6-2)[42], which indicates the annual balance of precipitation to evaporation for each representative zone.

a)

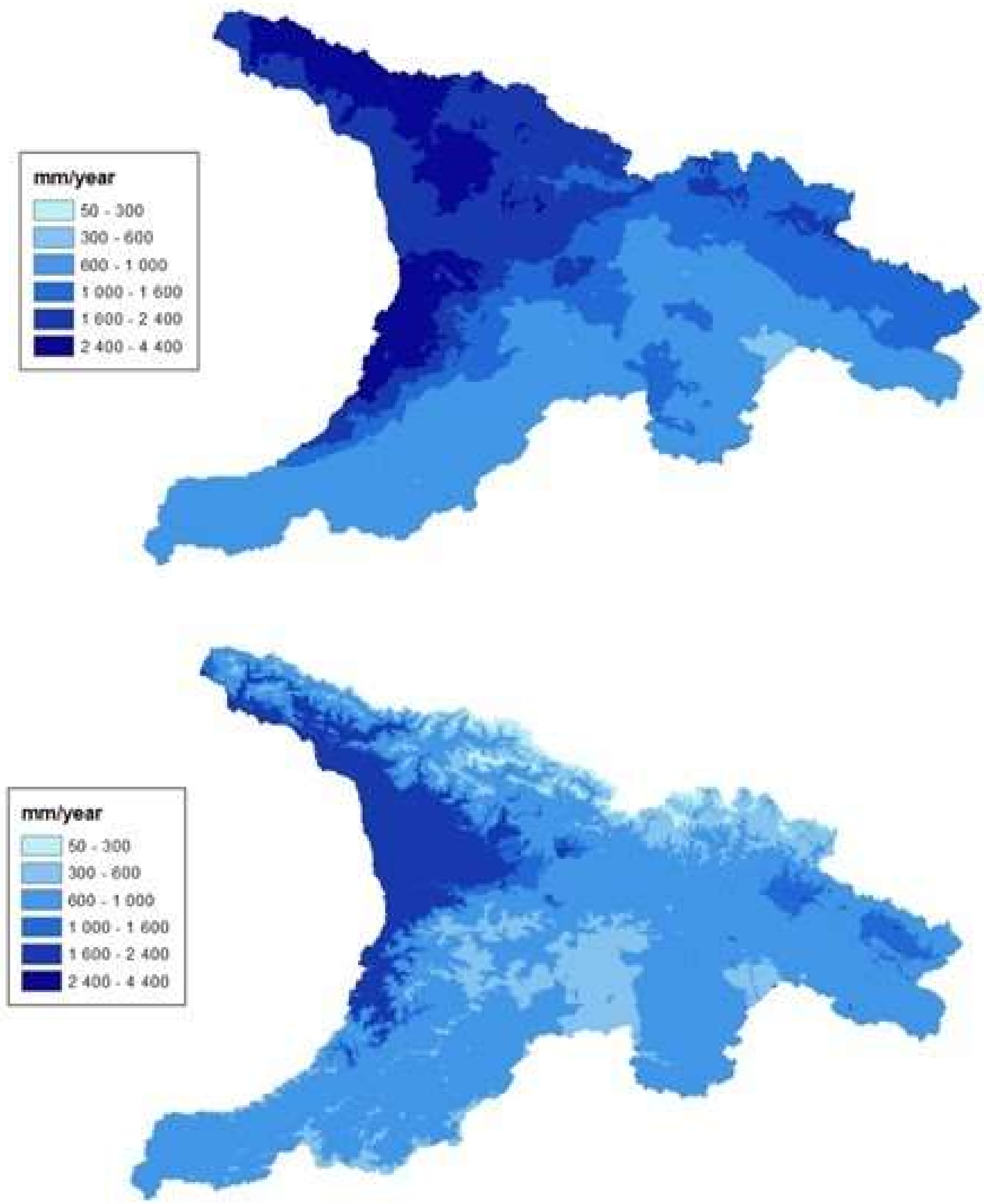


Figure 6-2. a) Mean annual precipitation (mm/year) and b) mean annual evaporation (mm/year) 1961-1990 for Georgia and upstream areas in Turkey and Armenia draining to watersheds in Georgia

Table 6-2. Four weather stations identified as representative of the agro-climatic regions of Georgia, and a summary of their climate

[42] Feasibility Study for Rehabilitation of Zemo Samgori Irrigation System, Final Report, Jacobs UK Ltd, December 2007

Station	Shiraki	Telavi	Tskhinvali	Samtredi
Location	Far south east	East	Centre	Mid-west
Latitude/ Longitude	41° 30 North 46° 50 East	41° 90 North 45° 50 East	42° 20 North 43° 90 East	42° 15 North 42° 30 East
Altitude (m)	555	562	671	26
Annual average rainfall (mm)	546	802	632	1461
Annual average potential evapotranspiration (mm)	814	931	935	928
Annual surplus/ deficit (mm)	-268	-129	-303	533
Summer surplus/ deficit (mm)	-305	-184	-392	-113

Rainfall, temperature and snow depth data were obtained from local weather gauging stations provided by the World Meteorological Organisation (WMO)[43] as well as from the GA and the National Environmental Agency (NEA). Historical climate records from local weather gauging stations however are limited in their data quality and length of record, therefore climate data for the catchments of ZSIS, including Sioni reservoir, Zhinvali reservoir and Tbilisi Sea (with upstream Mtskheta and downstream Tbilisi catchments) were obtained from Swedish Meteorological and Hydrological Institute (SMHI) and CatchX. SMHI provides historical climate (rainfall, temperature, potential evapotranspiration (PET)) reanalysed data and downscaled climate model projections from the SMHI catchment level climate and hydrology portal[44]. CatchX provides monthly precipitation (rainfall and snowmelt), temperature, evapotranspiration and run-off reanalysis data utilised for relevant catchments using the Catchment Water Explorer (CatchX; FAO CLIMWAT PET) [45], which provides a well-established baseline climate data set for Precipitation (P), Potential evapotranspiration (PET) and Actual Evapotranspiration (AET).

Due to limited historical observed climate data, only one gauge provided a sufficient record for comparing against CatchX and SMHI data. A complete daily record is available for Tbilisi (Airport, 41.68N, 44.95E) for the period July-1888 to December-1992. Average monthly climatology for Tbilisi Sea is presented in Figure 6-3, and an annual average timeseries of precipitation and temperature is presented in Figure 6-4 and Figure 6-5, respectively. This comparison indicates consistent seasonal patterns and interannual trends in precipitation and temperature between all datasets, however there is a limited period of overlap between CatchX and Tbilisi Airport records. Raw CatchX data presents a wetter cooler climate than SMHI and Tbilisi Airport (1990-2014), however the CatchX data represents an interpolated aerial average across the larger Tbilisi catchment of ~4,080 km^2, and an average elevation of 816 meters above sea level (m asl), compared to a SMHI's smaller Tbilisi Sea sub-basin data, with a catchment area of ~60 km^2 and average elevation of 623 m asl, therefore a correction of +100 mm precipitation, and -1°C per +100 m elevation change were applied for comparisons in Figure 6-3 to Figure 6-6.

Separate PET estimates are provided for the hydrological model (catchment average PET) and the demand models (crop PET), as the hydrological model requires an aerial average PET value representative for the catchment delineation. CatchX provides actual evapotranspiration from Earth2Observe tier-2 dataset. Earth2Observe dataset is a reanalysis multi-model ensemble that includes land surface and global hydrological models[45,46]. Catchment PET for SMHI was estimated using Oudin's formula[47] from temperature data and global radiation. SMHI catchment PET estimates were comparable with PET estimates in the FS (r^2 = 0.98). CatchX catchment AET (corrected for elevation) also strongly correlated with FS catchment PET estimates (r^2 = 0.80).

[43] Historical climate data: World Meteorological Organisation (WMO) Climate Explorer: Time series (knmi.nl)
[44] https://hypeweb.smhi.se/explore-water/climate-change-data/global-climate-change/
[45] https://ewgis.org/catchx-global/#
[46] Schellekens, J., Dutra, E., Martínez-de la Torre, A., Balsamo, G., Van Dijk, A., Sperna Weiland, F., Minvielle, M., Calvet, J.C., Decharme, B., Eisner, S. and Fink, G., 2017. A global water resources ensemble of hydrological models: the eartH2Observe Tier-1 dataset. *Earth System Science Data*, *9*(2), pp.389-413. https://doi.org/10.5194/essd-9-389-2017
[47] Oudin, L., Hervieu, F., Michel, C., Perrin, C., Andréassian, V., Anctil, F. and Loumagne, C., 2005. Which potential evapotranspiration input for a rainfall-runoff model? Part 2 - Towards a simple and efficient PE model for rainfall-runoff modelling. Journal of Hydrology 303(1-4), 290-306. https://doi.org/10.1016/j.jhydrol.2004.08.026

For crop water demand estimates, AgERA5 derived reference evapotranspiration (ETo) from the Copernicus Climate Change Service (C3S)[48] was obtained. The AgERA5 ETo datasets are estimated using the FAO Penman-Monteith method[49] using the agrometeorological indicators dataset based on the hourly ECMWF ERA5 data at surface level and is produced with a special resolution of 0.1 degree (10 km)[50]. The AgERA5 ETo dataset provided monthly ETo in mm/month for the period 1979-2021 and was obtained for the period 2001-2020, which was converted into daily, monthly and annual ETo (mm) for each 10 km square intersecting the command area. AgERA ETo estimates correlate strongly with FS Penman Monteith estimates ($r^2 = 0.98$) for crop PET for use in the demand model, whereby the feasibility PET was based upon constant monthly estimates of windspeed, relative humidity and sunshine hours.

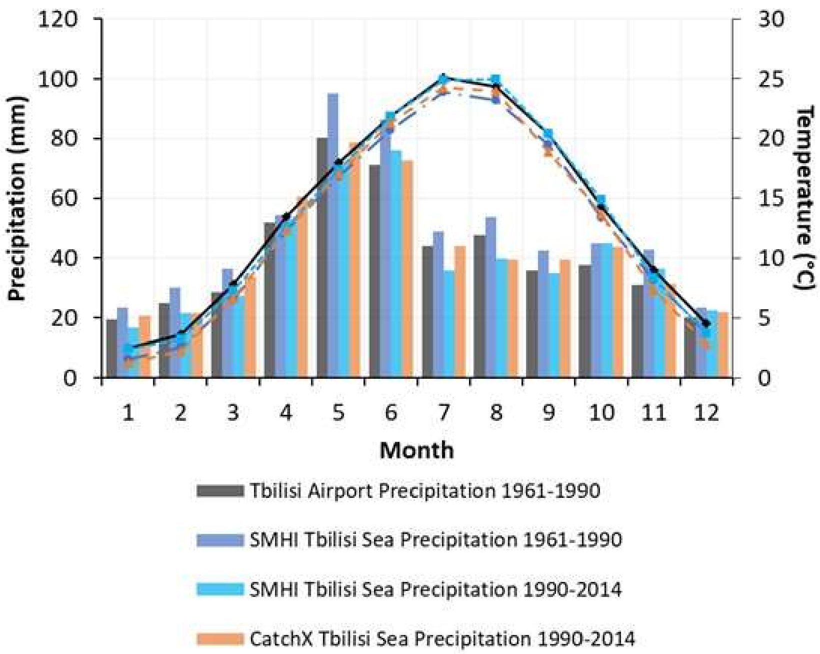


Figure 6-3. Average monthly climatology for Tbilisi Sea catchment for historical Tbilisi Airport weather station, SMHI and uplifted CatchX (based on elevation difference) data.

48 AgERA5 Data Source: https://cds.climate.copernicus.eu/cdsapp#!/dataset/10.24381/cds.6c68c9bb?tab=overview
49 Available at: FAO Penman-Monteith: http://www.climasouth.eu/sites/default/files/FAO%2056.pdf
50 Available at: https://data.apps.fao.org/map/catalog/sru/api/records/e564192d-401b-420a-a72f-70126e360eb5

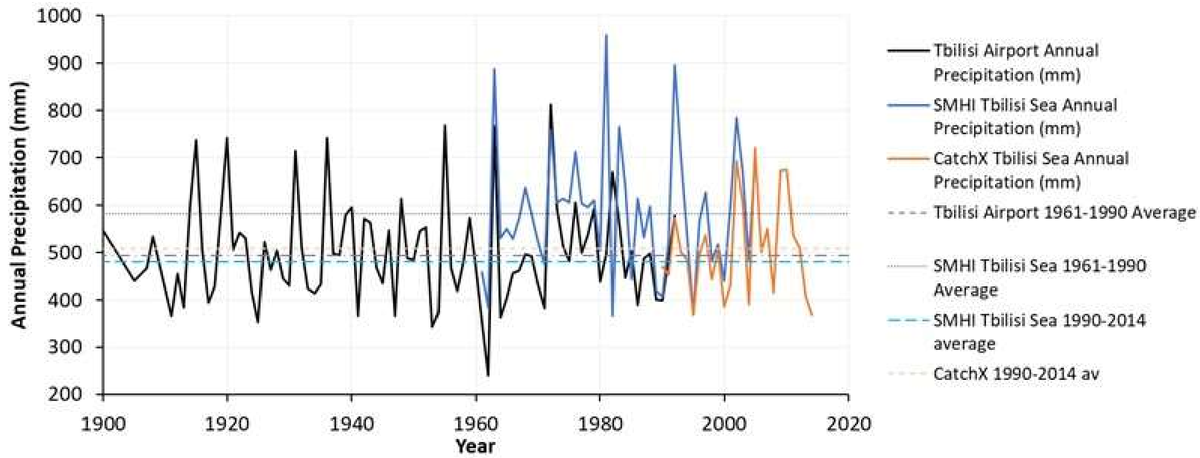


Figure 6-4. Annual precipitation timeseries for Tbilisi Sea catchment for historical Tbilisi Airport weather station, SMHI and uplifted CatchX (based on elevation difference) data. (Long term average values: Tbilisi Airport 1961-1990 = 493 mm; SMHI 1961-1990 = 583 mm; SMHI 1990-2014 = 367 mm; uplifted CatchX 1990-2014 = 508 mm.

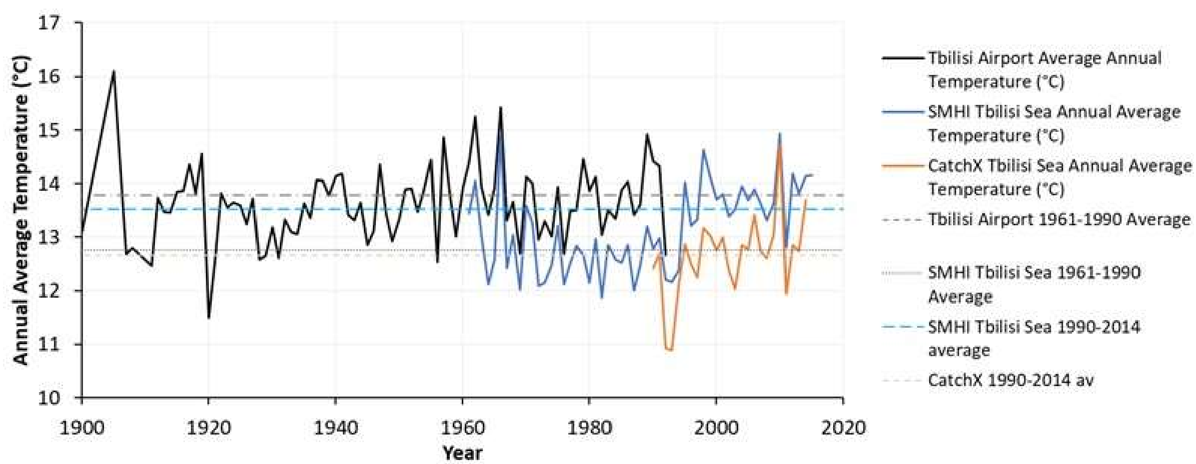


Figure 6-5. Annual average temperature timeseries for Tbilisi Sea catchment for historical Tbilisi Airport weather station, SMHI and uplifted CatchX (based on elevation difference) data. (Long term average values: Tbilisi Airport 1961-1990 = 13.8 °C; SMHI 1961-1990 = 12.8 °C; SMHI 1990-2014 = 13.5 °C; uplifted CatchX 1990-2014 = 12.7 °C.

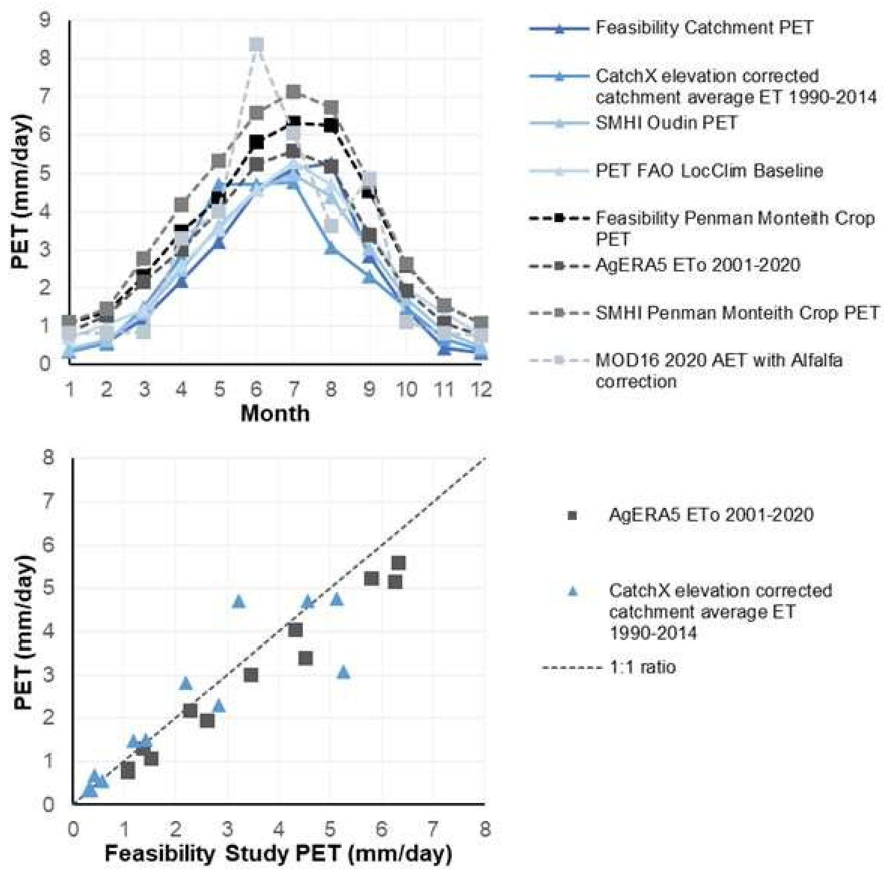


Figure 6-6. Monthly catchment baseline average (1990-2014) evapotranspiration comparison between feasibility report, SMHI and uplifted CatchX (based on elevation difference) data and crop ET (2001-2020) between feasibility report and SMHI Penman Monteith and remote senses sources MOD16 AET with alfalfa correction and AgERA5 ETo.

6.2.2. Sunshine Duration and Solar Radiation

Sunshine duration is measured in hours per month. Due to the topography surrounding the Tbilisi meteorological stations, early morning and late afternoon sunshine is partially occluded. Indicative high (2014) and low (1956) years sunshine durations are provided in Table 6-3.

Total monthly sunshine hours in Tbilisi are shown in Figure 6-7.

No instrumental data are available to quantify incident solar radiation.

Table 6-3. Sunshine hours in Tbilisi for indicative high and low years

	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec
1956	130	74	102	215	219	272	239	271	245	239	134	96
2014	58	111	158	147	203	251	262	265	169	126	65	64

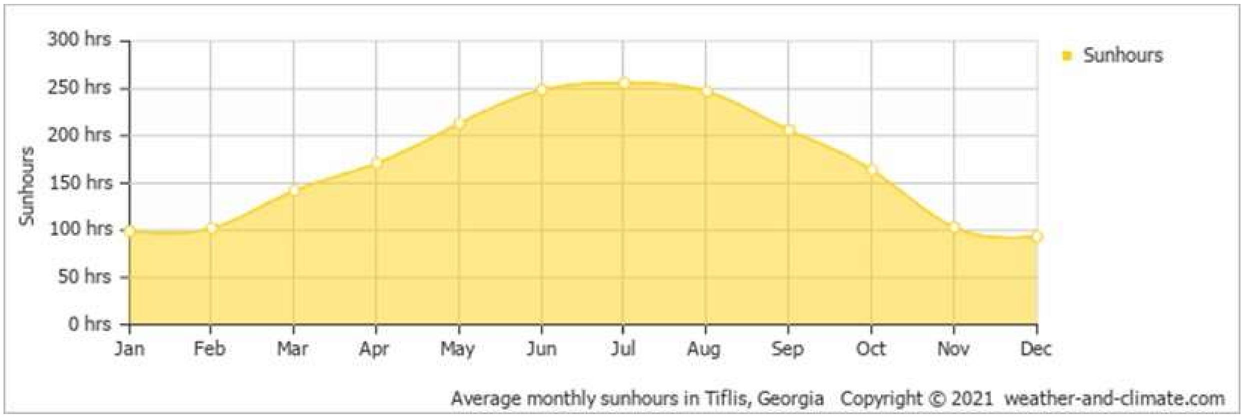


Figure 6-7. Average monthly sunshine hours in Tbilisi Region[51]

6.2.3. Humidity

Humidity data is available for Tbilisi International Airport, close to the ZSIS, and is therefore regarded as representative with regard to the ZSIS. The data below is averaged between 2007 and 2012. Figure 6-8 shows average daily highs in blue, and lows in brown. The relative humidity is shown with percentile bands (inner bands from 25th to 75th percentile, outer bands from 10th to 90th percentile). Humidity varies from 30% to 68% in summer months and 57% to 88% in Autumn months.

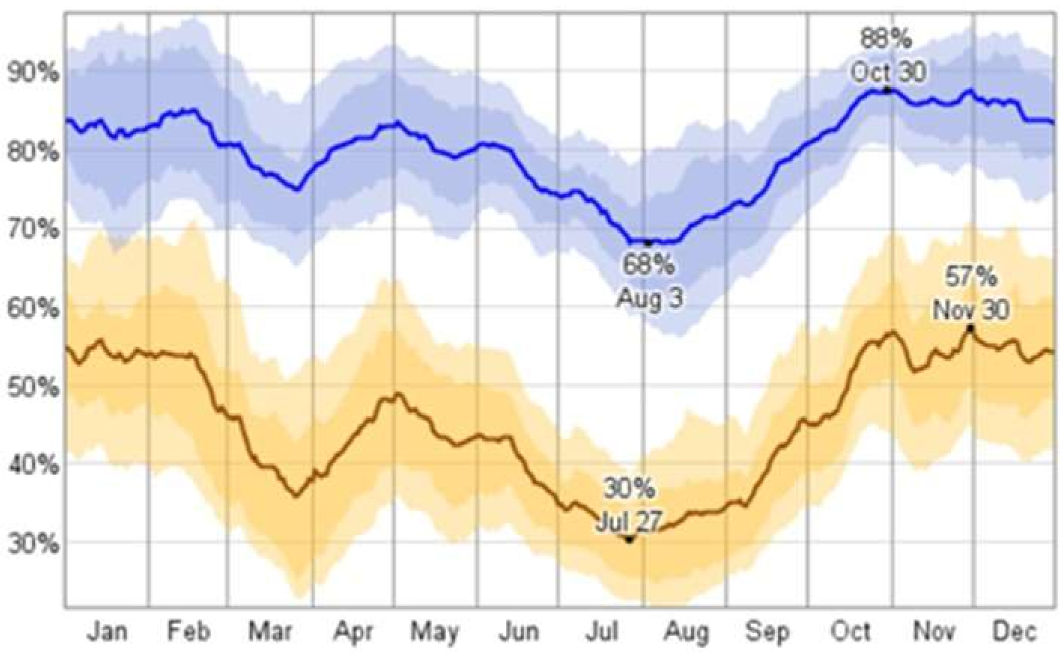


Figure 6-8. Humidity Variation at Tbilisi International Airport[52]

6.2.4. Wind

Monthly wind speed data was obtained in the Eptisa 2018 ESIA Report from the National Environmental Agency (NEA) for two years for Tbilisi. This was compared with wind data gained from various other sources, of which 'WeatherSpark-Beta' was the most informative, as shown in Table 6-4 and Figure 6-9Figure 6-9.

In Tbilisi the average monthly wind speed varies between 9.0 and 10.8 km/hr^{-1}. Over the course of the year typical wind speeds vary from 0 to 43 km.hr^{-1} (calm to strong breeze), and rarely exceed 58 km/hr^{-1} (strong winds). Both average and extreme wind exposure on open water bodies like the Tbilisi Sea and Sioni reservoir

[51] Available at: Average monthly hours of sunshine in Tbilisi City (Tbilisi Region), Georgia (weather-and-climate.com)
[52] Available at: https://weatherspark.com/averages/33784/Tbilisi-Georgia

are known to be high, as is demonstrated by Table 6-5, although the highest wind-run was in the exposed flat area of Tbilisi International Airport.

The prevailing wind direction is north-west (33% of the time) and west (12% of the time). It is least often from the south west (3% of the time) and north (4% of the time).

Table 6-4. Available Monthly Averaged Wind-Speed Data (km/hr^{-1})

Location	Alt (m)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Pasanauri	1,064	3.1	3.7	4.0	4.2	4.0	3.6	3.4	3.3	3.1	3.0	2.8	2.5
Tbilisi met. station	408	4.3	5.2	7.7	7.0	6.8	6.5	5.8	5.6	5.8	4.5	3.8	4.3
Tibilisi International Airport	468	13.3	16.4	21.2	18.7	17.2	20.2	18.0	17.1	15.1	13.5	14.0	13.0
Tbilisi Sea	540	10.8	10.8	9.0	9.0	8.8	Tbilisi Sea	540	10.8	10.8	9.0	9.0	8.8
Sioni Reservoir	1,041	11.1	11.8	11.8	12.6	12.6	12.5	11.8	11.3	11.5	11.4	10.8	10.5

Notes:

1. Pasanauri is 44 km northwest of Sioni reservoir and at a similar elevation but is relatively protected from wind by surrounding mountains.
2. 'Tbilisi m' (Tbilisi meteorological station) has a much longer record than any of the other stations, but is geomorphologically atypical. The values given are the averages of 1956 and 2014.
3. Tbilisi International Airport ('Tbilisi AP') is the wind data averaged for the period 2007-12.
4. The 'Tbilisi Sea' is known to be a very windy and exposed position and is at a similar elevation to most of the lower irrigation area. The wind speed values were roughly estimated – i.e. should be treated with caution.
5. Sioni reservoir wind speeds were computed from data presented in: https://www.meteoblue.com/en/weather/forecast/modelclimate/sioni-reservoir_georgia_611887 .The data appear to be post-1986 averages, but no indication of actual station-years is given.
6. In all stations the maximum and minimum monthly means were about 180% and 15% of the average monthly means.

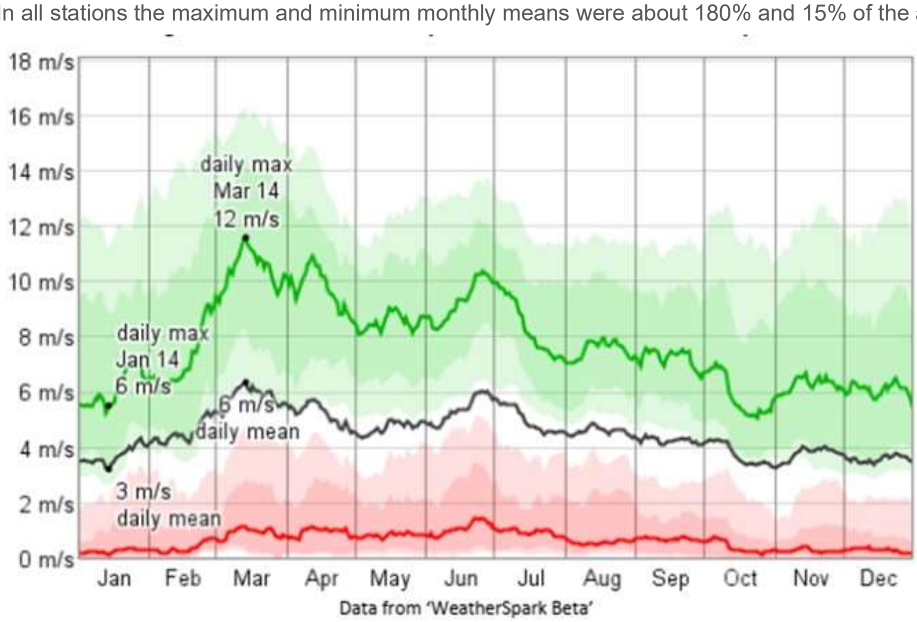


Figure 6-9. Variation in Wind Speed at Tbilisi Airport[53]

[53] Red line shows daily minimums; green line shows daily maximums; and black line shows daily averages

6.2.5. Projected Climate Change Impact

Projected climate data from SMHI Hype[54] provides 36 climate model ensembles across RCP4.5 and RCP8.5 emissions scenarios, including projected and bias corrected daily precipitation and maximum, minimum and average daily temperatures for 1950-2100. Additional SMHI historic observed daily precipitation and maximum, minimum and average daily temperatures are provided for the period 1961-2015 but are summarised for 1990-2014 in line with CatchX available baseline data.

All models were quality controlled, and models with erroneous or unrealistic projections were omitted from further analysis. Three models were selected for application in hydrological models based upon Tbilisi Sea 2050s impact factors (average change in precipitation (%) and temperature (°C) 2041-2060 versus the baseline average for 1990-2014). PET was estimated using Oudin's formula[47]. The selected models are:

1. RCP8.5 ACCESS1-0, referred to as the hot-wet model (+2.48°C warming and +18% precipitation);
2. RCP8.5 MPI-ESM-LR, referred to as the hot-dry model (+1.78°C warming and -14% precipitation);
3. RCP4.5 GFDL-ESM2M, referred to as the warm model (+0.85°C warming and -4% precipitation).

Monthly change factors for the selected model factors (Table 6-5) and other available models indicate how the magnitude and directionality of impact factors varies seasonally, thus signify the importance of incorporating monthly climate change factors to present shifts in the timing of rainfall and snowmelt, which will significantly impact the availability of water temporally.

Absolute values of precipitation, PET and P-PET (mm) were produced by perturbing average CatchX baseline climatology (1990-2014) with SMHI impact factors and adjusted to represent the elevation of each catchment. Projected annual precipitation fluctuates +6% to -24% from historic baseline annual average, with highest precipitation in the Hot Wet model and lowest precipitation within the Hot Dry model. Projected annual PET is set to increase in all models and periods; annual PET fluctuates +2.4% to +18% from historic baseline annual average. The variation in annual PET between models and periods (s.d. = 12-27 mm; coefficient of variation = 2.8%) is significantly less than variation in precipitation (s.d. = 44 - 94 mm; coefficient of variation = 10-12%), therefore the water balance may be more sensitive to projected changes in precipitation. The annual P-PET balance decreases in all models, periods and catchments relative to the historic baseline with the exception of Hot Wet 2032-2041. The balance of annual P-PET is positive for the Iori catchment upstream of Sioni in all models and years (period averages range: 355 - 636 mm). On average all models and periods for Sioni to Paldo Headworks (PHW) exhibit a positive annual P-PET balance with the exception of Hot Dry 2032-2041, however P-PET oscillates around 0 mm for the Warm and Hot Dry models on an annual basis. All catchments further downstream exhibit a negative annual average P-PET balance.

The intra-annual pattern of P-PET indicates a similar overall seasonal pattern across all three models and the historical baseline conditions, with summer deficit or low P-PET and winter surplus or high P-PET, further to large surpluses in Spring upstream of Sioni due to snowmelt. The P-PET balance is increasingly negative further downstream. All models indicate decreasing P-PET balance for the period of May to August. The Hot Wet model estimates large increases in water availability in September, whereas all other models indicate continued drier conditions in Autumn months. However, the Hot Wet model exhibits similar magnitude decreases in June and July P-PET relative to historic baseline as the Hot Dry model. The Warm model exhibits a P-PET pattern similar to the Hot Dry model, but with more conservative decreases in water availability relative to the historic baseline.

[54] Available at: https://hypeweb.smhi.se/explore-water/climate-change-data/global-climate-change/

Table 6-5. Monthly climate change factors for 3 climate models, derived from SMHI Tbilisi Sea projected 2050s impact factors (average change in precipitation (%) and temperature (°C) 2041-2060 versus the baseline average for 1990-2014)

Variable	Climate Change Scenario, Model and Model Impact Description			Monthly Change Factors												Average Annual Change	Units
				1	2	3	4	5	6	7	8	9	10	11	12		
Temperature (°C change)	RCP4.5	GFDL-ESM2M	Warm	0.40	0.21	0.73	0.67	0.94	1.00	0.67	0.82	1.82	0.59	1.34	0.95	0.85 °C	°C
	RCP8.5	MPI-ESM-LR	Hot & dry	0.94	2.95	0.76	2.07	1.37	2.11	1.64	3.23	2.87	1.91	1.57	0.00	1.78 °C	°C
	RCP8.5	ACCESS 1-0	Hot & wet	2.36	3.83	2.74	2.38	2.00	2.37	2.81	2.91	2.57	3.77	2.04	0.01	2.48 °C	°C
P (% change)	RCP4.5	FDL-ESM2M	Warm	31.6	9.0	29.0	-9.0	11.2	-27.2	2.5	-21.5	-19.0	-18.2	3.4	-1.6	-4.0%	mm
	RCP8.5	MPI-ESM-LR	Hot & dry	26.6	25.4	-21.1	20.0	-5.1	-35.5	-21.3	-37.0	-50.2	-22.2	17.7	-39.1	-13.9%	mm
	RCP8.5	ACCESS1-0	Hot & wet	60.1	-39.9	36.5	27.7	38.2	-19.2	-3.3	53.3	68.8	-14.4	1.4	6.9	18.0%	mm
PET (% change)	RCP4.5	FDL-ESM2M	Warm	4.9	2.1	6.0	3.8	4.2	3.8	2.3	2.7	7.3	2.7	10.1	10.6	4.1%	mm
	RCP8.5	MPI-ESM-LR	Hot & dry	12.5	42.4	6.2	12.2	6.2	8.1	5.4	10.8	11.8	9.9	11.3	0.2	9.4%	mm
	RCP8.5	ACCESS1-0	Hot & wet	35.4	54.0	25.6	13.9	9.5	9.0	9.7	9.8	9.7	20.2	16.5	0.0	13.3%	mm
P-PET (% change)	RCP4.5	GFDL-ESM2M	Warm	8.6	2.3	11.4	-9.9	8.4	-31.1	-0.5	-13.5	-13.7	-11.8	-0.1	-1.2	-36.9%	mm
	RCP8.5	MPI-ESM-LR	Hot & dry	6.6	1.0	-12.1	9.1	-11.1	-43.6	-17.7	-27.2	-32.7	-16.4	5.9	-11.9	-108.4%	mm
	RCP8.5	ACCESS 1-0	Hot & wet	10.3	-20.4	7.8	14.4	33.0	-28.3	-10.5	22.5	33.0	-14.7	-1.9	2.1	37.1%	mm

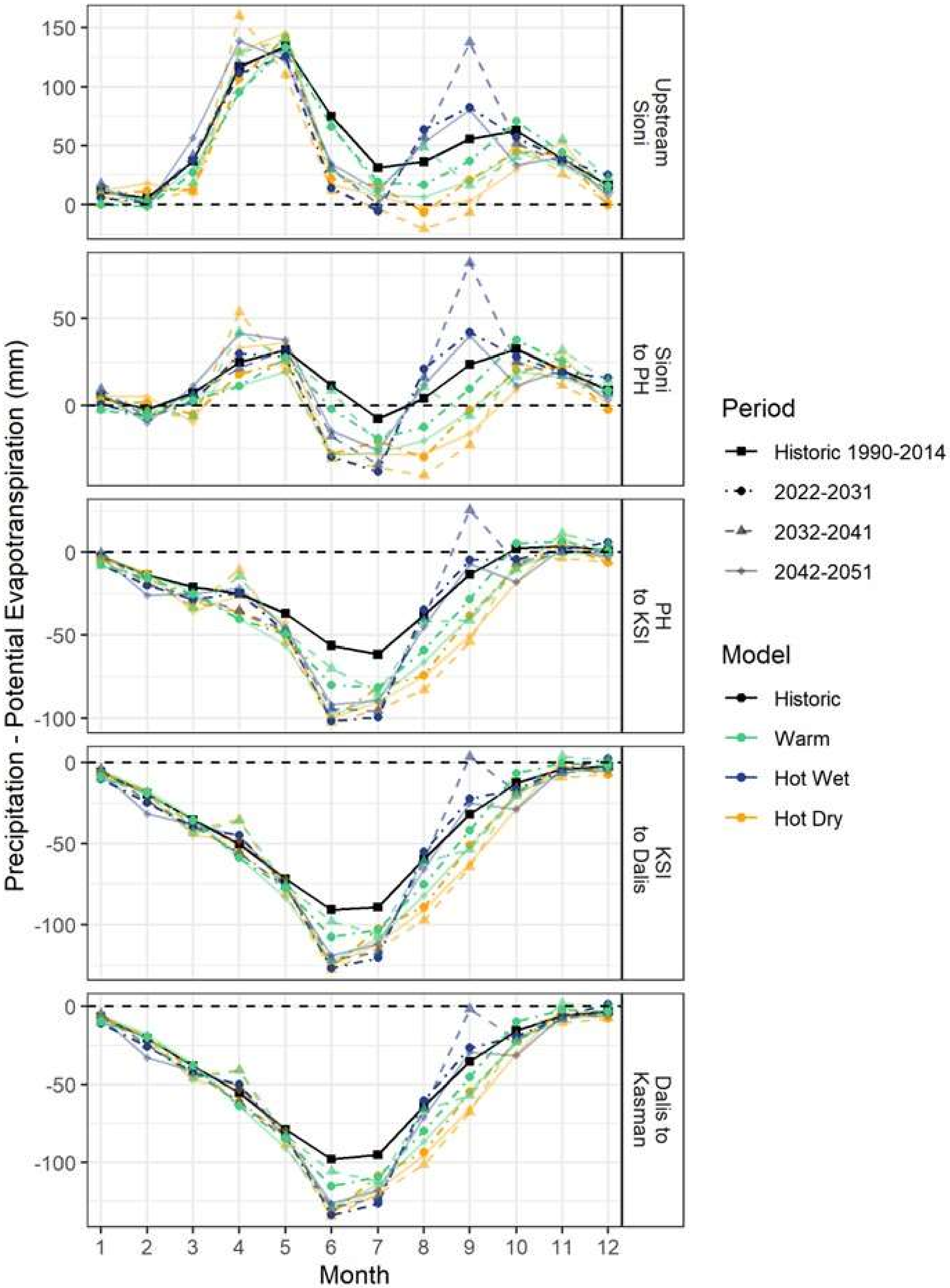


Figure 6-10. Monthly catchment periodic average precipitation minus potential evapotranspiration (P-PET; mm). P-PET here represents water availability as rainfall + snowmelt – evapotranspiration (PET represents catchment average PET used for catchment rainfall-runoff modelling).

6.3. Water Resources

Georgia's water resources include 45 reservoirs, with a total capacity of 3.3 km^3 and a total area of 163 km^2. They have a primary purpose of irrigation and hydroelectric production and a secondary purpose of water supply and recreation. They also have a flood control function and regulation of seasonal and annual river runoff.

The ZSIS is part of a complex regional water infrastructure developed during the Soviet era. As mentioned in Section 2, it covers the following water resources (

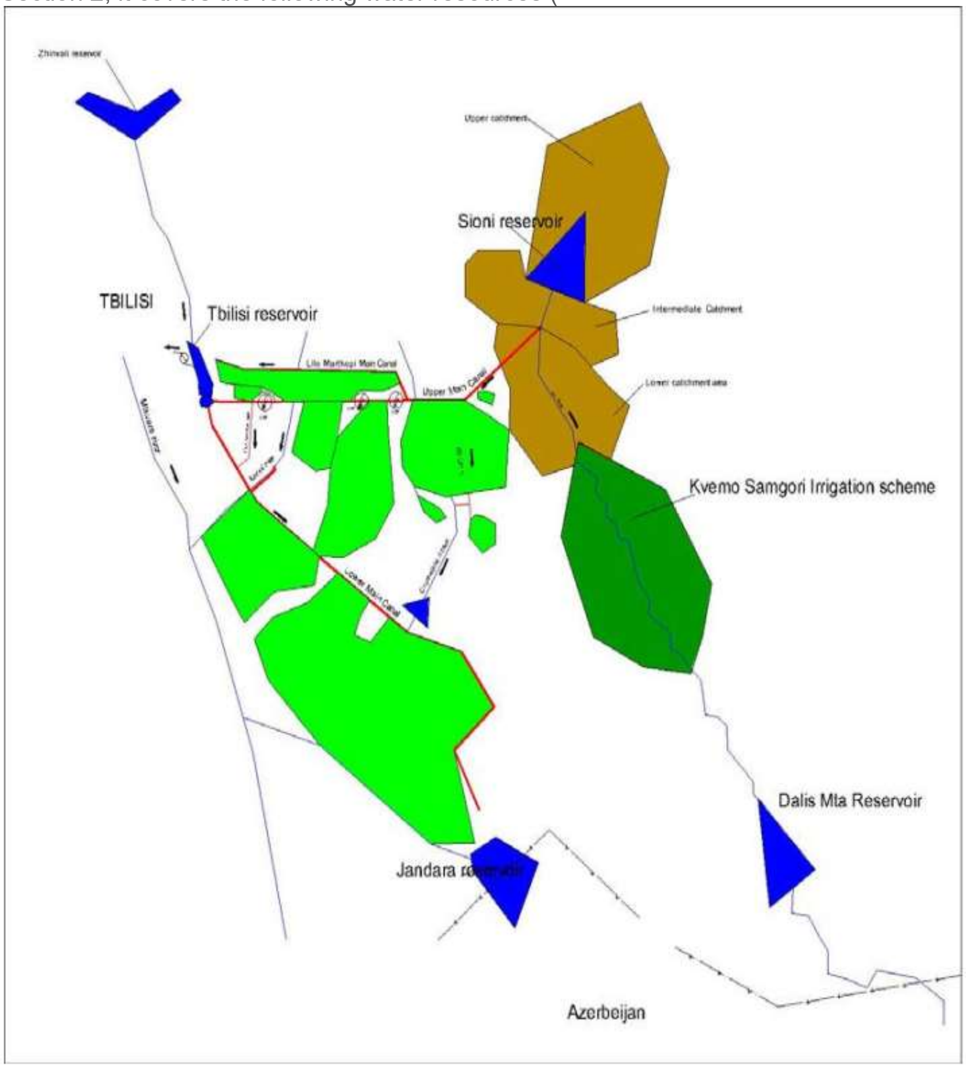


Figure 6-11):

- Iori River - which provides irrigation water to the UMC
- Chumatkhevi Creek – providing water from the UMC to the LMC
- Tbilisi Sea - which provides irrigation water to the LLMC
- Lochini River - inlet (feeder canal) from Lochini River to LMC
- Canals forming the LMC, LMMC and UMC
- Other water resources in the Project Area that are not within the 2022 FS include:
- Mtkvari (Kura) River - from which water can be pumped into the LMC
- Aragvi River and the Zhinvali Reservoir – which feed Tbilisi Sea
- Groundwater from the alluvial sediments of the River Aragvi floodplain terraces
- Jandara Lake - feed from the Kura River via the Gardabani canal and drainage from the LMC
- Dalis mountain reservoir ("Dalis Mta") - providing water sources downstream of the ZSIS on the Iori River

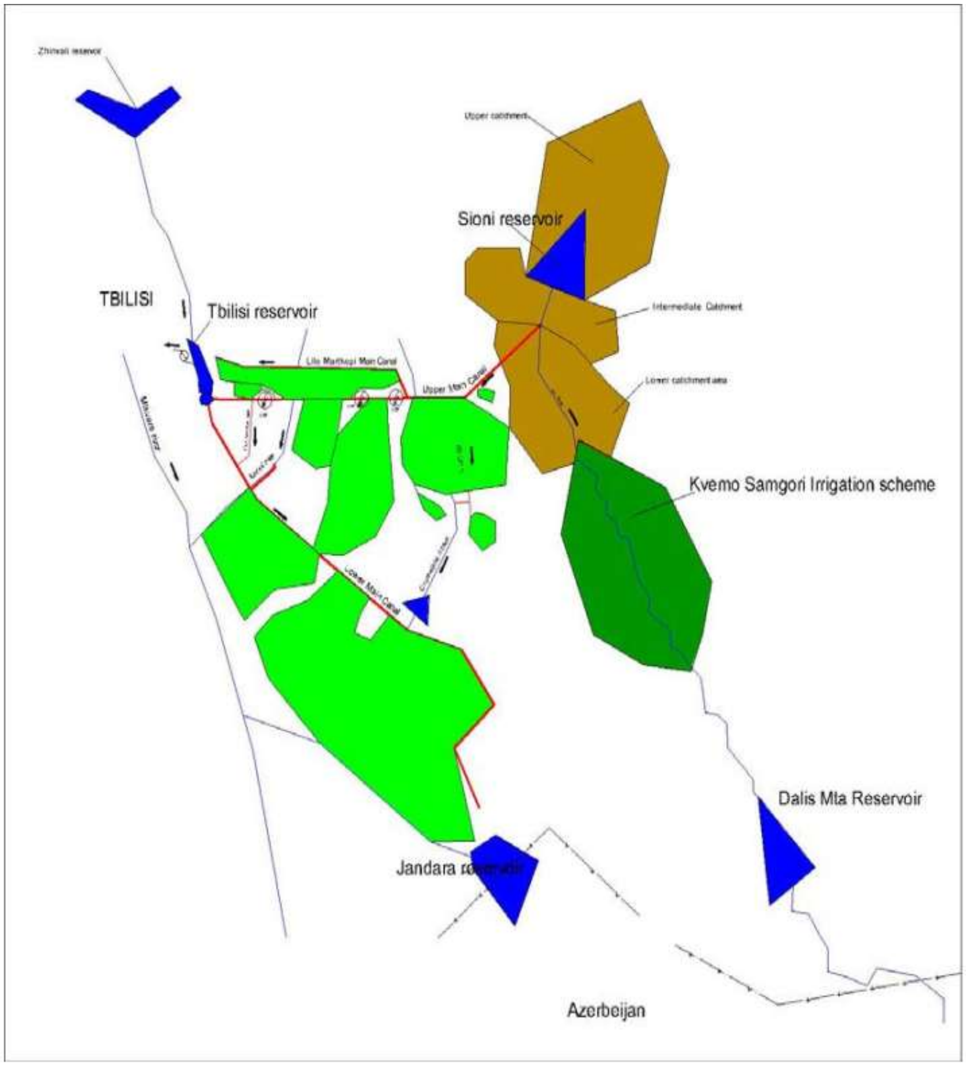


Figure 6-11. Key water resource features in the study area

6.3.1. Alazani-Iori River Basin

The Alazani-Iori River Basin (AIRB) covers the territory of Kakheti region, as well as the territory of Tianeti municipality of the Mtskheta-Mianeti region. Alazani and Iori River basins span a diverse range of landscapes stretching from the Greater Caucasus Mountains of Tusheti in the north at an altitude of 2,600-2,800 m asl, to the Alazani valley and the steppes and semi-arid lowlands of Vashlovani in the southeast. Landcover of the Alazani-Iori River basin consists of 31% forest, 22% arable land and 16% meadows and steppes used as hay-pastures[55].

Flow and tributaries of the Alazani-Iori River Basin are fed by 40% groundwater, 31% rainwater and 29% snowmelt. Flow is characterised by high waters in spring, stable low waters in winter and flash waters during heavy rains in spring and summer (Alazani discharge is distributed 37% spring, 31% summer, 21% autumn, 11% winter).

The ZSIS falls within several river catchments, mainly the Tbilisi catchment with the source water from the Iori being in the Iori river catchment. These river catchments are shown in Figure 6-12.

[55] European Union Water Initiative Plus for Eastern Partnership Countries (EUWI+): Results 2 and 3 ENI/2016/372-403 DEVELOPMENT OF DRAFT RIVER BASIN MANAGEMENT PLAN FOR ALAZANI-IORI RIVER BASIN IN GEORGIA

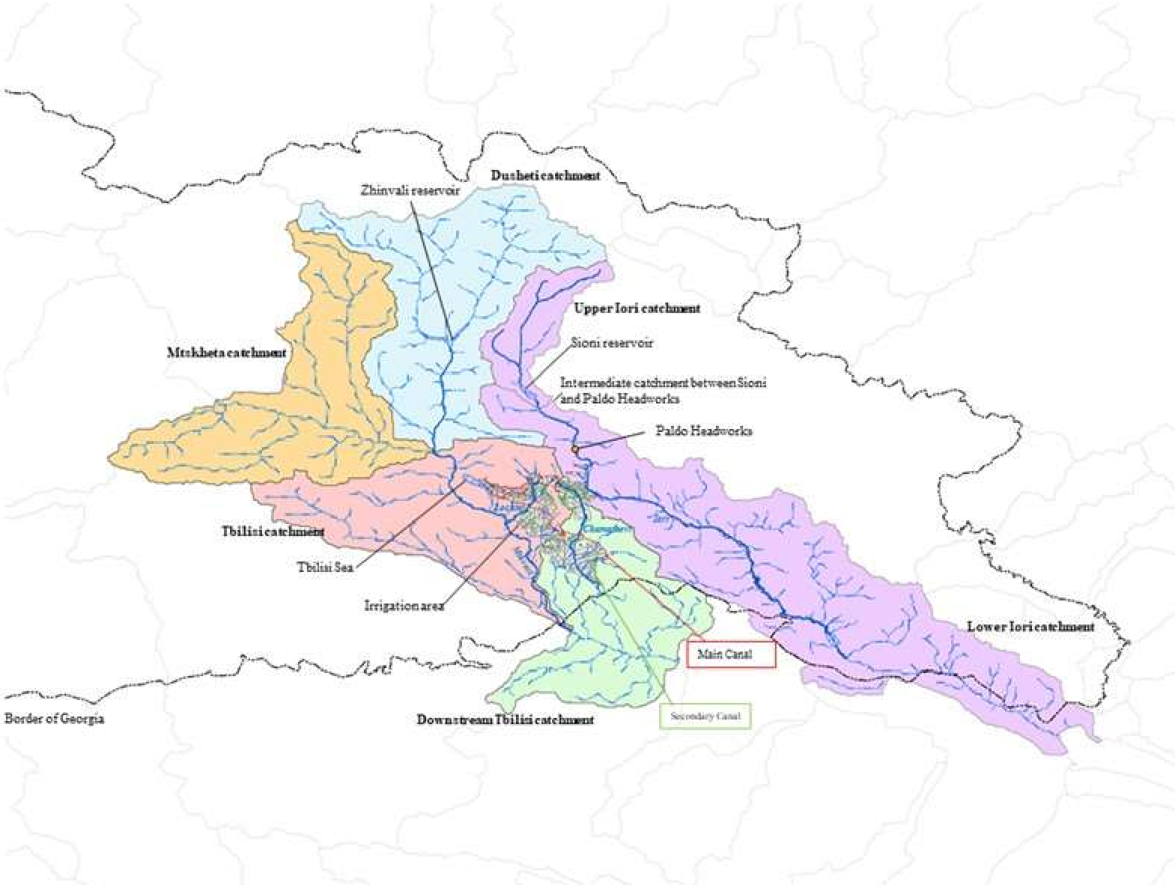


Figure 6-12. Hydrological catchment map of Georgia and the ZSIS Study Area

The Alazani-Iori River Basin was formerly an intensely monitored and studied river basin of Georgia. Hydrological observations commenced in Georgia in the year 1905 and more than 450 hydrological stations were used for observations in rivers, reservoirs and lakes during the 20th century, 42 of these were based within the Alazani-Iori River Basin. Most of these stations were operational between 1940-1990 but only four hydrological stations remain operational today. Figure 6-13 shows the hydrological stations within Georgia that were used for modelling flow for the period 1961-1990. Groundwater monitoring was resumed in 2013 by the Geology Department of National Environmental Agency (NEA), with a groundwater monitoring network across 33 monitoring wells.

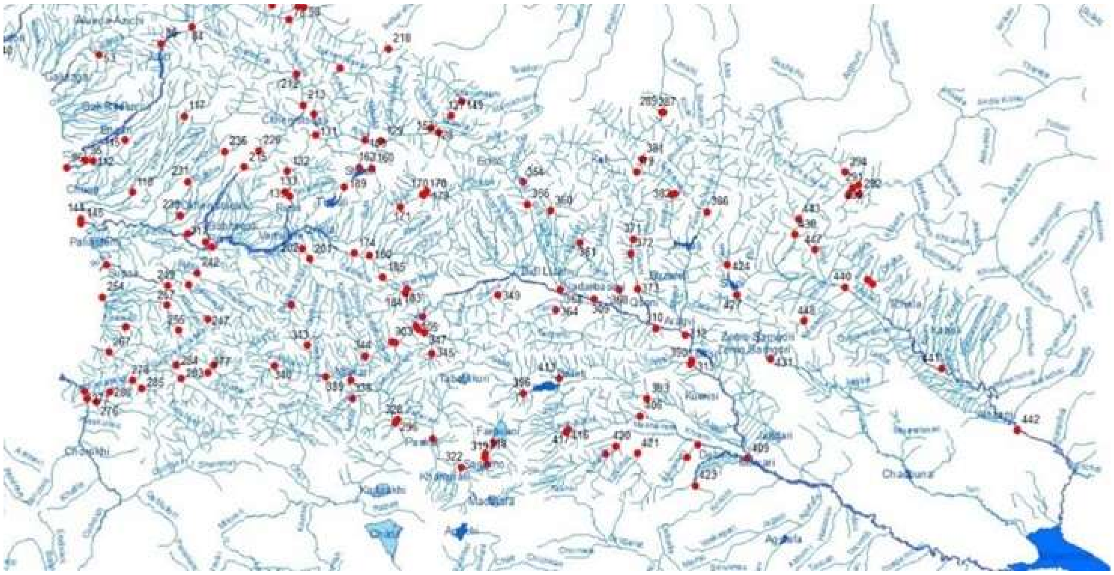


Figure 6-13. Hydrological stations in Georgia used for calibration and validation of the hydrological model

The main drivers of pressure within the Alazani-Iori River Basin are water abstraction for irrigation, hydropower plants, drinking water, fish farming and sand/gravel mining. After hydropower generation (92%), irrigation and domestic water use account for the biggest water intake (4.5%). In 2016, water abstraction in the Alazani-Iori River Basin was approximately 1,177 Mm^3, of which 25.13 Mm^3 was extracted from groundwater aquifers. Additional hydro-morphological pressures include impoundment effects, hydropeaking, habitat continuity interruption, barriers to fish migration and river continuity and modification to river morphology. These pressures are compounded by climate change impacts, whereby increasing frequency and length of drought will exacerbate the negative environmental impacts of abstraction and reduce water availability for HPP and irrigation. Increases in the occurrence and magnitude of heavy rainfall events will also increase the risk of floods and mudslides, which will have negative impacts on riparian habitats. Additionally, high rainfall events place additional pressure on already damaged dams and infrastructure, increasing the risk of dam failure which will endanger downstream populations.

6.3.2. Iori River

The Iori River has a total length of 320 km, a drainage basin of 4,650 km^2 (1,800 sq mi), a total fall of 2,520 m and an average slope of 78.7%. The river originates in the Greater Caucasus Mountains in eastern Georgia and continues into Azerbaijan, where it is also known as Gabirry (Qabirry) and flows into the Mingachevir reservoir, which is drained by the river Kura. The main tributaries are the rivers of Khashrula (12 km), Sagome (18 km) Adedi (16 km), Gombori (13 km), Lapinakhevi (10 km), Ragolantskali (12 km), Lakbe (32 km) and Ole (29 km).

The Iori River also interacts with Georgia's three largest irrigation reservoirs; the Sioni reservoir (0.3 km^3), the Tbilisi Sea reservoir (0.3 km^3) and the Dalis Mta reservoir (0.18 km^3).

The Iori River supplies water to the ZSIS, consisting of two subsystems: Upper Samgori (starting at the Sioni Reservoir and ending at the Tbilisi Sea) and Lower Samgori (starting at the Tbilisi Sea and ending in the vicinity of Jandari Lake). PHW on the Iori connect to the UMC, allowing transfer for water supply to the ZSIS. The ZSIS receives on an average 148.79 Mm^3 per annum from the Iori and was designed to irrigate 41,000 ha originally, relative to a total area of 469,000 ha across Georgia.

Further downstream of the PHW, the Iori river provides irrigation water to the Kvemo Samgori Irrigation system; and to the Dalis Mta reservoir in Georgia; and the Mingechevir reservoir in Azerbaijan (which also receives water from the Kura River).

Eptisa (2018) reported that there have been three gauging stations in the upper Iori River, the last of which ceased operation in 1994. Since then there have been sporadic attempts to measure the discharge, but with no continuity of data collection. These sporadic records could not be traced.

Gauging was by means of twice daily manual stage readings, at 8 a.m. and 8 p.m. In 1980 there was an attempt at automated stage measurement, at 6 readings per day. No details of this automation could be traced.

Rating curves were said to be recalibrated annually, although only two rating curves were sighted, a decade apart, with at least 20% variation in the depth profile. The methodology for rating curve calibration, ‘instrumental’, was too vague to be helpful in assessing data quality.

The gauging stations, run by the Hydrological Department of the NEA were:

- Iori Lelovani station, upstream of the reservoir, operational during the years 1938 to 1994, but with a few extended gaps in the record. No data more recent than 1986 could be traced for this study.
- Iori Orkhevi station, downstream of the reservoir, operational between 1946 and 1961, and again between 1963 and 1992. The latter interval was post-dam, and hence did not measure the natural discharge, but the controlled discharge.
- A third gauge, Iori Orchamati, location uncertain, was flooded by the reservoir.

Eptisa found that all three gauges are effectively destroyed, and urgently in need of replacement.

6.3.2.1. River Flows

River flows in the Iori River upstream of Sioni reservoir can be estimated by calculating snowmelt and runoff; a simple model can reproduce the data in the previous feasibility report and Average monthly simulated runoff is significantly correlated with gauged Iori V. Lelovani runoff and gauged Sioni reservoir inflows (Figure 6-14, r^2 = 0.959 – 0.929).

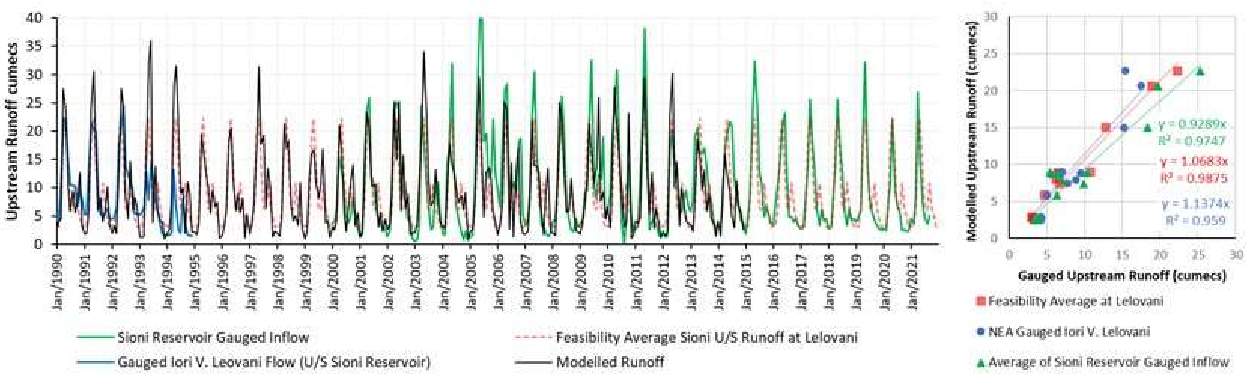


Figure 6-14. Monthly simulated and gauged Iori River flow upstream of Sioni Reservoir (cumecs) timeseries (left) and average scattergraph (right)

Average simulated monthly runoff patterns are presented in Figure 6-15. Within the Iori River, historic simulated runoff peaks within the month of May upstream of Sioni Reservoir (mean = 60.8 Mm^3) with a sharp rising limb in March due to snowmelt and low evaporative demand. Runoff recedes throughout the summer, maintained at ~ 23 Mm^3 through Autumn and declines to ~ 7Mm^3 in winter months. Runoff peaks within June and July in catchments between Sioni Reservoir, PHW and KSIS offtake. Due to a negative P-PET balance in downstream catchments, runoff generated within catchments is typically baseflow. Due to high summer PET and abstractions concentrated over summer months, monthly hydrographs and catchment runoff plus upstream release produces a peak flow in April and October in downstream catchments.

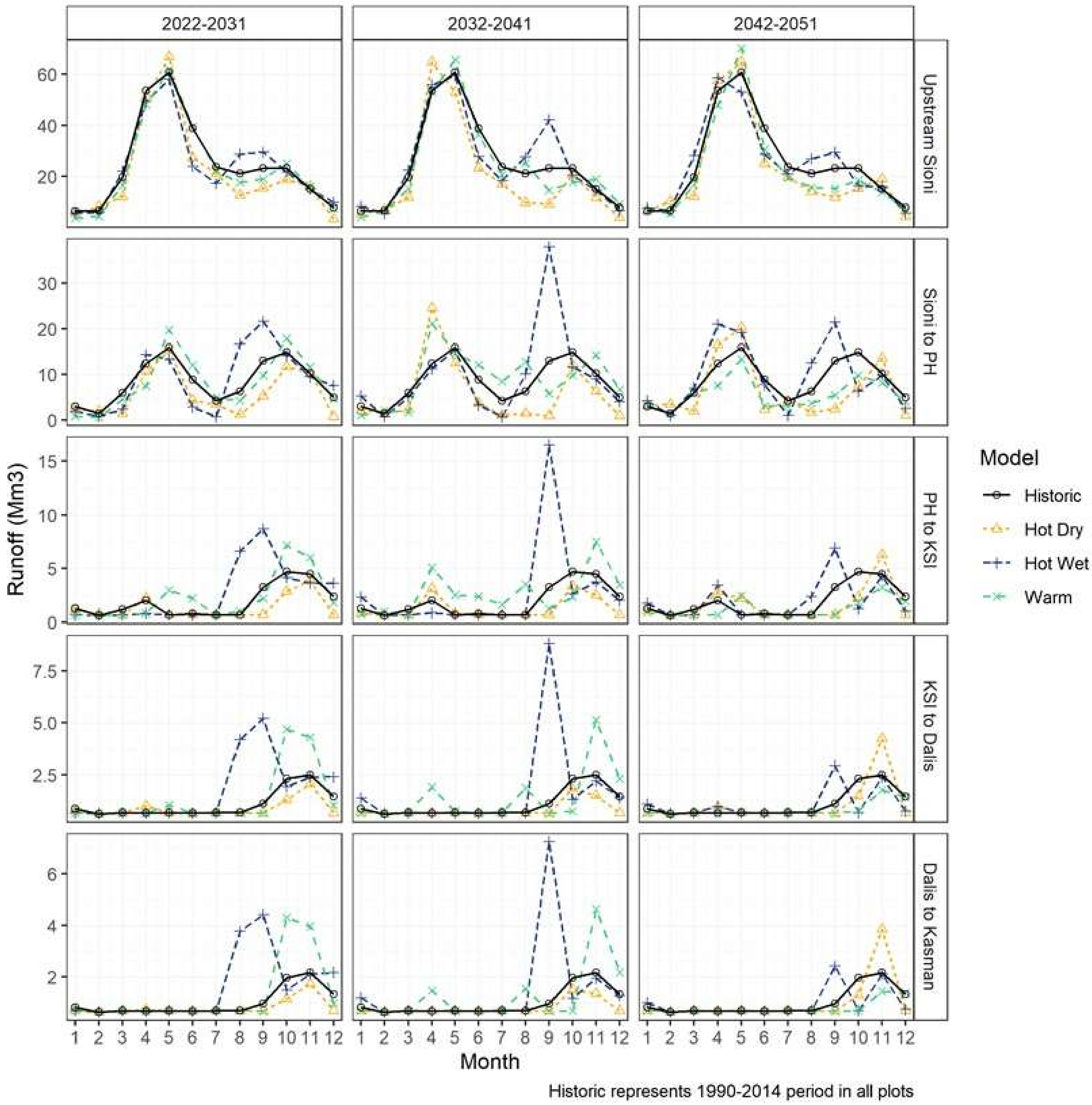


Figure 6-15. Monthly catchment periodic average runoff (Mm^3)

Projected changes in monthly P-PET have modified the distribution of simulated runoff annually. The main differences between models and relative to historic simulated runoff are summarised below:

- Upstream Sioni: runoff is reduced for the period of June to October; however, the Hot Wet model increases runoff in August and September.
- Sioni to PHW: hydrograph shapes differ between periods and models but mimic the historic hydrograph shape. The Hot Wet model observes the greatest modification to the shape of the hydrograph, with greater runoff than historic averages in August and September. The Hot Dry model observes large decreases in runoff May to October.
- PHW to KSIS: Projected monthly patterns are similar to historic, however the Hot Wet model predicts sooner and higher magnitude Autumn peak runoff, whereas the Warm model predicts slightly increased

Autumn runoff, and the Hot Dry model reduced Autumn runoff. These changes are less prominent for the 2042-2051 period.

- KSIS to Dalis Mta Reservoir and Dalis Mta Reservoir to Kasman Irrigation System (KIS), Azerbaijan: hydrograph shapes differ between periods but largely reflect the same changes to historic runoff as those predicted for PHW to KSIS.

Despite decreasing summer runoff upstream, increasing water availability within shoulder seasons downstream indicate the potential to store surplus water within Spring to meet Summer demand, and to replenish reservoirs in Autumn following peak demand.

Annual summaries of runoff (Table 6-6) indicate that the amount of downstream Iori river runoff after irrigation and other water use abstractions are projected to increase in all periods within the Hot Wet model (+ 48 Mm^3 / +31% to +67.5 Mm^3 / + 44%), with 2032-2041 representing the wettest period and 2042-2051 the driest period. The Hot Dry model estimates decreases downstream runoff in all periods (- 31 Mm^3 / - 20% to -12 Mm^3 / -8%), however 2042-2051 represents the wettest period. The Warm model estimates increased runoff in 2022-2031 (+ 32 Mm^3 / + 20%) and 2032-2041 (+ 49 Mm^3 / + 32%), but projects decreased runoff in 2042-2051 (- 27 Mm^3 / -18%) relative to baseline average runoff. This highlights the uncertainty of the impacts of projected climate change and emphasises that changes in water availability are not necessarily linear with time (i.e., it cannot be assumed that 2050's impact will be greater than 2030's impact), thus water demand assessments, irrigation system design and economic analysis should incorporate this uncertainty.

Table 6-6. Mean runoff generated within the catchment or within the catchment plus upstream release.

Model	Historic Modelled*	Warm			Hot Wet			Hot Dry		
Period	1990-2014	2022-2031	2032-2041	2042-2051	2022-2031	2032-2041	2042-2051	2022-2031	2032-2041	2042-2051
Runoff at Sioni reservoir	300.1	281.5	287.2	267.3	287.2	309.2	298.1	259.0	237.6	260.7
Runoff generated between Sioni reservoir and PH	101.2	98.2	110.6	68.8	105.7	114.5	113.5	69.0	69.6	78.0
Sioni to PH Runoff + Upstream release	401.3	389.1	398.6	346.9	400.9	417.0	418.0	341.7	307.1	339.2
Lochini river, Chumatkhevi creek and Tbilisi Sea catchment contributions	31.1	30.1	42.7	19.2	29.2	30.8	34.1	30.5	21.6	29.9
Intake into ZSIS at PH (average for 2000-2021)	135.4	125.9	122.6	119.6	124.7	123.6	120.5	116.9	97.4	109.9
Runoff generated between PH and KSIS	22.7	26.9	32.0	15.0	31.4	32.1	24.3	15.5	15.3	19.4
PH to KSIS Runoff + Upstream release	289.1	290.1	308.1	242.2	307.6	325.4	321.8	240.2	225.0	248.7
Intake into KSIS (average for 2018-2021)	175.0	133.8	128.0	132.6	133.2	129.0	134.0	134.5	120.4	129.9
Runoff generated between KSIS and Dalis Mta Runoff	12.8	16.3	16.7	9.9	20.7	19.7	12.8	10.4	9.9	12.6
KSIS to Dalis Mta Runoff + Upstream release	126.8	172.6	196.7	119.5	195.1	216.1	200.5	116.1	114.5	131.3
Runoff generated between Dalis Mta and Kasman	11.8	15.1	15.1	9.4	18.5	17.4	11.5	9.5	9.4	11.7
Dalis Mta to Kasman Runoff + Upstream release	138.6	187.7	211.8	128.9	213.7	233.5	212.0	125.6	123.9	143.1
Water generated from Georgia Iori catchment	448.5	438.0	461.6	370.4	463.5	492.8	460.2	363.4	341.8	382.4

Total water use by Georgia from Iori river	310.5	259.8	250.6	252.2	257.9	252.6	254.5	217.8	239.8	257.9
catchment water remaining in the Iori river after irrigation and other water use abstractions	138.0	187.7	211.8	128.9	213.7	233.5	212.0	125.6	123.9	143.1
% of water remaining in the Iori river	30.9	42.9	45.9	34.8	46.1	47.4	46.1	34.6	36.2	37.4

** It should be noted that the 1990-2014 historic flows are modelled historic flows based on a monthly mass balance model, and not actual historic flows. They account for a 10% EFR.*

It is estimated that on average 41% of the runoff from the Georgian catchment remains in the Iori river after irrigation and other water use abstractions are considered, except hot and dry climate scenario in this forthcoming decade (30.8%). However, the actual release depends on the operations of ZSIS & KSIS intakes and Dalis Mta & Sioni reservoirs.

6.3.3. Sioni Reservoir

Most of the active storage related to the ZSIS is within the Sioni reservoir. The Eptisa 2018 FS identified that the estimated active storage capacity, related to the interpolated 1,068.3 contour, is 311 Mm^3.

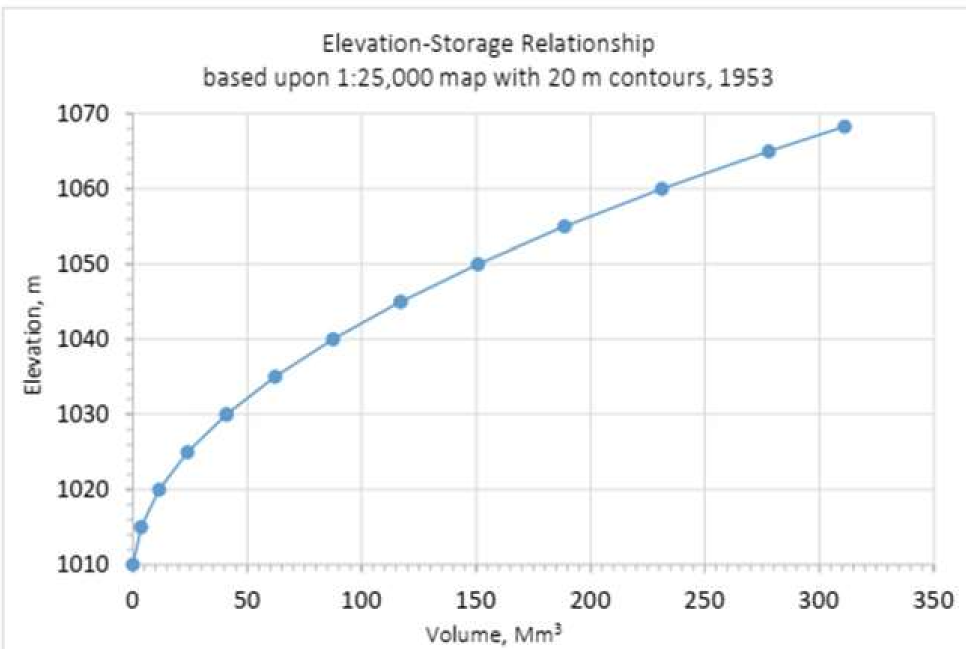


Figure 6-16. Computed elevation-storage relationship for Sioni Reservoir

6.3.4. Tbilisi Sea

Tbilisi Sea is an artificial lake in the vicinity of Tbilisi that was opened in 1953 and that serves as a reservoir, starting from a series of natural depressions occupied by three small saline lakes (Kukia, Ilguniani and Avlabari). Four closure dams were built to create a 320 Mm^3 reservoir. The lake has a length of 8.75 km and a width of 2.85 km. The surface area of this reservoir is 11.6 km2 (4.5 sq mi).

It provides for management of drinking water to Tbilisi and irrigation to the lower part of the ZSIS (via the LMC), with water secured from two sources, the Zhinvali Reservoir on the Aragvi River, and via the UMC from the Iori River Catchment.

The quoted storage for the 'Tbilisi Sea' is the total storage. The dead storage is 155 Mm^3, so the active storage, as shown in Figure 6-17, is the difference between quoted storage and dead storage.

The design maximum and normal active storages are 174 and 152 Mm^3, as opposed to the effective maximum active storage of about 65 Mm^3. The full supply level is 548 m while the effective maximum water level allowed is 539.60 m. The design storages are now regarded as unsafe.

According to the last 10 year record (2010-2020), on an average 34.68 Mm^3 per annum of water was let into the LMC from the Tbilisi sea. Nearly 76.10 Mm^3 per annum entered into the Tbilisi Sea for the same period.

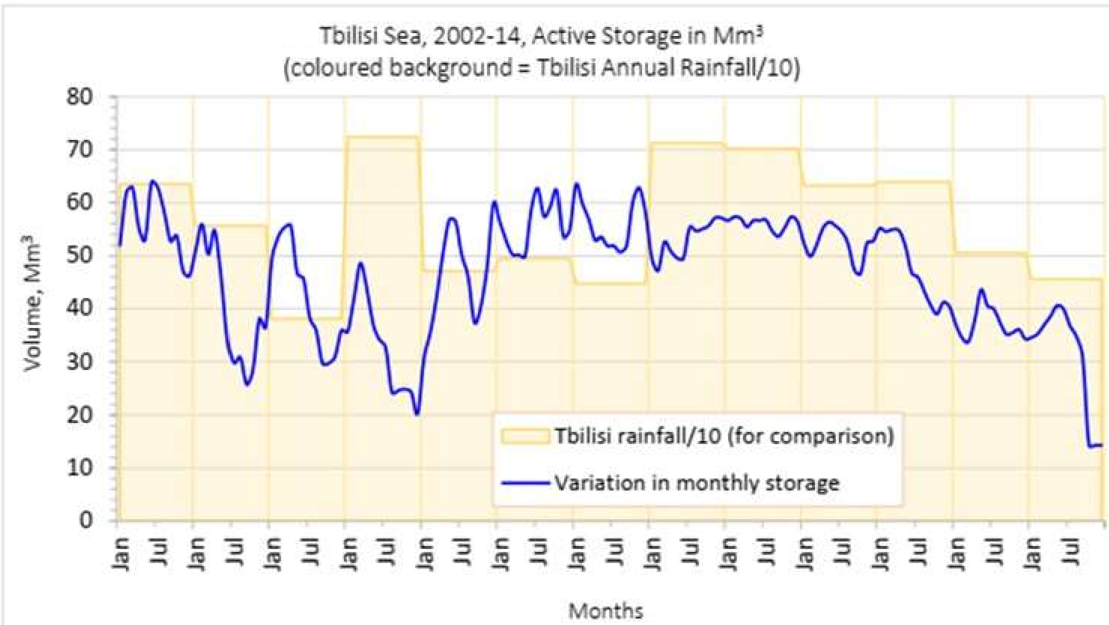


Figure 6-17. Tbilisi Sea Storage 12 year record to 2014

To maximize the reservoir storage, two concrete dams were constructed along the North Western fringes, and two earth dams were built along the southern fringes of the reservoir to raise the water elevation to maximum 548 m above sea level:

- Dam No. 1 - 237 m in length, comprising 11 sections with a maximum height of 7 m.
- Dam No. 2 - 290 m in length, comprising 14 sections with a maximum height of 14 m.

As water levels approached the design capacity, significant losses of water occurred through the weir foundations. Water losses averaged 120 l/s and several concrete blocks subsided by as much as 80 mm. Subsequently, the water level in the reservoir was decreased by between 10 and 16 m.

Between 1957 and 1959, a vertical grout screen was constructed in the vicinity of dam No.1 and, during 1964 to 1965 when the reservoir was refilled, filtration losses were observed to have decreased by a factor of 13.

However, no equivalent grout screen was constructed at weir No. 2, where a combination of sulphate salt dissolution and sediment removal due to suffusion increased water losses by a factor of 8 (from 1 l/s to 8 l/s).

In 1973 or 1978, when the reservoir water level was close to original full design capacity with the water level at 542 m above sea level, two major sinkholes ("gryphons") were observed along the southern flanks of the reservoir. When water levels in the reservoir were lowered to between 535 and 536 m, one of these leaks stopped flowing and the other was considerably diminished.

The reservoir level was lowered for remedial works, which comprised backfilling of the sinkholes and the grouting of the foundations of no 2 dam. The grouting of Dam 2 was not completed, (only 135m out of a total dam length of 286 m) but was abandoned when it was decided to hold the reservoir down to 539.6 m level.

In 2002 a new observation network was constructed at 9 sites, involving a series of boreholes along each of 27 sections radiating from the reservoir. The issues of leakage appear to have ceased.

6.3.5. Chumatkhevi Creek

Chumatkhevi Creek starts above the UMC and currently discharges water diverted from the UMC into the creek. The creek also collects groundwater as it flows downstream. Part of the water from the creek is taken out at the LMC intake, the rest goes towards Jandara Lake. Along its route water is extracted by pumps and at least one gravity canal from private initiatives of farmers.

6.3.6. Mtkvari (Kura) River

The Mtkvari river is internationally known as the Kura River. The Mtkvari River runs in the broad and deep valley between the Greater Caucasus and the Lesser Caucasus mountains. It starts in Turkey and flows through Georgia then Azerbaijan, via the Mingechevir reservoir (the largest body of water in Azerbaijan) before flowing into the Caspian Sea. Around 435 km of the river is in Georgia, where it flows to the west of Tbilisi. The Aragvi River is a tributary of the Mtkvari River.

The Mtkvari River feeds water into Jandara Lake via the Gardabani Canal.

6.3.7. Aragvi River and the Zhinvali Reservoir

The Aragvi River is a tributary of the Mtkvari River. The Zhinvali reservoir is located on the Aragvi River.

The Zhinvali reservoir was commissioned in 1985 and is intended as a seasonal reservoir without carry over from year to year. Transfer infrastructure (the “tunnel” between the Bodorma reservoir and Tbilisi reservoir) was designed and built for 12 m^3/s to supply drinking water (5 m^3/s) and irrigation water (7 m^3/s) to the ZSIS. The average inflow to Zhinvali reservoir exceeds 1.2 Bm^3 of which 370 Mm^3 can be stored in the Zhinvali reservoir and used.

The Eptisa 2018 ESIA Report states that there is in principle water available from the Zhinvali reservoir but the quantity available is estimated to be in the order of 100 Mm^3 per year or 58 Mm^3 over a period of 7 months, but this is subject to the actual leakage from Tbilisi Sea and to water requirements for drinking water, in cases the flow in the main conduit is interrupted for maintenance and repair purposes beyond the one month period of the year, when the water in Zhinvali reservoir is considered to be too loaded with sediment for consumption.

6.3.8. Lochini River

The Lochini River is a tributary of the Mtkvari River, with a length of 30 km and a river basin area of 207 km^2. There is an inlet (feeder canal) from the Locini River to the LMC. It contributes 1.2 m^3/s to the LMC.

6.3.9. Gardabani Canal

The canal transfers water from the Mtkvari River to Jandara Lake, to the south of the ZSIS.

6.3.10. Groundwater

Groundwater resources in Georgia equate to 21.7 km^3 (or 573 m^3/s) which represents 43% of annual runoff from the area of Georgia and 23% of annual precipitation. Groundwater resources are distributed unequally with 65% in western Georgia, 25% in eastern Georgia and 13% in southern Georgia.

The Alazani-Iori River Basin is also a rich underground water resource with 23 aquifers in contact with surface ecosystems that need to be protected and managed.

According to the Eptisa 2018 ESIA, the Aragvi River floodplain terraces provide groundwater in the Project Area.

6.4. Drainage

Due to the morphology of the command area served by the UMC, LMMC and LMC canals, drainage is not a significant concern for the agriculture activities. The water table is well below crops root depth. No swamps or mashes have been noted during the Eptisa site visits. Surface waters are naturally drained by the topographic features and the cross slope of the sub-areas, which guarantee gravity flow. On the contrary, erosion is a problem especially along the unlined canals generally crossing the upper belts of the command areas along the maximum slopes.

Drainage water from the Chumatkhevi Creek is either diverted to the LMC or, together with the drainage water from the catchment areas of G18 to G28, and all natural creeks which flow across that part of the irrigation scheme, is diverted to Gardabani Canal and Jandara Lake. This only occurs in periods when there is excess water within the ZSIS, and in recent years it is understood this condition has not been met therefore no water has been diverted into Jandara Lake from the ZSIS.

6.5. Downstream Water Users

The main water users downstream of the PHW on the Iori River are as follows:

- **Gravel quarry** which uses river water for washing river gravel. The water is in principle returned to the river but with a heavy sediment load.
- The **fishponds and irrigation schemes at Khashmi and Patardzeuli** are located near the Iori fish farms. The recorded irrigated area in 2021 is 270.17 ha, which includes 70 ha of fishing ponds, and the recorded water intake is 6.1 Mm3 (data from GA). The potential area for irrigation in Khashmi is 300 ha[56] and this area is famous for the unique grape species –Khashmi Saperavi. The estimated annual irrigation requirement is 3.28 Mm3 and the fishpond requirement is maximum of 3 Mm3.[57] The Khashmi irrigation canals were rehabilitated in May 2016 with the state funds.
- **Kwemo Samgori Irrigation System (KSIS).** The KSIS is planned to irrigate 24,541 ha, nearly equally between right main canal (RMC) (12,096 ha) and left main canal (LMC) (12,445 ha). However, the average irrigated area in the last four years is only 6,706 ha (Table 6-7). However, the proposed development is considered, after discussion with the GA, as 21,000 ha[58].

Table 6-7. KSIS Irrigated area and measured inflow

Year	Irrigated Area(ha)			Annual Irrigation Delivery (Mm^3)			Annual Irrigation Delivery (Mm^3/ha)		
	RMC	LMC	Total	RMC	LMC	Total	RMC	LMC	Total
2018	3,608	1,129	4,737			148.0	-	-	31,241
2019	5,697	2,582	8,279	60.0	53.0	113.0	10,532	20,528	13,649
2020	4,790	2,237	7,027	35.5	38.1	73.6	7,411	17,029	10,473
2021	4,793	1,989	6,782	32.3	37.6	69.9	6,739	18,909	10,307
Average	4,722	1,984	6,706	42.6	42.9	85.5	8,227	18,822	11,477

The annual irrigation inflow per ha analysis indicates that the irrigation water consumed by LMC is more than the double by RMC due to the following factors:

- RMC is being converted to pressurised system, whereas the distribution in LMC is still under open channel irrigation system.
- Nearly 78% of the LMC command area is farmed by small farmers (< 5 ha), whereas only 16% of the RMC command is farmed by small farmers. The existence of large farms may have influence on the efficient use of water in RMC than LMC.
- The projected irrigation demand in 2020s, if the canals and other distribution networks are rehabilitated, operated and maintained well, is estimated at 7,915 m^3/ha or 142.5 Mm^3 per annum to irrigate 18,000 ha.
- **Irrigation scheme at Kasman village**, which is a border village in Azerbaijan, gets its supply from the canal from the Iori/Gabirri river. The command area for this irrigation scheme is 1,522 ha[59]. This is the last irrigation scheme before the Gabirri river drains into Mingechevir reservoir. Estimated irrigation requirement for the command area is 15.03 Mm^3 per annum.
- **Dalis Mta reservoir**: Dalis Mta reservoir was constructed in the 1980s to supply the arid lands in the lower zone of Iori Plain water (approximately 1,600 ha) with irrigation. It has a total capacity of 180 Mm^3 and a live storage of 140 Mm^3. The irrigation system, which had to irrigate Iori Plain was never built. Currently, the use of this resource for irrigation is actually impossible, as its operational outlet needs some rehabilitation.

[56] Available at: | საქართველოს მელიორაცია | Georgian amelioration (ag.ge)
[57] Personal communication with the "Georgia Golden Resort", who owns the Mukhrovani Lakes.
[58] Modernisation of the KSIS RMC is ongoing under a WB financed project. Modernisation of the KSIS LMC is planned with the financial support from the ADB.
[59] United Nations (2011), "Second Assessment of Transboundary Rivers, Lakes and Groundwaters", at Economic Commission for Europe – Convention on the Protection and Use of Transboundary Watercourses and International Lakes, ISBN 978-92-1-117052-8

- **Mingechevir reservoir:** the reservoir serves several purposes to include hydroelectric power production and water storage for irrigation. Mingechevir reservoir, behind the dam, supplies water to the Upper Qarabag and Upper Sirvan Channels which help irrigate about 1,000,000 ha of farmland in Azerbaijan. It has a storage capacity of 15,730 cubic kilometres, covering 605 km^2. The reservoir receives water from the Kura River (Mtkvari River in Georgia), Alazani River and the Iori River.

Downstream users of the ZSIS:

- **Four HPPs on UMC, industrial users and water supply to village household plots**. The previous study assessed there to be 15.6 Mm^3 of water per annum from the UMC used for industrial water supply purposes.
- **Tbilisi Sea** – as identified earlier, the Tbilisi Sea receives water from the UMC (as well as other sources). Tbilisi Sea is used for potable water supplies to Tbilisi. The previous study assessed 6 Mm^3 of water flowed from UMC into the Tbilisi Sea for use by GWP for Tbilisi water supply, though this water is provided from the Zhinvali reservoir on the Aragvi River.
- **Jandara Lake** is also supplied with water from Mtkvari River via the Gardabani Canal. Water from the ZSIS only flows as drainage towards Jandara Lake when there is excess water and therefore there has been no flow from the LMC to Jandara Lake for a number of years.

6.6. Transboundary Agreements

Jandara Lake is situated downstream of the ZSIS on the Georgian-Azerbaijani border. The lake is supplied with water from Mtkvari River via the Gardabani canal with a capacity of 15 m^3/s. The Gardabani canal transits into a natural water course to which the tail drain of the LMC and the secondary and tertiary canals of LMC canal (starting with and downstream of G15, including most of G15, G15-1, G15-2 and G15-3) connect. The GA signed a new agreement with the equivalent institution in Azerbaijan (Amelioration Irrigation Open Joint Stock Company (AIOJSC) on 22nd February 2018 for the supply of 57 Mm^3 of water to Jandara Lake through Gardabani irrigation canal. Out of the 57 Mm^3, 20 Mm^3 is envisaged to preserve the environmental balance in the lake, the remaining 37 Mm^3 is intended for irrigation of 8,400 ha in Agstafa district, Azerbaijan Republic. Nothing is specified in the agreement about the quality of water. The Agreement is prepared on an annual basis.

There are no other transboundary agreements in place.

6.7. Environmental Flow Requirements

An Environmental Flow is defined as: *the quantity, timing, and quality of water flows and levels required to sustain freshwater ecosystems and the human livelihoods and well-being that depend on these ecosystems.* There are no legally established Environmental Flow Requirements (EFRs) in Georgia. The draft Water Bill identifies the general requirement for an EFR but does not set a percentage; and the methodology for determining the EFR is likely to be included in a ministerial order following adoption of the Bill. The current EFR release assumption, based on practice rather than any legal obligation, for river basin management in Georgia is 10% of the Mean Annual Runoff.

In the interim of specific legal guidance, the USAID *"Guide to support the methodology for the assessment of environmental flows for the rivers and streams of Georgia"* provides a methodology for identifying EFRs.

6.8. Water Balance

The water balance model considers the available water, ZSIS irrigation demand and other water demands downstream on the Iori River. These are explained below.

6.8.1. ZSIS Irrigation Demand

In order to assess the irrigation demand for the ZSIS, information from various sources was used in the Feasibility Study, including the GA Irrigation Requirement Manual, FAO CLIMWAT Data, MODIS MOD16 global evapotranspiration product from the NASA/EOS project, etc. The information from these various sources identified that irrigation demand varies from 2,000 to 9,768 m^3/ha/annum. The irrigation demand of 7,180 m^3/ha/annum derived using FAO's AgERA global evapotranspiration data was used for the study as it is a value between the low and high estimates by other methods. This source also used Penman Monteith method, and it is taken from the ZSIS area where there is limited/no climate data.

Irrigation requirements for the proposed scheme were then calculated on the basis of the existing cropping pattern extracted from the GA contracts database, for each of the five IZs identified, based on the land and climate suitability, farmers interest, market availability and related government support programmes. Consideration was also given to the irrigation efficiency (IE) post-project. These data were then used to identify the water demand for the ZSIS.

The infrastructure modernisation is expected improve the efficiency of the irrigation system. The impact of irrigation demand at various nodes of the irrigation system is presented in Table 6-8 below. The actual irrigation demand at present, calculated as the volume of irrigation water released into the UMC at PHW divided by the contracted command area, is equal to 21,979 m^3/ha - double the amount of theoretical demand and the losses are due to (a) unregulated supply (b) overuse by farmers (c) poor irrigation infrastructure and (c) illegal tapping. It is expected that the improvement to irrigation infrastructure and implementation of proper operation and maintenance procedures would reduce the irrigation demand per ha and water will be made available to irrigate the proposed command area.

An efficiency study undertaken as part of the 2022 FS indicates that the current overall irrigation efficiency is only 21% and the proposed modernisation is expected to increase the efficiency to 56% for the open channels surface irrigation system and to 73% in case of drip and sprinkler irrigation system.

Irrigation demand is then adjusted for projected evaporative demand for each decade of each climate model (Table 6-8). For the Warm and Hot Wet climate models, the irrigation demand during 2030s will be less than the 2020s due to expected increase in the rainfall; the irrigation demand will increase to new heights in 2040s due to increase in PET and reduction in rainfall, whereas Hot & Dry model projects hotter conditions and thus peak demand within the 2030s.

Table 6-8. Irrigation Requirements

		Irrigated Area (ha)			Annual Irrigation Delivery (Mm^3)			Annual Irrigation Delivery (m^3/ha)		
		UMC	LMC	Total	UMC	LMC	Total	UMC	LMC	Average
Current Actual Use (2020-21)*		2,736	3,124	5,861	50.6	79.3	129.9	18,793	26,118	21,979
Current theoretical Demand					28.4	50.2	78.6	10,383	16,066	13,379
Future Warm Model	2022-2031	6,485	10,732	17,217	45.2	78.7	123.9	6,951	7,307	7,173
	2032-2041	6,485	10,732	17,217	43.3	75.2	118.5	6,663	6,982	6,862
	2042-2051	6,485	10,732	17,217	49.5	86.5	135.9	7,605	8,029	7,869
Future Hot Dry Model	2022-2031	6,485	10,732	17,217	49.6	86.4	136.0	7,622	8,026	7,874
	2032-2041	6,485	10,732	17,217	53.0	92.2	145.2	8,150	8,559	8,405
	2042-2051	6,485	10,732	17,217	51.3	89.1	140.4	7,887	8,271	8,126
Future Hot Wet Model	2022-2031	6,485	10,732	17,217	45.1	78.4	123.5	6,936	7,278	7,149
	2032-2041	6,485	10,732	17,217	43.8	75.8	119.6	6,734	7,037	6,923
	2042-2051	6,485	10,732	17,217	45.5	78.8	124.3	6,993	7,314	7,193

** As per records provided by GA*

6.8.2. Other Water Demands

The following water demands are assumed in the water balance analysis:

- The previous study assessed 6 Mm^3 of water flowed from UMC into the Tbilisi Sea for use by GWP for Tbilisi water supply. The 2022 FS has maintained 6 Mm3 per annum contribution from UMC for Tbilisi drinking water supply as this has been the standard practice for a number of years. This is distributed during spring months and kept constant for all the years.

- The previous study also assessed there to be 15.6 Mm3 of water per annum from UMC used for industrial water supply and water supply to village household plots. The 2022 FS has maintained a similar value for industrial supply and spread it equally over all the months. The 2022 FS has also increased the demand by 10% for every decade to account for potential increases in demand.
- The 2022 FS has included 6.1 Mm^3 for the fish farm and Khashmi and Patardjeuli irrigation schemes on the Iori river, downstream of PHW. Uplift ratios were applied to this value in line with the evaporative demand of each model per decade.
- The 2022 FS has included KSIS water demand calculation for the cropping pattern as discussed in the baseline report and calculated for the 90% of the 21,500 ha (RMC - 9,500 ha and LMC – 12,000 ha), leaving the remaining 10% as annual fallow.
- The Tbilisi Sea evaporation losses are also included as the contribution from UMC supply.
- In the monthly water balance model, an assumed 20% of the long-term average monthly flow is reserved as environmental flow[60], to ensure mimicking seasonal variation in river flow, including of spring peak flows, in support of natural ecological processes and aquatic biodiversity. There are no legal water sharing agreements / arrangements for Iori river basin and there is no specific release from the Dalis Mta reservoir (no data available).

6.8.3. Water Balance Model Conceptualisation

A monthly water balance model was developed to simulate historic flows in the Iori basin using rainfall-runoff modelling, monthly demand profiles and considering infrastructure capacities. A conceptualisation of the water balance model is presented in Figure 6-18. This indicates how runoff is simulated in lumped catchments and the inflows and outflows of each catchment, and how water resources are managed at each infrastructural node within the water balance model (Sioni Reservoir, PHW, ZSIS and KSIS offtakes).

The following concepts were used:

- Rainfall and snowmelt is provided by CatchX precipitation and temperature data and factored for each catchment based upon elevation above mean sea level (m).
- Catchment runoff is calculated as a function of catchment rainfall multiplied by a rainfall runoff coefficient (0.4636), plus snowmelt, based upon calibrations against observed Iori runoff upstream of Sioni Reservoir and precipitation-evapotranspiration balances. Upstream contributions include runoff released from upstream infrastructure after demand contributions and include environmental flows (Sioni Reservoir, PHW and KSIS offtake). Water contributions from Tbilisi Sea, Chumatkhevi Creek and Lochini River catchments are assumed to be constant.
- Sioni Reservoir has a maximum capacity of 325 Mm^3 and dead storage of 10 Mm^3, these thresholds determine reservoir spill and available water for downstream release. If downstream demand cannot be fulfilled, additional flow is released downstream, based upon water availability within the reservoir.
- Downstream environmental flows are fixed at 20% of average monthly runoff, to allow for water abstraction while maintaining seasonal variation in river flow, including a mimic of spring peak flows, in support of maintaining aquatic biodiversity[61].
- Water is taken from the Iori River to supply the ZSIS' UMC and LMC, and GWP drinking and industrial water requirement, accounting for contributions from the catchments of the Tbilisi Sea, Lochini River and Chumatkhevi Creek. When the required flow to meet demand exceeds the carrying capacity of the canal (11.5 m^3s^{-1}), flow is diverted in advance to be stored within Tbilisi Sea to meet high demand months.

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[60] As the current 10% of minimum annual flow accepted in Georgia as ecological flow is not in line with international views on ecological flows, Atkins opts to use 20% of the long-term average monthly flow as ecological flow, to allow for water abstraction while maintaining seasonal variation in river flow, including a mimic of spring peak flows, in support of maintaining aquatic biodiversity. The 20% is an estimation, as ecological flows are river-specific, commonly determined based on in-depth integrated research of hydrologists and ecologists. The EFR varies internationally from as low as 10% to 90% of the monthly flow depending on the season, weather zone and water requirement for the habitats. The EFR could be revised in the future depending on based on the methodology for the assessment of environmental flow in rivers to be adopted by the Ministerial Order.

[61] The 20% is an estimation, as ecological flows are river-specific, commonly determined based on in-depth integrated research of hydrologists and ecologists. The EFR varies internationally from as low as 10% to 90% of the monthly flow depending on the season, weather zone and water requirement for the habitats. The EFR could be revised in the future depending on based on the methodology for the assessment of environmental flow in rivers to be adopted by the Ministerial Order.

The above other water demands (section 6.7.6) have been accounted for in the model.

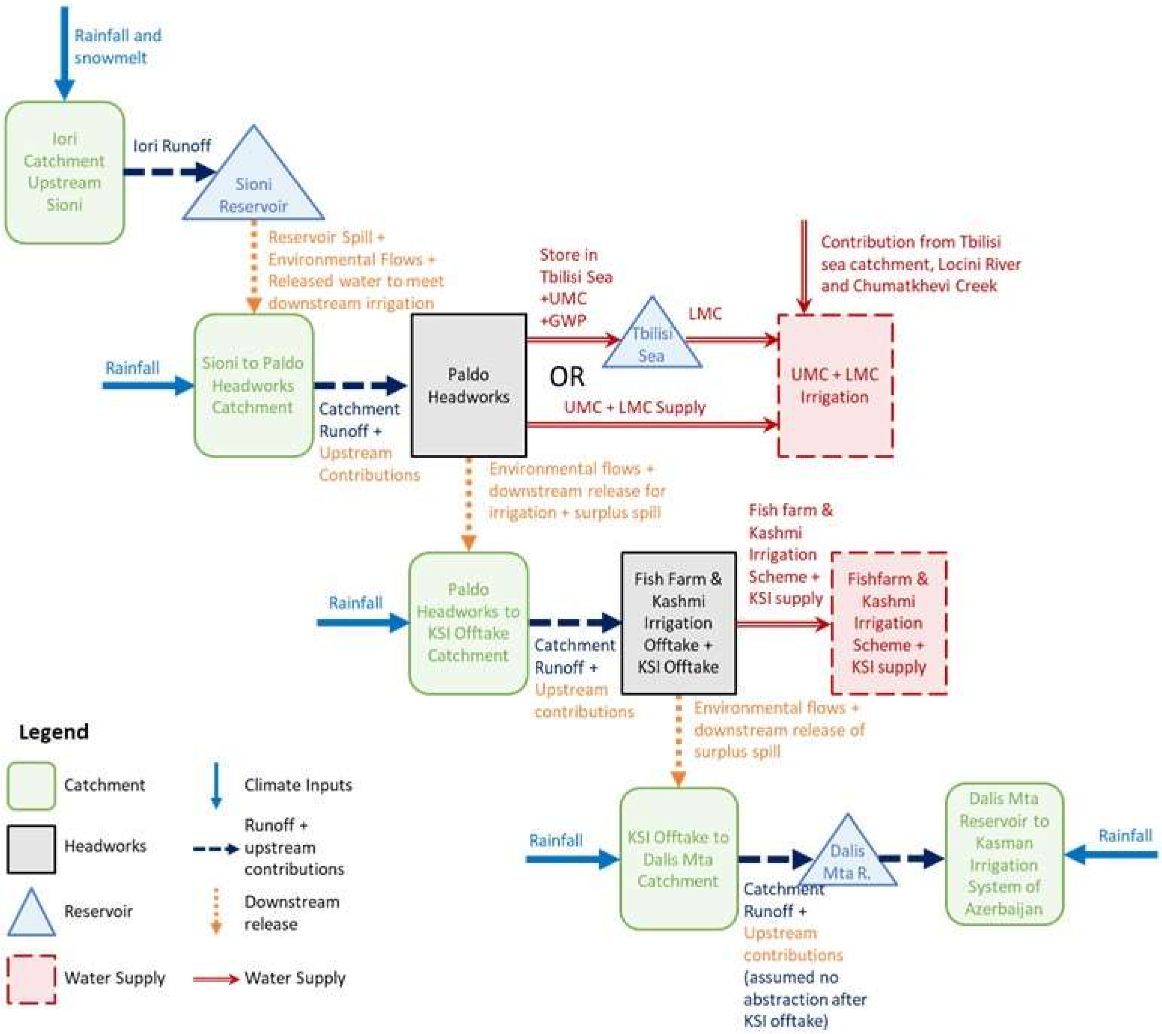


Figure 6-18. Schematic diagram of Iori river basin

6.8.4. Supply Conclusions

The irrigation requirements (Table 6-8 above) were used in each climate change model on each model, with demand differing on a decadal basis in relation to theoretical demands associated with climate, and possible losses.

Upon the occurrence of model failure (i.e., reservoir depleted and/or demand cannot be met without compromising environmental flows), the percentage command area is decreased incrementally until no failures occur. This gave rise to differences in the maximum irrigable command area and subsequently total water supply between models and periods:

- Hot Wet: 100% irrigable for all periods, (or 108% irrigable when a fixed value is applied for whole period before failures occur).
- Warm: 100% irrigable for 2022-2031 and 2032-2041, 91.5% irrigable for 2042-2051 when command area is adjusted for failing years only, or 90% irrigable when a fixed value is applied for whole period before failures occur,
- Hot Dry: 93% irrigable for 2022-2031, 77.3% irrigable for 2032-2041, 86.3% irrigable for 2042-2051 when command area is adjusted for failing years only, or 76% irrigable when a fixed value is applied for whole period before failures occur.

Based upon a fixed demand value (command area percentage, with irrigation demand accounting for differences in climate under each scenario) for the whole simulation period, the average command area that can be met across the three climate models is 88% before failures occur. This also indicates that the Warm model reflects average conditions between the three models. If the model is run at 100% of proposed demand, the Hot Dry model results in failures in 17 out of 30 years, reducing to 5 years of failures at 85% and 0 at 75% (Figure 6-14). The Warm model produces failures in 5 years out of 30 at 100% of proposed demand, dropping to 3 years of failures at 90% and 0 failures at 90%, whereas the Hot Wet model produces 0 failures up to 101% of proposed demand (Figure 6-14). The intra-annual distribution of model failures temporally is shown in Figure 6-14 (when applying 100% command area), indicating failures only occurring in July-October, with most failures occurring in September for unmet demand, however reservoir failure is more common in August. Failures persist in October for meeting UMC and LMC demand, whereas October failures are much less common for the reservoir and for KSIS demand. Modifying the demand area within the model to produce 0 failures is reflected in reduced supply (Mm^3, Figure 6-15), notably within months June to August during peak demand.

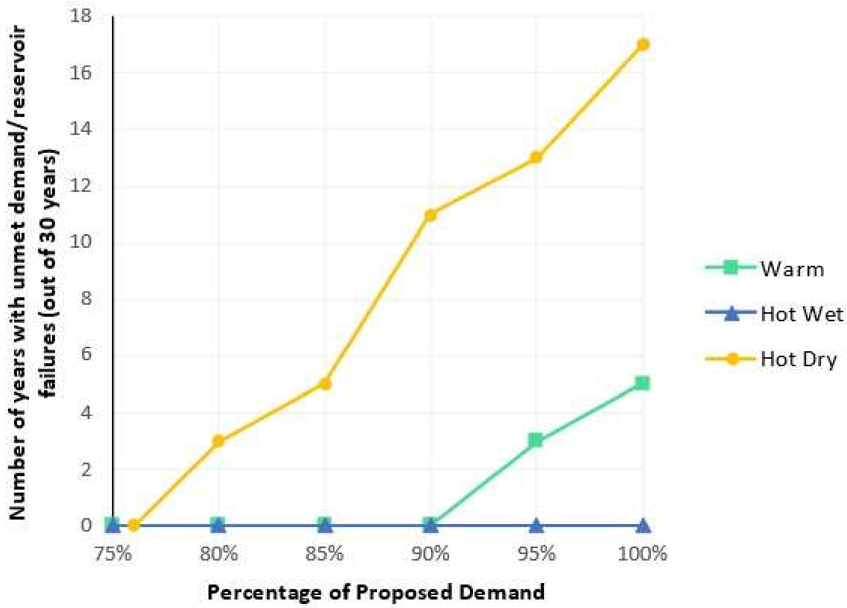


Figure 6-19 – Number of years with unmet demand or reservoir failures for the period 2022-2051 at different levels of proposed demand requirements.

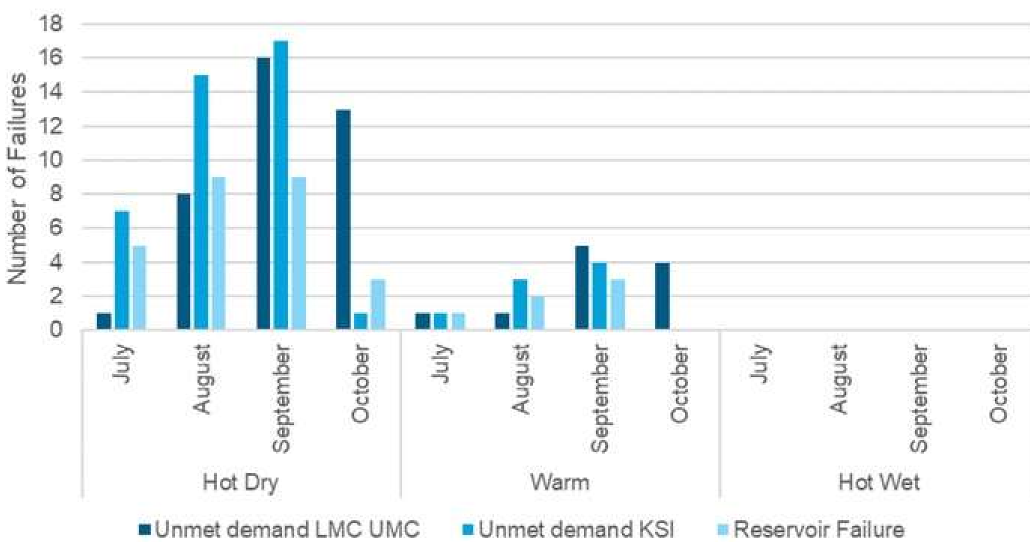


Figure 6-20. Distribution of model failures by month when the command area is set to 100%.

In summary, the water available from the Iori river could irrigate 97.4% (average of three scenarios) of the total potential ZSIS and KSIS command area of 35,605 ha in the first decade (2022-2031) and it will go down to 92.3% in the third decade (2042-2051).

6.9. Surface Water Quality

Data on surface water quality for the Iori River, which is the main source of the ZSIS irrigation water, has been obtained from NEA for 2020, and from the Eptisa 2018 ESIA Report for the ZSIS canals. Data were originally collected in the field for Eptisa and tested by the Atmospheric Air, Water and Soil Analysis Laboratory, from the Department of Environmental Pollution Monitoring, of the National Environmental Agency of Georgia.

The NEA has two observation points in the Iori Basin, at Sasadilo and Sartichala. Sartichala is located within the ZSIS Project Area. According to the table below, average annual values for specific pollutants for 2020 are below the maximum permissible concentrations (MPC).

Table 6-9. Surface water monitoring results, annual average values, 2020[62]

Measured Parameters	Unit	Iori-Sasadilo	Iori-Sartichala	MPC[63]
BOD5	mg/l	1.82	2.00	6
Ammonia	mgN/l	0.321	0.366	0,39
Nitrite	mg/l	0.108	0.064	3,3
Nitrate	mg/l	0.892	0.441	45
Phosphates	mg/l	0.1314	0.1933	3.5
Sulphate	mg/l	24.86	58.27	500
Chloride	mg/l	2.83	4.96	350
Iron	mg/l	0.0407	0.1040	0.3
Zink	mg/l	0.0009	0.0025	1
Copper	mg/l	0.0012	0.0012	1
Lead	mg/l	0.0030	0.0046	0.03

As part of the 2018 ESIA, Eptisa commissioned a number of water samples from different points along the main ZSIS canals, as shown in Figure 6-21. The samples were analysed for a variety of parameters including pH, turbidity, BOD5, COD, ammonium, suspended solids, chlorides, oil products, mineralisation, Iron and Zinc) and E-Coli. The results are shown in Table 6-10 below. They have been compared to the MPC of the surface water protection from pollution as set out in Government Resolution N425, 2013 December 31, Tbilisi.

Table 6-10. Water analysis results[64]

[62] Source: National Environmental Agency
[63] Maximum permissible concentrations according to the Technical Regulation for Protection of Surface Waters of Georgia from Pollution approved by the Government of Georgia Resolution #425, December 31 2013
[64] Tested by the Atmospheric Air, Water and Soil Analysis Laboratory, Department of Environmental Pollution Monitoring, NEA of Georgia

Sample No	Location (coordinates)	Results of Sample Analyses			Comparison to Maximum Permissible Concentrations (MPC)[65]
		Parameters	Results of Analyses	MPC for surface water[66]	
A1 Tbilisi Sea (Lower)	Easting 44.89299 Northing 41.71636	pH	6.8	6.5 - 8.5	
		BOD5 mg/l	0.62	6.0	
		Chloride mg/l	12.5	350	
		E-Coli in 1 L	30	5,000	
A2 Dairy Factory Effluent	Easting 44.92780 Northing 41.69988	pH	6.3	6.5 - 8.5	
		BOD5 mg/l	1.23	6.0	
		Chloride mg/l	28	350	
		E-Coli in 1 L	280,000	5,000	
A3 Drainage Channel	Easting 45.01003 Northing 41.64100	pH	6.5	6.5 - 8.5	
		BOD5 mg/l	1.05	6.0	
		Chloride mg/l	21.5	350	
		E-Coli in 1 L	1,100	5,000	
A4 Paldo Headworks	Easting 45.13517 Northing 41.84823	pH	7.0	6.5 - 8.5	
		BOD5 mg/l	0.7	6.0	
		Chloride mg/l	13	350	
		E-Coli in 1 L	600	5,000	
B1 At the top of Upper Samgori Channel (Paldo) Tunnel Entrance Background	X-0511082 Y-4632688	pH	7.19	6.5 - 8.5	
		Fe mg/l	0.5198	0.3	
		Zn mg/l	0.0051	1.0	
		BOD5 mg/l	0.80	6.0	
		COD mg/l	2.94	30.0	
		Ammonia mgN/l	0.381	0.39	
		Chloride mg/l	4.712	350	
		Mineralization mg/l	254		
		Turbidity NTU	4.64		
B2 Vaziani Military Settlement and from down the Channel	X-0504927 Y-4611520	pH	7.80	6.5 - 8.5	
		Fe mg/l	0.7611	0.3	
		Zn mg/l	0.0072	1.0	
		BOD5 mg/l	0.88	6.0	
		COD mg/l	3.92	30.0	

[65] Non-compliances are marked orange
[66] MPC set by the Government Resolution #425 on December 31, 2013

Sample No	Location (coordinates)	Results of Sample Analyses			Comparison to Maximum Permissible Concentrations (MPC)[65]
		Parameters	Results of Analyses	MPC for surface water[66]	
		Ammonia mgN/l	0.669	0.39	
		Chloride mg/l	5.515	350	
		Mineralization mg/l	355		
		Turbidity NTU	26.0		
		TPH	0.0064	0.3	
		E-Coli in 1 L	22,000	5,000	
B3 Additional Channel Connection after 200 m	X-0512734 Y-4605035	pH	7.95	6.5 - 8.5	
		Turbidity NTU	2.81		
		PH mg/l	0.0011	0.3	
B4 The Upper Channel Samgori, Lilo	X-0499598 Y-4614641	pH	8.11	6.5 - 8.5	
		Fe mg/l	0.7118	0.3	
		Zn mg/l	0.0077	1.0	
		BOD5 mg/l	0.65	6.0	
		COD mg/l	2.94	30.0	
		Ammonia mgN/l	0.529	0.39	
		Chloride mg/l	5.061	350	
		Turbidity NTU	19.0		
		TPH mg/l	0.0022	0.3	
		E-Coli in 1 L	43,000	5,000	
B5 Tbilisi Sea Channel from the Upper Samgori	X-0491456 Y-4618166	pH	8.12	6.5 - 8.5	
		Fe mg/l	0.8180	0.3	
		Zn mg/l	0.0051	1.0	
		BOD5 mg/l	0.73	6.0	
		COD mg/l	3.92	30.0	
		Ammonia mgN/l	0.552	0.39	
		Chloride mg/l	4.995	350	
		Turbidity NTU	8.10		
B6 Tbilisi Sea Channel Output, ≈ 2 km down from the left side Cement Industry. From the additional	X-0494444 Y-4616458	pH	8.08	6.5 - 8.5	
		Fe mg/l	0.8314	0.3	
		Zn mg/l	0.0079	1.0	
		BOD5 mg/l	0.89	6.0	
		COD mg/l	4.90	30.0	

Sample No	Location (coordinates)	Results of Sample Analyses			Comparison to Maximum Permissible Concentrations (MPC)[65]
		Parameters	Results of Analyses	MPC for surface water[66]	
Channel from the Cement Factory (≈ 200 m Orkhevi)		Ammonia mgN/l	0.630	0.39	
		Mineralization mg/l	291		
		Suspended Solids	77.2		

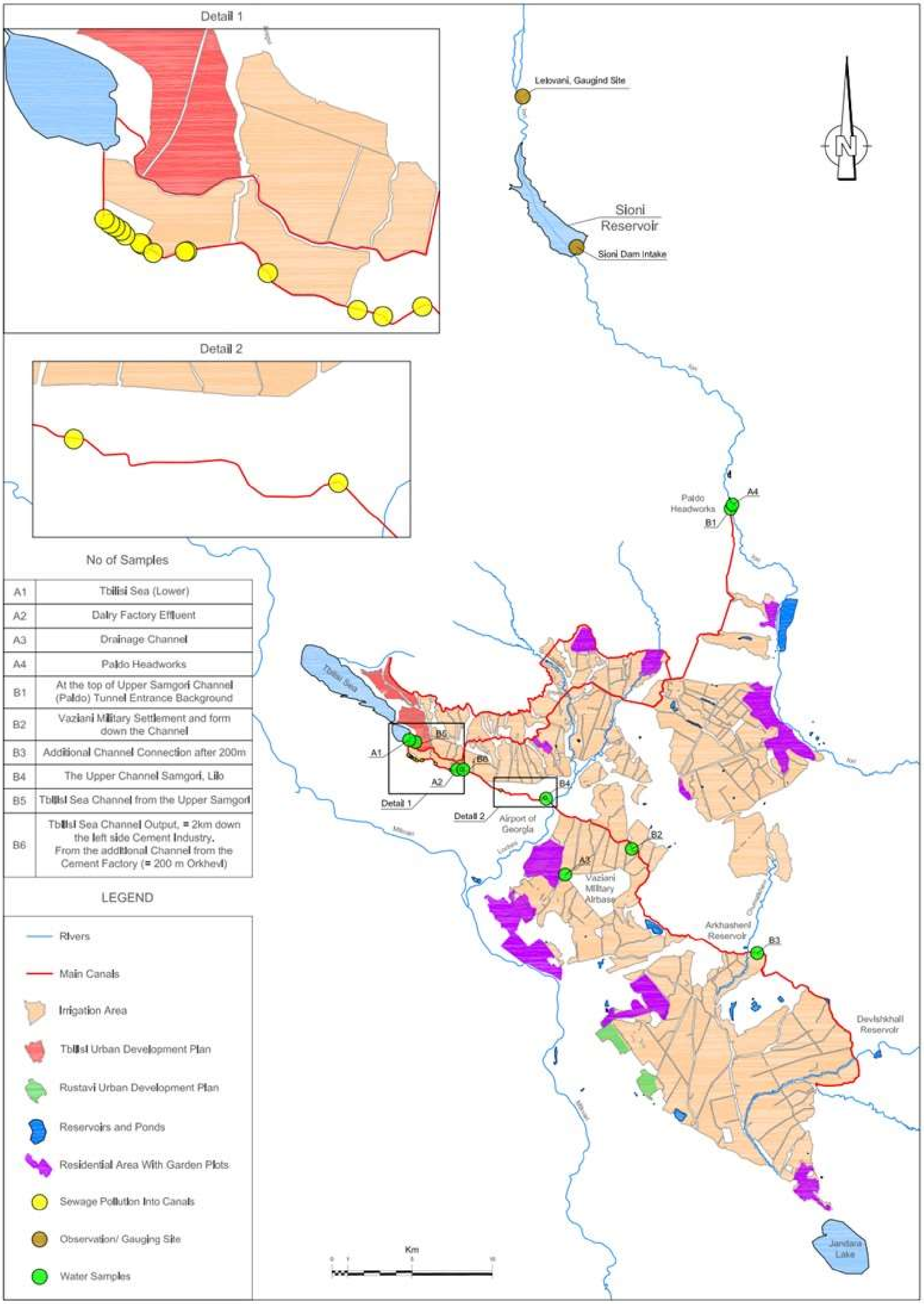


Figure 6-21. Map showing the location of water sampling points

Table 6-10 indicates that for the majority of parameters the water samples within the ZSIS main canal system meet national MPC. However, enhanced concentrations were identified for E-Coli, Iron and Ammonia in water samples from some sites. In particular, water sampled from the Upper Channel Samgori, Lilo contains exceeded concentrations of these three parameters:

- E-Coli exceeded MPC in water sampled from the following sites: dairy factory effluent (56 times), Vaziani military settlement (4.4 times) and from down the channel and the upper channel Samgori, Lilo (8.6 times).
- Iron concentration exceeded MPC in water sampled from the top of Upper Samgori Channel (1.7 times), Vaziani military settlement (2.5 times) and from down the channel and the upper channel Samgori (2.4 times), Lilo, and Tbilisi Sea Channel from the Upper Samgori (2.7 times).
- Enhanced concentration of Ammonia has been identified in water sampled from Vaziani military settlement (1.7 times) and from down the channel and the upper channel Samgori (1.4 times), and Tbilisi Sea Channel Output (1.6 times).

Also, pH that is lightly lower than the value set by national requirements was found in water sampled from dairy factory effluent.

Water samples were also collected at the following drainage sites as part of the Eptisa work, and analysed for parameters such as pH, Conductivity, Carbonate CO_3 (CO_2), Sulphates (SO_4), Chlorides (Cl), Potassium (K), Sodium (Na), Calcium (Ca), Magnesium (Mg):

- Lochini River at Diversion River
- Drainage Collector Lemsveniera, (Bull)
- LMC Pond TB409
- Chumatkhevi Creek, Railroad Bridge
- Chumatkhevi Creek, Diversion into LMC
- Chumatkhevi Creek, ds of LMC
- Akhali Samgori, Drainage Collector
- Drain in Sartichala

The results are shown in Table 6-11. As can be seen, the quality of water varies across the various receiving waters.

Drainage water from the irrigation canal systems has never been treated. Contamination of drainage water is mainly with gypsum ($CaSO_4$ $2H_2O$) and remnants of chemicals with which the crops are treated: pesticides, herbicides and fungicides.

Gypsum is in itself not a toxic product and it is used as fertilizer in some parts of the world. It can cause problems in horizons of the soils if the gypsum content exceeds 25%. It is noted that, in accordance with the Law of Georgia “On Pesticides and Agro-Chemicals” (1998, last amended in 2018), only registered pesticides are allowed to be used in Georgia.

Table 6-11. Results of water analysis

No	Measured Parameters	Units	Lochini River at Diversion River	Drainage Collector Lemsveniera, (Bull)	LMC Pond TB409	Chumatkhevi Creek, Railroad Bridge	Chumatkhevi Creek, Diversion into LMC	Chumatkhevi Creek, ds of LMC	Akhali Samgori, Drainage Collector	Drain in Sartichala	Artesian Well Sartichala	Methods
1	pH	pH	7.31	7.35	7.56	7.91	7.75	7.81	7.7	7.67	7.78	ISO 10523:2010
2	Conductivity	µ sms/cm	609.00	975	2,678	636	1,125	1,038	3,350	1,922	3,258	Mobile apparatus Oxi330i/340i
3	Carbonate CO_3 (CO_2)	mg/l	15.14	13.9	2.7	5.98	3	3.3	7.39	7.92	13.02	Titrimetric
4	Sulfates	mg/l	640.98	1,047	2,565	623	1,173	1,074	3,601	1,637	3,328	ISO 10304-1:2007
5	Chlorides	mg/l	14.45	48	70	4	28	28	118	16	6	ISO 10304-1:2007
6	Potassium	mg/l	1.4	1.5	3.1	1	1.6	1.5	2.2	1.4	1.2	ISO 9964-3:2010
7	Sodium	mg/l	18.50	52.5	80.5	7.5	32.5	38.5	120.5	30.5	11.5	ISO 9964-3:2010
8	Calcium	mg/l	147.60	163.26	285.95	132.35	160.46	158.01	408.34	276.87	253.49	ISO 6058:2008
9	Magnesium	mg/l	10.76	45.27	133.63	10.87	20.7	35.32	75.14	10.52	122.32	ISO 6058:2008

A number of cases of sewage discharges directly into irrigation canals were also identified during the Eptisa field surveys and the current 2021 field walkovers. The Eptisa sites are shown by the yellow dots in Figure 6-21 above and are concentrated around Zone 3 to the north of Tbilisi City and between Zones 3 and 4. The 2021 field survey also identified discharges in zone 4.

Examples of this pollution are shown in Table 6-12.

Table 6-12. Evidence of sewage discharged into canals

Site description	Source	Photo evidence
Discharge of the Sewage into the Canal, Varketili X491541; Y4617017	Eptisa ESIA 2018	
Discharge of Wastewater into the Canal from Damaged Sewage Well, Varketili X491871; Y4617031	Eptisa ESIA 2018	

Site description	Source	Photo evidence
Water Discharge from the Concrete Plant, Varketili X494331; Y4616460	Eptisa ESIA 2018	
Water Discharge from Plastics Plant. According to Director information, Water is used for Cooling X499531; Y4614697	Eptisa ESIA 2018	
Wastewater Discharge into the Canal, Lilo Settlement X496787; Y4615151	Eptisa ESIA 2018	

Site description	Source	Photo evidence
Water Discharge into the Canal from Agriculture Lands X492729; Y4616808	Eptisa ESIA 2018	
Water discharge from the poultry farm, G7 LMC	2021 field visit	
Water discharge from industrial site into the LMC canal	2021 field visit	

Site description	Source	Photo evidence
Other discharges into the LMC, 2º reach	2021 field visit	

6.10. Geology and Soils

The Caucasus mountains belong to Jurassic terrigenous with volcanic rocks and divided cretaceous carbonaceous (Figure 6-22). The Iori River originates in the clay shales, siltstones and conglomerates of Aalenian, Toarcian and Pliensbachian stages. Based on this map, the command area is covered with two types: Quaternary continental molasse with volcanic rocks and Neogene terrigenous with volcanic rocks.

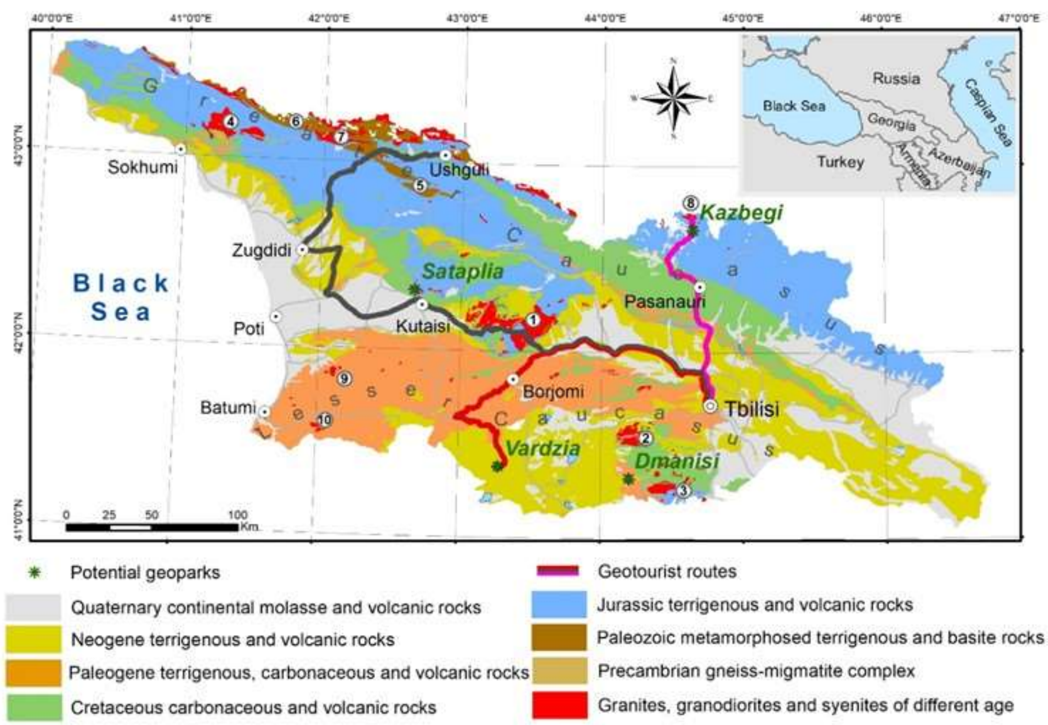


Figure 6-22. Simplified Geological Map of Georgia[67]

[67] Source: Irakli Gamkrelidze, Avtandil Okrotsvaridze, Ferando Maisadze, Levan Basheleishvili, Gorgi Boichenko and Irakli Skhirtladze (2019), " Main features of geological structure and geotourism potential of Georgia, the Caucasus", Modern Environmental Science and Engineering (ISSN 2333-2582), May 2019, Volume 5, No. 5 pp 422-442.

Soil surveys were undertaken by Eptisa and reported in the Soils Assessment Report (Part 7 of the Detailed Engineering Design and Bill of Quantities) dated March 2016. The location of the soil sample sites is shown in Figure 6-23 and the types of soil present are summarised below.

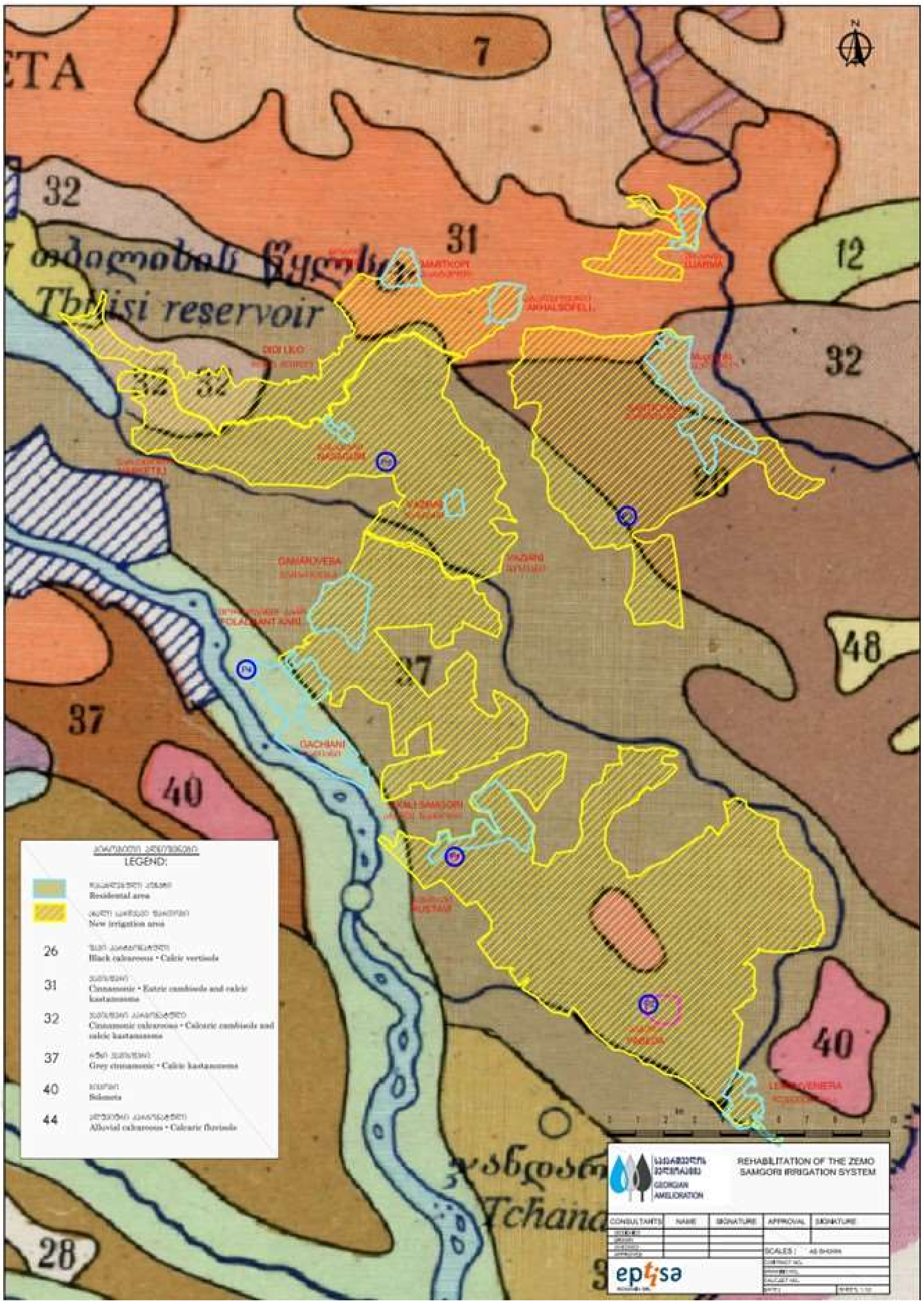


Figure 6-23. Soils of ZSIS and location of Eptisa soil samples

The prevailing soils (subtypes) in the ZSIS are:

- Chromic cambisols (alkaline soils, Solonetzic soils and Gypsum soils)

- Grassland chromic cambisols (Superficial meadow chromic cambisols, Meadow, chromic cambisols)
- Vertisols

The key characteristics of these soils, the conditions in which these soils developed, horizon layers, and crops cultivated are provided in Table 6-13 below.

The total area of **chromic cambisols** in Georgia is 5.8% (402,000 ha). This soil is spread in the south-eastern part of South Georgia – in Marneuli, Gardabani, Sagarejo and other regions. It borders with brown soils, vertisols, meadow chromic cambisols. Weak alkaline or alkaline reaction is characteristic to chromic cambisols. Humus content is low (below 3%). The type of humus is fulvate-humate. Existence of a carbonic-illuvial horizon is characteristic to these soils. The content of carbonates ranges between 4.2 and 23.1%. Carbonates can be observed on the soil surface. Calcium prevails in exchange cations, in depth its content decreases on account of increase in exchange magnesium content. Exchange sodium, the content of which in some cases reaches 12-14% out of the sum of bases, is present in the absorption complex of chromic cambisols.

The following family categories are distinguished in chromic cambisols:

- Alkaline soil – The upper part of the profile (5-15 cm) is more friable. A brown-alkaline soil horizon, compacted, with heavier mechanic composition, is situated below. Content of exchange Na is not always high.
- Solonetzic soils – are formed on saline rocks and have weakly differentiated profile. Freely soluble salts are observed from upper horizon, and in the depth of 1 m they are reaching 2%.
- Gypsum soils (carbonic calcium gypsum) – the humus horizon is of little thickness. There is a gypsum-containing horizon below

Salinization is often observed in these soils. To increase the fertility of these soils it is necessary to use mineral and phosphorous fertilizers, artificial regulation of moisture with strict observation of irrigation standards.

The total area of **grassland chromic cambisols** in Georgia is 3.3% (228,800 ha). It is formed in the conditions of increased moisturization of chromic cambisols. The soil is mainly spread in Marneuli and Gardabani regions. It is observed on comparably little areas in Kaspi Region. It is spread on quite a great area on Alazani plain (the right side of the Alazani River, the south-eastern part).

The reaction of meadow chromic cambisols is weakly alkali or alkali, the content of humus is low (2.5% in the humus horizon), but the profile has humus content in depth. Carbonates are observed in the surface, their amount increases in depth. The capacity of absorption is high. Exchange calcium prevails in the absorbed complex. The soil belongs to light and medium clays. Argillization is observed in the middle and lower parts of the profile.

Grassland chromic cambisols are divided into three sub-types:

- Surficial grassland chromic cambisols is formed in the areas to which additional surficial moisturization and deep seated groundwaters are characteristic. The signs of gleyzation are observed in the upper horizons.
- Surficial grassland chromic cambisols is formed in the areas where ground waters do not seat deeply (3-5 m). Gleyzation is observed in the lower horizons and soil forming rock, and also weekly in the upper horizons.
- Typical grassland chromic cambisols is formed in the areas where ground waters stand near (2-3 m) and surficial moisturization is observed additionally. Intensive gleyzation can be observed in the whole profile.

The following family categories are distinguished in grassland chromic cambisols:

- Common – this family has all the signs and properties of the sub-types of meadow chromic cambisols.
- Alkaline soil – is developed on salinized rocks or under influence of salinized waters. Exchange Na content in the densified alkaline soil horizon is more than 5% of absorption capacity.
- Solonetzic soils – are formed in the same conditions as the previous family of soils. Easily soluble salts are observed not deeper than 150 cm.

This soil has roughly the same usage as chromic cambisols, though agricultural activity is less restricted due to more moist content.

The total area of **vertisols** in Georgia amounts to 3.9% (266,800 ha). This soil is spread in the segment plain zone between mountains – in Gare (Outer) and Shida (Inner) Kakheti, Kvemo (Lower) and, partly, Shua

(Middle) Kartli Regions. The formation of one part of this soil is related to the evolution of alluvial plains. Weak alkaline reaction is characteristic to vertisols. Calcium carbonates are found in the surface. Their content gradually changes in depth. $CaCO_3$ content equals to average 7-20%, humus content in the humus horizon is average 4-5%, its amount is gradually decreasing. Humic acids are major components of the humus of vertisols, this means that humic qualitative type of humus is characteristic to the soil. The content of physical clay is around 60-80%. Sulfate salts prevail in the composition of dry sediments. Gypsum content equals to 2.30-15.70%, besides, its maximum is observed in the middle of the profile in 50-70 cm depth.

Vertisols are divided into three sub-types:

- Meadow gleysol vertisols are formed in depressions. The accumulative layer is quite thick. The signs of gleyzation are lower than 50 cm. Carbonates are mainly presented with concretions or white spots. The mechanical composition is heavy argillous – light argillous. The black humic layer is quite thick, though the content of humus is low which is explained with the increased quantity of the fraction of humic acids closely connected to clay minerals. The type of humus is humic. The high exchange capacity is characteristic to the soil.
- Alkalized vertisols are distributed on comparably small areas. Carbonates are found from 0.5 m. The reaction of the upper layers is neutral, and of the lower ones – weak alkaline. The type of humus is humicfulvic or humic. The absorption capacity is quite high (30-40 mg/equiv.).
- Typical vertisols are spread in the conditions of a levelled relief. Carbonates are found from the lower part of an arable layer (25-30 cm below). The content of humus is medium. The type of humus is humic. The absorption capacity is quite high. The content of exchange sodium is found with small amount (2-3% out of the total capacity). Carbonated vertisols are widely spread. Carbonates are found from the surface. The content of humus is little. The mechanical composition is light and medium argillous. The type of humus is humic. The exchange capacity is quite high.

The following family categories are distinguished in vertisols:

- Common – is separated out in all sub-types. It is formed comparatively homogenous fine soil, moderately carbonated rocks. This family has all features and properties of the above mentioned sub-types of vertisols.
- Solonetzic – within humic layer it has a solometzic compacted horizon with 5% capacity and the content of more absorbed sodium.
- Vertisols is divided into types with humus content – weakly humic (<2%), little humic (2-3%), medium humic (3-5%), much humic (<5%).

The advantageous thermal resources of these soils provide an opportunity for two harvests of crops and vegetables. The main problem is the dry summer period when cultures need to be watered. The soils are sensitive to hydraulic erosion by irrigation. Vertisols are slippery when wet and very hard when dry. They are known to be difficult soils to work as the period between too wet and slippery and too dry and too hard is relatively short.

Table 6-13. Soils types in the ZSIS

Soil type	Brief description	Five factors of soil formation according to V. Dokuchaev					Horizon	Crops
		Ecology	Climate	Relief	Parent rock	Age		
Chromic cambisols	Undifferentiated, argillous, carbonic profile with a small humus profile. Main diagnostic indicators are humus and carbonic profiles with comparable stretch, well expressed argillization in the middle of the profile and existence of carbonates from the surface. Salinization is often observed in these soils.	Steppe soil of the subtropical belt.	A moderately dry subtropical climate with a temperature of the coldest month of 0, -10^{0}C , and of the warmest month 24-25-^{0}C. Average annual temperature is 12-13^{0}C. The duration of a vegetation period exceeds 7 months. The sum of active temperatures is 4000-4500^{0}C. The average annual atmospheric precipitation equals to 300-500 mm. The number of snowy days range between 20 and 40. The average annual humidity coefficient is 0.4-0.6.	Plains, foothills and low mountainous areas.	Sediments of proluvial, alluvial, eluvial-deluvial genesis with different granulometric, mineralogic and chemical composition. These sediments are often saline.	Relatively old age of soil formation.	ACa - humus horizon with thickness of 20-30 cm, brownish-dark sandy clay. In virgin soil the upper part is of slighter mechanic composition with fine-grained structure; clear transition. BmCa - metamorphic horizon of clay accumulation has a thickness of 40-50 cm, is grayish brown, dense, heavier than humus; rounded-block mass carbon layers are represented with veins or white deposits;	Various species of fruit and vegetable, but agriculture is limited due to the lack of water. Phosphorus to be absorbed is presented with little amount in these soils. Potential for erosion and secondary salinization.

Soil type	Brief description	Five factors of soil formation according to V. Dokuchaev					Horizon	Crops
		Ecology	Climate	Relief	Parent rock	Age		
							gradual transition. BCam - horizon where clay accumulation is combined with the maximum carbonate content; gray-brown, carbonate layers come in the form of spots and concretions; gradual transition. BCCa - carbonic transition, often towards a saline rock	
Grassland chromic cambisols	Undifferentiated profile; A horizon is thicker than a horizon of chromic cambisols soils;	Major part of the area is covered with winter pasture.	Moderate dry subtropical climate. The temperature of the coldest month is 0-1^{0}C, of the warmest one - 24-25^{0}C and the average annual temperature equals to 12-13^{0}C.	Plains, foothills and low mountains.	Sediments of proluvial, alluvial, alluvial-deluvial genesis with different mechanical, mineralogical and chemical composition.	Comparatively old age of soil formation.	ACa(g) - humic, the horizon with 20-35 cm thickness, dark grayish brown, moist, dense, there are roots, signs of gleysol are observed,	The same usage as chromic cambisols, although agricultural activity is less restricted due to high

Soil type	Brief description	Five factors of soil formation according to V. Dokuchaev					Horizon	Crops
		Ecology	Climate	Relief	Parent rock	Age		
	Signs of gleysol throughout the whole profile; Strong argillization; An anthropogenic factor (the impact of irrigation) plays an important role in the soil formation process of these soils		The duration of vegetation period exceeds 7 months (220 days). The sum of active temperatures is 4000-4500^{0}C. The average annual atmospheric precipitation equals to 300-500 mm. Maximum precipitation falls in spring and autumn (80%). Snow cover is unstable. The Number of snow days range between 20 and 40. The average annual humidity coefficient equals to 0.4-0.6.		Sediments are sometimes salinized.		lumpy, clear transition. B Cat(g) - brown with 40-60 cm thickness, sub-lumpy, moist, argillous, with signs of gleysol, single roots, gradual transition. BCag - light brown, 40-60 cm, gleysol, white disk shaped of carbonates, sub-lumpy.	moisture content.
Vertisols	Slight differentiation in horizon; Thick humus horizon; Increased density; Clay-mechanic composition.	Damp meadows.	Dry subtropical type of climate with warm, practically non-snowy winter and hot, dry summer. The temperature of the warmest month (June) is 22.9^{0}C and of the coldest (January) 0.3^0-3.8^{0}C. The average annual temperature equals to 10-11.9^{0}C, the sum of active	Intermountain lowland is rather young, belong to the Upper Tertiary and Quaternary periods.	Sarmatian and Akchaghylian-Apsheronian sediments.	Comparatively young age of soil origin	A1 - humic, with black clay, lumpy-angled or grainy, with glaze on structural facets having great number of roots, dense with total thickness of 15-25 cm.	Thermal resources give an opportunity to take two harvests of crops and vegetate twice a year. The main problem is the existence of a dry summer period when

Soil type	Brief description	Five factors of soil formation according to V. Dokuchaev					Horizon	Crops
		Ecology	Climate	Relief	Parent rock	Age		
			temperatures amounts to 4,000^{0}C; the duration of vegetation period is six-seven months. The annual quantity of precipitation ranges between 400 - 600 mm. Minimum precipitations is observed in the winter months, and maximum - in May-June. Precipitations usually appear in the form of rain. During the whole year, evaporation exceeds the amount of atmospheric precipitations (humidity coefficient ranges from 0.3 to 0.9); the average annual relative air humidity varies between 64 and 70%. The soil temperature does not fall below 0^{0}C during the whole year and, thus, the bio gene of soil is quite high.				A1 - humus horizon, black, slightly gay, argillous, sub-prismy, dense, with glaze on structural facets, of slagged construction, single roots, with total thickness of 10-20 cm. B - blackish-brown, argillous, lumpy-prismy, with glaze on structural facets, dense, slagged, with total thickness of 15-25 cm. BC - beige, argillous, with “white wheels” of carbonates, dense	cultures need to be watered. In these conditions it is possible to grow technical (cotton, olive, tobacco) cultures.

6.11. Air Quality

According to data in the Eptisa 2018 ESIA Report, Ministry of Environment Protection and Agriculture data for 2015 indicates that 22.2% of total emissions in Georgia were reported in the Kvemo Kartli region, where the majority of ZSIS villages are located. The emissions for various parameters for 2015 can be seen in Figure 6-24. These high levels of emissions were attributed to large enterprises located in the region, such as HeidelbergCement Georgia Limited, enterprises of the Georgian cement Limited, thermal power plants of the International Energy Corporation of Georgia Limited and Mtkvari Energy Limited, metallurgical enterprises of Rustavi Steel Limited and Geostile Limited, fertiliser production from Rustavi Azoti Limited, and ferro-alloys production fom Rusmetal Limited. Of these, the main sources of emissions are cement and construction materials production, as well as thermal power generation.

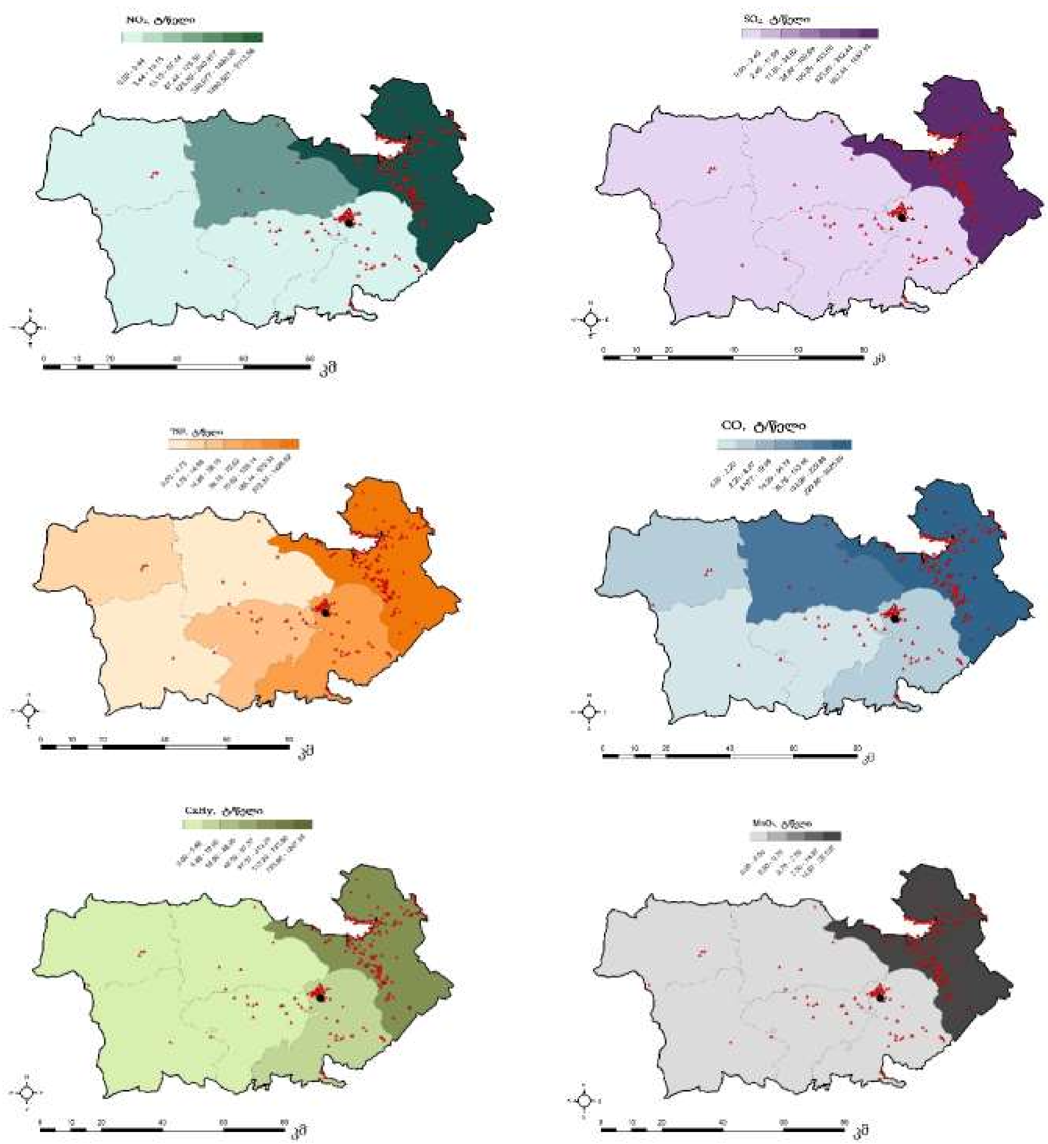
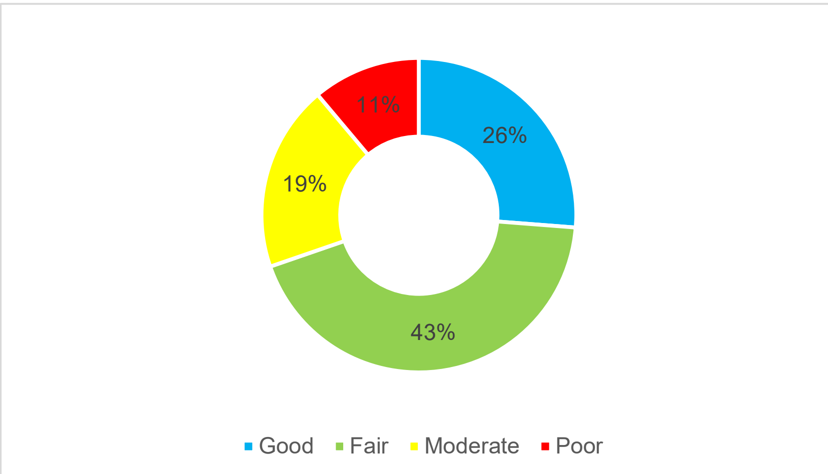


Figure 6-24. Emission maps for the Kvemo Kartli region (upper left: NO_2 tonnes/pa, upper right: pSO_2 tonnes/pa, middle left: TSP tonnes/ a, middle right: CO_2 tonnes/pa, lower left: CxHy tonnes/pa, lower right: MnO_2 tonnes/pa)

Data was also collected from the NEA for 2021. NEA has one observation station in the Samgori district of Tbilisi. Air quality monitoring results for 2021 from Varketili (Latitude: 41.7017; Longitude: 44.8756) in the Samgori District of Tbilisi are provided in Figure 6-25. This indicates that in general air quality is fair to good, with around 30% of the time air quality being moderate or poor.



Key:

	Good
	Fair
	Moderate
	Poor
	Very poor

Figure 6-25. Air quality data for the last 365 days (from 15 October 2021) for Varketili, Samgori District, Tbilisi

6.12. Noise and Vibration

No monitoring is undertaken of ambient noise in or near the Project Area The main source of noise identified during the field visit undertaken in October 2021 was the E60 motorway – Tbilisi bypass road.

6.13. Natural Hazards

Natural hazards in Tbilisi include earthquakes, severe storms triggering floods and landslides, extreme heat, hurricanes, tornadoes, and wildfires. Other hazards include wind erosion and hydraulic erosion.

6.13.1. Earthquakes

Georgia is situated in Caucasus region, between the Black and Caspian Seas. It is one of the most seismically active regions in Alpine-Himalayan collision belt. The main seismotectonic feature is the junction between the Arabian and Eurasian plates.[68] The most recent significant earthquake took place in September 2009 when an earthquake measuring 6.2 struck 156 km north-west of Tbilisi. Small earthquakes are frequent.[69]

6.13.2. Landslides

Landslides are a risk in Tbilisi. According to the World Bank and Global Facility for Disaster Reduction and Recovery (GFDRR) *ThinkHazard!,* which provides a general view of the hazards for a given location, landslide susceptibility is classified as high.[70]

The last major landslide (and flood) in Tbilisi was 13-14 June 2015, when heavy rain in the River Vere basin and its tributaries caused a drastic increase in the water level and triggered/activated large-scale landslide and debris flow events. According to official government figures, the flooding killed 19 people, displaced 67 families and directly affected around 700 people.[71]

[68] Available at: Georgia_FDSN_2004.pdf
[69] Available at: Natural disasters - Georgia travel advice - GOV.UK (www.gov.uk)
[70] Available at: Think Hazard - Georgia - Landslide
[71] Available at: Tbilisi Landslide Disaster Georgia | Mountain Risk Consultancy (mountain-risk.com)

According to the Geological Bulletin (issued by the NEA), in Gardabani municipality four landslides with a total area of 18,337 ha were recorded in 2019. One settlement was identified as under moderate risk, and two settlements under low risk. A road and a high voltage mast were damaged due to these landslides.

According to data available, from the ZSIS area villages, activation of landslide and mudslide processes is expected in Norio, Martkopi and Akhali Samgori. Examples of landslides around Norio are shown in Figure 6-26.

No landslides were observed in Sagarejo municipality in 2019. There were three mudslides with water supply headworks pipelines, motorway and railway bridges listed as damaged infrastructure.

In the ZSIS, extensive damage can be caused by leaking irrigation infrastructure that leads to landslides. The stability of the terrain at existing ravines is uncertain. There are locations with landslides in the upstream part of the Upper Main Canal.

A ravine, 22 m deep, was created by the release of water from UMC G9 into an unlined channel. There is a risk that it might fail with catastrophic consequences. A 22 m deep erosion gully has appeared on an outlet from UMC G9 canal (see Figure 6-26). This is a typical evolution of the release of water into an unprotected channel with steep slopes as well as the erodibility of the sandy subsoil.

Landslides. Village of Norio, left slope of the River Norioskhevi Gorge

498312 – 4626715

Landslides. Left slope of the River Norioskhevi Gorge to the North of village of Norio

496917 – 4629399

An erosion gully on an outlet from UMC G9

Figure 6-26. Gardabani municipality landslides (2019) and erosion gully

6.13.3. Floods

Tbilisi is subject to floods, with the last severe flood occurring in 13-14 June 2015, when heavy rain in the River Vere (a right bank tributary of the Kura River) basin and its tributaries caused a drastic increase in the water levels.

Data in the Eptisa 2018 ESIA Report indicates that the available data for flood risk in the Lori River only addresses the frequency of flooding upstream of Sioni dam. On the assumption of a stationary dataset, the distribution of flood intensity was developed as shown in Figure 6-27. In most years the Sioni reservoir has sufficient unused storage capacity that, in nearly all cases, the discharge to Paldo headworks is 100% controllable. Sioni overspill, in the order of once or twice a century, remains a possibility but with appropriate reservoir management, extreme storm conditions should be containable further downstream within the natural channel and overbank ephemeral storages.

There remains an undetermined risk of catastrophic flooding from either seismic failure of Sioni dam itself, or rotational slumping of hillsides into the reservoir, thereby causing a high-stage pressure wave which would over-top the Sioni dam.

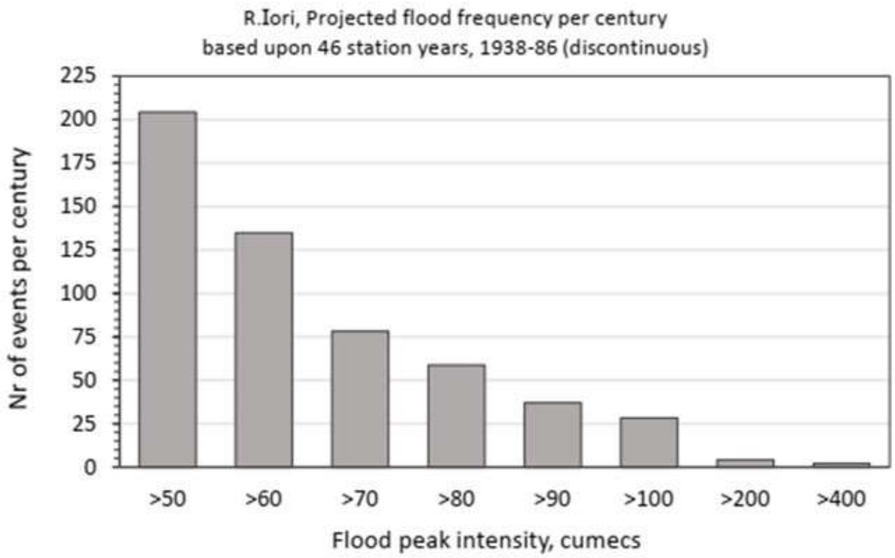


Figure 6-27. Flood frequency inflow to the Sioni Reservoir

6.13.4. Hydraulic erosion

Erosion occurs in the catchment area of the Sioni reservoir, which can result in reduced capacity of the reservoir storage volume due to consequent sediment runoff (which would then reduce the available water for irrigation). Erosion of the alpine meadows is usually caused by overgrazing and damage by vehicles.

Within the irrigation area, the black soils (loamy clay), vertisols of the Sartichala and Lemshveniera sectors may experience erosion due to drying out then being washed off in heavy rain or excessive irrigation flows.

The subsoil of the slopes downhill of the LMMC are a friable agglomerate of sand, loam and pebbles which is readily washed out by flowing water and which results in ravine formation.

6.13.5. Wind erosion

Wind erosion occurs across the irrigation areas due to the high wind velocities, which occur periodically in the area. The predominantly loamy soils are susceptible to aeolian transport of the silt particles especially if the soil is left uncovered after the fall ploughing until spring.

6.14. Land Use and Landscape

Available data from GEOSTAT according to the last agricultural census (2014) indicates the area of land in hectare to different land uses in the relevant municipalities. In general, all lands that are not actively cultivated (and protected) are grazed, with free-roaming cattle. As such, overgrazing is an issue in all area including the Project Area where livestock are kept.

Table 6-14. Agricultural land operated by agricultural holdings and Non-agricultural land operated by agricultural holdings and its structure, ha

Location	Agricultural land					Non-agricultural land	Land occupied by buildings and yards	Woodlands	Reservoirs for aquaculture	Other non-agricultural land
	Agricultural land	Arable land	Land under permanent crops	Green houses	Natural meadows and pastures					
Tbilisi	2,817	2,159	258	15	385	1,341	1,326	1	0	13
Sagarejo	63,446	19,450	3,229	1	40,766	1,421	1,387	13	4	17
Gardabani	25,424	14,293	538	22	10,571	1,642	1,607	1	18	16

Urbanization and industrialization is also ongoing in the surroundings of Tbilisi Sea, the Lilo area and the city of Rustavi. The Tbilisi Master Plan (2019)[72] envisions expansion of the built area to the east of the Tbilisi Sea, and recreational zones to the north-east. The Consultant was informed that overall around 800 ha of the ZSIS command area has already been re-categorised as part of the Tbilisi Urban Development Plan. In the downstream section of the UMC, visual inspections also showed the ongoing expansion of the road network as well as enterprise development in the Lilo area east of Tbilisi.

Description: orange zone directly to the east and south-east of Tbilisi Sea earmarked for housing development, and green zones to the north-east of the Tbilisi Sea showing the envisioned development of recreational zones with parks, gardens, sport facilities. Source: Tbilisi Master Plan (2019)

Description: Enterprise and by-pass road development along the boundaries of TUs in downstream part of IZ-3, canals UMC-G20 – UMC-G28. Source: Google Earth.

Figure 6-28. Examples of urbanization developments in the ZSIS command area

The Vaziani Military Airbase is also located in the centre of part of IZ4 closest to Tbilisi City, spread over 10,000 ha.

A site visit was undertaken in October 2021 of the following sites that shows the predominant landscapes:

Table 6-15. October 2021 site visit land uses

[72] Tbilisi General Land Use Master Plan, prepared by the City Institute Georgia between 2015 and 2018, adopted by the Tbilisi city council in 2019.

Location	General description	Image
Start of the LMC G6 secondary canal 41°40'13.2"N 45°01'19.0"E (41.670337, 45.021954	Flat terrain. Scattered bushes and trees. Adjacent land plots are possibly meadows and some are cultivated. To the north of this site is an Industrial area, and to the west the Poultry farm “Chirina” and a Fruit Storage and Sorting Facility.	 Secondary canal in poor condition.
Downstream of the secondary canal (G6), to the south from the point 1. 41°38'23.3"N 45°00'38.8"E (41.639811, 45.010764)	Flat terrain. Scattered bushes and trees. Adjacent land plots are used as pastures. Visible signs of overgrazing. Gas towers are observed indicating that there is an underground gas pipeline. Vaziani military base is located to the south of the site.	 Land used as pasture
G15 and G16. LMC Canal Point 3 - 41°36'00.2"N 45°06'17.3"E (41.600045, 45.104809)	Hilly terrain. Scarce vegetation. Free from bushes and trees. Small ravines. Arid. Possible that the canal is used for livestock for drinking.	 Arid landscape

Location	General description	Image
Outflow of Chumatkhevi creek into LMC 41°35'51.2"N 45°09'01.0"E (41.597541, 45.150272)	Hilly terrain. Arid. Used as pastures. Signs of overgrazing and wind erosion. Signs of underground communications, probably an oil pipeline.	
G10 41°35'15.8"N 45°09'22.0"E (41.587726, 45.156098)	Hilly terrain. Few trees around farmhouses.	 Uninhabited farmhouse
Area of G23 and G24 41°34'22.1"N 45°11'49.1"E (41.572796, 45.196957)	Flat terrain surrounded by hills. Used as pastures and growing corn.	

6.15. Biodiversity

Data on the ZSIS flora and fauna has been taken from the Eptisa 2018 ESIA Report. Although the report indicates that certain species were identified during field surveys, no details are available of the nature and/or extent of those field surveys.

6.15.1. Protected and Designated Sites

National Designations

Tbilisi National Park is located to 20 km north-east of the city, between the city and Sioni reservoir. And to the north of the irrigation area. The national park was established in 1973 on the basis of the previously existing Saguramo National Reserve (established in 1946) and is the oldest national park in Georgia. The area of the park is 243 square kilometres. The Park is mainly covered by trees and shrub of oak, hornbeam, and beech. Protected mammals in the park include red deer, lynx, Eurasian brown bear, red fox, and jackal. The Park is outside the scope of the study area.

The Gardabani Managed Reserve is located downstream on the River Mtkvari in Gardabani Municipality and Marneuli Municipality in Kvemo Kartli region of Georgia, near the Azerbaijan border at a distance of 39 km from Tbilisi. It protects floodplain forest groves as well as local fauna. It has been considered to be included into Ramsar Convention list of Wetlands of international importance and is a candidate Emerald Site.[73]

The Iori Managed Reserve is located downstream of the project area adjacent the River Iori, in Kakheti, Sighnaghi Municipality. Its area is 1,336 ha. The area protects the floodplain forest on the banks of the River Iori. Species include Georgian iris, Eichler tulip, barberry, tamarisk, cistus tree, sapwood, juniper, hornbeam, palirius, etc. Mammals include boar, wolf, otter, jungle cat and others are found here; birds include pheasant, francolin, partridge, Egyptian vulture, griffon vulture, forest owl, kestrel; and reptiles include Mediterranean turtle and giurza.[74]

There is also a Gardabani Wildlife Refuge located along the River Mtkvari on the left side of the river, to the west of the Project Area.

International Designations

In terms of international designations, the Caucasus Endemic Bird Area (EBA)[75] covers Georgia, Armenia, Azerbaijan, Iran, and Turkey (Figure 6-29). Several mountain ranges are included but the EBA is largely defined by the Greater Caucasus (reaching 5,600 m) and, to the south, the Lesser Caucasus (4,095 m). These mountains support a diverse variety of vegetation types including broadleaved and coniferous forests, montane steppe and woodlands, subalpine and alpine meadows and semi-desert vegetation. The subalpine and alpine zones are used by all the restricted-range bird species. Forested habitats close to the treeline are important for Phylloscopus lorenzii, a species which is sometimes considered to be conspecific with the widespread Mountain Chiffchaff P. sindianus of south-west Asia. Other restricted range species in the EBA include the Caucasian Grouse (*Lyrurus mlokosiewiczi*) and Caucasian Snowcock (*Tetraogallus caucasicus*). The EBA boundary near Tbilisi extends just past Martkopi to Vaziani and Sartichala to the east.[76]

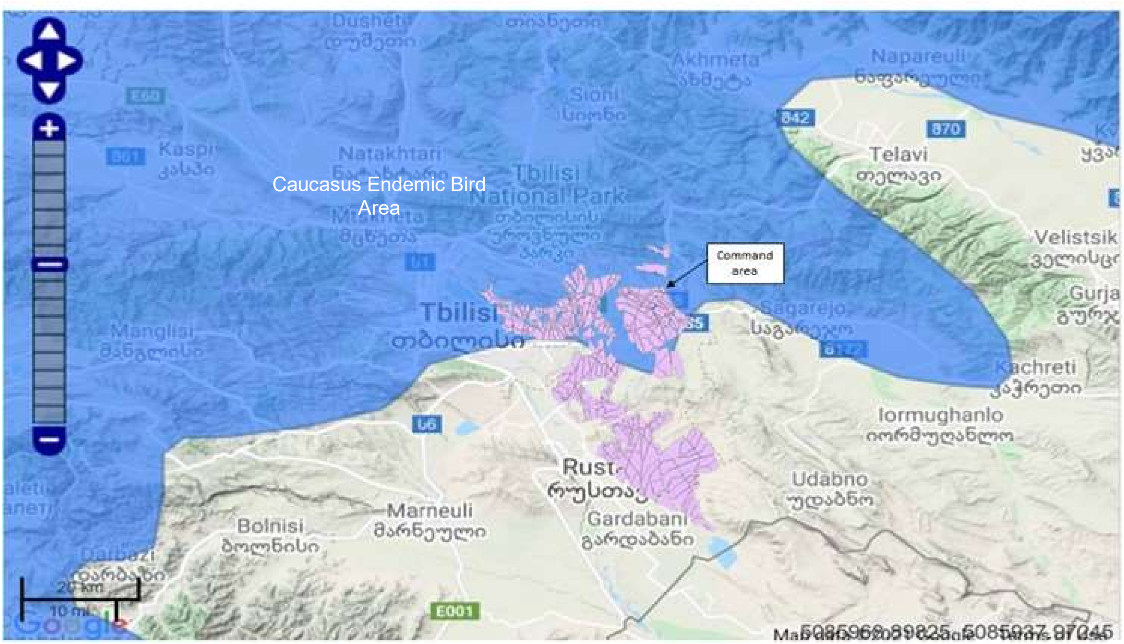


Figure 6-29. Caucasus Endemic Bird Area

[73] Available at: [Managed Reserve Info - Agency of Protected Areas of Georgia (apa.gov.ge)]
[74] Available at: [Managed Reserve Info - Agency of Protected Areas of Georgia (apa.gov.ge)]
[75] Most bird species are quite widespread and have large ranges. However, over 2,500 are restricted to an area smaller than 50,000 km^2, and they are said to be endemic to it. BirdLife International has identified regions of the world where the distributions of two or more of these restricted-range species overlap to form Endemic Bird Areas.
[76] Available at: [BirdLife Data Zone]

There are three Important Bird Areas (IBAs) within the Project Area (Figure 6-30), as follows[77]:

- Jandari Lake IBA – IBA trigger species *Pygmy Cormorant Microcarbo pygmaeus* and Eastern Imperial Eagle *Aquila heliaca*
- Iori IBA – meets the IBA criteria A1, B2, B3 (2000). The site is an outstanding site for raptors, with at least 25 diurnal raptors and six owls recorded: *Neophron percnopterus*, *Gyps fulvus*, *Accipiter brevipes* (occurs on passage), *Aquila nipalensis* (passage and winter visitor), *Falco biarmicus*, *F. cherrug* (occurs in winter, but breeding recently confirmed for one pair and suspected for a second). This is the only site in Georgia *supporting Francolinus* (common) and also has the country's largest population of *Alectoris chukar*. Among other breeding species are *Delichon urbica* (large cliff colonies), *Cercotrichas galactotes* (rare and irregular), *Sitta tephronota*, *S. neumayer* and *Sturnus roseus* (abundant), while *Tichodroma muraria* visits the area in winter.
- Lower Kura Valley IBA - meets the IBA for the Eastern Imperial Eagle *Aquila heliaca*.

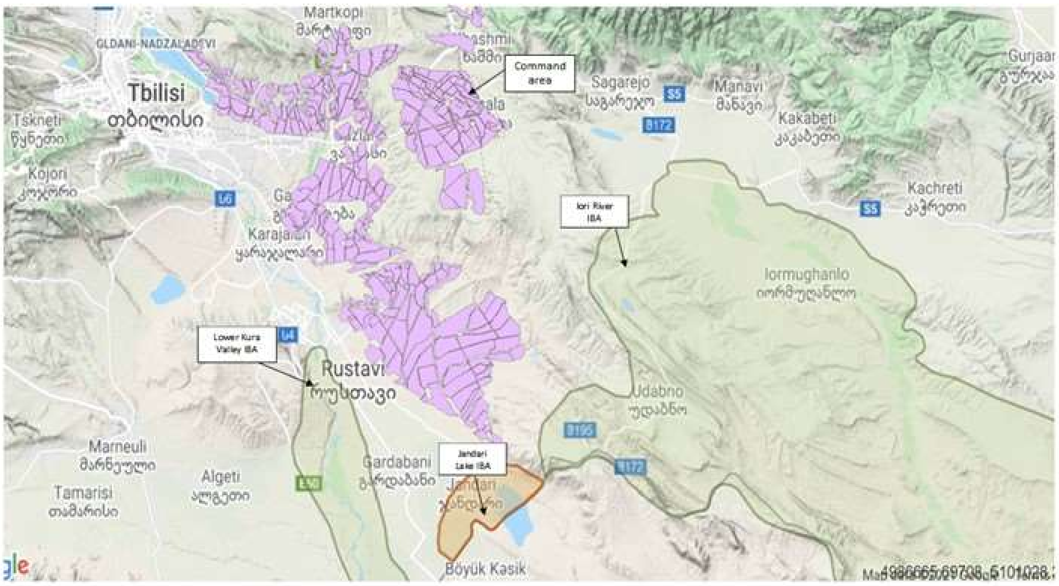


Figure 6-30. Important Bird Areas in the Project Area

The Emerald Network is an ecological network made up of Areas of Special Conservation Interest. In accordance with obligations under the Bern Convention on the Conservation of European Wildlife and Natural Habitats, and the EU-Georgia Association Agreement, Georgia officially nominates candidate Emerald Sites. At present, there are 66 Emerald Sites in Georgia, from which 46 are designated sites[78], four candidate sites[79] and 16 proposed sites. The Lower Kura Valley IBA coincides with the Gardabani Nature Reserve, which is an Emerald Network 'Candidate Site'. The sites closest the ZSIS are shown in Figure 6-31 below.

[77] Available at: BirdLife Data Zone

[78] Strasbourg, Officially Adopted Emerald Sites, 3 December 2021 (coe.int);
[79] Strasbourg, Officially Nominated Candidate Emerald Sites, 3 December 2021 (coe.int)

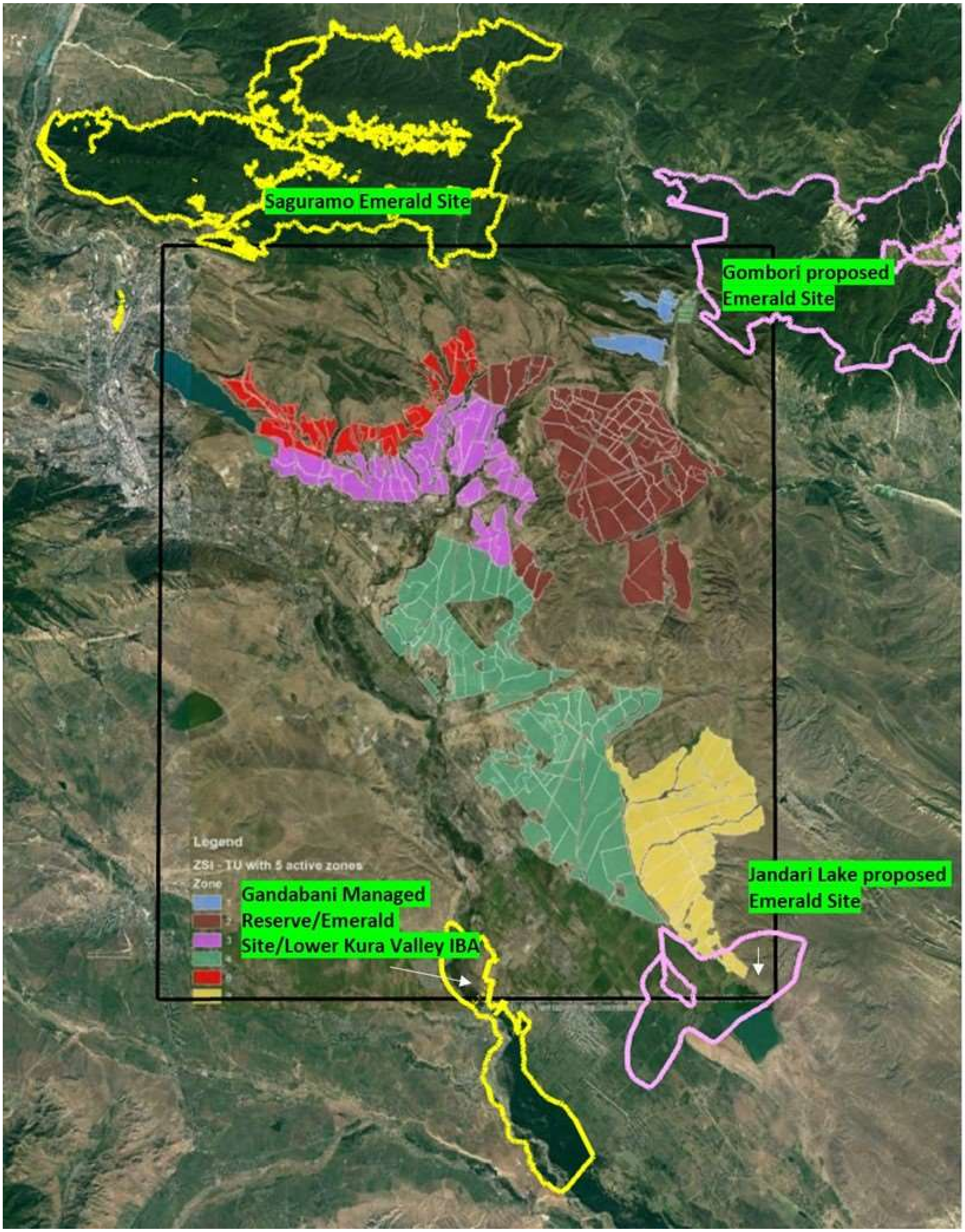


Figure 6-31. Area of Special Conservation Interest/Emerald Sites (proposed and confirmed) in the vicinity of the ZSIS

6.15.2. Biodiversity, Flora and Fauna

The biodiversity of Georgia is important from the national, regional and global points of view. The Caucasus region, which includes Georgia, has been identified by the World Wide Fund for Nature (WWF) as a Global 200 Ecoregion, based on selection criteria such as species richness, levels of endemism, taxonomic uniqueness, unusual evolutionary phenomena, and global rarity of major habitat types. Moreover, Conservation International has identified the region as a global "hotspot"—that is, one of the 25 most biologically rich and most endangered terrestrial ecosystems in the world.[80]

Georgia's ecosystems include alpine and subalpine meadows, lowland steppe grasslands, coastal, mountain and inland wetlands, coniferous and beech forests, oak woodlands and mixed deciduous forests, wetland forests, arid light woodlands, riparian shrub, and forest vegetation along rivers.

The flora of Georgia contains between 4,200 and 4,500 species of vascular plants. Of these, 9% are endemic to Georgia and 14% are endemic to the Caucasus.

The fauna of Georgia consists of species characteristic not only of Georgia and the Caucasus, but also of their areas of origin, such as southwestern Asia and the Middle East/east Mediterranean regions.

Five hundred representatives of butterflies and moths (Macrolepidoptera) have been described in Georgia, nearly a third of them endemic or relic species.

Four species of newts and nine species of frogs and toads are found in Georgia. One species is endemic to Georgia and two to the Caucasus.

Fifty-three reptile species occur throughout Georgia, consisting of 3 tortoises, 27 lizards and 23 snakes. Of these, three snakes and 12 lizards are endemic to the Caucasus. Six reptiles are included in the Georgian Red Data book.

Three-hundred-and-sixty bird species have been recorded in Georgia. Caucasian snowcock (*Tetraogallus caucasicus*) and Caucasian black grouse (*Tetrao mlokosiewiczi*) are alpine species endemic to the Caucasus.

There are 68 species of small mammals in Georgia. Nineteen of these species are endemics.

Throughout Georgia there are 84 species of freshwater fish. Twenty-nine species are found in the basin of the Caspian Sea, of which 11 are also found in Black Sea basins. Twelve of the native species are found only in the basin of the Mtkvari river, and nine of these are endemic to this river and its tributaries. [81]

6.15.2.1. Terrestrial Flora

The ZSIS crosses several habitats from Paldo village situated in the River Iori river gorge to Tbilisi reservoir:

- Two different broadleaf forest habitats, i.e. riparian forest and oak-hornbeam forest are present in Paldo village, where headwork of the ZSIS is located. Riparian forest fragments are also distributed in small river gorges located between Tbilisi reservoir and Vaziani village area;
- Steppe vegetation dominated by bluestem (*Bothriochloa ischaemum*), which forms several plant communities in steppe. Steppe habitat is a basic habitat type distributed in the area ZSIS corridor started from Vaziani and stretching to Tbilisi reservoir;
- Vegetation of urban and rural areas is present in the villages and arable lands around the villages;
- *Matorral sclerophyllous* shrubbery dominated by Jerusalem thorn (*Paliurus spina-christi*), the most widespread vegetation type after steppe vegetation and which is present in Vaziani – Lilo (Tbilisi reservoir) section;
- Marsh vegetation located along the canals and small marshes; and
- Artificial tree plantations in the form of windbreaks along the arable lands and pine forest spots, planted on the eroded slopes for soil fixation.

All of these habitats are strongly affected by anthropogenic factors such as extensive grazing, gardening, forest cutting and infrastructure development. Within the ZSIS, natural habitats have been transformed into agricultural lands and/or degraded by anthropogenic activities including infrastructure development and overgrazing.

[80] Biodiversity Assessment for Georgia, available at: 118-Georgia-PNACH659_2000 (1).pdf
[81] Biodiversity Assessment for Georgia, available at: 118-Georgia-PNACH659_2000 (1).pdf

Rare and endemic plant species occur in remaining fragments of riparian forests and xerophyllous shrubbery located in the dry gorges of areas surrounding the ZSIS and the broadleaf forest of Paldo- Mukhrovani, outside the current project area.

Some tree species, included in the Red List of Georgia (*Pyrus demetrii, Juglans regia, Ulmus minor)* were recorded during the Eptisa surveys near canals:

- Several individuals of walnut (*Juglans regia)* have been found in the vicinity of village Patara Lilo, on slopes near the canals (GPS: N4144246; E04454471) as well as in Martkopi village (GPS: N4146303 E04501431).
- During the field survey several tens of *Ulmus minor* have been revealed near Patara Lilo village (GPS: N4144070; E04455472), as well as near Tbilisi reservoir (GPS: N4145323; E04452418) along and in the damaged canals. Several trees of *Ulmus minor* were observed near the Martkopi – Akhalsopeli road (GPS: N4145393; E04502350) along the secondary canals. Walnut trees are revealed in this area as well.
- Wild pears (*Pyrus fedorovii*) – endemic species of Georgia have been found near Patara Lilo village (GPS: N4144120; E04456081).

Small dry river gorges and sclerophyllous shrubbery between Patara Lilo and village Vaziani are habitats with early spring blooms of rare and endemic species: Georgian Iris (*Iris iberica*), Caucasian Cyclamen (*Cyclamen vernum*), endemic Peonies (*Paeonia* spp.), Orchids (*Orchis* spp.), Pulsatilla (*Pulsatilla violacea*), Violets (*Viola* spp.) Caucasian Helleborus (*Helleborus caucasicus*), Yellow Star of Bethlehem (*Gagea lutea*) etc.

Tables of the status of observed vegetation are provided in Appendix A.

Vegetation was also observed within the canals of the ZSIS during the October 2021 site visit, as shown in the figure below.

Figure 6-32. Vegetated canals observed in the ZSIS during October 2021 site visit

6.15.2.2. Terrestrial Fauna

Fauna within the ZSIS is not very diverse since the natural landscape has been modified by agriculture over a long period and the area is highly populated.

Within the valleys of the Rivers Iori, Alazani and Mtkvari there is a bird migratory route. As identified in section 6.14.1, there are also three IBAs to the south of the ZSIS area. Around 201 bird species could be present in the Project Area and its surroundings. Of these, 17 bird species are included into the Red List of Georgia.

Field surveys undertaken and reported in the Eptisa ESIA in 2018 indicated that only 25 species of vertebrates were identified during the surveys:

- 2 species of amphibians: Lake Frog (*Pelophylax ridibundus*), Green Toad (*Bufo viridis*);
- 2 species of reptiles: Five-streaked Lizard (*Lacerta strigata*), European Blind Snake (*Typhlops* vermicularis);
- 15 species of birds: Great Tit (*Parus major*), Common Buzzard (*Buteo buteo*), Common Magpie (*Picapica*), Eurasian Tree Sparrow (*Passer montanus*), European Greenfinch (*Carduelis chloris*), Eurasian
- Hoopoe (*Upupa epops*), Grey heron (*Ardea cinerea*), Crested Lark (*Galerida cristata*), Egyptian Vulture (*Neophron percnopterus*), Hooded Crow (*Corvus cornix*), Common Blackbird (*Turdus merula*),
- Common Starling (*Sturnus vulgaris*), Nothern Wheatear (*Oenanthe oenanthe*), European Goldfinch (*Carduelis carduelis*), Eurasian Jay (*Garrulus glandarius*);

- 6 species of mammals: Bush Vole (*Microtus major*), Brand's hamster (*Mesocricetus brandti*), Red Fo (*Vulpes vulpes*), Lesser Wood-Mouse (*Sylvaemus uralensis*), Social vole (*Microtus socialis*), Jacka (*Canis aureus*).

Two of above mentioned species - *Neophron percnopterus* and *Mesocricetus brandti* - are included in the Red List of Georgia as vulnerable species.

6.15.2.3. Aquatic Flora and Fauna

There are a number of small water bodies allocated across the ZSIS, such as shown in the figure below.

Twenty three fish species could occur in Paldo reservoir, Tbilisi Sea and Jandara Lake (which are connected by irrigation canals) and the artificial and natural ponds in the ZSIS, of which one species – Golden Spined Loach (*Sabanejewia aurata*) - is in Red List of Georgia.

Figure 6-33. Small waterbodies observed in the ZSIS during October 2021 site visit

6.15.2.4. Critical Habitats

The objectives of EIB's Environmental and Social Standards (2018) and its Performance Standard 3 on Biodiversity and Ecosystems are to protect and conserve biodiversity using a precautionary approach, adopt the mitigation hierarchy approach, with the aim of achieving no net loss of biodiversity, and where appropriate, a net gain of biodiversity, and promote good international practice in the sustainable management and use of living natural resources.

Performance Standard 3 applies to the following types of habitat:

- Natural Habitat
- Semi-Natural Habitat
- Urban Habitats

More stringent requirements apply where projects are located in areas or ecosystems that are considered to represent "critical habitat", including a presumption in favour of avoidance and a requirement to demonstrate positive outcomes (net gain) of biodiversity in cases where projects do take place. Promoters are therefore required to determine through an assessment whether their projects are located within or could affect any areas of critical habitat.

Performance Standard 3 considers an area as "critical habitat" if it supports any of the following features, and is needed to sustain them in a viable state:

- Highly threatened or unique ecosystem;
- Population of critically endangered, endangered or vulnerable species, as defined by the IUCN Red List of threatened species and in relevant national legislation;
- Population, range or distribution of endemic or restricted-range species, or highly distinctive assemblages of species;
- Habitat required for the survival of migratory species and/or congregatory species;
- Biodiversity and/or ecosystem with significant social, economic, or cultural importance to local communities and indigenous groups; and
- Habitat of key scientific value and/or associated with key evolutionary processes.

The following is a summary of the findings of the screening of the Project against Performance Standard 3 requirements. The full screening is provided in Appendix B.

Two study areas were considered for the critical habitats screening:

- **Study Area 1**, the Irrigation Zones and associated habitats identified in the command area of the ZSIS correspond to “semi-natural habitats” whose ecological assemblages have been substantially modified in their composition, balance or function by human activities, predominantly through irrigated agriculture and a network of irrigation channels developed since the 1950s. Habitats include cultivated ground, uncultivated gullies and field margins and vegetated areas lining canal banks or where lined channels have collapsed into disrepair.
- **Study Area 2** covers a wider area, from two IBAs in the southern part of the project (one of which is also the Gardabani Managed Reserve and an Emerald Network ‘Candidate Site’) to the Caucasus EBA to the north of the project. Study Area 2 considers the bird species that triggered these designations and the neighbouring irrigation scheme. Inherent in these considerations are the resident and migratory bird patterns at a wider catchment/regional scale (Figure 6-34) and at the Central Asian - Indian Flyway Scale (Figure 6-35) which need to be understood and acknowledged.

Figure 6-34. Project area at a regional catchment scale

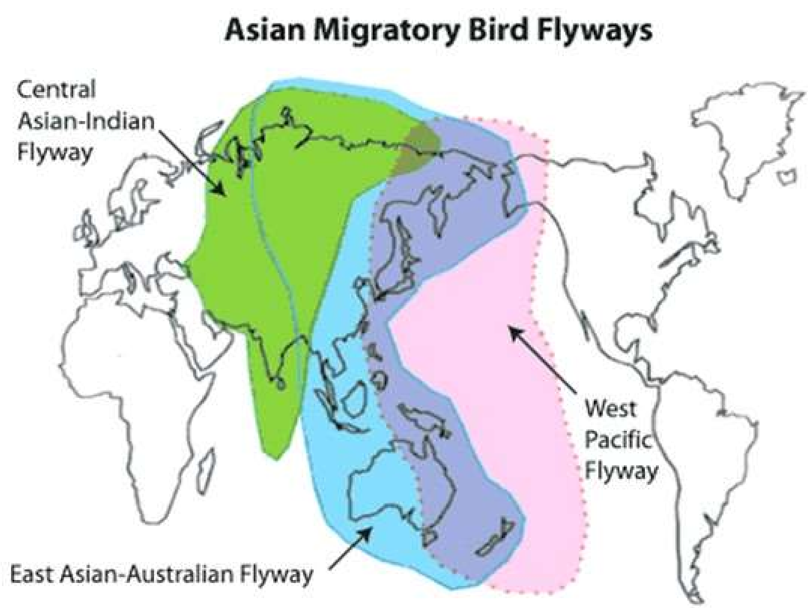


Figure 6-35. Project area within the Central Asian-Indian Flyway

Whilst habitats within the ZSIS are generally identified as semi-natural habitats in accordance with the Performance Standard, the presence of the EBA and IBA could mean that there are some habitats that support important bird species in the wider Project Area.

The irrigation fields, being "semi-natural" habitat, modified over time through irrigated agricultural practices and other anthropogenic activities (e.g. livestock grazing, tree cutting, urban development) are not considered to contain "critical habitat" as per the EIB criterion (Table 6-16). Consequently there is no 'red flag' for infrastructure investment and upgrade of the irrigation system.

That is not to say the irrigation area is not important to biodiversity. Vegetated gullies and canal lines, small water bodies, thickets, shrubs and small trees, steppe vegetation, fields of crops and stubble and vegetated margins will all harbour biodiversity and require responsible development practices.

There is potential for the Project upgrade of the irrigation system to adversely affect site integrity of the neighbouring EBA and IBAs (Lower Kura Valley IBA, also known as the Gardabani Managed Reserve and a Candidate Emerald Network site; and Jandara Lake IBA), for example through noise and changes to offtake of surface or groundwater water. This would require more detailed assessment and development of a biodiversity mitigation strategy during the detailed design stage. Further investigation is also needed to determine when the Gardabani Emerald Candidate Site will officially be designated.

Table 6-16. Critical Habitat summary

Criterion	Study Area 1 Irrigation Command Area	Study Area 2
Highly threatened or unique ecosystems	Not applicable	Possible e.g. in Gardabani Managed Reserve/Lower Kura Valley IBA (an Emerald Site).
Population of critically endangered, endangered or vulnerable species, as defined by the IUCN Red List of threatened species and in relevant national legislation	Possible due to potential presence of IUCN and Georgia Red Book endangered species and Annex II and IV species	Possible due to potential presence of IUCN and Georgia Red Book endangered species and Annex II and IV species
Population, range or distribution of endemic or restricted-range species, or highly distinctive assemblages of species	Unlikely but cannot be ruled out at this stage.	Possible due to potential presence of unique or rare assemblages of migratory and restricted-range species.
Habitat required for the survival of migratory species and/or congregatory species	Unlikely but cannot be ruled out at this stage.	Possible due to potential presence of rare migratory species.
Biodiversity and/or ecosystem with significant social, economic, or cultural importance to local communities and indigenous groups	Not applicable	Possible, e.g. Gardabani Managed Reserve/Lower Kura IBA
Habitat of key scientific value and/or associated with key evolutionary processes	Possible due to presence of 1 proposed ASCI within Study Area 1	Applicable with Caucasus EBA, 3 IBAs one being the Gardabani National Reserve, 2 ASCIs and 2 proposed ASCIs.

6.15.2.5. Ecosystem services

EIB Performance Standard 3 on Biodiversity and Ecosystems refers to the *Millennium Ecosystem Assessment*[82] for the categories of ecosystem services.

Ecosystem services are classified along functional lines, using categories of provisioning, regulating, cultural, and supporting services:

- Provisioning services: products obtained from ecosystems e.g., food, freshwater, fuel, genetic resources, medicinal plants, and ornamental resources);
- Regulating services: benefits obtained from the regulation of ecosystem processes such as air quality maintenance, climate regulation, water purification, erosion control, biological control and pollination.
- Cultural services: nonmaterial benefits people obtain from ecosystems through spiritual enrichment, cognitive development, reflection, recreation, and aesthetic experiences, such as spiritual values, knowledge systems, sense of place and aesthetic value; and
- Supporting services: The extent to which the land unit provides supporting services, either positive (e.g., migration corridor, pollination, pest control, nutrient cycling, soil formation and retention), or negative (e.g., disease sources, pest outbreaks).

Ecosystems include drylands, cultivated lands and urban lands, amongst others. Key ecosystem services relevant to ecology that may be affected by the Project are provisioning and regulating services of the rivers, e.g., consumables such as fish and certain birds related to the Iori River, and supporting services, e.g., migration corridors, related to the Iori River. The canals also provide irrigation services as well as industrial and HPP services.

6.16. Waste Management

Waste collection and management in Tbilisi is under direct control via the TbilService Group. Currently there is little recycling of Municipal Solid Waste (MSW) apart from some small-scale schemes operated by community groups and NGOs. Tbilisi landfill is located in the area adjacent to village of Didi Lilo. The landfill has an area of 84 ha and receives waste from Tbilisi. 397,500 tonnes of waste was disposed on the Tbilisi landfill in 2017.[83] A hazardous waste facility is located in Tbilisi.[84]

The Tbilisi Green City Action Plan identifies that, despite improvements over the last few years, there is still a need to further modernise the waste management infrastructure, in particular vehicles and containers used in the collection of MSW. A new waste treatment facility is also planned adjacent to the current Tbilisi landfill.

In Sagarejo municipality, Sagerejo Landfill is located in the village of Ninotsminda. The landfill is 1.9 ha and receives waste from Sagarejo municipality. The average volume of monthly disposed waste is 2,400 m^3.[85]

In Gardabani municipality, waste is disposed to the Rustavi landfill, which receives about 2,957 tonnes of waste from Rustavi and Gardabani monthly.[86]

Sanitari Ltd, a multi-profile company providing services related to household and non-household, toxic and hazardous waste treatment; bioremediation of contaminated soils and other wastes, is also located in Gardabani municipality, at Gamarjveba.

Illegal dumpsites are a problem in Georgia in general. The Eptisa field visits reported illegal dumping of solid waste occurs adjacent to the main canals of the ZSIS. This is mainly construction waste, consisting of the soil, blocks, bricks and concrete debris. Household waste is found dumped as well associated with relatively densely populated areas.

Furthermore, hazardous waste such as asbestos containing materials, the remains of the schist tiles, were observed in the Eptisa field visits along the main canals, which were mixed in with the construction waste.

In agriculture it is difficult to define waste. Usually, waste is something that is externalized. But in traditional agriculture, many by-products are re-used on site.

Wastes include:

- Manure produced by livestock.

[82] Available at: Ecosystems and Human Well-being: A Framework for Assessment (millenniumassessment.org)
[83] State of Environment Report of Georgia 2014-2017
[84] Available at: Green City Action Plan (tbilisi.gov.ge)
[85] Municipal Solid Waste Company of Georgia, available at: waste.gov.ge
[86] Ibid

- Non-marketable fruits.
- Plastic films used for fruits and vegetable growing.
- Food processing wastes.

According to the data provided in the Value Chain Analysis report in the 2018 FS, the waste generation in the study area was calculated as a total of around 44,000 tonnes of dry matter per year from crops and husbandry.

Figure 6-36. Illegal waste dumping within ZSIS area and canals, especially along the LMC system and parts of the LMMC near Martkopi village

7. Socio-economic Baseline

This Section presents the baseline socio-economic conditions in the Project Area. Data has been obtained from the Eptisa 2018 ESIA Report and has been supplemented by available statistical data provided by the National Statistics Office of Georgia, readily available internet sources, and site survey. It should be noted that the information in the Eptisa ESIA covered the wider command area and is therefore provided where still relevant for general reference and context of the wider study area, including data collected in the census of the wider ZSIS villages; however, the proposed Project in the 2022 FS is covering a smaller area and therefore, where available, updated information has been provided.

7.1. Administrative Units and Villages

As identified earlier, the ZSIS is predominantly located in the region of Kvemo Kartli, though also covers parts of Kakheti and Tbilisi regions. These regions and their relevant municipalities and districts are highlighted below (and shown in Figure 7-1):

- Kvemo Kartli region comprises of six municipalities: Bolnisi, Dmanisi, **Gardabani**, Marneuli, Tetritskaro, Tsalka, and one self-governing unit – Rustavi.
- Kakheti region comprises of eight municipalities: Akhmeta, Telavi, Kvareli, Lagodekhi, Gurjaani, **Sagarejo**, Signagi and Dedoplistskaro.
- Tbilisi region comprises a self governing city (Tbilisi), four districts (including **Samgori**[87]) and 22 villages.

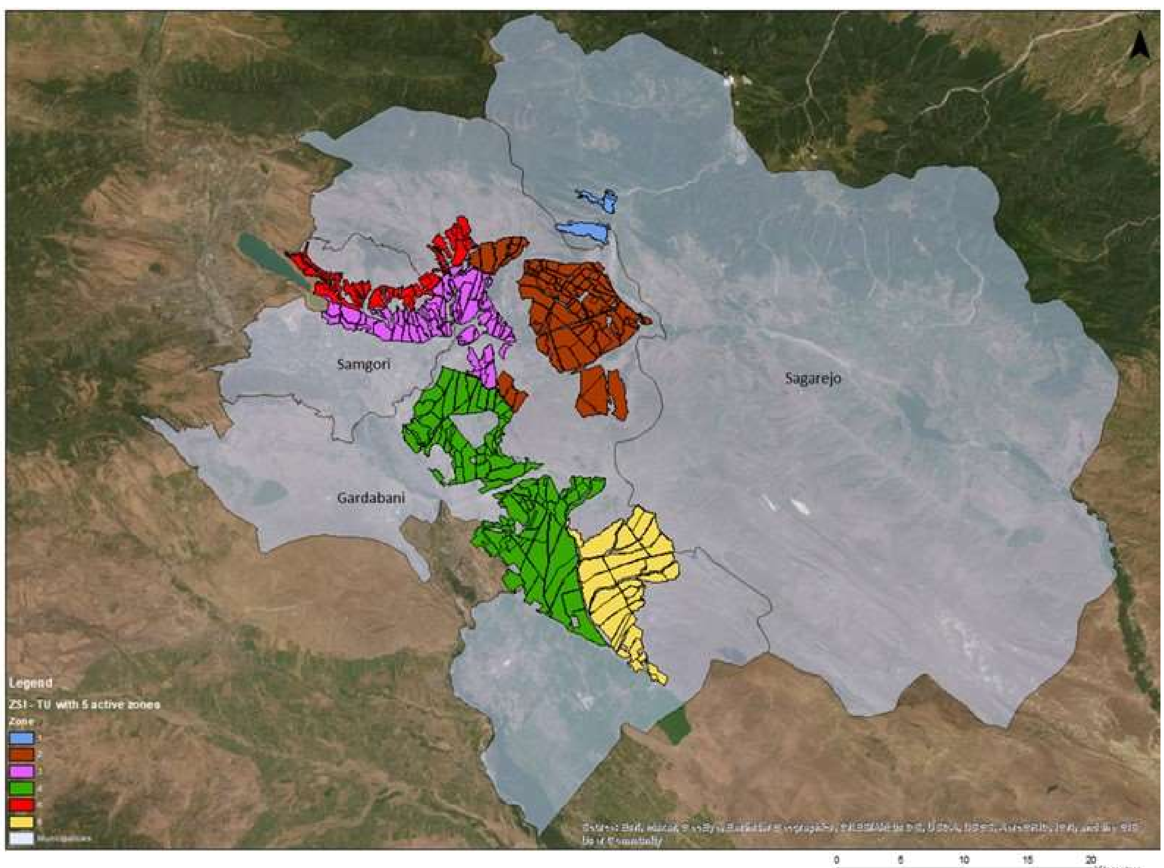


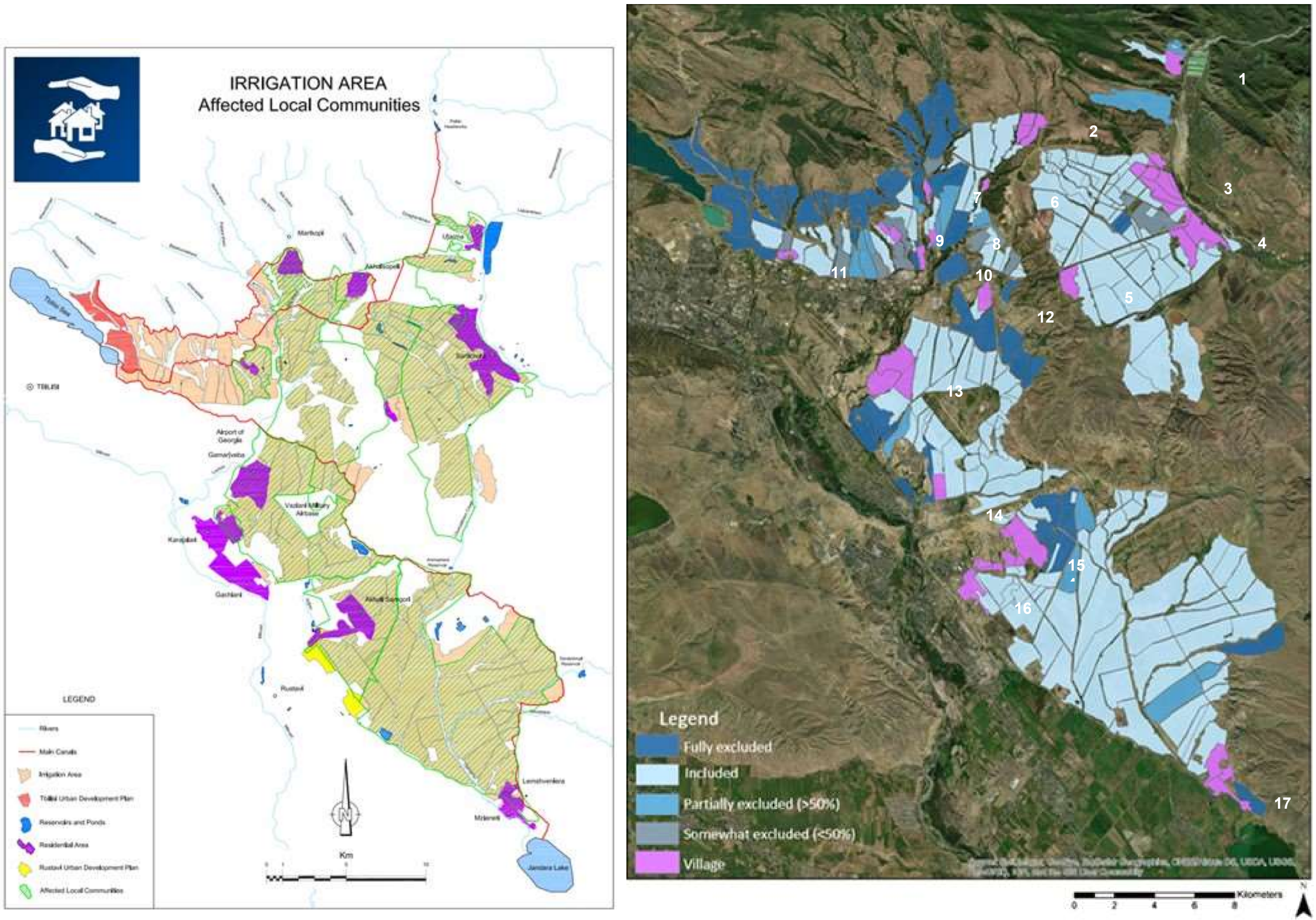
Figure 7-1. Administrative units and the ZSIS

[87] Samgori is part of the larger Isani-Samgori District in Tbilisi. Some statistical data is provided for Isani-Samgori and some for Samgori in this chapter.

In total 25 villages were included in the original scheme. This includes five villages in Samgori District, three villages in Sagarejo Municipality and 17 villages in Gardabani Municipality. The communities in the original command area are listed in Table 7-1 taken from the Eptisa 2018 ESIA Report. This has been updated with the 2021 studies, with the villages and areas that are in the command area under consideration has been identified. Note that some of these villages were not identified in the original table and therefore are shown in *italic*. Figure 7-2 overleaf shows the location of these villages, comparing the Eptisa map that covers the ZSIS with the current proposed potential irrigable tertiary units in the ZSIS command area.

Table 7-1. Villages covered by ZSIS

Municipality / Region	Community	Village / Settlement
Samgori District, Tbilisi	-	*Orkhevi*, part of Varketili
		Nasaguri
		Tsinubani (Lochini)
		Patara Lilo
		Daba Didi Lilo
Sagarejo, Kakheti	Ujarma	Ujarma
		Mukhrovani
		Paldo
Gardabani, Kvemo Kartli	-	Agtaklia
	-	Akhali Samgori - *Meprinveleoba*
		Brotsuela settlement
	Akhalsopeli	Akhalsopeli
		Mukhrovani
		Satskhenisi
		Mukhranis Metskhoveleoba (also called Mukhrovani)
	Gamarjveba	Gamarjveba
		Gamarjveba 1
		Poladaantkari
	Lemshveniera	Lemshveniera
		Mzianeti
		Nagebi
	Martkophi	Martkopi
		Vaziani
		Saakadze
	Sartichala	Sartichala
		Muganlo
	Norio	Norio
	Rustavi	-



Key
1 – Ujarma
2 – Akhalsopeli
3 – Muganlo
4 – Satichala
5 - Mukhranis Metskhoveleoba
6 – Saakadze
7 - Brotseula
8 - Brotseula
9 - Nasaguri
10 - Lochini / Tsinubani
11 - Orkhevi (Place) part of Varketili districts
12 - Vaziani
13 - Gamarjveba
14 - Akhali Samgori Meprinveleoba
15 - Part of Rustavi
16 - Part of Rustavi, industrial
17 - Lemshveniera and Mzianeti

Figure 7-2. Communities (Eptisa map) and villages within the 2021 potential irrigable tertiary units in the ZSIS command area

7.2. Demographics

7.2.1. Population

The total population of Kvemo Kartli region on January 1st, 2021 was 437.3 thousand people, of which 192.3 thousand (44%) constituted the urban population and 245.0 thousand (56%) the rural population[88]. The population density amounted to 68 persons per square km[89].

The total population of Kakheti region on January 1st, 2021 was 309.6 thousand people, of which 70.9 thousand (23%) constituted the urban population and 238.6 thousand (77%) the rural population[90]. The population density amounted to 27.2 persons per square km[91].

The total population of Tbilisi region on January 1st, 2021 was 1,202.7 thousand people, of which 1172.0 thousand (97%) constituted the urban population and 30.7 thousand (3%) the rural population[92]. The population density amounted to 2 385.2 persons per square km[93].

Population data for 2019 to 2021 for the main Project municipalities is provided in Table 7-2. The population of Gardabani Municipality, as of January 1st, 2021 was 80,329, with 11,700 people (15%) were living in urban areas, while 68,700 (85%) in rural areas. The population of Sagarejo Municipality as of January 1st, 2021 was 52,335, from which 10,500 (20%) were settled in urban areas and 35,400 (80%) in rural areas. The population has been relatively stable in both municipalities between 2019 and 2021, though is a decrease from earlier years.

Table 7-2. ZSIS Municipality Demographical Data 2019-2021[94]

Regions, self-governed units	Total Population		
	2019	2020	2021
Gardabani Municipality	80,788	80,368	80,329
Sagarejo Municipality	52,23	52,238	52,335

No data are currently available for Samgori District for 2019-2021, however, data from the latest population census as of November 5th, 2014 reported a population of 177,844 with only 5% of the Samgori district population living in rural areas.[95]

Population numbers for the villages in the ZSIS area are also only available for 2014 and are detailed in the following table.

Table 7-3. Population numbers for the villages in the ZSIS (2015)

Location	Total	Men	Women
Samgori District	177,844	82,318	95,526
Village Varketili	3,004	1,456	1,548
Village Nasaguri	1,509	748	761
Village Patara Lilo	666	325	341
Village Tsinubani	1,274	619	655
Town Didi Lilo	2,417	1,131	1,286
Sagarejo Municipality	51,761	26,035	25,726

[88] Available at: https://www.geostat.ge/regions/#
[89] Available at: Geostat, 2020.Vital statistics report in Georgia
[90] Available at: https://www.geostat.ge/regions/#
[91] Available at: Geostat, 2020.Vital statistics report in Georgia
[92] Available at: https://www.geostat.ge/regions/#
[93] Available at: Geostat, 2020.Vital statistics report in Georgia
[94] Source: National Statistics office of Georgia
[95] Available at: http://census.ge/en/results/census1

Location	Total	Men	Women
Ujarma Community	479	224	255
Village Ujarma	445	206	239
Village Mukhrovani	16	-	-
Village Paldo	18	-	-
Gardabani Municipality	81,876	40,144	41,731
Village Agtaklia	1,811	831	980
Village Akhali Samgori	1,870	911	959
Akhalsopeli Community	2,315	1,132	1,183
Village Akhalsopeli	1,549	762	787
Village Mukhrovani	334	158	176
Village Satskhenisi	432	212	220
Gamarjveba Community	5,677	2,756	2,921
Village Gamarjveba	4,670	2,255	2,415
Village Gamarjveba 1	313	148	165
Village Poladaantkari	694	353	341
Lemshveniera Community	2,272	1,095	1,177
Village Lemshveniera	1,642	795	847
Village Mzianeti	233	108	125
Village Nagebi	397	192	205
Martkopi Community	11,400	5,534	5,866
Village Martkopi	7,397	3,672	3,725
Village Vaziani	3,686	1,714	1,972
Village Saakadze	317	148	169
Sartichala Community	10.219	5,072	5,147
Sartichala	6,009	2,972	3,037
Muganlo	4,210	2,100	2,110
Village Norio (Norio Community)	3,756	1,883	1,873
TOTAL:	**48,669**	**23,699**	**24,936**

The 2014 census indicates that a total population in the ZSIS villages were 48,669, of which 23,699 (49%) were male and 24,936 (51%) were female.

Of the total 11,439 households in the ZSIS identified by the Eptisa 2018 Report, 3,452 had a female head of household and 7,989 had a male head of household. The average age of the heads of household was 56 years, for male heads of household 55 years while, for female 58 years. Households consisted of on average 2.5 people, with one in six families consisting of three people and one in about eight families consisting of four people. Thirty seven percent (3,959 households) were single person households, and 4,316 households were living as a couple. There were 1,034 households with only elderly people (over 65 years old).

Birth rates in the ZSIS area are shown in Table 7-4. As can be seen, the number of births in Tbilisi and Gardabani Municipality has decreased since 2010, with Sagarejo Municipality showing more of a fluctuation.

That said, rural births in Tbilisi and Sagarejo Municipality have increased, though decreased in Gardabani Municipality.

Table 7-4. Number of live births (persons) by regions, self-governed units and urban-rural settlements 2010-2020

Regions, self-governed units	Years		
	2010	2015	2020
Tbilisi City	17,382	17,509	15,271
Urban	16,975	16,947	14,646
Rural	407	562	625
Samgori District	n.a.	n.a	n.a
Sagarejo Municipality	**665**	**944**	**709**
Urban	154	145	118
Rural	**511**	**799**	**591**
Gardabani Municipality	**1,350**	**1,423**	**1,031**
Urban	188	215	167
Rural	1,162	1,208	864

According to the National Statistics Office of Georgia data for Georgia in 2020, the population is growing in Tbilisi and Kvemo Kartli regions however is declining in the Kakheti region, though this trend has slowed since 2019 (Table 7-5).

Table 7-5 shows a significant slowing down of the increase in persons in Tbilisi. In general, 2020 for Sagarejo Municipality shows an increase in the number of persons, whereas Gardabani Municipality shows a slight decrease in 2020 compared to 2010 and 2015.

Table 7-5. Population growth (%) by regions

Regions, self-governed units	Years		
	2019	2020	2021
Kvemo Kartli Region	0.2	0.2	0.7
Kakheti Region	-0.7	-0.8	-0.2
Tbilisi	1.1	1.2	1.5

Table 7-6. Natural increase by regions self-governed units and urban-rural settlements (persons)

Regions, self-governed units	Years		
	2010	2015	2020
Tbilisi	5,760	5,132	1,393
Urban	5,637	4,915	1,244
Rural	123	217	149
Samgori District	n.a	n.a	n.a
Sagarejo Municipality	**-165**	**347**	**162**
Urban	**-16**	**-1**	**4**
Rural	-149	348	158

Regions, self-governed units	Years		
	2010	2015	2020
Gardabani Municipality	**1,350**	**1,423**	**1,031**
Urban	188	215	167
Rural	1,162	1,208	864

The total crude birth rate[96] in Georgia per 1,000 population was 12.5 in 2020. It was slightly higher in urban settlements (12.7) compared to rural settlements (12.3)[97].
The population density is shown in Table 7-7 for 2015 to 2021. This shows a slight increase in Kvemo Kartli region and Sagarejo municipality and a slight decrease in Kakheti Region and Gardabani Municipality. Population density is significantly higher in highest in Tbilisi (2,385.2 people per sq. km) than in Gardabani Municipality (66.3 people per sq.km), where the majority of the ZSIS is located and the lowest is in Sagarejo Municipality (33.7 people per sq.km).

Table 7-7. Density (n Density (number of population per 1 sq.km) by regions and self-governed units, as of 1 January

Regions, self-governed units	Years		
	2015	2020	2021
Kvemo Kartli Region	66.1	67.5	68.0
Gardabani Municipality	67.3	66.3	66.3
Kakheti Region	**28.0**	**27.3**	**27.2**
Sagarejo Municipality	33.4	33.6	33.7
Samgori District	2,212.6	2.349,7	2,385.2

7.2.2. Sex and Age Structure

For Georgia as a whole, the share of men and women to the total population as of 1st January 2021 equals, respectively, 48.2% and 51.8%[98]. The distribution across different ages groups is shown in Figure 7-3.

[96] Number of live births over a given period divided by the mid-year population over that period. It is expressed as average annual number of live births per 1,000 population
[97] Demographic Situation in Georgia, 2020, available at https://www.geostat.ge/en/single-archive/3361
[98] Available at: 2020-VS-Report-(eng).pdf (geostat.ge)

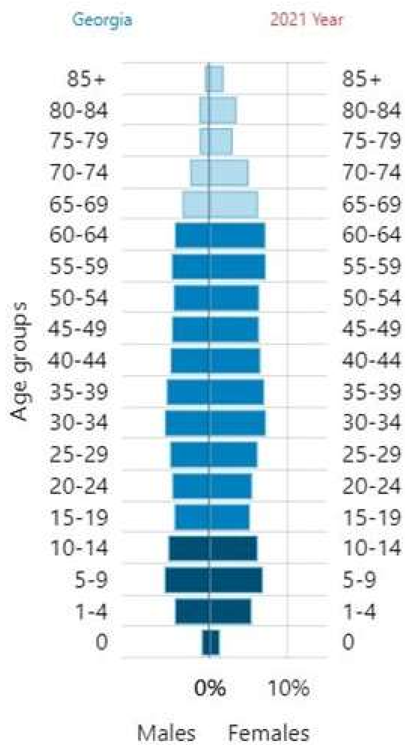
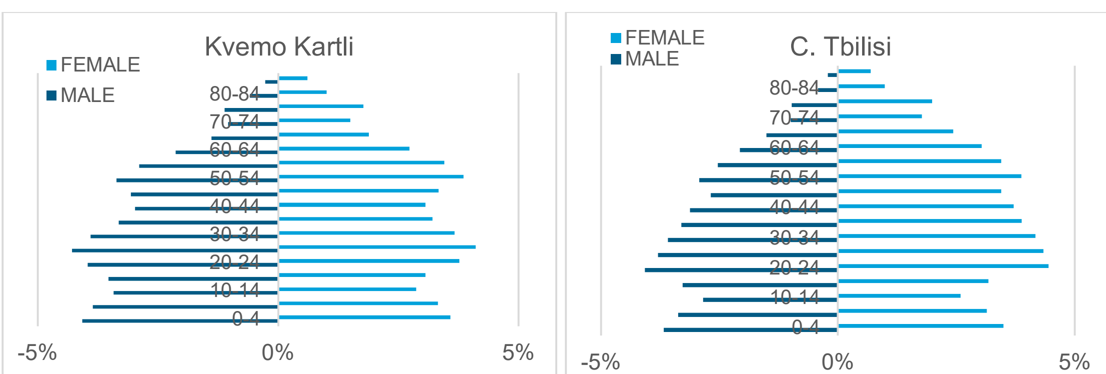


Figure 7-3. Georgia sex and age structure, 2020

Data for the regions is only available from the 2014 census and are presented below. Broadly, these show that Tbilisi has a younger population and the main Project region, Kvemo Kartli, has slightly more males across most age categories, with a higher population in the age categories 0-9 and 15-34. This is broadly similar for Kakheti region.



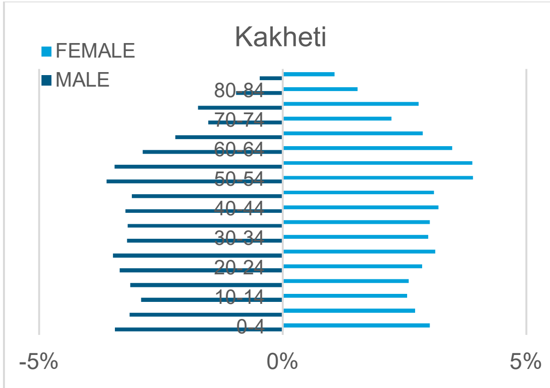


Figure 7-4. Project regions sex and age structure, 2014

According to the 2014 census, of the total population in the ZSIS area, 23,699 (49%) were male and 24,936 (51%) were female. Accordingly, sex ratio was 0.95 (95 males per 100 females). The age group 0-17 constituted 23.5%; the age group 18-64 – 63%; and the age group 65+ – 13%. Within the age group of 0-17, male population was higher than female population, while in the age groups of 18-64 and 65+ male population was lower.

Table 7-8. Population by age groups and sex in the ZSIS area[99]

Both Sex				Male				Female			
Total	0-17	18-64	65+	Total	0-17	18-64	65+	Total	0-17	18-64	65+
48,699	11,441	30,785	6,422	23,699	6,033	15,139	2,527	24,936	5,408	15,646	3,882

7.2.3. Ethnicity and Culture

Georgians are the predominant ethnic group in Georgia, according to the 2014 census 86.83% of the population. Oher groups include Azerbaijanis (6.3%), Armenians (4.5%), Russians (0.7%), Ossetians (0.4%), Yazidis (0.3%), Ukrainians (0.2%), Greeks (0.2%), Assyrians (0.1%) and Others (0.5%).

In Gardabani municipality, 54.2% of the population are ethnic Georgians, 43.5% ethnic Azerbaijani and, 0.7% is ethnic Armenian.

In Sagarejo municipality 66% of the population are ethnic Georgians, 33% ethnic Azerbaijani, and 0.3% are Russians, and 0.2 Armenians.

85% of the ZSIS area population are ethnic Georgians, while 13% are Azerbaijani and 1.7 belong to other nationalities. All of the Azerbaijani population leaves in the villages belonging to Gardabani municipality, predominantly in the villages of Agtaklia and Muganlo. 90% of population in Agtaklia and 99% of population in Muganlo are Azerbaijani.

[99] 2014 census data received from Geostat

Table 7-9. ZSIS area population by nationality, 2014[100]

Total Population	48,669
Georgians	41,335
Azerbaijani	6,227
Armenian	253
Russian	196
Ossetian	82
Yazidi	102
Ukrainian	0
Kist people	0
Greek	23
Assyrian	0
Other	158

7.2.4. Language

Georgian is the official language of Georgia and the native or primary language of 87.6% of the population, followed by 6.2% speaking Azerbaijani, 3.9% Armenian, 1.2% Russian, and 1% other languages. The population who could not speak the Georgian Language in Gardabani Municipality was 33.7%, according to the 2014 General Population Census. While in Sagarejo Municipality, the number of people who could not speak Georgian was 25.9%.

Georgian is a native language for the 85% of the ZSIS project area population, while Azerbaijani language is native for the 13%. For the remaining 1.86%, the native languages are Ossetian, Russian, Armenian or other.

Table 7-10. ZSIS area population by native language, 2014[101]

Total Population	48,669
Georgian	41,352
Abkhazian	0
Ossetian	26
Azerbaijani	6,199
Russian	406
Armenian	148
Other	325
Not specified	0

7.2.5. Religion

Most of the population in Georgia practices Orthodox Christianity, primarily in the Georgian Orthodox Church, whose faithful make up 83.4% of the population. According to a 2014 census, 83.4% of the Georgian population identified themselves as Eastern Orthodox Christian, 10.7% Muslim, 3.9% Armenian Apostolic, and 0.5% Catholic.

[100] 2014 census data received from Geostat
[101] 2014 census data received from Geostat

In Gardabani Municipality majority of the population is Christian Orthodox, with 55.03% of the total population. The Muslim population is 42.93%.[102]

In Sagarejo Municipality majority of the population are followers of Christian Orthodox, with 66.21% of the total population. In contrast, the Muslim population is 30.56%.[103]

85% of the ZSIS area population are Orthodox Christians, while 13% are Muslims. Muslim population lives in the villages belonging to Gardabani municipality.

Table 7-11. Population of ZSIS project villages by religion, 2014[104]

Total Population in ZSI area	48,669
Christian Orthodox	41,547
Muslim	6,287
Armenian-Apostolic	34
Catholic	0
Jehovah's Witness	33
Yazidism	82
Protestantism	11
Judaism	0
Other	0
None	0
Not specified	386

7.3. Health

Based on the most recent available data, life expectancy at birth in Georgia was 73.4 in 2020, compared to 74.1 in 2019 and 74.0 in 2018. Life expectancy is higher for females (77.7 in 2020) in comparison to males (69.1 in 2020).[105]

Crude death rate in Georgia per 1,000 population was 13.6 in 2020. It was higher in rural settlements compared to urban settlements. From the ZSIS municipalities, the crude death rate was highest in Gardabani municipality and lowest in Sagarejo municipality.

Table 7-12. Crude death rate (death toll per 1,000 population) in ZSIS municipalities, 2020[106]

	Total	Urban	Rural
Georgia	13.6	12.3	15.5
Tbilisi	11.6	11.5	15.5
Sagarejo Municipality	10.5	10.8	10.4
Gardabani Municipality	12.7	9.2	13.3

The main causes of mortality in the Project regions are shown in Table 7-13. Aside from COVID-19, mortality in the regions in 2020 was mainly caused by ‘diseases of the circulatory system’, followed by neoplasms. In general, deaths were highest in Tbilisi, with ‘Diseases of the respiratory system’ being high after circulatory system and neoplasm causes.

[102] Available at: https://religion.gov.ge/statmaps/#
[103] Available at: https://religion.gov.ge/statmaps/#
[104] 2014 census data received from Geostat
[105] Available at: https://www.geostat.ge/en/modules/categories/320/deaths
[106] Data receved from Geostat

Table 7-13. Main causes of deaths in the Project regions (2020)[107]

Cause of death	Kvemo Kartli	Kakheti	Tbilisi
TOTAL	**4,892**	**4,544**	**13,878**
Certain infectious and parasitic diseases	72	42	304
Neoplasms	776	656	2,375
Diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism	21	21	110
Endocrine, nutritional and metabolic diseases	130	94	161
Mental and behavioural disorders	4	3	51
Diseases of the nervous system	44	57	143
Diseases of the eye and adnexa	0	0	0
Diseases of the ear and mastoid process	0	0	0
Diseases of the circulatory system	2,209	2,536	3,069
Diseases of the respiratory system	315	310	1,244
Diseases of the digestive system	128	149	425
Diseases of the skin and subcutaneous tissue	4	0	6
Diseases of the musculoskeletal system and connective tissue	4	1	1
Diseases of the genitourinary system	39	25	184
Pregnancy, childbirth and the puerperium	1	1	4
Certain conditions originating in the perinatal period	32	24	94
Congenital malformations, deformations and chromosomal abnormalities	13	10	22
Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified	652	293	4,300
Injury, poisoning and certain other consequences of external causes**	205	215	602
Codes for special purposes (U07.1 - COVID-19, virus identified)	243	107	783

The WHO also identifies that the number of recorded deaths in motor vehicle accidents is higher than the average rate for the European Region, particularly among males who are four times more likely to die from a motor accident than females.[108]

From the main groups of acute chronic diseases diagnosed in 2020, the highest number of cases falls on diseases of respiratory system (33%), the second highest was diseases of circulatory system (9.5%) and the third – diseases of urogenital system (7%).[109]

[107] Available at: https://www.geostat.ge/regions/#
[108] Available at: https://www.euro.who.int/__data/assets/pdf_file/0020/351731/20170818-Georgia-Profile-of-Health_EN.pdf
[109] Available at: https://www.geostat.ge/en/modules/categories/54/healthcare

7.4. Education

According to the 2014 census, 26.7% of the Georgian population has a high education, 17.4% has a professional education degree, while 36.7% achieved the general education (secondary education) level. The basic and primary levels of general education achieved were indicated by 8.4% and 5.7% of the population, respectively. The data on the level of education differs according to the types of settlements. For instance, 78.0% of the population with high education live in the urban settlements, while 22.0% - in the rural settlements. 47.2% of the population with general education lives in the urban settlements.[110]

The literacy levels in the Project Area regions, from the 2014 census, are summarised in Table 7-14. Higher education levels are higher in Tbilisi, compared to all regions and Georgia nationally. In all regions and Georgia, except Tbilisi, a secondary education is the most frequently attained, followed by higher education.

Table 7-14. Population 10 years of age and over by regions and educational attainment in Project Area regions (2014)[111]

Educational attainment	Georgia	% of total	Kvemo Kartli	% of total	Kakheti	% of total	Tbilisi	% of total
Total population 10 years of age and over	**3,228,691**	**100**	**361,105**	**100**	**279,294**	**100**	**957,011**	**100**
Higher education	863,422	27	60,909	17	49,359	18	425,686	44
Professional education	562,118	17	47,992	13	53,373	19	137,550	14
Complete general education (secondary education)	1,183,967	37	149,833	41	107,255	38	256,718	27
Basic level of general education	272,789	8	44,475	12	33,607	12	51,808	5
Primary level of general education	184,022	6	28,894	8	20,443	7	39,412	4
Has no primary education, but is able to read and write	104,492	3	16,933	5	10,017	4	29,367	3
Illiterate	12,576	0	4,133	1	2,013	1	1,136	0
Not stated	45,305	1	7,936	2	3,227	1	15,334	2

Like in other regions in Georgia, the most frequently attained education level in the ZSIS villages is secondary education (40%). This followed by professional education (19%) and higher education (16%). Only 3% have no primary education. Higher percentage of women have higher and professional education compared to man, while higher percentage of men have complete secondary education.

[110] Available at: http://census.ge/files/results/Census_release_ENG.pdf
[111] Available at: http://census.ge/en/results/census1/educationge

Table 7-15. Population 10 years of age and over by educational attainment in the ZSIS villages (2014)[112]

Educational attainment	Total in ZSIS Villages	% of total	Men	% of total men	Women	% of total women
Total population 10 years of age and over	**41,630**	**100**	**20,012**	**100**	**21,585**	**100**
Higher education	6,790	16	2,914	15	3,867	18
Professional education	7,804	19	3,350	17	4,446	21
Complete general education (secondary education)	16,521	40	8,505	42	8,004	37
Basic level of general education	5,235	13	2,666	13	2,553	12
Primary level of general education	2,868	7	1,356	7	1,444	7
Has no primary education, but is able to read and write	1,422	3	688	3	691	3
Illiterate	121	0	40	0	57	0
Not stated	706	2	341	2	336	2

7.5. Economy and Employment

Georgia is a small market economy of 3.7 million people with a per capita Gross Domestic Product (GDP) of $4,691.2 and an unemployment rate of nearly 17.6% in 2019 (before the COVID-19 pandemic).

Services contribute the most to GDP (58.57%), followed by industry (21.63%). Agriculture provides around 7.37% of GDP (2020)[113]. Although the GDP has been growing through the last 10 years, agricultural output has increased only slightly (Figure 7-5). Accordingly, the share of agricultural output in the GDP, which declined significantly up to 2010 and was stable at around 9.0% between 2010 and 2015, decreased since, to 8.4% in 2020. The decline in the share of agriculture in GDP can be explained by a higher growth in other sectors of economy (e.g. construction, manufacturing, wholesale and retail trade), rather than a decline in agricultural production.

[112] Data received from Geostat
[113] Available at: https://www.statista.com/statistics/441382/georgia-gdp-distribution-across-economic-sectors/

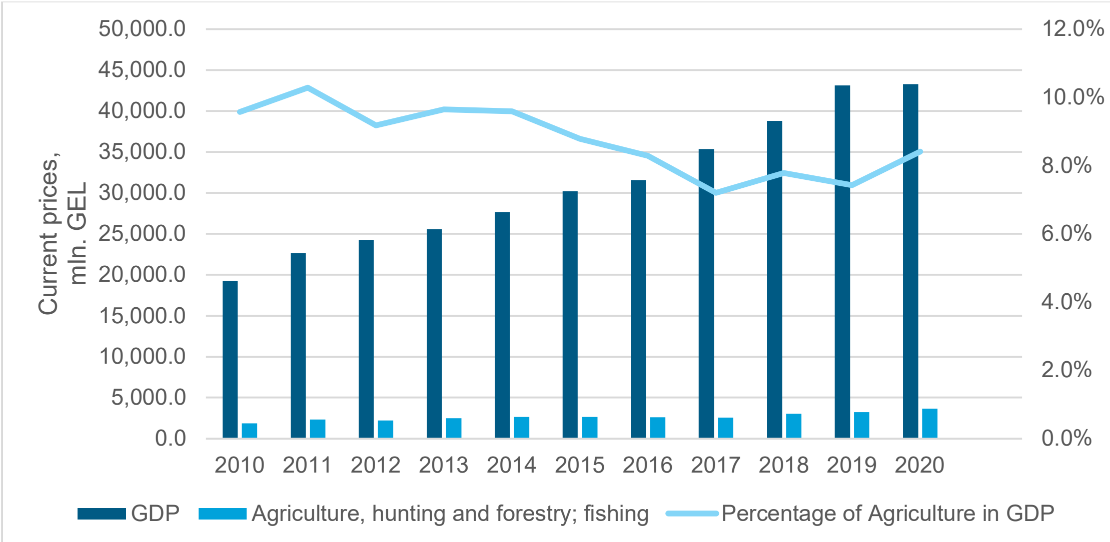


Figure 7-5. GDP and Agriculture in Georgia[114]

Economic reforms and initiatives by the government, private sector and the donor community since 2012 have however started to reinforce Georgia's agriculture sector. The state budget for agriculture increased to 3.8% in 2018 suggesting a growing commitment to the government to the sector; this growth trend is maintained in 2020 (around 10% increase compared to 2018).

The turnover by business sector for 2020 in Tbilisi, Kvemo Kartli and Kakheti is shown in Table 7-16. In all regions, 'Wholesale and retail trade' has the highest turnover, followed in general by 'construction' and 'manufacturing'. 'Agriculture, forestry and fishing' is higher in Kvemo Kartli and Kakheti as would be expected. Overall, 'Agriculture, forestry and fishing' is 0.08%, 4% and 6% of all economic activities in Tbilisi, Kvemo Kartli and Kakheti, respectively.

Table 7-16. Turnover by Kind of Economic Activity, 2020 (mil. GEL)[115]

	Tbilisi	Kvemo Kartli	Kakheti
TOTAL	**88,036.9**	**5,612.4**	**2,011.9**
Agriculture, forestry and fishing	70.0	240.1	112.1
Mining and Quarrying	7.5	905.0	20.2
Manufacturing	3,946.9	1,427.3	614.5
Electricity, gas, steam and air conditioning supply	2,530.1	613.9	28.1
Water supply; Sewerage, Waste Management and Remediation Activities	179.5	41.0	2.4
Construction	5,560.4	233.4	97.5
Wholesale and retail trade; repair of motor vehicles and motorcycles	33,249.4	1,889.2	1,066.1
Transportation and storage	3,572.0	104.7	9.0
Accommodation and food service activities	860.5	17.6	32.9

[114] Source: National Statistics Office of Georgia
[115] Available at: National Statistics Office of Georgia (geostat.ge)

	Tbilisi	Kvemo Kartli	Kakheti
TOTAL	**88,036.9**	**5,612.4**	**2,011.9**
Information and communication	1,820.6	11.1	1.5
Real estate activities	1,008.7	48.7	8.7
Professional, scientific and technical activities	1,316.6	12.9	3.2
Administrative and support service activities	632.5	2.1	3.2
Education	394.7	8.4	1.2
Human health and social work activities	885.4	34.4	9.8
Arts, entertainment and recreation	31,919.9	20.1	0.7
Other service activities	82.1	2.4	0.9

About two-thirds of the workforce is considered self-employed, predominantly as subsistence farmers. However, according to GEOSTAT's updated methodology on employment[116], as of 2020, the Georgian agriculture sector employs about 19.8% of the population.

The active labour force in the Project Area is highest in Tbilisi at 492.4 thousand, and lowest in Kakheti, at 109.5 thousand (Table 7-17). In all cases, the majority of the labour force is in hired employment. The unemployment rate is highest in Kvemo Kartli at 22.2%, and lowest in Kakheti at 10.4%. In all cases, the rate is higher than the national unemployment rate of 6.5% for 2020.

Table 7-17. Labour Force Indicators, thousand persons, 2020

Region	Tbilisi	Kvemo Kartli	Kakheti
Total 15 + population	916.6	343.4	247.0
Labour force (Active population), total	492.4	172.2	122.2
Employed	393.3	134.0	109.5
Hired	339.7	77.9	57.1
Self-employed	53.4	56.0	52.4
Not-identified worker	0.2	0.0	0.0
Unemployed	99.2	38.2	12.7
Population outside labour force	424.2	171.2	124.8
Unemployment rate, percentage	20.1	22.2	10.4
Labour force participation rate (Economic activity rate), percentage	53.7	50.1	49.5
Employment rate, percentage	42.9	39.0	44.3

The average number of employed persons per economic activity for 2020 in Tbilisi, Kvemo Kartli and Kakheti is shown in Table 7-18. Partly reflecting turnover, the highest average number of employed persons is attributed to 'Wholesale and retail trade'. 'Agriculture, forestry and fishing' is 1%, 7% and 10% of the total average number of employed persons, respectively.

[116] Since December 2020, GEOSTAT updated the methodology in a way that people involved in agriculture are represented only by those people who are employed in this sector and/or produce agricultural commodities for commercial purposes.

Table 7-18. Average Number of Employed Persons, 2020[117]

	Tbilisi	Kvemo Kartli	Kakheti
TOTAL	443,272	39,282	20,656
Agriculture, forestry and fishing	3,308	2,641	2,017
Mining and Quarrying	140	4,273	402
Manufacturing	36,640	8,587	5,814
Electricity, gas, steam and air conditioning supply	11,893	1,368	147
Water supply; Sewerage, Waste Management and Remediation Activities	10,932	985	217
Construction	38,009	2,835	1,503
Wholesale and retail trade; repair of motor vehicles and motorcycles	136,956	8,509	6,502
Transportation and storage	35,858	1,852	435
Accommodation and food service activities	17,664	801	1,024
Information and communication	22,041	403	115
Real estate activities	10,643	1,255	336
Professional, scientific and technical activities	18,941	697	297
Administrative and support service activities	17,873	65	101
Education	16,120	1,071	279
Human health and social work activities	51,466	2,870	1,137
Arts, entertainment and recreation	10,722	806	181
Other service activities	4,066	264	149

Table 7-19 shows distribution of employees according to main types of economic activity in the ZSIS regions. The majority of work force is employed in the service sector in Tbilisi (88%) and Kvemo Kartli (55%). In Kakheti 45% is employed in the service sector, while 46% is employed in Agriculture. 0.5% and 29% are employed in Agriculture in Tbilisi and Kvemo Kartli respectively. In the industry sector are employed 11% in Tbilisi, 9% in Kakheti and 15% in Kvemo Kartli.

Table 7-19. Distribution of employees according to the main types of economic activity, 2020 (Thousand men)[118]

	Tbilisi	Kakheti	Kvemo Kartli
Total	**393,3**	**109,5**	**134,0**
Agriculture	2,1	50,3	39,0
Industry	43,9	10,1	20,7
Service*	347,3	49,1	74,2

* Construction is involved

Source: Labour Force Survey

7.6. Livelihoods

Per capita monthly incomes, expenditure and wages for the three regions are provided in Table 7-20. As can be seen, the average monthly per capita income is highest in Tbilisi (324.2 GEL), then Kakheti (288.7 GEL),

[117] Available at: National Statistics Office of Georgia (geostat.ge)
[118] Data received from Geostat

then Kvemo Kartli (256.4 GEL); and the per capita expenditure is also highest in Tbilisi (256.3), then Kakheti (246.2 GEL) then Kvemo Kartli (190.5 GEL). Average monthly salaries are 1394.4, 759.4 and 998.4 GEL, respectively.

Table 7-20. Per capita monthly incomes, expenditure and wages per region, 2020

	Tbilisi	Kvemo Kartli	Kakheti
Distribution of Average Monthly Incomes per Capita (GEL)			
1. Income, total (2+3)	324.2	256.4	288.7
2. Cash income and transfers	321.3	238.8	259.2
Wages	189.8	112.2	84.8
From self-employment	25.4	24.6	23.3
From selling agricultural production	0.1	18.7	42.4
Property income (leasing, interest on deposit, etc.)	5.0	1.6	0.5
Pensions, scholarships, assistances	59.9	55.2	74.6
Remittances from abroad	6.1	10.1	11.0
Money received as gift	35.0	16.4	22.7
3. Non-cash income	2.9	17.6	29.4
4. Other cash inflows	14.9	13.3	42.0
Property disposal	0.2	0.4	3.1
Borrowing and dissaving	14.7	13.0	38.9
5. Cash inflows, total (2+4)	336.2	252.1	301.2
6. Cash and non-cash inflows, total (3+5)	339.1	269.7	330.7
Distribution of Average Monthly Expenditures per Capita			
1. Consumption expenditure, total (2+3)	256.3	190.5	246.2
2. Cash consumption expenditure	253.3	172.9	216.7
On food, beverages, tobacco	98.0	78.0	102.7
On clothes and footwear	10.5	6.2	5.0
On household goods	7.9	6.4	6.5
On healthcare	26.4	16.9	34.9
Housing, water, electricity, gas and other fuels	40.8	22.4	23.4
On transport	24.6	16.0	18.5
On education	7.2	2.0	2.0
Other consumption expenditure	37.8	25.0	23.7
3. Non-cash expenditure	2.9	17.6	29.4
4. Cash non-consumption expenditure	69.8	48.1	82.2
On agriculture	0.2	4.0	24.1

	Tbilisi	Kvemo Kartli	Kakheti
On transfers	6.6	3.1	7.0
On saving and lending	60.6	34.9	42.1
On property acquirement	2.4	6.0	9.1
5. Cash expenditure, total (2+4)	323.2	221.0	298.9
6. Expenditure, total (3+5)	326.1	238.6	328.4
Average Monthly Nominal Earnings (GEL)	1394.4	998.4	759.4

In 2020, the share of income derived from the sales of agricultural production in Georgia as a whole constituted only 5.3% of the total household income, which indicates that agriculture production is largely oriented towards self-consumption.

According to the Eptisa 2018 ESIA Report, the population of the villages in ZSIS area is mainly self-employed in the agricultural sector. 79% of households interviewed in the villages by Eptisa reported agricultural production as their main income, while only a half of interviewed urban inhabitants participate in agricultural activities (49%). The main source of income of the local people is selling of agricultural products to the local markets. The exception is the residents of Samgori district villages, who are mostly employed in Tbilisi.

7.7. Physical Infrastructure and Services

7.7.1. Road Infrastructure

The East-West Highway (the E60) is the main corridor for transit through Georgia and it runs to the east of Tbilisi. The ZSIS is connected via the E60, S5 and A38 to the east of Tbilisi and the E60 and R24 to the south towards Rustavi.

Roads to almost all villages from the highway are in good condition with an asphalt layer. Internal gravel roads in the towns require rehabilitation; for example, roads to the villages Norio, Patara Lilo, Agraklia, Akhalsopeli, Mukhrovani are in poor condition. To reach the villages, there are private mini-bus routes from Tbilisi and back, which are not part of municipal transport.

The roads inside the irrigation units are poor in number and condition. A large part of the command area is uncultivated and abandoned since several years, consequently its road network has suffered lack of maintenance and erosion from runoff, wind, snow, etc. The main canal UMC and its bigger secondary ones, like the UMC G7, G8 and G9, have a side service road in good or medium condition, as well for the LMC which service road is utilized by the Army too. The roads along the LMMC and its secondary canals are in very bad condition.

7.7.2. Health Facilities

Effective from 1 April 2013 the government-funded comprehensive healthcare programme was launched in Georgia, with the purpose of providing the population with access to free primary and emergency care.

According to the latest Statistical Report published by the National Centre of Disease Control and Public Health, there were 266 hospitals, 2,280 out-patient medical establishments and 71 emergency centres in 2019 in Georgia. Number of hospital beds per 100,000 population constituted 469.6. There were 853.3 doctors and 527.2 nurses per 100,000 population. There were in total 1,269 village doctors in the country. The number of doctors per 100,000 of population has been increasing since 2006. It is significantly higher in Georgia than in European Union and CIS countries. At the same time, there has been a decline in the number of nurses per 100,000 population in the period of 1998-2013, and despite an increasing trend in recent years, it is significantly lower compared to European Union and CIS countries.[119]

Table 7-21 below shows statistical data on health-care institutions in the ZSIS regions:

[119] Available at: https://ncdc.ge/#/pages/content/1e1e9d2c-84f9-41ef-8db4-d5cdf0e46f90

Table 7-21. health-care institutions in the ZSIS regions

	Tbilisi	Kvemo Kartli	Kakheti
Number of hospitals and medical centres, unit	114	18	15
Number of hospital beds	8,900	1,004	646
Number of medical institutions rendering out-patient services to population, unit	460	215	274

The number of private insurance beneficiaries is very small in the Gardabani and Sagarejo municipalities. The medical Centre of Geo-Hospitals clinics network is functioning in Gardabani. However, due to the proximity to the capital, most of the population use hospitals in Tbilisi. There are also several different medical services and health care centres in Rustavi.

Table 7-22. Healthcare Infrastructure in ZSIS villages

	Outpatient Clinic	Nearest Emergency Service
Samgori District		
Varketili	-	in 5 km
Nasaguri	-	in 17 km
Tsinubani	-	in 22 km
Sagarejo Municipality		
Ujarma Community	✓	in 30 km
Gardabani Municipality		
Village Akhali Samgori	✓	in Rustavi (10 km)
Akhalsopeli Community	✓	in Sartichala (25 km)
Gamarjveba Community	✓	in Village Gamarjveba
Lemshveniera Community	✓	in Rustavi
Martkophi Community	-	-
Village Vaziani	✓	In Village Gamarjveba (7 km)
Village Saakadze	-	In Village Gamarjveba (15 km)
Sartichala community	✓	in 0.5 km

7.7.3. Education Facilities

For the beginning of the 2021/2022 school year, there were 65 secondary schools in Isani-Samgori district in Tbilisi, 27 – in Sagarejo municipality and 36 – in Gardabani municipality (

Table 7-23).

Table 7-23. Number of public and private general education institutions in the ZSIS municipalities for the beginning of the school year, 2021/2022[120]

Area	Number
Tbilisi	292
Isani-Samgori District	65
Kakheti	191
Sagarejo Municipality	27
Kvemo Kartli	267
Gardabani Municipality	36

Source: Ministry of Education and Science of Georgia.

In ZSIS area secondary schools are present in all villages except for villages of Saakadze. Mzianeti and Paldo[121]. The closest high schools are located in the Tbilisi and Rustavi. Ethnic non-Georgian youth studies are mostly provided in Baku universities. Ethnical non-Georgian youth often do not continue education after finalization of secondary schools.

7.7.4. Energy Services

100% of the households in the ZSIS regions are supplied with electricity. 98.3% of the households in Tbilisi, 90.7 of the households in Kvemo Kartli and 92.8% of the households in Kakheti are provided with centralized natural gas supply (Table 7-24).

Table 7-24. Share of the households provided with electricity and central system of gas supply in the ZSIS regions, 2020[122]

	Tbilisi	Kvemo Kartli	Kakheti
Share of the households provided with electricity	100	100	100
Share of the households provided with central system of gas supply	98,3	90,7	92,8

There is natural gas supply to all villages in the ZSIS area except Ujarma Community uniting villages of Ujarma, Mukhrovani and Paldo in Sagarejo municipality and villages of Mukhrovani, Poladaantkari, Mzianeti and Muganlo in Gardabani municipality.[123] However, residents of villages mostly use wood for heating.

In the total usage of energy in households in Georgia in 2018, the share of electricity was 16.4%, of natural gas – 51.8% and of firewood – 29.9%. Using firewood as a source of energy is common in rural areas in Georgia, which is considered as significant factor in energy poverty. In 2018 firewood was used as the primary means of heating in 17% of urban households and 78.3% of rural households, in total in 45.8% of all households in Georgia.[124]

7.7.5. Potable Water Supplies

68.9% of the population in Georgia is connected to centralized water supply system.[125] The percentage varies across the regions. 99.5% of the households in Tbilisi are provided with the water supply system installed in the dwelling, while in Kvemo Kartli and Kakheti this number is lower, 67.5% and 61.4% respectively.

[120] Data received from Geostat
[121] Available at: https://www.datalab.ge/ge/dataview/v/429/
[122] Available at: https://www.geostat.ge/regions/#
[123] http://www.socargas.ge/en/area-of-service?regioni=0&raioni=0&qalaqi=0
[124] Country Gender Equality Profile of Georgia, UN Women, 2021. Available at: https://www2.unwomen.org/-/media/field%20office%20georgia/attachments/publications/2021/country%20gender%20equality%20eng%20final.pdf?la=en&vs=4357
[125] Available at: https://www.geostat.ge/en/modules/categories/565/environmental-indicators

Table 7-25. Distribution of the households by the basic supply sources of the drinking water in the ZSIS regions, 2020[126]

	Tbilisi	Kvemo Kartli	Kakheti
The water supply system installed in the dwelling	99.5	67.5	61.4
The water system tap in the yard or in the vicinity	0.5	23.3	30.2
The well in the yard or in the vicinity	0.0	6.2	3.7
Natural spring in the yard or in the vicinity	0.0	3.0	4.6
Other sources	0.0	0.0	0.0

According to the 2018 data, 14.3% of the rural population in Georgia does not have access to drinking water on their premises. About 77.6% of the rural population is satisfied with the water quality. [127]

Central water supply operated by GWP (Georgian Water and Power) Company is provided to all villages located in Samgori district, as well as to Gamarjveba community. United Water Supply Company of Georgia provides drinking water to the villages Sartichala, Muganlo, Agtaklia. There is central water supply in Akhali sopeli, Lemshveniera community, Akhali Samgori as well. Residents of Martkopi community obtain drinking water from springs, groundwater and local water intakes.

7.7.6. Sanitation

According to 2020 data, 50.1% of the population in Georgia is connected to wastewater collection systems. However, only 36.5% of population is connected to wastewater treatment facilities. Thus, 13.6% is connected to wastewater collection systems without subsequent treatment.[128] Wastewater collection systems cover only cities and municipal centres in Georgia, but not villages. According to the 2018 data, piped sewer system is available in 15.8% of rural households.[129]

From the ZSIS area only Samgori district in Tbilisi is provided with wastewater collection and treatment services. Collected wastewater is treated at Gardabani wastewater treatment facility operated by GWP (Georgian Water and Power). It is the only wastewater treatment facility in the ZSIS area regions.

7.8. Land Tenure and Ownership

Since regaining independence, Georgia has been in a process of few reforms of land registration. Although land reform was launched in Georgia in 1992, only 25% of the croplands have been registered with the Public Registry to date. Through resolution #48 of 18 January 1992 (amendments #128 and #290, 1992), the Government of Georgia granted 1.25 ha of cropland to the Georgian citizens and the Constitution of Georgia (1995) granted Georgian citizens the right to land ownership and inheritance. Under the Georgian legislation (Law on "Private Ownership of Agricultural Lands, Law on Land Registration, Civil Code"), land can be sold, leased or rented, if it is registered with the Public Registry as private property.

In June 2016, the Parliament of Georgia adopted a new law "*On the Improvement of Cadastral Data and the Procedure for Systematic and Sporadic Registration of Rights to Plots of Land within the Framework of the State Project"* to tackle issues related to land registration. This latest land registration has started with the sporadic and later with pilot systematic approaches. Nevertheless, to date, Georgia could not reach the complete land registration. Although state finances the majority of land registration, landowners have not been active in registering their land, because of various reasons. In order to accelerate process and complete land registration, the scaling up of systematic land registration is recommended. In addition, a new state project on land registration was launched to encourage and simplify registration of land ownership.

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[126] Available at: https://www.geostat.ge/regions/#
[127] Country Gender Equality Profile of Georgia, UN Women, 2021. Available at: https://www2.unwomen.org/-/media/field%20office%20georgia/attachments/publications/2021/country%20gender%20equality%20eng%20final.pdf?la=en&vs=4357
[128] Available at: https://www.geostat.ge/en/modules/categories/565/environmental-indicators
[129] Country Gender Equality Profile of Georgia, UN Women, 2021. Available at: https://www2.unwomen.org/-/media/field%20office%20georgia/attachments/publications/2021/country%20gender%20equality%20eng%20final.pdf?la=en&vs=4357

In Georgia, land is owned by the state (central government, or municipality-owned, or managed by Administration of Protected Areas) or private sector. Some years ago, Georgia blocked land ownership by foreigners.

Land privatization occurs via electronic auctions, in which every person willing can participate. While this is a transparent policy, a challenge from an agricultural perspective is that farmers often miss or lose auctions and land is obtained by non-farmers who often rent the land to the real farmers for a high(er) price which farmers can barely pay.

There are about 2,000 parcels of land rented out by the state. Leasing of state-owned land has similar challenges as land privatization – it is mostly leased via auctions and “non-farmers” obtain land use rights that later are transferred for a higher price to the “real farmers” on the black market. As farmers are not given priority in the land leasing, and farmers are not guaranteed long-term land use rights for a particular land plot, they do not have motivation to invest in that land and/or take care of that land. This results in land degradation and hinders the development / modernisation of the farmers and farming in the country.

At present, the land tenure status of farmers can be divided into following categories:

- Landowners, who have registered their lands with exact borders (GPS coordinates).
- Landowners, who have registered their lands based on a conventional survey and who need to correct borders by using GPS coordinates.
- Landowners, who have not registered their land but have documents that confirm their property.
- Leaseholders, who lease land from legal persons or public institutions.
- Land users, who do not have any documents confirming their land ownership or land use rights.

It should also be noted that land is taxed based on the category of agriculture land: arable, pastures and meadows. In addition, the tax rate differs across regions and municipalities of the country. Although in general the tax rate on land is not high, sometimes farmers complain about the unfair variation in land tax rate across the country, because the quality of land is not considered in the tax rate calculation.

Available data from GEOSTAT according to the last agricultural census (2014) is presented in Table 7-26. This shows that across the Project regions, the majority of the lands are operated and owned lands, with a much smaller number renting land.

Table 7-26. Agricultural and non-agricultural land area operated by agricultural holdings according to land tenure type, ha

Location	Operated land	Owned land	Rented land
Tbilisi	4,157	4,126	31
Sagarejo	64,866	45,395	19,471
Gardabani	27,066	24,594	2,472

The underdeveloped land market is one of the key systemic challenges for Georgia’s agriculture. Land market development first and foremost requires complete land registration with comprehensive cadastral data (developing modern land administration systems).

Land privatization occurs via electronic auctions, where every person willing can apply. This might be a transparent policy; however, farmers often miss or lose auctions and land is distributed to non-farmers. They then often rent land to farmers at a high price.

There are also some 2,000 parcels of land leased by the state. Leasing of state-owned land has the same challenge as in case of land privatization – it is mostly leased via auctions and “non-farmers” can get land, and later rent it to “real farmers” on the black market.

As farmers are not given priority and are not guaranteed the land longer-term, they do not have motivation to invest on that land and/or take care of that land which results in the land degradation.

Developing competitive Georgian agriculture also requires land consolidation however, the country does not have a land consolidation policy that would encourage real farmers to enlarge their land plots. As a result, Georgia’s small-scale farmers loose in the competition with large-scale farmers. Land fragmentation also hinders development of the real and dynamic farmers willing to enlarge their farmsteads but cannot find land for sale or lease around their farms.

Tax rate on land also differs based on the category of agriculture land: arable, pastures and meadows. In addition, the tax rate differs across regions and municipalities of the country. Although, tax rate on land is not high in general, sometimes farmers complain about the unfair distribution of tax rate on land across country, because the quality of land is not considered in the tax rate calculation.

7.9. Agriculture

7.9.1. Overview

Of the whole territory of Georgia, 43.4% (more than 3 million ha) is designated as agricultural land, which also includes pastures and meadows, while 43% of the remaining area is covered with forest. Due to the collapse of the Soviet Union and the dismantling of collective farms, the sown and planted areas of annual and perennial crops have reduced, as well the number of livestock, although the number of poultry have increased (Table 7-27).

Table 7-27. Sown Area and Livestock Numbers between 2006-2019, Georgia[130]

Year	Sown Area (ha)	Cattle	Pig	Sheep and Goat	Poultry
2006	330,200	1,080,300	343,500	789,200	5,400,700
2007	297,200	1,048,500	109,900	797,100	6,149,700
2008	329,300	1,045,500	86,400	769,400	6,682,300
2009	289,700	1,014,700	135,200	673,800	6,674,800
2010	256,700	1,049,400	110,100	653,900	6,521,500
2011	262,400	1,087,600	105,100	630,400	6,360,200
2012	259,600	1,128,800	204,300	742,600	6,159,100
2013	310,700	1,229,700	191,200	856,800	6,760,700
2014	274,900	970,000	169,700	916,900	6,657,800
2015	263,700	992,100	161,500	891,400	8,308,600
2016	240,000	962,700	136,200	936,500	8,237,800
2017	220,300	909,700	150,700	907,000	8,386,000
2018	207,100	878,900	163,200	869,500	8,110,900
2019	203,000	869,500	155,500	891,600	9,466,400
2020	211,300	923,100	155,200	793,000	9,906,900

7.9.2. Agricultural Output

The agricultural output of Georgia as of 2020 amounts to 5,471.7 million GEL, 48% of which comes from animal husbandry, 45% from plant growing and 7% from agricultural services (Figure 7-6). Cattle are the predominant type of livestock husbandry, with the vast majority of farmers in all regions owning 3.8 head of cattle on average[131].

[130] Source: National Statistics Office of Georgia
[131] AO. 2017. www.fao.org/georgia/news/detail-events/en/c/1073576/

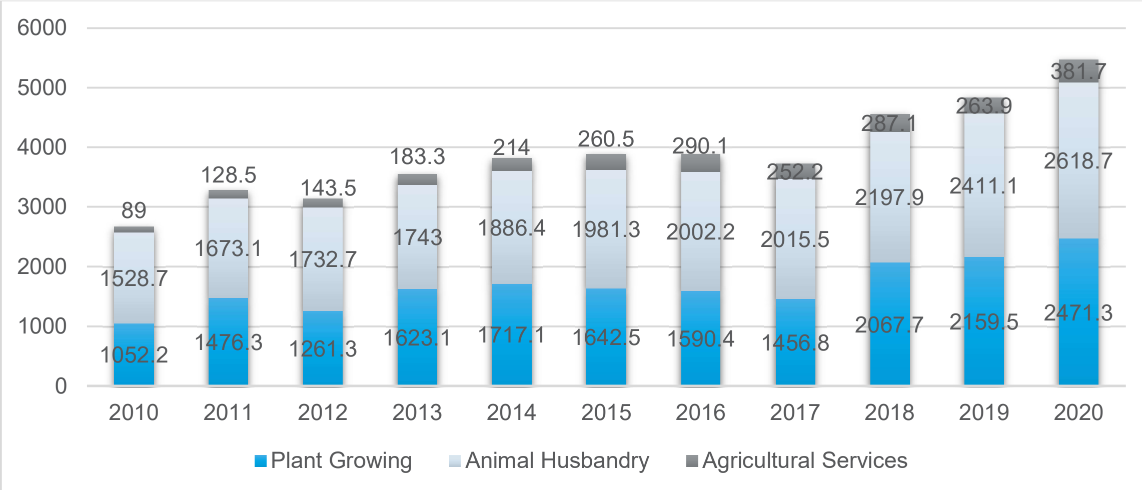


Figure 7-6. Output of Agriculture (Million. GEL)[132]

7.9.3. Agricultural Holdings

According to the 2014 Agricultural Census, there are 642,209 agricultural holdings in the country, on a total area of 787,714 hectares of agricultural land. The average agricultural land area operated by an agricultural holding is 1.37 hectares.

In the Kvemo Kartli region, in 2020 the share of agricultural holdings[133] oriented mainly on crop production was 49.2%. It is noted that the sown area of annual crops decreased between 2017 and 2020 by 4%, from 29.7 to 28.6 thousand ha. In addition, in 2020 the share of agricultural holdings mainly engaged in livestock farming in the Kvemo Kartli region was 22.6%, while 28.2% of the agricultural holdings was engaged equally in mixed crop and livestock production.[134]

In the Kakheti Region, in 2020 the share of agricultural holdings oriented mainly on crop production was 66.6%, while the share of holdings oriented on livestock farming was 5.6% and of those engaged equally in crop and livestock production was 27.8%. The sown area of annual crops decreased also in the Kakheti region between 2017 and 2020 by 2%, from 76.1 thousand ha to 74.6 thousand ha.[135]

According to the Agricultural Census 2014, the total number of holdings in the Kvemo Kartli region is 73,392 of which, family holdings is 72,936, with 18,058 family holdings in Gardabani Municipality. Of the region family holdings, 72% are managed by a man. The total number of holdings in the Kakheti region is 97,106, of which 96,600 are family holdings. There are 13,549 are family holdings in Sagarejo Municipality. Of the region family holdings, 71% are managed by a man.[136]

While specific data for Kvemo Kartli and Kakheti were not immediately available, across Georgia for all crop groups distinguished (grains-and-leguminous crops, potato-vegetables-melons, other-crops) family holdings provide the major share in sown area (93.7%), varying from 98.7% for the “potato-vegetables-melons” crop group, 93.2% for the “grains-and-leguminous crops” crop group, and 89.5% for the “other-crops” crop group. Consequently, the share of agricultural enterprises is 6.3% overall, and 1.3%, 6.8* and 10.5% for the respective individual crop groups listed. Accordingly, family households also dominate in the production of all major crops, their share varying from 98.9% for haricot beans, 97.9% for potato, to 92.3% for wheat and 90.4% for vegetables.

[132] Source: National Statistics Office of Georgia

[133] An agricultural holding is an economic unit engaged in agricultural production under single management without regard to its size and legal status. Two types are distinguished: (i) family holding – an agricultural holding operated by a household; and (ii) agricultural enterprise – an agricultural holding operated by a legal entity (limited liability company, general partnership, limited partnership, joint stock company, cooperative, etc.).

[134] Available at: https://www.geostat.ge/en/modules/categories/196/agriculture

[135] Available at: https://www.geostat.ge/en/modules/categories/196/agriculture

[136] Available at: http://census.ge/files/results/agriculture/Agricultural_Census_2014.pdf

Overall, of all agricultural holdings in the Kvemo Kartli region, in 2020 54.9% produced "primarily for own consumption", i.e. selling 10% or less of their production. Another 15.9% of the agricultural holdings produced "mainly for own consumption", i.e. selling more than 10% and up to 50% of their production. [137]

Of all agricultural holdings in the Kakheti region, in 2020 52.8% produced primarily for own consumption (selling 10% or less), while 13.8% produced mainly for own consumption (selling more than 10%, up to 50% of their production).[138]

7.9.4. Crops

The following crops are of relevance in Georgia and the Project Area:

Maize

Maize demand is expanding due to the poultry industry and other agro-industrial products. However, like any cereal supply chains, a maize value chain development is hindered by several constraints affecting productivity and competitiveness, i.e. supply and demand, price setting locally, regional and globally, climate/weather, inputs, infrastructure and market delivery.

Maize imports significantly increased in the years 2017-2020. In 2017 maize imported was equivalent to USD 16 million and in 2020, USD 24 million. The volume of imported maize was 80,244 tonnes in 2017 and 118,676 tonnes in 2020.

Cultivation with traditional methods includes coulter ploughs, disk harrows and precision speeders. Fertilizer application is at a rate of 180-250 kg/ha of ammonium nitrate and 80-120 kg/ha of NPK (nitrogen, phosphorus, and potassium fertiliser). "Karate" insecticide is often used. Hybrid varieties are planted at a rate of 75,000-85,000 seeds per ha which is about 16-18 kg/ha. Local varieties require 30-35 kg/ha, which have a longer crop cycle duration. Harvesting is done with combine harvester, which have a 4.5 m cutter head specific for maize and are used by medium and large farmers. Production techniques are typical for large farms.

Small farmers are using local varieties due to hybrid seeds having high costs. They can plant produced seeds from previous harvests, so there is no need for new seeds but a risk for inbreeding causing pest and diseases and lower yield/ha. They have relatively small plots and harvest is done manually. The straw is chopped and ploughed on medium and large farms, while small farmers harvest cobs by hand, which are bunched and stored. The straw is collected and used as cattle feed.

Onion

According to National Statistics Office in Georgia, in 2017 about 42,000 tonnes of onions were produced with an average yield of 9.3 t/ha. From 2017 to 2020, domestic onion production dropped from 42,000 tonnes to 12,900 tonnes. The soil and climate in Georgia are suitable for onion cultivation.

Farmers are using both seeds and seedlings to plant onions. Depending on the varieties planting rate fluctuates. Most of farmers are spraying seeds with fungicide before planting. Some farmers are using machinery to cultivate and harvest the fields, while other small farmers are using small machinery such as hand tractors or manpower. To increase soil fertility farmers are applying 50 t/ha of manure before ploughing as well as insecticides, mainly Marshall. After planting farmers are using (NPK) fertilizer. All fertilizers and pesticides are provided by the small input shops in Gardabani, Rustavi and Tbilisi. Fields are irrigated by furrow irrigation.

Tomato

According to GeoStat, in 2020, 46,300 tonnes of tomatoes were produced with an average yield of 13.8 t/ha.

Farmers are either buying seeds from local input suppliers and raising seedlings, or buying already raised seedlings from their neighbours, depending on the variety. Most common varieties are Slivka, Sultan, and Shady Lady. Farmers are using machinery only for ploughing, whereas other operations are done manually and with small scale machinery.

There is no developed grading / packing operation, and all post-harvest handling is done manually in wooden or plastic boxes.

Potato

Domestic markets are generally supplied with local early potatoes starting in mid-May from Kvemo Kartli. Local normal potatoes are available on the market beginning in mid-September; first from low-land areas in Samtskhe-Javakheti; then from the high-lands within the same region. Domestically produced potatoes are

[137] Available at: http://census.ge/files/results/agriculture/Agricultural_Census_2014.pdf
[138] Available at: http://census.ge/files/results/agriculture/Agricultural_Census_2014.pdf

generally present on the market until the February-March period. Potatoes are imported throughout the year to meet needs during the off season. The import volumes decline during the summer period and, peaks and troughs are generally in December and July, respectively.

Potatoes are presently relatively widely grown, but mostly under rain fed conditions and for domestic consumption. It is a delicate crop, and not very profitable.

Vegetables

Vegetables are cultivated in small farms for domestic consumption, some surplus being sold on local market. Greenhouses are coming up to feed the Tbilisi and other local towns and villages.

Cucumber

Cucumbers from Kvemo Kartli are available from the end of May. Local cucumbers can be found on the market through the end of August. Small quantities of local cucumber supply also are available in April and September. Imports are supplied throughout the year with the exception of the July-August period, when local produce dominates the market. Import supplies peak and trough in April and June, respectively.

Eggplant

The market is generally supplied with local eggplant starting in July and supplies last through the end of October. Import supply peaks and troughs are June and September, respectively. Imports are obtained throughout the year with the exception of August, when local produce availability is at its peak.

Beans

Markets are generally supplied with local bean starting in August, and these supplies dominate the market through the October-November period. With the exception of November and January the Georgian market is generally supplied with imported beans. Peaks and troughs in import supplies are May and February, respectively.

Most of farmers are using their own seeds and for land fertility they are using manure at a 30-50 t/ha rate and up to 150 kg/ha of Ammonium nitrate. Inputs such as fertilizers and pesticides are provided by input suppliers located in Gardabani, Rustavi and Tbilisi. Own compost and mulch can also be used to improves the quality and quantity of the greens.

Due to the very small size of parcels, only small-scale machinery and manpower is used for cultivating. Plots are mainly irrigated with furrow irrigation and could be using watering hosepipes and watering irrigation cans.

7.9.5. Annual Crops Sown and Harvested Areas

The sown and harvested area of annual crops as well as the production of and average yield of crops in the Kvemo Kartli region is summarized in Table 7-28 and

Table 7-29.

The sown area for wheat, barley and maize has increased since 2017; the area of Haricot beans, potatoes, tomatoes, onion, melons and annual grasses. All other crops remain stable in area sown. Generally, the area harvested is the same as sown, except wheat and barley, where less is harvested.

The production of annual crops has increased significantly for wheat and maize; and has decreased for various other crops, in particular perennial grasses. Yields have also increased for wheat and maize, as well as haricot beans, potatoes, cucumber, tomatoes, onion, melons and perennial grasses. Yields have decreased for barley and annual grasses.

Table 7-28. Sown and harvested area of annual crops in Kvemo Kartli[139] ('000 ha)

Data: 2020	Sown area of annual crops				Harvested area of annual crops			
	2017	2018	2019	2020	2017	2018	2019	2020
Wheat (winter)	3.5	3.5	3.3	4.5	3.5	3.5	3.0	3.8
Barley	1.6	2.0	1.3	1.9	1.5	2.0	1.3	1.5
Maize	4.4	6.1	8.4	8.8	4.4	6.1	8.3	8.8

[139] National Statistics office of Georgia, 2021. Agriculture of Georgia 2020

Data: 2020	Sown area of annual crops				Harvested area of annual crops			
	2017	2018	2019	2020	2017	2018	2019	2020
Haricot beans	0.7	0.7	0.6	0.4	0.6	0.7	0.6	0.4
Potato	4.1	5.1	3.5	3.4	4.1	5.1	3.5	3.4
Cucumber	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Tomato	0.9	0.7	0.6	0.6	0.9	0.7	0.6	0.6
Onion	0.5	0.2	0.1	0.2	0.5	0.2	0.1	0.2
Melons	0.2	0.2	0.2	0.1	0.2	0.2	0.2	0.1
Watermelon	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Annual grasses	0.5	0.4	0.3	0.4	0.5	0.4	0.3	0.4
Perennial grasses	9.4	9.7	7.9	6.1	9.4	9.7	7.8	6.0

Table 7-29. Production and average yield of annual crops in Kvemo Kartli

	Production of annual crops ('000 tonnes)				Average yield of annual crops (t/ha)			
	2017	2018	2019	2020	2017	2018	2019	2020
Wheat	7.2	8.3	6.8	9.8	2.1	2.4	2.3	2.6
Barley	2.7	4.3	2.6	2.7	1.7	2.1	1.9	1.8
Maize	14.6	19.1	26.8	33.2	3.4	3.1	3.2	3.8
Haricot beans	0.5	0.7	0.6	0.7	0.8	1.0	0.9	1.5
Potato	38.0	47.9	38.9	46.3	9.3	9.4	11.0	13.8
Cucumber	10.0	14.3	12.6	13.9	24.9	29.0	24.0	27.9
Tomato	19.0	18.6	19.2	17.0	18.6	23.4	27.0	25.9
Onion	4.2	2.5	1.0	2.3	9.3	10.4	12.1	12.9
Melons	3.5	3.3	3.1	2.4	18.5	16.4	15.6	19.7
Watermelon	1.5	1.5	2.1	1.7	15.4	17.2	18.5	18.6
Annual grasses	1.4	1.0	1.6	1.0	3.0	2.8	5.2	2.5
Perennial grasses	37.0	34.6	27.9	25.4	4.0	3.6	3.6	4.2

The sown and harvested area of annual as well as the production of and average yield of crops in the Kakheti region is summarized in Table 7-30 and

Table 7-31.

As with the Kvemo Kartli region, the sown area for wheat and barley has increased since 2017, though the area of maize has decreased together with the area of Haricot beans, potatoes and vegetables. Generally, the area harvested is the same as sown, with a minor exception of haricot beans. There is no sowing of annual grasses or perennial grasses recorded.

In terms of production of crops, barley, wheat, vegetables and melons have increased whilst maize, haricot beans, and potatoes have decreased. The annual yield of crops has however decreased for wheat, barley, haricot beans, and potatoes; and increased for maize and vegetables only.

Table 7-30. Sown and harvested area of annual crops in Kakheti ('000 ha)

Data: 2020	Sown area of annual crops				Harvested area of annual crops			
	2017	2018	2019	2020	2017	2018	2019	2020
Wheat	35.3	34.5	34.8	37.4	35.2	34.4	34.7	37.4
Barley	10.0	13.8	13.7	13.8	9.9	13.7	13.4	13.8
Maize	17.8	13.0	12.9	13.2	16.5	12.9	12.6	13.1
Haricot beans	0.6	0.4	0.4	0.4	0.6	0.4	0.4	0.4
Potato	0.9	0.7	1.3	1.0	0.9	0.7	1.2	1.0
Vegetables	2.6	2.4	2.3	2.4	2.6	2.2	2.2	2.4
Melons	2.1	2.1	2.2	2.1	2.1	1.8	2.1	2.1
Annual grasses	-	-	-	-	-	-	-	-
Perennial grasses	-	-	-	-	-	-	-	-

Table 7-31. Production and average yield of annual crops in Kakheti

	Production of annual crops ('000 tonnes)				Average yield of annual crops (t/ha)			
	2017	2018	2019	2020	2017	2018	2019	2020
Wheat	80.4	86.1	83.5	80.7	2.3	2.5	2.4	2.2
Barley	21.8	33.3	29.9	25.0	2.2	2.4	2.2	1.8
Maize	51.1	63.6	53.6	49.3	3.1	4.9	4.3	3.7
Haricot beans	0.6	0.4	0.3	0.3	0.8	0.9	0.7	0.7
Potato	4.6	4.7	5.8	4.2	4.7	6.2	4.6	4.1
Vegetables	15.2	21.5	19.2	21.1	3.8	5.1	5.1	5.3
Melons	61.7	52.1	60.3	67.5	29.4	29.4	29.4	29.4
Annual grasses	-	-	-	-	-	-	-	-
Perennial grasses	-	-	-	-	-	-	-	-

While specific data for Kvemo Kartli and Kakheti were also not immediately available for the permanent crop group "fruits", across Georgia family holdings provide the major share in the production of the crop group "fruits" – 96.8%, while consequently, the share of agricultural enterprises is 3.2%.

Of the total fruit production of 228.6 thousand tonnes in 2020, the share of the Kvemo Kartli region was only 3.0% (6.9 thousand tonnes), the distribution across specific crops is presented in Table 7-32. The share of the Kakheti region was higher at 14%. The distribution across specific crops is presented in

Table 7-33.

Table 7-32. Production of permanent crops in Kvemo Kartli ('000 tonnes)

	2017	2018	2019	2020
Fruits	114.1	188.2	144.4	228.6
Pome fruit, incl.:	2.1	2.1	3.3	2.9
Apple	1.7	1.6	2.8	2.3

	2017	2018	2019	2020
Pear	0.4	0.4	0.3	0.3
Stone fruit, incl.:	2.0	1.5	1.3	1.7
Plums, prune, damson	0.5	0.5	0.5	0.5
Cherries	0.4	0.3	0.2	0.4
Peach and nectarine	0.3	0.1	0.1	0.1
Sour plum, cherry plum	-	-	-	-
Nuts	0.5	0.7	0.5	0.9
Walnut	0.2	0.4	0.3	0.5
Hazelnut	0.3	0.3	0.2	0.3
Subtropical fruit (Persimmon, fif, Feijoa, kiwi, pomegranate, loquat, mulberry)	2.5	2.0	2.1	2.3
Grapes (white grapes, red grapes)	4.5	5.9	4.2	5.5
Citrus (tangerine, orange, lemon)	-	-	-	-

Table 7-33. Production of permanent crops in Kakheti ('000 tonnes)

	2017	2018	2019	2020
Fruits	114.1	188.2	144.4	228.6
Pome fruit, incl.:	1.3	1.3	1.2	1.6
Apple	0.8	0.8	0.7	1.0
Pear	0.4	0.4	0.3	0.3
Stone fruit, incl.:	32.2	24.5	21.4	27.2
Plums, prune, damson	0.6	0.5	0.4	0.6
Cherries	0.5	0.4	0.3	0.7
Peach and nectarine	29.9	21.7	18.9	22.2
Sour plum, cherry plum	0.9	1.4	0.8	2.2
Nuts	2.7	3.1	4.7	3.1
Walnut	0.6	0.7	0.8	1.0
Hazelnut	2.0	2.3	3.9	2.1
Subtropical fruit (Persimmon, fif, Feijoa, kiwi, pomegranate, loquat, mulberry)	3.3	4.0	3.7	3.8
Grapes (white grapes, red grapes)	134.8	188.2	223.7	239.3
Citrus (tangerine, orange, lemon)	-	-	-	-

7.9.6. Livestock Farming

Livestock farming is a common activity in the Kvemo Kartli region, with the number of agricultural holdings with cattle amounting to 31,156 (2014). For Kakheti, the number of agricultural holdings with cattle amounting to 24,779 (2014).

As of 2020, there are 171,900 heads of cattle in the Kvemo Kartli region, of which 47.6% are cows. Since 2017 number of cattle increased from 148,800 heads to 171,900 heads in 2020[140]. Kvemo Kartli produces more than 100 million litres of milk annually[141], while it is noted that between 2016-2019, the production of milk increased from 105.2 million litres to 121.9 million litres per year.

As of 2020 there were 94,000 heads of cattle in the Kakheti region, of which 45.5% are cows. Since 2017, the number of cattle has decreased slightly from 95,900 heads in 2017. Kakheti produced 63.6 million litres of milk annually in 2020, the production of which has also increased since 2016[142].

The importance of livestock farming in the Project regions is summarized in

Table 7-34.

Table 7-34. Livestock production in Kvemo Kartli and Kakheti compared to Georgia[143]

2020	Number of animals		
	Georgia	Kvemo Kartli	Kakheti
Bovine animals	925.8	171.9	94.0
Bovine animals >2 yrs.	512.9	92.2	-
Dairy cows, buffalos	450.8	81.9	42.8
Pigs	165.7	33.6	25.6
Sows	30.4	3.9	4.0
Sheep	896.2	179.2	552.1
Ewes	655.3	139.0	399.7
Goats	50.3	6.1	18.8
Mother goats	33.3	4.4	12.5
Poultry (all types)	10,146.5	5,213.7	1,290.9
Chicken	9,980.0	5,199.0	-
Turkey	78.5	-	-
Ducks and geese	77.0	8.3	-
Beehives	228.5	23.6	45.2

While specific data for the regions were not immediately available, in contrast to crop production, across Georgia the share of family holdings in animal production for the production group “meat” in 2020 was only 37.7%, while the share for agricultural enterprises was 62.3%. However, for the different subgroups the shares vary significantly: “beef” is predominantly produced by family holdings (92.9% vs 7.1%), as is “sheep and goat meat” (99.9% vs. 0.1%) and to a less extent “pork” (64.1% vs 35.9%), while poultry meat is mainly produced by agricultural enterprises (74.6% vs. 25.4%).

For the production group “eggs” a similar distribution as for “meat” was observed – 27.3% produced by family holdings, 72.7% produced by agricultural enterprises. On the contrary, “milk” was predominantly produced by family holdings (95.9% vs. 4.1%), as well as “honey” (88.3% vs. 11.7%).

[140] Available at: https://www.geostat.ge/en
[141] Geostat.ge https://www.geostat.ge/en/modules/categories/196/agriculture
[142] Available at: https://www.geostat.ge/regions/#
[143] Available at: https://www.geostat.ge/regions/#

With beef and milk almost exclusively produced by family holdings, as expected it can be observed that the majority of the family holdings own only 1-2 heads of cattle. Figure 7-7 shows the distribution of agricultural holdings by the number of cattle in Kvemo Kartli, showing that around 2% (577) of the agricultural holdings own more than 20 heads of cattle. Consequently, 98% owns less than 20 heads of cattle.

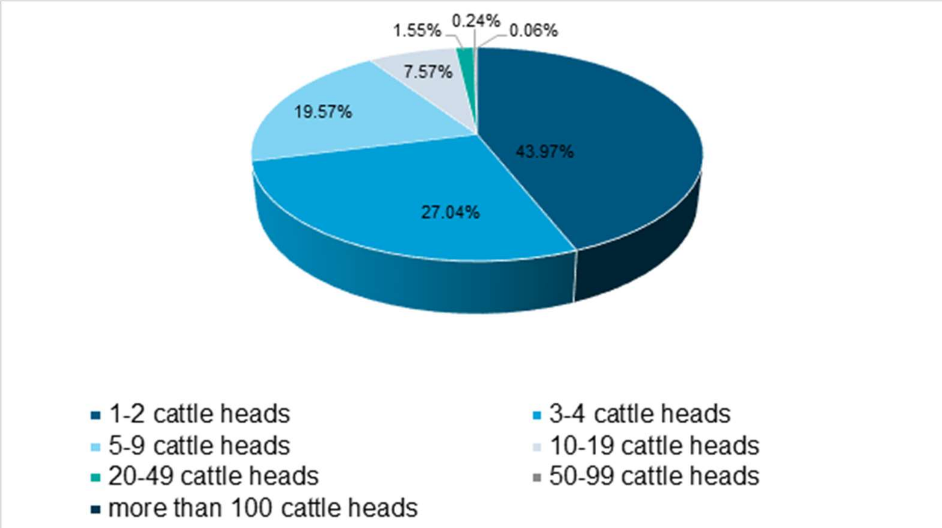


Figure 7-7. Agricultural holding by number of cattle heads in Kvemo Kartli[144]

7.9.7. The ZSIS

7.9.7.1. Land Ownership and Farm Land Distribution

Land ownership is recorded by the Georgian National Agency of Property Registration (NAPR). A census conducted within the Eptisa 2018 ESIA concluded that 60% of the land plots in the ZSIS command area (29,900 ha) were formally registered with the NAPR, equal to 75% of the ZSIS command area (with 25% reported as unregistered).

Using the information on land plot registration up to 28 October 2021 as provided by the NAPR, as part of the 2022 FS the present-day status of land registration in the ZSIS command area was re-analysed. Visual inspection of the locations of land plots within TU boundaries indicates that to date most land plots in TUs of the ZSIS command area seem to have been formally registered with the GA. The conclusion supports the observation of the Eptisa 2018 FS that the adoption of the law “On the Improvement of Cadastral Data and the Procedure for Systematic and Sporadic Registration of Rights to Plots of Land within the Framework of the State Project” in June 2016 as well as a state project on land registration launched to encourage and simplify registration of land ownership had its effects on improving the registration rate of land plots in recent years. The 2021 land plot registration with the GA is shown in Table 7-35.

The improved registration rate is important, as the modernisation of the ZSIS irrigation system will be economically feasible only if more than 90% of the plots are in use for agriculture production.

Table 7-35. Distribution of land by Registration

	ha (gross)	%	Number of plots	%
Registered	22,023	75	23,296	60
Unregistered	7,517	25	15,383	40
TOTAL	**29,539**		**38,779**	

As part of the 2021/2 FS, the 2021 plot registration database was classified by plot size class as well as TU land suitability for agricultural production, the results of which are presented in Table 7-36. Reasons for not

[144] Source: National Statistics Office of Georgia

including all areas in the TUs as available for irrigation is due to urbanisation, industry, steep slopes, gullies and rocky lands that would not be suitable. As can be seen, the 2021 distribution of farm plots is still skewed towards small farms (<0.25 ha) which account for 50% of the plots but only 5.7% of the total area, with plots >10ha accounting for 2% of plots but the majority of the total area at 63%. This is similar, though with a slight reduction in number of small plots, to the findings of the previous census in the 2016 work that indicated that small plots (<0.25 ha) accounted for 63% of the total number of plots but only 11% of the total area and large farm plots (> 10 ha) accounted for 1% of total plots but 58% of the total area. There has therefore been a slight increase in larger farms since the previous work.

Table 7-36. Estimation of registered land area available for agriculture inside TUs

Class	Fully included within current Project		P = partially excluded (>50% of the TU land area) within current Project		S = somewhat excluded (<50% of the TU land area) within current Project		Total Plots considered within ZSIS command area		
	Reg. Plots	Area (ha)	Reg. Plots	Area (ha)	Reg. Plots	Area (ha)	Reg. Plots	Area (ha)	Area (%)
			25% included (i.e. available for irrigation)		75% included (i.e. available for irrigation)				
<0.25	6,808	951	179	18	717	87	7,704	1,055	5.7%
0.25-1.25	5,977	2,512	125	73	476	250	6,577	2,835	15.3%
1.25-5	398	1,071	29	68	15	39	442	1,178	6.4%
5.0-10	237	1,680	4	22	3	26	244	1,728	9.3%
>10	364	11,416	6	206	5	97	375	11,719	63.3%
TOTAL	13,784	17,630	342	387	1,216	499	15,342	18,516	100.0%

Note: An estimated 1,200 ha of registered land plots in villages are additionally available for agriculture, to an overall area of registered land plots suitable for agriculture estimated based on the NAPR database at around 19,700 ha.

In the ZSIS command area, in 2020 and 2021 only 23.4% and 32.5%, respectively, of the lands contracted were cultivated by owners, while the remaining 76.6% and 67.5%, respectively, were used by land renters. This shows the limited interest of landowners to cultivate their (small) plots, renting it out to farmers-renters able to consolidate and cultivate crops on a bigger area with economies of scale.

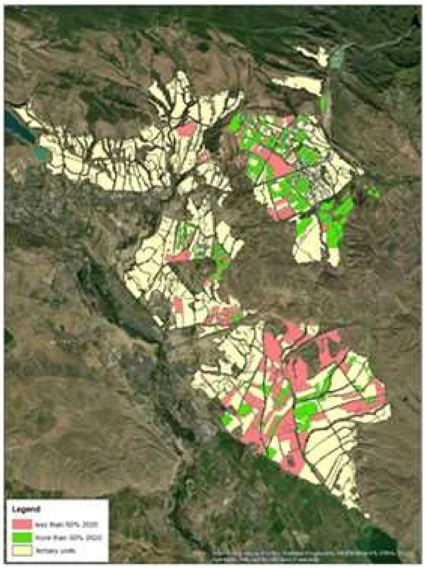
7.9.7.2. Irrigation Contracts

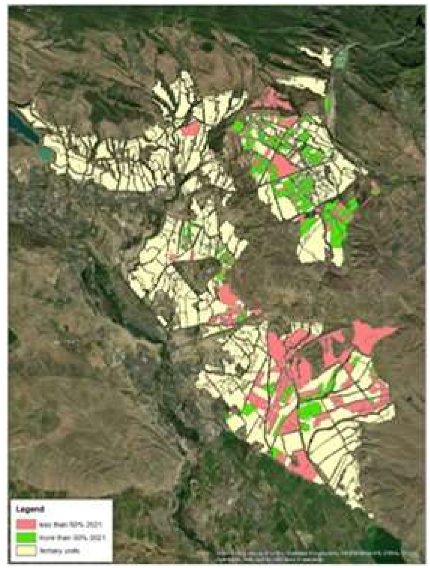
Information on the land user type from the GA for 2020 and 2021 is provided in Table 7-37. Analysis of the water supply contracts database managed by GA shows that for 2020 and 2021 a total of 4,298 contracts were signed, with 2,462 and 1,836 contracts signed in 2020 and 2021, respectively. It is noted that specifically in 2020, in response to the covid impacts, the GoG cancelled the annual fee for irrigation (flat fee of 75 GEL/ha), resulting in more farmers signing contracts. In 2021 such "subsidy" was not offered by the GoG and this may be one of the reasons for less contracts in 2021. The location of these contracts is shown in Figure 7-8.

Table 7-37. Overview of contracts signed for irrigation water supply in 2020 and 2021

Irrigation Zone	# of contracts	Contract area (ha)		# of contracts	Contract area (ha)
IZ-1	7	23.7		20	28.9
IZ-2	1,695	2,813.6		1,235	2,843.1
IZ-3	150	153.1		140	80.3
IZ-4	419	1,932.9		340	1,186.2

Irrigation Zone					
	# of contracts	Contract area (ha)		# of contracts	Contract area (ha)
IZ-5	145	1,438.8		61	1,154.4
IZ-6	46	42.0		40	27.3
TOTAL	**2,462**	**6,404.1**		**1,836**	**5,320.1**





Note: green and red-marked TUs distinguish the percentage of the land area of the individual TUs that was provided with irrigation water under contracts signed between GA and the farmers.

Figure 7-8. Overview of land areas with water supply contracts in 2020 and 2021

Tables 7-39 and 7-40shows the breakdown by plot size of the above contracts. Analysis of the GA database of contracts signed for irrigation water supply in 2020 and 2021 shows that in both years more than 50% of the contracts were signed for land plots <0.25 ha, covering around 4% of the land area contracted. On the other hand, in 2020 and 2021 respectively 3.4% and 7.6% of the contracts were signed for land plots >10 ha, covering respectively 33.0% and 62.7% of the land area contracted in these years. Analysis of the differences between 2020 and 2021 is interpreted as showing the effect of the government's response to support the agricultural sector during the COVID-19 pandemic - on 20 May 2020 generous anti-crisis state subsidy program packages came into force that offered farmers incentives both for land cultivation and signing a contract with GA.

Table 7-38. Plots and land area with water supply contracts in 2020

Plot size classes	Contracts		Area		Plot size / contract	Legal status of contract holder	
	(#)	(%)	(ha)	(%)	(ha)	Household	Corporate
≤0.25 ha	1,268	51.5%	277.0	4.3%	0.22	100.0%	0.0%
0.25 – 1.25 ha	528	21.4%	299.0	4.7%	0.57	95.5%	4.5%
1.25 – 10.00 ha	583	23.7%	3716.7	58.0%	6.38	90.1%	9.9%
>10 ha	83	3.4%	2111.3	33.0%	25.44	50.6%	49.4%
of which: corporate	*41*	1.7%	*1311.9*	20.5%	32.00		
of which: household	*42*	1.7%	*799.4*	12.5%	19.03		

Plot size classes	Contracts		Area		Plot size / contract	Legal status of contract holder	
	(#)	(%)	(ha)	(%)	(ha)	Household	Corporate
Total / Average	**2,462**	**100.0%**	**6,404.1**	**100.0%**	**2.60**	**95.0%**	**5.0%**

Source: GA service center, ZSIS contract data for 2020

Table 7-39. Plots and land area with water supply contracts in 2021

Plot size classes	Contracts		Area		Plot size / contract	Legal status of contract holder	
	(#)	(%)	(ha)	(%)	(ha)	Household	Corporate
≤0.25 ha	945	51.5%	202.8	3.8%	0.21	100.0%	0.0%
0.25 – 1.25 ha	441	24.0%	251.3	4.7%	0.57	94.2%	5.8%
1.25 – 10.00 ha	310	16.9%	1532.6	28.8%	4.94	65.9%	34.1%
>10 ha	140	7.6%	3333.3	62.7%	23.81	55.7%	44.3%
of which: corporate	*62*	3.4%	*1696.2*	31.9%	27.36		
of which: household	*78*	4.2%	*1637.1*	30.8%	20.99		
Total	**1,836**	**100.0%**	**5,320.1**	**100.0%**	**2.90**	**89.5%**	**10.5%**

Source: GA service center, ZSIS contract data for 2021

Table 7-40 data from the GA shows that most of the irrigation contracts are signed on rented/leased lands – 76.6% and 67.5% respectively in 2020 and 2021 showing 9.1% increase within owners. Another interesting fact is that contracts are mostly signed with physical persons rather than legal entities (94.9% and 90.5%). Additionally, most of the contract signers are male 90.37% and 93.37% in 2020 and 2021.

Table 7-40. Land by user type

Users	2020	2021
land user: owner	23.4%	32.5%
land user: user/tenant	76.6%	67.5%
Contract type: physical person	94.9%	90.5%
Contract type: legal entity	5.1%	9.5%
% of contracts: male	90.37%	93.37%
% of contracts: female	9.63%	6.63%

7.9.7.3. Inventory of Farming Practices

A rapid field survey was conducted on 2-4 November 2021, during which visits were made to the different zones identified in the command area of the ZSIS and an updated review of the main land use and crops is provided in Table 7-41.

Table 7-41. Crops in the ZSIS command area

Zone	Description	Crop Suitability Summary
Zone 1 - Paldo Headworks UMC-G1 to UMC-G5	Three farmers were surveyed - one small (<1.25 ha) and two large farmers (> 1.25 ha). Dominant crops here are grain maize and alfalfa. As the area has a relatively high elevation (750-800m), the varieties of crops are partly limited. For example, grapes and fruits are not suitable to	Dominant crops are grain maize and alfalfa. Grapes and fruits are not suitable as hail is quite frequent as well as early/late freezing.

Zone	Description	Crop Suitability Summary
	be grown for commercial purposes as insufficient amounts of sugar are accumulated during the growing period (e.g. if sugar content does not exceed 18% in grapes, it is impossible to produce quality wine). Also, hail is a quite frequent event, as well as early/late freezing. According to farmers, there is sufficient water in the canal and they are the first users of the water, but there is no infrastructure at all after the outlet from the UMC. Furrow irrigation is the main way of delivering water to the plots. Water flows through soil ditches and causes severe erosion locally and washes topsoil off the fields if extra water is used. According to farmers, there is sufficient machinery and other resources for the area. UMC is the source of the irrigation.	
Zone 2 - UMC-G6 to UMC-G09 and LMMC to Martkopi	The area is located around the villages Sartichala and Mughanlo. Three farmers were surveyed - one small (0.25 - 1.25 ha) and one large farmer (> 1.25 ha) and one corporate (> 100 ha). Renting and lending land is common practice in the area, as well as big landowners unifying neighbouring lands. Corn maize has become a dominant crop in the irrigated area (replacing wheat and barley) with well-developed value chains. Some farmers have artificial water reservoirs and a few use drip irrigation system between the rows, as well as pivot systems and furrow irrigation. Some large scale farmers have planted fruit and grape orchards with help of government programs “Plant the future” and “Preferential Agrocredit for Fixed Assets“. This kind of cropping pattern is incentivised by the government but it is not accessible for everybody as orchard establishment and maintenance investments need to be carried for 3-4 years until first harvest is collected and sold. Meanwhile a farmer must just spend money. Also, it needs additional infrastructure such as anti-hail netting but in terms of water use efficiency, drip irrigation is very effective and its use is obligatory in case of participation in the programs (there is no state program directly financing drip irrigation or other infrastructure for annual crops and vegetables, only indirect financing can be secured through Preferential Agrocredit for Fixed Assets, which has a minimum limit of 20,000 GEL so it is not suitable for small scale production).	Corn maize is the dominant crop in this zone along with fruit and grape orchards on large scale farms. It is also suitable for a variety of crops including vegetables, wheat and barley.
Zone 3 - UMC-G10 to UMC-G29	The surveyed area was around UMC-G10 and UMC-G11 where main agricultural activities are taking place. Downstream, beyond G16 urbanization takes place and intensive agriculture is not a case, instead previously irrigated lands are now either marginalized pasture lands or under infrastructural development. Three farmers - one small (<1.25 ha) and two large farmers - > 5 ha - were surveyed. There is no problem with lack of water but infrastructure, particularly collectors, gates and other distribution network elements beyond the UMC are not functional. Farmers have to manage everything themselves and use additional workforce to redistribute	The cropping pattern in this zone is mostly based on grapes, berries, fruits and other perennial crops. Maize and alfalfa are produced on smaller pieces of land compared to other zones. Farmers are using drip irrigation for newly established orchards (e.g., berries) and furrow irrigation for older crops (e.g. grapes).

Zone	Description	Crop Suitability Summary
	water in the fields. Problem also is to deliver water to the farm borders without crossing neighbours' lands. Cropping pattern here are mostly based on grapes, berries, fruits, almond, walnuts and other perennial crops. Maize and alfalfa are produced on smaller pieces of land compared to other zones. Farmers are using drip irrigation systems for newly established orchards (e.g., berries) and furrow irrigation for older crops (e.g. grapes). Improvement in infrastructure and reliability of the water availability can lead this area to more orchards in future as soil-climate conditions are suitable.	
Zone 4 - LMC-G04 to LMC-G20	The area is irrigated by means of the Lower main canal (G5 to G20). Three farmers - one medium (>1.25 ha) and two large farmers (> 5 ha) were surveyed in the area. The problem with the LMC is that it partly is a non-lined earthen canal (9km) while the remaining has concrete lining. Also, infrastructure of secondary and tertiary canals is almost completely missing (there are only gates that do not work properly and beyond that, water flows in furrows of soil. Also, the waste water discharge system of the Vaziani army base directly discharge effluents into the LMC without any treatment, which causes a threat for environment and food safety. Cropping patterns in the area comprises of grasses, alfalfa, berries, vegetables (e.g. tomatoes) and fruit/nut orchards. Water shortages and poor infrastructure lead to relatively undeveloped agricultural sector in the area. Farmers mainly focus on grasses and other annual crops.	Cropping patterns in this zone comprise of grasses, alfalfa, berries, vegetables (e.g. tomatoes) and fruit/nut orchards. Water shortages and poor infrastructure lead to relatively undeveloped agricultural sector in the area. Farmers mainly focus on grasses and other annual crops.
Zone 5 - LMC-G21 to LMC-G28	Four farmers - two small (< 1.25 ha) and one large farmer (>5 ha) and one corporate (>100 ha) farmers were surveyed. The area comprises of surroundings of Akhali Samgori village and farmlands of Lemshveniera village. Those are driest places of the command area. Also, there is almost no infrastructure such as roads and electricity. The southern part of the zone has social importance as it is near border region with Azerbaijan. Cropping patterns here are limited to grasslands with natural vegetation for winter pastures, silage maize and alfalfa. The area used to be arable, but after water shortages it became marginalized and is used as pastures and hay meadows. There are large corporate farmers with hundreds of hectares as well as small landowners. Corporate farmers use pivot systems but water is not sufficient for that, small farmers use furrow irrigation approach and water is not available for that as well, this leads to conflicts between farmers. Also, as landowners have informal ownership over the canals, they close and open it according to their needs so that transportation to canal and back to farm may be several times a day is costly in terms of petrol and wearing out vehicles. For example during 2021 season water was available only for one month and it was not sufficient anyways, so water scarcity is the biggest problem for the zone.	Cropping patterns in this zone are limited to grasslands with natural vegetation for winter pastures, silage maize and alfalfa.

7.9.7.4. Crops

As can be seen from the Table 7-42, annual crops such as maize, grass and alfalfa dominate the command area. However, the area of perennial crops (fruits and nut) has increased from 4.8% in 2020 up to 10.4% in 2021 mostly from newly established intensive orchards co-funded from state program “Plant the future”.

Table 7-42. Crops

Crops	2020	2021
% of perennial crops	4.8%	10.4%
% of annual crops	95.2%	89.6%
% of maize	46.0%	58.9%
% of grass	36.7%	21.3%
% of alfalfa	5.1%	3.4%
% of almond	0.5%	4.8%
% of vineyard	0.2%	2.0%
% of saplings	1.7%	1.9%
% of other crops	9.9%	7.7%

The project "Plant the Future" is initiated by the MEPA and is implemented by the Agriculture and Rural Development Agency (ARDA). This project started in 2015 and the key objectives are effective use of agricultural land, planting the permanent crops, import substitution, enhancing export potential, possibility of providing raw materials to processing enterprises, and as a result improving socio-economic conditions in rural areas. Under the project, financial support for potential beneficiaries includes co-financing for purchasing the saplings of permanent plants and constructing drip-irrigation systems, i.e. 70% of the cost of purchasing the saplings is financed and 50% of the cost of purchasing drip-irrigation system is financed. In case of agricultural cooperatives, not more than 80% of the cost of purchasing the saplings is supported and not more than 60% of the cost of purchasing drip-irrigation system is supported. Furthermore, under the “Sub-component of Berry Crops Financing” fully funded (100%) support is provided for covering the cost of purchasing the seedlings and drip-irrigation system on agricultural land plot from 0.15 to 0.5 ha. In addition, individuals and legal entities are financed up to 50% of the cost of construction of well/pump station and up to 60% in the case of agricultural cooperatives.[145]

There is another program: Preferential Agro-credit Project which has been initiated by the MEPA and implemented by the ARDA since 27 March of 2013. The purpose of the project is to improve the processes of primary agricultural production, processing, storage and sale by providing the legal and natural entities with cheap, affordable long-term and preferential funds. Within the frame of the project, the enterprises engaged in the processes of primary agricultural production, processing and storage will receive the preferential agro-credit/agro-leasing from the financial institutions for fixed and current assets. But the challenge for farmers is that the program has lower limitation of credit amounting 20,000GEL that is sometimes not accessible if farmer cannot provide guarantee as a land or other estate.

Both the programs "Plant the Future" and “Preferential Agrocredit” are creating incentives for farmers to go for perennial crops with efficient irrigation system, but it also means that after planting an orchard, farmer has to wait and only invest for several years before first yield and income. This is accessible for rich investors and not regular farmers.

7.9.7.5. Cropping Patterns

Agricultural land use in the ZSIS command area is characterized mostly with primary production of fodder, forage and maize for grain or feed/silage. Dominant crops are maize, alfalfa and perennial grass, in support of the livestock sector in general and poultry production specifically. Other crops grown include grapes (table

[145] Available at: https://www.degruyter.com/document/doi/10.1515/opag-2021-0012/html

grapes as well as for wine), nuts (almond, walnut, hazelnut), and blackberries, raspberries, apples, pears, cherries and vegetables on smaller areas.

Based on the information gathered during interviews with small and large farmers in 2021, the present irrigated cropping patterns were derived for each of the project zones. The present cropping patterns are shown in Table 7-43, which shows that the overall irrigated area is dominated by maize production (53%) followed by alfalfa (20%). Maize production is prevalent in Zones 1 and 2, while both maize and alfalfa are the main crops in Zones 3 and 4. Berries, grapes and fruit/nut trees are also grown, particularly in Zones 2, 3 and 4, while grassland (mainly partially irrigated) accounts for 80% of the cropped area in Zone 5 where water shortages are widespread. Present cropping patterns were also derived for three categories of farm size, i.e. marginal/small (< 1.25 ha), medium farm (1.25 ha to 10.00 ha) and large farm (> 10 ha) and these are presented in Table 7-44.

Table 7-43. Cropping Patterns by Zone: Present

Crop	% of Cultivated Area					
	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Overall Project
Wheat	0%	4%	0%	0%	0%	1%
Maize	85%	87%	40%	30%	11%	53%
Alfalfa	10%	2%	25%	50%	8%	20%
Grass	0%	0%	0%	0%	80%	12%
Vegetables	0%	1%	0%	5%	0%	1%
Berries	0%	0%	10%	10%	0%	5%
Grapes	0%	1%	18%	0%	0%	4%
Fruit/Nut Trees	2%	5%	7%	5%	1%	5%
Cropping Intensity (%)	100%	100%	100%	100%	100%	100%

Source: Field Survey and consultants' estimates, November 2021.

Table 7-44. Cropping Patterns by Farm Size: Present

Crop	% of Cultivated Area			
	Marginal/Small Farms (< 1.25 ha)	Medium Farms (1.25 ha - 10.00 ha)	Large Farms (>10.00 ha)	Overall Project
Wheat	0%	1%	1%	1%
Maize	35%	52%	62%	53%
Alfalfa	25%	20%	15%	20%
Grass	8%	10%	15%	12%
Vegetables	2%	0%	0%	1%
Berries	10%	5%	3%	5%
Grapes	10%	5%	0%	4%
Fruit/Nut Trees	10%	7%	4%	5%
Cropping Intensity (%)	100%	100%	100%	100%

7.9.7.6. Crop Yields

- According to the Eptisa 2018 ESIA, the main crops cultivated in the area are wheat, barley, fruits, alfalfa, maize, vine and vegetables. Based on data collected during farmer interviews in 2021, as well as information made available from Geostat for the Kvemo Kartli area, present crop yields were derived for each of the project zones. The estimated average crop yields in the present are presented in Table 7-45. Vegetables, Alfalfa, berries, grapes and fruit/nut trees currently provide the highest yields.

Table 7-45. Crop Yields: Present

Crops	Average Crop Yield (ton per hectare)						
	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Overall Project	%
Wheat	n/a	2.5	n/a	n/a	n/a	2.5	3%
Maize	8.0	9.0	8.0	8.5	7.0	8.0	9%
Alfalfa (hay)	15.0	15.0	15.0	15.0	15.0	15.0	16%
Grass (hay)	n/a	n/a	n/a	n/a	5.0	5.0	5%
Vegetables	25.0	n/a	n/a	n/a	n/a	25.0	27%
Berries	n/a	n/a	12.0	15.0	n/a	13.5	15%
Grapes	n/a	10.0	15.0	n/a	n/a	12.5	14%
Fruit/Nut Trees	10.0	10.0	10.0	10.0	10.0	10.0	11%

Source: Field Survey and consultants' estimates, November 2021; n/a = not applicable

7.9.7.7. Crop Inputs

Based on data collected during the 2018 FS as well as information collected during the field study in 2021, crop inputs per hectare (i.e. seeds/seedlings, fertilisers, herbicides and pesticides) were derived for a range of crops. The estimated levels of crop inputs are presented in Table 7-46.

Table 7-46. Crop Inputs: Present and Future With Project

Crops	Crop Inputs (kg per hectare)					
	Seed (kg) / No. Seedlings	Inorganic Nitrogen Fertilizer	Inorganic NPK Fertilizer	Organic Fertilizer	Herbicide	Pesticide
Wheat	240	200	-	-	2	1
Maize	27.5	300	100	-	2	1
Alfalfa (hay)	20		100	-	-	1
Grass (hay)	15	200	100	-	-	-
Vegetables	20,000	300	200	10,000	2	3
Berries	25,000	250	250	-	5	10
Grapes	2,500	200	200	-	5	10
Fruit/Nut Trees	750	200	200	-	5	10

Source: (i) Rehabilitation of the Zemo Samgori System (Ref. ORIO13/GE/01), Deliverable 3, Part 4: Financial and Economic Analysis, EPTISA, August 2018, and (ii) Field Survey and consultants' estimates, November 2021.

The most labour demanding crops are vegetables, berries, grapes and fruit trees which require a substantial number of labourers for harvesting and post harvesting tasks. In addition, the planting and pruning of berries, grapes and fruit trees is also labour intensive (

Table 7-47).

Table 7-47. Labour Requirements

Crops	Labour Requirements (days per hectare)							
	Land Preparation	Planting	Pruning	Fertilizer Application	Herbicide/ Pesticide Application	Irrigation	Harvesting	Post Harvesting
Wheat	1	1	-	2	1	3	3	1
Maize	1	1	-	2	1	4	1	1
Alfalfa	1	1	-	1	1	4	8	6
Grass	1	1	-	1	-	3	6	4
Vegetables	2	2	-	3	2	8	100	20
Berries	1	25	10	3	2	5	100	20
Grapes	1	15	10	3	2	5	50	10
Fruit Trees	1	15	10	3	2	5	50	10

Source: (i) Rehabilitation of the Zemo Samgori System (Ref. ORIO13/GE/01), Deliverable 3, Part 4: Financial and Economic Analysis, EPTISA, August 2018, and (ii) Field Survey and consultants' estimates, November 2021.

7.9.7.8. Equipment

The census data from the Eptisa 2018 ESIA indicated that only 6% of the HHs in ZSIS owned agricultural equipment as listed in Table 7-48, with most equipment being more than 10 years old. Vulnerable groups were not significantly different to non-vulnerable groups in this respect. The most frequently used equipment needed for agricultural activities was identified as hand tools (5.1% of HHs), then Tractors (both 4WD and 2WD), but the owners of them (83 HHs) make less than 1% of the total HHs in the ZSIS (at the time of the Eptisa survey).

Table 7-48. Equipment owned (as recorded in Eptisa surveys)

Ownerhsip of agricultural equipment	Number	Percentage in General Sample	Pecentage within the group pf equipment owners
Tractor 4WD	59	0.5%	8.2%
Tractor 2WD	24	0.2%	3.3%
Power tiller	8	0.1%	1.1%
Plow	1	0.0%	0.1%
Harrow	1	0.0%	0.1%
Sprayer	1	0.0%	0.1%
Mower	6	0.1%	0.8%
Hand tools only	604	5.1%	83.5%
Car	7	0.1%	1.0%
Other	12	0.1%	1.7%
TOTAL	723	6.0%	100.0%

7.9.8. Irrigation Systems

The design command is estimated at 29,944 ha, of which 589 ha is located in Zone 1 (UMC G1 to G5), 7,395 ha in Zone 2 (UMC G6 to G9), 4,096 ha in Zone 3 (UMC G20 to G29, 10,502 ha in Zone 4 (LMC G5 to G19) and 5,298 ha in Zone 5 (LMC beyond G19).

The areas currently being irrigated with the design command area are given in Table 7-49 and it can be seen that 7,565 ha (25.2% of the design command area) are being irrigated, while the remaining 22,429 ha (74.8% of the current design command area) are not irrigated. Zone 2 (UMC-G6 to UMC-G09) and Zone 4 and 5 (LMC-G04 to LMC-G27) have a mixture of furrow irrigation, centre-pivots and drip networks with intensive and highly mechanised agriculture oriented large-scale farmers.

Table 7-49. Irrigated Area by Zone

Project Zone	Design Command Area (hectare)	Present Irrigated Area (hectare)
Zone 1 - Paldo Headworks UMC G1 to UMC G5	588.7	39.0
Zone 2 - UMC G6 to G9 & LMMC to Martkopi	7,394.8	2,890.8
Zone 3 - UMC G20 to G29	4,096.0	448.8
Zone 4 - LMC G5 to G19	10,501.6	2,170.2
Zone 5 - LMC beyond G19	5,298.3	2,016.5
Zone 6 – LMMC after Martkopi	2,114.8	0.0
Total Area	29,994	7,565.2
% of Design Command Area	100%	25.2%

Source: Consultants' estimates.

Most of the ZSIS command area is therefore underdeveloped in terms of irrigation infrastructure with very few exceptions like in Zone 1 where there is a newly added super intensive 195 hectares (to be extended up to 245 in 2022) almond orchard; Zone 2 Sartichala area with several pivot irrigation systems (up to 15 units) and tens of hectares of intensive orchards of apples, pears and table grapes with drip irrigation and also the only case of drip irrigation for maize on 27 hectares; Zone 5 with several pivot systems (up to 10 units); and occasional drip irrigated orchards of berries and vineyards in zones 3 and 4.

Water use efficiency is becoming important, however a lack of electricity infrastructure along farm lands together with low interest of farmers to invest in on farm development on rented land, is hindering the progress and water shortage because of its unsustainable use, is one of the biggest problem of the agriculture in the ZSIS. Also, because of severe water pollution from poultry factory and army base, drip irrigation system in Zone 4 has demonstrated very poor results because of clogging pipes.

7.9.9. Livestock

According to the census data in the Eptisa 2018 ESIA, 35% of rural inhabitants report having domestic animals. Bulls and cows are the most common domestic animals in the ZSIS villages (71%). 44% of interviewed households in rural areas stated an intention to have domestic animals, if irrigation water becomes available after the system modernisation. They mainly named cows / bulls (72%), pigs (53%) and hens (41%) as desired livestock.

7.9.10. Vulnerable Groups and Poverty

In 2020 19.7% of the population in Georgia was under 60% of median consumption, while 7% was under 40% of median consumption, and 21.3% was under absolute poverty line. Relative and absolute poverty indicators are higher in rural areas as compared to urban areas. In 2020 share of the population under 60% of median consumption was 26.8% in rural and 14.9% in urban areas; share of the population under 40% of median consumption was 10% in rural and 4.9% in urban areas; and share of the population under absolute poverty line was 17.1% in urban and 27.5% in rural areas. From the ZSIS regions, absolute poverty is highest in the Kvemo Kartli region and lowest in Tbilisi (Table 7-50).

Table 7-50. Share of the population below the absolute poverty line in ZSIS regions (%), 2020

ZSIS region	% below the absolute poverty line
Kakheti	18.6
Tbilisi	14.5
Kvemo Kartli	32.0

According to data of the Georgian Social Services Agency, there were 59,887 pensioners and 14,336 social welfare beneficiaries in Tbilisi, Isani-Samgori District, 13,453 pensioners and 2,595 social welfare beneficiaries in Gardabani municipality and 9,333 pensioners and 1,799 social welfare beneficiaries in Sagarejo municipality in 2021 (Table 7-51 and Table 7-52). According to Table 7-53, subsistence allowance beneficiaries are highest in Tbilisi, Isani-Samgori District, then Gardabani municipality and then Sagarejo municipality.

Table 7-51. Number of pensioners, September 2021

Municipality	Number of pensioners (total)	Number of pensioners with IDP status
Tbilisi, Isani-Samgori District	59,887	3,566
Sagarejo	9,333	17
Gardabani	13,453	203

Table 7-52. Number of social welfare beneficiaries, September 2021

Municipality	Number of social welfare beneficiaries	Among these:			
		men	women	disabled	IDPs
Tbilisi, Isani-Samgori District	14,336	9,652	4,684	9,151	1,210
Sagarejo	1,799	1,182	617	1,290	3
Gardabani	2,595	1,679	916	1,885	76

Table 7-53. Registered in the social programmes database and subsistence allowance beneficiaries, September 2021

Municipality	Households		Population	
	Registered in the social programmes database	Subsistence allowance beneficiaries	Registered in the social programmes database	Subsistence allowance beneficiaries
Tbilisi, Samgori District	21,104	12,624	65,634	45,054
Sagarejo	4,933	2,137	16,846	9,417
Gardabani	6,184	4,241	20,892	15,955

For the majority of households in rural areas, agriculture is the main source of income, however, due to a number of constraints, it is difficult to achieve commercial success and therefore households can be at risk of poverty. According to Transparency International's report on "Georgia's Agricultural Sector: Key Trends for 2012-2019", low productivity is the main reason for poverty for people employed in agriculture. Low productivity has been continuously affecting the competitiveness of Georgian agricultural products on the domestic and global markets. To compete on the global market, Georgian producers have to concentrate on attaining various food safety and quality standards to comply with the requirements set forth in Association Agreement signed in 2014 between EU and Georgia.

The main challenges of food security nationally include high import dependency, low local production and the lack of physical or economic access to nutritious food, particularly for those living in mountainous regions. Although the Global Food Security Index[146] is not calculated for Georgia, the country depends on food-imports: Self-Sufficiency Ratios (SSR) are low for many necessary agro-food products. However, according to Global Hunger Index, in 2020 Georgia ranked 26th among 132 countries which is a significant improvement compared to 2000. The Gini Coefficient, which measures the degree of inequality in the distribution of income, decreased since 2011 and remains 0.36 on average. The share of the population below the absolute poverty line is declining year by year; in the period 2011-2016, it declined by 15% and constitutes 21% where it remains today.

Data on vulnerable groups in the ZSIS villages from the Eptisa 2018 ESIA Report is provided for 2014 in Table 7-54. The survey data showed that women living alone, or with children, as well as eco-migrants comprised the main structure of vulnerable households. About a half of the interviewed households in ZSIS area as part of the previous FS were considered vulnerable (51%). The declared annual income of 26% of households was lower than the annual minimum living allowances (defined by the official statistics of Georgia). Every fifth household consisted only of elderly people (60 years old and older). 58% of vulnerable groups - adult women (18-59) live alone and are economically vulnerable (monetary income under the minimum living annual allowances). Almost all inhabitants of two villages in the ZSIS area, Lemshveniera (Nagebi) and Mzianeti, are ecomigrants (343 interviewed households). These are people who were relocated to the ZSIS after their original village became uninhabitable by a natural catastrophe in 1990s.

Table 7-54. Vulnerable Groups for the Villages Irrigated by ZSIS (as recorded in Eptisa survey)

Village	Total Population	Pensioners (>65years)	Social welfare and subsistence allowance beneficiaries	Disabled people	Refugees / IDPs
Samgori District	177,844				
Varketili	3,004			3	150
Nasaguri	1,509			5	
Patara Lilo	666			2	
Tsinubani	1,274			6	7 families
Daba Didi Lilo	2,417			28	47 families
Sagarejo Municipality	51,761				
Ujarma Community	479	91	21 families	11	3 families
Gardabani Municipality	81,876				
Village Agtaklia	1,811	560	30		5 families
Village Akhali Samgori	1,870	320	119		
Akhalsopeli Community Villages Akhalsopeli and Mukhrovani	2,315	260	110		
Gamarjveba Community	5,677	733	119		26 families
Gamarjveba	4,670				
Gamarjveba 1	313				
Foladaantkari	694				

[146] Available at: https://impact.economist.com/sustainability/project/food-security-index/Country

Village	Total Population	Pensioners (>65years)	Social welfare and subsistence allowance beneficiaries	Disabled people	Refugees / IDPs
Lemshveniera Community Villages Lemshvenieram Mzianeti, Nagebi	2,272	403	148	24	Almost all inhabitants
Martkophi Community	11,400				
Village Martkopi	7,397	1,193	430	103	
Village Vaziani	3,686	230		41	186
Village Saakadze	317	50		8	
Sartichala community	10,219	1,512	170	18	35 families
Sartichala	6,009				
Muganlo	4,210				
Village Norio	3,756	420	405	62	

In general, it was reported that vulnerable households practiced less diverse agriculture than non-vulnerable households. Livestock was also more comment for non-vulnerable households than vulnerable households. Overall, the Eptisa 2018 ESIA reported that vulnerable households lack relevant resources for agricultural activities and the scale of their agricultural production is lower than non-vulnerable households. Nevertheless, they reported an equal level of interest towards the potential of the irrigation system's modernisation, as well as possibility of their engagement in making the ZSIS area agriculturally more diverse.

7.10. Gender and Inclusion

Georgia ranks 49th out of 156 countries with a score of 0.732 on the Global Gender Gap Index according to World Economic Forum's Global Gender Gap Report (2021), which is a 25-point improvement compared to 2020 when Georgia ranked 74th with a score of 0.708.16.[147]

In Georgia, there are more boys than girls born in the absolute majority, a trend that has remained stable over the years (with the share of new-born boys equalling 52% in 2021) (see Figure 7-9 below). However, women above the age of 30 exceed men in number due to men's higher mortality rates. The general population of Georgia is aging, and the share of women aged 65 years old and above has increased from 15.3 in 2020 to 18.3% in 2021 (for men, 10.9 and 11.8% respectively)[148]. Life expectancy is significantly higher for women, being 77.7 years for women and 69.1 years for men.

[147] Country Gender Equality Profile of Georgia, UN Women, 2021. Available at: https://www2.unwomen.org/-/media/field%20office%20georgia/attachments/publications/2021/country%20gender%20equality%20eng%20final.pdf?la=en&vs=4357
[148] WOMEN-AND-MEN-IN-GEORGIAN_-2021.pdf (geostat.ge)

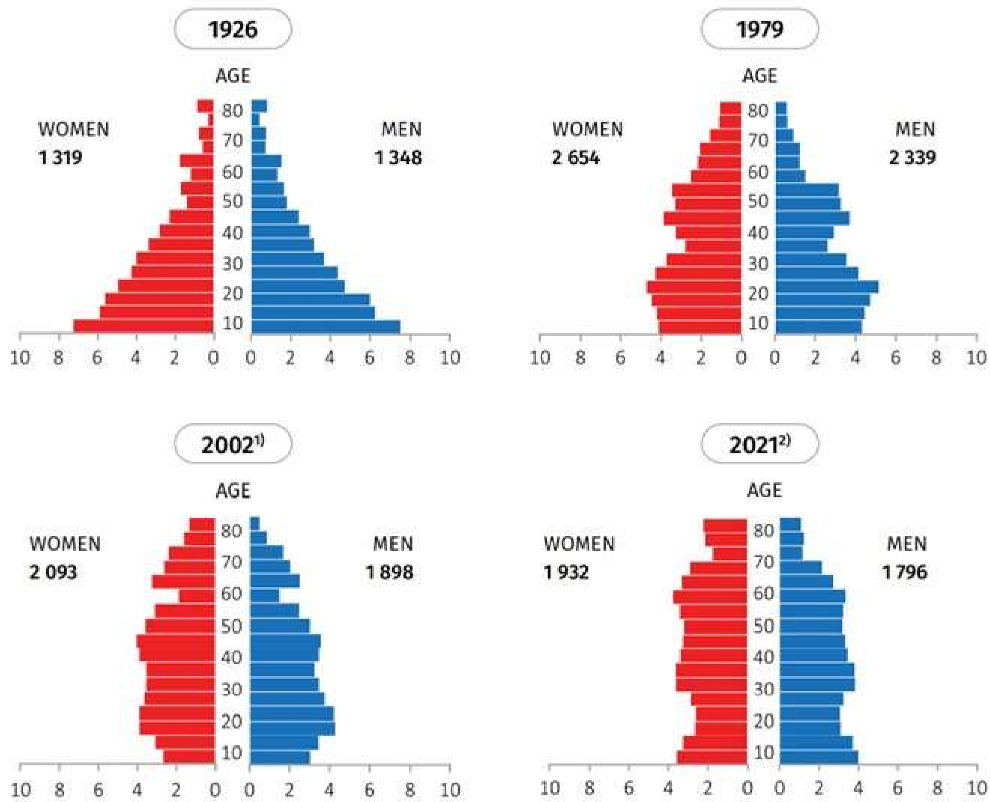


Figure 7-9. Population by age and sex (numbers in 1000s and percentage distribution)

Source: Geostat (2021)

The share of women and girls entering primary school – net primary school enrolment – has remained at a high level over the years (around 96% in 2020). According to 2020 data, more women than men have secondary vocational training, while more men have primary vocational and complete secondary education in Georgia.[149]

[149] Statistical Publication - Women and Men in Georgia, 2021. Available at: https://www.geostat.ge/en/single-archive/3362

Table 7-55. Population aged 15 and older by age group and educational attainment (numbers in 1000s)

	PRIMARY/ BASIC EDUCATION	COMPLETE GENERAL EDUCATION	PRIMARY VOCATIONAL	SECONDARY VOCATIONAL	HIGHER EDUCATION	NO EDUCATION
15-19						
Women	58.6	37.1	0.4	0.6	0.0	0.4
Men	66.5	30.6	0.6	0.4	0.0	0.9
20-29						
Women	13.3	95.1	3.5	21.8	66.2	0.8
Men	15.3	143.7	4.6	15.1	45.3	1.5
30-39						
Women	18.0	79.0	7.5	39.3	115.5	2.0
Men	22.8	107.8	6.7	19.8	91.5	1.9
40-49						
Women	10.9	77.4	6.6	42.3	97.0	0.7
Men	13.5	101.9	10.7	24.0	79.0	1.2
50-59						
Women	7.3	93.8	8.2	76.6	84.3	0.8
Men	5.0	97.8	16.3	49.8	67.9	0.5
60+						
Women	59.1	193.1	17.6	126.4	145.6	7.3
Men	28.9	126.1	18.4	78.8	107.4	2.4

Source: Geostat (2021)

Georgia is among the countries with the highest rates of early or child marriage in Europe (17.2% in 2005, 14% in 2010 and 13.9% in 2018), which is one of the key reasons for dropping out of school for girls. In 2020 60 pupils left school because of marriage, 56 of whom were girls. The share of women aged 20–24 who were married or in a union before the age of 18 is highest among ethnic Azerbaijanis (37.6 %), followed by ethnic Georgians (12.4 %) and ethnic Armenians (4.5 %). A difference is also observed among rural (25%) and urban (8%) populations, with rural women being more likely to get married under the age of 18.[150]

In terms of employment, the number of women employed at a national level in Georgia was lower for women than men in 2020 (546.9 thousand and 695.0 thousand, respectively). The labour force participation rate is 40.4% for women and 62% for men, with the unemployment rate also higher for men at 20.2% compared to 16.25.[151]. Although the unemployment rate is higher for men, women's economic inactivity rate is approximately 1.5 times greater than men's – yet this is obviously related to women's overrepresentation in unpaid work. At the same time, the gender gap in labour force participation is higher in rural population.[152] While the unemployment rate is higher for men in all categories of education level, when it comes to the population with no education, the unemployment rate is twice as high for women as it is for men.[153]

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[150] Country Gender Equality Profile of Georgia, UN Women, 2021. Available at: https://www2.unwomen.org/-/media/field%20office%20georgia/attachments/publications/2021/country%20gender%20equality%20eng%20final.pdf?la=en&vs=4357
[151] Available at: https://www.geostat.ge/en/modules/categories/683/Employment-Unemployment
[152] Country Gender Equality Profile of Georgia, UN Women, 2021. Available at: https://www2.unwomen.org/-/media/field%20office%20georgia/attachments/publications/2021/country%20gender%20equality%20eng%20final.pdf?la=en&vs=4357
[153] Ibid.

Gender differences in wages remain significant, as women earn less than two thirds of men's average monthly salary. In 2020, average monthly nominal earnings of men employees equalled to 1407.7 GEL, of women - 952.2 GEL. Thus, the ratio of women's wages to men's wages was 67.6 %, which is 3.8 percentage points higher than the 2019 data.[154]

Figure 7-10 shows the distribution of households by the sex of the head of household (41.2% female-headed in urban areas versus 28.4% in rural areas):

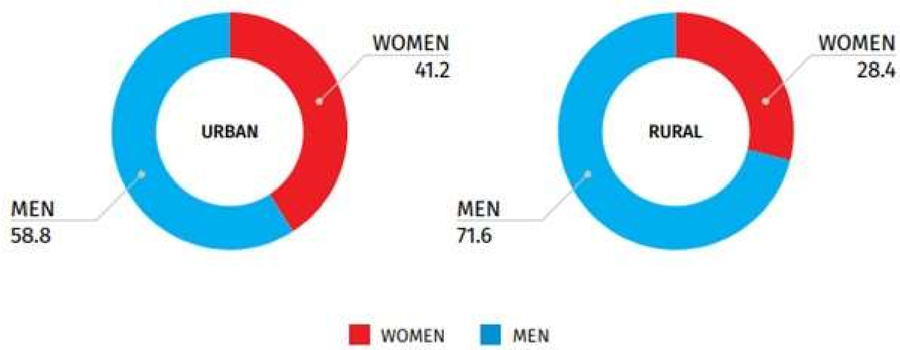

Figure 7-10. Distribution of households by sex of the head of household in urban and rural areas

Source: Geostat (2021)

Men own and dispose of larger shares of almost all types of assets such as real estate, land and large equipment in Georgia. The asset gender gap favouring men is more pronounced in rural areas. In 2015, 37.7% of landowners were women and 62.3% were men. In addition, if differentiating between the documented ownership and reported ownership, men are more than twice likely to be documented as owners than women. Furthermore, studies show that even in case of documented ownership, women have limited access to credit, grant schemes and governmental subsidies due to lack of registered lands.

It is also notable that men and women receive asset ownership through different ways that emphasize the gender gap. Men mostly acquire ownership through inheritance and allocation or gifts, while women acquire ownership mainly through marital laws. According to recent studies, there are several reasons for unequal access to land rights: patriarchal inheritance practices (sons being favoured over daughters); women's limited access to economic resources to buy land; traditional understanding of women's role within household; women leaving households when getting married without claiming their share of land/assets; and lack of knowledge and understanding about their ownership rights and the law.[155]

In terms of access to services such as connections to the centralised water supply system, only 68.9% of the population in Georgia has access.[156] The share of households provided with the water supply system installed in the dwelling is 99.5% in Tbilisi 67.5% - in Kvemo Kartli and 61.4% - in Kakheti. According to the 2018 data, 14.3% of the rural population in Georgia does not have access to drinking water on their premises, while a piped sewer system is available in 15.8% of rural households. About 77.6% of the rural population is satisfied with the water quality. Collection of drinking water is almost equally divided between men and women, with 50.6% of men and 45% of women being responsible for collecting water for their household.[157]

Regarding the total usage of energy within households, the share of electricity was 16.4%, of natural gas – 51.8% and of firewood – 29.9% in 2018. Firewood is used as the primary means of heating in 17% of urban households and in 78.3% of rural households, this represents 45.8% of all households in Georgia. Using firewood is considered as significant factor in energy poverty, with a disproportionally negative effect on women's health, since women spend more time at home doing housework and are exposed to larger amounts of smoke and particulate matters - a direct cause of respiratory diseases.[158]

[154] Statistical Publication - Women and Men in Georgia, 2021. Available at: https://www.geostat.ge/en/single-archive/3362
[155] Country Gender Equality Profile of Georgia, UN Women, 2021. Available at: https://www2.unwomen.org/-/media/field%20office%20georgia/attachments/publications/2021/country%20gender%20equality%20eng%20final.pdf?la=en&vs=4357
[156] Available at: https://www.geostat.ge/en/modules/categories/565/environmental-indicators
[157] Country Gender Equality Profile of Georgia, UN Women, 2021. Available at: https://www2.unwomen.org/-/media/field%20office%20georgia/attachments/publications/2021/country%20gender%20equality%20eng%20final.pdf?la=en&vs=4357
[158] Ibid.

Women are also disproportionally affected by the impacts of climate change such as increased floods, landslides, draughts, and fires. According to recent studies, women are usually less ready to react quickly to natural disasters due to the prevailing attitudes and expectations about women's roles. The most vulnerable groups towards natural disasters are people living in high mountainous regions and rural areas as well as poor people and those living below the poverty line and people living alone. Furthermore, recent studies show that women and children are 14 times at greater risk of dying during disasters than men. [159]

In terms of women's participation in decision-making and leadership positions, from the three government branches in Georgia, the largest gender power gap has been traditionally observed in the legislative branch, both at the national and at the municipal levels. The share of women members of the Parliament of Georgia constituted 21% in 2020, while the political representation of women in the municipal organs made up 11%. In the top positions of the executive branch, the share of women varies from 15% among ambassadors to 33% among government ministers. The judicial branch includes around 54% of women as general court judges.[160].

According to the Report of the Public Defender (Ombudsmen) of Georgia on Women's Rights and Gender Equality (2016), women's participation in local decision also making remains low. In 2016 women's participation in village gatherings and meetings was twice as less as of men. While this depends on various factors, according to the observations of the public defender's office, men often oppose to participation of female family members in these meetings. In addition, meetings' organizers often fail to adequately involve and inform women.[161]

Finally, the Geostat Women and Men in Georgia report (2021) indicated that there are no significant gender differences in terms of ICT uses/access by the Country's population. This represents significant opportunities for working towards a more inclusive agricultural sector.

7.10.1. Gender and Agriculture

A recent report from the Food and Agricultural Organisation (FAO) (2018)[162] indicated that there are still gender norms and stereotypes that severely hinder women's development in rural areas in Georgia. The gendered division of labour impacts decision-making within the household and family farming, as well as women's economic opportunities. Domestic responsibilities and agricultural work are considered a women's primary responsibilities. Marriage traditions often result in rural households investing less in girls than boys, since economic returns are perceived to be lower. This obviously have serious impacts on women's economic development opportunities as well as an impact on overall agricultural productivity.

Despite women's active participation in the agricultural sector (80 days more per year than men, on average[163]), there are entrenched biases that consider farming as a male activity while women are seen as 'farmers' wives'. There is a gendered division of labour in agricultural value chains, where in most regions, women focus on animal husbandry and men in crops[164]. These social norms limit women's participation in agricultural associations and access to information, extension services, and labour-saving technologies. Lack of female staff in rural advisory services further complicates this situation. The perception that using machinery is a 'male' activity also acts as a barrier for women's access to irrigation services, pesticides, fertilizers and agricultural inputs.

Significant gender disparities have been observed over the years in terms of the distribution of agricultural holdings managed by women and men, as well as the distribution of the land area operated by agricultural holdings. In 2020, 32.2% of agricultural holdings were managed by women, while 67.8% were managed by men; and 20.7% of lands operated under agricultural holdings were held by women, while men held 79.3% of them. Lack of land ownership, as explained above, also diminishes women's empowerment. This limits their access to finance, and to government subsidies due to lack of collateral. Women who own property, conversely, are also less likely to experience gender-based violence as they have 'a way out'.

[159] Ibid.
[160] Statistical Publication - Women and Men in Georgia, 2021. Available at: https://www.geostat.ge/en/single-archive/3362
[161] Report of the Public Defender (Ombudsmen) of Georgia - Women's Rights and Gender Equality, 2016. Available at: https://www.ombudsman.ge/res/docs/2019041112492319382.pdf
[162] FAO. 2018. Gender, agriculture and rural development in Georgia – Country Gender Assessment Series. Rome, pp. 80 Licence: CC BY-NC-SA 3.0 IGO.
[163] UNWOMEN (2018) Gender assessment of agriculture and local development systems in Georgia. Available at: https://georgia.unwomen.org/sites/default/files/Field%20Office%20Georgia/Attachments/Publications/2018/Agri%20and%20Local%20Dev%20Georgia.pdf
[164] Ibid.

This same report analyses data from Geostat and maintains that gender-based segregation in employment occurs both in a vertical and horizontal manner. Men are highly represented in managerial positions and technical professions such as engineering, agriculture and construction, whereas very few women are represented in these sectors. Representation in agricultural cooperatives, as explained above, it is also low for women. This is partly due to the lack of implementation of gender equality considerations in laws such as the Law of Cooperatives. Furthermore, according to the 2018 data, women represent only 25% of agricultural cooperative members, and only 4.7% of cooperatives (100 cooperatives out of 2,106) are managed by women.[165]

7.10.2. Gender and the ZSIS

From the information presented for the wider command area (based on the 2014 census data) it could be observed that education levels are aligned to national patterns. Hence, it is possible to infer that this is also the case for the proposed the project area. The most frequently attained education level in the ZSIS villages is secondary education (40%). This followed by professional education (19%) and higher education (16%). Only 3% lack primary education. Higher percentage of women have higher and professional education in comparison to men, while higher percentage of men have complete secondary education (42% versus 37% women).

Table 7-56. Population 10 years of age and over by educational attainment in the ZSIS villages (2014)[166]

Educational attainment	Total in ZSIS Villages	% of total	Men	% of total men	Women	% of total women
Total population 10 years of age and over	41,630	100	20,012	100	21,585	100
Higher education	6,790	16	2,914	15	3,867	18
Professional education	7,804	19	3,350	17	4,446	21
Complete general education (secondary education)	16,521	40	8,505	42	8,004	37
Basic level of general education	5,235	13	2,666	13	2,553	12
Primary level of general education	2,868	7	1,356	7	1,444	7
Has no primary education, but is able to read and write	1,422	3	688	3	691	3
Illiterate	121	0	40	0	57	0
Not stated	706	2	341	2	336	2

Data from the Eptisa 2018 ESIA Report indicated that about a half of the interviewed households in ZSIS area (as part of the 2018 FS), were considered vulnerable (51%) (data from 2014). From them, women living alone, or with children, as well as internally-displaced people (due to environment disasters – ‘eco-migrants’) comprise the structure of vulnerable household vulnerable groups in the ZSIS villages.

The declared annual income of 26% of households was lower than the annual minimum living allowances (defined by the official statistics of Georgia). Every fifth household consisted only of elderly people (60 years old and older). 58% of vulnerable groups - adult women (18-59) live alone and are economically vulnerable (monetary income under the minimum living annual allowances). Almost all inhabitants of two villages in the ZSIS area, Lemshveniera (Nagebi) and Mzianeti, were ecomigrants (343 interviewed households). These are people who were relocated to the ZSIS after their original village became uninhabitable by a natural catastrophe in 1990s.

[165] Ibid.
[166] Data received from Geostat.

Vulnerable households lack relevant resources for agricultural activities and the scale of their agricultural production is obviously lower than the non-vulnerable households.

For the 2021/2 update of the FS and ESIA report, information was also collected from a number of small and large farmers, as well as local agricultural extension officers and other government officials, located throughout the five project zones. It is important to note that most contracts are signed on rented/leased lands – 76.6% and 67.5% respectively in 2020 and 2021 showing 9,1% increase within owners. Another interesting fact is that contracts are mostly signed with physical persons rather than legal entities (94.9% and 90.5%). Additionally, most of the contract signers were male 90.37% and 93.37% in 2020 and 2021 (9.63% and 6.63% were women).

Annual crops such as maize, grass and alfalfa are dominating the command area. However, area of perennial crops has increased from 4.8% in 2020 up to 10.4% in 2021 mostly from newly established intensive orchards co-funded from state program "Plant the future". Considering the data collected at a national level, it is not expected to have many female beneficiaries of this type of programmes.

From the 35 representative surveys (8 in Zone 1, 8 in Zone 2, 5 in Zone 3, 9 in Zone 4, and 5 in Zone 5), all head of households were men, 8/35 cases were legal entities, and in 7/35 cases the head of household was over 60 years old. From the 35 surveys, the average number of household members was 3.

Women's actual involvement in agricultural activities within the Project area will need to be further assessed at more advanced stages of the Project to design targeted interventions.

7.11. Cultural Heritage

The National Agency for Cultural Heritage Preservation of Georgia manages the Cultural Heritage Database. Cultural monuments and objects are under State protection. Religious buildings are owned by the Patriarchy of Georgia in accordance with the Constitutional Concordat between the Georgian Orthodox Church and the State. Cultural heritage and archaeological sites in the Project Area are described below and shown in Figure 7-11.

7.11.1. Religious, Fortification and other Historical Sites

According to the Cultural Heritage Database and literature review, there are around 40 monuments in the ZSIS area, represented mainly by mediaeval churches, caved churches (some of them with fragments of wall painting), and towers. The following cultural heritage facilities are located in ZSIS area:

Table 7-57. Cultural heritage sites located within the ZSIS area

Location	Cultural Heritage	Description
Village Martkopi (LMMC)	Tushmalishvili Tower	XVIII c., The tower has 4 floors. The brick wall of the south wall of the tower depicts rhombuses and the cross of Golgotha. A decorative brick cornice is on the façade between the II and III floors. In 2002, the south wall of the tower collapsed.
	Sinjikashvili tower	XVIII c., The tower has a residential house attached to the west. The door is to the south and enters the II floor. building material: stone & bricks
	Church of the Archangels (Michael and Gabriel)	The church was built in 1779 by Gabriel Khuroshvili. In 1899, it was repaired by Davit Tushmalishvili with funds collected from the local inhabitants. It was finally completed and was given it final form in 1992. The building is a hall church, and it is built of cobblestones and bricks.
	Archangel's Temple	XVIII c., The Church is located in the forest northwest of the Martkopi Village.
	Kurgans	From Martkopi centre in 2-3 kilometres there are six kurgans located.

Location	Cultural Heritage	Description
Village Norio in Gardabani municipality	Takaant Tower	Late Middle Ages, c. XVI-XVIII Centuries. Building Material is stone. The tower has three floors.
	Norio Castle Fence	A late medieval fence in the middle of the village, quite large, with many modern outbuildings
	The Church of the Blessed Virgin Mary	.XVII-XVIII c,, in severe condition
	Martkopi monastery of the Deity (Large Complex)	Martkopi Monastery has been damaged and restored numerous times throughout history. Most of the monastery's extant structures are from the 17th to the 19th century. The complex consists of six monuments – Tower (1699), Martkopeli column, Dome church (XIX c), The tower-bell (1699), Column of Anton Martkopeli and other buildings.
	Ruins of Cosmas and Damian Church	C.XVII c.,
	Badridzeant tower	The tower is located on the right side of the road in the center of the village. The tower dates back to the 18th century. It has three floors.
	"Tsofuraant" tower	The tower was built in the XVIII century. It is an ancestral tower. It has three floors. The front door is located on the first floor. The entrance to the II and III floors is embedded in the wall.
	The ancient settlement of Norio	The archaeological site discovered during the construction process in the vicinity of Norio and Gldani is a rather large settlement of antiquity. Remains of up to 36 buildings and 178 pits were identified. By observing the obtained material, the village of Norio can be dated to BC. წ. IV-III centuries. Norio ancient settlement is located in the west of village Norio. Specifically, the 4 km long ridge divides the Lochini and Gldani valleys from the east on the western slope of the Ianlo ridge to the west.
Village Satkhenisi, Gardabani municipality	Church of the Virgin Mary of Satskhenisi	In the central square of the village, in a flat place, the grand ruins of the church are preserved. The church is built in the name of the Mother of God and is a less common type of three-nave basilica in Georgia. In the eastern part, there is a hall church built at the end of the XIX century.
Village Sartichala (east of UMC)	Sartichala Obelisk	It is dated 1849. The obelisk stands in the field on the right side of the highway. It is a three-part stone monument, which reaches a height of 3 meters. It was erected to mark the completion of the Iori canal, which began during the reign of Erekle II. The obelisk consists of a square pedestal, a round column, and a column crowning ball. Inscriptions in Georgian and Russian on all four pedestals and columns of the pedestal tell us that the construction of the Iori Canal began during the reign of Erekle II and was completed during the reign of Emperor Nicholas I and the reign of Crown Prince Vorontsov. Engineer-captain Vakhtang Bagration-Mukhraneli led the works, and Salzman headed the agricultural part from Tbilisi.

Location	Cultural Heritage	Description
	Historic Town Archeological Ruins	Early Middle Ages 4th-9th centuries. The town ruins are located 8 km away from the South of Sartichala.
Village Ujarma (UMC)	Fortress-city Ujarma	Fortress-city Ujarma contains 5 listed monuments. The buildings were constructed from the 5th c. till 18th c., Kviratskhoveli Church, Early Middle Ages, St. John the Baptist Chuch, Early Middle Ages, Archangels Church, Early Middle Ages, St. George Church, Late Middle Ages, Durgliant Sakdari, Early Middle Ages, Bridge, Middle Ages, Mukhrovani caved monastery, High Middle Ages with 16th-century wall painting, Avalishvilis' Church (late Middle Ags), Caved Monastery (Middle Ages), Datunashvilis' Church (Middle Ages), Ninikashvilis Church (Middle Ages), Caravan-Saray (Middle Ages), Pidani Church (Middle Ages), Three anonymous churches of the Middle Ages, Three non-identified ruins of the Middle Ages.
Village Udabno (east of LMC)	David-Gareja Udabno	The complex of the caved monastery called Tetri Senakebi or Mravaltskaro is located on the westernmost edge of the David-Gareja, 2.6 km away from the Low Samgori Main channel. It consists of caved churches, monastery canteen and caves utilised for various purposes. The complex is dated by 9th-10th cc. One of the caved churches has a wall painting dated by the 9th c.

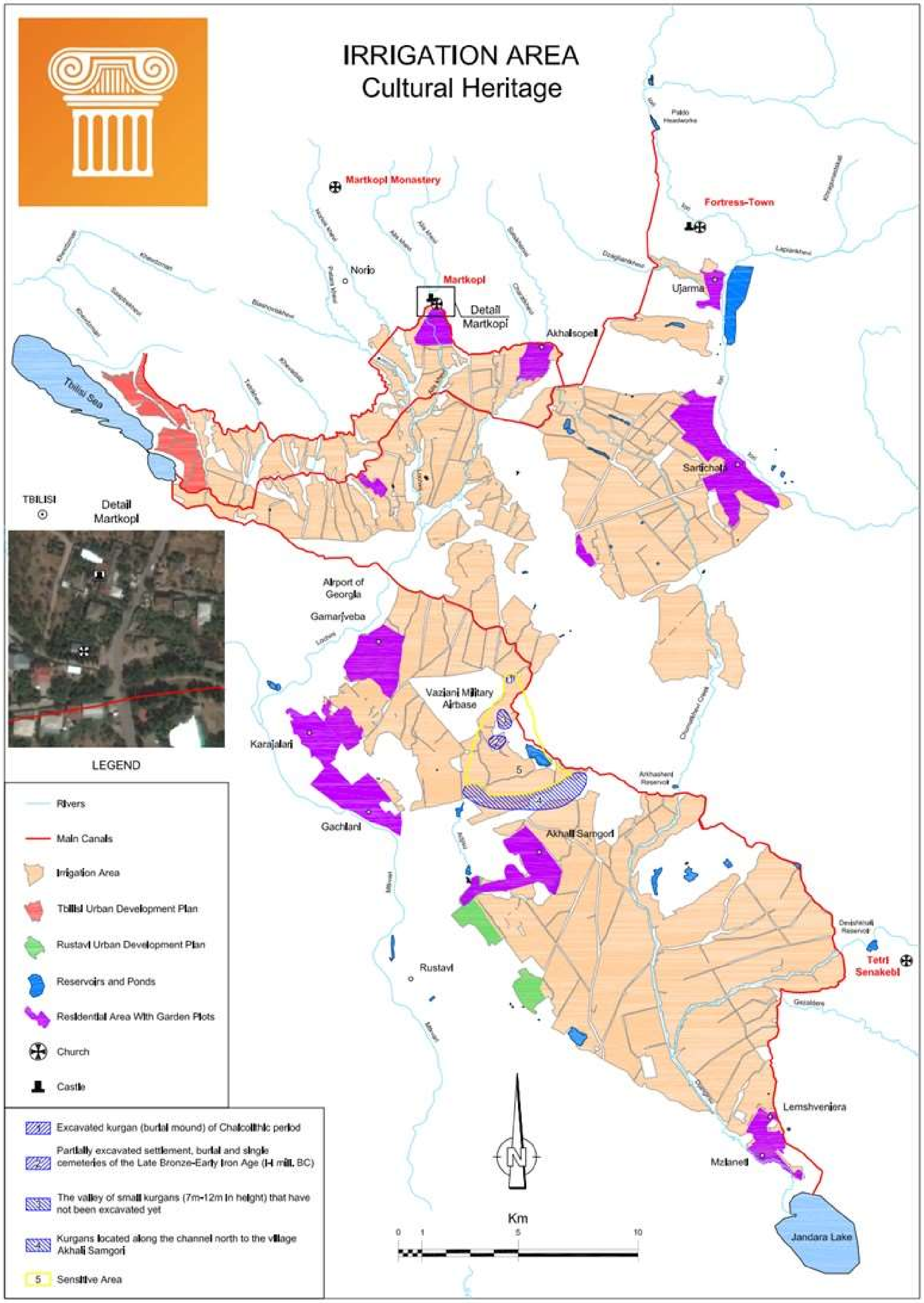

Figure 7-11. Cultural Heritage in the ZSIS

7.11.2. Archaeological Sites

Some archaeological sites dated from the Bronze Age to the Middle Ages are reported in the northern and central sections of the ZSIS, in the areas of Martkopi, Satskhenisi, Norio, Lilo and Gamarjveba.

The most sensitive areas from an archaeological perspective were identified in the Eptisa 2018 ESIA as being located in the area between Vaziani to Samgori. These areas are:

- Excavated kurgan (burial mound) of Chalcolithic period;
- Partially excavated settlement, burial and single cemeteries of the Late Bronze-Early Iron Age (II-I mill. BC);
- The valley of small kurgans (7-12 m in height) that have not been excavated yet; and
- Kurgans located along the canal north to the village Akhali Samgori.
- No archaeological findings are reported within the section of ZSIS from Samgori to Lake Jandara. A few kurgans[167] are observed around the Lake Jandara.

In addition, the 2021/2 FS agricultural survey highlighted that in Zone 1 there are two tombs near the irrigation canal UMC, G1 natural draining canal, one being historic and another more recent; and a cemetery near the LMC, G6 in Zone 4 (41.639006, 45.005459). This highlights that there may be other localised tombs or cultural heritage features that will need to be confirmed during detailed design.

[167] A kurgan is a type of tumulus or burial mound.

8. Stakeholder Engagement

8.1. Introduction

A stakeholder engagement plan (SEP) was prepared as part of the Eptisa 2018 ESIA. The SEP is a 'living document' and therefore the existing SEP should be developed in more detail by the GA, the Detailed Design TA and, during construction, the Construction Contractor(s), to reinforce both ownership and execution of the Plan in the future Project stages. The SEP is intended to be a document that responds to the specific and unexpected circumstances and challenges that may arise in the Project Area about which stakeholders need to be informed and consulted with if they are or will be potentially affected.

This Section provides a summary of the stakeholder engagement process that has fed into the Eptisa 2018 FS and ESIA process; engagement undertaken as part of the 2021/2 FS and ESIA; and an outline of the requirements for future engagement.

8.2. Goals of the SEP

The SEP outlines the principles and methods that Project implementers should be guided with to engage all existing and potential stakeholders during planning, construction, operation and decommissioning phases of the Project.

Constructive engagement and continuous dialogue with stakeholders is an essential part of good business practices. Thus, the goal of the SEP is to identify key groups of stakeholders and establish a general framework for building and maintaining positive relationships with them in all project development aspects.

The aims of the SEP are to:

- Outline the principles for stakeholder engagement.
- Identify stakeholder groups and resources for engaging with them.
- Define the general stakeholder engagement methods.

8.3. Principles for Stakeholder Engagement

As the existing SEP outlines, public consultation and stakeholder engagement is the basis for building strong, constructive, and responsive relationships that are essential for the successful management of the Project's environmental and social impacts. Public consultation and stakeholder engagement is an ongoing and living process that may involve stakeholder analysis and planning, disclosure and dissemination of information, consultation and participation, grievance mechanism, and mechanism for feedback provision.

The public consultation and stakeholder engagement process includes:

- Provision of relevant, timely and accessible information on modernisation activities to stakeholders in a gender-sensitive, culturally and linguistically appropriate and understandable format.
- Consultation with stakeholders on their opinions, concerns, preferences and perceived risks with respect to the project planning and implementation, including proposed approaches and mitigation measures to reduce possible impacts and to enhance potential benefits.
- Grievance mechanism to guide response and resolution process for stakeholder concerns or grievances.
- Provision of feedback on how the opinions, comments and concerns of stakeholders were taken into account.

8.4. Stakeholder Engagement and Public Consultation Legal Requirements

8.4.1. Requirements of National Legislation

The Constitution of Georgia guarantees public access to information and states the right of an individual to obtain full, unbiased and timely information regarding his/her working and living environment.

The Environmental Assessment Code was adopted on June 1, 2017. The Code was elaborated with the aim to align the national EIA procedures with the EU directives. The code will enter into the force from January 1,

2018. According to the new Code, subject to EIA are the projects listed in Annex I and those projects listed in Annex 2, which become subject to EIA based on the screening decision in accordance to Article 7 of this Code. According to the Environmental Assessment Code, construction and operation of irrigations systems is an Annex II activity and therefore is subject to screening, which is also confirmed by liaison with the EA Department of MEPA (December 2021). Consequently, a screening report should be submitted to the MEPA to confirm the need for an EIA. In the case that an EIA is required, the MEPA is responsible for EIA reports= disclosure and arrangement of public consultation meetings at the scoping stage and further after submission on EIA before issuance of Environmental Decision on the Project.

8.4.2. EIB Requirements

EIB environmental and social standards require a participatory approach applied in the engagement with project-affected individuals, communities, as well as other relevant stakeholders. Stakeholder engagement should:

- Identify people and/or communities that are or could be affected by the project, as well as other interested parties;
- Ensure that such stakeholders are appropriately engaged with on environmental and social issues that could potentially affect them through a sustained public participation process comprising both information disclosure and meaningful consultation;
- Maintain a constructive relationship with stakeholders on an ongoing basis through meaningful engagement throughout the planning, implementation, monitoring and decommissioning of the project.

Similar requirements for access to information and public involvement in decision making are also specified within the following:

UN ECE (Economic Commission of Europe) Convention on Access to Information, Public Participation in Decision – Making and Access to Justice in Environmental Matters, the “Aarhus Convention” establishes a number of rights of the public (individuals and their associations) with regard to the environment. This Convention provides for:

- **Access to environmental information**. The right of everyone to receive environmental information that is held by public authorities. Applicants are entitled to obtain this information within one month of the request and without having to say why they require it. In addition, public authorities are obliged, under the Convention, to actively disseminate environmental information in their possession;
- **Public participation in environmental decision-making**. The right to participate in environmental decision-making. Arrangements are to be made by public authorities to enable the public affected and environmental non-governmental organisations to comment on, for example, proposals for projects affecting the environment, or plans and programmes relating to the environment. These comments to be taken into due account in decision-making, and information to be provided on the final decisions and the reasons for it;
- **Access to justice.** The right to review procedures to challenge public decisions that have been made without respecting the two aforementioned rights or environmental law in general.

EC Directive 2003/4/EC of the European Parliament and of the Council of 28 January 2003 on Public Access to Environmental Information ensures that environmental information is systematically available and distributed to the public. The Directive requires Member States to ensure that public authorities are required to make the environmental information they hold available to any legal or natural person on request.

EU Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment, as amended by 2014/52/EU (the EIA Directive strengthens the need for effective public participation in decision-making, protection and promotion of cultural heritage and strengthens public access to information.

8.5. Identification of Stakeholders

In order to develop effective stakeholder engagement, it is necessary to identify who the stakeholders are and understand their needs and expectations for engagement, and their priorities and objectives in relation to the Project. Stakeholders are persons or groups who are directly or indirectly affected by a project, as well as those who may have interest in a project or the ability to influence its outcome, either positively or negatively.

Project stakeholders have been identified based on those individuals and groups that:

(i) are affected or likely to be affected (directly or indirectly) by the project (affected parties); or

(ii) may have an interested in the project (other interested parties).

Using these criteria, on the basis of the Project location, the following regions and municipalities/districts are relevant:

- Gardabani Municipality, Kvemo Kartli region
- Samgori District, Tbilisi region
- Sagarejo Municipality, Kakheti region

Stakeholder identification has also considered those groups or individuals identified because of their potential to impact or be impacted by the Project, based on:

- The Project's activities and area of influence (AoI);
- Potential, or review of current, positive and negative Project impacts;
- Contact by and with Project relevant government bodies and civil society and business groups; and
- Contact made by and with organisations expressing, or likely to have, an interest in the Project.

The identification of stakeholders has also included the identification of individuals and groups that may be differentially or disproportionately affected by the Project because of their disadvantaged or vulnerable status, and/or because these individuals or any other stakeholder groups are likely to be excluded from, or unable to participate in, the mainstream consultation process or would require specific measures and/or assistance to do so. During the preparation of the ESIA and this SEP, groups were examined and assessed to determine if they might be affected by the Project due to their gender, gender identity, sexual orientation, religion, ethnicity, indigenous status, age (including children, youths and the elderly), physical or mental disability, literacy, political views, or social status, or other attributes. The following key sub-groups of stakeholders were identified with respect to the Project in the Eptisa 2018 ESIA Report; elderly (age ≥60) with no younger adults in the family or living with grandchildren (≤17), economically vulnerable (households with incomes under the subsistence minimum), female-headed households, households whose heads are female, households whose income is less than average annual minimum living allowance, eco-migrants, and ethnolinguistic minorities (mostly Azeri speakers).

A stakeholder list has been prepared based on a review of the previous stakeholders list and the above considerations, and is provided in Table 8-1 below. These categories are not exclusive. One individual or group can belong to several categories. It is expected that other stakeholders may be identified during future Project phases and as such, this list will be updated as required and will be reviewed regularly and updated throughout the Project cycle. The risk associated with each stakeholder group can also be subject to change and therefore will also be reassessed periodically.

At a minimum, the stakeholder list will be revised prior to the start of the construction and operation phases.

Table 8-1. List of Project Stakeholders

Stakeholders	Primary type of interest, influence, or impact	Composition of Stakeholder
Potentially affected parties		
Project Beneficiaries	**Impact**. Directly impacted by project due to footprint of project, construction activities (e.g. disturbances and dust caused by the Project's traffic and construction works) and/or use of irrigated area proposed. Indirectly impacted due to changes in water distribution, management and production locally and grazing area availability.	Land owners / farmers within proposed command area: • Large corporate farmers • Large individual farmers • Cooperatives • Small farmers Other water users in the ZSIS: • HPPs • Industrial users
Georgian Water and Power Limited	**Impact , influence and interest.** Management of Tbilisi (Samgori) reservoir and provision of Drinking	Other water users

Stakeholders	Primary type of interest, influence, or impact	Composition of Stakeholder
	water from the Tbilisi reservoir. Tbilisi Sea receives water from the UMC.	
Agricultural trade and business	**Impact and Interest.** Interested in providing goods and services to the project. Impact through increased demand for goods and services.	Organisations and companies involved in the agricultural trade and business locally and regionally.
Local communities / organisations / persons within the Project area of influence	**Impact**. Environmental quality (general nuisance, loss of access, noise, dust, emissions) during construction. Influx of construction workers. Increased revenues during operation.	Road users Local communities and properties along construction routes Local businesses
Health service providers	**Impact**. Availability of health facilities for the construction and operation phases. **Interest**. Safety during construction and operation.	Local practitioners and health facilities
Public sector policing units	**Impact and Interest.** Provide support service in construction phase e.g., traffic control, Emergency Preparedness and Response Plan.	Police, ambulance, and fire service
Vulnerable groups	**Impact**. Vulnerable people may be disproportionately affected by the Project. Impacts include environmental quality, land and water access, personal and livestock safety during construction and operation; jobs and other economic benefits.	Elderly (age ≥60) with no younger adults in the family or living with grandchildren (≤17), economically vulnerable (households with incomes under the subsistence minimum), female-headed households, households whose heads are female, households whose income is less than average annual minimum living allowance, and eco-migrants (resettled from areas affected by previous natural disasters) and ethnolinguistic minorities (mostly Azeri speakers).
Interested and influencing parties		
EIB	**Influence**. Influence as Project lender.	EIB main and regional offices.
Georgian Amelioration Limited (GA)	**Influence**. Influence as Project Implementing Organisation.	GA based in Tbilisi.
Ministry of Environment Protection and Agriculture (MEPA)	**Influence and interest.** Influence and interest as regulate compliance with the requirements of environmental protection. MEPA is also the key state institution that defines the state strategy for irrigation sector.	Main offices in Tbilisi. Hydromelioration and Land Management Department Environment and Climate Change Department
Environmental regulator (NEA)	**Influence and interest.** The NEA is the main state institution that is in charge of organizing and carrying out environmental monitoring, which, among others, also includes the	National Environmental Agency (NEA)

Stakeholders	Primary type of interest, influence, or impact	Composition of Stakeholder
	observation and analysis of the quantitative state of water resources of Georgia. Influence and interest as regulate compliance with the requirements of environmental laws.	
Contractors and Sub-contractors	**Interest**. Interest due to employment opportunities	To be defined after Contractor selection
Georgian National Energy and Water Supply Regulatory Commission (GNERC)	**Influence** The GNERC is responsible for establishing water supply tariffs, including for irrigation water. The GNERC is also responsible for promoting water efficiency.	Water tariffs
Regional and local government	**Interest**. Elected representatives are accountable to their constituents and are therefore indirectly impacted by, and have an interest in, the project and its impacts on their constituents. **Influence**. Potential to influence labour opportunities for the local communities.	Kvemo Kartli region Tbilisi region Kakheti region Samgori District Sagarejo Municipality Gardabani Municipality
National Government Agencies	**Interest**. In the Project and its benefits. **Influence**. Power to regulate or influence the Project in terms of establishing policy, granting permits or other approvals or guidance for the Project, and monitoring and enforcing compliance with national Law throughout the project lifecycle.	Ministry of Regional Development and Infrastructure (MRDI) Ministry of Finances (MoF) Ministry of Culture, Sports and Youth Ministry for Labour, Health and Social Affairs National Agency for Public Registry Environmental Information and Education Centre (EIEC)
General public	**Interest**. Development of the country and improved road conditions/access.	Population of Georgia Tourists
Mass media	**Interest**. Interested in Project-related activities in the area, including management of impacts. Media are also potential local partners in providing forums for the Project to communicate with stakeholders **Influence**. Accountability to readership in the reporting of project developments and activities and influencing public opinion about the project.	Interested media organisations
United Water Supply Company (UWSC)	**Interest**. Interested in Project-related activities due to their responsibilities to ensure the provision of drinking water of	Water user

Stakeholders	Primary type of interest, influence, or impact	Composition of Stakeholder
	adequate quality in regions of Georgia (from Tbilisi Sea)	
Non-Governmental Organisations (NGOs), Civil Society Organizations (CSOs)	**Interest**. NGOs with environmental and social concern - potential partners of the Project. **Influence**. Lobbying and advocacy.	Local NGOs and CBOs National NGOs and CBOs
Education service providers	**Interest**. Interest in relation to education and training and retention of youth; investment back into the community.	Local schools, training institutions.
Other development agencies	**Interest**. Investment in agriculture in the region.	Other development banks in the region e.g., European Union, AFD, The World Bank, Asian Development Bank, IFAD, FAO

8.6. Stakeholder Engagement to Date

8.6.1. 2018 Feasibility Study and ESIA

The Eptisa 2018 FS and ESIA undertook the following engagement, as recorded in the SEP:

- Consultation meetings with 185-190 farmers in the villages of Gamardjeva, Sartichala, Akhali Samgori and Lemsveniera. A summary is provided in the table below:

Table 8-2. First consultation meetings

Villages	Gamardjeva	Sartichala	Akhali Samgori	Lemsveniera	Total
Date	18/01/16	21/01/16	26/01/16	29/01/16	-
Number of farmers attending the meeting	25 - 30	30	50	80	185 - 190
Venue	Village Gamarjveba, House of Culture	Village Sartichala,hall “White House”	Village Axali Samgori, Admin building	Village Lemshveniera, Public School	-

- Following the first consultation meetings, interviews were conducted with representatives of 100 vulnerable households, based on the questionnaire developed in advance.
- From October 2016 to April 2017, a door-to-door Census for the ZSIS was conducted by Analysis and Consulting Team (ACT). A hotline was also established on 26 September 2016 and was operational during census period. During this period, posters about the census and hotline were posted in public places in Project Area communities; information was posted on ACT’s Facebook page; and in the newspaper Rezonansi available in all regions on Georgia; and an announcement was broadcasted on the five most popular radio stations in Georgia owned by Radio Holding Fortuna. It is understood that overall, about 17,000 individuals were contacted and informed. 11,956 households were interviewed and 109 organizations were interviewed.
- Several consultation meetings were organized by ACT during October 2016 with local authorities of Samgori district and Sagarejo and Gardabani Municipalities as well as with representatives of local communities. The meetings were organized with support and participation of GA representatives. The meetings participants were provided with information brochures and posters.

- Intensive consultation with stakeholders was undertaken during September-November 2017 in four main location grouping beneficiary communities UMC, LMC, LMMC, with special meetings arranged for Azeri-speaking population. Separate consultation meetings were arranged with representatives of state institutions and private companies that operate or have interest in modernisation of ZSIS.
- An information brochure was developed providing details about the Project, proposed alternatives, ESIA process. The brochures were distributed to participants of public consultation and residents of beneficiary communities. Meetings were held in two rounds. At the first meeting participants were provided with detailed information on Eptisa 2018 FS alternatives and participants were given one month to share their opinions about the project and the alternatives. After that, a second round of consultation meetings was carried out with the purpose to discuss design decisions based on comments and remarks received during first phase of consultation process. In total 10 meetings were organized during the autumn, 2017 with participation 230 farmers and other stakeholders, as summarised in the table below.

Table 8-3. Second consultation meetings

Stakeholder group	Small and Medium size Farmers	Azerbaijani communities	Large Farmers	Representatives of State Institutions and Companies operated in the ZSIS
Date	14.09.2017	20.09.2017	22.09.2017	27.09.2017
Number of attendances	60	28	35	24
Venue	Rustavi, Center for Democratic Engagement	Village Karataklia, the club's building	Rustavi, Center for Democratic Engagement	Tbilisi, GA office
Date		07.11.2017	01.11.2017	
Number of attendances		17	15	
Venue		Village Muganlo, Public school building	Rustavi, Center for Democratic Engagement	

The Eptisa 2018 ESIA Report also makes reference to the following:

- A supplementary survey held with 25 farmers with mixed livestock and cropping activities in September 2017 whereby the farming activities were described in their totality.
- A telephone survey was conducted amongst 50 randomly selected respondents was held to assess the willingness to pay, willingness to join a water users organization.
- Focus group discussion with seven inhabitants of three villages of Zemo Samgori Zone: Gamarjveba, Gamarjveba I and Poladaantkari. The aim of the meeting was to identify the expected outcomes of rehabilitated irrigation system in terms of how it will affect the intensity of involvement of local community in agricultural activities.

8.6.2. 2022 Feasibility Study

During the 2022 FS, engagement has been ongoing with the GA to agree the Project concept.

Engagement was also undertaken with the GWP and the KSIS Project team to discuss irrigation demand and planning in their scheme. A farmer survey was also undertaken with representative farmers in the ZSIS in 2021. This engagement comprised a questionnaire related to household/organisation statistics, crops grown, crops interested in growing, animals owned, income, expenses and environmental and social challenges. The total number of farmers per farm size and Project zone is reported below. Liaison has also been undertaken with MEPA with regards to the requirement for a national EIA (December 2021).

Table 8-4. Farmer interviews completed in 2021

Farm Size	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Total
< 0.25 ha	1	2	1	2	2	8
0.25 - 1.25 ha	1	2	1	2	2	8
1.25 ha - 10.00 ha	1	2	1	2	2	8
>10 ha - family owned farms	1	2	1	2	2	8
>10 ha - Corporate farmers	1	1			1	3
Total Interviewed						35

8.7. Feedback

8.7.1. Eptisa ESIA Report

Issues identified in the Eptisa works included:

- All the respondents participating in the discussion said that about 60-70% of the population found it difficult to use the water. According to focus FGDs the problems related to irrigation water emerged in the villages after the disintegration of the Soviet Union which caused the collapse of the unified irrigation system. Another reason is the settlement of the refugees from conflict regions, which resulted in increased water consumption and seizure.
- Part of population has land plots they are not able to cultivate due to water shortage.
- The participants noted that water was available in certain areas of the villages, but in very small quantities which was not enough for the existing needs. The villagers living near the central canal and using the water from undamaged canals are not facing the problem. The participants also said that the population was trying to repair the canals with their own resources to be able to water agricultural plots and grow crops. 'We grow herbs using our own resources, with gravity feed, and now we are selling the greens.'
- Inhabitants of Zemo Samgori, in general, are very positive concerning the modernisation of the irrigation system, since they believe it will help to cultivate unused land plots or care more for cultivated ones. This will definitely increase the harvest of annual as well as perennial crops. The modernisation of the irrigation system will also promote animal husbandry in terms of enabling people to harvest animal fodder.
- FGDs clearly revealed that it is recommended to employ local people while carrying out irrigation system modernisation works. This will increase their income, which itself will prevent especially vulnerable HHs from poverty.
- During the census, the respondents were asked if they were planning to plant any perennial crops if irrigation water becomes available after the modernisation. In total, almost third of the HHs (32.3%) plans this agricultural activity. Compared to non-vulnerable families, 4.1% more families from the vulnerable HHs group stated that they are planning to plant some perennial crops after the ZSIS modernisation.
- All participants of FGDs noted that every household in the village grew agricultural products for their own consumption, but a part of the households tried to sell the agricultural products.
- As reported by FGDs, the villagers cultivate vineyards and orchards, grow annual crops like tomatoes, cabbages, greens, etc. The villagers are also involved in animal husbandry and mainly raise sheep and cattle.
- According to respondents agricultural crops are mainly grown for household consumption and in case the irrigation system is rehabilitated they are greatly interested in expanding their activity to sell their products.
- FGDs said that they could not rely solely on agricultural products and, for this reason, were self- employed (or their family member was self-employed) in the private or public sector. They also stated that revenues from agricultural sales are seasonal, whereas non-agricultural income is received on a monthly basis, and, therefore, is relatively more stable.
- According to the participants if farming activity is expanded the family members presently employed in the public or private sectors will also get involved, since agricultural activity is promising in Georgia; moreover, the villages are close to both Tbilisi and Rustavi city due to which they are not likely to face any problems in agricultural sales.

- Many interviewed farmers are open to modernisation and cooperative action but very sceptical, so demonstrations are needed to convince most people concerned.

8.7.2. Feasibility Study 2021/2

From the 2021 farmer surveys, only 6 farmers of the 35 had animals. The most common type of animals were cattle, but also poultry, then pigs and one farm with horses, ducks, and other animals.

It was recorded that smaller households were producing crops for self consumption.

The areas of support identified were very mixed across the 35 farmers, and overall covered all of the following:

- Assured water supply
- Subsidies on irrigation equipment / on farm development
- Agricultural credit support
- Help in buying agricultural land
- Post harvesting storage facilities
- Improved infrastructure such as gates and fences and farm roads
- Hail protection net system
- Agricultural credit support
- Farm equipment support
- WUO Formation
- Water quality management
- Modernisation of irrigation infrastructure
- Support on marketing

No challenges were identified in relation to getting produce to market, where relevant.

Furrow irrigation was identified as a common practice, through larger farms are interested in drip and pivot systems for perennial and annual crops.

Key infrastructure issues identified were:

- Lack of infrastructure
- Lack of water or unstable water supply during peak seasons
- Missing irrigation infrastructure on secondary and tertiary canals
- Lack of fences around fields

Key environmental issues identified were:

- Saline water, flooding, excessive growth of swamp plants.
- Drought, strong winds, hail.
- Soil erosion due to lack of infrastructure for water flows.
- Water flows in soil ditches and there are no gates to open/close fields, so farmers use sacks full of soil and primitive technologies. High permeability of soil because of gravel subsoil.
- Water quality concerns, particularly in the LMC due to the Biu-Biu poultry plant and other discharges such as Vaziani army base.
- Level of gypsum is high (<20 cm from topsoil at some places, based on local geomorphology) in LMC area.
- Risks of water pollution and transmission of animal diseases as command areas and canals are not fenced so are used by sheep herders as winter pastures.

- UMC - on the eastern part there is an industrial gravel extraction operation from the river Iori which results in frequent truck movements generating significant dust pollution.
- Ujarma village use a water pipe from the UMC that provides water to the upper part of the village – it is used for non-crop requirements e.g. sanitation, washing clothes, small gardens, orchard, etc.

Key social issues identified were:

- Conflicts over water use are reported as frequent.
- Abandonment of the area by small farmers and renting land to others is common practice so land fragmentation causes management problems.
- There are two tombs near the irrigation canal in UMC, G1 natural drainage canal. One is really old and another recent.

8.8. Future Engagement

The future Stakeholder Engagement Programme will comprise several phases as follows:

- Pre-construction Phase
- Construction Phase
- O&M Phase

Table 8-6 further below summarises the stakeholders to be engaged, the engagement methods, and the information to be disseminated, during the Project pre-construction, construction and O&M phases. The engagement programme will build on the existing system and structure of engagement with the participation of relevant local authorities.

The Programme will be reviewed regularly, at least quarterly, during construction, and bi-annually during O&M, to ensure that it remains valid and meets the needs of GA, the Project, local communities, and other relevant stakeholders. Subsequent versions of the SEP document will address the results that come from each engagement process and describe action plans in more detail.

General principles to be followed include:

- Regular, timely, accessible and appropriate dissemination of information in culturally appropriate formats, to facilitate an accurate and realistic understanding of potential impacts and benefits generated by the Project.
- Planned and transparent engagement where necessary, with appropriate notification, clear disclosure of objectives and an agreed process of interaction, recording and follow-up.
- All affected people and vulnerable groups within the Project Area will be consulted regularly throughout the Project lifetime.
- Advance warning will be provided to local communities regarding construction activities and schedule; including administrative level activities and timings.
- All Contractors, subcontractors, and employees will be issued with a Code of Conduct addressing expectations and punitive measures concerning their engagement with the local community, including expected discipline and behaviour (for example, covering inappropriate sexual fraternisation) in project-affected communities.
- Provision to stakeholders with the means to address concerns and grievances, in a structured, reliable and responsive manner.
- Report regularly and in a structured manner to all stakeholders, with special attention to appropriate forms of reporting among the participating communities.
- Establish and maintain the management capacity, responsibilities and systems to ensure the effective implementation of the detailed SEP.

8.8.1. Methods of Communication

Building upon the engagement methods utilised to date, and feedback gathered through previous consultation activities, the following are the key methods (other methods may also be identified / used, as appropriate) that are planned to be employed moving forward for effective stakeholder engagement and information disclosure, depending on ability to implement such measures are the time of engagement:

Public Meetings

Public meetings typically involve a range of activities such as slideshow presentations, poster displays, a question and answer period or roundtable discussions and dissemination of printed materials. Questionnaires may also be provided to attendees. The intention of public meetings is to facilitate opportunities for dialogue and a meaningful two-way exchange of information.

Focus Group Discussions

Small group meetings or FGDs for specific groups e.g., women.

Information boards

Information boards will provide the public access to leaflets and information materials. They will allow the public to obtain information the Project, as well as to lodge complaints or concerns. These may be established in each affected administrative unit (at community centres / Government offices).

Targeted meetings

Will be used as appropriate with individuals and organisations such as farmers that could be affected by construction activities, etc.

Formal Correspondence

Formal written correspondence will be used for communications with Georgian authorities and other stakeholders.

Awareness Materials

Construction/operation awareness materials in appropriate and targeted formats will be used to create awareness and inform communities of project activities and plans (including safety). These types of materials include posters and/or brochures.

Grievance Mechanism

A Grievance Mechanism has been developed to foster the effective resolution of grievances and community concerns. The Grievance Mechanism is central component of the Project's stakeholder engagement toolkit for the life cycle of the project.

Local Media, Radio, and Newspaper Articles

The Project may use media such as TV, radio and newspaper to disseminate information and create awareness.

Table 8-5. Main Stakeholder Groups and Project Communication Methods

Stakeholder group	Public Meetings	Focus Group Discussions	Information Boards	Targeted meetings	Formal Correspondence	Awareness Materials	Grievance Mechanism	Media, Radio, and Newspaper Articles
Project Beneficiaries	✓	✓	✓	✓	✓	✓	✓	✓
Georgian Water and Power Limited	✓			✓	✓			✓
Agricultural trade and business	✓	✓		✓	✓	✓		✓

Local communities / organisations / persons within the Project area of influence	✓		✓	✓	✓	✓	✓	✓
Health service providers				✓	✓			✓
Public sector policing units				✓	✓			✓
Vulnerable groups	✓	✓	✓	✓	✓	✓	✓	✓
Ministry of Environment Protection and Agriculture (MEPA)				✓	✓			
National Environmental Agency (NEA)				✓	✓			
Contractors and Sub-contractors	✓			✓	✓			✓
Georgian National Energy and Water Supply Regulatory Commission (GNERC)	✓			✓	✓			
Regional and local government	✓			✓	✓			✓
National Government Agencies	✓			✓	✓			✓
General public	✓							
Mass media	✓							✓
United Water Supply Company (UWSC)	✓			✓	✓			
NGOs, CSOs	✓	✓		✓	✓	✓		✓
Education service providers	✓			✓	✓			✓
Other development agencies	✓			✓	✓			✓

8.8.2. Pre-construction Phase

Prior to the start of construction, the Construction Contractor(s) will be responsible for developing a detailed construction phase SEP/Programme. This will include the following actions:

- **Development of a detailed list of stakeholders** - the Stakeholder List should be developed into a Stakeholder Register which provides a detailed list and contact database of stakeholders. This list will be developed through liaison with the GA and local government. Further relevant stakeholders will be identified through referrals from other stakeholders and contact made by organisations expressing an interest in the Project. The Stakeholder Register should be updated thereafter at least annually.
- **Development of detailed Stakeholder Engagement Programme** - the outline Stakeholder engagement programme provided in this SEP will need to be developed into a detailed engagement programme for the pre-construction and construction phase, with responsibilities attributed to the Construction Contractor(s) and, as relevant, the GA. The following will need to be taken into account in the development of the detailed Stakeholder Engagement Programme:
  - Development of key messages tailored for each defined type of stakeholders.
  - Design and production of communication material and awareness tools (e.g., brochures, hand-outs, leaflets, and press releases for media campaigns and media coverage).
  - Any engagement activities that will be undertaken with other organisations or partnerships e.g., NGOs.
  - Development of a detailed schedule outlining dates and locations when various stakeholder engagement activities will take place, when and who will attend.
  - Development of the Project Grievance Mechanism and Complaints Database. Local communities will also be fully informed of the grievance mechanism and how they can use it.

In addition to the above, the GA should develop an **Internal Communication Plan** to cover guidance on internal and external communications. The Plan should enable the effective communication between the GA, the TAs, the EIB and Construction Contractor(s) on general Project related issues and ensure these partners are regularly updated on the status and activities of the Project.

8.8.3. Construction Phase

The Construction Contractor(s) will be responsible for developing a detailed construction phase Stakeholder Engagement Programme. The construction programme should take into account the following:

- Information dissemination exercise on the construction programme and activities. This may involve the presentation of the information at appropriate community levels.
- Local communities will be informed in advance of any access restrictions and temporary alternatives to be used.
- Disclosure of the Contractor Code of Conduct to the local communities.
- Community health and safety awareness raising. Engagement will focus on general messages as well as a focus on high risk areas such as any construction works and high risk groups i.e. school children, herders.
- The Construction Contractor(s), with support from the TAs, will update the administrations on a monthly basis; or at frequency agreed as appropriate for the stage of construction works with each administration.

8.8.4. Operation and Maintenance Phase

The transition from construction to operation will result in a change in focus of the stakeholder engagement process. The aim of the engagement will be to maintain constructive and long-term relationships with the local communities, ensuring that local communities can benefit as intended from the Project and to ensure that any initial negative issues that may arise are dealt with quickly and efficiently.

The Stakeholder Engagement Programme for the O&M phase will be prepared by the GA, building on the actions identified for construction, and will be developed prior to the commencement of operations.

8.8.5. Summary of Future Engagement

Table 8-6 sets out a summary outline of proposed future engagement that will need to be developed, together with the timings that are typically associated with each of these activities.

Table 8-6. Outline of future stakeholder engagement

ID	Target Stakeholder / Group	Purpose / Information to be Disclosed	Planned Method	Proposed Additional / Alternate Methods for COVID-19 (Short Term)	Limitations	Proposed Alternate Methods (Long Term - Deferred)	Responsible Parties	Schedule / Frequency
				Pre-Construction				
1	Affected people (Local communities, farmers, local businesses)	General pre-construction planning and site preparation prior to construction, including location of any construction workers' camps. Overall schedule of site preparation and construction, including sub-activities, key stages and potential stages of stakeholder interest. Information on safety measures, access and traffic management during construction. Targeted safety measures for vulnerable and high risk groups. Collect opinions and concerns. Disclosure of Community grievance mechanism.	Public meeting prior to the start of construction to include community health and safety awareness raising presentation FGDs for vulnerable and high risk people to discuss community health and safety issues Awareness materials Local Media, Radio and Newspaper Articles Grievance mechanism	Information Boards Leaflet drops Telephone calls SMS texting Social media (Facebook) Feedback forms and feedback boxes at local administrative centres	Approach does not provide opportunity for face-to-face feedback. Information may be misinterpreted if provided without discussion.	Grievance Mechanism – via telephone if necessary Small group meetings	GA / Construction Contractor(s)	Prior to construction
2	Government agencies	Approvals and permits. General pre-construction planning and site preparation prior to construction. Overall schedule of site preparation and construction, including sub-activities, key stages and potential stages of stakeholder interest,	Targeted meetings, as requested Awareness materials	Telephone calls Web calls	Approach does not provide opportunity for face-to-face feedback. Information to be passed on to communities may be missed.	Grievance Mechanism Small group meetings	GA / Construction Contractor(s)	Prior to construction

ID	Target Stakeholder / Group	Purpose / Information to be Disclosed	Planned Method	Proposed Additional / Alternate Methods for COVID-19 (Short Term)	Limitations	Proposed Alternate Methods (Long Term - Deferred)	Responsible Parties	Schedule / Frequency
		access requirements / constraints. Discuss any grievances.						
3	Farmers and livestock herders	Specific consultation, including information on project components, in particular the use of a construction workforce, safety issues / management, and also potential employment opportunities, including skills required and training opportunities, traffic management and access routes.	Provision of information materials Grievance mechanism	Telephone calls SMS texting Feedback forms	Approach does not provide opportunity for face-to-face feedback.	Grievance Mechanism – via telephone if necessary One-to-one meetings	GA / Construction Contractor(s)	Prior to construction
4	Vulnerable groups	Specific consultation, including information on project components.	Targeted meetings and FGDs with vulnerable households prior to construction	Telephone calls	Approach does not provide opportunity for face-to-face feedback.	Grievance Mechanism – via telephone if necessary One-to-one meetings	GA / Construction Contractor(s)	Prior to construction
5	Affected people Vulnerable groups Businesses / suppliers Educational institutions General public	Upcoming construction phase employment opportunities, application processes. Project construction information (dates/ schedule, safety notifications, activities).	Notices in shops, local offices etc. in each settlement Publication via local government meetings Awareness materials Local media / newspapers / radio Grievance Mechanism	Information Boards in local administrative areas Leaflet drops Telephone calls SMS texting Social media (Facebook)	-	Grievance Mechanism – via telephone if necessary One-to-one meetings	Construction Contractor(s)	Prior to construction
6	Traffic police	Road safety.	Targeted meetings	Telephone calls Web calls Official Email/Written Letter	Inability to plan fully e.g. Emergency preparedness and response plan	Small group meetings	Construction Contractor(s)	Prior to construction

ID	Target Stakeholder / Group	Purpose / Information to be Disclosed	Planned Method	Proposed Additional / Alternate Methods for COVID-19 (Short Term)	Limitations	Proposed Alternate Methods (Long Term - Deferred)	Responsible Parties	Schedule / Frequency
7	Health centres Police Fire brigade	Development of Emergency Preparedness and Response Plan – availability of local resources emergencies.	Targeted meetings	Telephone calls Web calls Official Email/Written Letter	Inability to plan fully e.g. Emergency preparedness and response plan	Small group meetings	Construction Contractor(s)	Prior to construction
8	NGOs and CSOs – national and local	Provision of project information and awareness materials. Discussions on specific matters.	Formal correspondence / meetings Awareness materials Grievance mechanism	Local media, newspapers, radio Telephone calls Web calls Feedback forms	Approach does not provide opportunity for face-to-face feedback.	Small group meetings	GA / Construction Contractor(s)	Ad hoc / As required
9	Contractors	Contract information / Calls for Tender timing.	Tender documents – issued directly / via GA website	Telephone calls Web calls Official Email/Written Letter	-	Website Web calls	GA	Prior to construction
10	EIB	Formal correspondence as required.	Formal meetings / correspondence	Telephone calls Web calls Official Email/Written Letter	-	Not applicable	GA	Prior to construction
				Construction phase				
11	All stakeholders	Ongoing and upcoming employment opportunities, application processes.	Contractor and GA website Notices on information boards, shops, local offices in administrative centres Awareness materials Local media / newspapers / radio	Information Boards Grievance mechanism Telephone calls / SMS texting to local communities Social media (Facebook)	Approach does not provide opportunity for face-to-face feedback.	Grievance Mechanism – via telephone if necessary	Construction Contractor(s)	Bi-annual; and as required
12	Local communities	Inform on project implementation schedule / progress. Provide information on employment and	Group meetings at least twice during the construction period, or following a specific grievance	Telephone calls SMS texting Social media (Facebook)	Approach does not provide opportunity for face-to-face feedback. Wider feedback may be missed.	Local government / administrative meetings Grievance Mechanism – via	Construction Contractor(s)	Monthly / as required (due to updates in e.g. programme) Annually

ID	Target Stakeholder / Group	Purpose / Information to be Disclosed	Planned Method	Proposed Additional / Alternate Methods for COVID-19 (Short Term)	Limitations	Proposed Alternate Methods (Long Term - Deferred)	Responsible Parties	Schedule / Frequency
		applications. Regular engagement and notification of activities on and around site with community health and safety impacts (where applicable). Consult the local communities about their views / opinion on project implementation and impacts. Ensure awareness / availability of grievance mechanism and code of conduct.	Newsletters Grievance mechanism			telephone if necessary		
13	Vulnerable groups	Inform on project implementation schedule / progress. Provide information on employment and applications. Regular engagement and notification of activities on and around site with community health and safety impacts (where applicable). Consult local communities about their views/opinion on project implementation and impacts. Ensure awareness / availability of grievance mechanism and code of conduct.	FGDs/KIIs Newsletters Grievance mechanism	Telephone calls SMS texting	Approach does not provide opportunity for face-to-face feedback.	Grievance Mechanism – via telephone if necessary One-to-one meetings	Construction Contractor(s)	FGDs – at least twice during construction works or at a frequency agreed with EIB or directly with relevant persons Other items - monthly / as required Bi-annual updates
14	Employees	Code of Conduct. Inform of Project policy /	Training e.g. Code of Conduct	Smaller group training sessions	Project workforce will not be able to work if	Labour grievance mechanism – via	Construction Contractor(s)	Induction of employees, prior

ID	Target Stakeholder / Group	Purpose / Information to be Disclosed	Planned Method	Proposed Additional / Alternate Methods for COVID-19 (Short Term)	Limitations	Proposed Alternate Methods (Long Term - Deferred)	Responsible Parties	Schedule / Frequency
		plans in relation to stakeholder engagement and communities. Inform on external grievance mechanism. Inform on internal Labour grievances.	Information boards at construction camps and work sites Meetings in construction camp Awareness materials Labour grievance mechanism	Online training (depending on skills set)	significant restrictions are in place, therefore it is assumed that the alternate methods can be employed, or not work will proceed	telephone if needed		to them starting work on site Regularly during construction
15	All stakeholders	Schedule of construction works. Construction activities. Progress of construction. Construction impacts and mitigation measures (with opportunities for feedback). Ensure awareness / availability of grievance mechanism.	Notices on information boards, in shops, local offices in the relevant administrative centres Awareness materials delivered to local businesses / residents through leaflets Local media, radio, newspapers Grievance mechanism	Information Boards Telephone calls SMS texting Media Social media (Facebook)	-	-	Construction Contractor(s)	Ad hoc / As required
16	National government agencies	Inform on Project progress / provide detailed information.	Formal correspondence / meetings	Telephone calls Web calls Official Email/Written Letter Feedback forms	Approach does not provide opportunity for face-to-face feedback.	Website Web calls	GA / Construction Contractor(s)	Bi-annually; and as required
17	Regional government agencies	Inform on Project progress / provide detailed information. Regular engagement and notification of activities on and around site with community health and safety impacts (where applicable). Permits as required. Material use requirements	Formal correspondence / attend meetings KIIs Awareness materials Grievance mechanism	Telephone calls Web calls Awareness materials Feedback forms	Approach does not provide opportunity for face-to-face feedback. Information to be passed on to communities may be missed.	Grievance Mechanism – via telephone if necessary Small group meetings	GA / Construction Contractor(s)	Report feedback once a month Bi-annual reports

ID	Target Stakeholder / Group	Purpose / Information to be Disclosed	Planned Method	Proposed Additional / Alternate Methods for COVID-19 (Short Term)	Limitations	Proposed Alternate Methods (Long Term - Deferred)	Responsible Parties	Schedule / Frequency
		(water, aggregates, energy, etc). Discuss grievances.						
18	Media	Detailed project information on request.	Formal correspondence	-	-	-	GA / Construction Contractor(s)	Ad hoc / As required
19	NGOs and CSOs – national and local	Provision of project information and awareness materials. Discussions on specific matters.	Formal correspondence / meetings Awareness materials Grievance mechanism	Local media, newspapers, radio Telephone calls Web calls Feedback forms	Approach does not provide opportunity for face-to-face feedback.	Website Grievance Mechanism – via telephone if necessary	Construction Contractor(s)	Ad hoc / As required
20	EEIB	Formal correspondence as requested.	Formal meetings / correspondence	-	-	-	GA	As required.
21	Health centres Police Fire brigade	Communicate Emergency Preparedness and Response Plan and availability of services locally.	Targeted meetings	Telephone calls Web calls Official Email/Written Letter	Approach to emergency preparedness is not fully understood or tested	Small group meetings	Construction Contractor(s)	Regular basis, as agreed with organisations
O&M Phase								
22	Employees	Code of Conduct. Inform on internal HR grievance mechanism.	Training Grievance mechanism	Smaller group training sessions Online training (depending on skills set)	-	Labour grievance mechanism – via telephone if needed	GA	Regularly during operation
23	All stakeholders	Employment opportunities and skills required / sub-contracting opportunities during operation.	Advertisements within regional employment publications Information boards	Contractor and MoTR website Grievance mechanism Telephone calls / SMS texting to local communities	Approach does not provide opportunity for face-to-face feedback.	Grievance Mechanism – via telephone if necessary	GA / O&M Contractor(s)	During operation, as required

ID	Target Stakeholder / Group	Purpose / Information to be Disclosed	Planned Method	Proposed Additional / Alternate Methods for COVID-19 (Short Term)	Limitations	Proposed Alternate Methods (Long Term - Deferred)	Responsible Parties	Schedule / Frequency
				Social media (Facebook)				
24	Local communities	Road safety	Public consultation	Local media, newspapers, radio	Approach does not provide opportunity for face-to-face feedback.	-	GA	End of construction / beginning of operation
25	NGOs and CSOs – national and local	Discussions on specific matters / feedback on ongoing community issues.	Formal correspondence / meetings Awareness materials Grievance mechanism	Local media, newspapers, radio Telephone calls Feedback forms	Approach does not provide opportunity for face-to-face feedback.	Website Web calls	GA	Ad hoc / As required
26	EIB	Formal correspondence as requested.	Formal meetings / correspondence	-	-	-	GA	As required.
27	Health centres Police Fire brigade	Communicate Emergency Preparedness and Response Plan and availability of services locally	Targeted meetings	Telephone calls Web calls Official Email/ Written Letter	Approach to emergency preparedness is not fully understood or tested	Small group or one-to-one meetings	GA / WUOs	Regular basis, as agreed with organisations

8.9. Grievance Mechanism

A formal community Grievance Redress Mechanism (GRM) will be implemented to ensure that the relevant parties are responsive to any concerns and complaints, particularly from affected people and communities; and to ensure that there is a central approach and record of grievances.

Special attention will be paid to the training of designated staff involved in the management of the GRM. This grievance mechanism covers non-employees (i.e., affected people and other relevant stakeholders such as local communities). A separate Labour grievance mechanism will be provided for employee grievances (including Contractor’s employees), which will be reported in a Labour Management Plan.

A grievance mechanism is set out in the previous SEP, as follows:

8.9.1. Grievance Redress Process, Levels and Resolution Options

Persons or entities affected by the Project have the right to file complaints and/or queries on any aspect of irrigation infrastructure modernisation and construction activities. In order to ensure that grievances and complaints are addressed in a timely and satisfactory manner and that all possible avenues are available to beneficiary communities to air their grievances, the following mechanism for grievances will be set up:

First, complaints resolution will be addressed by the Design Consultant (during development phase) or Construction Contractor (during construction phase), where a dedicated representative for communication, also serving as a Grievance Focal Point, will be appointed. The Grievance Focal Point at Design Consultant’s or Construction Contractor’s level will address minor grievances and resolve them directly where possible. During the construction phase the representative of beneficiary communities may be invited to weekly site meetings to be continuously informed of the construction activities, address any issues and minimize grievances. Representatives of the Technical Supervision Consultant(s) and local authorities/community may be involved at this stage of the grievance resolution process. Grievances and complaints, as well as resolutions provided will be registered in the record-book maintained during the development phase/on-site during the implementation phase.

Second, if a grievance cannot be resolved immediately, the resolution will be addressed at the GA level, with the involvement of community relevant parties (as necessary including complaining party, Design Consultant, Construction Contractor(s), Technical Supervision Consultant(s), community representatives, etc.). GA will nominate a specialist to act as a Grievance Focal Point at the GA level and coordinate resolution of grievances. Representatives of NGOs and civil society can also be involved in the grievance resolution process as informal mediators. Within two weeks of the grievance being reported, the GA will discuss the case and recommend its settlement to parties. If the case remains unsolved a complaint can be lodged to the court. Representatives of NGOs and civil society can also be involved in grievance resolution process as informal mediators.

If after the intervention and assistance from the GA no solution has been reached and if the grievances redress system fails to satisfy the complaining parties, the aggrieved party can pursue further action by submitting their case to the appropriate court of law. Nevertheless, the abovementioned grievance mechanism does not limit a citizen’s right to submit the case to the court of law at the first stage of grievance process.

8.9.2. Grievance Focal Points, Complaints Reporting, Recording and Monitoring

Complaints can be received through the staff of the Design Consultant and/or Construction Contractor(s) and/or GA. A Grievance Focal Points will be designated at each of these levels to receive, help to resolve, report or forward complaints received from complaining parties and the general public. Details and contact information of Grievance Focal Points designated for the Project will be posted at each construction site.

Aggrieved parties or other concerned individuals may visit, call or send a letter or e-mail to any of the Grievance Focal Points to register their comments or grievances related to environmental, social or other aspects of the irrigation infrastructure modernisation activities. Grievance boxes will be installed at construction each site at a location accessible to public. Contents of grievance boxes will be checked and reviewed at least once per week. The Grievance Focal Points at Construction Contractor’s level will maintain a record-book to register the complaints on-site. Grievance information to be registered in the record-book include:

- Name and contact details of complaining party;
- Details of the nature of the grievance;

- Details on how the grievance was received; and
- Dates when complaint was received, responded to and closed out.

Aggrieved parties may wish to not disclose their names and contact details, in this case the response to grievance will be posted on a stand located nearby the grievance box at a publicly accessible and visible place, to ensure that responses to anonymous grievances are communicated.

Complaints unresolved immediately will be recorded in the grievance record-book by the Grievance Focal Point of the Construction Contractor(s) to keep track of their resolution status. Complaints unresolved at Construction Contractor's level will be communicated to GA's Grievance Focal Point, who will also be required to maintain a record-book on the grievances resolved at GA level and the solution provided. Grievance forms (see Appendix C) will be available at these entities to facilitate recording of complaints. Information of grievance resolution will be summarized in Construction Contractor's and GA's progress reports.

8.9.3. Disclosure of Grievance Redress Procedure

The GRM for the Project will be disclosed through information leaflets and presented during public consultations. During the meetings, it should be emphasized that the GRM is aimed at quick and amicable resolution of grievances and does not substitute the legal process established under national legislation. In the areas populated by minority groups meetings shall be held and information leaflets shall be provided in the linguistically appropriate manner, if the language used by the minority group is different from official language of Georgia. The information on the GRM will be also made available at Technical Supervision Consultant's and GA offices.

8.10. Monitoring

Stakeholder engagement and information disclosure should be reported via all convenient communication channels identified above. Depending on the specifics of grievances, monitoring measures can be as simple as compiling minutes of meetings and consultations, including questions raised and answers provided, as well as tracking the number of grievances received and resolved. The records on consultations and grievances should provide the background information for regular monitoring, both informal and formal. Therefore, even a simple tracking system should provide an opportunity to aggregate information and carry out Project level analysis.

9. Impacts and Mitigation Measures

9.1. Introduction

This section provides an assessment of construction and operation phases of the investment Project. In all cases, a qualitative assessment of the impacts has been made, in accordance with the approach set out in Section 5. It draws on, but also builds on, the assessment undertaken in the Eptisa 2018 ESIA. Where additional survey or assessment may be required as the project progresses, this is identified in the mitigaiton measures.

9.2. Water Resources

9.2.1. Construction

9.2.1.1. Methodology

The assessment for construction is based on professional judgement using the methodology set out in Section 5. Sources of impacts considered include works on the canals and construction activities and worker water requirements. Receptors include the canals and water sources related to potable water and construction water demand.

9.2.1.2. Potential Impacts

Potential impacts on hydrology in construction are limited, as the proposed works are for modernisation of existing infrastructure and no works are proposed on the Iori river. Within the irrigation canals, the works may temporarily affect the hydraulic flow of the canals, however, in many cases the flow is either poor or, in some cases, not present due to the poor condition of the canals (such as parts of the LMC and LMMC). There may also be minor alterations to existing drainage patterns from construction compounds, movement of construction vehicles over sites and topsoil storage. However, all of these impacts are considered to be of very low magnitude and the sensitivity of the canals is considered to be Low from a hydrological perspective, therefore a **Negligible** effect is anticipated.

During construction, the works and workers could be exposed to a potential flood risk. This risk is likely to be reduced along the canals due to the fact that the water entering the canals will be controlled during the works. However, any stripping of soils could result in increased surface water locally. The magnitude of increased flood risk is low and the sensitivity is considered low, therefore a **Negligible** effect is anticipated.

During construction, there will also be a demand for water, both potable water for the workforce on site and at any workers' construction camps, if used, and water for construction materials such as concrete mix and water dousing. Detailed Project water use information i.e., water demand and water sources to use, is not currently available at as the Construction Contractor(s) has not yet been appointed.

The IFC *Guidance Note on Workers' Accommodation Processes and Standards* (2009) identifies that, depending on climate, weather conditions and accommodation standards, 80 to 180 litres per person (worker) per day of potable water should be available. A review of other similar overseas projects indicates ranges from 135 to 180 litres per person per day. If a workforce of around 75 people on site at any one time is assumed, and assuming a worst case of 180 litres/day, 13,500 litres/day would be required during construction.

Estimates vary on water required for construction purposes; however, key water demand will be for mixing concrete (e.g. 250 litres per m^3), filling materials (e.g. 20 litres per m^3) and for water dousing. The Construction Contractor will be required to prepare a water demand and management plan as part of the ESMP. Without mitigation measures, the magnitude of impact is Medium for the construction period. The significance of effect on available water resources is **Moderate Adverse**, assuming a Medium sensitivity in relation to availability of local water resources as the existing sources for potable water have a moderate natural resilience to imposed stresses in the Project area.

9.2.1.3. Mitigation Measures

A detailed Water, Wastewater and Drainage Management Plan will be prepared and implemented by the Construction Contractor(s) which identifies a water needs and supply assessment; water saving good practices; and they will obtain the necessary permits for water abstraction. Control measures related to water resources will include (water quality is addressed in the next sub-section):

- Set targets for water reuse and recycling on site.
- Construction Contractor(s) will undertake regular training of workers on measure to conserve water during construction and within any work camps required.
- The Project will be expected to source its water under permit from the relevant authorities. Any such permit will include a review of the impact of water abstraction, to ensure that potential impacts on water supplies are considered.
- Construction workers will be provided with potable water from approved sources e.g. mains water supply. Surface or groundwater will not be used without prior permissions from the relevant authorities in place.
- Where construction water supply is not a mains supply, a mass balance model shall be used to understand the impacts of reduced dilution capacity on the abstraction water body/bodies. This may require additional monitoring data (quality and flow) to be collected at and downstream of abstraction locations. Where model results suggest significant increases in concentrations, specific measures (dependent upon the nature of the abstraction) to help reduce volume of abstraction would need to be identified e.g. re-use on site, multiple water supply options, etc.
- Construction Contractor(s) will ensure no flood risk exacerbation through careful consideration of construction drainage and flood risks to workers from construction activities.
- Construction Contractor(s) will assess flood risk in periods of high rainfall.

9.2.1.4. Residual Effects

A **Negligible** effect in relation to hydrology of the canals is anticipated during construction.

A **Negligible** effect on flood risk is anticipated during construction.

A **Minor Adverse** effect in relation to construction water demand is anticipated once mitigation measures are in place.

9.2.2. Operation

9.2.2.1. Methodology

The operational phase water resources impact assessment is based on ascertaining potential impacts on the receptors the Iori River and water users and uses within and downstream of the ZSIS, based on professional judgement using the methodology set out in Section 5 and drawing on the results of the water balance model in the FS. Sources of impact are related to the water demands for the various different receptors.

The hydrological work covered in detail in the FS has comprised:

- Assessment of historical climate records using local weather gauging stations data, SMHI and CatchX and crop water demand estimates from remote sensed AgERA5 derived reference evapotranspiration.
- Assessment of projected future climates using SMHI Hype.
- Historic and future Iori catchment monthly runoff.
- Water demand balance, based on:
  - Irrigation water demand
  - Operational capacity (reservoir and canal carrying capacity)
  - Review of irrigation efficiency
  - Other water demands
- Monthly water demand balance across three climate change models i.e. “hot-wet”, “hot-dry” and “warm”, summarised for the periods 2022-2031, 2032-2041 and 2042-2051.

Details of the demand model are presented in section 6.8 and in more detail in the 2022 FS.

Note that whilst the requirements of the UMC, LMC and LMMC are identified separately, the model outputs combines these requirements together.

The assessment has therefore considered baseline and future climate change scenarios for the periods 2022-2031, 2032-2041 and 2042-2051 to determine the abstraction risks of the ZSIS on downstream water users and EFRs in the Iori River. It has also considered the impacts on water resource availability within the ZSIS, considering the baseline and future climate scenarios for the periods 2022-2013, 2032-2041 and 2042-2051.

9.2.2.2. Potential Impacts

The environmental assessment considers the following impacts:

- Impacts on the water availability in Iori River downstream of PHW, as a result of abstraction for the Project, including downstream EFRs
- Water availability within the ZSIS having impacts on:
  - Availability of water for irrigation as part of the ZSIS
  - Availability of water for the HPPs and existing industrial water use due to the Project
  - Availability of water in the Tbilisi Sea due to the Project
  - Availability of water in Jandara Lake due to Project

The outcome of the water demand model is shown in Table 9-1, which summarises the average runoff totals, supply, and percentage water use and percentage water reaching downstream of PHW for each model and period simulated. Values are shown in red where the future year scenarios will have less water than the historic modelled flows for the key locations of interest. A summary averaged across the three climate models for downstream water uses is shown in Table 9-2. These are discussed in more detail below.

Table 9-1. Mean runoff generated within the catchment or within the catchment plus upstream release. All values are given in Mm^3 unless percentage is stipulated.

Model	Historic Modelled*	Warm			Hot Wet			Hot Dry		
Period	1990-2014	2022-2031	2032-2041	2042-2051	2022-2031	2032-2041	2042-2051	2022-2031	2032-2041	2042-2051
Runoff at Sioni reservoir	300.1	281.5	287.2	267.3	287.2	309.2	298.1	259.0	237.6	260.7
Runoff generated between Sioni reservoir and PH	101.2	98.2	110.6	68.8	105.7	114.5	113.5	69.0	69.6	78.0
Sioni to PH Runoff + Upstream release	401.3	389.1	398.6	346.9	400.9	417.0	418.0	341.7	307.1	339.2
Lochini river, Chumatkhevi creek and Tbilisi Sea catchment contributions	31.1	30.1	42.7	19.2	29.2	30.8	34.1	30.5	21.6	29.9
Intake into ZSIS at PH (average for 2000-2021)	135.4	125.9	122.6	119.6	124.7	123.6	120.5	116.9	97.4	109.9
Runoff generated between PH and KSIS	22.7	26.9	32.0	15.0	31.4	32.1	24.3	15.5	15.3	19.4
PH to KSIS Runoff + Upstream release	289.1	290.1	308.1	242.2	307.6	325.4	321.8	240.2	225.0	248.7
Intake into KSIS (average for 2018-2021)	175.0	133.8	128.0	132.6	133.2	129.0	134.0	134.5	120.4	129.9
Runoff generated between KSIS and Dalis Mta Runoff	12.8	16.3	16.7	9.9	20.7	19.7	12.8	10.4	9.9	12.6
KSIS to Dalis Mta Runoff + Upstream release	126.8	172.6	196.7	119.5	195.1	216.1	200.5	116.1	114.5	131.3
Runoff generated between Dalis Mta and Kasman	11.8	15.1	15.1	9.4	18.5	17.4	11.5	9.5	9.4	11.7
Dalis Mta to Kasman Runoff + Upstream release	138.6	187.7	211.8	128.9	213.7	233.5	212.0	125.6	123.9	143.1
Water generated from Georgia Iori catchment	448.5	438.0	461.6	370.4	463.5	492.8	460.2	363.4	341.8	382.4

Total water use by Georgia from Iori river	310.5	259.8	250.6	252.2	257.9	252.6	254.5	217.8	239.8	257.9
catchment water remaining in the Iori river after irrigation and other water use abstractions	138.0	187.7	211.8	128.9	213.7	233.5	212.0	125.6	123.9	143.1
% of water remaining in the Iori river	30.9	42.9	45.9	34.8	46.1	47.4	46.1	34.6	36.2	37.4

** It should be noted that the 1990-2014 historic flows are modelled historic flows based on a monthly mass balance model, and not actual historic flows. They account for a 10% EFR.*

Table 9-2. Summary of water balance (in Mm^3 per annum), averaged across all 3 models (Table 9-1)

Period		Historic Modelled data #	2022-2031	2032-2041	2042-2051
Runoff at Sioni reservoir	1	300.1	275.9	278.0	275.4
Runoff generated between Sioni reservoir and Paldo Head Works (PHW)	2	101.2	91.0	98.2	86.8
Total runoff generation at PHW	3 = 1+2	401.3	366.9	376.2	362.2
Intake into ZSIS at PH **(this shows the impact of our project improvement)**	4	**135.4**	**122.5**	**114.5**	**116.7**
Intake into KSIS	5	175.0	133.9	125.8	132.2
Total Iori water used by ZSIS and KSIS	6=4+5	310.4	256.4	240.3	248.9
Runoff generated between the PHW and the border with neighbouring country	7	47.3	54.8	55.9	42.2
Total runoff generated within the Georgia catchment	8=3+7	448.6	421.7	432.1	404.4
Volume of catchment water remaining in the Iori river after irrigation and other water use abstractions	9 = 8-6	138.2	165.3	191.8	155.5
% of catchment water remaining in the Iori river after irrigation and other water use abstractions	10 = 9/8	**30.8%**	**39.2%**	**44.4%**	**38.4%**
% of total annual net potential irrigated command area (36,566 ha) served (average of three CC scenarios)	11	34.3% *	97.4%	92.5%	92.3%
Total Irrigable Area of ZSIS and KSIS (ha)	12	12,567 *	35,605	33,810	33,737

* - average of actual data received from GA for 2018-2020

- Modelled data (1990-2014)

Impacts on the Iori River

The average intake at PHW into the UMC based on data available for the past 20 years is 148.8 Mm^3 annually, though the model (Table 9-1) shows a value of 135.4 Mm^3.[168] The average remaining volume of catchment water downstream of PHW for the same period has been 265.9 Mm^3 (401.3 Mm^3 – 135.4 Mm^3).

In terms of future abstraction and downstream catchment water volumes (to understand if the baseline will change), the water demand model prepared as part of the 2022 FS has been used. The water demand model has considered the existing and likely future demands downstream of PHW. These are summarised below:

- Fish farm and Khashmi and Patardjeuli irrigation schemes on the Iori river
- KSIS
- 20% EFR

The model essentially takes into account that the above water demands will be met, so that the water available to the ZSIS is based on always ensuring these downstream water demands are met first. This assumption has been used across the three climate models and the periods 2022-2031, 2032-2041 and 2042-2051.

Table 9-1 above shows that in future scenarios less water will be available for intake into the ZSIS (see next section for discussion of the impact on the ZSIS). In relation to the release downstream, at the KSIS (which also accounts for the fishponds and irrigation schemes at Khashmi and Patardzeuli requirements), the modelled historic intake value is 175.0 Mm^3 and all future values are lower than this. The worst case is in the Hot Dry model for the years 2032-2041, where a reduction of 54.6 Mm^3 (175-120.4 Mm^3) is predicted. Taking the values in Table 9-2 which averages the climate models, in the worst case there would be a reduction of 49.2 Mm^3 (175–125.8 Mm^3) for the years 2032-2041. This could have an initial impact on the hydrology of the river, as less water will be available downstream. Figure 9-1 indicates that runoff generated upstream of Sioni reservoir is set to decrease in both Warm and Hot Dry models relative to historic runoff. However, under the different climate scenarios the amount of runoff from the Georgian catchment remaining in the Iori river after irrigation and other water use abstractions is on average 41%, exceeding the historic volume for 1990-2014 (30.8%) (Table 9-2), a result achieved by the reduced supply to irrigation from improved irrigation water delivery and use.. Potential implications for this on ecology are addressed in section 6.8.

All values for downstream catchment water availability for all future years and climate scenarios (Table 9-2) are significantly above the average 85 Mm^3 Annual Irrigation Delivery used by the KSIS between 2018 to 2021 (Table 6-7). Therefore, overall it is considered that the model has accounted for meeting the demands of the KSIS and the fishponds and downstream irrigation schemes, and therefore only a very low to negligible magnitude of impact is predicted to reflect the general reduction in downstream flow compared to the historic baseline. The KSIS and other downstream water users are considered receptors of high sensitivity, and therefore overall a **Negligible to Minor Adverse** effect, which is not significant, is predicted on downstream water users on the Iori River.

Figure 9-1 shows the different climate scenarios against the model historic baseline. The figure shows year on year changes, which provides more granularity than the numbers in Table 9-1 which are averaged over each decade.

[168] It is noted that the average abstraction over 20 years is 155 Mm^3, whereas the model set out in Table 9-1 identifies that the historic abstraction for 24 years (1990-2014) is 127.9 Mm^3. This difference is predominantly because the demand requirements imposed on the model do not reflect some of the actual demand in some years (for example, some years it has been up to 250 Mm^3) as the model is based on a constant demand. This difference is a function of the model, however, it is considered that the abstraction will not reach 250 Mm^3 and therefore the difference is not of concern for the assessment.

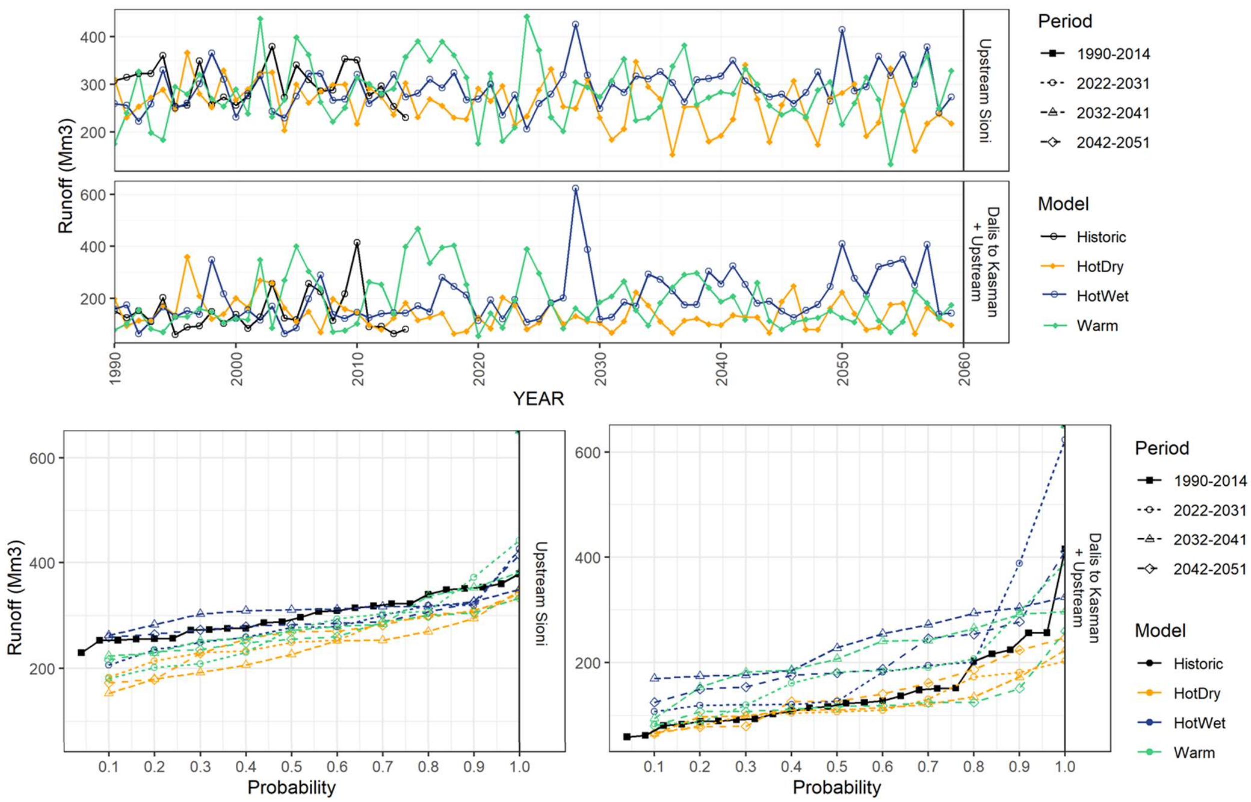

Figure 9-1. Catchment Runoff Annual Summary

With respect to EFRs downstream of PHW, the water balance modelling shows that at least 41% of the runoff water from the Georgian catchment remains in the Iori river after all irrigation and other water use abstractions having been taken into account, which is more than the suggested environmental flow of 20%. Therefore, a negligible impact magnitude is predicted on EFR, result in **Negligible** effect on downstream EFR. Though a negligible effect is predicted as a result of the Project, it should be noted that ultimately the water availability downstream of the PHW is also reliant on water from the catchment so total downstream volumes will depend on the operations of ZSIS and KSIS intakes and Dalis Mta & Sioni reservoirs.

There is no transboundary agreement for the Iori River with Azerbaijan downstream, therefore no transboundary effects are anticipated in relation to regulatory controls.

Impacts on irrigation water demand within ZSIS

As identified above, the water demand model has been undertaken on the premise that downstream water requirements are met first. Compared to the actual average abstraction at PHW of 148.8 Mm^3 annually, Table 9-1 shows that the future scenarios indicate a lower intake volume at PHW in the future. Accounting for the fact that the model shows a historic average abstraction at Paldo Headworks as 135.4 Mm^3, in the worst case of 2032-2041 for the Hot Dry scenario, the modelled reduction is 38 Mm^3 per annum (i.e. 135.4 - 97.4 Mm^3) diverted into the ZSIS. For the average of the climate scenarios, the key difference is for the period 2032-2041 when a reduction in 20.9 Mm^3 (135.4-114.5 Mm^3) is predicted over the historic modelled volume. The irrigation requirements for the Project for 2020/21 and future scenarios are set out in

Table 9-3. For the Warm and Hot Wet climate models, the irrigation demand during 2030s will be less than the 2020s due to expected increase in the rainfall; the irrigation demand will increase to new heights in 2040s due to increase in PET and reduction in rainfall, whereas the Hot Dry model projects hotter conditions and thus peak demand within the 2030s.

Table 9-3. Irrigation Requirements

		Annual Irrigation Delivery (Mm^3) for 19,129 ha			Water release required at the Paldo Headworks - averaged across the three climate scenarios (Mm^3)**
		UMC	LMC	Total	-
Current Actual Use (2020-21)*		50.6	79.3	129.9	-
Current theoretical Demand		28.8	39.3	68.1	-
Future Warm Model	**2022-2031**	50.8	88.2	139.0	118.0
	2032-2041	49.4	85.6	135.1	114.6
	2042-2051	53.9	93.9	147.8	115.7
Future Hot Dry Model	**2022-2031**	54.0	93.8	147.7	118.0
	2032-2041	56.6	98.3	154.9	114.6
	2042-2051	55.7	96.5	152.3	115.7
Future Hot Wet Model	**2022-2031**	51.1	88.7	139.8	118.0
	2032-2041	50.3	87.2	137.5	114.6
	2042-2051	52.0	90.0	142.0	115.7

** As per records provided by GA*

*** The release requirement is equal to the demand minus water from other sources*

In all cases, the demand in the future under the three climate models is higher than the current actual use. Furthermore, the water release requirements at PHW in the future, averaged over the models, are lower than the current water release for the ZSIS. However, the difference will be balanced by the improvement to irrigation infrastructure and implementation of proper operation and maintenance procedures which would reduce the irrigation demand per hectare.

If the model is run at 100% of proposed demand:

- The Hot Dry model results in failures (i.e. insufficient water for the command area) in 17 out of 30 years, reducing to 5 years of failures at 85% and 0 at 76%.
- The Warm model produces failures in 5 years out of 30 at 100% of proposed demand, dropping to 3 years of failures at 95% and 0 failures at 90%.
- The Hot Wet model produces 0 failures up to 101% of proposed demand.

The model indicates therefore that there may be years in which the availability of water will reduce the area that can be irrigated. It also shows that modifying the demand area within the model to produce 0 failures is reflected in reduced supply, notably within months June to August during peak demand.

Using the averaged water balance across the three climate models, the model indicates that water is available to irrigate more than 90% of the combined potential command area of ZSIS and KSIS (35,605ha) accounting for 10% annual fallow land) and other demands in the next three decades.

Overall, the magnitude of the impact averaged across the three models can be seen a Very Low and with a high sensitivity of the irrigation water availability is predicted to result in a **Minor Adverse** effect on water availability for irrigation.

However, taking the worst case scenario of the Hot Dry model, a magnitude of impact on the available water is considered to be Low to Medium and with a Medium sensitivity of the irrigation water availability is predicted to result in a **Moderate to Major Adverse effect**. As identified above, this effect will be reduced through improvement to irrigation infrastructure and implementation of proper operation and maintenance procedures.

Impacts of water availability for the HPPs and industrial water use

The water demand model has taken into account the industrial water uses within the UMC, including a 10% increase in demand per decade on the assumptions made in the previous FS. As such, no impact on the industrial water users is predicted, even in the above worst case scenario of the Hot Dry model (as the area of irrigation would be reduced in favour of reducing the industrial water use). Therefore **no effect** on the industrial water use is anticipated.

The water demand model however does not include water requirements for the four HPPs. The current operation is that water is provided to the HPPs only when the irrigation demand has been met, and this is agreed between the various parties. Therefore, no change to the baseline conditions is proposed. Further analysis would be required to understand whether the HPPs would receive more or less water supply than currently.

Impacts on water availability within Tbilisi Sea

The UMC flow data analysis undertaken in the 2022 FS (Table 9-4) indicates that on an average 50% of the UMC diversion at PHW reaches Tbilisi Sea. On average over the 10 years of 2010 to 2020, an average of 153 Mm^3 was released at PHW, of which 77.5 Mm^3 was used by the UMC, 34.68 Mm^3 was released into the LMC and the balance at Tbilisi Sea was 41.43 Mm^3.

Table 9-4 – ZSIS Canal flow data analysis

Year	Released at Paldo Headworks	Used by UMC	Reached Tbilisi Sea	Released into LMC from Tbilisi Sea	% of UMC water release	Balance at Tbilisi sea
2010	254.01	96.73	157.28	45.94	29%	111.34
2011	251.62	88.73	162.89	27.08	17%	135.81
2012	193.82	97.93	95.89	14.85	15%	81.04
2013	115.71	62.91	52.80	17.12	32%	35.68
2014	122.77	80.69	42.08	30.49	72%	11.59
2015	116.16	66.46	49.70	21.42	43%	28.28
2016	178.87	66.23	112.64	57.77	51%	54.87
2017	141.26	76.52	64.74	53.92	83%	10.82
2018	105.60	58.92	46.68	34.88	75%	11.80
2019	114.45	89.17	25.28	34.48	136%	-9.20
2020	95.31	68.16	27.15	43.48	160%	-16.33
Average	**153.60**	**77.50**	**76.10**	**34.68**	46%	**41.43**
%		**50%**	**50%**	**46%**		

The potable drinking water requirements of the Tbilisi Sea are mainly served from the Aragvi River. Nonetheless, the water demand model has accounted for 6 Mm^3 of water from UMC into the Tbilisi Sea for use by GWP. As the UMC is not the primary source for the drinking water, no factor has been included for potential increased demand in the future and this number has been based on the consistent demand in recent years.

Therefore the ZSIS (through use of the UMC) is predicted to have **no effect** on the inflow requirements to the Tbilisi Sea and drinking water requirements. It should also be noted that the Tbilisi Sea will be used for storage of water for the ZSIS in the peak irrigation season. No more water would be released from Tbilisi Sea into the LMC than water is released into the Tbilisi Sea via the UMC.

In relation to the Tbilisi Sea contributions to the LMC, together with the Lochini River and Chumatkhevi Creek these are provided in Table 9-1. This shows that historically their contribution to the LMC was 45.6 Mm^3, which is anticipated to be reduced of note only in the 2042-2051 Warm scenario (to 27.7 M^3) and the 2032-2041 and the 2042-2051 Hot Dry scenario to 31.4 Mm^3. As shown from Table 9-4, the average released in the last 10 years to the LMC is 34.68 Mm^3. Therefore no significant reduction is predicted in the future. As the impact of the ZSIS water availability is considered across all canals, this is addressed in the section above.

Impacts on water availability in Jandara Lake

There is an agreement between Georgia and Azerbaijan for 57 Mm^3 of water to Jandara Lake through Gardabani irrigation canal. This water comes from the Mtkvari River. Drainage water from the Chumatkhevi Creek and from the LMC catchment areas of G18 to G28, and all natural creeks flow to the Jandara Lake. However, drainage water from the LMC entering the Gardabani canal only occurs when there is excess water in the ZSIS canal system, which has not been the case in recent years. As such, the current baseline is that the Lake does not receive water from the LMC (other than natural drainage). During operation of the ZSIS, it is also anticipated that the water within the ZSIS will be used within the scheme, and therefore only drainage from heavy rainfall is likely to contribute to flow into the Gardabani irrigation canal and ultimately Jandara Lake. As such, it is not anticipated that the Project will have an effect on water availability within Jandara Lake.

9.2.2.3. Mitigation Measures

Given the effects identified above, the main mitigation measures focus on the availability of water for the ZSIS. The 2022 FS identifies that there are three possible development pathways to address the constraints on the irrigated area under some climate model scenarios which will need further consideration as the Project is progressed:

a. The command area of either ZSIS or KSIS, or both could be proportionally reduced to match with 100% of water availability.
b. Irrigation requirement per ha could be reduced by introducing more sprinkler and drip irrigation systems, which is possible in case of further promoting the adoption of high-value agricultural cropping systems, including orchard trees, greenhouse crops, etc.
c. Cultivating less water demanding crops.

Options (b) and (c) will include measures such as:

i. Encouraging farmers to grow crops under sprinkler and drip systems, to reduce irrigation requirement;
ii. Adopting highly monitored and controlled irrigation scheduling and delivery, to ensure more efficient and effective water use;
iii. Encouraging farmers to grow less water intensive crops;
iv. Linking irrigation fees with volumetric irrigation water delivery, to encourage farmers to use water more efficiently.
v. Ensuring proper operation and maintenance of the irrigation infrastructure through WUOs, to reduce water losses along the distribution network.

In addition to methods for improved use of water, it is also recommended provision is made for a basic SCADA system. Further automation should be explored detailed design for example in pilot areas.

With regards to the Tbilisi Sea, as the reservoir will be a storage area for peak demand for the ZSIS, it is advisable that water management rules with clear particular priorities for all stakeholders are agreed between the GA and the other water users of Tbilisi Sea.

9.2.2.4. Residual Effects

With regards to effects on the availability of water in the Iori River downstream of Paldo Headworks, the water demand model has accounted for future demands for the ZSIS, Kasman and Mingechevir Reservoir are met as well as EFRs. No specific mitigation measures have therefore been proposed, other than ongoing monitoring of the wider system.

The effect of the ZSIS on downstream hydrology remains **Negligible to Minor Adverse.**

The effect on the KSIS and other downstream water users remains **Negligible to Minor Adverse** effect, which is not significant.

No effect is predicted on EFR as a 20% EFR is maintained in all climate models.

As there is no transboundary agreement for the Iori River with Azerbaijan downstream, **no transboundary effects** are anticipated in relation to regulatory controls.

Overall, the magnitude of the impact of water available for the ZSIS s is predicted to result in a **Minor to Moderate Adverse** effect. Mitigation will ensure the system is more efficient however, depending on actual climate change there may be years in which, even with mitigation in place, the identified command area of 19,129.4 ha cannot be irrigated.

With regards to the impacts of water availability in the UMC for the existing industrial water use, **no effects** on water availability is anticipated as this has been accounted for in the water demand model, including a 10% decadal increase in demand. No change in relation to the operating procedures for water for the HPPs will occur, the ZSIS will take priority over the HPP water demand. Further analysis would be required to understand whether the HPPs would receive more or less water supply than currently.

With regards to the impacts on water availability in the Tbilisi Sea, the ZSIS (through use of the UMC) is predicted to have a **Negligible** on the inflow requirements to the Tbilisi Sea and drinking water requirements. A steady demand of 6 Mm^3 into the future has been accounted for from the UMC in all future climate scenarios.

With regards to water availability to Jandara Lake, a **Negligible** as a result of the Project is anticipated.

9.3. Water Quality

9.3.1. Construction

9.3.1.1. Methodology

A qualitative approach to the assessment has been undertaken based on professional judgement and an estimation of likely impacts to understand the significance of effects.

The assessment considers the impacts of the Project on water quality of downstream river reaches, water bodies and the ZSIS canal system. Receptors include the Iori River, ZSIS irrigation canals, Chumatkhevi Creek, Tbilisi Sea (via drainage from the UMC) and Jandara Lake (via drainage from the LMC area); and Groundwater. Impacts of water quality on flora and fauna and humans are considered in sections 9.7 and 9.8 respectively.

9.3.1.2. Potential Impacts

Potential impacts include:

- Sedimentation of watercourses from soil erosion on exposed ground
- Changes in water quality from runoff and direct pollution incidences
- Changes to drainage and runoff
- Groundwater pollution from percolation of accidental spillages
- Changes to water quality

Sources of impact include:

- Site clearance and grading
- Modernisation of the canal network
- Oil and other accidental contaminant spills and leaks (e.g. waste oils and lubricants)
- Untreated wastewater discharges such as washing of vehicles or equipment; discharges from construction sanitary facilities and/or construction camp(s), if used

The irrigation canals are considered receptors of Medium sensitivity given their current water quality and use for irrigation. The Iori River, Tbilisi Sea and Jandara Lake are considered receptors of High sensitivity, given their broader uses and importance regionally, and, in the case of Jandara Lake, its transboundary nature. Groundwater is a receptor of Medium sensitivity due to its known availability and use in the Study Area.

Construction activities at Paldo Headworks, comprising the desilting of the settlement basins, could result in a release of sediments that could affect the turbidity of the Iori River, without appropriate mitigation measures in place. The magnitude of this impact is considered to be Very Low given the scale of the operation and the size of the Iori River and therefore, any potential impact on the Iori River would be **Minor Adverse** without mitigation measures in place.

Potential impacts on water quality within the ZSIS irrigation canals and the Chumatkhevi Creek where works are proposed include washout of material or spillages into the watercourses, leading to contamination of surface water resources; and contamination from construction machinery working in or near the river.

In-channel works could result in the release of sediments and increase of turbidity in the canals and the Creek. Unmanaged erosion generated from working in or near the watercourses could also result in changes to water quality, with an increased risk during periods of high rainfall, although it is also recognised that higher flows from rainfall runoff will also provide increased dilution.

Potential impacts also include contamination from storage and use of oil and chemicals potentially from construction machinery working in or near the river. Accidental spills could enter surface waters directly, in run-off (from land or road). Once in a watercourse, it can be difficult to contain the pollution which can then impact over a wide area downstream.

The magnitude of the impact of construction activities on the irrigation canals and the creek as a result of construction works is identified as Medium due to the anticipated nature of the works proposed (i.e., demolition of existing structures where relevant, additional excavation) and the time-frame over which these works will be completed (i.e., anticipated to be a few weeks in each section). As the irrigation canals and the creek are receptors of Medium sensitivity, a **Moderate Adverse** effect on their water quality is anticipated.

Potential impacts on water quality in the Tbilisi Sea will arise from direct impacts on the above flowing downstream into these water bodies, however, the general dilution effect both in terms of distance downstream and the size of this waterbody would be expected to reduce the magnitude of the impact if it were to occur, to Very Low, and therefore, a **Minor Adverse** effect would be anticipated on these water bodies. Only drainage in rainfall events would be expected to potentially wash any pollutants into Jandara Lake, therefore the magnitude of impact for the Lake is also considered Very Low during rainfall events, therefore, a **Minor Adverse** effect would be anticipated on Jandara Lake during rainfall events where they coincide with works in the area draining into the Lake.

Accidental spills could also percolate into groundwater and therefore affect groundwater quality, as well as river quality as groundwater contributes to river flow. The magnitude of this impact is considered Low, and therefore without mitigation in place this would result in a **Minor Adverse** effect.

Discharges of untreated water from construction camp(s) (if used) and on-site sanitation facilities may also affect water quality. Construction camp activities such as disposal of domestic waste and use of field latrines can potentially cause both surface and ground water contamination via surface run off and leaching through surface to groundwater aquifers. Camp site and location of latrines should be carefully selected by the Construction Contractor under the local environmental authority’s guidance. The impact magnitude has been assessed as Very Low as it is assumed that all necessary permits will be in place. Therefore, a **Negligible** effect as a result of untreated construction wastewaters is predicted.

9.3.1.3. Mitigation Measures

A Water, Wastewater and Drainage Management Plan and Spill Prevention and Response Plan will be prepared and implemented during construction, detailing best practice standards and procedures. The following control measures would be applied within these management plans to reduce impact from construction activities:

- Visual inspections should be undertaken during in-channel works for sedimentation events.
- Where necessary, sediment traps will be used for in-channel works to capture sediment released. Activities/time spent in-channel should be kept to a minimum.
- For land clearing and grading and soil erosion, drainage should be considered in the design of the on-farm irrigation systems that is implemented during the construction works.
- The quantity of excavated soil material will be limited as far as practical, and soils will be appropriately managed (see Soils assessment).
- Construction activities should, where possible, account for seasonality i.e. take place during ‘drier’ months of the year to minimise the impact of run-off.
- Hazardous substances/chemicals to be stored appropriately on site, e.g. in bunded/ impervious lined areas with no connection to site drainage channels. Hazardous substances/chemicals only to be handled by an appropriately qualified person.
- Arrangement of fuel tanks and other potential sources of contamination away from surface water bodies as much as possible.
- Wet cement and/or concrete will not be allowed to enter any watercourse, pond or ditch.
- Procedures to be followed when refuelling vehicles and equipment to minimise the risk of spills to the environment (e.g. spill kits) to be available.
- Vehicle and equipment wash to be undertaken at designated areas where all wastewater can be collected and disposed of by an approved contractor. No direct or indirect discharge to the site or the river.
- In the event that previously unidentified contamination is observed during construction, works in the affected area will cease and appropriate mitigation measures designed, or an appropriate disposal process identified.
- Site sanitary facilities to be provided.
- Wastewater treatment to be implemented in construction camp(s).

- No direct or indirect discharge to the site or surface water features is permitted.
- Required discharges must be treated, appropriately, particularly to remove sediment/silt, and, if necessary, discharge permits must be obtained. No direct or indirect discharge to the site or the river.
- Waste or litter entering surface water features will be prohibited. Any construction debris will be removed from rivers or drainage channels.
- Dust levels to be appropriately controlled on site to ensure air quality standards remain acceptable but also to prevent dust being blown into surface water resources.
- A Spill Prevention and Response Plan will be developed and implemented to ensure compliance with safe handling rules for fuels and lubricants. Spill kits to be readily available adjacent to chemical storage areas as well as active construction site areas where accidental spillages may occur e.g. drip trays under heavy plant that could suffer from fuel/oil/lubricant leaks; Train all fuel and chemicals handling staff to use spill kits work according to the emergency preparedness and response plan.
- Tool box talks and training will be provided of the construction workforce on pollution prevention and implementation of the Water, Wastewater and Drainage Management Plan and Spill Prevention and Response Plan.

9.3.1.4. Residual Effects

With the mitigation measures in place, overall a **Minor Adverse** effect on water quality within the various surface water bodies is anticipated as the risks cannot be fully removed. A **Negligible** effect on groundwater is predicted.

9.3.2. Operation

9.3.2.1. Methodology

A qualitative approach has been used based on professional judgement and an estimation of likely magnitude of impacts based on the water resources availability. The assessment considers the impacts of the Project on water quality of the following receptors: the source river, the Iori, the ZSIS canal system, and downstream river reaches/water bodies such as the Tbilisi Sea and Jandara Lake. Soils may also be affected and are considered in section 9.5. The impact of changes in water quality on flora and fauna is considered in section 9.7 and on human health in section 9.8.

Potential impact sources include: abstraction at Paldo headworks, increased erosion, increased fertilisers/pesticides use, untreated wastewater discharges from other sources along the canals and rubbish dumped along the canals, and the release of hazardous substances during maintenance (e.g. accidental spills and leaks).

9.3.2.2. Potential Impacts

Potential impacts include:

- Changes in water quality in the Iori River due to changes in downstream flow volumes
- Improvements in water quality from modernisation of the canals
- Sedimentation of watercourses from soil erosion runoff
- Pollution of watercourses
- Changes in water quality from runoff and direct pollution incidences
- Groundwater pollution from percolation of accidental spillages
- Untreated wastewater discharges

As identified in section 9.1, the modelled change in flow volume per annum downstream of the Dalis Mta Reservoir is predicted to increase from 22.2% to up to 35.6% over the modelled periods, with the exception of the Hot Dry model in 2022-2031 when a slight decrease to 21.4% is predicted (see Table 9-1 above). The model assumes that sufficient water is present for the water uses downstream of PHW. Therefore, whilst the runoff generated upstream of Sioni will decrease from historic flows, the flow downstream of Dalis Mta Reservoir increases as a result of reduced supply to the ZSIS which is taken as indicative of flows in the Iori River downstream of PHW. In the first decade, when the change is likely to be felt most, changes range from 32.1% for the Warm model, 34.6% for the Hot Wet model and 21.4% for the Hot Dry model. In terms of water quality, for the first two models this increase in flow downstream of PHW will have a diluting effect. For the Hot

Dry model this represents a minor decrease in flow that could reduce the dilution potential of the river. The increase in water available in the Warm and Hot Wet models is seen as positive in terms of water quality and having a Medium magnitude of impact; as the River is a receptor of Medium sensitivity and downstream water users are receptors of high sensitivity, this could result in a Moderate to Major Beneficial effect, respectively on the receptors, for the Warm and Hot Wet models. For the Hot Dry model, the reduction in downstream water flow is considered very low and therefore, a Negligible to Minor Adverse effect on water quality, respectively, is predicted.

During operation of the ZSIS, improvement in the water quality of the canals can be anticipated due to the modernisation of the canals, including removal of vegetation and rubbish, and due to the provision of improved canal linings. Final impacts in relation to the linings will depend on the type of lining used. Improvement in water quality due to improved canals will have a positive knock-on effect downstream in the Tbilisi Sea (via drainage from the UMC). Overall, the magnitude of impact is considered to be Low. However, any positive impact will be affected by the use of pesticides and chemical fertilizers and existing untreated discharges to the canals, as discussed below.

As agriculture modernizes, more pesticides and chemical fertilizers may be used. However, modernizing agriculture will also encompass conservation measures and integrated pest management. Based on data collected during the Eptisa 2018 FS of the ZSIS as well as information collected during the field study in 2021, crop inputs per hectare of fertilisers, herbicides and pesticides were derived for a range of crops in both the present and future ‘with project’ situations. The results are presented in Table 9-5. The results show a slight reduction in the need for Inorganic Nitrogen Fertilizer for wheat and maize; with an increase in Inorganic NPK Fertilizer for wheat, maize and alfalfa of 100 kg/ha; and an increase in Organic Fertilizer for berries, grapes and trees by 5,000 kg/ha. No other change is anticipated. The main reason that significantly higher fertilisers, herbicides and pesticides is not anticipated is due the anticipated (i) adoption of improved crop varieties, (ii) enhanced soil nutrition, (iii) integrated pest management, and (iv) better crop husbandry.

Table 9-5. Crop Inputs: Present and Future With Project

Crops	Crop Inputs (kg per hectare)									
	Inorganic Nitrogen Fertilizer		Inorganic NPK Fertilizer		Organic Fertilizer		Herbicide		Pesticide	
	Present	Future With Project	Present	Future With Project	Present	Future With Project	Present	Future With Project	Present	Future With Project
Wheat	200	100	-	100	-	-	2	2	1	1
Maize	300	200	100	200	-	10,000	2	2	1	1
Alfalfa			100	200	-	-	-	-	1	1
Grasses	200	200	100	100	-	-	-	-	-	-
Vegetables	300	300	200	200	10,000	10,000	2	2	3	3
Berries	250	250	250	250	-	5,000	5	5	10	10
Grapes	200	200	200	200	-	5,000	5	5	10	10
Fruit/Nut Trees	200	200	200	200	-	5,000	5	5	10	10

Source: (i) Rehabilitation of the Zemo Samgori Irrigation System (Ref. ORIO13/GE/01), Deliverable 3, Part 4: Financial and Economic Analysis, EPTISA, August 2018, and (ii) Field Survey and consultants’ estimates, November 2021.

Agricultural chemicals, especially if they are used unsafely, can be carried back to surface water bodies or may enter groundwater. This would be the case with or without rehabilitated irrigation systems - pesticides can enter water (surface and/or ground water) and can enter the food chain in various ways, and affect humans, fish, and wildlife. Whilst the amount of use per ha is not anticipated to increase significantly, it should be recognised that the extension of the irrigable area by around 11,896 ha (from the 2021 figures, whereby 5,320 ha were irrigated, and a planned net annual irrigation area of 17,216.4 ha) means that overall from the Project, there will be an increased use of fertilisers, herbicides and pesticides due to the increase in hectares farmed. The Project will have limited control over what farmers actually use and therefore, the magnitude of the impact is considered to be Medium and the effect on the canals (low sensitivity) which will receive the drainage runoff, **Minor Adverse** (the knock-on effect on humans is considered in section 10.8). The impact magnitude downstream will be influenced by potential dilution effect of the canal waters, though the canals may also receive pollution from various sources along them therefore resulting in an additional impact. However, the Tbilisi Sea is a large waterbody and therefore would be expected to provide dilution effect. Overall, a Low magnitude of impact is anticipated on the Tbilisi Sea resulting in a **Moderate Adverse** effect as this waterbody is of High sensitivity.

Accidental spills during O&M activities could runoff into the canals (Medium sensitivity) and/or percolate into groundwater (Medium sensitivity) and therefore affect groundwater quality, as well as river quality as groundwater contributes to river flow. The magnitude of this impact is considered Low, and therefore without mitigation in place this would result in a **Minor Adverse** effect.

There are currently untreated wastewater discharges (in some areas such as Varketili and the LMC) which could increase as a result of a more reliable water supply and expansion of the irrigated area. The negative effects of wastewater discharges include nutrification of water bodies. Without mitigation in place, this could result in a Medium magnitude of impact and therefore a **Moderate Adverse** effect on the water quality of the canals (which are of Medium sensitivity).

9.3.2.3. Mitigation Measures

Increased use of pesticides, herbicides and fertilisers in newly irrigated land area

- Training in appropriate use and handling of chemicals i.e. application between periods of rainfall to limit risk of runoff and ensure applications are the appropriate amount (i.e. no excess).
- Water use should be limited to the correct amount to ensure runoff of fertiliser/pesticide polluted water does not return to the water course.
- Develop monitoring regime.
- Develop and implement a detailed Spill Prevention Plan for the management of all chemicals, fuels and oils used during the O&M phase.
- Spill kits and spill booms to be readily available.

Accidental spillages resulting from maintenance activities:

- Training in appropriate use.
- During O&M activities, spill kits will be kept in accessible locations at all times, and employees trained in their use and disposal; implementation of the Spill Prevention and Response Plan in the event of a spill.

Other pollution sources:

- Prohibit untreated discharges to the canals.

Lining of canals resulting in leaching of chemicals to water course:

- Undertake risk assessment of potential liners.
- Regular inspection and monitoring of existing surface water drainage features (including pipe network) to maintain their character and function.

Manure management:

- Option to pass the waste through a biogas digester. The resulting products are less potentially harmful. The fact that the production would be locally concentrated opens the way for a large capacity digester.

Other:

- Monitor water quality under the changed conditions during at least two years with samples taken at the beginning, middle and end of the irrigation season and in winter.

9.3.2.4. Residual Effects

With the above measures in place, the impact of the project on water quality within the canals, downstream waterbodies and groundwater is considered to be reduced to **Negligible** to **Minor Adverse**.

9.4. Air Quality and Noise

9.4.1. Construction

9.4.1.1. Methodology

A qualitative assessment has been undertaken, based on consideration of the following area of influence (AoI):

It is considered likely that receptors could be affected by changes in air quality where they are within 200 m of a road due to changes in traffic and vehicular emissions, or by an increase in dust and particulate matter where they are within 350 m of construction activities or 50 m from the route used by construction vehicles on the public highway, and up to 500 m from compounds and other secondary access points.[169]

It is considered that noise impacts may reasonably be expected to be limited to within 300 m of proposed construction activities. The AoI for assessing the potential for noise impacts related to construction associated traffic may reasonably be expected to be limited to within 50 m of the kerb line of public roads used by traffic associated with construction activities.[170]

Vibration levels from mobile heavy construction equipment are generally considered to be imperceptible at distances greater than around 20 m from the source, meaning there is the potential for vibration impact from mobile heavy construction equipment when construction activities are undertaken within the urban areas, and when passing in proximity to isolated properties along the rural areas of the route.

Ecological receptors are considered in section 10.7.

9.4.1.2. Potential Impacts

Dust

Potential impacts include:

- Increase in dust emissions arising from dust generating activities leading to an increase in dust soiling at sensitive receptors
- Increases in particulate matter concentrations at sensitive receptors due to construction activities

Dust generating sources include:

- Preparation and use of temporary haul roads
- Loading, transporting, and unloading dust generating earth materials
- Excavations and earth moving activities
- Demolition works
- Construction / modernisation of canals
- Concrete batching plant
- Construction and worker vehicle movements
- Topsoil storage piles
- Rehabilitation of temporarily disturbed areas

Receptors will mainly include farmers working on the fields close to the construction works as well as any individual properties within the receptor distances to construction works identified in section 9.4.1.1 above, and local communities and residents in properties along roads used to reach the construction works, including along the E60, S5 and A38 to the east of Tbilisi and the E60 and R24 to the south towards Rustavi, and local roads within the ZSIS. Construction activities can give rise to dust emissions if not effectively managed, due to dust generated from site preparation, site excavation, construction activities and the tracking out of dust from Heavy Duty Vehicles (HDVs) onto the local road network.

Demolition of existing canals, where required, will result in dust emissions, as will earthworks to facilitate modernisation of canals. Construction works may also result in exposed areas of soil which will potentially generate dust when it is windy, with dust potentially being generated when winds blow at all times of day or night, not just during active periods of construction. The presence of concrete batching plant, if used, during the

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[169] Institute of Air Quality Management (IAQM) (2018). Guidance on Air Quality Monitoring in the Vicinity of Demolition and Construction Sites v1.1, Available at: https://iaqm.co.uk/text/guidance/guidance_monitoring_dust_2018.pdf
[170] Design Manual for Roads and Bridges (DMRB), LA111 Noise and Vibration Rev 2, May 2020

construction activities could also result in significant emissions of dust, though the impact will depend on their location in relation to sensitive receptors.

Larger dust particles fall out of the atmosphere quickly after initial release and therefore tend to be deposited in close proximity to the source of emission. The level and distribution of dust emissions will vary according to the duration and location of activity, weather conditions, and the effectiveness of suppression measures. Although unlikely to cause long-term or widespread changes to local air quality, the Project could cause temporary concern for residents. Dust can locally cause impacts on human health as well as impact on crops.

The magnitude of dust impact is considered to be Medium. The sensitivity of the farmers and local properties as well as crops are considered to be high, with larger communities along the main roads of Medium sensitivity. Overall, therefore, the effect of dust is considered to be **Major to Moderate Adverse**, respectively, for the period of construction mainly.

Gaesous emissions and greenhouse gases (GHGs)

Potential impacts include:

- Change in ambient concentrations of gaseous emissions at sensitive receptors as a result of exhaust emissions arising from construction plant and traffic
- Increase in GHG emissions from construction plant and traffic

Gaseous emission sources include:

- Gaseous and GHG emissions from construction equipment/machinery
- Gaseous and GHG emissions from construction vehicle movements

The main sources of gaseous emission during construction will be road construction machinery, equipment and trucks used for material transportation. The operation of vehicles and equipment will result in emissions of carbon monoxide (CO), sulphur dioxide (SO_2), and oxides of nitrogen (NO_x) from diesel fuel. However, the emissions will only be emitted during the use of machinery during active construction periods.

The greatest impact on air quality due to emissions from vehicles and typical construction plant e.g. excavators will be in areas immediately adjacent to site access. Generally, it is considered that additional vehicle movements generated during the construction phase will have the potential to influence local air quality at sensitive receptors located within 200 m of roads used by construction traffic. Traffic contribution to pollutant concentration reduces with increased distance from the road, with negligible effect beyond 200 m. This will therefore apply mostly within the urban areas, though may also affect some isolated properties where they are located within 200 m of construction traffic movements.

Final details of the plant and equipment likely to be used on site will be determined by the appointed Construction Contractor(s). The number of plant and their location within the site are likely to be variable over the construction period and at this stage no data is available on construction vehicles or plant.

There may be a temporary increase in local air pollutant concentrations due to exhaust emissions from plant used on the construction site, however any effect on air quality is likely to be temporary and is therefore considered to be of low magtitude. The sensitivity of the farmers to gaseous emissions considered to be high, with larger communities along the main roads of Medium sensitivity. Overall, therefore, the effect of dust is considered to be **Moderate to Minor Adverse**, respectively, for the period of construction only.

Noise

Potential impacts include:

- Noise impacts arising from construction activities due to noise-generating equipment/items of plant including noise from construction associated traffic, on nearby Noise Sensitive Receptors (NSR) e.g., residential properties

Noise emission sources include:

- Earthworks (including excavations and earth moving activities)
- Demolition works
- Construction / modernisation of canals
- Construction and worker vehicle movements on local roads

Whilst prediction methods are available to determine the level of noise during construction activities, the precision of any such predictions is necessarily limited by the assumptions that must be made regarding the number and type of plant to be utilised, their location and detailed operating arrangements. At this stage, as the

Construction Contractor has yet to be appointed, specific details on the number, type and location of construction plant that might be used during construction are not available. However, based on similar projects and equipment that is used, a qualitative assessment has been made of the temporary impacts likely to arise from construction works, based on available information, previous similar experience, and professional judgement.

Indicative construction activity noise levels at varying distances are presented within Table 9-6, based on generic construction equipment in accordance with the methodology within British Standard BS5228-1:2009+A1:2014 *Code of practice for noise and vibration control on construction and open sites – Part 1: Noise*. The table presents the indicative construction activity noise levels over a range of distances (assuming hard ground and no effective screening between construction activity and noise sensitive receptor, to represent a reasonable worst-case assessment). The noise levels presented assume free-field conditions to enable direct comparison with the measured ambient noise levels at the noise-sensitive receivers. This table suggests, indicatively, that at distances of up to 200 m World Health Organisation (WHO) day-time threshold of 55 dB could be exceeded.

As the majority of residential properties are not in close proximity to the canals and therefore the likely site of the construction works, their sensitivity is considered to be High and therefore the overall impact within 200 m to be **Major to Moderate Adverse** and **Minor Adverse to Negligible** beyond 200 m. These effects are felt during the period of the noisy activity and therefore are likely to be intermittent.

Table 9-6. Indicative construction activity and associated noise level over varying distances

Construction Activity	Construction Activity noise level dB $L_{Aeq,T}$ at receiver (m)									
	10	20	30	40	50	60	70	80	90	100
Demolition	80.1	74.1	70.5	68	66.1	64.5	63.2	62.0	61.0	60.1
Earthworks	76.7	70.7	67.2	64.7	62.7	61.2	59.8	58.7	57.6	56.7
Construction	75.5	69.5	65.9	63.4	61.5	59.9	58.6	57.4	56.4	55.5
Construction Activity	Construction Activity noise level dB $L_{Aeq,T}$ at receiver (m)									
	125	150	175	200	225	250	275	300	325	350
Demolition	58.1	56.6	55.2	54.1	53	52.1	51.3	50.5	49.8	49.2
Earthworks	54.8	53.2	51.9	50.7	49.7	48.8	47.9	47.2	46.5	45.8
Construction	53.5	52.0	50.6	49.5	48.4	47.5	46.7	45.9	45.2	44.6

Vibration

Potential impacts include:

- Vibration impacts arising from construction activities due to vibration inducing equipment/items of plant including construction associated traffic on nearby sensitive receptors

Vibration emission sources include:

- Heavy and vibration inducing construction equipment/machinery

Vibration levels from mobile heavy construction equipment are generally considered to be imperceptible at distances greater than around 20 m from the source. Given the distance of receptors to the canals and therefore likely distance from the construction works, it is considered that the impact of vibration is unlikely to occur and therefore is insignificant. Once working methods and confirmed plant schedules are available from the Construction Contractor the potential to induce perceptible vibration levels at nearby receptors and should be considered in further detail.

9.4.1.3. Mitigation Measures

Mitigation measures are as follows:

- Advance warning should be given to local communities regarding construction activities (e.g. construction schedule). Detailed engagement with those in premises (residential or other) within 300 m of the works front, in advance of the works. Community grievance mechanism must be put in place and disclosed.

Air quality

An Air Quality Management Plan will be prepared and implemented. All works will be undertaken in accordance with national laws and best practice. Control measures will include:

- Contractor to comply with national dust emission standard.
- All construction staff including drivers will be inducted for environmental awareness and site procedures, for example vehicle speed, use of designated roads.
- Crusher site and mixing plants shall be located at a distance of at least 500 m to 1 km downwind from sensitive receptors. The crusher site will be cleaned on regular basis to remove fine dust.
- Regular dust suppression (watering based on 2-4 litres/m^2) along roads and the earthwork sites where necessary (i.e. dust is being generated). Use wheel washes, shaker bars or rotating bristles for vehicles leaving the site where appropriate to minimise the amount of mud and debris deposited on the roads.
- Enforce speed limits for all construction vehicles of no more than 20 km/h.
- Earth material transporting trucks shall be covered with tarpaulin.
- During demolition works destruction dust shall be suppressed by ongoing water spraying and/or installing dust screen enclosures at site.
- PPE will be provided to workers exposed to dust.
- Construction vehicles will strictly follow approved deviation routes to avoid creating multiple earth tracks.
- Soil stripping during windy periods will be prohibited.
- Conduct regular visual inspections of air quality at active construction sites.
- Parked construction vehicles and equipment will not be located in proximity to sensitive receptors (e.g. health centres, schools, residential properties).
- Cover stockpiles.
- All project staff including drivers to be inducted for environmental awareness and site procedures, for example vehicle speed, use of designated roads.
- Erect visible signs informing site road traffic of permissible routes.
- Where practicable, implement a wheel washing system dislodge accumulated dust and mud prior to leaving the sites.
- Prohibit bonfires and burning of waste materials.
- Rehabilitate disturbed areas as soon as practicable.
- Emission of pollutants from the vehicles and machineries shall be measured in accordance with national standards.
- Construction vehicles shall be inspected at the start of construction and regularly to ensure the vehicles meet relevant emission standards. Equipment and machinery will be maintained to manufacturers' specifications by regular servicing to maintain efficiency in combustion and reduce carbon emissions.
- Vehicles and machinery that meets the emission standard only shall be allowed to operate.
- No excessive idling of construction vehicles at sites.
- Daily visual inspection of dust and emissions (e.g. smoke from exhausts) at active construction sites.
- Prohibit idling of road construction machinery.

Noise and Vibration

A Noise and Vibration Management Plan will be prepared and implemented. All works will be undertaken in accordance with national laws and best practice. Control measures will include:

- Ensure all staff and operatives are briefed on the requirement to minimise noise nuisance.
- Use of attenuation measures such as silencers/enclosures where appropriate.
- Avoidance of unnecessary sounding of horns.
- Construction machinery and equipment will not be revved unnecessarily and will be turned off when not in use.
- Establishment of agreed criteria whilst undertaking significantly noisy or vibration-causing operations near to sensitive locations.

- Noise-generating works in urban areas will be undertaken during normal working hours i.e. Daytime (07:00-19:00), and Saturday (07:00-13:00). These hours should be disclosed and agreed with receptors within 300 m in advance of the works.
- Work during the evenings (19:00-23:00 weekdays; 13:00-23:00 Saturday, 07:00-23:00 Sunday) and night time (23:00-07:00) should be avoided where receptors are located within 300 m of the works. Where this is not possible, advance warning should be given to those potentially affected and the grievance mechanism disclosed to those potentially affected.
- Daily auditory monitoring of noise levels when working near receptors (i.e. in towns or near properties).
- Where necessary, i.e. due to grievances, monitoring of noise at NSRs.
- Maximum speed limit for all construction vehicles is 20 km/h.
- Equipment maintained in good condition with regards to minimising environmental noise and vibration as well as workers exposure to harmful noise and vibration and will be maintained regularly. Noise-generating devices should be maintained in good operating condition with regular maintenance.
- Temporary site/facility siting:
  - Work accommodation camps, construction facilities, laydown and storage areas and access roads will be located at least 500 m from NSRs.
- All construction machinery and equipment will be:
  - In conformance with relevant national or international standards, directives or recommendations on noise or vibration emissions.
  - Modern and maintained regularly, paying attention to all noise-reducing devices, silencers or mufflers.
  - Subject to preventive inspections and planned maintenance in order to maintain in good condition with regards to minimising environmental noise and vibration as well as workers exposure to harmful noise and vibration.
  - Positioned appropriately to minimise noise at sensitive locations.
  - Started up sequentially rather than simultaneously.
  - Engines of machinery and equipment not revved unnecessarily and should be turned off when not in use.

9.4.1.4. Residual Effects

Residual effects from dust arising from construction activities are considered to be **Moderate Adverse** as mitigation measures cannot fully control dust in an existing dusty and windy environment. However, this adverse effect will generally only occur for the period of time of the dust generating works.

Gaseous emissions from construction vehicles and equipment are considered to be **Minor Adverse**. With relevant mitigation measures in place and considering the short-term nature of the impact on receptors, it is concluded that gaseous emission on air quality will not be significant during construction.

There is the potential for short-term **Moderate and even Major Adverse** in relation to noise emissions within 200 m even with mitigation in place. However, as the majority of receptors are likely to be at a distance of greater than 200 m, in general only **Minor Adverse to Negligible** effects are predicted.

Negligible and therefore insignificant effects in relation to vibration are predicted.

9.4.2. Operation

9.4.2.1. Methodology

A qualitative assessment has been undertaken based on the infrastructure proposed as part of the Project.

9.4.2.2. Potential Impacts

No specific aspects of the proposed 2022 FS design are identified as likely to generate significant air, noise or vibration emissions. No new pumps are proposed that would generate. Whilst the details of on-farm irrigation systems is not known, the likely systems are unlikely to result in significant adverse effects as it is not anticipated that on-farm systems will use equipment with air or noise emissions beyond short term, very localised impacts.

During operation, there will be requirements for O&M activities that could lead to isolated and short periods of noise and air emissions and O&M related traffic. However, maintenance in general will be on an in-farm basis and therefore significant emissions are not anticipated.

9.4.2.3. Mitigation Measures

No mitigation measures are required.

9.4.2.4. Residual Effects

A **Negligible** effect is anticipated.

9.5. Soil Quality and Fertility

9.5.1. Construction

9.5.1.1. Methodology

A qualitative assessment has been undertaken, based on consideration of the the following aspects of soils:

- Topsoil - topsoil is highly fertile soil with the presence of organic matter and important nutrients and is therefore considered a receptor of high sensitivity.
- Land/soils - the irrigated area may induce/reduce soil erosion and is considered a receptor of high sensitivity.

Other sensitive receptors that could be affected by soil erosion and contamination include land/water users, humans, irrigation canals and rivers, and biodiversity. These are considered, as appropriate, within the relevant topic assessments.

9.5.1.2. Potential Impacts

Potential impacts include:

- Loss and deterioration of soils from excavation, removal and stockpiling
- Compaction where soils are left *in situ* but are subject to traffic loads
- Potential soil loss through erosion where vegetation is disturbed or removed
- Contamination as a result of accidental spillage of fuels or chemicals and/or potential to encounter contaminated land

Pathways are the means by which an activity can affect a receptor. In some cases, this may be a physical migration pathway, such as a movement of contamination through soil/groundwater, or it may be the inherent nature of the activity itself; for example, excavation of soil will have a physical impact on the soil. The main pathways considered are summarised below:

- Removal of soils during earthworks
- Clearance of vegetation
- Construction vehicle movements
- Temporary storage and access roads, if required
- Stockpiling
- Use of machinery
- Construction wastes and wastewater
- Potentially contaminated land

Loss and deterioration of soils

During construction topsoil is expected to be directly affected. The soils' resilience and recoverability are considered to be low as soil formation is a long-term process and there is no natural resilience to imposed stresses.

Although no new canals are proposed, some excavation may be required to rehabilitate and modernise the existing canals. The amount of topsoil layer to be removed will be clarified during detailed design. Removed topsoil will be stored on pre-selected areas and after completion of works it will be used for cultivation of marginal zones. Soils to be impacted will mainly be existing farmland or land that was previously farmed but is not currently.

Inappropriate storage (e.g. stockpile too high) or storage for too long may result in loss of soil structure, which can increase the risk of soil deterioration, including encouraging processes such as soil erosion and soil compaction. The loss of soil structure also potentially impacts organism activity, water retention capacity and nutrient retention capability. In general, it will be possible to reverse the impact of storing topsoil as long as the soils are stockpiled in accordance with best guidance and are not stockpiled for too long.

As topsoil are a receptor of High sensitivity, and the magnitude of impact could be Medium, the overall significance of the loss of topsoil, without rehabilitation, would be **Major Adverse.** If the topsoil is used by spreading on the cultivated land, then it is a **Minor Adverse.**

Soil disturbance, either directly or indirectly, is also anticipated as a result of the works footprint, stockpiling and compaction. Erosion and deterioration of soils may occur where vegetation is disturbed or removed. Overall, the likelihood of the impact to occur is relatively low and highly localised. As such, the magnitude of the impact has been classified as Very Low and the overall significance of the effect related to loss from erosion to be **Minor Adverse**.

Compaction of soils

There is an increased risk of compaction in areas where soils are left *in situ* but are subject to construction traffic loads and the presence of stockpiles. The soils' ability to recover from compaction is considered to be medium due to the long-term nature of soil formation however the soils' resilience to imposed stress is potentially low and therefore is a receptor of High sensitivity. The impact will be highly localised and possible to reverse in temporary construction areas. Consequently, the impact magnitude has been classified as Low. The overall significance of the effect without mitigation measures is **Moderate Adverse**.

Potential contamination of soils and risk and/or potential to encounter contaminated land

There is a risk of contamination of soils from leaks and minor spills during the handling and storage of fuels and chemicals, for example during refuelling and operation of plant, washing of equipment; and inappropriate management and storage of wastes, including wastewaters. Based on the anticipated activities and materials to be used during construction an unmitigated spill or leak would be of minor extent and recover in several years and is considered an impact with a potential Low magnitude. Soils are receptors of High sensitivity therefore the overall significance of contamination, if it were to occur, is assessed as **Moderate Adverse.**

There is also the potential for encountering contaminated soils during construction, which could affect humans – human health is addressed in section 9.8.

9.5.1.3. Mitigation Measures

Mitigation measures are summarised below and would be incorporated into a Soil Management Plan and Spill Management Plan.

<u>Soil loss and disturbance</u>

General

- Maintenance of machinery and equipment shall be conducted in a designated area where the conditions are not adverse to the soil and the environment.
- Construction sites should be properly organized. This will reduce the amount of size of degradation area. Area demarcation, vehicle movement and vegetation clearing only within footprint area for rehabilitation works.
- Additional construction haul roads will be avoided where possible to avoid multiple earth tracks.

Soil stripping and stockpiling

- Topsoil shall be stripped and stored in accordance with relevant standards (Technical Regulation of Georgia on Stripping, Stockpiling, Use and Reinstatement of Topsoil (2014)).
- Topsoil stripped shall be separately stored in topsoil stockpiles.
- Ensure that the following parameters have been met for any topsoil stockpile:
    - maximum height is 2 m;
    - length is 30-50 m;

    - lateral slopes shall not exceed 20 degrees; and
    - the top compacted
- Topsoil stripping during heavy rains will not be allowed;
- No storage at less than 25 m from river/streams, subject to the site specific topography.
- Topsoil shall be stored in a manner that is less susceptible to wind to enable re-use of topsoil for rehabilitation;
- Topsoil stockpiles shall be used for rehabilitation;
- In the event that the stockpiles experience significant erosion the contractor will be required to implement corrective action, such as installing erosion matting over the stockpiles if further surface compaction and/or topsoil seeding fails. The Contractor shall protect the stockpiles from flooding and run-off by placing berms or equivalent around the outside where necessary.

Compaction of soils

- Heavy duty trucks and equipment to strictly follow approved tracks.

Potential contamination of soils and risk of encountering potentially contaminated soils

- Best practice management should be applied to mitigate impacts from oil and fuel spillage including during regular maintenance of vehicles and equipment.
- The Contractor should develop and implement detailed Spill Prevention and Response Plan for the management of all chemicals, fuels and oils used during the Project, including the septic tanks and diesel generators;
    - Use of the sawdust, sand, cloth or special synthetic absorbent material to avoid spreading of soil contamination in the event of an oil spill event;
    - The layer of soil contaminated should be removed and disposed of in agreement with the MEPA;
    - On-site environmental and safety staff shall be trained with neutralization skills;
    - Spill kits shall be kept in accessible locations at all times during construction, and employees trained in their use and disposal; and
    - Strict procedures will be followed when refuelling to minimise the risk of spills to the environment.
- To minimise the potential for leaks or spills all bulk materials used and wastes generated during the construction activities that have the potential to pollute will be stored within appropriate storage facilities (bunded, secondary containment) and procedures will be implemented for handling, storage, transport and transfer, subject to a full method statement to address construction risks and avoid impacts; these requirements will be set out in a detailed Waste Management Plan.

9.5.1.4. Residual Effects

With the application of the above measures, residual effects on soils from loss and deterioration are considered to be reduced to **Minor Adverse**. Land will be disturbed during the construction period, however the relative permanent land take will be limited. When construction is completed, it is intended that all topsoil will be reused (by spreading on the land or around the constructed area) and therefore not lost.

With the application of the above measures, residual effects on soils from compaction are considered to be reduced to **Minor Adverse**.

With the application of the above measures, residual effects on soils the risk of encountering potentially contaminated soils are considered to be reduced to **Minor Adverse to Negligible**.

9.5.2. Operation

9.5.2.1. Methodology

The same methdology as identified in 9.4.1.1 above has been applied for the operational impact assessment.

9.5.2.2. Potential impacts

Although the ZSIS was originally designed to irrigate 41,000 ha, currently around 5,320 ha (13% of the design command area) is irrigated, while the remaining area is not currently irrigated for a variety of reasons discussed earlier in this report. Under the proposed FS, agricultural activities will be undertaken on a net annual potential irrigated area of 17,216.4 ha. This therefore represents an increase of 11,896.4 ha under irrigation.

Potential impacts include:

- Changes to soil properties including salinization
- Compaction where soils are subject to cultivation practices and farm machineries
- Potential soil loss through erosion where vegetation is disturbed or removed or desertification
- Contamination as a result of accidental spillage of fuels from farm machineries or chemicals from fertilisers, pesticides and herbicides and/or potential to encounter contaminated land

The main pathways for impacts to occur during operation are:

- Use of fertilisers, pesticides, herbicides and weedicides
- Farm machinery movements
- Vehicles carrying farm inputs and produces
- Use of ZSIS for grazing
- Wind erosion
- Water erosion pathway if inappropriate irrigation techniques are used, and water volumes are delivered in excessive amounts
- Associated buildings for storage

The application of fertilisers, deposits of chemicals through water, spillages from farm machinery, erosion and the work associated with the agricultural development could result in potential adverse impacts on land, water and habitats. These impacts are discussed in turn below.

Salinisation

Salinisation in the long run is due to application of water with poor quality, shallow groundwater level and/or soil chemical properties. Soil salinization is mainly due to composition of salts in the soil, the quantity and quality of irrigation water, irrigation and drainage method applied, and the fertilisers added.

The Project Area is formed of Chromic cambisols including gypsum and part of the terrain has been mined for this mineral. Salinisation is often observed in these soils. Other soils are grassland chromic cambisols and vertisols which are less prone to salinisation.

The risk is of salinisation is reasonably limited when irrigation takes place with the water from Sioni reservoir given its better quality. The risk is higher however if water from Lochini river and Chumatkhevi creek are used without proper dilution as their base flows are comparatively saline when compared to the Iori River. This is therefore more likely to affect the LMC and LMMC.

Inadequate drainage of excess water could result in waterlogging and increased soil salinity. Overuse of water my raise the saline groundwater table and could contribute for the increase of salt at the root zone of the crops and may affect crop production.

Negative effects of salinisation are:

- Depresses microbiological activities including soil respiration and enzyme activities;
- Degrades soils physical condition and damages to soil structure;
- Reduces water and nutrient intake capacities; and
- Ultimately reduces crop yield.

Soils are receptors of High sensitivity. In this case, as soil and water quality for this scheme is considered good to poor, the impact magnitude is considered Very Low to Low. Therefore, the overall significance of soil compaction is assessed as **Minor to Moderate Adverse** (Moderate adverse in areas of gypsum).

Soil Compaction

The compaction of soil in agricultural areas is normally a result of using farm equipment during cultivation and harvesting, sometimes as a result of natural soil farming processes such as the impact of raindrops and runoff, and irrigation water movement which carries clay and silt particles to clog pore spaces in the sub-surface soil.

The negative effects are:

- Reduces water infiltration due to clogging of pore spaces;
- Increases runoff, erosion and water ponding on the surface;
- Reduces water holding capacity of soil column;
- Reduces soil aeration and nutrient availability;
- Impedes root growth; and
- Ultimately reduces crop yield and affects the topsoil texture and structure.

Soils are receptors of High sensitivity. Heavy farm equipment is used in parts of the Project Area, especially for maize harvesting, though is less common on the smaller, household farms. With an increased area under irrigation (around 11,896 ha more than the 2021 area), and possible consolidation of smaller plots into larger production units, it can be anticipated that there will be an increase in the use of farm equipment. The predicted magnitude of impact is considered Low to Medium. As soils are receptors of High sensitivity, the overall significance of soil compaction is assessed as **Moderate to Major Adverse.**

Erosion

Agricultural practices (for example soil tillage, irrigation application and crop root growth) break the soil column, and eroded soil is then transported by either wind, rain, runoff or irrigation. The negative effects are:

- Loss of productive topsoil;
- Reduces available water in the soil;
- Reduces soil nutrients availability;
- Pollutes waterways;
- Eroded soil can contain nutrients, fertilisers and pesticides and increase nutrification of water bodies; and
- Increases particles of soil in the air through erosion from the wind.

In the Project Area there is a widespread risk for increased erosion by wind as the existing natural grass cover will be replaced by cultivated plots which have exposed soil surfaces for considerable periods of the year. There already exist artificial tree plantations in the form of windbreaks along the arable lands.

Overgrazing is very common in Georgia, especially for winter pastures such as in the command area. Erosion may therefore occur from potential overgrazing from free-roaming cattle and (seasonally) sheep, though the expansion of crop cultivation may also reduce this risk as there could be less livestock.

Furthermore, wind erosion is currently known to be an issue as there the area experiences periodic high wind velocities. The predominantly loamy soils are susceptible to aeolian transport especially if the soil is left uncovered after the fall ploughing until spring.

The magnitude of the potential impact in the Project Area is considered Medium given the wind velocities and known erosional issues, and the soils are receptors of High sensitivity resulting in a **Major Adverse** effect prior to mitigation.

Soils in the Project Area are also susceptible to water erosion and have marked existing gullying from hydraulic erosion. For example, the soils of both the Lilo Martkopi slopes and the Sartichala and Lemshveniera sectors are erodible, and care must be taken to prevent degradation in the long term. The black soils, (loamy clay) vertisols of Sartichala and Lemschveniera crumble at the surface when dry and these soil particles may be carried with runoff water in the case of heavy rain or excessive irrigation flows. The soil also liquefies due to lack of cohesion when submerged so that again soil particles can be carried away with flowing water.

The subsoil of the slopes downhill of the Lilo Martkopi canal are a friable agglomerate of sand, loam and peddles which is readily washed out by flowing water and which results in ravine formation. Extensive damage is caused by leaking irrigation infrastructure. A ravine, 22 m deep, was created by the release of water from UMC G9 into an unlined channel. The stability of the terrain at such existing ravines is uncertain.

There are also locations with landslides in the upstream part of the UMC. One such slide was caused by a defective lining of an interceptor ditch.

Soils are receptors of High sensitivity. In this case, hydraulic soil erosion is common in the study area, the magnitude of impact is considered Medium; therefore, the overall significance of soil compaction is assessed as **Major Adverse.**

Soil Contamination

Irrigated agriculture is a significant source of soil and water contamination, emanated from agro-chemicals (fertilisers, pesticides, and herbicides) application, spillages from farm machineries and poor quality of irrigation water. In particular, the quality of the irrigation water collected from the Upper Channel Samgori, Lilo contains exceeded MPC in the previous ESIA was poor. Furthermore, as shown in Figure 6-18 in Section 6, wastewaters are discharged untreated into the irrigation in some areas such as Varketili and the LMC.

The negative effects of soil contamination are:

- Alter the physiochemical properties and increased concentrations of some pollutants may cause reductions in the yield;
- High concentration of heavy metals can affect the environmental health of crops, flora and fauna;
- Nutrification and eutrophication of water bodies; and
- Food and animal safety.

Soils are receptors of High sensitivity. The magnitude of impact associated with fertilisers etc. is considered to be Low currently, though may increase to Medium in the future given the expansion of the Project Area and the requirement for fertilisers etc given the soils, especially on chromic cambisols. Therefore, the overall significance of soils and indirect receptors such as fauna is assessed as **Moderate to Major Adverse.**

9.5.2.3. Mitigation Measures

Mitigation measures are summarised below and should be incorporated into an Operation and Maintenance (O&M) Plan.

Soil salinisation

- Provide enough drainage facilities to maintain leaching;
- Manage quantity of fertiliser application, method of application, fertiliser scheduling;
- Manage irrigation water quantity and quality applied and adopt irrigation scheduling including sufficient water for leaching – this may include water quality sampling and measuring ground water levels at the start of the project operations and at regular intervals thereafter to monitor the impact of the water quality on the soils;
- Grow the right type of crops and in rotation to reduce soil salinization and to maintain soil structure and nutrient levels. It also prevents continuity of soilborne pests;
- Classify irrigation field according to soil salinity class and grow salt tolerant crops on saline plots;
- Use of mulching to reduce evaporation;
- Train farmers to avoid overuse of water in the irrigation field and the excessive application of fertilizers and pesticides;
- Apply periodic leaching of saline soils; and
- Introducing organic compost and manure in increase soil organic carbon content in the soils.

Compaction of soils

- Minimise the farm machinery use to reduce soil compaction, especially when the soil is wet;
- Alter the farm machinery to reduce the axle loads, lowest allowable tyre pressure, etc;
- Adopt conservation agriculture to reduce disturbance to the soil and thus reducing the compaction of soils;
- Soil mulching or leaving plant residues will reduce the impact of raindrop and irrigation water. It will also increase the organic matter content of the soil;
- Crop management practices such as cover crops, crop rotation, direct seeding, increase the levels of soil organic matter;
- Crop rotation with annual crops which can penetrate compacted soil layers and utilise natural wetting-drying and freeze-thaw cycles to mellow the soil; and

- Irrigation management through wetting-drying cycles to increase aeration and induce natural soil processes.

Soil Erosion

- Adopt conservation agriculture approach (less ploughing and tilling) to protect soil from erosion and degradation. This will also improve to retain soil nutrients and reduce disturbance to the soil structure;
- Encourage farmers to sow a cover crop on ploughed land to reduce the velocity of the wind which reaches the exposed soil surface. Cover crops could be plant roof covers, as natural plants or selected species for sowing;
- Provide plant residue cover to reduce the impact of raindrop and splash;
- Application of manure in a mixed farm system should be promoted, as organic matter of soils plays a crucial role in maintaining the stability of the soil structure. Livestock and crop production should be integrated. The manure produced by the chicken farms could be digested and the effluent applied as organic manure;
- Provide adequate drainage facilities to reduce soil salinization, as erosion and stormwater control measures and even to lower the groundwater level below the root zone;
- Ploughing of contour levees across long slopes with grassed outfalls to drains. Information on the distance between such levees, their slope and arrangement of out falls should be disseminated to farmers;
- Restoration and maintenance of the existing system of interceptor drains, berms and road side ditches; Existing ravines could be stabilized by building up gabion retention walls where the bed leaves the eroded formation and forms its dejection cone. The gabions could be built up in steps allowing consolidation in between the addition of every next layer of gabions. Extreme prudence is required as, given the very high vertical sides of the ravines, there is considerable risk of collapse so no excavation or compaction can be done;
- Leaking irrigation infrastructure along canals in areas of gullying must be prevented or repaired within days after occurrence;
- Status of drains and infrastructure to be reviewed in annual inspections;
- Established tracks to be used to avoid additional erosion paths; relevant signage for access roads to be put in place;
- Apply windbreak plantations to protect the soil from wind erosion. Functional wind breaks will reduce overall wind velocities. Wind breaks should be continuous and include hedges which prevent funnelling of the wind near the soil.

It is recommended to promote and support the establishment of wind breaks and to allow the farmer who has an adjacent plot to lease the wind break at low or no cost land against an obligation to maintain the wind break giving him all benefits and fruits from the wind break. It is recommended to combine the black poplar, plum trees and Italian poplar used in the past with the insertion of nuts and fruit trees in the alignments as well as thorny hedges to close the gap at the ground level using such species as the endemic bar berry, and the local Wild citrus species in this way also providing a hedge.

The Eptisa 2018 ESIA Report identified that it may be interesting to consider the experimentation with (and subsequent promotion of) the “Agriculture Food Forestry Systems” (AFFS), in which fruit trees (combined with incentivised wood/fuel wood trees) act as wind breaks. In the figure below a schematic comparison between the ZSIS agricultural system and AFFS is presented.

The principles of the AFFS are:

- Plant trees which “pump” water and minerals from the deeper layers to the surface in the plant were organic matter is produced.
- Prune the trees constantly to optimize the organic matter production.
- Use the organic matter to produce layers on the surface in a way that the soil surface is covered.
- Work the organic matter into the soil and don’t use chemicals.
- Combine (fruit) trees with other crops to produce food.
- Irrigation can accelerate the process.
- Use machines to decompose organic matter to accelerate the process.

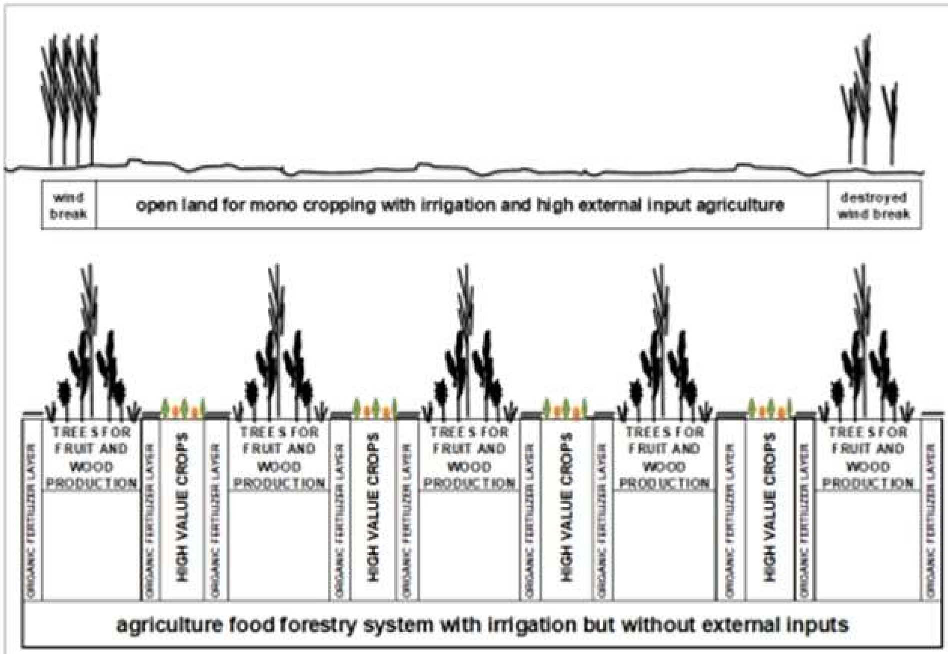


Figure 9-2. ZSIS agricultural system and AFFS Sketch

- Encourage farmers to sow a cover crop on the ploughed land to reduce the velocity of the wind which reaches the exposed soil surface.
- Application of manure in a mixed farm system have to be promoted. Livestock and crop production should be integrated. The manure produced by the chicken farms could be digested and the effluent applied as organic manure.
- Promote the ploughing up of contour levees across long slopes with grassed outfalls to drains. Information on the distance between such levees, their slope and arrangement of out falls could be disseminated.

<u>Soil contamination</u>

- Apply organic farming practices to avoid excess chemical usage;
- Include small-scale meteorological stations to provide farmers with the ability to take informed decisions about irrigation, use of pesticides, etc.
- Filtration of irrigation water to reduce soils contamination;
- Undertake regular soil tests to apply right quantity of fertilisers;
- Check irrigation water quality and apply right quantity to reduce salinization with adequate leaching and erosion;
- On-site WUO members shall be trained with neutralization skills;
- Use of sawdust, sand, cloth or special synthetic absorbent material to avoid spreading of soil contamination in the event of an oil spill event;
- Create designated collection points for domestic and hazardous waste;
- Domestic wastes should be disposed of at approved places;
- Maintenance of machinery and equipment used in farms shall be conducted in a designated area where the conditions are not adverse to the soil and the environment.

9.5.2.4. Residual effects

With the application of the above measures, residual effects on soils from salinisation are considered to be reduced to **Minor Adverse** (in gypsum soils) to **Negligible** (other soils).

With the application of the above measures, residual effects on soils from compaction are considered to be reduced to **Minor Adverse** or **Negligible.**

With the application of the above measures, residual effects on soils from wind erosion is considered to be **Minor Adverse** and from hydraulic erosion, **Minor to Moderate Adverse.**

With the application of the above measures, residual effects on soils from contamination are considered to be reduced to **Minor to Moderate Adverse**.

9.6. Materials Use and Waste Management

9.6.1. Construction

9.6.1.1. Methodology

As there is no published guidance for assessing the impacts of materials use, waste and waste management, and detailed design information is not currently available, a qualitative approach has been taken.

9.6.1.2. Potential Impacts

Material Use

Potential impacts include:

- Impacts associated with material use e.g. borrow pits, if required

Sources of impact on material resources and waste management include:

- Demand for construction materials e.g. concrete
- Borrow pits, if used

Potentially sensitive receptors include:

- Project and third-party waste facilities
- Construction workers
- Flora and fauna (including livestock)
- Surface water bodies and ground water
- Soils

The consumption of natural and non-renewable resources will have an adverse impact on material resources. The potential for significant effects depends on the volumes required, origins and sources of materials, including their general availability (production, stock, sales) and the proportion of recovered (reused or recycled) materials they contain. The main resources required for construction of the Project include concrete and water.

There is limited data on the specific requirements given the stage of the Project and that the Construction Contractor is likely to dictate the final types and quantities of materials required; therefore, the ultimate sourcing and quantities of materials is not currently known. It is assumed that the majority of the materials are likely to be procured in country, from existing resources. This will result in a reduction in available materials. Where existing sites are used, however, this will reduce the potential damage caused to the topsoil and subsoils as a result of formation of new quarries or borrow pits.

It is also likely that primary materials consumption will be reduced by the reuse of material generated through excavation arisings where possible.

The natural resources required for the Project are therefore considered generally available in the region and therefore of Low sensitivity, and the magnitude of the requirement Medium, resulting in a **Minor Adverse** effect.

Waste

Potential impacts include:

- Impact of excavated materials and their management / disposal
- Potential waste streams likely to be generated during construction and impacts associated with waste management, including disposal and capacity of existing waste management facilities

Sources of impact on material resources and waste management include:

- Demolition works e.g. rock, concrete debris and metals from existing canals
- Earthworks including excavating, site clearance and land levelling
- Construction works, including construction equipment repair and maintenance
- Any worker's accommodation camps

Potentially sensitive receptors include:

- Project and third-party waste facilities
- Construction workers
- Flora and fauna (including livestock)
- Surface water bodies and ground water
- Soils

The types of waste and main works that will give rise to these wastes are set out on Table 9-7, together with proposed waste management procedures. No details are currently available on volumes.

Table 9-7. Waste types to be generated during construction phase and proposed management procedures

Works	Activity	Waste type generated	Proposed waste management
Preparatory works	Vegetation clearance	Vegetation waste - significant amount of biodegraded waste such as vegetation removed from and along canals will be generated.	To be left on-site where possible. Timber shall be transferred to local authorities. Remaining vegetation to be removed to landfill.
Demolition / Reconstruction	Reconstruction of existing canals	Waste construction and demolition materials, non-contaminated by asbestos (bulky demolition waste)	Materials to be recycled (on or off site) or screened and re-used (on or off site). Removal by track to landfill.
Excavation	The majority of materials generated during the construction phase are anticipated to be excavated soil for reconstruction of canals.	Contaminated soil (including excavated soils)	Removal by track to landfill. Soils to be used as backfill around structures. Soils to be left on-site and graded to levels. Soils to be recycled (on or off site) or screened and re-used (on or off site).
Construction	Non-hazardous waste, such as construction debris, packaging waste, waste wood and metals	Paper and cardboard waste	Recycled.
		Mixed metals	Recycled.
		Waste tires	Removal by track to landfill.
		Waste construction and demolition materials, non-contaminated by asbestos	Removal by track to landfill.
		Concrete waste	Recycled. Removal by track to landfill.
		Packing materials contaminated by mineral and synthetic oils	Removal by track to landfill.
		Wastes from illegal dumping. As revealed during field visits illegal dumping of solid waste occurs adjacent to the main canals of ZSIS. This is mainly construction waste, consisting of the soil, blocks, bricks and concrete debris.	

Works	Activity	Waste type generated	Proposed waste management
	Hazardous waste such as paint and emulsion and fuels.	Paint and coating residues	Collected by third parties, i.e. licensed specialist companies.
		Spillage control materials used to absorb oil and chemical spillages	Collected by third parties, i.e. licensed specialist companies.
		Chemicals, such as anti-freeze	Collected by third parties, i.e. licensed specialist companies.
		Spent engine oils and lubricants	Collected by third parties, i.e. licensed specialist companies.
		Machine/engine filter cartridges	Collected by third parties, i.e. licensed specialist companies.
		Oily rags, spent filters, contaminated soil, etc.).	Collected by third parties, i.e. licensed specialist companies.
Workers on site, illegal dumped Municipal Solid Waste (MSW), workers' accommodation camps (if used)	MSW	MSW is anticipated to arise from the site-based workforce during construction, in particular at the construction camps. Also MSW from illegal dumping in the study area. This includes non-hazardous solid wastes such as office, kitchen, and domestic wastes.	Removal by track to landfill - Illegally disposed waste must be removed from the project site before commencement of construction work and disposed on the nearest municipal landfill.

As the majority of the works require modernisation, with no new canals, the impact magnitude for excavated wastes is considered to be low to medium.

Reconstruction of canals is likely to result in the generation of a medium quantity of construction wastes.

Whilst sufficient details are not currently available, it is envisaged that based on similar construction projects that a medium to high magnitude of wastes will arise in relation to the generation of other construction wastes. This will include general construction wastes, MSW and hazardous wastes.

It may be possible to re-use some excavated materials on site. For all other wastes, there will be a need for their disposal at the local landfill and, in the case e.g., hazardous wastes, to specific licensed companies. Given the availability of the local landfill, which is considered a receptor of low sensitivity, a **Negligible to Minor Adverse** effect is predicted in relation to excavated wastes and a **Minor to Moderate Adverse** effect in relation to management of demolition and construction wastes. This is most likely to be Moderate Adverse if a construction camp is required.

In relation to hazardous wastes, only small amounts are anticipated (low) however, as there are fewer hazardous waste facilities they are considered to be of Medium sensitivity and therefore a **Minor Adverse** effect in relation to the management of hazardous waste is predicted.

There are potentially a number of risks to human health and the environment that may be associated with the handling, storage and disposal of waste, both on and off-site. Inadequate management of wastes can also have adverse impacts on human health, including potential hazards of handling hazardous substances include inhalation of hazardous vapours and corrosive reactions to body parts; Fire hazard; and Potential for reaction between incompatible chemicals; as well as runoff on to local crops which could then be ingested. Humans are considered to be receptors of High sensitivity and the environment, Medium. Without appropriate mitigation measured in place, the magnitude of the impact could be Low to Medium, resulting in a **Moderate to Major Adverse** effect.

9.6.1.3. Mitigation Measures

Material Use

Wherever possible, the efficient use of materials will be sought. This includes re-use of materials on site wherever feasible e.g. using excavated materials for aggregate and embankments. Targets should be set within the Construction Materials Use and Waste Management Plan for recycling and re-use on site.

Waste

According to Waste Management Code of Georgia if over 200 tonnes of non-hazardous waste or over 1,000 tonnes of inert materials or any volume of hazardous waste is generated annually as a result of Contractor's activities, they shall prepare and ask the Ministry of Environment and Natural Resources of Georgia to approve the Waste Management Plan for the Company, report on waste inventory and appoint an environmental manager, and submit an information on his/her identity to the Ministry of Environment and Natural Resources of Georgia in accordance with requirements of the "Waste Management Code".

Regardless of total wastes anticipated, a detailed Construction Materials Use and Waste Management Plan will be prepared by the Construction Contractors. Control measures to be included in the Plan include the following:

- The waste hierarchy should be applied in construction planning to ensure efficient use and management of resources so that priority is to prevent generation of waste at source (i.e.: smart purchase approach by estimating the amount correctly and efficient use of materials so that no surplus material that might end up as a waste) and facilitate waste recovery wherever possible.
- Contractors should pre-determine types and amount of hazardous, non-hazardous and inert waste to be generated as much as possible in order to enable planning of management actions effectively prior to construction (i.e.: define location and volume of waste dumpsites, storage, transportation and disposal of hazardous waste, and waste disposal methods etc).
- Provide construction workers with training on waste management to improve knowledge and awareness on reducing waste generation, waste types and their classification, and project waste management rules.
- Provide all vehicles/drivers waste collection sacks to prevent any unauthorized waste disposal.
- Equip construction areas with containers for collection of domestic and construction waste and spent fuel and lubricants. Each designated waste storage area will be equipped with waste skips, containers or bins for temporary storage before recycling, treatment or disposal off site.
- No storage will be permitted within 50 m of rivers/streams/canals.
- The designated waste storage area will be located away from surface water drains and areas which discharge directly to the water environment.
  - Temporary storage areas for inert and non-hazardous waste will;
  - be placed in areas with minimum fire and explosions risks;
  - be easily identifiable and clearly signed; and
  - have periodic inspections and findings documented.
- Waste storage containers will be:
  - clearly labelled – to describe the contents using the appropriate waste labels which shall be completed;
  - old labels shall be removed to avoid confusion;
  - appropriate to the waste they contain;
  - appropriately sealed (e.g. with a lid or cover); and
  - not emitting any harmful gases or generating heat.
- Waste will be stored in a manner that:
  - prevents a contact between incompatible wastes; and
  - allows for inspection between containers to monitor leaks or spills.
- Hazardous waste will be stored in closed containers away from direct sunlight, wind and rain.
- Secondary containment systems will be constructed with materials appropriate for the wastes being contained and adequate to prevent loss to the environment.
- Secondary containment is included wherever liquid wastes are stored in volumes greater than 220 litres.; the available volume of secondary containment will be at least 110% of the total storage capacity, or 25% of the total storage capacity.
- Readily available information on chemical compatibility to employees will be provided, including labelling each container to identify its contents.
- The hazardous waste storage area will be clearly identified and demarcated, including on a facility map or site plan. Access to hazardous waste storage areas will be limited to employees who have received proper training.

- Periodic inspections of waste storage areas will be conducted; inspection findings will be documented.
- Spill response and emergency plans will be prepared to address their accidental release.
- Temporary storage areas for inert and non-hazardous waste will be placed in areas with minimum fire and explosions risks.
- Storage areas will be provided with fire extinguishers, spill kits according to the type and quantity of stored hazardous waste. Waste containers will be secured and labelled with the contents and associated hazards, be properly loaded on the transport vehicles and be accompanied by a shipping paper with the description of the load and its associated hazards.
- Hazardous waste will be transported from the construction site to appropriately licenced/permitted facilities for treatment, recycling, re-use or disposal.
- Waste generated during the modernisation works, as well as waste dumped along the canals, shall be disposed on Rustavi landfill operated by “Solid Waste Management Company” of Georgia.
- Development of a project-specific landfill site, following appropriate regulatory requirements. Inert construction waste such as concrete debris, rocks, and pebbles removed from the canals, as well as excess soil and silt with non-hazardous substance can be disposed on the sites allocated by the local authorities for filling and relief works. These could for instance be at deep erosion gullies created in the past by leaking irrigation structures and canals.

9.6.1.4. Residual Effects

A **Minor Adverse** effect in relation to material use is predicted as although consumption can be minimised, materials will be required for the Project.

With the above measures in place, a **Negligible** effect on landfill capacity from excavated wastes and a **Minor Adverse** effect on landfill capacity from demolition and construction wastes is predicted.

A **Minor Adverse** effect on hazardous waste facilities will remain as it is not possible to avoid generation of any hazardous wastes.

A **Minor Adverse to Negligible** effect in relation to risks to human health and the environment is predicted with mitigation measures in place.

9.6.2. Operation

9.6.2.1. Methodology

The assessment includes a qualitative consideration of the potential waste streams likely to be generated during O&M; and impacts associated with waste management, including disposal and capacity of existing waste management facilities. Wastewaters related to runoff of crops treated with fertilisers is addressed under water quality in section 9.2.

No significant impacts on materials use are anticipated during operation and are therefore not assessed.

9.6.2.2. Potential Impacts

During operation, wastes will be generated during routine maintenance works, which may include vegetation and rubbish clearance from canals and small amounts of demolition wastes, including potentially hazardous waste. Maintenance and repair works may require workers to be based on-site for an extended period of time, requiring temporary welfare facilities.

Different types of waste will also be generated in the processing of the crops produced and manure from any livestock kept such as poultry. In addition, waste may be generated along canals (fly tipping).

Potentially sensitive receptors include:

- Third-party waste facilities
- O&M workers
- Local communities
- Flora and fauna (including livestock)
- Surface water bodies and ground water
- Soils

The nature of routine O&M activities and repair works during the operational phase is unknown at this stage, therefore the volume of expected operational waste cannot be calculated. However, the anticipated waste streams are likely to be both non-hazardous/inert and hazardous, as follows:

- Organic waste
- Livestock wastes
- Concrete
- Oil and lubricants
- Paper
- Plastic
- Glass
- Metal
- Waste electrical and electronic equipment (WEEE)
- Other (hazardous or non-hazardous)

Overall, waste generation from operation of the ZSIS is anticipated to be low to medium in magnitude, depending on the on-farm activities. As identified for construction, there is a licensed landfill in the Project area. The sensitivity in terms of available capacity at the non-hazardous landfill is considered Low; the sensitivity of hazardous waste facilities is considered Medium due to need for specific facilities that are fewer in number/availability. This is predicted therefore to result in a **Negligible to Minor Adverse** effect on non-hazardous waste facilities and a **Minor to Moderate Adverse** effect on hazardous waste facilities.

Uncontrolled dumping of MSW may also continue to occur adjacent the canals, especially with increased use of land within the ZSIS. Whilst this is not a Project operational impact, this waste could impact on the Project as it may enter into canals, necessitating more frequent maintenance clearance to maintain their functionality and maintain adequate water quality.

There are potentially a number of risks to human health and the environment that may be associated with the handling, storage and disposal of certain types of waste, or lack of collection of waste. Incorrect handling and storage could result in possible cross contamination, wind-blown litter, and contamination of air, soil and water resources, or in the case of organic waste, the spread of pests and disease; as well as direct and indirect effects on human health and fauna. Humans are considered to be receptors of High sensitivity and the environment, Medium. Without appropriate mitigation measured in place, the magnitude of the impact could be Low to Medium, depending on individual farm wastes, the scale of O&M activities and waste management practices in place; resulting in a **Moderate to Major Adverse** effect.

9.6.2.3. Mitigation Measures

During operation, an O&M Plan should be developed that addresses waste management requirements for maintenance activities. This should include:

- Provision of suitably equipped waste management sites.
- Provision of regular training for staff and WUOs on recycling and waste reduction and the practices necessary to minimise waste and facilitate good practice waste management.
- Provision of dedicated areas for the storage of hazardous waste arisings (including batteries and WEEE).
- Recycling of vehicle and plant maintenance waste i.e. oil or grease contaminated filters and recycling or re-use of empty chemical containers or bags.
- Fines for illegal dumping of MSW waste.
- Regular review and clearance of waste in irrigation canals.
- Removal of hazardous waste by a specialist licensed company.
- Develop a manure action plan. Provide technical specifications for storage of manure.
- Promote the construction of Bio-digesters to reduce wastes and generate power or as heat for processing agricultural products.
- Impose cropping patterns which allow a balanced management of the generated waste.

9.6.2.4. Residual Effects

With these measures in place, O&M wastes are considered to result in a **Minor Adverse to Negligible** effect in relation to waste management facilities and a **Minor Adverse to Negligible** effect in relation to risks to human health and the environment.

9.7. Biodiversity

9.7.1. Construction

9.7.1.1. Methodology

The assessment includes all land within and adjacent the proposed command area where direct or indirect impacts on biodiversity receptors could occur as a result of the Project. It also includes an area of up to 500 m either side of any construction activities and construction compounds recognising that disturbance due to changes in visual, noise and vibration stimuli can impact on certain species of animals.

The sensitivity of the different groups of ecological receptors is summarised below:

- Disturbed or modified habitats e.g. cultivated arable land, grazed land – Low - as modified habitats are likely to only support a limited diversity of species. That said, it should be noted that these areas may be able to support larger populations of species present due to the availability of food sources such as seeds, which in turn may result in higher numbers of invertebrates and small mammals.
- Protected species (e.g. EU Habitats Directive Annex IV species, Georgia Red Book species) – High – there is the presence of rare and endemic plant species in the fragments of riparian forests and xerophyllous shrubbery located in the dry gorges of surrounding areas of the irrigation system corridor. Two species included in the Red List were identified during the Eptisa ecology surveys - Egyptian Vulture (*Neophron percnopterus*) and Brand's hamster (*Mesocricetus brandti)* and the potential for Mediterranean Tortoise (*Testudo graeca*). The Golden Spined Loach (*Sabanejewia aurata*) is also on Red List of Georgia and is known to occur in Paldo reservoir, Tbilisi Sea and Jandara Lake.
- Other species – Low - the majority of non-protected species are likely to be common and widespread within the wider area.

The critical habitats assessment has been discussed in section 6.15 and is presented in Appendix B.

9.7.1.2. Potential Impacts

Potential impacts include:

- Direct loss and degradation of wildlife habitats
- Mortality and injury to species
- Disturbance to species from noise, light or other visual stimuli
- Changes to the local hydrology and water quality that could impact aquatic and riparian receptors
- Potential sources of impact include:
- Siting of construction compounds and any workers' camp(s)
- Movement of construction vehicles and personnel
- Storage of waste
- Works within canals
- Accidental pollution incidences
- The sensitivity of receptors is addressed in section 9.7.1.1 above.

Direct habitat loss and degradation

The Project works during construction will predominately relate to modernisation of the existing irrigation infrastructure and will not involve the construction of any new canals. Therefore, there will be limited direct terrestrial habitat loss, related to access tracks and the movement of vehicles mainly. (In the longer run, there will be a conversion of lands within the command area currently used for grazing to irrigable cropland, this is discussed in the operational impacts below). For the most part, if is expected that existing tracks will be used and therefore minimal disturbance is anticipated. There will, however, also be a requirement for the clearing of canals that have become vegetated with low sensitivity vegetation. An increase in the generation of dust and particulate matter could also result in the degradation of habitats due to smothering of vegetation in habitats that are of Low or Medium sensitivity.

Due to the limited extent of habitat loss under the construction footprint and potential degradation in comparison to the extent of similar habitat present within the wider area, the magnitude of the impact is considered to be low. The potential significance of the low impact of loss of habitats of low (modified habitats) to high importance (xerophyllous shrubbery) is therefore considered to be **Negligible to Moderate Adverse**, respectively.

Given the level of vegetation in a number of the canals, the magnitude of impact within canals is expended to be Medium. The potential significance of the Medium impact of loss of habitats of low (canal habitats) importance therefore considered to be **Minor Adverse.**

The valleys of Rivers Iori, Alazani and Mtkvari are important since the valleys for migratory birds, with the rivers and floodplains providing shelter and feeding areas for waterfowl and waders. The clearance of brush/shrub vegetation during modernisation works could affect birds that use these habitats for nesting, hiding or feeding. Loss of habitats as a direct result of construction works could also have an impact on species using these habitats. Due to the limited extent of habitat loss and potential degradation in comparison to the extent of similar habitats present within the wider area, the magnitude of the impact on terrestrial species using these habitats is considered to be Low. The significance of the low impact of habitat loss on species of conservation concern (Egyptian Vulture (*Neophron percnopterus*) and Brand's hamster (*Mesocricetus brandti))* that are of high importance, prior to mitigation, is therefore considered to be **Moderate Adverse**. The significance of the low impact of habitat loss on other species (low importance) is considered to be **Negligible.**

Direct mortality and disturbance

The construction of the Project has the potential for disturbance and direct mortality of species. Changes in visual, noise and vibration stimuli due to the increased presence of people and plant, could result in the temporary disturbance and displacement of species that may be present within or close to the works areas.

Scavenging birds such as vultures, kites and eagles, and mammals such as red fox, may be attracted to waste storage areas within site compounds and therefore may be at risk of collision with site infrastructure and plant, consuming poison used to control pests or becoming trapped in excavations. Additional construction traffic on existing and access roads could also result in an increase in road casualties. Vegetation clearance and accidental fires have the potential to destroy birds' nests and young and to kill reptiles and amphibians. Night working and artificial lighting of works and compounds at night could lead to disturbance of resting, foraging and commuting species.

Due to the temporary nature of the works and limited extent of the construction footprint (including potential associated site compounds) in comparison to the foraging and roosting resources available to species in the wider area, the magnitude of the impact is considered to be Low. The significance of the low impact of disturbance and mortality prior to mitigation on species of conservation concern that are of high importance is therefore considered to be **Moderate Adverse.** The significance of the low impact of habitat loss on other species (low importance) is considered to be **Negligible.**

Changes to the local hydrology and water quality

Changes in local hydrology and water quality due to works in the canals and the potential for uncontrolled discharges respectively, could adversely impact riverine and aquatic habitats and species downstream of construction works. Potential impacts also include contamination from storage and use of oil and chemicals from construction machinery working in or near the river. Accidental spills could enter surface waters directly or in run-off (from land or construction tracks). Impacts include from works at Paldo headworks potentially affecting downstream habitats and species in the Iori River and works on the canals affecting Tbilisi Sea. The construction works will be temporary however, once pollutants are in a watercourse, it can be difficult to contain them, which can then impact habitats and species downstream. There will however be dilution effects in the Iori River and Tbilisi Sea due to the size of these waterbodies. Overall, a Low magnitude of impact is predicted on hydrology and water quality, given the works proposed. The significance of changes in local hydrology and water quality (Low) on riparian and aquatic habitats and species of low importance and high importance is therefore considered to be **Negligible and Moderate Adverse,** respectively.

9.7.1.3. Mitigation Measures

A Biodiversity Management Plan will be prepared and implemented. Control measures will include:

- An ecological survey of the construction works areas will be undertaken prior to the start of works, to identify the presence of any Species of Red List of Georgia. Where present, appropriate method statements and, as required, translocation plans will be drawn up. Where necessary, collaboration with national botanical garden of Georgia and local collection units in Tbilisi to translocate red listed and endemic species of wild pears. Translocation can also be done locally: pear species can be moved in the nearest places outside the irrigation system corridor.
- The following areas have previously been identified as requiring monitoring should construction works take place near them: N41040.105'/E045002.044', N410 35.867/E045004.792 and N41045.773/E045003.042, where Georgian Red List species hamster (Mesocricetus brandti) have been recorded.
- Minimise habitat disruption and damage by working within designated works areas.
- 'Toolbox talks' provided by a construction environment manager, Environmental Clerk of Works or equivalent to ensure workforce are aware of required mitigation and legislation.
- Any carcasses on/near roads in the vicinity of the Project should be removed to prevent scavengers (including vultures) coming close to roads and colliding with site infrastructure and plant. The carcasses could also be placed at a location away from the construction footprint in order to provide additional resources for scavengers and help to prevent these species coming into contact with infrastructure and plant.
- Where possible, food and domestic waste storage areas should be covered to avoid attracting vultures and other scavengers.
- Use of poison at waste sites should not be allowed.
- Measures should be taken to prevent fire.
- Management of noise, dust and air emissions. Avoidance of excessive noise and illumination (especially at night) is recommended where practicable.
- Vegetation requiring clearance should be undertaken cleared outside of the breeding bird season (April to August) where practicable. If this is not possible, a pre-clearance walkover will be completed by a suitably qualified ecologist to check for the presence of active bird nests. Should any nests be identified, it is recommended that these are excluded from works until such time that the chicks have fledged the nest.
- Any vegetation clearance in sensitive areas within the footprint of the new canal should be undertaken in two stages (a high cut, a short period to allow reptiles, amphibians and small mammals to disperse followed by a lower cut).
- Ensure all deep excavations are covered at night or ramps/sloping sides provided where practicable to allow animals to escape. Permanent habitat crossing corridors (i.e. pathways providing cover) on canals at regular intervals to be provided should be installed as early as possible during the construction phase.
- Measures will be taken to prevent spread of any invasive plant species, if present. This includes avoiding site clearance in, and movement of soils from areas containing invasive species and appropriate treatment of individuals plants where applicable.
- Monitoring of sites post-construction, where species have been translocated or as advised in construction method statements.
- Management of aqueous discharges and waste.
- A Traffic Management Plan should be prepared and implemented. Control measures include:
- Control of speed limits on construction routes around the site.

9.7.1.4. Residual Effects

With all proposed mitigation measures fully implemented, it is considered that the adverse impacts during construction in relation to all habitats and species can be reduced so that they are not significant i.e. **Minor Adverse to Negligible**.

9.7.2. Operation

9.7.2.1. Methodology

The assessment consider the extent of the proposed command area and the 11,896.4 ha of land available but not currently irrigated, making a general assumption that these lands currently used for grazing are likely to be converted to cropping.

9.7.2.2. Potential Impacts

Potential impacts include:

- Direct loss and degradation of wildlife habitats
- Fragmentation and isolation of habitats and species (severance)
- Mortality and injury to species
- Changes to water quality
- Potential sources of impact include:
- Conversion of grazing lands to cropping
- Use of fertilisers, pesticides and herbicides
- Operational and maintenance activities (accidental pollution incidences)
- Movement of operation vehicles and personnel
- Storage of waste
- The sensitivity of receptors is addressed in section 9.7.1.1 above.

Direct habitat loss and degradation

The Project will involve the permanent provision of irrigation up to an additional 11,896 ha of land over the current land being irrigated (the available command area is considered to be 17,216.4 ha (based on 10% area in fallow, approximately 17,216.4 ha would be under irrigated agriculture), and the 2021 area under irrigation was 5,320 ha). This land is currently within the command area but either not currently in farming use or is used for grazing. With the provision of irrigation water, it can be expected that most of the area would be converted to cropping, though this will of course depend on uptake by land owners and renters. This land is currently predominately grazed habitats however, the previous Eptisa surveys did also survey pockets of xerophyllous shrubbery (High sensitivity) and ponds and streams (Low sensitivity). The potential area of land that will convert to crops is large though the extent of ponds, streams and shrubbery is a small proportion of this area and it is assumed that not all ponds, streams and shrubbery are likely to be removed, therefore a Low magnitude of impact is predicted. This will result in a **Moderate Adverse** effect (for High sensitivity habitats) to **Negligible effect** (for low sensitivity habitats), should these habitats be affected.

Any permanent loss of habitat from subsequent agricultural operations (e.g. ploughing/planting of crops) and degradation will have an indirect impact on certain species due to loss of resources. The command areas contain areas of habitats that provide shelter and feeding areas for waterfowl and waders and the ponds and streams could contain habitats for amphibians during the breeding season in early spring. Any clearance of brush/shrub vegetation could affect birds that use these habitat for nesting, hiding or feeding, mammals such as Brandt's hamster (*Mesocricetus brandti*) or amphibians, as well as other fauna using these habitats. It is not possible to predict with certainty the magnitude of this impact, however, based on the above a Low Medium magnitude of impact is predicted, and therefore the significance of effect of habitat loss prior to mitigation on species of conservation concern that are of high importance is therefore considered to be **Moderate Adverse**. The significance of the impact of habitat loss on other species (low importance) is considered to be **Negligible**.

Contamination may occur to flora during operation from the application of fertilisers, pesticides and herbicides, as well as accidental spills associated with routine operation and maintenance activities. The magnitude of impact associated with agrochemicals is considered to be Low currently, though may increase to Medium in the future given the expansion of cropping within the command area and the requirement for agrochemicals given the soil types present. Therefore, the overall significance of effect on habitats of conservation concern that are of high importance is considered to be **Moderate Adverse and** the impact on other habitats of low importance is considered to be **Negligible**.

Severance

The works do not require the construction of new canals and therefore, no additional severance is anticipated as a result of Project infrastructure. However, as identified above, the area of land that may be converted from grazing to cropping could be up to 11,896.4 ha which could present some severance of habitats and fragmentation and isolation of species. Furthermore, canals that are not currently transferring irrigation water will now within the proposed Project area. These watercourses may restrict the movement of certain small mammals and reptile species, and potentially result in isolated populations becoming more vulnerable to disease and extreme weather conditions, leading to a decrease in numbers. The magnitude of this impact is considered to be Medium, as populations of these species would still be present in non-fragmented habitats. The significance of the Medium impact of severance prior to mitigation on relevant species of conservation concern that are of high importance (e.g. Brand's hamster (*Mesocricetus brandti)*) is therefore considered to be **Major Adverse.** The significance of the Medium impact of severance on other species (low importance) is considered to be **Minor Adverse.**

Mortality and injury to species

The extension of water provision in a larger number of canals than currently presents an increased risk of small mammal mortality in the canals.

Although the increase in use of agrochemicals is not considered to be significant, they may now be applied in up to 11,896.4 ha of land currently predominantly used for grazing. This increased intensity of agricultural production may have negative impact on fauna species especially on small mammals and raptors, as well as pollinators.

Contamination may also as a result of accidental spills associated during routine operation and maintenance activities.

The magnitude of these impacts impact is considered to be Low at first, increasing to Medium as larger areas are converted to cropping. Therefore, the overall significance of effect on species of conservation concern that are of high importance is considered to be **Moderate to Major Adverse** and the impact of habitat degradation through contamination on other species (low importance) is considered to be **Negligible to Minor Adverse**.

Changes to water quality

In relation to the release of water downstream of Paldo Headworks, the water balance model shows that more water will be available at the border with Azerbaijan in most climate change scenarios, indicating that there will be more water in the Iori River downstream of Paldo in the future than the current baseline (see section 9.1 on water resources and hydrology); and that an EFR of above 20% is maintained. This increase in flow could also have an impact on aquatic flora and fauna in the Iori River however, as this will occur over time it is predicted that the flora and fauna may adapt to the changes in the regime (which occur naturally) and no significant adverse effects are currently predicted though this will depend on actual and not modelled conditions.

In relation to water quality (see section 9.2) in the first decade, when the change is likely to be felt most, changes range from 32.1% for the Warm model, 34.6% for the Hot Wet model and 21.4% for the Hot Dry model. In terms of water quality, for the first two models this increase in flow downstream of Paldo Headworks will have a diluting effect. For the Hot Dry model this represents a minor decrease in flow that could reduce the dilution potential of the river. In relation to water quality, a Moderate to Major Beneficial effect was predicted for the Warm and Hot Wet models and a Negligible to Minor Adverse effect on water quality was predicted for the Hot Dry model. Changes in water availability and quality may have a knock-on effect on aquatic habitats and species. In general terms, a potential reduction in water quality related to a Hot Dry model may have an adverse effect on aquatic flora and fauna in the Iori River. Overall, though, given the EFR will be maintained the magnitude of impact is considered to be Very Low and therefore effects on aquatic habitats and species to be **Minor Adverse to Negligible** for species of conservation concern and species of low importance, respectively.

Changes in water quality due to runoff of agrochemicals and other existing untreated discharges into the canal water, which will then be applied to lands could have a knock-on effect on adjacent flora and fauna. Water quality in the canals could also have an effect on aquatic flora and fauna in the Tbilisi Sea from water diverted from the UMC. There will however be dilution effects due to the size of this waterbody, therefore taking into account the agrochemical requirements and dilution aspects, a Low magnitude of impact is predicted. The significance of changes in water quality in the canals (Low) on riparian and aquatic habitats and species of low importance and high importance (all sites) is therefore considered to be **Negligible and Moderate Adverse,** respectively.

9.7.2.3. Mitigation Measures

In relation to design of the Project, the following are recommended:

- Habitat crossing corridors (i.e. pathways providing cover) on canals at regular intervals, vegetated with species similar to that present in surrounding habitats, and in sensitive areas to allow movement of small mammals, reptiles and amphibians.

A Biodiversity Management Plan should be prepared and implemented. Control measures will include:

- Introduction of integrated pest management and modern technologies which reduce chemicals usage.

- Incorporation of water efficiency methods of irrigation in project design.
- Training and capacity building in water management techniques.

9.7.2.4. Residual Effects

With all proposed mitigation measures fully implemented, it is considered that the adverse impacts on biodiversity during construction in relation to Direct habitat loss and degradation, Severance, Mortality and injury and changes in water availability and quality can be reduced so that they are not significant i.e. **Minor Adverse to Negligible**.

9.8. Socio-economic Impacts

9.8.1. Methodology

At the time of writing this report, no detailed information is available on the number, type and location of construction plant that might be used as the detailed design has not been completed and Construction Contractors have not been appointed. It is therefore considered appropriate for a predominantly qualitative assessment of the Project socio-economic impacts to be made, based on available information and professional judgement. The social impact assessment has therefore been undertaken based on the generic methodology presented in Section 5. Sensitivity is assessed in relation to each impact, and therefore is reported in the impact assessment sections below.

9.8.2. Economic and Employment Impacts

9.8.2.1. Construction

9.8.2.1.1. Potential Impacts

Potential impacts relate to employment opportunities and increased revenue as a direct and indirect consequence of Project construction.

Sources of impact may include:

- Direct construction-related employment contracts
- Demand for services and products
- Influx of construction workers resulting in a demand for local services

Potentially sensitive receptors include:

- Local communities
- Local businesses
- Local, regional and national government

The effects of construction employment are generally likely to be positive and potentially include increased direct earning opportunities for local working age unemployed and underemployed persons and increased expenditure on local goods and services resulting in further indirect employment and increased short-term disposable income and wellbeing among beneficiaries. This impact, however, is contingent on the proximity of construction employment sourcing, with low-level local recruitment entailing higher worker influx and heightened potential for transferable diseases and social and cultural discord (see section 9.8.5).

Although exact construction workforce numbers and employment categories are unknown, previous estimates in the region of 75 full-time employees at any one time (potentially up to 300 in total) have been used for assessment. In the Project Area, the unemployment rate is highest in Kvemo Kartli at 22.2% where the majority of the works are proposed. Whilst regional data are not available, nationally unemployment is highest among the young (15-24)[171] therefore the employment opportunities represent significant benefits to this group, albeit on a temporary basis. Proximity to Tbilisi and the general educational attainment in the Project Area suggests that skilled personnel are available however, Eptisa census data (see Figure 9-3) from the project communities (villages) within the ZSIS indicates that nearly half of the surveyed population was declared to be unskilled and therefore, job opportunities for locals may be restricted to unskilled labour such as clearing trees, excavation by hand, removal of damaged concrete, filling gabions, applying coating, etc.

[171] Available at: https://www.geostat.ge/en/modules/categories/683/Employment-Unemployment

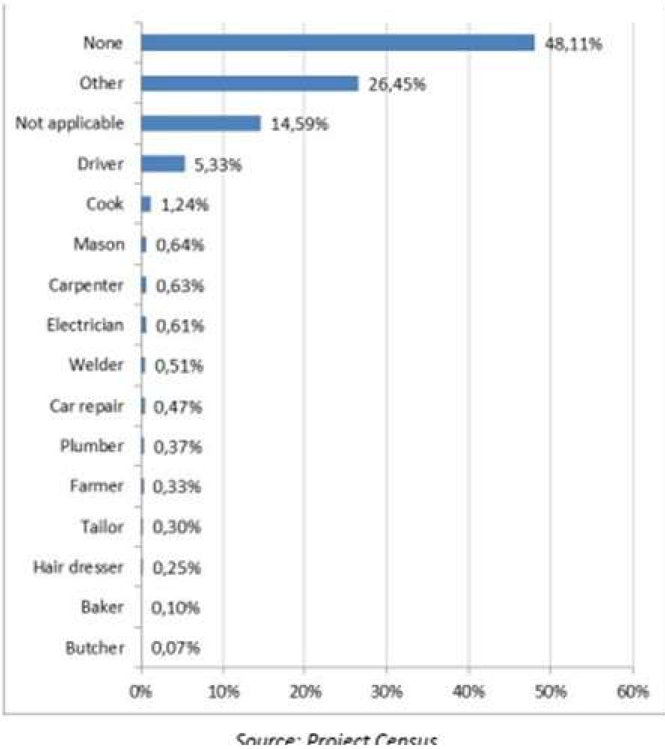


Figure 9-3. Main skills of household Members surveyed in Project Area (Eptisa)

Overall, although temporary (for the period of construction only) the magnitude of impact, in terms of employment provision numbers in the context of local unemployment and underemployment levels, is considered Low to Medium and the workforce is considered to be a receptor of High sensitivity. The significance of the effect is **Moderate to Major Beneficial** for the period of the construction works.

The related income and expenditure benefits of construction employment such as demands of construction transport providers for food, other consumable goods and overnight accommodation will contribute to the local economy. The local economy will also be positively affected during construction through construction employee expenditure on transport, assets, hard goods and consumables. This will be further enhanced locally through any direct demand by the main Contractor for project materials, provisions and services. Overall, the sensitivity of the local economy and businesses, which will predominately benefit from the construction phase, is considered Medium in the ZSIS villages due to the vulnerability of the agricultural sector. A Low to Medium magnitude of impact is anticipated, as all construction projects have positive impacts but the extent to which will depend on materials and goods sourcing. Therefore, depending on the sourcing of services and goods, up to a **Moderate Beneficial** effect is predicted, for the period of construction, on the local economy and a **Minor Beneficial** effect at the wider economic scale.

9.8.2.1.2. Mitigation Measures

A Community Liaison Officer will be appointed by the Construction Contractor(s) to facilitate engagement with the local communities in relation to labour opportunities.

A Labour Management Plan will be prepared and implemented to manage labour processes. Control measures will include:

- Collaboration with local authorities to reduce discrimination against local workers in the community.
- Development of a local procurement and recruitment policy that enhances purchase of local content, use of local workers and women, and promotes the use of local goods and services.
- The recruitment process will be fully disclosed to the public and open to all people locally of working age and ability, including women. The process should be based on appointment by merit rather than by any

political, clan, or class affiliation but should be affirmative with regard to promoting opportunities to less advantaged and more vulnerable people locally.

- Recruitment campaigns aimed at the local population, accompanied by appropriate training for the development of the required skills, as well as vocational training on recurring maintenance jobs. These campaigns and job opportunities should also be aimed at vulnerable groups with actions focused on groups such as the low income level households or eco-migrants. In the case of households led by women, suitable occupational opportunities should be identified aside the usual hard labour tasks that are most commonly performed by men during the construction stage.
- Prioritisation of procurement of goods locally wherever possible, including perishable goods provided by local agricultural product producers (farmers).
- Working conditions, including wage and benefit entitlements, will be documented and communicated to all employees who will have access to, a grievance mechanism from the point of contract.
- A Grievance Mechanism shall be established during the construction phase to ensure that local communities and stakeholders have an adequate channel to voice concerns.

9.8.2.1.3. Residual Effects

Even with the enhancements proposed, overall significance of the Project on employment and the economy will be up to **Moderate Beneficial** as construction employment numbers are small, and the effects will be relatively short term and of limited extent due to the construction workforce requirements.

9.8.2.2. Operation

9.8.2.2.1. Potential Impacts

Potential impacts include employment opportunities and economic revenue from the expanded irrigated area, as well as related economic benefits of improved food security and knock-on demand for agricultural and other goods (as wages increase) in the local economy.

Sources of impact may include:

- Operation of the project including access to land plots and demand for farm labour
- Maintenance activities
- Demand for services and products

Potentially sensitive receptors include:

- Farming economy
- Local farmers
- Local communities
- Local businesses
- Local, regional and national government

Most, but not all, socio-economic impacts in the Project's operating phase are anticipated to be positive. The most tangible category of significant operating impacts includes those resulting from the effects of the improvements to existing land irrigation and the effects of increasing the area of land under irrigated, so raising both the productive potential and the size of cultivatable land that is available to local farmers, both at small farmer and private farmer levels (up to an additional 11,896.4 ha over 2021 levels). Whilst specific data is not currently available, based on the 2021 number of contracts (1,836) and the 2021 area under cultivation (5,320 ha), this is on average 0.34 contracts per ha, a further 4,044 contracts could be anticipated. There is a well identified potential of growth for agricultural products as the main Georgian market is Tbilisi that is close by, and many products are currently imported.

The main impacts to stem from these effects are to; increase local employment and income generating opportunities; improve local food security; and raise agricultural earnings and expenditure. These are all impacts that are especially pronounced in the context of household farmers who may lack the capital or adaptive means to establish alternative livelihoods.

Currently, around 5,320 ha are irrigated (2021 numbers), and a further up to 11,896.4 ha will be available for irrigation as a result of the Project, so just over double the current area of land that can be used for productive cultivation. If the potential expansion in agricultural scale and productivity were to be realised, then a significant increase in crop output could be achieved in the short to medium term. As identified in Table 9-8 below, it is estimated that the average yield of maize is expected to rise from 8.0 tonnes per hectare to 10.0 tonnes per hectare and significant increases in crop yields are also anticipated for alfalfa (from 15.0 tonnes/ha to 20.0 tonnes/ha), berries (from 13.5 tonnes/ha to 15.5 tonnes/ha), grapes (from 12.5 tonnes/ha to 16.5 tonnes/ha), and fruit trees (from 10.0 tonnes/ha to 15.0 tonnes/ha). The average yields of wheat and vegetables are also expected to rise.

Table 9-8. Crop Yields: Present and Future with Project

Crops	Average Crop Yield (tonne per hectare)											
	Zone 1		Zone 2		Zone 3		Zone 4		Zone 5		Overall Project	
	Present	Future With Project	Present	Future With Project	Present	Future With Project	Present	Future With Project	Present	Future With Project	Present	Future With Project
Wheat	n/a	n/a	2.5	3.0	n/a	n/a	n/a	n/a	n/a	n/a	2.5	3.0
Maize	8.0	9.5	9.0	10.5	8.0	10.0	8.5	10.0	7.0	9.0	8.0	10.0
Alfalfa (hay)	15.0	20.0	15.0	20.0	15.0	20.0	15.0	20.0	15.0	20.0	15.0	20.0
Grass (hay)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	5.0	10.0	5.0	10.0
Vegetables	25.0	35.0	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	25.0	35.0
Berries	n/a	n/a	n/a	n/a	12.0	16.0	15.0	17.0	n/a	n/a	13.5	16.5
Grapes	n/a	n/a	10.0	15.0	15.0	18.0	n/a	n/a	n/a	n/a	12.5	16.5
Fruit/Nut Trees	10.0	15.0	10.0	15.0	10.0	15.0	10.0	15.0	10.0	15.0	10.0	15.0

Source: Field Survey and consultants' estimates, November 2021; n/a = not applicable

The increase in the land used under irrigation will result in direct revenue to the State through WUOs; as well as indirect revenues through improved food security and an increase in expenditure in the Project Area through a demand for goods and services directly related to agriculture as well as knock-on effects through economic growth and demand for consumer products.

Furthermore, training and capacity building of local farmers could result in increased knowledge and skill levels, which will be of economic benefit to the individual person and to society as a whole.

The magnitude of the positive economic impact will depend on crop yields and farmer revenue and is currently predicted to be Medium. The sensitivity of the local economy is considered Medium and of the regional and national economy, Low, therefore a **Major to Moderate Beneficial** effect is predicted, respectively.

In relation to job opportunities within the GA and WUOs, operation of the Project is not expected generate significant job opportunities at the local level, though it can be expected that the maintenance of the Project will generate some job opportunities such as routine maintenance of canals and structures which may provide limited local job opportunities. Overall, the magnitude of employment opportunities arising from the direct operation and maintenance at the GA and WUO level are considered to be Very Low and with the local community as High sensitivity, the overall effect is **Minor Beneficial**.

In relation to job opportunities on farms, this will depend on the nature of the farm plots and whether they are all developed for farming. However, given the area of land that can be irrigated will be doubled as a result of the Project, it is not unreasonable to assume that this will provide some employment opportunities directly to households that farm on these plots, within larger companies that may rent or buy land, as well as a seasonal demand for labour during harvest periods both on smaller and larger commercial farms. That said, as identified in the 2022 FS, it is anticipated that land preparation, planting, fertiliser spreading, pesticide application, as well as harvesting and post harvesting tasks for wheat, maize, alfalfa and grass, are likely to be fully mechanised and therefore do not have high labour requirements. As such, a larger proportion of new opportunities may be in seasonal labour demands. The most labour demanding crops are vegetables, berries, grapes and fruit trees which require a substantial number of labourers for harvesting and post harvesting tasks and therefore the majority of new jobs may be seasonal. In addition, the planting and pruning of berries, grapes and fruit trees is also labour intensive. Overall the magnitude of employment opportunities is considered to be Low, and Medium during harvesting periods. With the local community as receptors of High sensitivity, the overall effect is **Moderate Beneficial** in general and possibly **Major Beneficial** during periods of seasonal labour demand.

9.8.2.2.2. Mitigation Measures

The realisation of longer-term sectoral developments from the operation of the Project that can drive, consolidate and sustain local economic development will be highly contingent on complimentary interventions to develop farmer and farm organisation capacity. In particular, there is a need for low-cost programmes to: improve farmer awareness and understanding of more efficient water and land resource use and more effective farming methods and techniques; improve the access and representation of women and other more marginalised sections of the local community; and, promote and support the establishment, governance and organisation of WUOs, and other local systems of collective agrarian purchasing, production, processing, transportation and marketing. The use of local supplies and contractors for O&M activities should be prioritised wherever possible.

For the direct benefits of expanded farm output from Project operation to be realised by the local population in the short to medium term they will need to have access to land and the ability to make investments in farm services, machinery, labour, seeds, pesticides, fertilisers and livestock. According to the Eptisa surveys of command area households, about a half of the interviewed households were considered vulnerable (51%) and the declared annual income of 26% of households was lower than the annual minimum living allowances (defined by the official statistics of Georgia). Therefore such investment may be contingent on the availability of an affordable and accessible agricultural loan facility. In the absence of such credit, there is a distinct risk that the opportunities presented by the Project will not be affordable to economically marginalised households, or that such opportunities are monopolised by wealthier community members least in need of development support.

9.8.2.2.3. Residual Effects

With the mitigation measures in place given the extent to which new structures will need to be put in place, etc. there is no change to the pre-mitigation predictions. Overall, the implementation of Project should result in **Moderate** to **Major Beneficial** effects on the economy as a whole and a **Minor to Moderate Beneficial** effect on employment locally and in the region; with up to **Major Beneficial** effects on local employment during seasonal labour demand.

9.8.3. Livelihood Impacts

9.8.3.1. Construction

9.8.3.1.1. Potential Impacts

Potential impacts include those related to construction employment opportunities that will have a positive impact on incomes and therefore livelihoods; and the construction works on the canals that could affect access to existing farmers during the works and therefore affect income or access to subsistence crops.

Sources of impact may include:

- Direct construction-related employment contracts
- Demand for services and products
- Construction works on the canals
- Pollution events in the canals or on land from the construction works

Potentially sensitive receptors include:

- Existing farmers
- Local businesses
- Local communities

Project construction represents livelihood benefits particularly, and most directly, for Project workers and their families for whom improved financial security, and work skills and experience development could be relatively quickly realised during construction. Project construction employment will comprise a mix of skilled, semi-skilled and unskilled requirements, all of which will be temporary. The range of salaries therefore is likely to be both below and above sector averages, depending on the position. Construction of the Project could provide temporary workers with the opportunity to up-skill during the period of employment, both through obligatory induction training and through more applied short courses for example, in excavating, vehicle and equipment use. This training, and the subsequent experience of working on the Project, will increase the transferable skill base and future income generating prospects of employed construction workers. However, given the anticipated workforce size discussed above and the skills of the command area community, and its short term nature, the overall magnitude of this impact on livelihoods from increased employment opportunities is likely to be Low. Local communities are considered receptors of High sensitivity with respect to livelihoods, and therefore at most a **Moderate Beneficial** effect is predicted.

The construction works could result in the temporary blocking of irrigation canals during reparation works and the restriction of land access from construction activities and access routes. In the absence of mitigation, these effects could impede farmer access to land and water resources for crops and livestock, which in turn could result in impacts on livelihoods and food security (specifically, for subsistence farmers). The magnitude of the impact will depend on the nature and location of the works, as well as the time of year. This will only affect those command areas that are currently under irrigation/farming. Overall, a Medium magnitude of impact is predicted, with subsistence farmers being of High sensitivity and commercial farmers of Medium sensitivity, therefore a **Major to Moderate Adverse** effect could occur without mitigation, respectively.

Downstream users and, in some cases their livelihoods, are potentially at risk of being impacted in the event of Project construction related accidents and pollution during works in or immediately adjacent waterbodies affected by construction works. As works are proposed at Paldo headworks and in various ZSIS canals, there is a risk for downstream water users (such as the KSIS and existing farmers within ZSIS. The sensitivity is High for those that use the water for irrigation and personal use. The magnitude of this impact without appropriate mitigation in place is considered to be Low, and therefore a **Moderate Adverse** effect is possible on livelihoods from pollution events.

9.8.3.1.2. Mitigation Measures

As identified under section 9.8.2.1.2, a Labour Management Plan will be prepared and implemented to manage labour processes, including a local procurement and recruitment policy will be developed that enhances purchase of local content, use of local workers and women, and promotes the use of local goods and services to maximise the potential for livelihood benefits for local communities.

To manage access to land and water during the works, the following should be addressed:

- The timing of the works should be such to avoid key demand periods for water.
- Advance warning of works should be provided to farmers, with appropriate measures in place for provision of access, including access to land and water, throughout works.
- Implementation of a stakeholder grievance mechanism, which is widely publicised and accessible to community members at Project sites.

Water pollution prevention measures are addressed under water quality in section 9.3.

9.8.3.1.3. Residual Effects

The residual effect on livelihoods from employment opportunities and demand for goods is considered to remain **Moderate Beneficial**, as there are limited job opportunities and the impact will be temporary, for the periods of construction only.

The effect on livelihoods from potential access restrictions, with mitigation measures in place, is considered to be reduced to **Minor Adverse or Negligible**.

The effect on any downstream livelihoods from pollution events during construction, with mitigation measures in place, is considered to be reduced to **Minor Adverse or Negligible**.

9.8.3.2. Operation

9.8.3.2.1. Potential Impacts

Potential impacts on livelihoods during operation include:

- Improvements in livelihoods due to provision of more irrigated land
- Impacts on smaller and vulnerable farmers from the loss of properties/selling up by small land owners due to increased land prices, and potentially becoming landless
- Impacts on vulnerable households due to changes in livelihood preferences from livestock to crop farming
- Entry barriers to users
- Impacts on users currently connected to the ZSIS on an illegal basis

Sources of impact may include:

- Operation of the Project enabling agricultural production on irrigable areas
- Reorganisation of water provision including establishment of WUOs
- Demand for workers including seasonal workers

Potentially sensitive receptors include:

- Existing small farmers
- Existing private operators
- Plot owners
- Local communities
- Local business (including future private operators)

Improvements in livelihoods due to provision of more irrigated land

The water balance study showed that the carrying capacity of the UMC is adequate to meet the ZSIS irrigation demand for agricultural production in 17,216.4 ha net annual potential irrigated area but only if the Tbilisi Sea serves as an intermediary storage basin to ensure that i both the peak demand for irrigation water in the UMC and LMC during June-August can be met in parallel and also adopted water saving techniques at the farm level.

As with economic impacts described above, the realisation of improvements to existing land irrigation and the increasing the area of land under irrigated (an additional 11,896.4 ha will be provided with irrigated water over 2021 levels), will raise both the productive potential and the size of cultivatable land that is available to farmers. The main impacts to stem from increased cultivable land and productive potential on livelihoods are an increase the sustainability of existing agrarian livelihoods through increased local employment (either directly at household levels, or through permanent or seasonal employment, particularly on medium and larger sized farms), and income generating opportunities; and through improved local food security. These impacts are especially pronounced in the context of household farmers, especially those that are vulnerable, who may lack the capital or adaptive means to establish alternative livelihoods.

The extent to which these positive impacts are realised will naturally depend on a number of factors such as the final organisational structure of the WUOs, access for households to farm plots, the number of privately owned larger farms (and their labour requirements), and the cost associated with participating in the Project, including water tariffs and machinery, etc.

Based on the estimation of registered land area available for agriculture inside TUs (Table 7-36 in Section 7), an area of 18,516 ha is recorded as estimated registered lands within the command area, of which, 5.7% are plots <0.25 ha, 15.3% are plots of 0.25-1.25 ha, 6.4% are plots of 1.25-5 ha, 9.3% are plots of 5-10 ha and 63% are plots >10 ha. Smallholder and micro farms generally have lands of less than 1.25 and less than 0.25 ha, respectively. Medium and large farms typically have lands of more than 1.25 and more than 5 ha respectively. Whilst the provision of irrigation water to a larger area of land will allow smallholder and micro farmers currently not farming to do so, on small scale farms <1.25 ha this is likely to be more for subsistence and therefore, more significant impacts on livelihood are likely to be more effectively realized through cooperative ventures which would allow economies of scale.

Such a shift would be important because the limited size and productivity of small farms can preclude the generation of significant marketable surpluses or value-added products. In this respect, the Project, through the development of WUOs, has the potential to help secure the sustainability of threatened livelihoods, but to also catalyse a change that allows farm livelihoods to increase and, in many cases, expand beyond a predominantly subsistence and exchange based system to a more lucrative and scalable market based system that provides opportunity for profitability, wider employment, reinvestment, value-added processing and growth.

Whilst it is recognised that the water balance model across the three climate scenarios indicates that water is available to irrigate more than 90% of the combined command area and therefore there may be years in which the 17,216.4 ha cannot be irrigated, the farmers and the GA will decide on the cropping pattern for the coming year based on water available in the reservoir at the beginning of the cultivation season. Irrigation planning and scheduling will address any deficient rainfall and flow risks during the cultivation season, minimising the risk to farmer livelihoods. The 2022 FS also recommends water saving techniques to be adopted at the farm level to increase water use efficiency and thus enabling more area to be irrigated with less water available.

The sensitivity of smallholder and micro farmers is considered High and the sensitivity of medium and larger farm businesses as Medium. The magnitude of the impact will be dependent on numerous factors as outlined above, and therefore based on similar schemes is tentatively assessed as Low for small farmers in the short term (increasing to medium in the longer term) and Medium for medium/larger farms that are likely to be able to maximise the benefits of the Project more rapidly. Therefore, a **Moderate to Major Beneficial** effect on the livelihoods of small farmers and a **Moderate Beneficial** effect on larger farming business livelihoods is predicted. However, further discussion on potential adverse effects on smaller farmers' livelihoods is provided in the following sections.

Impacts on smaller and vulnerable farmers from the loss of properties/selling up by small landowners due to increased land prices

Economically vulnerable households might find incentives to sell their lands if the investments needed to connect to the irrigation system and to start agricultural activities are too high in comparison to the immediate net gain obtained from selling their properties. Spatial distribution might be a factor when determining the likelihood of a household to sell their land after Project implementation in that, small, isolated properties are more likely to opt for selling their plots as the chances for land consolidation and association with other farmers is lower than those with the potential for a grouped pattern. Sale of land plots may result in an induced change of livelihoods and possible migration for those economically vulnerable households, whose living standards might be significantly altered after becoming landless.

The Eptisa 2018 ESIA Report identifies that, out of the total 10,861 households interviewed in their socioeconomic census, 2,830 (26% of the total) are considered to be economically vulnerable. Their stated average annual income amounted to 1,903 GEL, which implies only 18% of the average earnings by non-vulnerable households. Although other vulnerable groups identified in the baseline studies are also subject to this risk, the economically vulnerable are considered as the most likely to become landless.

The estimated average value of land for economically vulnerable households as reported in the Eptisa 2018 ESIA amounted to 69,356 GEL which might be expected to increase as a consequence of the Project. The land surface owned by vulnerable households was reported as amounting to 1,098 ha, distributed in 2,260 plots. These numbers are taken as indicative in general within this ESIA, as the area under irrigation as reported for 2020 and 2021 is lower than when the Eptisa 2018 FS was undertaken and therefore not directly comparable. However, they serve to provide a general indication of vulnerable households within the ZSIS.

The Eptisa census data for vulnerable households is shown in Table 9-9. On average, only 8% of vulnerable households total income was reported as obtained from agricultural works performed on their own land, pensions and salary earning in private or public organizations being their main source of earnings (50% and 25% respectively) (see Figure 9-4).

Table 9-9. Main socio-economic characteristics of economically vulnerable households (from Eptisa survey census)

Total land area owned by households (hectares)	1,098
Total number of land plots owned by the household	2,260
Share of households with annual income	39%
Average estimated annual income per household (GEL)	1,903
Average estimated value of income (GEL) of vulnerable households	69,356
Total number of households	2,830

Notes: Based on Eptisa Report:

Annual household income is less than average annual minimum living allowance (2016-2017 data). For calculation of minimum annual living allowance the official statistics of Georgia in 2016 and 2017 were used. Average minimum annual living allowance was calculated according to the size of the household:
- *One-member Household: 1,731 GEL*
- *Two-member Household: 2,770 GEL*
- *Three-member Household: 3,116 GEL*
- *Four-member Household: 3,462 GEL*
- *Five-member Household: 3,895 GEL*
- *Six-member Household: 4,605 GEL*

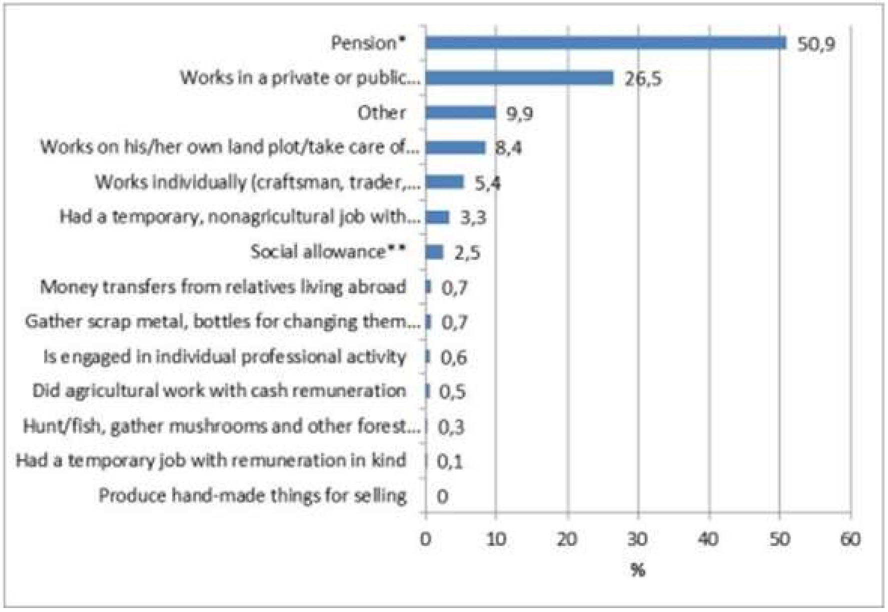


Figure 9-4. Sources of income by economic activity by households interviewed in the Eptisa surveys

It is possible that economically vulnerable households may also face investment costs not covered by the Project, which in turn may result in a burden given their economic situation and incentives selling of any land owned. Overall, the magnitude of the impact on smaller and vulnerable farmers could be Medium given the number of smaller farms that are within the proposed new command area and the changes proposed. The sensitivity of vulnerable (economic) households is High, resulting in a potential **Major Adverse** effect on their livelihoods.

Impacts on vulnerable households due to changes in livelihood preferences from livestock to farming

As irrigation becomes more available and incentives for farming activities are more evident, it is expected that there will be a shift from livestock to crop farming. This may result in sale of livestock as a means to finance possible equipment needs for crop activities. However, those households that are solely dependent on a very limited number of animals for additional income may find it unprofitable to sell their animals to switch to crop activities (losing high quality produce such as fresh milk and cheese), and at the same time may have challenges to find sufficient area for grazing as more land currently under grazing is converted to crops. The Eptisa census indicated from households interviewed that an increase of almost 10% in livestock farming was anticipated, against significantly greater increases in annual crops and fruit trees. In general terms, the census found that future plans to expand livestock activities for small holders are considerably smaller than the expected increase in agricultural activities. The potential stress over available grazing land might be particularly detrimental to households who solely depend on a limited number of animals and for which a livelihood switch towards agriculture may not be a viable option given its higher investment cost. According to the Eptisa census data, the total number of vulnerable households whose main source of income is livestock or agricultural activities is 45.

The magnitude of this change from land used for grazing to crop production is predicted to be Medium. Given that vulnerable households are receptors of High sensitivity, overall a **Major Adverse** effect on vulnerable households is predicted from the loss of land for grazing. On a positive note, the development of the Project may influence the development of the livestock sector in a significant way, allowing to move from traditional livestock to professionalized intensive livestock, however, the extent to which more vulnerable households have the resources and money to achieve this will depend on costs for the transition and any support provided to them. If less land is available for grazing, a move from extensive to intensive livestock farming will be required and, in order to facilitate this transition, it will be necessary to make investments on the part of the breeders for the implementation of new intensive livestock facilities (calf feedlots, automated milking rooms, etc.), as well as a professionalization of the farmers.

Entry barriers to users

A potentially significant negative impact of operation relates to potential changes that may arise related to water tariffs and land costs – affecting existing farmers and potential farmers that would like to start farming on the newly irrigated area.

Data on current (2021) rates based on Consultant's estimates is provided in the following table:

Table 9-10. Current rates for land and irrigation fees

Irrigation Fees	GEL/ha	75.00
Land Tax	GEL/ha	36.00
Land Rent (irrigated)	GEL/ha	500
Land Rent (non-irrigated)	GEL/ha	300

It should be noted that the GA is not free to set tariffs for irrigation water supply, the rates of which are established by the Georgian National Energy and Water Supply Regulatory Commission. Irrigation fees remain at the flat level of GEL 75/ha, where they have been for a number of years. This may represent a significant expenditure for users of the newly irrigated lands for households/small farmers.

With respect to modern irrigation technologies, which are likely to be promoted by the Project, many farmers are not familiar with these. Without an education and training campaign this could be seen as an entry barrier to smaller farmers, and they may opt out of the system or simply not to join due to high costs or lack of training. The introduction of modern irrigation techniques (mostly drip and sprinkle irrigation) was the subject of extensive discussions during consultations with farmers and other stakeholders for the preparation of the Eptisa 2018 ESIA report. Representatives of foreign farmers operating in the area pointed out that in order to make farming more attractive to younger Georgian generations it is important to introduce modern irrigation technologies, so that the agricultural industry can evolve from a subsistence strategy to a potentially exporting sector. After resolving water deficit and with existing resources, local farmers can become exporters as well, but if traditional methods are continued to be used, economic gains will be reduced. During the Eptisa census interviewees were asked to comment on three different technical options (based on the Eptisa 2018 FS) for the design of the irrigation project:

1. The entire system will be rehabilitated. The farmers will use the traditional irrigation system, but in this case 50% of land will be satisfied with irrigation water. Do not include any novelty, modernisation. However, it will be cheaper.
2. The traditional system of irrigation will be used, but only half of the farmers will be connected to the irrigation system. Modernisation will take place in the system where the cost is a low and water will be available for half of farmers.
3. The whole system will be rehabilitated. Water supply from secondary canals will be provided by underground pipes and not by open canals. Water will have pressure and this will allow to put down drip or sprinkle systems. Which will be related to certain costs from farmers but water will be sufficient for everyone.

From the 18 responses, consensus was reached regarding the preference for the third option, stating that it is more efficient as it allows the exact quantity of water needed to be provided and therefore more land to be irrigated, although some farmers stated that this would not be the best system for the local soil conditions. Farmers also commented that, despite the fact that the third alternative is undoubtedly modern and necessary, it also requires investments from the farmers, and it is unclear how farmers are ready to adapt to this system. In this sense, participants stated that they are willing to join the third option provided that water in the system will be enough and that the unfair water distribution will be eradicated.

Vulnerable households (45 as identified by the Eptisa surveys) and small farmers are considered receptors of High sensitivity. Without appropriate mitigation in place and given the uncertainties over the cost of the Project at farm level, the magnitude of the barrier impact is considered to be Medium for smaller and more vulnerable household farmers and, therefore, the significance of the effect pre-mitigation is **Major Adverse**.

Impacts on users currently connected to the ZSIS on an illegal basis

Evidence based on direct observations from the Eptisa 2018 ESIA Report and 2021 field surveys show that a number of households are currently benefiting from the system by accessing it illegally thorough minor self-constructed infrastructure, although an estimation of the number of plots irrigated through these practices is unknown. It is therefore likely that these groups map oppose implementation of the Project given that they will have to face the tariffs to join the system which they have been enjoying free of cost for an extended period of time. It is not known whether these groups are vulnerable or not, therefore, the sensitivity of these groups is considered Medium. The magnitude of the impact is Low, as whilst the full extent of connections is not known, it is not occurring in all places within the system. Therefore, a **Moderate Adverse** effect on these users (High sensitivity as there are likely to be of lower income groups) is anticipated, that could have an impact on their livelihoods.

Impacts on livelihoods from potential pollution events

Downstream water users and, in some cases their livelihoods, are potentially at risk of being impacted in the event of Project O&M related accidents and pollution. Increased pollution may also occur due to increased use of agrochemicals over a larger area. This is likely to mainly affect downstream users on the canals, not the Iori River, and would be of a concern mainly for the Tbilisi Sea as this is also used for potable (albeit then treated) water. As identified in the water quality assessment, it would be expected that any spills would have a level of dilution. The magnitude of the impact is considered Low to Very Low. Downstream user livelihoods are considered High sensitivity for smallholders and vulnerable farmers and Medium sensitivity for farming businesses. For business, therefore, a **Negligible to Minor Adverse** effect is predicted and on high sensitivity receptors a **Minor to Moderate Adverse** effect is predicted.

9.8.3.2.2. Mitigation Measures

A number of mitigation measures are required, predominately related to the set up and management of the Project. These measures are summarised below:

- The process of providing access to the newly irrigated lands should be fair and equitable. As there are no existing WUOs, a well-developed WUO(s) will be needed for the development and implementation of efficient water distribution system and continuous maintenance in the future. The WUOs, once established, should set out a clear and broadly equitable policy of who can gain access to the irrigated land (for new irrigated areas) and establish who can determine the use and management of water resources.
- Ideally, the challenges of entry to land for farming through rental prices should also be reviewed. Any process of auctioning and renting the land should be fully transparent, open to all interested local parties, and land lots should be rationed by household and apportioned in affordable sizes so as not to exclude less advantaged sections of the community.
- Apply a gradual tariff system with a certain degree of subsidization for vulnerable users.
- To maximise opportunities of efficiency of the Project, there is a need to increase the capacity and awareness among the governing bodies on resource management and the provision of training smaller farmers through WUOs on various topics such as modern methods of cultivation of land; growing dwarf fruit trees; modern methods of increasing the yield of forage grasses, potatoes; and rational use of fertilizers.
- The implementation of the Project should run in parallel to an adequate training program for the gradual acquisition of skills and knowledge necessary to optimize the use of the new infrastructure, maximizing hence the number of potential users. The program should not only focus on the technological aspects but also on financial management and marketing. As some of the foreign farmers and some large Georgian farmers operating in the area are already familiar with drip irrigation systems, they may facilitate the process for technological transfer. Their involvement in the program its therefore recommended.
- In terms of entry barriers, the Project could look to participate in government programmes such as “Plant the future” and “Preferential Agro-credit for Fixed Assets“ to support the development of fruits and vineyard orchard drip irrigation system.
- In order to discourage households from selling their land it is recommended to launch an information campaign, through which farmers can have awareness of the risks and expected gains from engaging in agricultural activities under the rehabilitated irrigation system. Potential farmers have to understand that farming cannot be done successfully if undertaken at small scale and without necessary care, time, skills and resources.
- Investigate the possibility to launch a pilot program of starter packages accompanied with necessary extension to provide demonstrations for small farmers about the possibilities and conditions of modern, irrigated intensive crop production.
- Cooperative services should be developed for the supply of inputs, land preparation, spraying and daily collection and marketing of the products during the harvest season.

- To address a reduction in pastureland, it is recommended to implement improved systems for the management of communal pastures, including organizational development, registration, entitlement to graze, grassland management including fertilizer application, seeding, fencing and rotational grazing. Associated work on the management of pastures does not exist at the moment and no irrigation or fertilizers are currently being applied. The setup of an organizational structure for managing pastures and grazing activities can be financed through an affordable grazing fee to be paid by interested users to cover shared costs. Many interviewed farmers are open though sceptical to modernisation and cooperative action, so demonstrations are needed to convince livestock farmers.
- Consideration of the need for credit facilities, soft loans or subsidies for example to 25 or 50 years that allow an easy payment of investments.
- To minimise pollution event risks, consider management option such as adjusting cropping calendar depending on the climate conditions; and cropping patterns to reduce the risk of pollution downstream.

9.8.3.2.3. Residual Effects

The residual effect on improvements in livelihoods due to provision of more irrigated land are considered to be **Moderate to Major Beneficial** with the implementation of mitigation measures to enhance the positive effects of the Project.

The residual effect on smaller and vulnerable farmers and the risk of loss of properties/selling up is considered to be reduced to **Minor Adverse to Minor Beneficial**, assuming that measures as identified above are in place to safeguard these farmers.

The residual effect on vulnerable households due to changes in livelihood preferences from livestock to farming is considered to be reduced to **Minor Adverse to Minor Beneficial**, assuming that measures as identified above are in place to safeguard these farmers.

The residual effect related to entry barriers to the Project is considered to be reduced to **Minor Adverse to Minor Beneficial**, assuming that measures as identified above are in place to ensure equitable access to the Project.

The residual effect on users currently connected to the ZSIS on an illegal basis is considered to be reduced to **Minor Adverse to Minor Beneficial** for those that are supported to access the Project and be able to benefit from it.

The residual effect on livelihoods related to pollution events with mitigation measures in place is predicted to be **Minor Adverse to Negligible.**

9.8.4. Economic and Physical Displacement Impacts

9.8.4.1. Methodology

The assessment is based on the premise that no new irrigation canals are required and that the majority of the command area under consideration is registered land. Further assessment will be required once the detailed design is available to confirm the findings of the assessment set out below.

9.8.4.2. Construction

9.8.4.2.1. Potential Impacts

No physical displacement is anticipated as a result of the Project as no new canals are proposed, and all works proposed are related to modernisation of existing infrastructure.

During construction there may be some temporary economic displacement related to temporary diversion or blocking of irrigation canals during reparation works and the restriction or blocking of land access for construction purposes, that could impact on access to crops and could, in the worst case, result in impacts on food security and/or loss of income. In relation to potential water restrictions, this will only affect those current beneficiaries such as farmers (for 2021, there were 1,836 contracts and therefore it is assumed this roughly equates to the number of farms/farmers) and other industrial users on the UMC. No additional impact on the HPPs is predicted, as agreements are in place that these HPPs only receive water when it is available within the system.

It is assumed that works will be undertaken in such a way to avoid or minimise to the extent possible any restrictions on water downstream and will be undertaken outside key crop water demand periods, and therefore the potential magnitude of impact related to economic displacement is considered to be Very Low to Low. The works are also only likely to result in very low-level disruption to land access. Current beneficiaries such as farmers and industrial users can all be considered as receptors of High sensitivity and therefore without additional mitigation measures, the effect may be **Minor to Moderate Adverse,** albeit temporary.

9.8.4.2.2. Mitigation Measures

As far as possible, works should aim to maintain access to land and water resources. Where this is not possible, engagement should be undertaken with the affected parties to agree on optimal time of year for the works and other temporary measures, where necessary, to main water supply and/or access.

A grievance mechanism will be put in place.

9.8.4.2.3. Residual Effects

Overall, it is anticipated that the potential effect on economic displacement will be **Minor Adverse to Negligible**.

9.8.4.3. Operation

9.8.4.3.1. Potential Impacts

No permanent physical displacement is anticipated as a result of the Project as no new canals are proposed, and all works proposed cover modernisation of existing infrastructure. Farmers are expected to develop their field with their own funds, and therefore any permanent equipment used and placed on land will be determined by each farmer.

The main potential change in relation to displacement impacts is associated with a loss of grazing area compared to the current baseline. As identified earlier, as irrigation becomes more available and incentives for farming activities are more evident, it is expected that there will be a shift from livestock to crop farming. As the Project seeks to irrigate up to a further 11,896.4 ha of land over 2021 levels, this is likely to affect the area of land available for grazing.

This view is also supported by the prediction of the 2022 FS of a reduction in alfalfa and grasses as follows across the command area zones:

Table 9-11. Current and Future Grass/Alfalfa Cropping Pattern

Crops	% of the cultivated area									
	Zone 1		Zone 2		Zone 3		Zone 4		Zone 5	
	Present	Proposed	Present	Proposed	Present	Proposed	Present	Proposed	Present	Proposed
Grass/Alfalfa	15.3%	5.0%	3.9%	0.5%	3.3%	4.0%	64.2%	41.0%	70.7%	25.0%

There may therefore be a permanent displacement of livestock in the Project Area. However, the loss of grazing land may be balanced by more intensive livestock rearing and that livestock rearing may also be replaced with crop development and therefore, the extent of any economic displacement from these potential changes is difficult to predict currently. In general terms, the census undertaken in 2016 found that future plans to expand livestock activities for small holders, who would be the most vulnerable to economic displacement, are considerably smaller than the expected increase in agricultural activities. The magnitude of this impact in relation to economic displacement is considered to be Low and the sensitivity of small farmers with livestock High, therefore it is possible that without safety nets in place a **Moderate Adverse** effect (economic displacement) may be experienced by a small number of households. For example, according to the Eptisa census data the number of vulnerable households whose main source of income is livestock or agricultural activities is 45.

9.8.4.3.2. Mitigation Measures

Measures should be put in place to ensure that more vulnerable farmers have the opportunity to fully participate in the Project and are not left more vulnerable. Additional measures and incentives therefore may be required for vulnerable families holding livestock.

In order to facilitate a move from extensive to intensive livestock farming and achieve an increase in livestock in productivity, it will inevitably be necessary to make investments on the part of the breeders for the implementation of new intensive livestock facilities (calf feedlots, automated milking rooms, etc.), as well as a professionalization of the farmers.

It is recommended to implement improved systems for the management of communal pastures, including organizational development, registration, grassland improvement techniques, etc.

A community grievance mechanism should be in place to address potential displacement as well as other unforeseen community impacts and claims.

At this stage, it is not anticipated that a Livelihood Action Plan is required however, this should be reviewed on the basis of the detailed scheme as a it develops and, if required, developed in line with the Resettlement Policy Framework.

9.8.4.3.3. Residual Effects

The residual effect of potential economic displacement on vulnerable livestock owners is considered to be **Minor Adverse**, possibly becoming **Minor Beneficial** in the future depending on the measures put in place and their ability to participate in the benefits of the Project.

9.8.5. Community Health, Safety and Security

9.8.5.1. Construction

9.8.5.1.1. Potential Impacts

Potential construction impacts include those related to health, safety and wellbeing. For the purposes of this assessment, wellbeing simply refers to people's general state of mental health and happiness.

Sources of impacts may include:

- Construction nuisance, air quality, noise and traffic
- Movement of vehicles
- Construction site activities
- Influx of construction workers
- Security detail for construction works

Potentially sensitive receptors include:

- Local communities
- Farmers
- Women and marginalised / vulnerable groups

Potentially significant impacts may arise as a result of the direct geophysical effects of Project construction activities, such as land clearance, demolition works, excavating, stockpiling, backfilling, compacting, levelling, movements of construction personnel, and material and equipment transport and handling, which can heighten dust levels, vehicle emissions, noise and vibration.

There are a number of public safety risks and potential impacts that need to be considered in construction phase works, including public injuries as a result of, for example; movement of construction vehicles including HGVs, use of equipment, open excavated areas, construction materials and equipment being dropped; and machinery or operator loss of control. All of these potential risks, however, are considered negligible in the context of a Contractor's ESMP. As it is assumed that site construction works will be restricted access areas, the main source of risk of injury will be from construction traffic, particularly along the rural roads to site. In the case of an incident, health infrastructure is relatively good due to proximity to Tbilisi. The potential for construction related incidents is considered to be Medium without mitigation and the sensitivity of the local population High, which could result in a **Moderate Adverse** effect.

The construction works may result in an increase in gaseous and noise emissions via construction vehicles and machinery and suspension of dust locally, especially if works are undertaken in drier periods. These effects can negatively impact physical health, by way of impediments to hearing and breathing and eye and respiratory infections, and negatively impact general wellbeing by way of annoyances caused by the requirement for higher frequency clothes and house cleaning in the case of increased dust levels, by way of the anxiety and stress caused by disturbance to livestock, conversations, and periods of rest, contemplation and worship, in the case of increased noise and vibration levels. Construction traffic may also cause nuisance to communities living in close proximity to access roads and other road users, who could be affected at certain periods of time when there are high levels of deliveries of equipment and personnel to site, as well as removal of wastes from site. This could result in delays and congestion and general inconvenience locally.

The impact of construction generated noise, dust and vibration on human health and wellbeing is predominantly a function of community receptor proximity and exposure to construction-related activity sources. In general, construction nuisance related to noise is limited to within about 300 m of the proposed construction activities. It is noted however that impacts from construction noise may be greater at night-time. Temporary noise effects depend on the type of activity were provided in section 9.4 above. Noise sensitive receptors such as residential properties are likely to be most affected within 50 m of construction activities, though at distances of up to 200 m the WHO day time threshold of 55 dB could be exceeded depending on the activity and equipment used. For air quality, dust impacts are typically experienced within 350 m of construction activities or 50 m from the route used by construction vehicles on the public highway (IAQM, 2014). Exposure to PM_{10} has long been associated with a range of health effects.

Within the ZSIS, the proposed works (along canals) are not located within 350 m of any local communities. However, there are isolated properties along the canals and also, farmers working in the fields adjacent the canals that could be within 350 m. The prevailing winds, and the distance between the main construction-related activities and these population centres, mean that noise, vibration and dust generation from these activities are unlikely to cause any significant impact on project community health and wellbeing.

There are also settlements located along potential labour and material supply corridors (i.e. the main roads) to the Project, and therefore a more significant construction-related noise, dust and vibration impact source is likely to arise from construction traffic passing through the settlements en-route to the main construction sites. The potential change in traffic flow, especially during peak construction, is likely to be marked in relative terms compared to the existing baseline especially on the more rural roads, and the effects of noise, dust and vibration from this traffic will be enhanced as a result of the large and heavy nature of the construction transport vehicles typically employed.

Seasonality will be a key factor in determining the traffic noise, dust and vibration levels, being highest during the warmer drier months of the year and much lower during the colder damper winter months when in particular dust impacts are tempered by snow absorption and suppression and its impacts are tempered by the reduced exposure of residents due to their propensity to seal doors and windows and reside inside. Given that residents are receptors of High sensitivity, and the magnitude of this impact is likely to be Low to Medium, depending on the time of year, the significance of the effect is considered to be **Moderate to Major Adverse** for residents/farmers within 350 m of the works and Very Low to Low and therefore **Minor to Moderate Adverse** for local communities (which is the majority of the Project receptors). However, all construction related impacts are temporary/short term, and can be reduced through implementation of mitigation measures, including good housekeeping, and appropriate engineering practice as identified below.

Downstream users are potentially at risk of being impacted in the event of Project construction related accidents and pollution during works in or immediately adjacent waterbodies affected by construction works. As works are proposed at Paldo headworks and in various ZSIS canals, there is a health risk for downstream water users. The sensitivity is High for those that use the water for irrigation and personal use. The magnitude of this impact without appropriate mitigation in place is considered to be Low, and therefore a **Moderate Adverse** effect is possible.

In relation to safety and security, the presence of the construction workforce may lead to risks associated with 'local influx' from those seeking construction employment. The number of construction workers will be employed during the construction period is around 75 at any one time (up to 300 in total is predicted) however the knowledge that there is a construction project hiring can encourage an influx beyond available positions. The non-local workforce may be accommodated in temporary construction camp(s) and/or within Tbilisi. An influx can result in rapid changes in local demographics and put pressure on social structures and local services and increase disturbance and pressure on natural resources due to construction activities. An influx of non-local workers could potentially cause local discomfort and nuisance, in particular presenting a risk of increased gender-based violence risks, especially to women and young girls. Workers may also create potential conflicts with local people. This is likely to be felt more intensively in Project villages than the larger towns or Tbilisi. An influx of temporary workers and the interaction between the construction workforce and local communities may also increase occurrence of communicable diseases. This raises the risk of contracting HIV/AIDs or other Sexually Transmitted Diseases (STDs) and the dangers this poses for the carrier's health and that of unwitting current or future partners. The sensitivity of the local population to health impacts is Medium to High (by virtue of existing health conditions, see section 7.3) and the overall influx is likely to be Low given the Project location, therefore the overall significance of effect is considered to be **Minor to Moderate Adverse**.

No information on security personnel to be used by the Construction Contractor(s) is currently available. In the case that security personnel are deployed at construction workers' camp(s) and/or at works sites, the Contractor will be required to ensure that any private security service providers comply with Georgian Law and have been vetted. It is recommended that a due diligence investigation for all security personnel, where used, is conducted to make sure they have appropriate licensing, experience and training for security contractors.

9.8.5.1.2. Mitigation Measures

In addition to the detailed Air Quality and Noise and Vibration Management Plan mentioned previously, a detailed Community Health, Safety and Security Plan and a Traffic Management Plan will be prepared and implemented that covers on and off construction site areas.

Control measures will include:

- Community liaison in advance of works to ensure that the local community and road users are aware of the risks associated with construction sites; as well as training to the construction workforce in terms of occupational and community health and safety to reduce the risks of accidents during the construction works. Advance warning to local community regarding construction activities (e.g. construction schedule in advance activities).
- Access to construction sites and facilities will be restricted to authorised personnel only.
- Provision of appropriate safety management on site including barriers to separate construction workers from traffic to avoid injury to workers and the general public.
- Appropriate selection of plant, construction methods and programming. Only plant conforming with relevant national or international standards, directives or recommendations on noise or vibration should be used.
- Select quiet equipment. For example, compare noise levels from tools when buying or hiring equipment. Use information from the manufacturer or suppliers to choose the quietest tools effective for the job.
- Ensure, through preventive inspections and planned maintenance, that construction plant is maintained in good condition to reduce noise and vibration as well as worker exposure to harmful noise and vibration.
- Avoid unnecessary revving of engines and switch off equipment when not required.
- Start-up plant and vehicles sequentially rather than all together.
- If any construction workers' camps are required, ensure that they are located at least 300 m from construction sites and at least 25 m from residential properties.
- Trucks that supply aggregates will have their buckets properly covered with tarpaulin during transit to prevent wind pick-up of dust, spill of materials and the release of dust into the atmosphere.
- Construction vehicles will be prevented from driving on unauthorised/ unplanned areas. Signs will be erected on deviation and access roads to ensure that heavy duty trucks strictly follow approved deviation tracks and additional construction haul roads will be avoided where possible to avoid creating multiple tracks.
- Construction deliveries will avoid peak periods of traffic such as rush hour, seasonal traffic, times of livestock movement.
- Normal dust mitigation measures e.g. covering stockpiles of dusty materials and damping down, will be adopted during the construction phase. Where possible, temporary roads and haulage routes will be located away from residential development and croplands. Speed limits will be put in place to minimise the generation of dust on access roads particularly near residential areas, crops or grazing sites.
- Dust-generating activities should be restricted during windy conditions.
- Design fertile soil storage pile according to Georgian standards and cover stockpiles.
- All Site Workers including drivers should be inducted for environmental awareness and site procedures, for example vehicle speed and use of designated roads to reduce suspension of dust.
- To reduce the risk of STIs, a short course in community awareness and responsibility (that includes instruction on sexual harassment, conduct, and health) will be included as part of the induction programme for all Project employees and contractors, and all Project employees and subcontractors will be issued with

a Code of Conduct addressing expectations and punitive measures concerning their discipline and behaviour (including for inappropriate sexual fraternisation) in project-affected communities.
- Implementation of a stakeholder grievance mechanism, which is widely publicised and accessible to community members at Project sites to support the reporting and redress of any transgressions, sexual or otherwise, of the Code of Conduct. This will be widely disclosed, publicised and accessible to all community members.
- For any security personnel/companies used, a due diligence investigation should be conducted to make sure they have appropriate licensing, experience and training for security contractors.

An Emergency Response Plan will be prepared, that will consider impacts on local communities and how local communities may need to respond in the case of an emergency.

A detailed Traffic Management Plan will be prepared and implemented. Control measures will include:

- Contractor to train all drivers and ensure suppliers are aware of the correct and approved haul roads and to avoid creating multiple earth trucks.
- Appropriate ingress/egress required where construction traffic requires to move to/from the haul road to the public road.
- Construction vehicles to keep to agreed access routes, minimise risk and disruption to project affected communities. Speed limits (30 km/h or less) shall be imposed on construction traffic to minimise risk of accidents, especially where construction traffic is using the public road and at entrance/egress points onto the public road; and along access roads. All Project transport providers and employees to be strictly required to limit their speed to 30 km/h or less when passing through any settlements as part of their contractual obligations, with the suspension or cancellation of contract in the event that this is not adhered to.
- Traffic marshals will be in place during HGV deliveries to site.

9.8.5.1.3. Residual Effects

Assuming all mitigation measures are implemented, it is considered that the residual effect on health and wellbeing will be **Minor to Moderate Adverse** for a short period of time during high construction traffic periods or intense bursts of construction activity where these take place near people using nearby fields.

9.8.5.2. Operation

Potential impacts during operation related to health, safety and wellbeing may include wellbeing impacts over possible water resource and land use disputes and environmental externalities among farmers.

Sources of impacts may include:

- Water quality in canals
- Use of herbicides, pesticides and fertilisers
- Use of farm equipment and vehicles
- Improved livelihoods and access to food security
- Influx of farmers
- Access to irrigation water and land

Potentially sensitive receptors include:

- Farmers
- Local communities

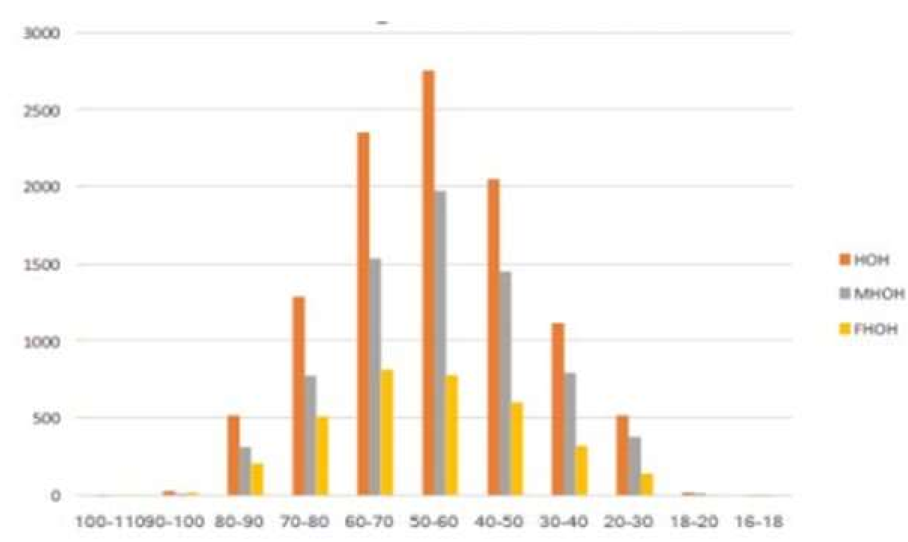
One of the potential effects of the improved and expanded irrigation as a result of the Project will be to improve the flow of stagnant or semi-stagnant waters in the existing irrigation canals, which can serve as breeding sites for vector borne diseases. Improved flow of water could result in some minor improvements to farmer health and the local communities in the ZSIS. Open irrigation canals present a hazard to the local population, in particular children, because of the risk of contracting water borne diseases such as typhoid, paratyphoid, salmonella and dysentery and because of the risk of community residents accidentally drowning. However, no new canals are proposed and therefore this risk is currently experienced. If anything, the opportunity for an improved flow and a potential improvement in water quality if untreated discharges to the canals are also regulated, will result in a benefit to farmer and local community health. Improvements in water quality are considered to be Very Low to Low in magnitude and sensitivity of farmer and local community High, therefore the overall benefit could be **Minor to Moderate Beneficial**.

However, one of the effects of agricultural expansion will be to increase the use of pesticide, fertilisers and herbicides (by virtue of the increased area under irrigation) which can be toxic to humans if not properly controlled and managed. The magnitude of the impact is considered to be Low as it is anticipated that more efficient use of pesticide, fertilisers and herbicides will be promoted (though the Project will have limited control over what farmers actually use). As farmers are receptors of High sensitivity, overall the effect has the possibility to be **Moderate Adverse** however, with training this could result in a **Minor Beneficial effect in the longer term**.

As with any farming operations, there is a risk of injury or accidents associated with the use of farm equipment, especially where new equipment is in use with little training. Likewise, an increased flow of traffic especially seasonally during harvest periods to local markets increases the risk of road traffic accidents locally. Overall, the magnitude of the impact is considered to be Very Low and as farmers and the local community are receptors of High sensitivity, the effect would be **Minor Adverse**.

Improved livelihoods and access to subsistence crops as a result of the Project, for those that have access, can be expected to have a positive effect on the wellbeing of farmers and their households, including those working full time and part time on farms. Overall, the impact on wellbeing is considered Low to Medium depending on each individual's circumstances, and therefore, the effect would be **Moderate to Major Beneficial.**

Although projections of demographic changes at a regional level are difficult to estimate, it is reasonable to predict that the economic boost from implementation of the Project will result in job seekers establishing in the area. It is expected in the longer term that there will be a net impact on demographics as a result of job opportunities, both directly and indirectly, associated with overall revitalization of the area. Agricultural activities carried out by newly connected households, organizations and cooperatives will require a labour force that will probably need to be met by incoming migratory flows. These migratory flows will likely include returned household members who previously left the region in search of job opportunities in nearby towns (most likely in Tbilisi). Due to the proximity to Tbilisi it is expected that the flow of commuter workers will also increase as new jobs and agricultural activities will be available to them. This in turn may cause the subsequent further impacts in terms of social infrastructure needs and social services that will be needed in the area as a consequence of the population increases. The Project census undertaken by Eptisa indicated that the Project Area has a highly aged demographic pattern (Figure 9-5 below), with an estimated average age of 43 years (56 years for household heads), whereas the national average remains at 38 years. This factor may result in an inflow of a younger and skilled generation of workers that are willing to take over agricultural activities under a modernized approach. This factor was also highlighted in the farmer's representatives during consultations undertaken by Eptisa.



Source: Project Census

Figure 9-5. Average Age of All, Male and Female Heads of Household

Larger agricultural producers and corporations operating in the area have stated their willingness to expand production and to diversify crops once the new irrigation system is available, which may provide some increase in labour force. Out of the 130 organizations contacted in the Eptisa census 75 (holding 4,271 Ha of agricultural land) declared to be interested in irrigation and to expand their production. The demand for labour will however be limited as farming activities are likely to be more mechanized. Where fruit trees, berries and to a lesser extend nuts are planted, there is likely to be a higher demand for seasonal labour.

An increase in migratory flows will also result in an increased demand for social infrastructure and services. Currently, basic social infrastructure indicators show that the Project Area enjoys a reasonable degree of social coverage, with clinics, hospitals and schools situated at affordable average distances (Table 9-12 collected by Eptisa), however, may become more strained in the longer term if a commensurate level of service development does not occur alongside population influx/growth.

The overall magnitude of an influx impact on the local community and services is considered to be Medium, the sensitivity of the local communities and local services is Medium given their proximity to a large city, Tbilisi, and therefore the overall effect is considered to be **Moderate Adverse** in relation to impacts on the wellbeing of the existing local communities and their access to social infrastructure.

Table 9-12. Social Indicators of Social Infrastructure (Distance from Household)

	Mean	Minimum	Maximum	Median
Distance to School	1.7 km	0.1 km	10 km	1 km
Distance to Market	7 km	0.03 km	45 km	4 km
Distance to Hospital	16 km	0.1 km	50 km	15 km
Distance to Clinic/Medical Unit	4 km	0.1 km	50 km	2 km

Other impacts on security and wellbeing include possible disputes arising from water resource and land use access. In the case of land use access, disputes may arise between crop farmers and livestock farmers. The Eptisa 2018 ESIA reports that there are currently a high number of unfenced and underutilized land lots that, not having access to irrigation, are currently used as pastoral land for livestock belonging to nearby households. Large farmers often fence their land but farmers with remote and dispersed small plots will find this prohibitively expensive. The expansion of irrigable crop lands therefore may result in the limitation of available land for livestock activities, and livestock may roam into the new plots. This can be a particular problem when in small plots with high value crops. The Eptisa report indicated that almost all non-irrigated land is used as pastureland. A reduction in the area of pastureland can therefore be expected to give rise to social tensions between crop farmers and livestock farmers/owners. In the absence of more specific information on future livestock farming techniques by small holders, evidence on the intensification of agricultural activities in detriment of livestock farming indicates a potential for disputes among farmers over conflicting land uses which will need to be properly managed. Given the extent of the use of the available lands for pasture currently, the impact of this may be Medium. With the sensitivity of both smaller crop and livestock farmers being High, the overall effect in terms of tensions could be **Major Adverse**, though limited to small scale farm areas.

In relation to disputes over water resources, as more irrigation becomes available in the area, urban owners who hold the land mainly for leisure purposes and/or as a second residence are likely to connect to the system. This may cause some pressure on the availability of water and hence disputes with farmers if water use is not appropriately managed and monitored for the use of farmers. Although specific figures on residential and leisure properties are not currently available, it is expected that the availability of water in the area will bring a reinforced use of these areas for residential and leisure purposes, which in turn may cause further unexpected stress to the system. As an element of water management will be expected as an integral part of the Project, the magnitude of the impact is considered to be Very Low to Low. The sensitivity of smaller farmers in particular is High, and therefore without additional measures in place **Minor to Moderate Adverse** effect. Conversely, the development of the Project will result in the provision of water over a larger area and a more reliable water source, which should result in a reduction of current disputes over water and more equitable distribution of water. The sensitivity of farmers is High, and therefore a **Moderate Beneficial** effect can be predicted.

Finally, in relation to security and wellbeing, as agricultural activities expand and diversify across the Project Area, the likelihood of conflict among neighbouring farmers may increase, for example due to possible cross-contamination effects. When asked in consultations undertaken by Eptisa, the majority of farmers stated that they will increase agricultural activities, extending the farming activities on owned land and introducing new types of crops. These statements came from both large and small scale farmers. Different types of crops grown in neighbouring land lots might turn out to be incompatible in terms of chemicals utilized, causing unwanted costs among different farms. Also, the practice of undergrowth burning, and other activities might be a cause of disruption and unwanted costs among different households that may ignite disputes in the area. With regard to cross-contamination, it is not considered that it will be significant since the herbicidal products of each group of plants are different and with different application times. Therefore, with a Very Low magnitude of impact and sensitivity of farmers High, overall at most a **Minor Adverse** effect in relation to this impact is predicted.

The quality of the water used from the irrigation canals may affect soil quality (see section 9.5) and crops and therefore can pose a risk to human health, livestock and fauna through ingestion. The quality of water in the canals was tested by Eptisa for 10 chemical and one microbiological parameter, including pH, turbidity, BOD, COD, ammonium, suspended solids, chlorides, oil products, mineralization, some heavy metals (iron, zinc,) and E-Coli. The results showed that iron concentration in almost all samples exceeds the MPC. According to the Eptisa survey it is likely that the increased amount of iron in the water may be due to natural content. Increased amounts of Ammonium ion and E.coli concentrations were recorded in some samples. The most probable cause of this is the discharge of untreated wastewater into the ZSIS canals. These are not an impact of the Project but will impact on the Project and, in areas of poor water quality, what crops can be grown safely. Downstream canal water quality may also be affected by upstream pollution as a direct result of the Project, through the use of agrochemicals which has been addressed above. Overall, the magnitude of the water quality impact on local farmer and local communities (High sensitivity) health is considered Medium in certain areas and lower in other areas, pre-mitigation, and therefore a **Major to Moderate Adverse** effect is predicted.

9.8.5.2.1. Mitigation Measures

Water management rules should be negotiated with clear priorities for all stakeholders to avoid disputes.

A conflict resolution procedure should be established with participation or representative of local authorities and farmers’ organizations for at least a transitional period after the implementation of the project.

An information campaign for the clarification of access conditions and the expected benefits of joining the system in terms of productivity and yield should be launched.

A complimentary programme of farmer awareness and understanding in efficient water resource use and safe handling and control of fertilisers, pesticides and herbicides is required as part of the Project implementation. Only authorized chemicals should be used. The MEPA should monitor the use of products, disseminate information on banned products and penalize offenders.

Adequate planning of further development of social infrastructure in the region should be properly planned and designed by public authorities in the face of likely migratory inflows as a consequence of the economic revitalization of the irrigated area. Close collaboration with agricultural organizations and companies operating in the area will be needed to provide more accurate estimates of labour demands in the sector in order to quantify the actual social needs in the long term. A comprehensive and detailed social development plan led by public authorities under a participatory approach should be put in place in parallel to Project development.

In order to facilitate a move from extensive to intensive livestock farming and achieve an increase in livestock in productivity, it will inevitably be necessary to make investments on the part of the breeders for the implementation of new intensive livestock facilities (calf feedlots, automated milking rooms, etc.), as well as a professionalization of the farmers, which will have an important impact on the market. It is recommended to implement improved systems for the management of communal pastures, including organizational development, registration, grassland improvement techniques, etc.

In relation to potential connections for water for residential homes and leisure uses, it is important to clarify that the Project will not be delivering bulk water for the drinking water supply purposes, so this use should be forbidden. However, should such a system be considered appropriate depending on water availability, a separate tariff system for residential homes and leisure uses of the water is recommended.

Land consolidation and the development of farmer´s associations should be encouraged in order to promote coordinated actions among different producers. Land distribution according to compatible types of crops should be encouraged not only in order to optimize the irrigation system but also to avoid environmental externalities that could result in local disputes. Regarding treatments, it is considered important to instruct farmers on integrated agriculture and organic farming practices, which reduce this type of risk. In addition, it is essential to choose well-regulated and regulated application equipment and the application of phytosanitary products in the absence of winds, or as much soft winds.

In relation to existing untreated discharges from urban and industrial areas, all enterprises discharging wastewater into canals of ZSIS should be required to meet national standards as a minimum.

The creation of a local governing body for the resolution of disputes is recommended, including a compensation mechanism in case of damages such as those caused by crossed contamination.

9.8.5.2.2. Residual Effects

With appropriate training and awareness building in place, it is likely that any adverse health effects can be ameliorated, and beneficial effects enhanced, resulting in net **Moderate Beneficial effects**.

Improved livelihoods and access to subsistence crops will remained a **Moderate to Major Beneficial** effect.

With appropriate development of social infrastructure in line with any influx, overall there should be a **Negligible** effect on local community wellbeing and access to social infrastructure.

With appropriate measures in place, the risk of conflicts and consequent impacts on wellbeing will be reduced to **Minor Adverse** and **Negligible** effects and for access to irrigation water, will remain **Moderate Beneficial**.

With mitigation in place, the impact of water quality contributing to adverse health risk will be reduced to **Minor Adverse** and **Negligible** effects.

9.8.6. Labour and Working Conditions

9.8.6.1. Construction

9.8.6.1.1. Potential Impacts

Potential impacts during construction are related to labour conditions, working conditions and occupational health and safety (OHS).

Sources of impact during construction include:

- Construction employment
- Construction sites and work activities
- Movement of construction-related vehicles and equipment

Potentially sensitive receptors are construction workers and third party suppliers.

Details about the labour procedures and management, and any construction workers' camps are not yet known. However, it is expected that the Construction Contractor(s) will comply with the national labour and employment law and good international industry practice (GIIP) and will ensure that all employees, permanent and temporary, will be provided with a contract. It is also expected that the Project will comply with the Labour Code of Georgia on working hours, working conditions, OHS, and the management of non-employee relations and grievances. Where the Labour Code does not cover the full range of working conditions, GIIP will be followed. If not managed in accordance with the legislation and GIIP, there could be significant risks and/or impacts associated with labour grievances, supply chain issues, OHS, and child and forced labour. The potential impacts on labour and working conditions could be medium risk to project development outcomes prior to implementation of mitigation measures, resulting in a **Moderate to Major Adverse** effect if adverse impacts materialise.

In relation to OHS, it is assumed that the Construction Contractor(s) will have sufficient workforce, with adequate training and equipment to deliver the Project. However, as with all construction sites, there is the potential for workers to be exposed to heightened personal safety risks relating to workplace activities (for example, exposure to the risk of drowning where works are carried out in the vicinity or in the river or due to works with hazardous materials, or due to the spread of diseases such as COVID-19, etc.). The Construction Contractor(s) will be required to develop management arrangements and procedures to avoid hazards and, where this is not possible, mitigate the risks to the workforce in accordance with the hierarchy of risk management. The sensitivity of construction workers is considered high as on any construction project they can be exposed to a high risk of hazards. The magnitude of the potential risk of the hazard occurring, prior to mitigation, is Medium to High. Should a hazard cause harm to a worker (or member of the public), the overall significance of the effect is considered **Major Adverse**.

9.8.6.1.2. Mitigation Measures

Labour and working conditions

Once further details are available, the GA should make available for the EIB's review a set of more comprehensive information to perform a labour assessment. At minimum, the labour assessment should cover the GA's human resources policies and management capacity to implement and monitor these, including for primary contractors and first-tier suppliers; as well as the relevant management systems and procedures.

A detailed Human Resources Policy and Labour and Working Conditions Management Plan will be developed by the Project and any Construction Contractor(s), to be approved by the GA and Lenders. The HR policy and Labour Management Plan will be readily available and understandable to all employees, and set out its approach to managing employees, including rights under Georgian labour and employment law, and employee rights to join worker organisations and bargain collectively.

If requested by the Lenders, independent labour audits organised by the GA will be conducted during construction; one audit to be conducted shortly after mobilisation, and one audit to be conducted at peak in terms of workforce volume.

Control measures will include:

- Labour conditions, working procedures, camp conditions and supply chain must be undertaken in accordance with the Georgia Labour Code, EIB Performance Standard 8 (Labour Standards) and Performance Standard 9 (Occupational [and Public] Health, Safety and Security).
- The Human Resources Policy will be non-discriminatory and shall observe equal opportunities. Employment decisions will be based on professional skills and competencies. Employment relationships must be fair and equal in all its aspects, including remuneration, recruitment, promotion, termination of employment and disciplinary practices. No employment decisions will be taken based on personal characteristics which are unrelated to inherent job requirements: gender, race, ethnic, social and indigenous origin, religion, political opinion, nationality, disability and sexual orientation cannot impair equality of opportunity or treatment in suitable employment or occupation, including access to vocational training.
- Opportunities to maximise gender equality and minimise any potential for gender-based violence and harassment (GBVH) should be taken where possible by the Construction Contractor. The Code of Conduct will, in relation to GBVH provisions, refer specifically to Codes of Conduct that meet the International Labour Organization's Convention No. 190 on eliminating violence and harassment in the world of work (which will take effect in 2021) and the EBRD, IFC and CDC Groups sector-level briefs on GBVH – 'Addressing Gender-Based Violence and Harassment (GBVH) in the Construction Sector'[172]and 'Addressing Gender-Based Violence and Harassment (GBVH) in the Public Transport Sector'[173].
- No forced or compulsory labour will be employed. Any restriction of freedom of movement of the labour force during the course of their employment shall be avoided.
- In line with the ILO Minimum Age Convention No. 138 and the Worst Forms of Child Labour Convention No. 182, child labour will not be employed or used.
- The treatment of any migrant workers will not be less favourable than that of no-migrant workers undertaking similar functions. This includes enjoyment of same rights and of equal opportunities and treatment.
- Collective bargaining agreements undertaken with workers' organisations will be respected and Construction Contractor's will promote fair working conditions.
- A third party supplier procedure will be developed and adopted, and all suppliers will be expected to meet the same standards as outlined here.
- A formal Project labour grievance mechanism will be set up and maintained. Reporting of grievances and resolutions proposed to be reported by Construction Contractor(s) to GA as a minimum in monthly reports.

Construction workers' camps

[172] Available at: https://assets.cdcgroup.com/wp-content/uploads/2020/07/14193353/Addressing-GBVH-in-the-construction-sector.pdf
[173] Available at: https://assets.cdcgroup.com/wp-content/uploads/2020/07/14193354/Addressing-GBVH-in-the-public-transport-sector.pdf

If construction workers' camps are used, the camps will be established in accordance with EBRD/IFC guidance: Workers' accommodation: processes and standards[174]. The Construction Contractor(s) will prepare for approval by the GA and Lenders, a Camp Management Plan prior to construction.

- A Code of Conduct will be prepared that includes measures for construction camp living.
- Security shall be hired to guard camps and shall be available for prompt communication with workers.
- Food safety, drinking water quality and hygiene at any worker camps will be required and regular controls will be imposed.

Occupational health and safety

The Construction Contractor(s) management system will follow the Project ESMP and be aligned with international standard ISO 45001 and developed in alignment with EIB Performance Standard 9 (Occupational [and Public] Health, Safety and Security).

A detailed OHS plan will be developed and implemented that promotes and protects the health and safety of employees at work throughout the project life cycle by ensuring safe, healthy, hygienic and secure working and accommodation conditions and, effectively, a working environment that respects and safeguards the right to privacy. Control measures will include (but not to be limited to):

- Site Rules
- Job and task specific hazard analysis and controls for all activities
- Requirements for and enforcement of PPE use
- Safety training for personnel
- Develop and implement an emergency response procedure
- Maintain statistics of total work hours, lost time, incidents, injuries, near misses, etc.
- Develop and implement a reporting and investigation procedure
- Appropriate public and employee insurance
- Toolbox talks to share information on risks, accident prevention, etc.
- Ensure no prohibited materials such as asbestos containing materials (e.g. pipes) are procured or used
- Provision of appropriate safety management on site including barriers to separate construction workers from traffic to avoid injury to workers and the general public

A detailed Emergency Preparedness and Response Plan detailing preventative measures for all types of incidents covered in the plan will be developed and implemented. This plan should be developed and implemented in liaison with local community members, authorities and emergency services. This Plan be in place prior to construction commences on site. It should include as a minimum:

- Identification of potential emergencies and risk assessments e.g. spills, fires, collisions, worker injury
- Roles and responsibilities
- Development of procedures to respond to identified emergencies
- Equipment required e.g. first aid facilities, firefighting equipment, etc.
- Testing and inspection regimes for emergency equipment
- Muster points and evacuation routes
- Training requirements
- Communication protocols to workers, public and other affected parties
- Location of nearest medical facilities
- Update and review cycle

A COVID-19 policy and emergency plan will also be prepared and implemented.

[174] EBRD/IFC (August 2009), Workers' accommodation: processes and standards. A guidance note by IFC and EBRD. Available at: https://www.ifc.org/wps/wcm/connect/topics_ext_content/ifc_external_corporate_site/sustainability-at-ifc/publications/publications_gpn_workersaccommodation

9.8.6.1.3. Residual Effects

With the mitigation measures proposed, it is considered that the Project will have a **Minor to Moderate Beneficial** effect on labour and working conditions.

9.8.6.2. Operation

9.8.6.2.1. Potential Impacts

Potential impacts during operation are related to labour and working conditions and OHS of farmers as well as O&M staff.

Sources of impact during operation include:

- Maintenance activities e.g. clearance of canals
- WUOs agreements
- Use of farming machinery and use of hazardous materials e.g. fertilisers
- Movement of farming-related vehicles and equipment

Potentially sensitive receptors are O&M staff, and third party suppliers, and irrigation operators (small and large farmers).

O&M staff will be required, serviced both from within the GA, WUOs and contracts with O&M Contractors; however, at this stage it is not known if additional workforce would be required. It is expected that the GA, WUOs and any of their O&M Contractors will comply with the Georgia Labour Code and will ensure that all employees, including both permanent and temporary employees, will be provided with a contract. It is also expected that the Project will comply with the Labour Code on working hours, working conditions, occupational health and safety, and the management of non-employee relations and grievances. However, if not managed, there could be impacts associated with supply chain, OHS, child and forced labour. The potential impacts on labour and working conditions are anticipated to be medium risk and workers of High sensitivity, and therefore effects could be **Major Adverse** during operation without appropriate mitigation in place.

The 2022 FS identifies that effective water governance would entail legislative, institutional, organisational and administrative reforms, including practicing Integrated Water Resources Management (IWRM). Good governance requires formulating and providing an appropriate enabling environment that includes facilitating collective decision making, effective institutions and suitable policy, legal and political frameworks. This is not currently in place for the Project and therefore results in risks in relation to labour and working conditions in relation to contracts for use of the irrigable area, especially for those farmers that rent. Newly created WUOs should set out a clear and broadly equitable policy of who can gain access to the irrigated land (for new irrigated areas) and establish who can determine the use and management of water resources. In addition, it will be necessary for WUO members to be provided with training on various topics, including; modern methods of cultivation of land; growing dwarf fruit trees; modern methods of increasing the yield of forage grasses, potatoes; and rational use of fertilizers. The potential impacts on labour and working conditions related to WUOs and contracts are anticipated to be medium risk and farmers (particularly small farmers) of High sensitivity, therefore and therefore effects could be **Major Adverse** during operation without appropriate mitigation in place.

OHS risks during operation will depend on the activity, and therefore appropriate training will be required. Higher risks are associated with the use of farming machinery. As identified earlier, there will be some increase in the use of herbicides, pesticides and fertilisers that can be toxic to humans if not properly controlled and managed. The magnitude of these negative health impacts, however, is expected to be relatively low. A low risk is also anticipated with operational vehicles moving to and from farms and markets, as this activity already occurs. The potential impacts on O&M for farmers are anticipated to be Low to Medium risk and workers of High sensitivity, therefore and therefore effects could be **Moderate to Major Adverse** during operation without appropriate mitigation in place.

In terms of specific maintenance activities, it is assumed that a sufficiently trained and equipped workforce will be provided to deliver them in accordance with Georgia Labour Code and GIIP. The potential impacts on O&M OHS are anticipated to be Low risk and workers of High sensitivity, therefore and therefore effects could be **Moderate Adverse** during operation without appropriate mitigation in place.

9.8.6.2.2. Mitigation Measures

A Labour Management Plan and Human Resources policy will be developed and implemented for O&M activities. This should be developed by both the GA and WUOs. An Emergency Preparedness and Response

Plan will also be developed and implemented for O&M activities. It is also expected that an Emergency Preparedness and Response Plan will be developed and implemented for operation of the Project by WUOs.

The Global Water Partnership identified ten criteria for effective water governance that were further refined by the World Water Assessment Programme into eight principles of good governance, as set out in section 2.5.2.4.

The WUO should have the characteristics of (a) direct involvement of the irrigators, (b) effective monitoring and sanctioning, and (c) holding officials accountable. The WUO will become self-regulating, self-supporting, and self-governing on issues concerning irrigation management. The irrigation agency will play a regulatory role, but the WUO becomes responsible for all day-to-day O&M. In terms of access to farming plots, appropriate contracts should be put in place with farmers and access to plots should be on the basis equal opportunities. The WUO should also facilitate farmers in an understanding of legal mandates through group responsibilities, thereby creating a strong and formal institutional backing for immediate action on management responsibilities.

Land registration and ownership mapping should form part of the WUO sub-project so that membership can be fully documented, and details of hydrological boundaries can be assessed in relation to land ownership. The approach would be to use community organisation activities to gradually develop ownership mapping for the whole of ZSIS during the two-year tenure of the sub-project. The mapping should be GIS based using hand-held GPS's for identifying plot boundaries supported by any relevant web-based remote sensing that can be used.

An Operation and Maintenance (O&M) OHS Plan will be developed and implemented, including an Emergency Preparedness and Response Plan.

In terms of OHS, training in use of farming equipment, appropriate use and handling of chemicals, PPE, and of the use of spill kits, where relevant. Farmers should also undertake regular maintenance of equipment to reduce the risk of injury.

A Project Grievance Mechanism should be in place to cover labour and OHS requirements.

9.8.6.2.3. Residual Effects

With appropriate training and awareness building in place, it is likely that any adverse effects can be ameliorated, and beneficial effects enhanced, resulting in net **Moderate Beneficial effects**.

9.8.7. Gender (and Vulnerable Groups)

9.8.7.1. Construction

9.8.7.1.1. Potential Impacts

Potential impacts are related to women's potential to access temporary jobs during the construction period and the impacts of construction workers and activities in the local community.

Sources of impact during operation include:

- Project construction employment
- Construction workforce
- Demand for goods and services
- Construction nuisances e.g. noise, dust, etc.
- Physical or Economic Displacement

During the construction phase, there are some expected positive impacts on Gender. For example, it is expected that this phase will directly and indirectly generate professional and casual employment opportunities (i.e.: construction-related employment, increased demand for goods and services). This will include employment in sectors that are traditionally considered as female, such catering, service industry and administration, and opportunities for female technical experts within the Project Management Unit (PMU). The construction sector, however, is traditionally male dominated and opportunities related to unskilled and skilled construction works labour jobs are expected to be undertaken by men. Women are receptors of High sensitivity however the number of likely job positions overall is low and for women, likely to be Very Low during construction. The effects of employment opportunities are assessed as **Minor Beneficial** in relation to Gender.

The construction works will have impacts on adjacent communities due to increased traffic and access constraints, and disruption of everyday activities. These impacts have been addressed above and, although in some cases may affect women disproportionately, these are unlikely to be significant in the case of this Project and therefore no additional scoring is provided for women; mitigation measures are identified below. Should the project result in physical or economic displacement, this could also affect women disproportionately. While it is not expected that the construction phase will generate a large influx of temporary workers and Contractors in the Project area, there are examples in the past that have shown that construction projects can generate harmful social dynamics in local communities, with particular negative consequences on Gender-based Violence and Harassment (GBVH)[175]. Women are considered receptors of High sensitivity and the magnitude of the impact in relation to construction related potential impacts low (based on the size of the works and construction workforce), resulting in a **Moderate Adverse** effect (though Major Adverse effect on the individual if it were to occur).

9.8.7.2. Mitigation Measures

The following mitigation measures should be implemented:

- It is recommended that the Georgian Amelioration Limited (GA) develop a Human Resources gender strategy or action plan *inter alia* with measures to encourage more women being employed to mid- and senior-level positions within the GA.
- The Project and Contractors Labour Management Plan should specifically identify gender equal opportunities and targets. A Code of Conduct to address GBVH and inappropriate sexual fraternisation should also be included and be a requirement to comply with for all third party suppliers and supply chain organisations involved in the Project.
- The Project will likely revitalise local economic activities requiring raw materials, equipment and goods and services. To maximise benefits, whenever possible, it would be important to target women-led businesses (whenever possible) to support their development. To maximise these employment opportunities for women, awareness sessions on gender equality are recommended to understand the importance of gender equality and social inclusion in the recruitment process. Recruitment processes should be transparent, publicly disclosed, and be accessible to all people locally of working age, regardless of gender and ability. These requirements should be set out in the Labour Management Plan.
- The construction works should consider their schedule, whenever possible, with respect to activities that could severely affect access to education and healthcare facilities, or the development of economic activities. This will help mitigate gendered impacts that particularly affect women and disadvantaged communities.
- All construction works that are expected to affect local residents and adjacent businesses should implement a communication strategy in a timely manner. This strategy should inform the implementation schedule of the Project to mitigate the disruption of traffic and transport services, everyday life, and economic activities. This communication should be in a format and language accessible for all and address any gender-specific issues.
- The Construction SEP should ensure that it is gender sensitive. This includes consideration of measures such as:
  - Stakeholder engagement team should be diverse, to capture women and other groups' needs.
  - Information on the Project should be available in formats and languages that are culturally appropriate and accessible for all, with particular attention to the needs of persons with hearing and visual impairments, or persons with low-literacy levels.
  - Ensure that the voices of women and disadvantaged groups are heard (for example by Focus Group Meetings that specifically target women or other groups of interest).
  - Ensure meeting schedules do not compete with women's domestic and community responsibilities and that there is adequate infrastructure to ensure mothers' participation (i.e.: care services or support).
  - Ensure meetings are held in a location and building that is accessible to PWD (e.g.: with accessibility considerations such as ramps or lifts, PWD-friendly toilets, etc.). Outreach options should be considered.

[175] CDC (n/d). Addressing Gender-Based Violence and Harassment (GBVH) in the Construction Sector. Available at: https://assets.cdcgroup.com/wp-content/uploads/2020/07/14193353/Addressing-GBVH-in-the-construction-sector.pdf

9.8.7.3. Residual Effects

Given the employment levels likely for the construction phase, this is considered to remain as a **Minor Beneficial** effect in relation to Gender.

Adverse effects in relation to GBVH risk and other impacts in vulnerable persons is considered to be reduced to **Minor Adverse** with the above mitigation measures in place.

9.8.7.4. Operation

9.8.7.4.1. Potential Impacts

Potential impacts during operation are predominately related to women's (and other vulnerable persons) access and participation within and ability to benefit from the Project.

Sources of impact during operation include:

- Operation of the Project and WU)s
- Use of farming machinery
- Demand for goods and services
- Food security

Despite the existence of a formal gender mainstreaming policy in national strategies, women have a less favoured position with regard to formal employment and participation. Their access to assets and productive resources is significantly lower than that of men. The Project provides an opportunity to promote greater economic inclusion for women. In particular, the development of WUOs and their membership base, if planned around gender sensitive policies, could result in improved equity and reliability of water distribution among users, presenting in particular an opportunity to improve gender equality. Overall, the High sensitivity of women in agriculture, coupled with the potential to increase women in agriculture having a Low to Medium magnitude of impact, the significance of the effect is **Minor to Moderate Beneficial** in the long term.

The irrigation development of the area has also potential to contribute to the skills development and training of local communities. These opportunities should be accessible to all: in locations, schedules and formats that are accessible to all and compatible with other domestic and community responsibilities. Overall, the High sensitivity of women and other vulnerable groups in agriculture, coupled with the potential to increase skills to these more marginalised having a Low to Medium magnitude of impact, the significance of the effect is **Minor to Moderate Beneficial** in the long term.

The project should also result in significant improvements in food security, agricultural output (increasing both subsistence and commercial farming) and economic development. Improving the condition of irrigation structure will decrease water shortages and contribute to farmers' adaptation to climate change. This is particularly beneficial for those groups who are disproportionally affected by the impacts of climate change, such as women. Overall, this group of people is of High sensitivity. The magnitude of impact of food security is considered Low to Medium, depending on the final Project set up, and therefore the significance of the effect is **Minor to Moderate Beneficial**.

9.8.7.5. Mitigation Measures

The main recommendation for gender inclusion is related to WUOs set up and functioning. Since they are currently non-operational, there is an opportunity to develop a gender inclusive approach that encourages female farmers' participation in decision-making processes within the agricultural sector. This could include an affordable and inclusive membership that does not restrict women's participation (for example, memberships that are not tied to land ownership). The development of WUOs, their membership base and the PMU, if planned around gender-sensitive policies, could result in improved equity and reliability of water distribution among users, thus enhancing gender equality. Women's networks and associations could be strengthened, especially in relation to the development of the WUOs.

To achieve this, there is a need to increase capacity and awareness among the governing bodies of irrigation processes on gender equality and to link these issues to resource management and especially water management. To maximise benefits, the GA and new WUOs should adopt gender-positive policies. Equitable opportunity should be given to men and women to join the WUOs as part of the expansion of the irrigable area. Training requirements should take into account the needs of women as well as men.

Awareness sessions should be developed with the assistance of the PMU at a policy and project level to raise awareness about gender equality and to dismantle the unconscious biases and stereotypes that limit women's participation in the construction and agricultural sectors. Wherever possible, the implementation of women-targeted activities and programmes should be incorporated into the Project.

Qualified advisory services, especially for women, who are typically less involved in training provision, should be created. Training topics of interest to women may include, but not necessarily be limited to:

- Modern methods of farming;
- Growing berries in the garden; and
- Processing of milk and wool at home.

The Project should also seek ways in which to contribute to training and extension services related to irrigation (and agriculture more generally) and capacity building activities more accessible to women (i.e.: outreach options or convenient locations, and timings that do not compete with domestic/care responsibilities). Given that there is not a gender digital gap in Georgia (according to Geostat data), priority could be given to ICT-based communication campaigns to disseminate these activities or provide information in spaces that women frequently use (i.e.: markets, women's rooms). In order to tackle time poverty, these campaigns could be used as an opportunity to link women to publicly available care services (whenever possible) and to promote labour-saving technologies.

9.8.7.6. Residual Effects

The residual significance of the effect on Gender and Vulnerable Persons, assuming the mitigation measures are put in place, is **Moderate Beneficial** in the long term.

9.9. Cultural Heritage

9.9.1.1. Construction

9.9.1.1.1. Potential Impacts

A negative impact on cultural resources is considered significant if it meets one or more of the following criteria:

- Exposes a cultural monument/object to an increased risk of damage or loss
- Threatens the physical integrity of a cultural resource

Sources of impact during construction include:

- Excavation works
- Movement of personnel and construction vehicles

There are around 40 monuments in the ZSIS area, represented mainly by mediaeval churches, caved churches (some of them with fragments of wall painting), and towers, however, none of these are adjacent the existing canals. Therefore, no significant impacts on cultural resources are anticipated, assuming no new irrigation canals construction takes place.

During the 2021 interviews with farmers, the presence of two tombs and a cemetery near irrigation canals. Therefore, it is not possible to rule out the possibility of further sites that could be in close proximity to proposed works areas. Local tombs and cemeteries are considered receptors of High sensitivity. Without mitigation in place, the magnitude of impact could be Medium to High, this could result a localised **Major Adverse** effect.

Some archaeological sites dated from the Bronze Age to the Middle Ages are reported in the northern and central sections of the ZSIS, in the areas of Martkopi, Satskhenisi, Norio, Lilo and Gamarjveba. These are considered areas of High sensitivity. The possibility of the new archaeological discoveries exists if the existing canals are widened or deepened as part of the proposed works. No new canals are proposed and therefore the chance of this occurring is minimised, and the magnitude of the impact is considered Low. Without mitigation in place, damage to archaeological find could result a **Moderate Adverse** effect.

9.9.1.1.2. Mitigation Measures

The following mitigation is proposed:

- Archaeological watching brief and suspension of construction operations if archaeological objects or artefacts are discovered during earth works, informing the GA and Ministry of Culture and Monument Protection about the chance finding and resume works only after respective permission is issued.

- Protection of any tombs or other local sites identified close to works through fencing. Where necessary, agreement with owners for their translocation to a site agreed with the owner of the asset.
- Toolbox talks - organize training among construction workers and supervisors to raise awareness on cultural heritage and implementation of the Chance Finds Procedure.

9.9.1.1.3. Residual Effects

With all mitigation measures in place, the residual effect on locally important sites such as tombs is predicted to be **Minor Adverse**. The residual effect on buried archaeology is predicted to be **Negligible**.

9.9.1.2. Operation

The operation of the ZSIS will have no impact on the setting or use of existing cultural monuments and objects.

There is a possibility of new archaeological discoveries during the ploughing of fields, though the “new” area to be irrigated have been farmed in the past therefore this is considered to be a very low chance of occurring and therefore effects are predicted to be **Negligible.** An Archaeological watching brief will be in place for any intrusive O&M activities.

10. Cumulative Impacts

10.1. Introduction

This Section provides an assessment of the cumulative impacts of the Project. The assessment of cumulative impacts is typically performed, in general terms, in a qualitative manner based on the existing information of the present or future activities taken into consideration and the judgment of the ESIA Team.

This assessment covers two types of cumulative impacts:

- Impacts of interrelationships within the same project on a single receptor (for example, for example the effects of noise, dust and traffic on a single receptor); and
- Impacts on a resource, ecosystem, or human community of that action arising from the Project in combination with other existing, planned or reasonably defined developments.

10.2. Impacts of Interrelationships within the Project

10.2.1. Potential Cumulative Construction Impacts

Cumulative construction impacts are generally associated with the interactions of the following impacts affecting a single receptor:

- Air quality;
- Noise and vibration;
- Water resources and quality;
- Soils;
- Traffic and transport; and
- Waste management.

Cumulative effects are most likely to be experienced by farmers and local communities close to the proposed works and along access roads to the works.

During the construction phase, there is potential for cumulative effects related to nuisance and disturbance caused by noise, dust, increased construction traffic movements and poor waste management practices on farmers and local communities. Overall, the combined effects of dust, air emissions and noise on farmers and local communities as a single receptor will be greater than the effect of a single impact on these receptors and could have a significant effect on health and well-being. As with the individual assessments, the works will be for a shorter period outside any one location and will be temporary.

Cumulative effects may also be experienced on flora and fauna in the Project area. Disturbance caused by noise, dust, light, increased construction workers and traffic movements, poor waste management practices and potential pollution incidences could have a combined cumulative effect that is greater than the effect of a single impact. As identified under the individual assessment topics, best practice construction management practices will be put in place that should avoid pollution incidences. Noise, dust and general disturbance will also be managed through the ESMP.

10.2.2. Potential Cumulative Operation Impacts

Cumulative operation impacts are generally associated with the interactions of the following impacts affecting a single receptor, in this case, either local communities or flora and fauna receptors:

- Economy;
- Livelihoods; and
- Pollution and waste management.

The combined total of direct and indirect impacts of the Project through the stimulation of economic growth and local businesses could result in increased potential for employment opportunities and increased revenue, having a combined positive effect on local community livelihoods.

During operation there could be cumulative effects associated with the use of agrochemicals together with other existing untreated discharges in the canals. This could have an elevated impact on local farmers as well as soils and flora and fauna.

10.3. Impacts Associated with Other Projects

10.3.1. Other Planned or Projected Projects

Other Projects concurrent or planned, of potential relevance in the Project Area, include:

- MEPA projects such as support to Cooperatives, Plant the Future, extension services cover the area (see website of the MEPA and the Strategy 2017-2025).
- Private sector investments:
  - Construction of 16 chicken houses of 2,400 m^2 each (2 million birds every 8 weeks).
  - 10,000 tonnes storage facility for maize (Biu of Chirina).
  - 1,600 ha private farm at the downstream end of G7 (by Agromax LLC) who also planted a 1 Ha high density apple orchard and intend to plant 100 Ha more and 160 Ha of grapes.
  - A 10 ha greenhouse complex is being built which will impact on the market for vegetables in winter time.
- A new Tbilisi railroad alignment was built east and northeast of Tbilisi Sea, but the project has been on hold for years.
- Development of a services/industrial area of several Ha on the left bank of the LMC canal, upstream of the highway to Rustavi (upstream of G6) with a storm water drainpipe connected to the main canal around outlet G5-4.
- Urban developments.
- GWP investments in water infrastructure to secure the water supply: planned investments in the infrastructure of the Tbilisi Sea.
- Ministry of Defence:
  - A facility of 2,800 ha in the area between UMC G7 downstream and the LMC with restricted access. Chumatkhevi creek passes through this area.
  - A much smaller facility existing at the downstream end of G15-1.
  - A facility of 2,600 ha for which water will be provided to sustain the existing grass and bush vegetation.
- A new non-hazardous municipal solid waste landfill will be constructed in Tetritskaro municipality in Kvemo Kartli region that will serve Bolnisi, Dmanisi, Tetritskaro, Tsalka and Marneuli municipalities.[176]
- .[177] A wastewater treatment plant is under construction in Marneuli municipality, Kvemo Kartli region. Construction of wastewater treatment plants are planned in the following cities in the Kakheti region: Gurjaani, Sighnagi/Tsnori and Kvareli.
- Modernisation of water supply systems is planned/implemented by the United Water Supply Company of Georgia in the Kvemo Kartli as well as the Kakheti regions. Within the ZSIS area, construction and modernisation of water supply systems is ongoing in the village of Muganlo, Gardabani municipality. The works will be completed by May 2022

10.3.2. Potential Cumulative Construction Impacts

Given that the programme for construction of the Project is not currently known, it is difficult to predict with certainty impacts during construction of the Project together with other developments.

However, in general terms, if these works are undertaken at the same time as other works in the same area, this could result in combined impacts of dust, air emissions and noise and traffic disturbance that could have a cumulative effect on farmers and local communities. Depending on transport routes used to reach each sites works, the increase in traffic could also affect other local communities along access routes.

[176] http://waste.gov.ge/ka/?page_id=6477
[177] http://water.gov.ge/page/full/47

The demand for a workforce from more than one project being constructed at the same time could also have cumulative effect through a combined demand for construction workers, raw materials, equipment and goods and services. This will result in increased employment opportunities and increased revenue than this Project alone. It could also result in a larger influx of construction workers and retrenchment following the construction phase. In the event that works are undertaken at the same time as other projects, the demand for resources and services could put more pressure on the local communities and facilities (e.g., workers, water supply, health care centres, electricity supply). The combined total of direct and indirect impacts on the economy, employment and livelihoods, both positive and negative, could be greater if this Project is undertaken at the same time as the other road development projects.

10.3.3. Potential Cumulative Operation Impacts

MEPA projects such as support to Cooperatives, Plant the Future and extension services provide the opportunity to increase the benefits arising from the Project on its own.

GWP planned investments in the infrastructure of the Tbilisi Sea and its connection to the Djinvali reservoir are of interest to the Project as they would secure water supply for Tbilisi, the demand for which is likely to increase as a result of the Project, and guarantee that irrigation water is not taken from the system. In the case that the infrastructure is not be properly maintained, it could result in irrigation water being diverted for drinking water as an emergency measure, which would have an adverse effect on farmers if they cannot get access to irrigation water.

With respect to the Ministry of Defence and the facility in the area between UMC G7 downstream and the LMC with restricted access, it may be necessary to gain access for maintenance and improvement works for the Project. Furthermore, if the area is not accessible for grazing this may lead to overgrazing in other areas in the vicinity. Finally, the use of service roads by the Ministry could damage the tracks along the main canal which could have an adverse effect on their use by local farmers.

In regard of other urban developments, the Project has taken into account the areas that have been or are likely to be developed, and therefore it is unlikely that these developments would result in any pressure on the agricultural lands.

The landfill will not be connected to the ZSIS area but will significantly improve the waste management situation in the wider region. A new municipal solid waste landfill is planned in Kakheti region as well, though the location is not yet confirmed.

In the case that the wastewater treatment plants ares constructed, the treated wastewater may become available for parts of the ZSIS. Furthermore, these facilities may contribute to reduced discharges to the canals.

No operational impacts are anticipated with the modernisation of water supply systems by the United Water Supply Company of Georgia in the Kvemo Kartli as well as the Kakheti regions.

11. Additional Project Implementation Recommendations

11.1. Introduction

In addition to the specific environmental and social measures discussed under construction and operation impacts above, and the implementation approach set out in the 2022 FS, the following measures are proposed to be put in place to ensure successful Project implementation.

11.2. Project Management Unit

Section 2.5.6 of this report sets out the technical assistance proposed for the Project, as se out in the 2022 FS. This includes the use of a Project Management Unit (PMU) to assist with Project management, technical design review, monitoring and evaluation, etc. as the Project is implemented. It is recommended that within the PMU, the following personnel are appointed:

- Environmental and Social Expert
- Community Liaison Officer / Stakeholder Specialist
- Gender specialist (see section 11.5 below)

During the detailed design stage, the Environmental and Social Expert should ensure that the design is reviewed for any change or updates to this impact assessment, and the Environmental and Social Management System/Plan (see section 12) is updated accordingly. They should also be responsible for confirming whether a national EIA is required. It is also recommended that a detailed critical habitats assessment is undertaken once further details on the design are available and, as necessary, a detailed Biodiversity Management Plan prepared.

11.3. Establishing Water User Organisations

It is recommended that a template contract for provision of irrigation water supply services from state irrigation systems to WUOs is developed, as well as developing a new template contract for supply of irrigation water from WUOs to farmers. A unified automated billing system for should be developed in the GA including development of reserve funds in WUOs, an introduction of an insurance system for farmers against crop failures, including those caused by water scarcity in sources and other force majeure circumstances, etc. as mechanisms to protect the financial and economic interests of all key stakeholders of the irrigation sector.

11.4. Asset Management

It is recommended that an inventory of the irrigation infrastructure is undertaken by the GA, including all necessary documentation (technical datasheets, Acts of Asset Transfer, etc.) and that the GA/PMU assists the new WUOs in the registration of the ownership rights to the transferred irrigation systems. Such assistance shall at the very least include consultations for WUOs on the legal and procedural aspects of registration.

11.5. Training and Capacity Building

Professional training and capacity building are essential to ensuring the ongoing success of the Project. Both technical and non-technical training will need to be delivered for personnel from GA, as well as WUOs, and beneficiary farmers - including women and vulnerable persons - on irrigation, cropping, soil management and associated practices, improved water management practices, business management, markets and decision making around water and agriculture.

It is recommended that a training needs assessment system is introduced as well as developing annual capacity building programs in all the GA divisions and WUOs.

In addition to standalone training, it will be necessary to ensure there are ongoing advisory services available for staff, especially for women who may not have had the same access to historical training.

11.6. Gender

During the design and planning stage, there are significant opportunities for gender inclusion. For example, the implementation of the Project will result in employment opportunities within procurement of services, works and equipment, contracting and sub-contracting, monitoring, and reporting on the progress of works and execution of the contracts. It is recommended to use these opportunities to develop awareness on providing equal opportunities for all, regardless of gender. Ideally, gender-transformative approaches should be implemented to sensitise the implementing bodies on the importance and benefits of working towards gender equality in the sector (e.g.: reducing the gender gap) and tackling the unconscious bias that limit women's participation.

There are two main aspects that would should be considered in the design stage:

- Develop a gender-sensitive survey and/or women-only focus group discussions (FGDs) before signing contracts to better understand roles, level of engagement and needs from women in the agricultural sector. This process should also capture the needs of different socio-economic groups and particularly target vulnerable groups.
- Work with local education institutions: whenever possible, involve local education institutions and use this opportunity to involve female experts that could contribute to building capacity and to progressively change the unconscious biases that restrict women's participation in the agricultural sector.

For the purposes of the implementation and management of the Project, a PMU should be set up that addresses the environmental and social aspects of the Project as it is developed. It is recommended that this PIU includes a Gender Specialist.

It is also recommended that the GA develop a Human Resources gender strategy or action plan *inter alia* with measures to encourage more women being employed to mid- and senior-level positions within the GA. With more specific consideration of the Project implementation, there is opportunity for the WUOs to encourage improved equality in access to farms and in the running of the WUOs. Similarly, therefore, the WUOs should develop a Human Resources gender strategy.

12. Environmental and Social Management Plan

12.1. Introduction

This section provides a summary of the ESMP developed for the Project. An ESMP is essentially a management tool and standalone component from the ESIA that provides the assurance that the mitigation measures developed for the significant effects of a project are implemented and maintained throughout the project lifecycle. It outlines management strategies for safety, health and environment stewardship in the proposed project implementation. It states in specific terms how the Project proponent's commitments will be implemented to ensure sound environmental practice.

A standalone ESMP has been prepared for the Project, which addresses the identified potential environmental and social impacts identified in the previous sections of this ESIA.

12.2. Environmental and Social Management System (ESMS) Overview

The ESMP should form part of an overall Environmental and Social Management System (ESMS) that should be developed for Project implementation. The ESMS is a structured approach to identifying and managing environmental and social risks and impacts on an ongoing basis. It provides a set of policies, procedures, tools and management plants to identify and manage environmental and social risks.

The elements an ESMS are as follows:

- Policies and procedures;
- Identification of environmental and social risks and impacts;
- Management programmes;
- Organizational capacity and competency;
- Emergency preparedness and response;
- Stakeholder engagement; and
- Monitoring and review.

The structure of the ESMS and ESMPs is shown illustratively in Figure 12-1. The ESMP is a component of the ESMS.

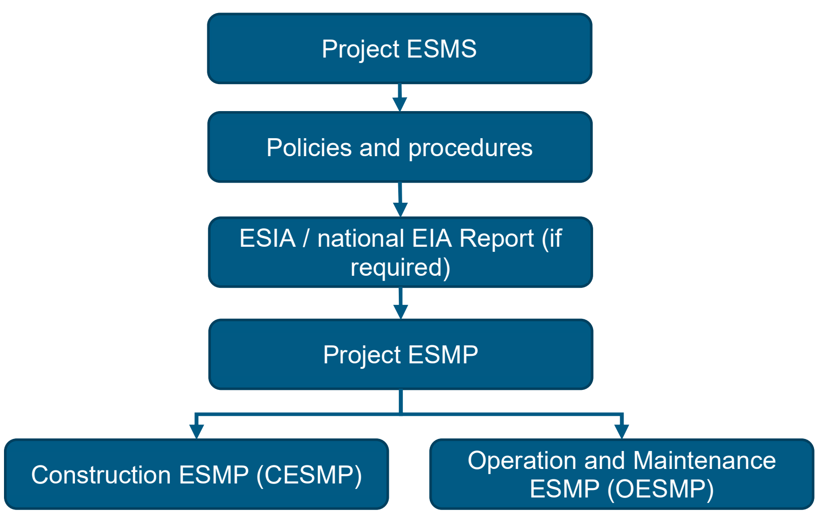


Figure 12-1. ESMS and ESMP structure

The Implementing Body (GA with support from the PMU) should develop the ESMS, and each Construction Contractor will be required to develop an ESMP in line with the Project ESMS. The ESMS elements are summarised in Table 12-1.

Table 12-1. Environmental and Social Management System

ESMS Element	What is in place	What should be developed
Policies and procedures	GA operates within the framework of national environmental and labour legislation and regulations. National EIAs are conducted for modernisation and operation of irrigation systems as required by Georgian legislation or Lender's environmental and social policy. Environmental and Social Management and Monitoring Plans define the mitigation and monitoring measures for the impacts identified within the scope of the ESIA procedures to be used in practice by the project implementing agency - the GA - and bring its activities into compliance with the environmental and social requirements envisaged by the national legislation as well as with the environmental and social policies of international finance organizations.	It is recommended that the GA develop and adopt the following policies as a minimum: • Environmental Management Policy • Corporate and Social Responsibility Policy • Human Resources Policy (covering GBVH) • Occupational H&S Policy • Grievance Policy The following procedures are recommended as a minimum: • Monitoring procedure - to ensure that effective monitoring and reporting of activities that may have impact on the environment are undertaken on a regular basis. • Training, Awareness and Competence Procedure - to ensure organizational capacity and competency - provides guidelines for environmental and social awareness training of employees and contractors to ensure personnel have the specific skills, knowledge and competency levels in their roles, and that appropriate training is provided where gaps in skills, knowledge and/or competency are identified. • Document Control and Record Keeping Procedure – to describe the procedure for the control of all documentation relating to the ESMS and proper maintenance of environmental and social records. • Non-conformance, Corrective and Preventive Action Procedure - to provide a guideline to ensure that major technical non-conformances are identified and included on the Register; and system non-conformances are identified and addressed. • Emergency Preparedness and Response Procedure – to identify the potential for and to respond to accidents and emergencies, and for preventing and mitigating the environmental and social impacts that may be associated with them. A Legal and Permit Register and Commitments Register should also be developed to detail the method by which GA management any Contractors comply with legislative and other requirements.
Identification of environmental	Environmental and Social Risks and impacts related to the Project are identified by ESIA and relevant	It is recommended that the GA/PMU update the current assessment during the detailed design phase.

ESMS Element	What is in place	What should be developed
and social risks and impacts	measures are included in the ESMP.	Further work should be undertaken on critical habitats during the detailed design.
Management programmes	A framework ESMP has been prepared as part of the current Technical Assistance work. A Framework Resettlement Policy has been prepared as part of the current Technical Assistance work.	The ESMP should be updated during the detailed design phase. The ESMP shall be included in tender documents and the tender participants will have to specify their environmental and social protection duties in their proposals. Each Construction Contractor will develop their own detailed ESMP. As necessary to reflect the impacts of the detailed design, a Resettlement Action Plan (RAP) and/or Livelihood Restoration Plan (LRP) will be prepared.
Organizational capacity and competency	Three senior Environmental specialists are placed under the Water Regime Management and Environment Protection Unit of GA. There are no environmental specialists in the regional offices of GA. Social and H&S specialist are not appointed either in central or regional offices of the GA.	During construction: Construction Contractor(s) shall appoint a full time Environmental and Social Manager and H&S Manager responsible for the implementation of mitigation measures defined by the ESMP. The GA/PMU shall appoint an Environmental and Social Manager to audit Construction Contractor(s) performance. During O&M: GA central and regional offices shall be responsible for all Environmental and Social issues, including monitoring of implementation mitigation measures through its ESMS structure and qualified safeguards staff. Integrated Pest Management will be promoted through development of capacity programmes to train farmers.
Emergency preparedness and response	The requirement for an Emergency Preparedness and Response Plan is set out in the ESMP.	Development of Emergency Preparedness and Response Plan is required by ESIA which shall be developed by Construction Contractor(s). Emergency Preparedness and Response Plan for operation phase of ZSIS should be developed by GA.
Stakeholder Engagement	A Stakeholder Engagement Plan including Grievance Redress Mechanism was developed and attached to the Eptisa ESIA. Website of the GA includes detailed information about GA activities, services provided to the customers, irrigation methods, fines, Application and service conditions, Fees and payment options, as well as contact information.	It is recommended to hire a Community Liaison Officer (CLO) who will be responsible for developing and continued implementation of Stakeholder Engagement Plan. Each Construction Contractor will be expected to also have a CLO in place. Grievance Focal Points shall be designated at the levels of Construction Company(s) and GA for proper execution of grievance mechanism. Details and contact information of Grievance Focal Points designated for the project shall be posted at each construction site, Kvemo Kartli Regional Office and at the Zemo Samgori Service Centre.
Monitoring and review	Environmental and Social Monitoring Plan is developed and included in the ESMP. The	The ESMP shall be reviewed and updated during detailed design, and in accordance with results of regular monitoring.

ESMS Element	What is in place	What should be developed
	Monitoring Plan describes the parameters to be monitored, the activities to be executed, locations, time and frequency of monitoring activities, and the collection, analysis, and reporting of monitoring data.	The following reports shall be produced in regular ways for GA management, stakeholders as appropriate and for the donor: • Incident & Near-Miss Reports • Inspections and Observations • Monthly Environmental and Social Report • Annual Monitoring Report

12.3. ESMP Scope

The standalone Framework ESMP has been developed to complement this ESIA, commensurate with the current level of detail known on the Project, to ensure that commitments that will be made to minimise project-related environmental and social impacts are upheld throughout Project implementation. The ESMP is a live document and should be amended during Project construction and operation to reflect any changes which occur to the design and performance or the relevant environmental and social conditions.

The Framework ESMP therefore sets out the framework for the development of a more detailed ESMP as the Project progresses to ensure compliance with the EIB Performance Standards and Georgian environmental and social standards in managing identified environmental and social risks and impacts of the Project at each stage, i.e., during design, pre-construction, construction/post-construction handover and operation.

The Contractor and Sub-contractors during the construction phase and the Operator and all employees during the operational phase will comply with the ESMP requirements as applicable to the tasks they are employed to undertake.

12.4. ESMP Objectives

The objectives of the ESMP as it is developed will be to:

- Describe the committed construction, operation and decommissioning management measures to be implemented as outlined in the project ESIA;
- Describe specific additional measures required to implement construction related good practice, EIB requirements and national legislation;
- Identify the roles and responsibilities of the environmental and social management organisation of the Project; and
- Communicate environmental and social expectations and requirements within the Project team.

12.5. Content of the ESMP

The Framework ESMP contains guiding principles and procedures for reporting, training, monitoring and review to which Contractors, Sub-contractors and the Operator are required to comply with throughout the construction, operation and decommissioning phases of the Project.

The ESMP covers:

- Project description;
- Applicable standards;
- Summary of impacts and management measures;
- Monitoring programme;
- Institutional and organisational arrangements;
- Key roles and responsibilities;
- Capacity Development and Training;
- Stakeholder Engagement;
- Inspection, auditing and reporting;

- Non-conformance and corrective action procedure; and
- Implementation schedule.

12.6. ESMP Management

The ESMP will be revised and updated during subsequent Project stages. In summary, these phases will comprise:

- **Detailed Project Design Phase** – update of the ESMP (the ‘Project ESMP’) by the Implementing Body/PMU (or their designated consultants).
- **Pre-construction, Construction and Handover Phase** (the “construction” phase) – development of detailed ‘Construction ESMPs’ that follow the requirements set out in the Project ESMP. These will be prepared by each Construction Contractor. Construction ESMPs will be submitted to the Project Implementor/PMU and the EIB for approval. During construction, amendments may be required to the Construction ESMP if any major changes occur to the Project’s design, performance, environmental and social conditions or resulting from incidents or accidents. The process of Change Management will be the ultimate responsibility of the relevant Construction Contractor, and changes will be reviewed and approved by the Project Implementor.
- **Operation and Maintenance (O&M) Phase** – development of the ‘O&M ESMP’. At least three months before the operations will start, the Project Implementor with support from the PMU will develop the O&M ESMP. The O&M ESMP will reflect all necessary requirements of the Project ESMP for the O&M stage, including any additional measures considered necessary for the O&M stage, implementing the environmental and social management during operation.

The Project ESMP will be incorporated in the work tender documents and the tender participants will have the possibility to specify their environmental and social protection duties in their proposals. After the onset of the construction works, the ESMP will be the part of the agreement between the Implementing Body and the Construction Contractor(s) and it will be necessary to accomplish the requirements set forth in the approved Construction ESMP in the course of the construction works.

The Construction Contractor(s) will be expected to obtain all necessary permits for their works. If the Construction Contractor(s), wishes to open quarries or extract material from riverbed (rather than purchasing these materials from other providers), then the Contractor must obtain licenses for inert material extraction.

12.7. Roles and Responsibilities

Environmental and social governance of the Project will be exercised by the GA through its Water Regime Management and Environment Protection Unit. The GA with the support of the PMU will be responsible for monitoring the performance of Construction Contractor(s) and their implementation of their approved ESMP. The GA/PMU should ensure that Construction Contractor(s) understand their responsibilities to mitigate environmental problems associated with their construction activities and facilitate training of their staff in implementation of the ESMP.

As identified in section 11, it is recommended that the GA/PMU appoint a full time Environmental and Social safeguards specialist to monitor environmental and social performance of Project implementation. Appointment of a Gender specialist is also recommended.

The Construction Contractor(s) will be expected to appoint an Environmental and Social Manager, Health and Safety and CLO for the duration of the construction works as a minimum.

Once the Project is operating, responsibility for environmental management will pass to GA and its regional service in Kvemo Kartli region, as the operator of the irrigation scheme and they should implement mitigation measures defined for the O&M phase. However, involvement of the WUO at the local level and MEPA, at national level will be required for implementation of some mitigation measures.

12.8. Content of Management Plans

Detailed management plans will be developed as identified above. Each detailed management plan will contain the following headings/information:

- Identified impact and the affected receptors;
- Management plan scope and objectives;

- Relevant national and international legislation and guidance documents;
- Roles and responsibilities;
- Other relevant management plans to the impact;
- Mitigation measures; and
- Monitoring requirements.

12.9. Management Plans

The following detailed Construction Management Plans are recommended:

- Biodiversity Management Plan
- Air Quality Management Plan
- Noise and Vibration Management Plan
- Traffic Management Plan
- Soil Management Plan
- Materials Use and Waste Management Plan
- Water, Wastewater and Drainage Management Plan
- Emergency Preparedness and Response Plan
- Spill Prevention and Response Plan
- Labour and Working Conditions Management Plan
- Occupational Health and Safety Plan
- Labour Grievance Mechanism
- Community Health, Safety and Security
- Community Grievance Mechanism
- Chance Finds Procedure
- Construction Workers' Accommodation Plan, if required

The following detailed O&M Management Plans are recommended:

- Biodiversity Management Plan
- Agrochemicals Management Plan
- Integrated Pest Management
- Emergency Preparedness and Response Plan
- Spill Prevention and Response Plan
- Labour and Working Conditions Management Plan
- Labour Grievance Mechanism
- Community Health, Safety and Security
- Community Grievance Mechanism

12.10. Summary of Measures

A summary of the mitigation measures identified in this ESIA are provided in Appendix D. These measures will need to be incorporated into the relevant detailed management plans. The monitoring plan is provided in the standalone ESMP.

General measures to be undertaken during the detailed design and pre-construction phase include:

- Ensuring that all relevant permits and licences are obtained for the proposed works.
- Advance warning to local communities regarding construction activities (e.g. construction schedule). Detailed engagement with those in premises (residential or other) within 350 m of the works front, in advance of the works. Community grievance mechanism must be put in place and disclosed.
- Appointment of Environmental and Social Managers.

13. Conclusions

The ZSIS, located to the east of the capital Tbilisi, in the Mtkvari (Kura) river basin, was originally designed to irrigate 41,000 ha. Phase 1 was completed in 1954 and the remainder of the scheme in 1964. Upon completion the ZSIS was the largest irrigation system in Georgia.

Of the original design command area, which was designed to benefit 25 villages, in 2020 and 2021 only 6,404 ha and 5,317 ha, respectively, were irrigated after signing an agreement for irrigation water supply with GA. This is less than one-third of the potential irrigable area.

The GoG wants to revive the irrigation system and has indicated that this particular project has been identified as a key enabling project for the recovery of the agricultural sector and to boost the economy. The improvement of ZSIS is strategically aligned with the objectives of various GoG strategies.

The GoG is seeking the support of the EIB. The EIB has appointed WS Atkins Limited (the Consultant) to undertake a Technical Assistance Assignment, comprising the update of the Eptisa 2018 FS and Eptisa 2018 ESIA of the ZSIS, prepared between 2015 and 2018 with the support of the Netherlands Government, to align with EIB standards and requirements.

The actual irrigated areas of ZSIS, in 2020 and 2021, were 6,404 ha and 5,317 ha respectively and the corresponding irrigation supply, at Paldo Headworks, were 24,024 m^3/ha and 19,934 m^3/ha. Irrigation use at present is more than double the amount of theoretical demand and the losses are due to (a) unregulated supply (b) overuse by farmers (c) poor irrigation infrastructure and (d) illegal tapping.

A land suitability exercise has been undertaken as part of the 2022 FS. This identified IZ-2 (UMC-G06 to UMC-G09 and LMMC to Martkopi village), IZ-4 (LMC-G05 to LMC-G20), and IZ-5 (LMC-G21 to LMC-G28) as the most relevant areas for the ZSIS modernisation investment project. A total of 19,129.4 ha has been identified as the command area, following the exclusion of lands in use for wind breaks and roads, currently non-registered lands, and build-up areas in villages, of industrial complexes and commercial enterprises as well as lands currently undergoing or planned to undergo urban development, etc. of that, an estimated 10% is considered to be annually left fallow, equal to 1,912.9 ha, therefore a corrective annual command area for crop production of 17,216.4 ha was applied in the water resources and agro-economic analyses as being the basis for crop production and income generation.

A monthly water balance model was developed to simulate historic flows in the Iori basin using rainfall-runoff modelling, monthly demand profiles and considering infrastructure capacities. Iori river supplies water to ZSIS, KSIS, Khashmi and Patanjeuli irrigation schemes. In summary, the water available from the Iori river could irrigate 97.4% (average of three climate scenarios) of the total potential ZSIS and KSIS command area of 36,566 ha in the first decade (2022-2031), reducing to 92.3% in the third decade (2042-2051).

Three possible development pathways are identified:

a. The command area – of either ZSIS or KSIS, or both - could be proportionally reduced to match with 100% of water availability
b. Irrigation requirement per ha could be reduced by introducing more sprinkler and drip irrigation systems, which is possible in case of further promoting the adoption of high-value agricultural cropping systems, including orchard trees, greenhouse crops, etc.
c. Cultivating less water demanding crops.

In conclusion, the FS Design Concept Report assumes that development pathway (b) and (c) will be the preferred options, meaning that modernisation of the ZSIS will allow to irrigate 100% of the command area in the next 30 years, made possible by promoting a combination of one or several of the following measures:

i. Encouraging farmers to grow crops under sprinkler and drip systems, to reduce irrigation requirement;
ii. Adopting highly monitored and controlled irrigation scheduling and delivery, to ensure more efficient and effective water use;
iii. Encouraging farmers to grow less water intensive crops;
iv. Linking irrigation fees with volumetric irrigation water delivery, to encourage farmers to use water more efficiently.
v. Ensuring proper operation and maintenance of the irrigation infrastructure through WUOs, to reduce water losses along the distribution network.

As part of the Technical Assistance Assignment, the EIB requires that the Eptisa 2018 ESIA is updated in line with EIB Environmental and Social Standards (2018). This document presents the ESIA Report. It forms one of several documents prepared to meet EIB requirements as follows:

- Environmental and Social Impact Assessment (ESIA)
- Environmental and Social Management Plan (ESMP)
- Resettlement Policy Framework (RPF)

The primary objective of the ESIA is to identify the environmental and social risks, impacts and benefits of the Project and to inform the technical and financial decision making of the FS.

This ESIA has been prepared based on the Eptisa 2018 ESIA Report, supplemented by additional desk-based study, site walkover, and further detailed hydrological, agricultural and technical analysis as part of the 2022 FS review. No additional detailed site surveys have been undertaken.

Overall, the conclusion of the ESIA is that the impacts of the Project are manageable, and construction and operation of the Project will not result in irreversible, unacceptable risks to people or the environment. However, the findings of this report should be reviewed as the Project progresses and further details on the design emerge.

The main benefits of the Project are to modernise the ZSIS, which was the largest irrigation scheme in the country and the closest scheme to Tbilisi, in order to enable the recovery of the agricultural sector. It will also provide a more reliable water source, over a wider area, whilst maintaining downstream water user requirements and ecological flow requirements. In so doing, it provides an opportunity to increase subsistence and commercial farming, with positive knock-on effects in the economy and livelihoods from demand for agricultural products and sales.

The GA has overall responsibility for delivery of the Project and will be assisted in this role by the TA programme (set out in section 2.5.6), including a PMU.

During design

It is anticipated that the Project will be subject to further detailed design engaged by the GA. The ESIA and ESMP prepared for this work should form part of the tender documentation for the detailed design consultant. The detailed design consultant will be expected to address the measures proposed in this ESIA and the accompanying ESMP to avoid and minimise adverse environmental and social impacts wherever possible.

During this stage, further assessment of critical habitats based on the final design should also be undertaken. Based on the screening exercise for critical habitats, there is potential for the upgrade of the irrigation system to have moderate adverse effects on the site integrity of the neighbouring EBA and IBAs (Lower Kura Valley IBA, also known as the Gardabani Managed Reserve and a Candidate Emerald Network site; and Jandara Lake IBA), for example through noise and changes to offtake of surface or groundwater water. A more detailed assessment once the design is progressed will assist in determining whether there are significant adverse effects that require mitigation, for example, through the adoption of a Biodiversity Management Plan.

During construction

A Construction Contractor will be appointed to construct the Project. The ESIA and ESMP updated during the detailed design phase should form part of the tender documentation for the Construction Contractor. The Construction Contractor shall provide sufficient staffing to manage the environmental and social (E&S) performance of the Project and E&S staff to be approved by the GA/PMU.

With appropriate mitigation in place through a Project ESMS and ESMP, the majority of the adverse effects are anticipated to be reduced to Minor Adverse to Negligible and are, for the most part, temporary i.e., occurring for the period of the construction works only.

The following beneficial effects are predicted:

- Employment opportunities including increased direct earning opportunities for local working age unemployed and underemployed persons and increased expenditure on local goods and services resulting in further indirect employment and increased short-term disposable income and wellbeing among beneficiaries.
- Local economy effects through construction employee expenditure on transport, assets, hard goods and consumables. This will be further enhanced locally through any direct demand by the main Contractor for project materials, provisions and services.

- Construction employment opportunities that will have a positive impact on incomes and therefore livelihoods. Construction of the Project could also provide temporary workers with the opportunity to up-skill during the period of employment.
- Improved labour and working conditions, including OHS, due to compliance with national and international standards; with the potential for positive directly and indirectly generated professional and casual employment opportunities for women.

The following significant adverse effects (i.e. moderate or major adverse effects) however are predicted to remain following mitigation:

- Increase in dust emissions and particulate matter arising from dust generating construction activities leading to an increase in dust soiling at sensitive receptors such as individual properties, farmers and local communities. These effects will be short term, for construction works period only.
- Noise impacts arising from construction activities due to noise-generating equipment/items of plant including noise from construction associated traffic, on nearby Noise Sensitive Receptors within 200 m e.g., residential properties. These effects will be short term, for construction works period only.
- Community Health, Safety and Security risks such as public injuries as a result of, for example; movement of construction vehicles including HGVs, use of equipment, open excavated areas, construction materials and equipment being dropped; and machinery or operator loss of control; construction related accidents and pollution incidences; and 'local influx' potentially resulting in rapid changes in local demographics and pressure on social structures and local services, increase disturbance and increased risk of GBVH and the prevalence of STIs.

During operation

One of the principal underlying drivers for the Project is to modernise the ZSIS to increase agricultural production and improve food security and livelihoods.

During operation, therefore, the Project will have a direct and indirect positive impact on the national, regional, and local economy. The following beneficial effects are predicted:

- Improvements in food security, agricultural output (increasing both subsistence and commercial farming) and economic development. Improving the condition of irrigation structure will decrease water shortages and contribute to farmers' adaptation to climate change. This is particularly beneficial for those groups who are disproportionally affected by the impacts of climate change, such as women.
- Economic revenue from the expanded irrigated area, as well as related economic benefits of improved food security and knock-on demand for agricultural and other goods (as wages increase) in the local economy.
- Employment opportunities within the agricultural space will depend on the nature of the farm plots and whether they are all developed for farming. Given the area of land that can be irrigated will double, it is not unreasonable to assume that this will provide some employment opportunities directly to households that farm on these plots, within larger companies that may rent or buy land, as well as a seasonal demand for labour during harvest periods both on smaller and larger commercial farms. Mechanisation however may favour seasonal rather than full time employment.
- Operation of the Project is not expected generate significant job opportunities at the local level, though it can be expected that the maintenance of the Project will generate some job opportunities such as routine maintenance of canals and structures which may provide limited local job opportunities.
- Improvements in livelihoods due to provision of more irrigated land. The main impacts to stem from this are an increase the sustainability of existing agrarian livelihoods through increased local employment and income generating opportunities; and through improved local food security. These impacts are especially pronounced in the context of household farmers, especially those that are vulnerable, who may lack the capital or adaptive means to establish alternative livelihoods. However, medium/larger farms are more likely to be able to maximise the benefits of the Project more rapidly. Improved livelihoods and access to subsistence crops as a result of the Project, for those that have access, can be expected to have a positive effect on the wellbeing of farmers and their households, including those working full time and part time on farms.
- Project packages may encourage economically vulnerable households to keep their lands and benefit from the Project. Also, as irrigation becomes more available and incentives for farming activities are more evident, it is expected that there will be a shift from livestock to crop farming. This could provide new opportunities for households previously solely dependent on a limited number of livestock.
- Improvements in relation to previous entry barriers to irrigated land through incentives and support.

- Health improvements in relation to improving the flow of stagnant or semi-stagnant waters in the existing irrigation canals, which can serve as breeding sites for vector borne diseases. Improved flow of water could result in some minor improvements to farmer health and the local communities in the ZSIS.
- Health, safety and security benefits in relation to various aspects such as training in the use of pesticide, fertilisers and herbicide; training in the use of dangerous farm machinery; and improved management of water resources having a positive effect on wellbeing and security through more equitable distribution of water.
- Improved labour and working conditions, including OHS, due to compliance with national and international standards; with the potential for positive directly and indirectly generated professional and casual employment opportunities for women.
- With targeted intervention, improvements in women's (and other vulnerable persons) access and participation within and ability to benefit from the Project. The Project provides an opportunity to promote greater economic inclusion for women and other vulnerable groups. The irrigation development of the area has also potential to contribute to the skills development and training of local communities.

The following significant impacts (i.e. moderate or major adverse effects) however are predicted to remain following mitigation:

- Water availability within the ZSIS will have an impact on the area of land that can be irrigation as part of the ZSIS. As identified above, using the averaged water balance across the three climate, the model indicates that water is available to irrigate more than 90% of the combined command area of ZSIS (and the KSIS and other demands) in the next three decades (resulting in a potential residual effect of moderate adverse). The 2022 FS proposes measures in place to address this. These assumptions are based on modelled data and obviously actual impacts will depend on actual climate change that occurs.
- Hydraulic erosion may still result in moderate adverse effects given the types of soils in the ZSIS and rainfall conditions. Whilst the modernisation should reduce this risk significantly, it may not be possible to completely eradicate this risk. Hydraulic erosion may result in loss of productive topsoil, reduced water availability in the soil, reduced soil nutrients, and pollution of waterways.
- Irrigated agriculture is a significant source of soil and water contamination, emanating from agro-chemicals (fertilisers, pesticides, and herbicides) application, spillages from farm machineries and poor quality of irrigation water. This may affect soils by: Altering its physiochemical properties and increasing the concentrations of some pollutants, with knock-on effects for nutrification and eutrophication of water bodies; and food and animal safety. Depending on final methods use on farms, this could result in a moderate adverse effect on soil quality and fertility especially as the Project will not be able to control what is undertaken on each farm plot.

Management of Environmental and Social Performance

The environmental and social impacts of the Project will be managed through a Project ESMS to be developed by the GA/PMU, which will include updating the 2022 ESIA Report (where applicable), Framework ESMP and the Eptisa SEP. The GA/PMU may also need to develop a RAP and/or LRP, depending on the final design and displacement impacts of the Project. The Construction Contractor, likewise, will need to develop, GA/PMU approval, and implement a detailed Construction ESMP and SEP. The performance of the Contractor during construction will be overseen by the GA/PMU. During operation, an O&M ESMP will be prepared, and its implementation will be managed by the GA and the WUOs.

APPENDICES

Appendix A. Flora and Fauna

English Name	Scientific Name	IUCN Status	National Status
Black Aspen	Populus nigra	Data Deficient (DD)	Near Threatened (NT)
White leaf aspen	Populus hybrida	Not Evaluated (NE)	n.a.
Common Hornbeam	Carpinus betulus	Least Concern(LC)	n.a.
Velvet Maple	Acer velutinum	Least Concern (LC)	Data Deficient (DD)
White Willow	Salix alba	Least Concern (LC)	Least Concern(LC)
Black alder	Alnus glutinosa	Least Concern (LC)	n.a.
Lime	Tilia begoniifolia	Not Evaluated (NE)	Least Concern (LC)
Ash	Fraxinus excelsior	Near Threatened (NT)	Least Concern (LC)
Field Elm	Ulmus minor	Data Deficient (DD)	Vulnerable (VU)
Wild pear	Pyrus caucasica	Not Evaluated (NE)	Least Concern (LC)
Mulberry	Morus alba	Not Evaluated (NE)	Least Concern (LC)
Black mulberry	Morus nigra	Not Evaluated (NE)	Data Deficient (DD)

The understory is composed of the following:

English Name	Scientific Name	IUCN Status	National Status
Small-flowered Black Hawthorn	Crataegus pentagyna	Least Concern (LC)	n.a.
Medlar	Mespilus germanica	Least Concern (LC)	Least Concern (LC)
Hazel	Corylus avellana	Least Concern (LC)	Least Concern (LC)
Black Sea Dogwood	Cornus australis	n.a.	n.a.
Tamarisk	Tamarix ramosissima	Least Concern (LC)	Least Concern (LC)
Elder	Sambucus nigra	Least Concern (LC)	Least Concern (LC)
Wild cornel	Cornus mas	Least Concern (LC)	Least Concern (LC)

The following lianas are present:

English Name	Scientific Name	IUCN Status	NationalStatus
Ivy	Hedera helix	n.a.	Least Concern (LC)
Elder	Sambucus nigra	Least Concern (LC)	Least Concern (LC)
Wild cornel	Cornus mas	Least Concern (LC)	Least Concern (LC)
Clematis	Clematis vitalba	Least Concern (LC)	Least Concern (LC)
Smilax	Smilax excelsa	n.a.	Least Concern (LC)
Silk vine	Periploca graeca	n.a.	n.a.
Wild grapevine (rarely)	Vitis vinifera ssp. sylvestis	n.a.	Near Threatened (NT)

The following herbaceous species and sedges are present:

English Name	Scientific Name	IUCN Status	National Status
Wavyleaf basketgrass	Oplismenus undulatifolius	n.a.	Not Evaluated (NE)

broad-leaved enchanter's nightshade	Circaea lutetiana	n.a.	Not Evaluated (NE)
hedge woundwort	Stachys sylvatica	n.a.	Not Evaluated (NE)
Sweet Woodruff	Asperula odorata	n.a.	Not Evaluated (NE)
large-leaved pachyphragma	Pachyphragma macrophyllum	n.a.	Not Evaluated (NE)
Common nipplewort	Lapsana grandiflora	n.a.	Not Evaluated (NE)
Sanicle	Sanicula europaea	Least Concern (LC)	n.a.
Herb-Robert	Geranium robertiana	n.a.	Not Evaluated (NE)
Glutinous sage	Salvia glutinosa	n.a.	Not Evaluated (NE)
Palm-leaf marshmallow	Althaea cannabina	n.a.	Not Evaluated (NE)
Marsh mallow	Althaea officinalis	n.a.	Not Evaluated (NE)
False hemp	Datisca cannabina	n.a.	Not Evaluated (NE)
	Lysimachia dubia	Least Concern (LC)	Not Evaluated (NE)
	Lysimachia verticillaris	n.a.	Not Evaluated (NE)
	Cynanchum acutum	n.a.	Not Evaluated (NE)
Ribwort plantain	Plantago lanceolata	n.a.	Not Evaluated (NE)
Small tumbleweed mustard	Sisymbrium loeselii	n.a.	n.a.
	Carex contigua		Not Evaluated (NE)
Remote sedge	Carex remota.	Least Concern (LC)	Not Evaluated (NE)

Small marshes in the floodplains are covered with grasses and moor-grass:

English Name	Scientific Name	IUCN Status	National List Status
	Carex contigua		Not Evaluated (NE)
Remote sedge	Carex remota.	Least Concern (LC)	Not Evaluated (NE)

Appendix B. Critical Habitats Screening

Attached as a separate document.

Appendix C. Grievance Form Template

<table>
<tr><td colspan="3">Grievance recording form</td></tr>
<tr><td colspan="3">Project: Zemo Samgori Irrigation System in Georgia</td></tr>
<tr><td colspan="3">Grievance Focal Point:</td></tr>
<tr><td>Name:</td><td colspan="2">Position:</td></tr>
<tr><td>Address:</td><td colspan="2">Telephone:
E-mail address:</td></tr>
<tr><td colspan="3">Complaining Party:</td></tr>
<tr><td>Name:</td><td colspan="2">Position:</td></tr>
<tr><td>Address:</td><td colspan="2">Telephone:
E-mail address:</td></tr>
<tr><td colspan="3">Grievance Details:</td></tr>
<tr><td colspan="3">What happened?</td></tr>
<tr><td colspan="3">How this became a problem for you? How this disturbs you?</td></tr>
<tr><td colspan="3">Where did it happen?</td></tr>
<tr><td>When did it happen?
Once (date) ___________</td><td>Several times (how many?)
_______</td><td>On-going problem
_______</td></tr>
<tr><td colspan="3">What would you like to see happen to improve the situation?</td></tr>
<tr><td colspan="3">Grievance registration and resolution status:</td></tr>
<tr><td colspan="3">How was the grievance received:
□ In person □ By phone □ By mail □ By email
□ Other (please describe)……………</td></tr>
<tr><td>Grievance registration date:</td><td>Grievance number:</td><td>Registered by:</td></tr>
<tr><td>Response required Yes/No</td><td colspan="2">Person responsible for preparing the response:</td></tr>
<tr><td>Response sent (date):</td><td colspan="2">Response registered (date):</td></tr>
</table>

Appendix D. Summary of Mitigation Measures

Attached as a separate document

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