Source: Photos taken by the Consultant during the site visits

WATER RESERVOIRS PROJECT - ARMENIA

Environmental and Social Impact Assessment for the Kasakh Reservoir Construction Project

ESIA REPORT

Rev03

December 2025

Prepared for:

European Bank for Reconstruction and Development

and

Water Committee under the Ministry of Territorial Administration and Infrastructure of the Republic of Armenia

ATMS Solutions

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- **European Bank for Reconstruction and Development**
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Disclaimer

This Environmental and Social Impact Assessment (ESIA) Report has been prepared at the request of the Client in accordance with applicable national legislation, the European Bank for Reconstruction and Development (EBRD) Environmental and Social Policy (ESP, 2019) and Performance Requirements (PRs) as well as Good International Practices (GIP).

The ESIA is based on information, data, and documentation provided by the Client, third parties, and publicly available sources, as well as site visits and stakeholder engagement activities undertaken at the time of assessment. Reasonable efforts have been made to verify the accuracy and completeness of the information used; however, the consultants do not warrant that such information is complete or free from error. Any reliance placed on this Report by third parties is at their own risk.

This Report reflects the professional judgment of the consultants, taking into account the scope of work agreed with the Client, the conditions prevailing at the time of preparation, and the information reasonably available. Environmental and social conditions, regulatory frameworks, project design, and stakeholder concerns may change over time. Accordingly, the findings, conclusions, and recommendations presented herein may require revision should new information become available or should material changes to the Project occur.

This ESIA Report has been prepared solely for the purposes described above and should not be relied upon for any other purpose, including but not limited to detailed engineering design, legal interpretation, or financial decision-making. The consultants accept no responsibility or liability for the use of this Report, in whole or in part, by any party other than the Client or EBRD, or for any purpose other than that for which it was prepared.

List of Abbreviations

ACL - Admissible Concentration Limits
BAP - Biodiversity Action Plan
BMP - Biodiversity Management Plan
CCSM - Community Climate System Model
CESMP - Construction Environmental and Social Management Plan
CH - Critical Habitat
CJSC - Close Joint Stock Company
CIA - Cumulative Impact Assessment
CN - Construction Norms
CN&R - Construction Norms and Rules
NDC - Nationally Determined Contribution
DSL - Dead Storage Level
EBRD - European Bank for Reconstruction and Development
EIA - Environmental Impact Assessment
EIEC - Environmental Impact Examination Center
EPRP - Emergency Preparedness and Response Plan
ESAP - Environmental and Social Action Plan
ESIA - Environmental and Social Impact Assessment
ESMP - Environmental and Social Management Plan
ESMS - Environmental and Social Management System
ESP - Environmental and Social Policy
EU - European Union
E&S - Environmental and Social
FSL - Full Supply Level
GBVH - Gender-Based Violence and Harassment
GHG - Greenhouse Gas
GPN - Good Practise Note
GRP - Glass-Reinforced Plastic
HMMP - Hazardous Materials Management Plan
ICH - Intangible Cultural Heritage
IFI - International Financial Institution
LLC - Limited Liability Company
LT-LEDS - Long Term - Low Emission Development Strategy
ME - Ministry of Environment
MSDS - Material Safety Data Sheets
MWL - Maximum Water Level

OHS - Occupational Health and Safety
OHSMP - Occupational Health and Safety Management Plan
GA - Government of Armenia
PAP - Project Affected Person
PBF - Priority Biodiversity Features
PE - Polyethylene
PPE - Personal Protective Equipment
PR - Performance Requirement
PSHA - Probabilistic Seismic Hazard Assessment
RA - Republic of Armenia
SDA - Spoil Disposal Area
SPMP - Spill Prevention and Management Plan
SEP - Stakeholder Engagement Plan
SNCO - State None Commercial Organization
SSESMMP - Site-Specific Environmental and Social Management and Monitoring Plan
STD - Sexually Transmitted Disease
TLV - Threshold Limit Value
TMP - Tree Management Plan
TsMP - Topsoil Management Plan
ToR - Terms of Reference
VEC - Valued Environmental and Social Component
WB - World Bank
WMP - Waste Management Plan
WUA - Water Users Association

Content

1. Introduction

1.1 Background

The Government of the Republic of Armenia ('RA') plans to construct 17 reservoirs within the EU support initiative 'Recovery, resilience and reform: post 2020 Eastern Partnership priorities' to the Government of Armenia ('GA') to enhance the water and food security level in the country. The European Bank for Reconstruction and Development ('EBRD' or the 'Bank') is considering provision of a loan to the GA to finance the construction of five water reservoirs in different regions (marzes) of Armenia (the 'Project'):

- Kasakh reservoir in Aragatsotn Marz[1],
- Lichk reservoir in Syunik Marz,
- Yelpin reservoir in Vayots Dzor Marz,
- Artik reservoir in Shirak Marz,
- Astghadzor reservoir in Gegharkunik Marz.

The EBRD has categorized this greenfield project as 'A' in line with its Environmental and Social Policy ('ESP') (2019) because it may cause significant environmental and social impacts. This means that a comprehensive Environmental and Social Impact Assessment ('ESIA') report and associated documents must be elaborated, followed by their public disclosure for a minimum period of 120 days.

The Project's implementing agency is the Water Committee under the RA Ministry of Territorial Administration and Infrastructure ('Client' or 'Water Committee' or 'WCRA'). The Water Committee hired a national consultants to carry out Environmental and Social ('E&S') studies, develop Environmental Impact Assessment ('EIA') reports for the Project's five reservoirs in accordance with the relevant national legislation, and obtain environmental expert examination conclusions (permits) from the State Authorized Body (that is, the Environmental Impact Examination Centre (EIEC) under the RA Ministry of Environment (ME)).

The national EIA reports for the five reservoirs have passed the national expert examination process and received positive environmental expert examination conclusions. Although the national EIA reports comply with national requirements, they need to be further upgraded to align with the EBRD Environmental and Social Policy (ESP), including the implementation of a series of supplementary E&S studies:

- Spring season field biodiversity surveys and Critical Habitat Assessment,
- Appropriate Assessments and Biodiversity Action Plans (if required),
- Analysis of Project alternatives,
- Cumulative impact assessment,
- Assessment of impacts of the associated facilities,
- Assessment of greenhouse gas emissions and climate change mitigation measures,
- Water infiltration and loss study, water and soil quality surveys, etc.

One of the five reservoirs listed above is planned for construction within the administrative boundaries of Voskehat, Voskevaz, and Oshakan rural settlements in Ashtarak community (Aragatsotn Marz, RA), as well as Amberd and Aygeshat settlements in Khoy community (Armavir Marz, RA). The Kasakh Reservoir is designed with a capacity of 10 mln. m^3 and will be fed by the

[1] "Marz" means "Region" in Armenian

Kasakh and Amberd Rivers. It is intended to provide irrigation water to 21 settlements in Armavir Marz.

This ESIA report presents the key findings of the national EIA report for the Kasakh reservoir, which has been significantly upgraded to incorporate the outcomes of the supplementary studies outlined above as well as restructured and refined to ensure alignment with the EBRD ESP.

The positive environmental expert examination conclusion №233-24 for the Kasakh EIA report was issued by the EIEC under the ME on 01.11.2024 (**Annex 1**).

1.2 Objective and Scope of Works

The objective of the Assignment is to identify and assess any potentially significant future adverse environmental and social impacts associated with the proposed Project, assess compliance with applicable national E&S legislation and the EBRD ESP (2019) and Performance Requirements ('PR'), determine the measures needed to prevent or minimize and mitigate the adverse impacts, and identify potential environmental and social benefits / opportunities, including those that would improve the environmental and social sustainability of the Project.

The scope of work under the Assignment included the following tasks:

1) Reviewing and identifying applicable national E&S legislative requirements, as well as EU substantive environmental standards, Good International Practices ('GIP'), and EBRD Performance Requirements ('PR').
2) Outlining the Project components and associated facilities.
3) Updating the existing E&S baseline data developed during the national EIA studies by incorporating the results of the supplementary studies.
4) Analysing the outputs of the stakeholder consultation process conducted during the national EIA studies, and identifying key stakeholder concerns and recommendations.
5) Analysing project alternatives and justifying the selected option.
6) Identifying the Project's footprint and assessing its impacts on the physical, biological, socio-economic, and cultural environments, including potential benefits and opportunities from Project implementation.
7) Cumulative impact assessment and transboundary impact.
8) Proposing E&S management and mitigation measures, and assessing residual impacts.
9) Developing an environmental monitoring plan and site-specific E&S management plans.

1.3 Content of the ESIA Report

This report has been prepared as part of the Project's ESIA study. It is structured in a manner to address the following sections requested by the Project 'ToR':

Chapter 1 - Introduction,
Chapter 2 - Project Description,
Chapter 3 - Project Alternatives,
Chapter 4 - Legal and Regulatory Framework,
Chapter 5 - ESIA Methodology and Approach,
Chapter 6 - E&S baseline,
Chapter 7 - Stakeholder Consultation,

Chapter 8 - E&S Impacts Assessment, Benefits and Opportunities, Mitigation Measures,
Chapter 9 - E&S Management and Monitoring.

1.4 Sources of Information

The key information and data sources used to prepare this ESIA report include:

- Project ToR (issued by the EBRD),
- ToR for the local EIA consultant,
- National EIA report for Kasakh reservoir (in Armenian) (minenv.am),
- State examination conclusion №233-24 for the Kasakh EIA report issued by the Environmental Impact Examination Centre under the Ministry of Environment on 01.11.2024,
- Project design document for Kasakh reservoir,
- Information about the Water Committee from its website (scws.am),
- Armenia Water Reservoirs - Technical, Economic and Green Due Diligence Gap Analysis, Draft Final Report, 2023-2024, Ove Arup & Partners,
- Technical, Economic and Green Due Diligence of Water Reservoirs in Armenia Inception Report, March 2024, Ove Arup & Partners,
- Armenia reservoirs Project: Transboundary Impact Assessment Report, Revision A, June 2025, SLR Consulting,
- Documents/information provided by the Water Committee,
- E&S reports and documents related to the ongoing water sector projects (Vedi and Kaps reservoirs),
- Meetings/consultations with the national EIA Consultant and the Client,
- Result of field studies and meetings with the Project stakeholders,
- Key findings of supplementary studies,
- Available maps, layouts, reports, etc. related to the project area.

2. Project Description

2.1 Agricultural Problems specific to the Project Region and Command Area

Armavir Marz is distinguished by its well-developed agriculture. The geographical location and climatic conditions of the region are favourable for the development of both crop production (including perennial plants and vegetables) and animal husbandry. The most developed sectors of animal husbandry are cattle breeding (both large and small), pig farming, and poultry farming. In regard to the crop production, fruit and vegetable growing, viticulture and melon cultivation are the most prominent. Cereal crops are also practiced.

The construction of the reservoir aims to supply water to the Stage-2 Hrazdan Down Channel. This canal originates from the inlet section of the Stage-1 Hrazdan Down Channel, located in Yerevan near the Victory Bridge. The total length of the channel is 10.4 kilometres, and various sections have been repaired at different times. The channel currently provides irrigation water to 21 settlements in Armavir Marz, also known as the Project command area (**Figure 2-1**). The irrigation status of the agricultural lands in the command area is outlined in **Table 2-1**.

Figure 2-1. Map of Project command area

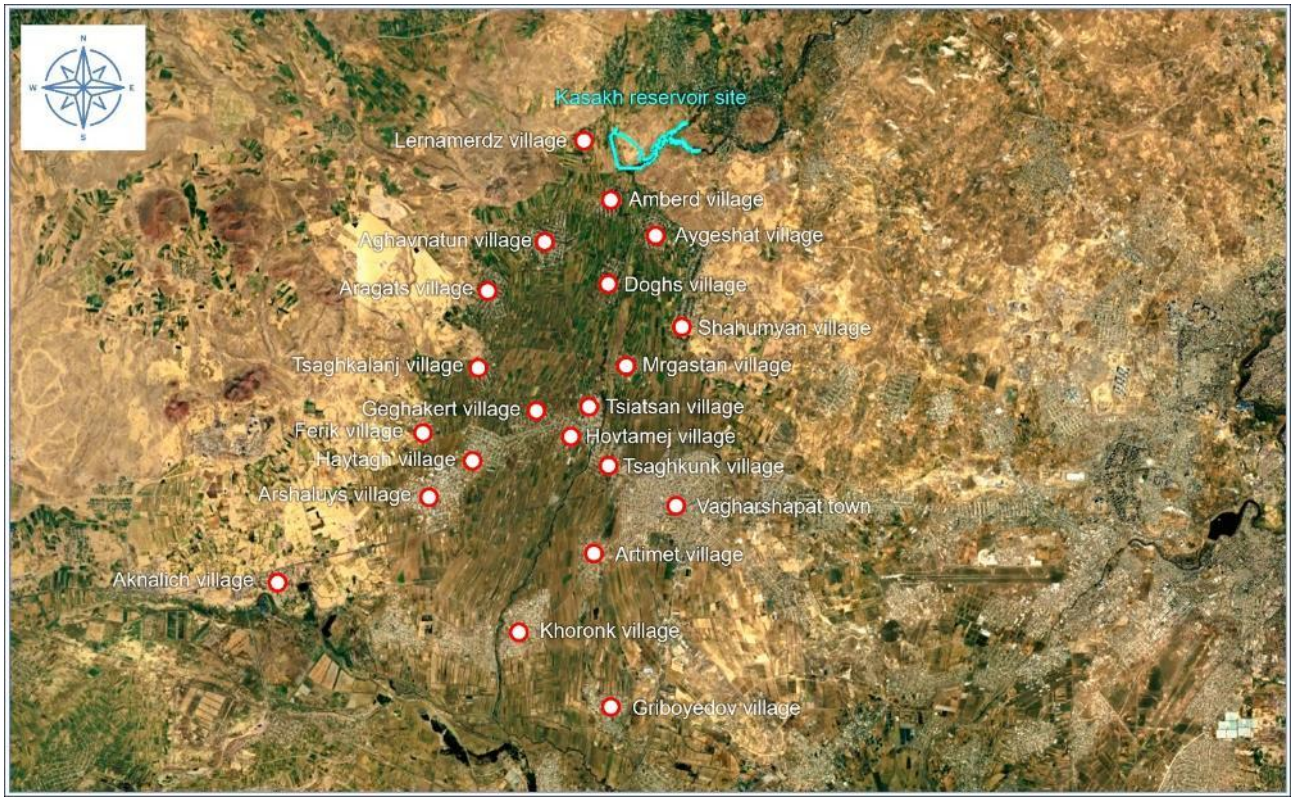


Table 2-1. Status of irrigated agricultural lands in the Project command area (2022 data)

Settlement	Agricultural lands that can be irrigated, ha	Actually irrigated lands in 2022, ha	Non-irrigated agricultural lands, ha	% of actually irrigated agricultural lands	% of non-irrigated agricultural lands
Amberd	280.0	225.1	54.9	80.4%	19.6%
Leramerdz	80.0	54.6	25.4	68.2%	31.8%
Aragats	420.0	333.4	86.6	79.4%	20.6%
Aghavnatun	380.0	262.9	117.1	69.2%	30.8%
Ferik	130.0	118.9	11.1	91.5%	8.5%

Settlement	Agricultural lands that can be irrigated, ha	Actually irrigated lands in 2022, ha	Non-irrigated agricultural lands, ha	% of actually irrigated agricultural lands	% of non-irrigated agricultural lands
Tsaghkalanj	250.0	173.4	76.6	69.4%	30.6%
Arshaluys	600.0	347.0	253.0	57.8%	42.2%
Aknalich	500.0	437.5	62.5	87.5%	12.5%
Haytagh	300.0	203.7	96.3	67.9%	32.1%
Geghakert	350.0	229.4	120.6	65.6%	34.4%
Hovtamej	180.0	150.9	29.1	83.8%	16.2%
Tsiatsan	185.0	123.0	62.0	66.5%	33.5%
Doghs	230.0	143.0	87.0	62.2%	37.8%
Tsaghkunq	180.0	97.7	82.3	54.3%	45.7%
Aygeshat	190.0	149.4	40.6	78.6%	21.4%
Mrgastan	150.0	92.6	57.5	61.7%	38.3%
Shahumyan	170.0	105.7	64.3	62.2%	37.8%
Echmiadzin	950.0	689.3	260.7	72.6%	27.4%
Artimet	400.0	370.0	30.0	92.5%	7.5%
Khoronk	70.0	33.6	36.4	48.0%	52.0%
Griboyedov	220.0	175.4	44.6	79.7%	20.3%
Total	**6215.0**	**4516.6**	**1698.4**	**72.7%**	**27.3%**

The **Table 2-1** shows that 27.3% (1698.4 ha) of agricultural lands within the Project command area are not irrigated due to the lack of water.

Except for the Lernamerdz, Doghs, Aygeshat, and Shahumyan villages, irrigation water for the remaining settlements is supplied mechanically, that is, water is pumped from the main channel to the water users through the pumping system. As a result of the Project implementation, the irrigation water supplied from the reservoir will increase the volume of water in the main channel and the supply to end users will continue to be carried out mechanically. Given this, the Project does not aim to replace the mechanical irrigation method with gravity, and therefore, no cost savings related to electricity or pump maintenance are anticipated.

2.2 Water Demand in the Project region

As concluded in **Section 2.1**, 1698.4 ha of agricultural lands within the Project command area are not irrigated due to the lack of water. According to the calculations of irrigation water needs, the planned reservoir will have sufficient capacity to irrigate 503.0 ha of agricultural lands. In other words, out of the 1,698.4 ha of non-irrigated land within the Project command area, it will be possible to fully irrigate 503.0 ha.

Irrigation water for the command area is provided by the "Echmiadzin" Water Users Association (WUA). As of 2022, the total number of water users is 3,440 households. The agricultural lands irrigated through the canal along with the amounts of water used for irrigation in recent years are presented in **Table 2-2**.

Table 2-2. The agricultural lands irrigated through the canal and supplied with water in recent years

Year	Irrigated lands, ha	Used water, mln.m^3
2018	5,555	64.7
2019	5,043	55.0
2020	4,972	61.0
2021	4,641	65.0
2022	4,517	57.8

As a result of the Project implementation, 503.0 ha of agricultural lands in the command area will be cultivated within 1-2 years following the commissioning of the Kasakh reservoir. Based on the cultivation patterns observed on the currently irrigated 4,516.6 ha of agricultural land, it is anticipated that the following types of crops will be cultivated on the 503.0 ha of land to be irrigated by the planned reservoir (**Table 2-3**)[2].

Table 2-3. Types and quantities of crops to be cultivated on the lands to be irrigated by the planned reservoir

№	Types of crops	After Project implementation	
		Lands to be irrigated, ha	%
1	Winter wheat	10.1	2.0
2	Cereal crops such as barley	10.1	2.0
3	Perennial grasses and legumes	45.3	9.0
4	Vegetables	115.7	23.0
5	Horticultural crops	40.2	8.0
6	Potato	50.3	10.0
7	Fruit orchards	139.5	27.8
8	Vineyards	91.8	18.2
Total		**503.0**	**100**

2.3 Key Outputs of the Hydrological Study

2.3.1 Study of Water Flows

The survey of the reservoir catchment basin and analogous rivers was used in the Kasakh Reservoir feasibility study. Hydrological studies of the Kasakh River catchment began in 1919 at the Ashtarak hydrometric station, located 29 km upstream of the reservoir site, and have continued to the present day. Over the years, ten hydrometric stations have been operated on the Kasakh River. Currently, six hydrometric stations are in use: three on the Kasakh River, and one each on the Gegharot River, the Shakhverd River, and the Aparan Reservoir.

The Kasakh River originates on the northern slopes of Mount Aragats and flows into the Metsamor River near the border with Turkey. The catchment basin extends approximately 36 km from east to west and 73 km from north to south. The highest point is the peak of Mount Aragats at 4,090 m, from which the Kasakh River originates via its most abundant tributary, the Amberd River. The lowest point of the river basin is approximately 830 m at the river's mouth. The total length of the river is 89 km, and the overall catchment area is 1,480 km². In the area of the Kasakh Reservoir dam, located just below the confluence of the Kasakh and Amberd rivers at an elevation of about 950 m, the catchment area is 1,356.5 km², with an average weighted elevation of 2,131.8 m.

Actual data from the Ashtarak hydrometric station on the Kasakh River were used to analyse the average annual discharges relevant to the Kasakh Reservoir. According to RA Government Decree № 1909-N, *"On Approval of the Management Plan of the Hrazdan Water Basin Management Area for 2022–2027"* as well as the *Fourth National Communication on Climate Change*, the vulnerability of the annual flow of Armenia's rivers is assessed under three climate scenarios. For the Ashtarak hydrometric station:

- Under the CCSM4 RCP6.0 scenario, river flow is projected to decrease by 20.4% by 2100,
- Under the CCSM4 RCP8.5 scenario, by 31.97%,

[2]Preparation of design and cost estimation documents for construction of Kasakh reservoir in Armavir Marz of the Republic of Armenia, Explanatory Note, 2024

- And under the METRAS RCP8.5 scenario, by 32.3%.

Taking these scenarios and the corresponding calculations into account, the projected characteristic discharges in the Kasakh River at the reservoir site for the year 2100 are presented in Table 2-4.

Table 2-4. Discharges with different probabilities in the Kasakh River section in the year 2100 under various climate change scenarios

P (percentage)	Discharge, m^3/s	CCSM4 RCP6.0 Scenario *Decrease of 20.4%*	CCSM4 RCP8.5 scenario *Decrease of 31.97%*	METRAS RCP8.5 scenario *Decrease of 32.3%*
25%	4.34	3.45	2.96	2.94
50%	3.66	2.91	2.49	2.48
75%	3.07	2.44	2.09	2.08
95%	2.53	2.01	1.72	1.71

The Kasakh River exhibits an annual flow distribution typical of rivers in Armenia. It has a distinct spring flood phase, low-water periods in winter and summer, and a secondary autumn flood phase. Spring floods are primarily caused by snowmelt and rainfall, while autumn floods, which are usually short and less pronounced, result mainly from rainfall. During the low-water seasons, the river is mainly fed by springs and melting snowdrifts; summer low-water periods may occasionally be accompanied by rain. However, due to flow regulation by the Aparan Reservoir, the hydrological data recorded at the Ashtarak hydrometric point do not clearly reflect these natural seasonal patterns.

Table 2-5 shows the annual flow distribution in the Kasakh River bed for years with varying average discharges. It clearly shows a spring flood phase from March to May, while the summer phase (July-September) is primarily influenced by releases from the Aparan Reservoir for irrigation purposes.

Table 2-5. Distribution of monthly flows of years with average discharge and 25%, 50%, 75% and 95% probabilities

Unit	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Annual
1973 - year of maximum flow (25% probability)													
m^3/s	3.21	3.27	3.37	11.88	3.72	3.50	6.10	3.82	3.03	3.04	3.59	3.60	4.34
$mln.m^3$	8.31	7.99	9.04	30.80	9.97	9.07	16.33	10.24	7.85	8.14	9.30	9.64	136.66
%	6.08	5.85	6.61	22.54	7.29	6.63	11.95	7.49	5.74	5.95	6.80	7.05	100.0
1982 - year that coincides with 50% probability													
m^3/s	2.38	2.06	3.58	7.76	3.65	4.51	3.52	4.20	3.12	3.04	3.04	3.03	3.66
$mln.m^3$	6.16	5.03	9.58	20.11	9.79	11.68	9.43	11.26	8.08	8.14	7.87	8.11	115.23
%	5.35	4.37	8.31	17.45	8.49	10.14	8.18	9.77	7.01	7.06	6.83	7.04	100.0
2000 - year of low flow (75% probability)													
m^3/s	2.86	2.91	2.95	6.03	2.15	2.38	2.79	3.06	2.90	2.87	2.78	3.13	3.07
$mln.m^3$	7.41	7.11	7.90	15.63	5.76	6.16	7.48	8.20	7.53	7.69	7.21	8.38	96.44
%	7.68	7.38	8.19	16.21	5.98	6.39	7.75	8.50	7.80	7.97	7.47	8.69	100.0
2001 - year of minimum flow (95% probability)													
m^3/s	2.99	3.11	3.92	3.50	1.91	1.83	2.21	2.47	1.63	2.00	2.26	2.59	2.53
$mln.m^3$	7.76	7.58	10.51	9.07	5.10	4.74	5.91	6.61	4.21	5.34	5.87	6.94	79.63
%	9.74	9.52	13.20	11.38	6.41	5.95	7.43	8.30	5.29	6.71	7.37	8.71	100.0

It can be concluded from the **Table 2-5**, that total flow volume can reach 115.23 mln. m^3 in years with 50%-probability discharges, 96.44 mln. m^3 in those with 75%-probability discharges, and 79.63 mln. m^3 in minimum flow years with 95% probability.

2.3.2 Maximum Flow

Hydrological calculations of the Kasakh Reservoir's maximum flows were based on data from the Ashtarak hydrometric station. However, this station does not record the maximum regulated flows released from the Aparan Reservoir. To estimate the maximum flows, the differences between the inflows at the Vardenis hydrometric point and the outflows at the Hartavan hydrometric point (i.e., the net flow regulated by the Aparan Reservoir) were added to the discharges recorded at the Ashtarak hydrometric station for the period after 1966.

A 48-year data series was used to calculate the maximum discharges at the Ashtarak hydrometric station. The highest recorded discharge was 188 m^3/s in April 1953, while the highest recovered discharge was 200.1 m^3/s in May 1972. The average maximum discharge is 61.48 m^3/s, with a standard deviation of 41.84.

Table 2-6 below presents the corresponding maximum flow values at the mouth of the Kasakh Reservoir, taking into account the transformation of maximum flows in the Aparan Reservoir.

Table 2-6. Calculated values of maximum flows at the mouth of the Kasakh Reservoir and Ashtarak hydrometric station

River Mouth	Norm, m^3/sec	Probability, %							
		0.01	0.05	0.1	0.5	1	3	5	10
Kasakh, Ashtarak hydrometric station	46.6	195.2	173.8	164.0	139.8	128.6	109.0	99.2	84.8
Dam of the Kasakh Reservoir	56.9	238.6	212.4	200.5	170.8	157.2	133.2	121.3	103.6

2.3.3 Environmental Flow

The environmental flows were estimated based on data from the Ashtarak hydrometric station on the Kasakh River and the Parpi hydrometric point on the Shakhverd tributary of the Kasakh River, as defined by RA Government Decree No. 1909-N, *"On Approval of the Management Plan of the Hrazdan Water Basin Management Area for 2022–2027"*. Environmental flow for the Amberd River was not calculated due to the lack of recorded information. The environmental flows calculated in line with the RA Government Decree №57-N, dated 25.01.2018 are summarised in **Table 2-7**. According to the noted Government Decree, the environmental flow for each month is calculated by adding the average of the minimum 10-day discharge values from the winter low-flow period to 33% of the minimum monthly discharge.

Table 2-7. Environmental flows at Kasakh, Shakhverd near the dam of Kasakh Reservoir, m^3/sec

River section	Months											
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Kasakh River, Ashtarak hydrometric station	1.44	1.4	1.95	1.7	1.3	1.07	1.1	1.16	1.42	1.39	1.63	1.88
Shakhverd River, Parpi hydrometric station	0.3	0.3	0.3	0.32	0.33	0.31	0.25	0.24	0.24	0.24	0.24	0.24
Dam of Kasakh Reservoir	1.74	1.7	2.25	2.02	1.63	1.38	1.35	1.4	1.66	1.63	1.87	2.12

Hence, the minimum environmental flow near the dam of Kasakh Reservoir shall be 1.35 m^3/sec during the July, while the maximum environmental flow will be 2.25 m^3/sec in March.

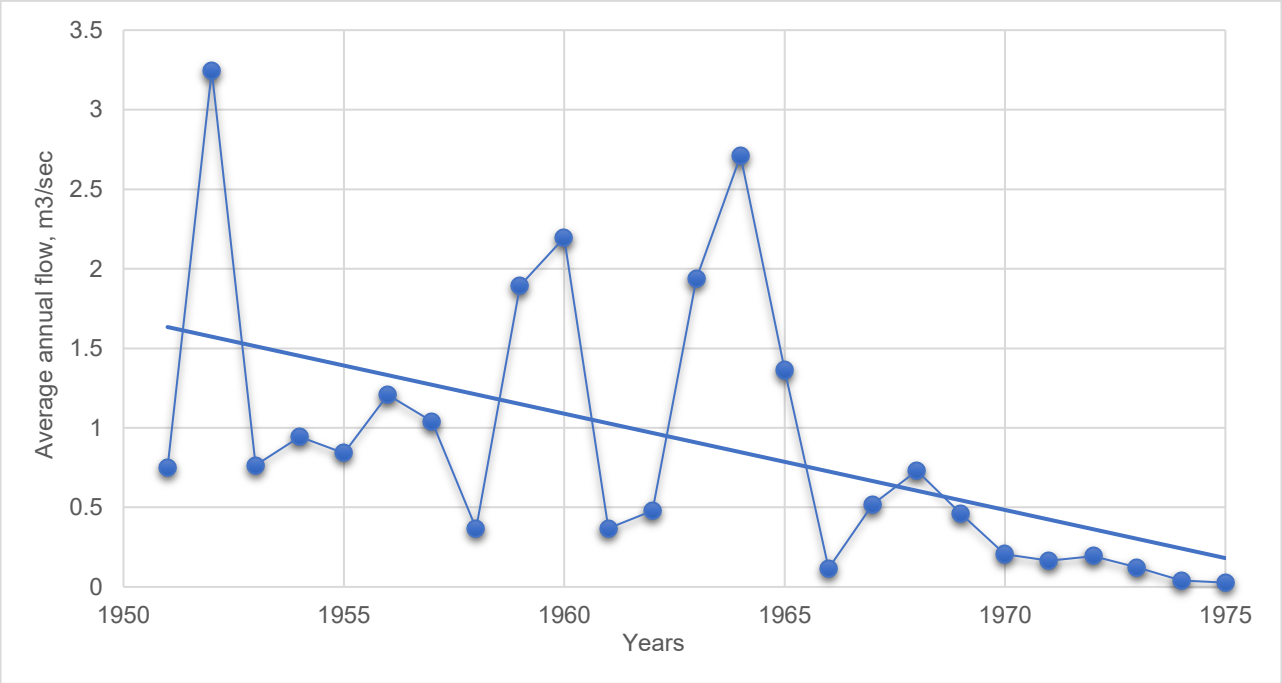
2.4 Sediment Load from the Feeding River

As with all channel-type reservoirs, in the case of the Kasakh Reservoir, the river's solid flow (sediment load) settles on the reservoir bed due to a reduction in water velocity. The deposition of sediments, depending on their particle size, is distributed along the reservoir bottom from the river mouth to the dam site. Coarser sediments tend to settle near the inflow area, while finer suspended particles can remain in the water column and disperse throughout the entire reservoir basin.

Filling the reservoir with river runoff leads to sedimentation, which depending on the sediment transport capacity of the Kasakh River may continue for several decades or even centuries. Based on the expected volume and rate of sediment accumulation, a dead storage volume has been designated for the reservoir.

Hydrological calculations of sediment transport near the Kasakh Reservoir dam were based on data from the Ashtarak hydrometric station. Data are available for the years 1933, 1934, and from 1950 to 1975. However, the data from 1933, 1934, and 1950 were excluded from the calculations due to their incompleteness.

Figure 2-2. Sediment transport dynamics recorded at the Ashtarak hydrometric station



The **Figure 2-2** clearly shows that, since 1966, the average annual sediment transport has decreased by nearly five times. This decline is attributed to the operation of the Aparan Reservoir, which traps upstream sediments. To obtain an accurate value for the sediment transport module, data from the period before the Aparan Reservoir became operational were used. The volume of sediments in the river section of the Kasakh Reservoir was then calculated excluding the catchment area of the Aparan Reservoir (656 km^2).

The average annual sediment load at the Ashtarak hydrometric station is 1.34 kg/s. The reliability of the sediment flow calculations was conducted in the Project design document. According to these calculations, a 50% reliability level corresponds to a sediment flow of 1.04 kg/sec, or 32,718 tons per year. At this level, the sediment yield (flow module) at the Ashtarak hydrometric point is 32.07

tons/km². Based on this flow module, the estimated annual sediment inflow into the Kasakh Reservoir watershed is 22,449 tons, or 0.71 kg/sec.

Taking into account the composition of the sediment load (sand, clay, silt, etc.), and using average bulk densities (1 m^3 of sand ≈ 1.53 tons, clay ≈ 1.1-1.6 tons, and silt ≈ 1.3-1.7 tons), the volume of annual sediment flow in the Kasakh Reservoir watershed assuming 50% reliability in the riverbed is estimated at approximately 14,969 m^3.

2.5 Water Infiltration from the Reservoir and Dam

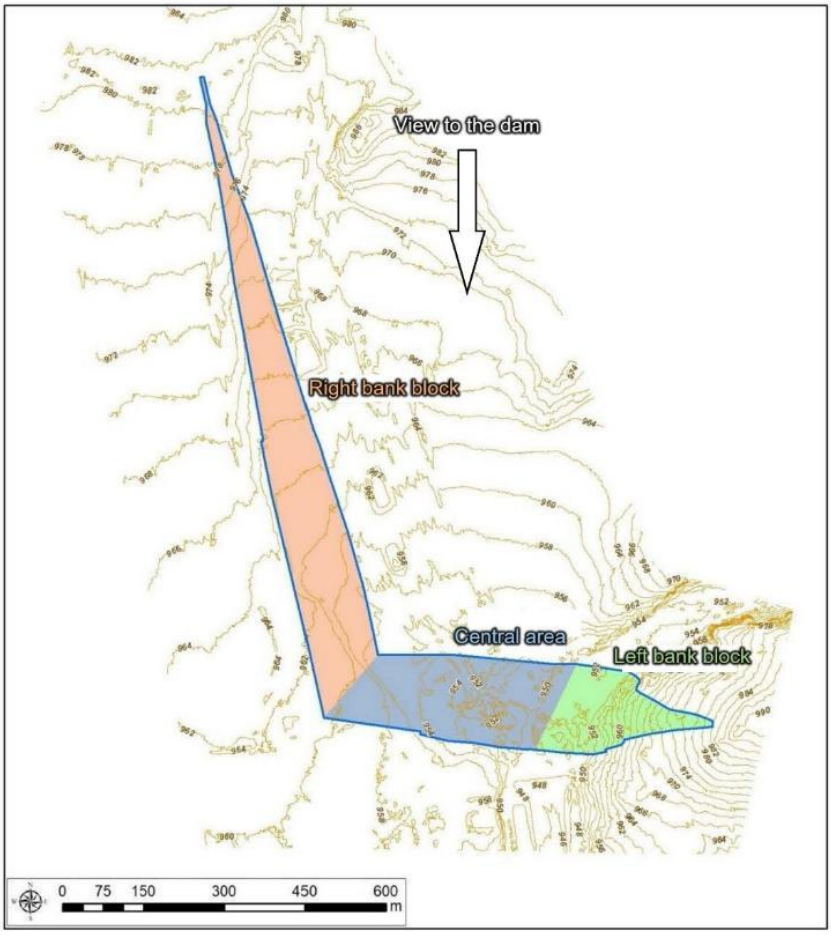
Water infiltration from the reservoir body was estimated during the engineering-geological surveys conducted as part of the Project design study. Within this study, the infiltration properties of the upper soil layer in the planned reservoir area were analysed. The main parameter characterizing the soil's infiltration properties is the permeability coefficient (K).

As a result of field investigations into the soil's filtration properties, the following was identified: in 11 water pumping and filling tests conducted in wells, the permeability coefficient ranged from 0.46 to 16.9 m/day, corresponding to low- and high-permeability soils.

Potential water infiltration from the reservoir body may occur through the reservoir bed, as well as via bypass routes along both sides of the dam.

According to the engineering-hydrogeological and geomorphological characteristics, the dam axis of the reservoir is divided into three blocks: the central area (Block 1, along the Kasakh River bed), the left-bank area (Block 2, left bank of the Kasakh River), and the right-bank area (Block 3, along the Amberd River bed) (**Figure 2-3**).

Figure 2-3. Locations of the dam blocks studied for water infiltration



The results of water infiltration calculations from the 3 blocks under the reservoir dam are summarised in Table 2-8.

Table 2-8. Water infiltration under the reservoir dam body

Parameter	Unit	Block 1	Block 2	Block 3	Total
Water infiltration values	m^3/day	17,563.0	22,636.0	6,371	46,570
	m^3/year	6,410,495	8,262,140	2,325,415	16,998,050

The calculations of the water infiltration from the bypasses on either side of the dam are summarised in Table 2-9.

Table 2-9. Water infiltration from the bypasses on either side of the dam

Parameter	Unit	Left bypass	Right bypass	Total
Water infiltration values	m^3/day	2,337.0	4,276.0	6,613
	m^3/year	853,005	1,560,740	2,413,745

Therefore, infiltration from the reservoir body and bypass routes is estimated at 53,183 m^3/day (46,570 + 6,613) or 19,441,795 m^3/year (16,998,050 + 2,443,745). This value is nearly twice the designed capacity of the Kasakh Reservoir (10.0 mln. m^3). Hence, it can be concluded that the hydrological conditions of the area are not favorable for reservoir construction, and appropriate anti-infiltration measures must be implemented, including:

1) In the bedrock section (central block), a trench 379 linear meters long and with an average depth of 10-15 meters should be installed, extending down to the basalt ceiling. The trench should be filled with clay soil and properly compacted to reduce the permeability coefficient to 0.01 m/day,
2) On the left bank of the dam (left block), a trench 1,162 linear meters long should be installed, reaching down to the basalt ceiling, with an average depth of 14 meters in the river section. The trench should be filled with clay soil and properly compacted to reduce the permeability coefficient to 0.01 m/day.
3) On the right bank of the dam (right block), a trench 298 linear meters long and 10 meters deep should be installed. It should be filled with clay soil and properly compacted to reduce the permeability coefficient to 0.01 m/day.
4) Remove the diluvial and eluvial cover soils down to the underlying volcanic rocks.

According to the estimations, the implementation of the above-mentioned measures will reduce water infiltration from the reservoir body to 12,659 m^3/year, which is within the acceptable range of losses.

2.6 Project Overview

2.6.1 Background

A previous feasibility study for the construction of the Kasakh Reservoir for irrigation purposes was conducted in 2014 by the 'Hayjrnakhagits'[3] Design Institute.

Based on Contract №JK-BMKhTsZB-22/5-N, signed on 22.11.2022 between the Water Committee and Modul LLC design company, the latter was appointed to develop the design documentation for the construction of the Kasakh Reservoir. The 2014 design study was used as baseline data and

[3]ArmWaterProject

was supplemented by Modul LLC through their own geodetic, geological, and hydrogeological surveys, as well as seismic microzonation and risk assessment, using state-of-the-art technical and technological equipment.

According to the Procedure for the Implementation of the Expert Examination of Urban Planning Documents, approved by RA Government Decree №596-N[4], the Project design document is subject to a state complex examination, which is currently in progress.

2.6.2 Current Design Study

During the design study, a series of desktop and field studies were conducted by the "Modul" LLC design company, including:

- Assessment of the agricultural problems in the Project region,
- Engineering-geological investigations,
- Geophysical surveys,
- Geodetic survey,
- Seismic microzoning study and seismic risk probability assessment,
- Hydrological studies,
- Design solutions for the reservoir, dam and supporting infrastructure,
- Feasibility study.

The results of the above-mentioned surveys and studies are summarised in the relevant volumes of the Project design document. Significant optimisations compared to the 2014 study were recommended by "Modul" LLC, including changes to the principal and conceptual approaches to water storage, modernisation of the main structures, and proposed solutions aligned with current construction industry practices.

In addition, calculations of the main structures and determination of their dimensions were carried out based on the principle of integrating modern studies with alternative solutions to ensure the selection of the most efficient option.

The national EIA study for the Project started in 2023, and the positive environmental expert examination conclusion № 233-24 for the Kasakh EIA report was issued by the EIEC under the Ministry of Environment on 01.11.2024 (**Annex 1**).

In parallel, a licensed company was engaged in 2024 by the Water Committee to identify the scope of the main impacts based on a social impact assessment, conduct detailed measurement survey, determine the affected lands and persons, assess their physical and economic losses resulting from the project implementation, and propose measures to compensate affected persons (APs) and assist them in restoring their livelihoods, in accordance with PR5 of the EBRD ESP, as well as the applicable regulations of the RA. All of the above has already been formalised in the Resettlement Plan (RP) for the Project.

2.6.3 Project Location

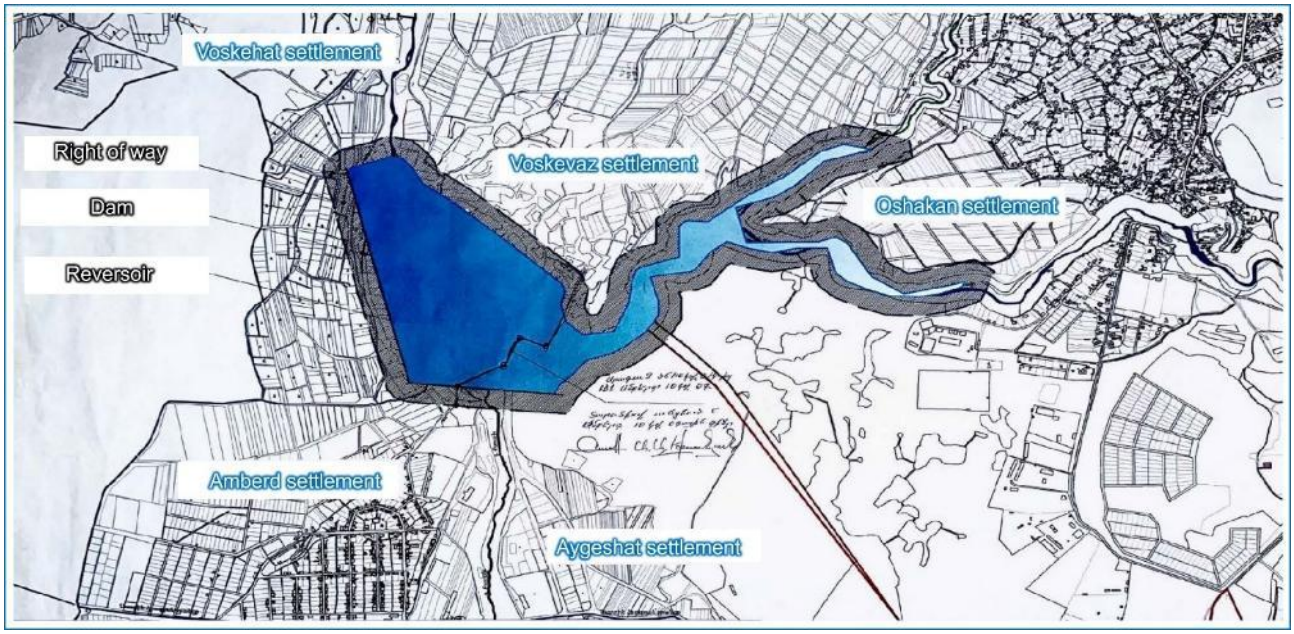
Kasakh Reservoir is planned for construction within the administrative boundaries of Voskehat, Voskevaz and Oshakan villages of Ashtarak community (RA Aragatsotn Marz) and Amberd and Aygeshat villages of Khoy community (RA Armavir Marz) (**Figure 2-4**) at the confluence of the Kasakh and Amberd rivers, at an elevation of 950-980 masl. The area proposed for the reservoir is

[4] https://www.arlis.am/hy/acts/206688

mainly covered by community and private lands of agricultural significance, including pastures and arable land.

The reservoir is designed to be fed by the Kasakh and Amberd rivers and will supply water to the Stage 2 Hrazdan Down Channel, through which 503 ha of agricultural land in 21 settlements of Armavir Marz will be irrigated (see **Figure 2-1**).

Figure 2-4. Location of the reservoir within administrative boundaries of 5 settlements



The Project site is located approximately 15 km northwest of Yerevan, the capital of Armenia. The distance between the reservoir site and Ashtarak, the administrative center of Aragatsotn Marz, is 5 km, while the distance to Armavir, the administrative center of Armavir Marz, is 21 km. The M3 interstate highway passes approximately 2 km east of the project site, while the M1 highway is located 3.2 km to the north.

The connection between the M3 highway and the villages of Amberd and Aygeshat is provided via communal roads, while the villages of Oshakan, Voskevaz, and Voskehat are connected to the M3 highway via the H19 and to the M1 highway via the H20 regional roads.

The Project site can be accessed:

- From the south, via the Amberd settlement communal road,
- From the north, through the earthen roads of Voskevaz and Voskehat settlements.

2.6.4 Project Components

The Kasakh Reservoir will occupy an area of 89.7 ha; however, a total of 145.26 ha of land will be permanently allocated for the project's needs, including the protection zone around the reservoir, the dam, and supporting infrastructure.

The reservoir hydraulic unit consists of:

1. Dam,
2. Construction (diversion) outlets 1 and 2,
3. Irrigation outlet (offtake),
4. Bottom outlet,
5. Emergency spillway.

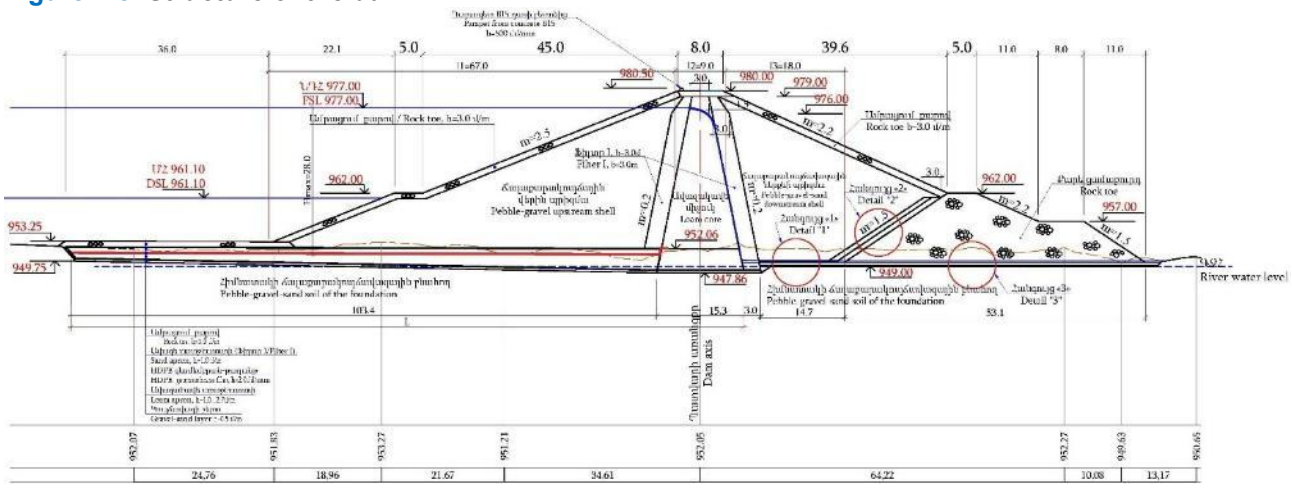
The Master Plan of the Project area, indicating Kasakh reservoir, its components and surrounding infrastructure is provided in **Annex 2** of this ESIA report.

2.6.5 Technical Solutions

Dam structure

The dam body will be constructed using locally available materials: a loam core with upstream and downstream filters around the core and a "gravel pebble" shell. There is upstream rock armour wave protection. The geological survey shows predominantly sands and gravels overlying highly fractured porous basalt and Tuffs. The loam is noted to be mined, potentially from 35 km away from site and then transported, but with more research said to be ongoing. Anti-seepage protection will be provided by a central loam core (**Figure 2-5**).

Figure 2-5. Structure of the dam



The height of the dam will be 32.14 m. The dam slopes are 1:2.5 (vertical:horizontal) on the upstream side and 1:2.2 on the downstream side. The width of the dam crest is 8 m, and its length is 1,686 m. The dam crest elevation has been determined for both the Full Supply Level (FSL) and the Maximum Water Level (MWL), with the MWL calculated at 978.524 masl.

The dam of the Kasakh reservoir has been designed as a class II Dam to Armenian legislation. Based on Dam Height and Volume this would be considered a Large High Hazard Dam as defined by ICOLD[5].

The layout of the dam is provided in **Annex 3** of this ESIA report.

Construction outlet 1

Construction (diversion) outlet 1 is a temporary working structure designed to convey river flows downstream during reservoir construction and to keep the construction site dry. For the purposes of the Project, the construction discharge is directed through a rectangular floor gallery (b = 4.0 m, L = 161.0 m). Calculations were based on a discharge with a 10% exceedance probability ($Q_{10\%}$ = 128.9 m³/s), from which the gallery's cross-sectional dimensions and floor slope were determined.

[5]Armenia Water Reservoirs - Technical, Economic and Green Due Diligence Gap Analysis, Draft Final Report, 2023-2024, Ove Arup & Partners

A barrier is planned to be constructed to intercept the river flow and convey it to the construction gallery. The barrier will be built as a rockfill dam with a sand-clay core and will remain in the reservoir after construction is completed.

Construction outlet 2

Construction (diversion) outlet 2 is an open channel with a length of 810.0 m and a cross-section of 4.0 × 2.0 m.

Irrigation offtake

The irrigation outlet consists of an intake well with a metal flume, from which a steel pipe with a diameter of 1,420 mm and a wall thickness of 12 mm extends for 170.0 meters within a reinforced concrete tunnel. Three-disc valves with a diameter of 1,400 mm are planned at the pipeline outlet.

Bottom outlet

A 110-meter-long steel pipe with a diameter of 1,020 mm and a wall thickness of 14 mm is installed in the gallery. Three-disc valves (1,000 mm) are planned at the endpoint of the bottom outlet.

Emergency spillway

To manage emergency discharge, an open-bank ditch spillway has been designed. It consists of the following components: (1) lateral spillway, (2) ditch, (3) transition section, (4) gallery beneath the dam crest, (5) high-velocity removal section, and (6) surge end section.

The spillway is designed to handle discharges with a 0.1% exceedance probability (Q=290.5 m^3/sec) and safely convey them downstream. According to the design, it is located on the left bank of the reservoir, immediately adjacent to the dam. The spillway has a total length of 237.4 m and consists of a trench intake section, a gallery passage beneath the dam, an open discharge-sweeping section, and a high-velocity surge section.

The technical characteristics of the main components of reservoir hydraulic unit are set out in **Table 2-10**.

Table 2-10. Main technical characteristics of the Kasakh reservoir

№	Key technical data	Measurement unit	Details
1. General data			
1.1	Location of the reservoir		Voskehat, Voskevaz and Oshakan villages of Ashtarak community (RA Aragatsotn Marz) and Amberd and Aygeshat villages of Khoy community (RA Armavir Marz). Confluence of the Kasakh and Amberd Rivers
1.2	Capacity of the Kasakh reservoir	mln. m^3	Total: 10.0
		mln. m^3	Active: 8.9
		mln. m^3	Dead: 1.12
1.3	Area occupied by the reservoir	ha	89.7
1.4	Area to be permanently allocated for the Project needs	ha	145.26

№	Key technical data	Measurement unit	Details
1.5	Surface area of the water horizon at the FSL	m^2	897,000
2. Dam			
2.1	Material of the body		Pebble-gravel
2.2	Dam type		Earth fill dam, with a loam core and apron
2.3	Reservoir surface Area (at top water level)	ha	89.7
2.4	Dam class (Armenian Standards)		II
2.5	ICOLD - Dam class		H=32.14m, V=10 mln. m^3 High
2.6	ICOLD - Dam hazard		PHC>200 High-(III)
2.7	Dam crest level	masl	980.0
2.8	Elevation of the bottom	masl	947.86
2.9	Dam height	m	32.14
2.10	Length of the dam with the crest	m	1686
2.11	Width of the crest	m	8.0
2.12	Stabilization of the upstream slope		Rock body
2.13	Stabilization of the downstream slope		Rockfill
2.14	Type of drainage		Drainage stone
3. Reservoir			
3.1	Type		On-stream
3.2	Dead Storage Level (DSL)	masl	961.1 m
3.2	Full Supply Level (FSL)	masl	977.0
3.4	Maximum Water Level (MWL)	masl	978.524
4. Construction (diversion) outlet 1			
4.1	Type		Bottom gallery
4.2	Construction discharge, $Q_{10\%}$	m^3/sec	128.9
4.3	Cross-section	m	4.0×3.5
4.4	Length of outlet	m	77.0
4.5	Length of gallery	m	161.0
5. Construction (diversion) outlet 2			
5.1	Type		Open channel
5.2	Construction discharge, $Q_{10\%}$	m^3/sec	13.9
5.3	Cross-section	m	4.0×2.0
5.4	Length	m	810.0
6. Irrigation outlet (offtake)			
6.1	Water intake structure		Intake well with metal flume
6.2	Garbage collection		Metallic mesh

№	Key technical data	Measurement unit	Details
6.3	Type of spillway		A steel pipe with a diameter of 1420 mm and wall thickness of 12 mm within a reinforced concrete tunnel
6.4	Length	m	170.0
7. Bottom outlet			
7.1	Type of outlet		A steel pipe with a diameter of 1020 mm and wall thickness of 14 mm installed in the gallery
7.2	Length	m	110
8. Emergency spillway			
8.1	Type		trench
8.2	Type of spillway		high velocity
8.3	Length of spillway	m	237.4

2.6.6 Land Resources Required for the Project

In total, 280 land plots covering a surface area of 1,452,605.40 m^2 are affected across 2 communities (Ashtarak and Khoy), including 5 settlements (Voskehat, Voskevaz, Oshakan, Amberd and Aygeshat) involving 123 Affected Households (AHs)[6]:

Private lands

There are 172 privately owned land plots totalling 726,241.40 m^2. Of these, 171 land plots are agricultural lands and 1 is a commercial. Among the 171 agricultural land parcels as detailed below:

- 115 are arable lands (339,094.46 m^2),
- 15 are fruit seed lands (40,833.50 m^2),
- 7 are fruit orchards lands (21,931.60 m^2),
- 14 are mainly cherry, sweet cherry, apple, mulberry orchards (43,235.70 m^2),
- 6 are classified as other lands (187,941.70 m^2),
- 14 are pastures (88,596.64 m^2).

There is one non-agricultural commercial land plot measuring 4,607.80 m². There are no illegal users or leaseholders on these lands.

Community lands

As per the Project's RAP, there are 106 community-owned land plots occupying 716,205.80 m^2. Of these, 103 land plots are agricultural lands, including:

- 100 arable lands plots (657,724.00 m^2),
- 2 land plots classified as other agricultural lands (6,635.80 m^2),
- One pasture land (45,325.00 m^2).

Some of these land plots are cultivated, while others are abandoned. However, the exact data on their current use will be determined during the Detailed Measurement Survey.

[6]Draft Resettlement Plan for the Construction of Kasakh Reservoir in Ashtarak and Khoy communities, Aragatsotn and Armavir Marzes, September 2024

In addition, there are 3 special-use water plots occupying 6,521.00 m^2. There are no illegal users on the community-owned lands.

State lands

There are 2 state-owned land plots totalling 10,158.20 m^2: one is non-agricultural, and another one is designated for special use. Of the total, 56.20 m^2 is allocated for soil use, and 10,102.00 m^2 is classified as water land [7]. There are no illegal users on the state-owned lands.

Temporary land use

All facilities required for the reservoir construction, except of the loam (clay) borrow pit, are situated within the Construction site (145.26 ha area permanently allocated for the Project needs). These facilities include a construction camp, a stone quarry, two pebble-gravel and loam borrow pits, three stone storage areas, three pebble-gravel storage areas and two topsoil temporary storage areas.

The loam (clay) required for dam construction will be sourced from a borrow pit located in the Gay community of the Etchmiadzin region, approximately 35 km from the Project site. Upon completion of the reservoir construction, the loam borrow pit will be recultivated and returned to Gay community.

Therefore, no temporary land use will be needed from the Project needs.

2.6.7 Description of the Construction Activities

The work schedule including the required workforce and types of construction machinery to be used during the construction is presented in **Figure 2-6**.

Duration of the construction works was determined based on the volume and labour intensity of the main earth/excavation and concrete works, the rational sequencing of tasks, and a consolidated assessment of operational constraints in line with Construction Norms and Rules - CN&R №1.04.03-85 "Norms for the duration of construction of facilities, buildings, and structures". The construction period was determined according to the construction work schedule (**Figure 2-6**) and amounts to 39 months[8].

The layout of the construction site showing the locations of borrow pits, topsoil, stone and pebble-gravel storage areas as well as the construction camp is presented in **Figure 2-7** and **Annex 4**.

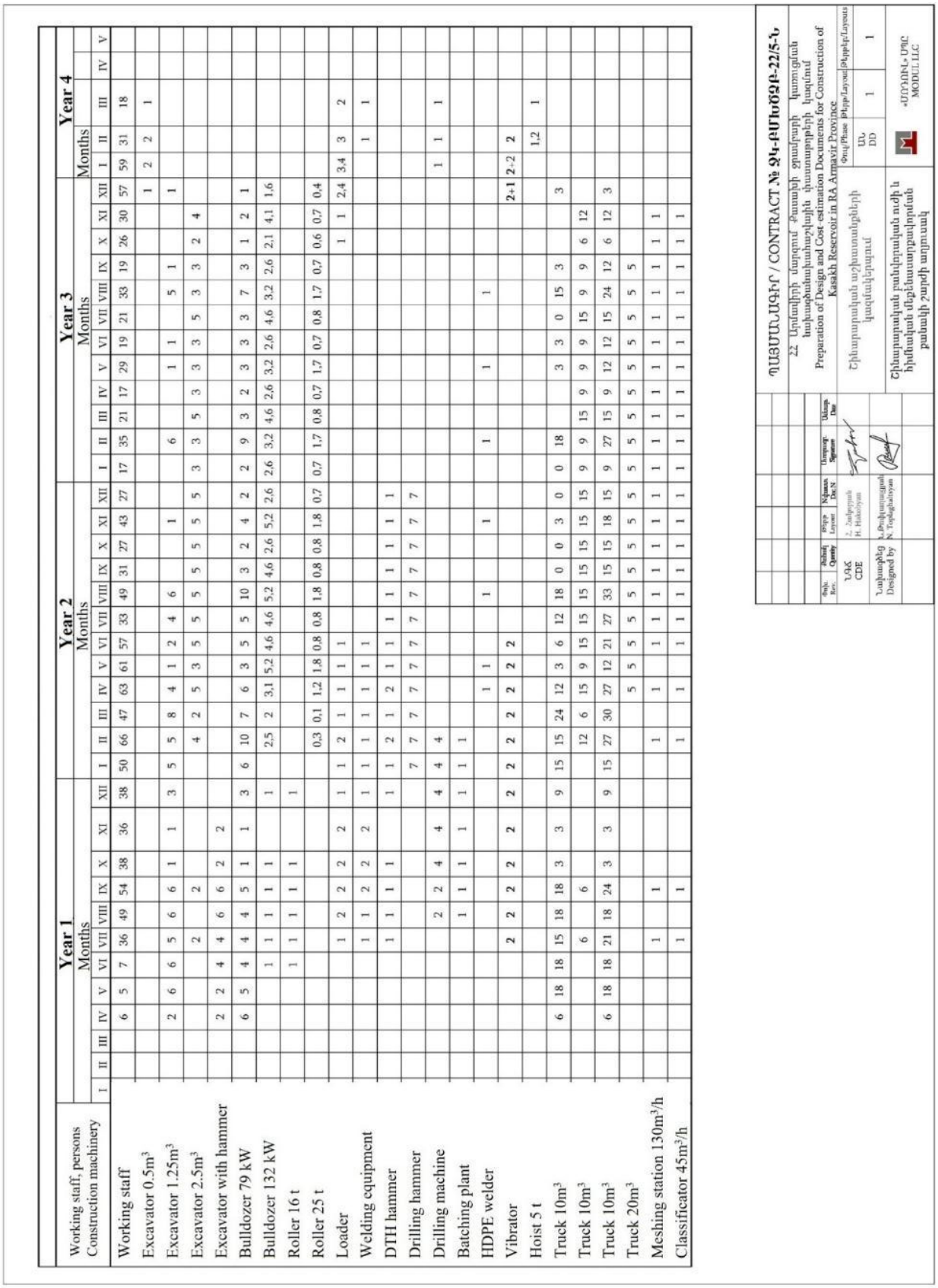
A construction camp will be established to the south of the reservoir dam. It will include a batching plant, storage areas for construction and other materials, administrative offices, and accommodation facilities. A stone quarry, covering an area of 10.7 ha, is located on the northern side of the reservoir area. Two borrow pits for pebble-gravel and loam, occupying 8.4 ha and 12.5 ha respectively, will supply approximately 1,145,000 m^3 of pebble-gravel material for dam construction. One loam (clay) storage area, three stone storage areas, and three pebble-gravel storage areas are planned within the construction site. All generated spoil will be reused as backfill material; therefore, no Spoil Disposal Areas (SDAs) will be required.

The loam (clay) for the dam construction will be delivered from the loam (clay) borrow pit located in the Gay community of the Etchmiadzin region, at a distance of 35 km. To ensure secure access to the Project site, two earth service roads will be constructed before the start of construction works (**Annex 3**). These roads will be used by the construction contractor to deliver construction materials (cement, additives, polyethylene and steel pipes, fittings, oil products, etc.), other supplies, and

[7]Water lands - areas occupied by water bodies such as rivers, natural and artificial reservoirs, and lakes, as well as areas designated for hydraulic, water management, and other facilities necessary for the use and protection of these water bodies.
[8]Preparation of design and cost estimation documents for construction of Kasakh reservoir in Armavir Marz of the Republic of Armenia, Explanatory Note, 2024

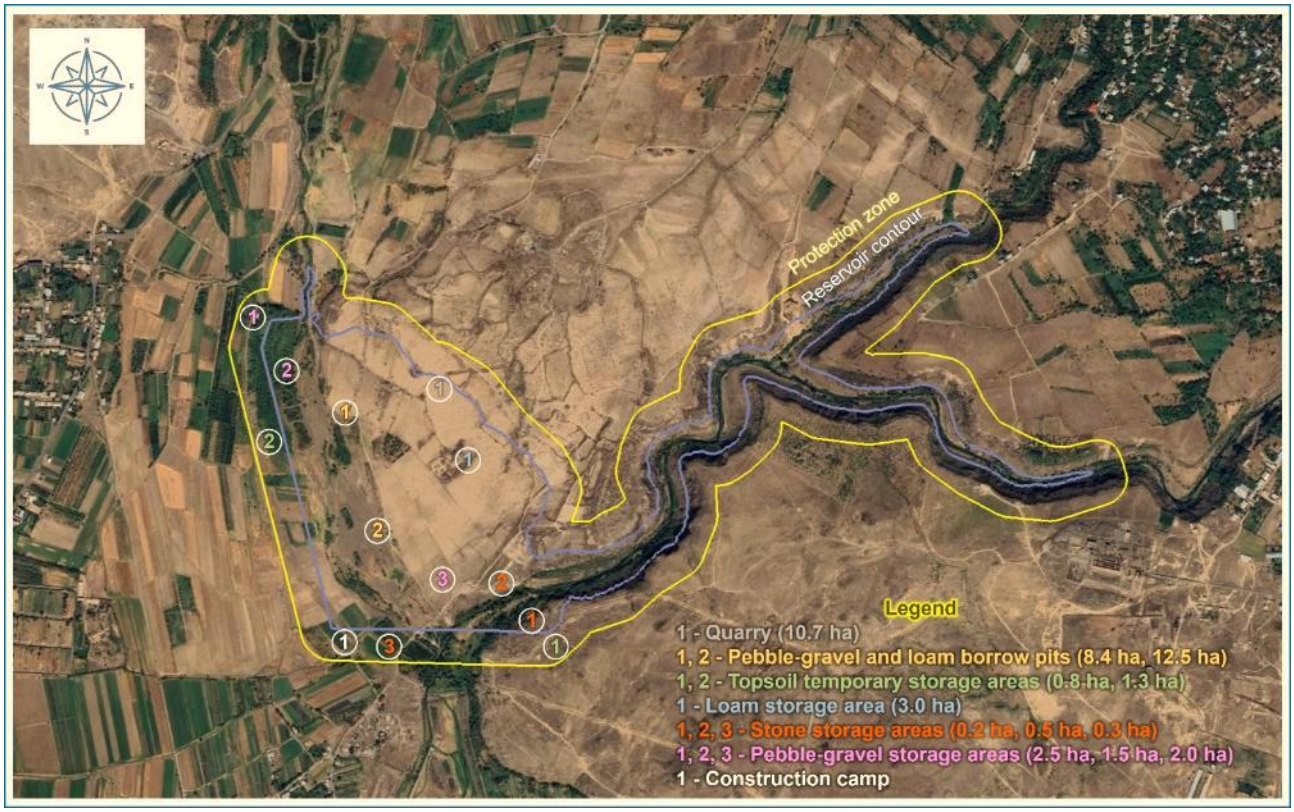
construction machinery to the Project site. The traffic density along the M1 and M3 highways, H19 and H20 regional roads as well as other community roads will increase during the construction activities.

Figure 2-6. Construction work schedule, required workforce and machinery



Working staff, persons / Construction machinery	Year 1 Months I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Year 2 Months I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Year 3 Months I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Year 4 Months I	II	III	IV	V
Working staff				6	5	7	36	49	54	38	36	38	50	66	47	63	61	57	33	49	31	27	43	27	17	35	21	17	29	19	21	33	19	26	30	57	59	31	18		
Excavator 0.5m³																																				1	2	2	1		
Excavator 1.25m³				2	6	6	5	6	6	1	1	3	5	5	8	4	1	2	4	6			1			6			1	1		5	1			1					
Excavator 2.5m³							2		2					4	2	5	3	5	5	5	3	3	5	3	3	3	5	3	3	5	3	3	2	4							
Excavator with hammer				2	2	4	4	6	6	2	2																														
Bulldozer 79 kW				6	5	4	4	4	5	1	1	3	6	10	7	6	3	5	5	10	3	2	4	2	2	9	3	3	3	3	7	3	1	2	1						
Bulldozer 132 kW						1	1	1	1	1		1		2,5	2	3,1	5,2	4,6	4,6	5,2	4,6	2,6	5,2	2,6	2,6	3,2	4,6	2,6	3,2	2,6	4,6	3,2	2,6	2,1	4,1	1,6					
Roller 16 t						1	1	1	1	1		1																													
Roller 25 t														0,3	0,1	1,2	1,8	0,8	0,8	1,8	0,8	0,8	1,8	0,7	0,7	1,7	0,8	0,7	1,7	0,7	0,8	1,7	0,7	0,6	0,7	0,4					
Loader							1	2	2	2	2	1	1	2	1	1	1	1																1	1	2,4	3,4	3	2		
Welding equipment							1	1	2	2	2	1	1	1	1	1	1	1																			1	1		
DTH hammer							1	1	1	1		1	1	2	1	2	1	1	1	1	1	1	1	1																	
Drilling hammer													7	7	7	7	7	7	7	7	7	7	7	7																	
Drilling machine								2	2	4	4	4	4	4																							1	1	1		
Batching plant								1	1	1	1	1	1	1																											
HDPE welder																1	1			1			1			1			1			1									
Vibrator							2	2	2	2	2	2	2	2	2	2	2	2																		2+1	2+2	2			
Hoist 5 t																																						1,2	1		
Truck 10m³				6	18	18	15	18	18	3	3	9	9	15	15	24	12	3	6	12	18	0	0	0	0	18		3	3	0	15	3		3							
Truck 10m³							6		6					12	6	15	9	15	15	15	15	15	15	15	9	9	15	9	9	15	9	9	6	12							
Truck 10m³				6	18	18	21	18	24	3	3	9	15	27	30	27	12	21	27	33	15	15	18	15	9	27	15	9	12	12	15	24	12	6	12	3					
Truck 20m³																5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5								
Meshing station 130m³/h							1		1					1		1		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1						
Classificator 45m³/h							1		1					1		1		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1						

Figure 2-7. Layout of the construction site



During the earthworks and excavation activities, the topsoil from the site will be removed and stored in accordance with existing regulations[9],[10]. According to the Project design study, 106,774 m³ of topsoil will be stripped and stored in temporary topsoil storage areas located outside the reservoir area but within the designated protection zone (**Figure 2-5**). The topsoil will later be used for landscaping activities.

The Project design document also envisions the construction of power supply lines and a substation. There is lack of information related to this power supply infrastructure, its technical parameters and required land-plots in the design document. The land use impacts regarding the power supply lines will be managed within the RAP study to be developed as required in the RF.

The main activities during the Project implementation, associated with the construction of the reservoir, dam and its supporting infrastructure, as well as the volumes of work to be performed and materials to be handled, are summarised in **Table 2-11**.

Table 2-11. Main activities and quantities of materials to be managed during the construction phase

№	Activity/operation	Project component	Materials to be managed	Measures proposed by the Design document
1	Vegetation clearance and removal of topsoil	Reservoir area	40,000 m³	Topsoil will be temporarily stored in the two designated storage areas within the Project site (**Figure 2-7**)
		Dam area	66,774 m³	

[9]The procedure for topsoil use, approved by the RA Government Decree №1396-N dated 08.09.2011
[10]The requirements for determination of topsoil stripping norms and for stripped topsoil preservation and use, approved by the RA Government Decree №1404-N dated 02.11.2017

№	Activity/operation	Project component	Materials to be managed	Measures proposed by the Design document
2	Generation and removal of the construction waste	Reservoir area	92,250 m^3	Disposal in the nearest landfill based on the agreement with the specialised company
3	Excavation and other earthworks	Dam area	401,063 m^3	The spoil materials will be used as backfill and for levelling purposes
		Construction outlet 1	33,700 m^3	
		Construction outlet 2	13,660 m^3	
		Emergency spillway	27,135 m^3	
4	Access road construction works	Earth road 1	17,731 m^3	
		Earth road 2	9,520 m^3	
5	Concrete and reinforcement works	Construction outlet 1	4,262 m^3 (concrete)	The concrete mixture will be delivered from the Batching plant installed in the Construction camp (**Figure 2-7**)
		Emergency spillway	5,606 m^3 (concrete)	
		Dam construction	1,010 m^3 (concrete)	
6	Concrete and reinforcement works	Construction outlet 1	105.93 t (reinforcement)	The reinforcement materials will be delivered from the Construction camp (**Figure 2-5**)
		Emergency spillway	145.58 t (reinforcement)	
7	Dam consruction works	Dam area	412,900 m^3	
8	Mining of pebble-gravel materials and their use in dam construction	Pebble-gravel and loam borrow pit 1	645,000 m^3	Pebble-gravel and loam borrow pits 1 and 2 are located within the area allocated for reservoir construction (**Figure 2-5**)
		Pebble-gravel and loam borrow pit 2	500,000 m^3	
9	Transportation of loam (clay) from the borrow pit	Dam area	256,000 m^3	The loam (clay) borrow pit for the construction of dam core is located in Gay community of the Etchmiadzin region, at a distance of 35 km
10	Mining of crushed stone	Dam area	412,900 m^3	Stone quarry is located within the area allocated for reservoir construction (**Figure 2-7**)

The required number of workers will vary throughout the Project implementation period. According to the construction time schedule (**Figure 2-6**), the maximum workforce will include 66 workers and technicians, 14 managers and engineers, and 19 officers. In total, 99 workers will be required for the construction stage.

The construction workforce will primarily comprise highly skilled professionals, such as welders, concreters and construction machinery operators, alongside unskilled labour recruited mainly from the project-affected settlements. Overall construction management will be overseen by the site manager and supported by foremen in line with construction phase management plans.

2.7 Associated Facilities

According to the EBRD ESP (2019), facilities or activities that are not financed under the Bank's loan agreement but are, in the EBRD's view, significant for the success of the project or for achieving agreed project outcomes are considered **Associated Facilities**[11].

All components required for the reservoir's operation, including access roads and power supply lines and a loam borrow pit in Gay Community, are included in the Project design document. Therefore, there are no components that can be classified as associated facilities for the Project.

2.8 Project Justification

The GA has prioritised the management of water resources for agricultural use and plans to construct 17 reservoirs within the EU support initiative 'Recovery, resilience and reform: post 2020 Eastern Partnership priorities' to the Government of Armenia to enhance the water and food security level in the country. The Program for the 17 reservoirs construction was developed by the Ministry of Territorial Development an Infrastructure (MTAI) on 2022 and approved by the GA.

The objective of the Program is to implement large-scale reservoir construction in Armenia to regulate surface water flow, manage water resources effectively, and increase both the availability of usable water and the area of agricultural land to be irrigated. The construction of the planned reservoirs will support the conversion of the existing irrigation system to gravity-based operation, which will help reduce power consumption and, consequently, lower the cost of agricultural production.

[11]These are new facilities or activities: (i) without which the project would not be viable, and (ii) would not be constructed, expanded, carried out or planned to be constructed or carried out if the project did not exist

3. Project Alternatives

3.1 Zero Option

Currently, irrigation water for 21 rural settlements (see**Table 2-1**) in Armavir Marz is supplied through the Stage-2 Hrazdan Down Channel. Of the 6,215.0 ha of agricultural land in these settlements, 1,698.4 ha (27.3%) remain unirrigated due to insufficient water supply. Based on irrigation water demand calculations, the planned Kasakh Reservoir will have sufficient capacity to irrigate 503.0 ha of agricultural land via the Stage-2 Hrazdan Down Channel. In other words, of the 1,698.4 ha of currently non-irrigated agricultural land within the 21 rural settlements, it will be possible to fully irrigate 503.0 ha.

Except for four villages, irrigation water for the remaining rural settlements is supplied mechanically, i.e. water is pumped from the main canal to users through a pumping system. Following the implementation of the Project, water released from the Kasakh Reservoir will increase the volume of flow in the Stage-2 Hrazdan Down Channel. However, the delivery to end users will continue to be carried out mechanically by the "Echmiadzin" Water Users Association (WUA).

Given this, the Project does not aim to convert the existing mechanical irrigation system to a gravity-fed system, and no cost savings related to electricity consumption or pump maintenance are anticipated. On the other hand, Armavir Marz is distinguished by its well-developed agriculture, and the availability of irrigation water is vital for the rural population and regional economic development.

The "Zero Option" of the Project meaning that the reservoir is not constructed or operated and irrigation of the 21 rural settlements in Armavir Marz continues using only the available water in the Stage-2 Hrazdan Down Channel would have the following negative consequences and therefore is not considered as acceptable solution:

1) 503 ha of agricultural lands in 21 rural settlements in Armavir Marz are not irrigated due to the lack of irrigation water in the Stage-2 Hrazdan Down Channel,
2) The economic development of rural settlements in Armavir Marz, one of the regions with the most favourable agricultural landscape and climatic conditions, would be constrained.
3) The existing water supply infrastructure operated by the "Echmiadzin" WUA is outdated, partially demolished (see **Figure 3-1**), and largely ineffective, requiring substantial investment for rehabilitation or reconstruction.

Figure 3-1. Existing irrigation water supply infrastructure near the planned Kasakh reservoir

3.2 Analysis of Alternative Capacities of the Reservoir

The capacity of the Kasakh Reservoir was determined based on the following factors: the hydrological data of annual flow distribution for years with 50% and 75% probability at the reservoir's cross-section; the irrigation water demand for 6,215 ha of land supplied by the Stage-2 Hrazdan Down Channel; estimated reservoir losses due to evaporation and infiltration and the required monthly environmental flow.

The total volume of the reservoir is 10 mln. m^3, of which 8.9 mln. m^3 is active and 1.1 mln. m^3 is dead levels. Water management justification calculations for 50% and 75% probability flows performed by the Project designer are summarised in **Table 3-1**.

Table 3-1. Options for the reservoir capacities

Months	50% probability flow					75% probability flow				
	Kasakh River flow	Flow entering the reservoir	Accumulated in the reservoir	Volume of the reservoir	Discharge from the reservoir	Kasakh River flow	Flow entering the reservoir	Accumulated in the reservoir	Volume of the reservoir	Discharge from the reservoir
XI	7.87	7.48	2.53	2.53		7.21	6.85	1.90	1.90	
XII	8.11	7.70	1.92	4.45		8.38	7.96	2.18	4.08	
I	6.16	5.85	1.09	5.54		7.41	7.04	2.28	6.36	
II	5.03	4.78	0.53	6.07		7.11	6.75	2.50	8.86	
III	9.58	9.10	2.29	8.35		7.9	7.51	0.04	8.90	1.09
IV	20.11	19.10	0.55	8.90	3.98	15.63	14.85			
V	9.79	9.3	0	8.90		5.76	5.47			
VI	11.68	11.10	0	3.40		6.16	5.85		8.90	
VII	9.43	8.96	0	1.18		7.48	7.11		7.19	
VIII	11.26	10.70	1.32	2.50		8.2	7.79		4.71	
IX	8.08	7.68	0	1.78		7.53	7.15		2.59	
X	8.14	7.73	0	0		7.69	7.31		0	
Total	115.24	109.48				96.46	91.64			
Brutto								8.9		1.09

The calculation for the 75% probability flow is based on the following approach: the reservoir's dead storage volume of 1.1 mln. m^3 is established in the first year and remains constant in subsequent years. Accumulation in the reservoir proceeds as follows: 1.9 mln. m^3 in November, 4.08 mln. m^3 in December, 6.36 mln. m^3 in January, 8.86 mln. m^3 in February, and 8.9 mln. m^3 in March. An additional 1.09 mln. m^3 is released into the river.

At a 75% flow probability, the irrigation water demand for 6,215 ha of land is 61.71 mln. m^3. Taking into account a 17% water loss in the Stage-2 Hrazdan Down Channel, the total irrigation water demand increases to 74.35 mln. m^3, with an average requirement of 12,000 m^3 per ha. Of this demand, 25.8 mln. m^3 is supplied from the Kasakh River (via transit flow), and 8.9 mln. m^3 from the volume accumulated in the reservoir, totalling 34.7 mln. m^3. The remaining 39.65 mln. m^3 will be delivered through the Stage-2 Hrazdan Down Channel during April, May, June, and July.

3.3 Analysis of Alternative Locations of the Reservoir Dam

3.3.1 Methodology for the Multi-Criteria Analysis of the Project Alternatives

A Multi-Criteria Analysis (MCA) methodology was developed in the ESIA to analyse the alternative options considered in the Kasakh Reservoir design study. The following common criteria for water reservoir construction projects were applied during the MCA:

- Environmental Impact
- Economic feasibility
- Social Impact
- Technical feasibility
- Water supply reliability
- Flood control and drought mitigation
- Cultural heritage.

All criteria should be measurable, relevant, and aligned with the project's goals and objectives. Each criterion should be assigned a weight that reflects its importance relative to the overall objectives of the project. Weights are typically determined based on expert input or stakeholder consultations and should total 100% (or 1.0 if using decimal values).

Each alternative option should be assessed and rated against the above-mentioned criteria using a consistent scale (e.g., a scale of 1 to 5, where 1 represents the poorest performance and 5 is the best). Ratings should be based on available data, as well as expert and/or stakeholder input.

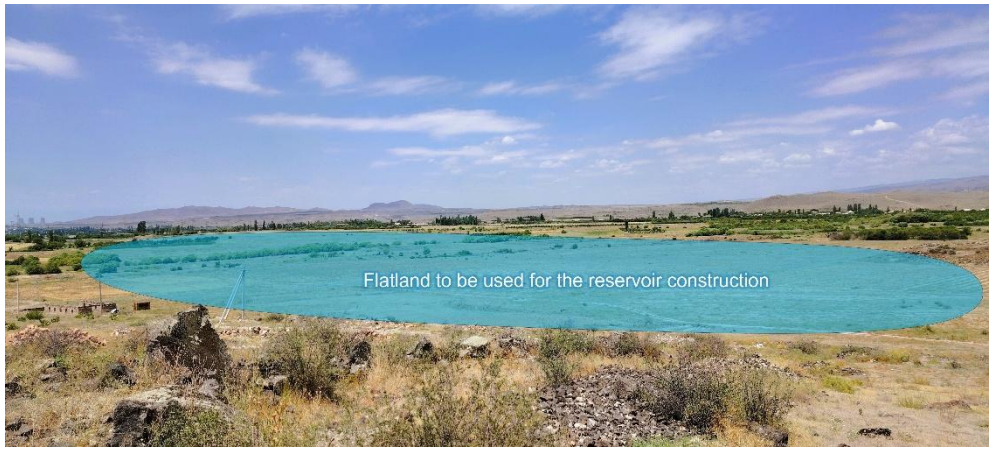
3.3.2 Proposed Locations

There are several limitations and considerations that make the selected area the most acceptable option for the construction of the reservoir and supporting infrastructure:

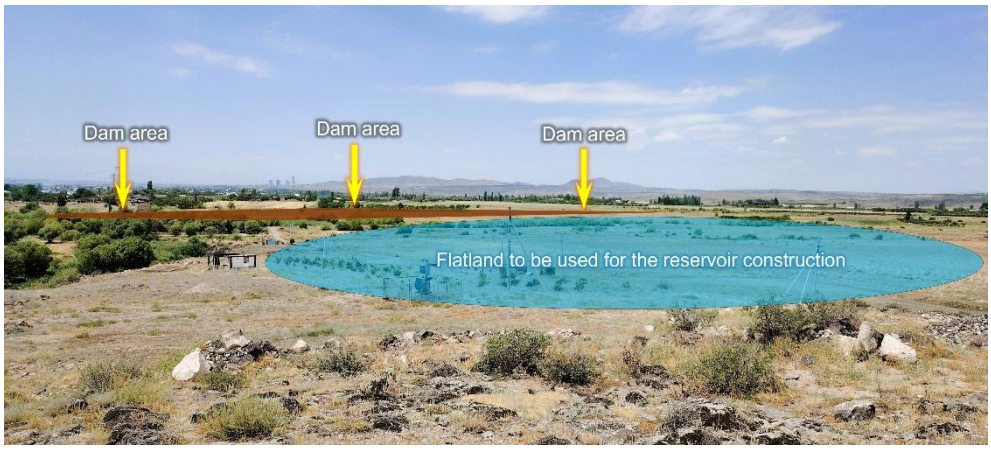
1) The availability of flatland, most of which is uncultivated (**Figure 3-2, a**).

2) Terrain conditions suitable for constructing a dam with minimal height requirements (**Figure 3-2, b**).

Figure 3-2. Flatland where the central part of the reservoir will be located and dam location



a) Flatland where the central part of the reservoir body can be located

b) Location of the reservoir dam and terrain of the project region	

3) The proximity of the Amberd rural settlement cemetery (**Figure 3-3**), located approximately 200 m south of the central axis of the reservoir dam, makes it impossible to shift the reservoir dam and body further south.

4) It is unfeasible to move the reservoir body to the west and north due to the presence of the private cultivated agricultural lands there and potential economic displacement impacts (**Figure 3-3**).

5) Theoretically, it would be possible to move the reservoir dam northward. However, this could have the following negative consequences:

    a. Private irrigated agricultural lands located north of the selected reservoir area would need to be alienated from private owners, which would not only increase the project budget but also trigger physical displacement,

    b. Moving the reservoir dam and body northward would raise water levels in the canyons of the Shakhverd and Kasakh Rivers (see **Figure 3-3**), resulting in the submersion of at least 11 cultural heritage sites identified during the national EIA study (see **Figure 6-19**).

6) The reservoir can be shifted to the east as well. However, this will lead to the submersion of the cultural heritage units (see provisions of item 5), a. above) and also will reduce the capacity of the reservoir,

7) The rise in water levels and submersion of the Shakhverd and Kasakh River canyons would negatively impact the canyon ecosystems and increase the extent of biodiversity areas requiring potential offsetting.

Theoretically, the following alternative locations can be discussed within the Project design and ESIA studies:

- **Option A: Project site (proposed Kasakh reservoir site) -** located approximately 200 meters north of the Amberd settlement cemetery, without affecting the cultivated agricultural lands situated to the west and north of the site. This option makes full use of the flatland area, most of which is uncultivated.
- **Option B: Area located north of the proposed reservoir site**, which could partially occupy cultivated lands to the north and raise the water level in the canyons of the Shakhverd and Kasakh Rivers.
- **Option C: Area located west of the proposed reservoir site**, which would reduce the planned reservoir capacity due to space limitations and would again raise the water level in the canyons of the Shakhverd and Kasakh Rivers.

However, the advantages of the Option A are obvious and are outlined in detail above. Therefore, there are no need for the application of the MCA methodology to determine the preferable option for the Kasakh reservoir construction.

Figure 3-3. Map of the reservoir and surrounding sensitive and critical features that constrain alternative site locations

3.3.3 Conclusion

The proposed location for the reservoir and its dam construction (Option A) is the only acceptable area in terms of:

- Technical and economic feasibility,
- Water storage capacity (will accommodate 10 mln. m^3 of water to be used for the irrigation purposed through the Stage-2 Hrazdan Down Channel),
- Resettlement and land alienation,
- Cultural heritage issues,
- Environmental and social impacts,
- Land alienation tenure issues.

The discussed alternatives are expensive, will reduce the capacity of the reservoir and have significant impacts on environmental and social resources, cultural heritage and land tenure issues.

4. Legal, Regulatory and Institutional Framework

4.1 Applicable Legal and Regulatory Framework

According to the ***Law on Environmental Impact Assessment and Expert Examination (2014, revised in 2023)***[12], there are two types of documents, which are subject to environmental impact assessment and expert examination. These documents are:

(i) Framework Document - a policy, strategy, concept, scheme of utilization of natural resources, program, master plan, urban development document, which are likely to affect the environment; and

(ii) (ii) Design Document - technical report, feasibility study and construction-engineering design of intended activity.

The Law establishes the general legal and organizational principles for conducting mandatory EIA of various types of activities and concept documents of sectoral development. According to the Article 12 of the Law, the types of activities, which should undergo EIA are divided into "A" and "B" categories depending on their expected environmental impact.

As per the Article 12 the Law, the reservoirs or artificial lakes with 500,000 m^3 and more capacities are subject of national EIA and State expert examination. The roles and authorities of parties engaged in EIA and expert examination processes are set in Chapter 2 of the Law. The procedure for public notification and public discussions is outlined in the ***RA Government Decree №1325-N*** dated 19.11.2014[13].

The ***Water Code (2002)***[14] provides the legal basis for protection of water resources, the provision of water for people and economic sectors through effective management of water resources and ensuring the protection of water resources for future generations. The Water Code includes the following: responsibilities of state/local authorities and public, development of the national water policy and national water program, water cadastre and monitoring system, public access to relevant information, water use and water system use permitting systems, trans-boundary water resources use, water quality standards, safe operation of hydraulic facilities, protection of water resources and state supervision. The quality of surface water in Armenia is monitored as per the principles of EU Water Framework Directive adopted by the ***RA Government Decree №75-N*** dated 27.01.2011[15].

Article 1 of the Water Code among others defines:

- 'Water protection zone' as an area designated to prevent the pollution and depletion of water resources, and to maintain a favourable water regime; such areas are not subject to privatization or confiscation.
- 'Sanitary protection areas of water ecosystems' as an area designated to protect water resources used for drinking, healthcare, domestic services, medical facilities, resorts, and other health-related purposes.

The Criteria for the definition of areas for sanitary protection of water ecosystems, flow formation, groundwater protection, water protection, ecotone and unalienable zones are approved by the ***RA Government Decree №64-N*** dated 20.01.2005[16].

The criteria for defining sanitary protection areas of water ecosystems are:

[12] https://www.arlis.am/documentview.aspx?docid=178468
[13] https://www.arlis.am/documentview.aspx?docid=188071
[14] https://www.arlis.am/DocumentView.aspx?docid=148955
[15] https://www.arlis.am/documentview.aspx?docid=200962
[16] https://www.arlis.am/DocumentView.aspx?DocID=13388

a) areas that are protected for the conservation of biological, hydrological and recreational values of water resources,
b) areas where the quality and quantity of surface and groundwater may be required for human health and well-being, including drinking water and water used for therapeutic and ecological integrity purposes,
c) sanitary protection areas of water ecosystems may include river or lake sections, humid areas, ponds and lakes, as well as adjacent areas that are subject to conservation taking into account their natural conditions as acting healthy environmental systems and areas where a restoration need (in the context of supervision over the contamination, erosion and other adverse impacts caused by floods effect on water quality and quantity) of human activity or natural environment will be raised,
d) sanitary protection areas of water ecosystems are defined with a radius of up to 90 m.

The criteria for defining areas of water protection zones are:

a) areas where the prevention of littering, pollution, eutrophication and depletion of water resources, as well as favourable conditions for the water regime, are enforced,
b) the areas of water protection zones include all areas intended for the conservation of water resources,
c) the areas of water protection zones are defined in the form of a strip up to 32 m long.

The Regulation for reservoirs water protection zones (strips) in the Armenian Soviet Socialist Republic (SSR) approved by the Decision №648 of the Council of Ministers of the Armenian SSR[17] applies to all reservoirs located within the borders of the Armenia, regardless their ownership.

The boundaries of the Water Protection Zone (WPZ) are defined for each reservoir by a **water protection design document,** taking into account the local conditions and methodological recommendations set for the determination of water protection zones (strips) of reservoirs. For new reservoirs the water protection design documents are drafted during the project design stage and included into the environmental measurements section. The commissioning of the newly constructed reservoirs shall be done within the water protection boundaries after implementation of all designed water protection measures.

Design document for the water protection zone of operating reservoirs is drawn up separately. Before drawing up the design of the water protection zone, it is determined by the minimum allowable sizes as follows:

- for the water protection zone - 500 m above the normal elevated water level[18],
- for the riparian water protection strip - 50-100 m above the normal elevated level.

The Riparian Water Protection Strips (RWPS) include islands, peninsulas, islets, etc., regardless of their size.

To prevent the pollution and depletion of the water object and to appropriately use its adjacent areas, the regime of economic activity and land use within the water protection zone of the reservoir is defined by the relevant design document.

Before the establishment of the WPZs, the national economic facilities[19] constructed within their boundaries continue to operate provided that the requirements and conditions set by this regulation as well as water protection measures envisioned by the design document are followed. The sizes of water protection zones, the procedure of land use within the WPZ, water protection and other

[17] https://www.arlis.am/DocumentView.aspx?docid=4965
[18] The term 'normal elevated water level' is not defined in the legal act; however, the Consultant assumes that it corresponds to the 'full supply level'
[19] national economic facility is a term used in the former Soviet Union time, now it means commercial units

measures are determined by specialized design companies in accordance with this regulation and agreed with water use and protection authorities and involved ministries and State bodies.

The objective of the ***Law on RA water national program (2006)***[20] is to meet the needs of the population and the economy through the effective management of usable water resources, ensure ecological stability, establish and use strategic water reserves, protect national water resources, and define measures aimed at addressing the issues outlined in the RA Water Code and the RA Law on the fundamentals of national water policy.

The objective of the ***Law on the fundamentals of national water policy (2005)***[21] is to ensure the availability of water resources in the quantity, regime, and quality necessary to meet human well-being, support the development of the republic's socio-economic system, and address both current and future economic and ecological needs.

The ***Law on lake Sevan (2001)***[22] regulates the relations related to the preservation, restoration, reproduction, natural development and use of the ecosystems of Lake Sevan, its catchment area and economic activity zone.

The ***Land Code (2001)***[23] defines the key provisions for land-use in Armenia. Land is classified as per designated purposes (categories) into: 1) agricultural land, 2) settlement land, 3) industrial, mining and other production designation land, 4) land for energy, transport, communication, utility infrastructure facilities, 5) land for specially protected areas, (6) special designation land, 7) forest land, 8) water land[24], and 9) reserve land. The Land Code also specifies soil preservation principles, objectives and regulations via the following RA Government decrees:

- The procedure for topsoil use, approved by the RA Government Decree №1396-N dated 08.09.2011[25],
- The requirements for determination of topsoil stripping norms and for stripped topsoil preservation and use, approved by the RA Government Decree №1404-N dated 02.11.2017[26],
- The procedure for soil excavation, approved by the RA Government Decree №572-N dated 10.05.2019[27].

The ***Law on surveillance over the land use and land conservation (2008)***[28] provides objectives and types of effective use and conservation of RA lands, inspection related to enforcement of land legislation and institutions, procedures of control, rights and responsibilities of entities controlling land use and protection. The Law applies to all lands of the RA Land Fund, irrespective of purpose, ownership and/or right to use.

The ***Law on waste (2004)***[29] provides the legal and economic basis for collection, transportation, disposal, treatment, re-use of wastes as well as prevention of negative impacts of waste on natural resources, human life and health. It defines the roles and responsibilities of state authorities as well as of waste generator organizations in waste management activities.

[20] https://www.arlis.am/documentview.aspx?docid=166250
[21] https://www.arlis.am/DocumentView.aspx?docid=166244
[22] https://www.arlis.am/documentview.aspx?docid=200928
[23] https://www.arlis.am/documentview.aspx?docid=150513
[24] Water lands - areas occupied by water bodies such as rivers, natural and artificial reservoirs, and lakes, as well as areas designated for hydraulic, water management, and other facilities necessary for the use and protection of these water bodies.
[25] https://www.arlis.am/documentview.aspx?docID=71439
[26] https://www.arlis.am/DocumentView.aspx?docID=117360
[27] https://www.arlis.am/documentview.aspx?docid=130889
[28] https://www.arlis.am/DocumentView.aspx?docid=144520
[29] https://www.arlis.am/documentview.aspx?docid=140521

The ***Law on alienation of property for overriding interests of the public (2006)***[30] defines procedures for determining the overriding public interest, for alienating property in order to ensure public interest and for compensation for the alienated property. This law applies to all land ownership (real or movable estate, property rights, equities, etc.) located and registered in Armenia and belonging to physical persons, legal entities and communities. The constitutional conditions for the alienation of property in order to ensure overriding interests of the public are: (i) the alienation must be carried out in exceptional cases defined by the law and in accordance with the procedure established by the law; and (ii) adequate compensation must be paid for the alienated property.

The ***Law on atmospheric air protection (1994, re-edited in 2022)***[31] regulates air quality as well as public relations in the field of prevention and reduction of adverse chemical, physical and biological impacts on air. The Law also regulates emission permits and provides permissible limits/concentrations for atmospheric air emissions. The RA Government Decree №160-N dated 02.02.2006 defines maximum permissible concentrations of ambient air pollution in residential areas.

The ***Law on flora (1999)***[32] and ***Law on fauna (2000)***[33] outline Armenia's policies for the conservation, protection, use, regeneration and management of natural populations of plants and animals as well as the impact of human activities on biodiversity. These laws are aimed at the sustainable preservation and use of flora/fauna and the conservation of biodiversity. The laws also contain provisions for assessing and monitoring flora and fauna, especially rare and threatened species. The RA Government Decree №71-N and №72-N on approval of the ***RA Red Book of animals***[34] and ***RA Red Book of plants***[35] respectively define the biology of threatened (rare, threatened, endangered, vulnerable) species of flora and fauna as well as their quantity, habitats and variety.

The ***Law on special protected areas of nature (2006)***[36] regulates special protected areas of the RA and eco-systems that have environmental, economic, social, scientific, educational, historical, cultural, healthcare and recreation value. It also outlines the legal basis for state policies regarding sustainable development, restoration, protection, reproduction and use of natural objects and complexes. The Law defines four categories of protected areas in Armenia: (i) State Reserves; (ii) National Parks; (iii) Sanctuaries; and (iv) Nature Monuments. The list of the nature monuments is approved by the RA Government Decree №967-N dated 14.08.2008[37].

The ***Law on protection and use of immovable cultural and historic monuments and historic environment (1998)***[38] provides the legal and policy basis for the protection and use of such monuments in Armenia. Article 15 of the Law describes procedures for discovering and registering monuments, establishing protection zones around them and creating historical and cultural reserves. Article 22 stipulates that the land plots located in historically sensitive areas can be allocated for construction, agricultural and other activities only upon approval of the authorized state body (Department of Historic and Cultural Monuments Preservation). The Law also sets the roles and responsibilities of State bodies engaged in management of cultural and historic monuments through the Procedure for State registration, study, conservation, strengthen, repair, reconstruction and use of immovable historic and cultural monuments, approved by the RA Government Decree №438

[30] https://www.arlis.am/documentview.aspx?docid=153844
[31] https://www.arlis.am/documentview.aspx?docid=146626
[32] https://www.arlis.am/documentview.aspx?docid=120784
[33] https://www.arlis.am/documentview.aspx?docid=120790
[34] https://www.arlis.am/DocumentView.aspx?DocID=56347
[35] https://www.arlis.am/DocumentView.aspx?DocID=56348
[36] https://www.arlis.am/documentview.aspx?docid=140513
[37] https://www.arlis.am/documentview.aspx?docid=157090
[38] https://www.arlis.am/DocumentView.aspx?docid=107521

dated 20.04.2002[39]. The RA Government Decree №2322-N[40], №754-N[41], №80-N[42], №628[43] and №1270-N[44] define the State lists of immovable historical and cultural monuments in the RA Syunik, Gegharkunik, Vayots Dzor, Aragatsotn and Shirak regions respectively, while the Government Decree №385-N approves the list of State owned immovable historical and cultural monuments that are not subject of alienation/acquisition[45].

The ***Law on intangible cultural heritage (2009)[46]*** regulates the legal relations arising from the processes of preservation, safeguarding, and development of intangible cultural heritage, including identification, documentation, research, application, recreation, teaching, and dissemination of intangible cultural values, protection of the property rights over such values, maintenance of intangible cultural heritage of Armenia, international cultural cooperation, cultural communication between peoples of foreign countries and those of the RA. Several legal acts have been adopted by the RA to promote the administration of the legal framework of the sector which enables to regulate relations pertaining to preservation, safeguarding, and development of intangible cultural heritage; the activities of communities that create, preserve and transmit intangible cultural values; international cultural cooperation, including: (i) Government Decree №310-A "On Defining the Criteria for Preparing the Lists of Intangible Cultural Values and Approving the List of Intangible Cultural Heritage Values"[47], (ii) Government Decree №36-N "On the Criteria for Preparing the Lists of Intangible Cultural Heritage in Need of Urgent Safeguarding, and the List of Intangible Cultural Heritage Values Based thereon"[48], (iii) Government Decree №241-N "On approving the criteria for defining cultural spaces and published the list of cultural spaces"[49], etc.

The ***Code on subsoil resources (2011)[50]*** contains the main provisions in the area of use and protection of mineral resources and underground water, including sanitary protection zones for underground water resources.

The ***Forest Code (2005)[51]*** regulates sustainable management of forests: guarding, preserving, rehabilitation, afforestation and rational use of forests and forest lands in Armenia as well as with forest stock-taking, monitoring and control.

The ***Law on environmental oversight (2005)[52]*** regulates the organization and enforcement of oversight of national environmental legislation and defines the legal and economic basis underlying the specifics of oversight over the fulfilment of environmental requirements and relations between the parties. The existing legal framework relating to natural resources and environmental includes a range of legal tools. Government decrees are the key legal instruments for implementing environmental laws. The other tools are Presidential orders, Prime-Minister's resolutions, and ministerial decrees.

The RA ***Law on public health (2024)[53]*** regulates the organization and implementation of preventive and anti-epidemic measures, immunoprophylaxis of diseases, prevention of the impact of harmful and dangerous environmental factors on the human body (environmental hygiene), epidemiological

[39] https://www.arlis.am/documentview.aspx?docid=137204
[40] https://www.arlis.am/DocumentView.aspx?DocID=36406
[41] https://www.arlis.am/DocumentView.aspx?DocID=38081
[42] https://www.arlis.am/DocumentView.aspx?DocID=37837
[43] https://www.arlis.am/DocumentView.aspx?DocID=36898
[44] https://www.arlis.am/DocumentView.aspx?docid=12877
[45] https://www.arlis.am/DocumentView.aspx?docid=55737
[46] https://www.arlis.am/DocumentView.aspx?docid=121003
[47] https://www.arlis.am/DocumentView.aspx?docid=151791
[48] https://www.arlis.am/DocumentView.aspx?docID=157499
[49] https://www.arlis.am/DocumentView.aspx?docID=134827
[50] https://www.arlis.am/documentview.aspx?docid=146898
[51] https://www.arlis.am/DocumentView.aspx?docid=121312
[52] https://www.arlis.am/documentview.aspx?docid=146636
[53] https://www.arlis.am/hy/acts/191172

surveillance, production control, public awareness, dissemination of medical and public health knowledge and promotion of a healthy lifestyle, teaching public health knowledge, sanitary-epidemiological control in the Republic of Armenia and registration of products (goods) subject to state registration (except for those regulated by the technical regulations of the Eurasian Economic Union), occupational hygiene services and public health expertise, as well as public relations related to the powers of the Government, state administration bodies in the field of public health, the rights and obligations of individuals and legal entities, individual entrepreneurs, the features of population protection in the event of establishing quarantine due to an epidemic that is the basis for a state of emergency, the mechanisms and procedure for exercising the right to health protection. In addition, there are sanitary-hygienic norms and standards approved by the RA Minister of Health and regulating the sanitary hygienic conditions in public and residential areas viz.:

- Sanitary Norms ("SN") №2-III-11.3. Noise in workplace, residential and public buildings and in the residential construction areas,
- Hygienic Norms ("HN") №2.2.4-009-06. The hygienic norms of the vibration in the workplace, residential and public buildings.

The ***Labour Code (2004)***[54] regulates collective and individual employment relationship; defines the basis and procedure of implementation for the establishment, revision and cessation of that relationship; assigns duties, authorities and responsibilities of the parties of employment relationship, as well as defines conditions for OHS. The Labour Code also recognizes workers' rights to form and to join workers' organizations of their choice, contains provisions for enabling collective bargaining, and prohibits any type of forced labour. Key principles related to ensuring the equal rights and opportunities for men and women are set out in the ***Law №HO-57-N (2013) On ensuring of equal rights and equal opportunities for men and women***[55]. As per Article 6 of this Law, gender discrimination is prohibited, *inter alia*, via setting different levels of wages, changing wages as well as worsening working conditions conditioned by gender. Armenia has ratified 29 Conventions of the International Labor Organization, including eight fundamental ones.

The ***Law on fire safety (2001)***[56] regulates the relations of the state bodies and local self-governing bodies of Armenia, organizations/companies and people in fire safety-ensuring sphere. It defines the basic ways of shaping the state fire safety policies, as well as legal mechanisms of their implementation, such as provision of the populations with effective and reliable fire protection systems. The Law is supplemented by the Fire Safety Rules (Order №595-N of the RA Minister of Territorial Administration and Emergency Situations (2015)[57]).

4.2 Ratified International Agreements

Armenia is a signatory/party to a number of **international agreements and conventions** related to the protection and management of the natural environment, communities, cultural heritage and labour issues.

[54] https://www.arlis.am/documentview.aspx?docid=152137
[55] https://www.arlis.am/DocumentView.aspx?docid=138982
[56] https://www.arlis.am/documentview.aspx?docid=144513
[57] https://www.arlis.am/documentview.aspx?docID=99397

Table 4.1. List of ratified by the RA international agreements applicable for the project

International agreements (convention or protocol)	Description
Convention on Wetlands of International Importance - (Ramsar 1971)	The Ramsar Convention is an intergovernmental treaty to maintain the ecological character and plan the sustainable use of Wetlands of International Importance. The Convention entered into force in Armenia in 1993.
Paris Convention for the Protection of the World Cultural and Natural Heritage (1972)	The Convention establishes the need to preserve natural and cultural heritage and the balance between the two. Armenia became a State party in 1993.
The Convention on the Conservation of Migratory Species of Wild Animals (1979) (Bonn Convention)	The objective of the Bonn Convention, which was adopted in 1979, is to ensure the conservation of land, marine and air migratory species over the whole of their area of distribution. Armenia is a State party since 2011
Convention on the Conservation of European Wildlife and Natural Habitats, Bern (1979)	The Bern Convention is a binding international legal instrument in the field of nature conservation, covering most of the natural heritage of the European continent and extending to some States of Africa. Ratified by Armenia in 2008.
The Convention on Biological Diversity (1992)	The three main objectives of the Convention are: the conservation of biological diversity; the sustainable use of the components of biological diversity; and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources. Signed by Armenia in 1993.
European Landscape Convention, Florence (2000)	The European Landscape Convention of the Council of Europe promotes the protection, management and planning of the landscapes and organises international co-operation on landscape issues.
United Nation Framework Convention on Climate Change (UNFCCC) (1992)	The UNFCCC is one of the «Rio Conventions» adopted at the Rio Earth Summit in 1992. The principal objective is to prevent «dangerous» human interference with the climate system. The UNFCCC entered into force in March 1994 and the first Conference of the Parties of the Convention took place in Berlin, 1995. Armenia became a state party in 2002.
Paris Agreement under the United Nations Framework Convention on Climate Change	The aim of the agreement is to decrease global warming through: (a) Holding the increase in the global average temperature to well below 2°C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5°C above pre-industrial levels, recognizing that this would significantly reduce the risks and impacts of climate change; (b) Increasing the ability to adapt to the adverse impacts of climate change and foster climate resilience and low greenhouse gas emissions development, in a manner that does not threaten food production; (c) Making finance flows consistent with a pathway towards low greenhouse gas emissions and climate-resilient development. Ratified by Armenia in 2017.
UN Convention to Combat Desertification, Paris (1994)	This Convention is the sole legally binding international agreement linking environment and development to sustainable land management.

International agreements (convention or protocol)	Description
	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. Ratified by Armenia in 1997.
UNESCO Convention for the Safeguarding of the Intangible Cultural Heritage (2003)	The purposes of this Convention are: (a) to safeguard the intangible cultural heritage; (b) to ensure respect for the intangible cultural heritage of the communities, groups and individuals concerned; (c) to raise awareness at the local, national and international levels of the importance of the intangible cultural heritage, and of ensuring mutual appreciation thereof; (d) to provide for international cooperation and assistance. Ratified by Armenia in 2006.
Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters, Aurhus Convention (1998)	The Aarhus Convention is a multilateral environmental agreement through which the opportunities for citizens to access environmental information are increased and transparent and reliable regulation procedure is secured. Armenia became a State-party in 2001.
Convention on Environmental Impact Assessment in a Transboundary Context, Espoo Convention (1991)	The Convention sets out the obligations of the Parties to carry out an environmental impact assessment of certain activities at an early stage of planning. Before permitting an industrial project, the country to decide on the project («country of origin») must notify any countries which could be affected by the transboundary impacts of a project located in another country («affected parties»). The affected party and the public in the affected area must be able to express their views and comments about the proposed project. This is a separate procedure which is additional to any relevant national permitting process. The permitting state must take these comments into account in its final decision and communicate it to the affected country and the public. The projects subject to consultations under the Convention are those listed in Appendix I including 'large dams and reservoirs'. Ratified by Armenia in 1997.
International Labour Organization (ILO) Conventions	Armenia has ratified 29 ILO conventions including the following fundamental ones: - Forced Labour Convention, 1930 (Ratified 17.12.2004), - Freedom of Association and Protection of the Right to Organize Convention, 1948 (Ratified 02.01.2006), - Right to Organize and Collective Bargaining Convention, 1949 (Ratified 12.11.2003), - Equal Remuneration Convention, 1951 (Ratified 29.07.1994), - Abolition of Forced Labour Convention, 1957 (Ratified 17.12.2004) - Discrimination (Employment and Occupation) Convention, 1958 (Ratified 29.07.1994), - Minimum Age Convention, 1973 (Ratified 27.01.2006), - Worst Forms of Child Labour Convention, 1999 (Ratified 02.01.2006).

4.3 EBRD Requirements

The main requirements of the EBRD for its own activities are formulated in the Bank's ESP (2019), and the requirements for the E&S aspects of the Client-borrower's activities are set out in the PRs[58]. The ESP sets E&S requirements for the EBRD clients' activities to achieve sustainable results. The PRs applicable to this Project are listed below:

PR1: Assessment and Management of Environmental and Social Risks and Impacts requires the EBRD client (borrower) to conduct an E&S assessment and / or audit. Assessment is carried out for all stages of the project (construction, operation, decommissioning). Based on the assessment and audit, an ESAP, an Environmental and Social Management Plan (ESMP), and other plans are developed. An important feature of the EBRD's requirements is the concept of associated facilities that are not financed by the Bank, and therefore are not part of the project, but which are significant in determining the success of the project[59]. These associated facilities may be carried out by both the client of the Bank and other parties. However, they should be part of the E&S assessment. PR1 is also applicable to contractors involved in project implementation. EBRD also requires borrowers to implement an E&S Management System (ESMS) appropriate to the nature of the project, as well as reporting to EBRD on the project's E&S performance, including compliance with the relevant PRs and the approved ESMP, ESAP, SEP and other documents or commitments.

PR2: Labour and Working Conditions establishes requirements in terms of labour and working conditions, including the prohibition of forced and child labour in the project. The PR2 requirements are based on the conventions of the ILO.

PR3: Resource Efficiency and Pollution Prevention and Control requires efficient use of energy, water and resources, and minimisation of waste, as well as compliance with good international practice (GIP), and application of a mitigation hierarchy. This PR is based on the principles of the EU Industrial Emissions Directive (Integrated Pollution Prevention and Control)[60] and calls for the implementation of EU requirements on the use of BATs and related standards for emissions and discharges.

PR4: Health, Safety and Security requires the client (borrower) to identify and assess community and occupational health and safety risks and implement preventive measures. The focus is on preventing and eliminating risks rather than reducing and minimising them.

PR5: Land Acquisition, Restrictions on Land Use and Involuntary Resettlement defines requirements related to project-induced land acquisition, including restrictions on land use and access to assets and natural resources, which may cause physical displacement (relocation, loss of land or shelter), and/or economic displacement (loss of land, assets or restrictions on land use, assets and natural resources leading to loss of income sources or other means of livelihood). The key requirement of PR5 is to avoid or, when unavoidable, minimise, involuntary resettlement via feasible alternative project designs/sites. A resettlement framework (RF), including livelihood restoration where needed, is developed in an early stage of the project to detail resettlement principles and organisational arrangements.

PR6: Biodiversity Conservation and Sustainable Management of Living Natural Resources determines the requirements for the conservation of biological and landscape diversity in the development area. PR6 requires the borrower to characterise the state of biodiversity, identifying sensitive species and habitats, and developing measures to avoid / reduce impacts. PR6 defines

[58]EBRD. 2019. ESP. https://www.ebrd.com/news/publications/policies/environmental-and-social-policy-esp.html.
[59]'These are new facilities or activities: i) without which the project would not be viable, and ii) would not be constructed, expanded, carried out or planned to be constructed or carried out' (EBRD ESP. 2019. Section II. Definitions).
[60]Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on Industrial Emissions (Integrated Pollution Prevention and Control). https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32010L0075.

criteria for critical habitat screening and requires developing a Biodiversity Action Plan (BAP) where significant adverse impacts on biodiversity are expected.

PR8: Cultural Heritage defines the requirements for the preservation of both tangible and intangible cultural heritage. PR 8 requires exploring the presence / possibility of the presence of objects of cultural heritage in the project's area of influence. Where the assessment identifies that the project may have material risks and impacts on cultural heritage, the client is required to develop a cultural heritage management plan.

PR10: Information Disclosure and Stakeholder Engagement. The EBRD requires careful and systematic stakeholder identification, including communities that may be affected by project impacts (affected groups) and groups whose vital interests may be affected by projects (vulnerable groups). The EBRD requirements for organising stakeholder engagement are also set out in its Access to Information Directive61. Meaningful stakeholder consultations are viewed by the EBRD as an ongoing process throughout the project lifecycle. The EBRD's stakeholder engagement requirements are detailed in the draft SEP for the Project.

4.4 Applicable EU Directives

The EBRD PRs require projects to comply with the relevant European Union (EU) environmental requirements in addition to the applicable national laws and regulations. The list of EU Directives that are relevant to the Project is given below.

Directive 2011/92/EU, as amended by Directive 2014/52/EU, on assessment of the effects of certain public and private projects on the environment (the EIA Directive)[62]

The Directive defines the environmental impact assessment (EIA process for certain public and private projects in the Member States to integrate environmental considerations into project preparation and authorisation. It applies to a wide range of projects listed in Annexes I and II. The projects listed in Annex I are considered to have a significant environmental impact (incl. inter alia 'dams and other installations designed for the holding back or permanent storage of water, where a new or additional amount of water held back or stored exceeds 10 million m^3'). For projects listed in Annex II, national authorities should determine the need for an EIA using a 'screening procedure'.

The key features of the EIA process are as follows:

- the project developer may request the competent authority to specify what should be covered by the EIA information to be provided (scoping stage);
- the developer must provide information on the environmental impact (in the form of an EIA report drafted in accordance with Annex IV of the Directive);
- the environmental authorities and the public, as well as local and regional authorities (as well as any EU countries that are affected) must be informed and consulted;
- the competent authority decides taking into consideration the results of consultations; this decision also includes a reasoned conclusion on the significant effects of the project;
- the authority informs the public of its decision.

[61]EBRD. 2019. Access to Information Directive. www.ebrd.com/documents/strategy-and-policy-coordination/access-to-information-policy-directive.pdf?blobnocache=true
[62]Directive 2014/52/EU of the European Parliament and of the Council of 16 April 2014 amending Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment. https://eur-lex.europa.eu/eli/dir/2014/52/oj. Directive 2011/92/EU of the European Parliament and of the Council of 13 December 2011 on the assessment of the effects of certain public and private projects on the environment (codification). https://eur-lex.europa.eu/eli/dir/2011/92/oj

Directive 2010/75/EU on industrial emissions (integrated pollution prevention and control) (the Industrial Emissions Directive)[63]

The Directive is the main EU instrument regulating the emission of pollutants from industrial facilities. It aims to protect human health and the environment in general by reducing harmful industrial emissions in the EU, in particular through the use of Best Available Techniques (BAT). It is noted that production facilities carrying out the activities listed in Annex I to the Directive *(including inter alia cement production for dam construction)* require a special permit (issued by the authorities in the EU Member States).

Directive 2009/147/EC on the conservation of wild birds (the Birds Directive)[64]

The Directive requires the Member States to protect wild bird species and protect and restore their habitats. Annex I lists wild bird species that shall be the subject to special conservation measures concerning their habitats. It is required to designate special 'protection areas' to avoid significant pollution or deterioration of habitats or any disturbances affecting the birds including birds associated with floodplain habitats to be affected by the Project. Outside these protection areas, it is also required avoid pollution or deterioration of habitats.

Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora (the Habitats Directive)[65]

The Directive requires the Member States to specify areas that are expected to ensure the conservation of flora and fauna species. It is stipulated the need for designating 'special areas of conservation' which, together with the existing special 'protection areas' established per the Birds Directive, to form a became a coherent European ecological network for protecting species and habitats (Natura 2000).

Directive 2000/60/EC establishing a framework for Community action in the field of water policy (the Water Framework Directive)[66]

The Directive aims to ensure an integrated approach to water management by establishing a framework for the protection of inland surface waters, transitional waters, coastal waters and groundwater. It envisions water management by river basin approach.

Directive 2008/98/EC on waste (Waste Framework Directive[67])

The Directive defines the priorities and principles of waste management and the basic concepts and requirements for waste recycling, reuse and disposal in a way that does not have a negative impact on the environment or human health. The principle of waste management hierarchy integrated in the Directive envisions the following sequence of priority in selection of waste management methods:

- waste prevention (prevention at the of waste generation at source);
- waste reduction;
- waste reuse;
- application of other methods of waste recovery, e.g. energy recovery;
- final disposal at landfills.

[63]Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial emissions (integrated pollution prevention and control) (recast). https://eur-lex.europa.eu/eli/dir/2010/75/oj
[64]Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the conservation of wild birds (Codified version). https://eur-lex.europa.eu/eli/dir/2009/147/oj
[65]Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora. https://eur-lex.europa.eu/eli/dir/1992/43/oj
[66]Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy. https://eur-lex.europa.eu/eli/dir/2000/60/oj
[67]Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain Directives. https://eur-lex.europa.eu/eli/dir/2008/98/oj

Directive 2003/10/EC on the minimum health and safety requirements regarding the exposure of workers to the risks arising from physical agents (noise)[68]

The Directive defines the physical parameters that serve as risk predictors, such as peak sound pressure, daily noise exposure level and weekly noise exposure level. It sets exposure limit values and exposure action values in respect to the daily and weekly noise exposure level as well as peak sound pressure. These exposure limits are to be available for Project construction workers.

Directive 2002/44/EC on the minimum health and safety requirements regarding the exposure of workers to the risks arising from physical agents (vibration)[69]

The Directive aims at ensuring health and safety of each worker and at creating a minimum basis of protection for all Community workers by timely detection of adverse health effects arising or likely to arise from exposure to mechanical vibration, especially muscle-skeletal disorders. These exposure limits are to be available for Project construction workers.

4.5 Good Industry Practice (GIP) Guidance

Specific E&S requirements applicable to the Project are set out in the EBRD's Sub-sectoral Environmental and Social Guidelines: Building and Construction Activities (2010)[70]. They elaborate on typical E&S risks related to construction, operation, maintenance and decommissioning of facilities. Other relevant EBRD guiding documents used in the ESIA relate to resettlement; forced labour; gender issues, non-discrimination and equal opportunity; workers' accommodation; and other E&S topics.

The International Finance Corporation (IFC) ***General Environmental, Health and Safety Guidelines (2007)***[71] (General EHS Guidelines) are technical reference documents with general and industry-specific examples of GIIP. The General EHS Guidelines contain the performance levels and measures that are generally considered to be achievable in facilities by existing technology at reasonable costs.

ICOLD Bulletin 173 (2021) - Integrated Operation of Hydropower Stations and Reservoirs. *This bulletin gives an overview of the main functional and operational aspects relating to cascade hydropower stations and reservoirs, it was formed by reviewing of all the related aspects proposed and case studies provided by committee members.*

ICOLD Bulletin 96 (1994) - Dams and environment - Water quality and climate. *This Bulletin gives an overview of effects of reservoirs on water quality and climate.*

ICOLD Bulletin 86 (1992) - Dams and Environment - Socio-economic impacts. *The present bulletin gives an overview of social and economic problems which may arise before, during or after the construction of a large dam.*

The International Commission on Large Dams (ICOLD) is the leading international professional and academic organization in the field of hydraulic engineering. Its mission is to develop the art and science of dam engineering, and to promote the sustainable development and management of the world's water and hydropower resources. ICOLD has 100 member countries.

[68]Directive 2003/10/EC of the European Parliament and of the Council of 6 February 2003 on the minimum health and safety requirements regarding the exposure of workers to the risks arising from physical agents (noise). https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2003:042:0038:0044:EN:PDF
[69]Directive 2002/44/EC of the European Parliament and of the Council of 25 June 2002 on the minimum health and safety requirements regarding the exposure of workers to the risks arising from physical agents (vibration). https://eur-lex.europa.eu/resource.html?uri=cellar:546a09c0-3ad1-4c07-bcd5-9c3dae6b1668.0004.02/DOC_1&format=PDF%20
[70]https://www.ebrd.com/downloads/about/sustainability/Building_Construction_Activities.pdf
[71]https://www.ifc.org/content/dam/ifc/doc/2000/2007-general-ehs-guidelines-en.pdf

4.6 Institutional framework

Several state bodies and their subordinate structures or units are involved in water management in Armenia. The main roles and responsibilities of these bodies in the field of irrigation water management are outlined below:

- **The Ministry of Environment (ME)** is the authorized body responsible for water resources management and protection in Armenia. It is tasked with developing and implementing the National Water Policy, National Water Program, and river basin management plans; protecting natural water bodies; preparing annual water balances; and overseeing their implementation.
- **The Environmental Impact Expert Examination Center (EIEEC)**, acting on behalf of the Ministry of Environment (ME), is responsible for organizing and implementing the expert examination and related processes for framework and design documents (projects) initiated by state and private entities, as well as individuals. Among other functions, the EIEEC ensures stakeholder participation in public discussions, facilitates the notification and involvement of interested parties in the expert examination process, and issues environmental impact expert examination conclusions.
- **The Water Resources Management Department**, under the ME, is responsible for regulating water resources management issues, including approving surface and groundwater extraction volumes, issuing water use permits, maintaining the State Water Cadastre, and managing water use related data. It also prepares documents for the suspension, amendment, or cancellation of water use permits.
- **The Hydrometeorology and Monitoring Centre** State Non-Commercial Organization (SNCO), under the ME, monitors meteorological, hydrological, and geophysical conditions in Armenia and provides disaster warnings. The Centre also supports the implementation of Armenia's international obligations in these areas.
- **The Ministry of Territorial Administration and Infrastructure (MTAI)**, along with its affiliated authorities and organizations, develops policy and regulations for the overall management of water infrastructure systems.
- **The Water Committee**, under the MTAI, is designated by the Water Code as the Water System Management Body. It is responsible for developing and implementing investment programs and submitting proposals to the Regulatory Commission concerning regulated tariffs and water system use permits.
- Irrigation in Armenia is managed by **"JRAR" Closed Joint-Stock Company (CJSC)** and 15 **Water Users Associations (WUAs)**. JRAR CJSC, a 100% state-owned enterprise, handles water abstraction and delivery, and is responsible for the maintenance and operation of first- and second-category irrigation systems. The WUAs operate reservoirs and distribute irrigation water to end users.
- **The Environmental Protection and Mining Inspection Body** is responsible for supervising and inspecting compliance with regulations related to the use and protection of water resources.

5. ESIA Methodology and Approach

5.1 Introduction

The ESIA is an iterative process that involves the prediction and assessment of potential impacts of the Project on the physical, biological, and cultural components (indicators) of the environment, as well as on social and socio-economic resources/receptors. During the ESIA study, recommendations were developed to eliminate, minimize, reduce, mitigate, or compensate for adverse impacts, while also enhancing expected benefits and opportunities. Appropriate management and monitoring measures have also been proposed.

The main stages of the ESIA study are as follows:

- Screening,
- Scoping,
- Baseline Study,
- Impact Assessment and Mitigation,
- Management and Monitoring,
- Stakeholder Engagement and Public Consultations.

5.2 Screening

Screening is the initial stage of the ESIA that is carried out to determine the level of the impact assessment as well as what legal and other requirements will be applied for the Project.

The construction of the Kasakh Reservoir, with a capacity of 10.0 mln. m^3, is a greenfield project that may trigger significant adverse environmental and/or social impacts. The EBRD has classified this project as Category 'A' under its 2019 Environmental and Social Policy (ESP), which means that a comprehensive ESIA report and associated documents must be prepared and publicly disclosed for a minimum of 120 days.

5.3 Scoping

The key task of the E&S scoping process is to determine the content and extent of the matters that should be addressed in the ESIA and its associated documentation. The Scoping process is not intended to provide detailed information about the Project. Rather, it serves as a preliminary overview, aimed at facilitating early engagement with relevant stakeholders and helping to identify potential Project impacts. Scoping is designed to ensure that the ESIA focuses on the most significant impacts, project alternatives, and other key issues.

The scoping process involves a comprehensive analysis of the activities and features associated with each stage of the Project lifecycle, and their potential to positively or negatively interact with environmental (including physical and biological receptors), social, and socio-economic resources and receptors.

5.4 Baseline Study

To provide a context within which the impacts of the Project can be assessed, a description of the physical, biological, and socio-economic (including social, economic, and health and safety) environment expected to prevail in the absence of the Project must be presented. In this regard, it is

essential to collect comprehensive baseline data on environmental, social, and socio-economic conditions through the collection of both primary and secondary information.

Secondary baseline data were gathered from documents prepared during the Project design phase and the national EIA study provided by the Water Committee and the National EIA Consultant, as well as from the gap analysis study conducted by the ESIA Consultant. In addition, baseline information related to the Project region, components, and associated facilities was collected by the Consultant from publicly available sources, reports, online databases, and interactions with Project stakeholders. The list of documents and information used during the secondary baseline data collection process is provided in **Section 1.4** of this ESIA report.

Where necessary, or where information is lacking, secondary baseline data should be supplemented with primary data collected during field surveys and investigations. The following field surveys were initially conducted by the National EIA Consultant and subsequently enhanced by the ESIA Consultant to describe the baseline conditions within the Project's footprint and to supplement the baseline chapter (**Chapter 6**) of this ESIA report:

Surveys conducted by the National EIA Consultant
• Biodiversity (flora and fauna) field investigation • Background air quality survey (determination of SO_2, NO_2, CO and dust actual concentration in the atmospheric air within the area of Project influence) • Water and soil quality survey • Ambient noise study (determination of actual noise levels within the Project's area of influence) • Socio-economic data collection and interviews • Archaeological field surveys
Supplementary studies conducted by the ESIA Consultant
• Cumulative impact assessment, • Assessment of impacts of the associated facilities, • Water infiltration and loss study, water and soil quality survey, • Assessment of Greenhouse Gas (GHG) emissions and climate change mitigation measures, • Spring season field biodiversity surveys and Critical Habitat Assessment, • Appropriate Assessment procedure, • Cultural Heritage studies and intangible Cultural Heritage survey

The results of the field surveys are provided in the annexes and summarised in the relevant sections of **Chapter 6**, and are further discussed in **Chapter 8** of this ESIA report.

The baseline outlines the existing E&S conditions and provides the context against which potential impacts will be identified and assessed. Specifically, the baseline aims to provide information to support the following:

1. Identify the key conditions and sensitivities within the zone potentially affected by the Project,
2. Provide baseline data for subsequent prediction and assessment of potential impacts to be generated during Project implementation,
3. Understand stakeholders' concerns and analysis of their perceptions and expectations,
4. Ensure a benchmark to assess future changes resulting from the Project implementation and monitor the effectiveness of mitigation measures.

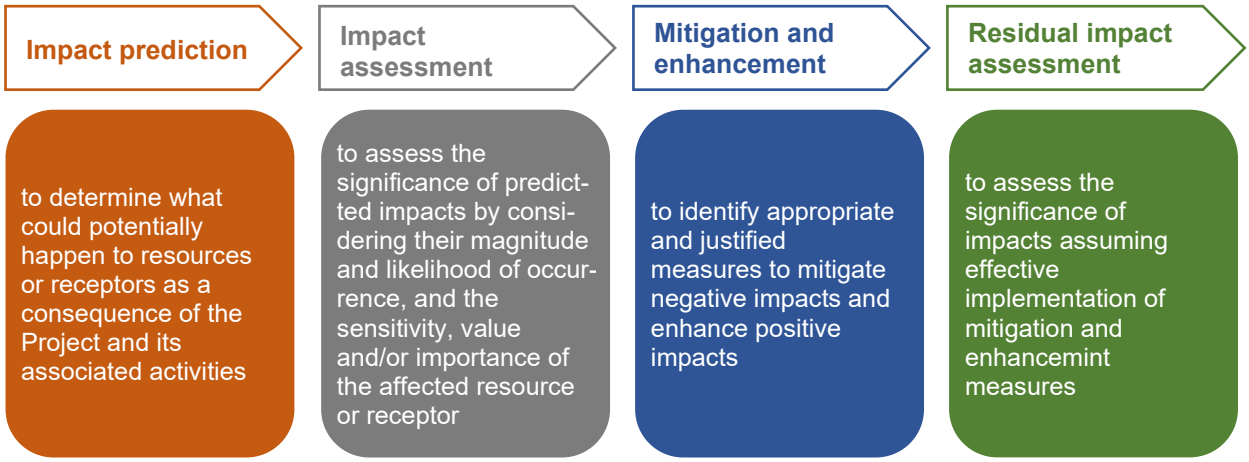
5.5 Impact Assessment and Mitigation

The potentially significant impacts identified during the scoping stage are subject to a full-scale appraisal during the ESIA study. The impact assessment follows a consistent process for the consideration of the following four aspects:

- Impact prediction,
- Impact evaluation,
- Mitigation and enhancement,
- Residual impact evaluation.

The scheme of impact assessment and evaluation process is presented in **Figure 5-1**.

Figure 5-1. Schematic view of impact assessment process



Impact Prediction

Impact prediction is an expert-driven process used to determine the likely consequences of the Project and its associated activities or features on the environment. Impacts on various resources and receptors are identified and assessed based on the potentially significant interactions determined during the scoping phase. Given the diverse range of potential impacts considered in the assessment process, a variety of prediction methods are typically employed, including quantitative, semi-quantitative, and qualitative techniques.

Impact Assessment

E&S impacts arise as a result of Project activities or features interacting directly with receptors, or causing indirect changes to the existing environment. Impacts can be described and quantified in various ways. In the course of this study, impacts on different components of the physical, biological, human, and social environment are assessed throughout the Project's lifecycle in terms of:

- Nature: positive or negative,
- Type: direct, indirect, residual,
- Magnitude: high, medium, low, negligible,
- Likelihood: high, medium, low,
- Duration of the Impact: temporary, short-term, long-term, permanent,
- Reversibility,
- Significance degree: significant, moderate, low, negligible.

The key characteristics of the impacts are defined in Table 5-1.

Table 5-1. Impact Characteristics

Impact Characteristics	Description
Type	**Direct impact** resulting from the direct interaction between a project activity and the resource / receptor. **Indirect impact** between the proposed activity and the environment/ receptor as a result of subsequent interactions within it. **Residual impacts** are defined as those impacts that remain following the implementation of the mitigation measures proposed.
Duration of impact	**Temporary (very low duration)** impacts would last for a short duration of six months of less and are reversible and intermittent or occasional in nature. The resource or receptor would return to the previous state when the effect ceases or after a short period of recovery. **Short-term (low duration)**, when impact is likely to be restricted for a duration of up to three years. **Long-term (medium duration**), when impacts would continue for an extended period of time; this is based on the understanding that there will be recovery of the effected environmental component to its best achievable pre-project state over time. **Permanent (high duration)**, when impacts would occur during the lifetime of the Project and cause a permanent change in the affected receptor or resource.
Magnitude	**Negligible**, when the impact having almost no influence on baseline conditions. **Low**, when resulting in slight changes of prevailing baseline conditions. **Medium**, when resulting in changes which are within the benchmark norms or shows some signs of stress on any of the components of environment. **High**, when resulting in changes which affects larger extent or shows signs of stress on receptors in larger extent.
Likelihood	**Low**, when event is unlikely, but may occur at some time during normal operating conditions. **Medium**, when event is likely to occur at some time during normal operating conditions. **High**, when event will occur during normal operating conditions.

Once the magnitude and likelihood of the impact has been characterized, the impact significance degree is assigned using the matrix in Figure 5-2.

Figure 5-2. Impact Significance Matrix

		Likelihood / Duration		
		Low	Medium	High
Magnitude	Negligible	Negligible	Negligible	Negligible
	Low	Negligible	Low	Moderate
	Medium	Low	Moderate	Significant
	High	Moderate	Significant	Significant

If the duration of an impact is long-term or permanent, but the likelihood is low or medium, the significance of the impact is evaluated one level higher.

In the case of a positive impact, no magnitude designation, other than 'positive', is assigned. For the purposes of this impact assessment, it is considered sufficient to indicate that the Project is expected to result in a positive impact, without quantifying the exact degree of positive change.

Context of impact significance for E&S resources is provided in **Table 5-2**.

Table 5-2. Context of impact significance

Significance of impacts	Description	
	Environmental resources	**Socio-economic resources**
Negligible	Impacts practically do not change the environmental baseline conditions, local in extent and temporary or short-term in duration	No significant changes in baseline conditions are expected, in-site in extent and temporary or short-term in duration impact. No significant inconveniences are caused
Low	Site, local and regional impacts which are not accompanied by long-term degradation of sensitive resources; effects are usually reversible and minor (do not require special mitigation measures); usually do not exceed the applicable standards (criteria, i.e. noise, vibration, etc.) in relation to the less sensitive resources	Short-term inconveniences caused by Project implementation to individuals and communities, but with no consequences to long-term change of livelihood or quality of life. Receptors either easily in part adapt to changes brought by the Project or proceed with previous livelihood
Moderate	Site and local environmental impacts, mostly long-term; impacts which do not affect critical resources but result in irreversible loss of biodiversity and habitats; impacts with regional effects persisting from 1 to 3 years; require development of cost reasonable impact mitigation measures	Direct and indirect impacts on livelihood and quality of life of the local communities or individuals. Receptors may undergo some difficulties to adapt to changes and they will be able to return to their former livelihood under condition of some support (for instance, compensation)
Significant	Significant impacts of regional and of the larger scale; medium-term, long-term and permanent impacts resulting in irreversible changes and degradation of baseline conditions; usually having adverse effects exceeding national environmental standards or associated with transnational environmental issues; involving effects of toxic substances and associated with potential emergencies affecting critical resources and sensitive receptors	Widely spread adverse direct and indirect impacts on both individuals and local communities which are practically cannot be mitigated or compensated. Affected receptors are not able to adapt to changes or proceed with previous livelihood
Positive	There will be a beneficial impact to a resource/receptor	There will be a beneficial impact to a resource/receptor

Mitigation and Enhancement

A key component of the ESIA process is to identify practical ways to avoid, reduce, or mitigate the potentially significant impacts identified during the study. These are referred to as mitigation measures and are incorporated into the Project as commitments. The objective of mitigation is to prevent, minimize, or manage significant negative impacts to as low as reasonably practicable, and to optimize and maximize any potential benefits or opportunities of the Project, where applicable.

A hierarchy of mitigation options is considered, with the preferred approach being to avoid the impact at source. The least desirable option is to provide compensation or an offset for residual impacts that cannot be reasonably avoided.

Embedded controls (i.e., physical or procedural controls that are planned as part of the Project design were considered as part of the Project (i.e., prior to the impact assessment stage of the ESIA process) as avoidance measures.

All mitigation measures outlined in the ESIA are summarized in an Environmental and Social Management Plan (ESMP) for the Project, which provides an overview of how these measures will be implemented during the construction and operation stages.

Residual Impact Assessment

Following the identification of potential E&S impacts, their significance is assessed, taking into account the proposed mitigation measures already incorporated into the Project design and, where appropriate, any additional mitigation measures that are considered feasible and justified.

Mitigation measures are applied to reduce impacts to as low as reasonably practicable; however, some impacts may not be eliminated entirely. These remaining impacts are referred to as residual impacts. One objective of the ESIA is to assess the significance of these residual impacts, which will remain after mitigation measures have been incorporated into the Project, and to determine the appropriate monitoring and measurement actions.

5.6 Management and Monitoring

At the final stage of the impact assessment process, basic management and monitoring measures are defined to determine whether: a) residual impacts or their associated Project components remain in conformance with applicable standards; and b) mitigation measures are effectively addressing impacts, and compensatory measures and offsets are reducing effects to the extent predicted.

5.7 Stakeholder Engagement and Public Consultations

International best practices for the implementation of an ESIA, along with the requirements of the EBRD, provide the basis for conducting active consultations with competent supervisory agencies, experts, affected local communities, and other stakeholders. These consultations aim to understand their views on the Project and its impacts, and to incorporate these perspectives into the prediction and evaluation of impacts, as well as the corresponding mitigation measures. Consultation is also valuable for identifying data and information within the studied area.

As part of this ESIA package, a Stakeholder Engagement Plan (SEP) has been developed, including a grievance mechanism, to serve as a structured and systematic approach for stakeholder engagement throughout all stages of Project implementation.

A series of public consultations will be held during the 120-day public disclosure period for the ESIA report and its supporting documents. Three consultation events are planned within this period: two will be conducted in the municipalities of Ashtarak and Khoy, respectively, and one in Yerevan city. These events will involve the participation of relevant state authorities, non-governmental organizations (NGOs), and other project stakeholders.

The public consultations will be conducted in a transparent and inclusive manner, ensuring meaningful stakeholder engagement. Their purpose is to inform the public and relevant stakeholders about the proposed Project, its potential environmental and social impacts, and the proposed mitigation measures. The consultations also aim to collect feedback, concerns, and suggestions from affected communities, government institutions, NGOs, and other interested parties to strengthen the ESIA process and support informed decision-making.

6. Environmental and Social Baseline

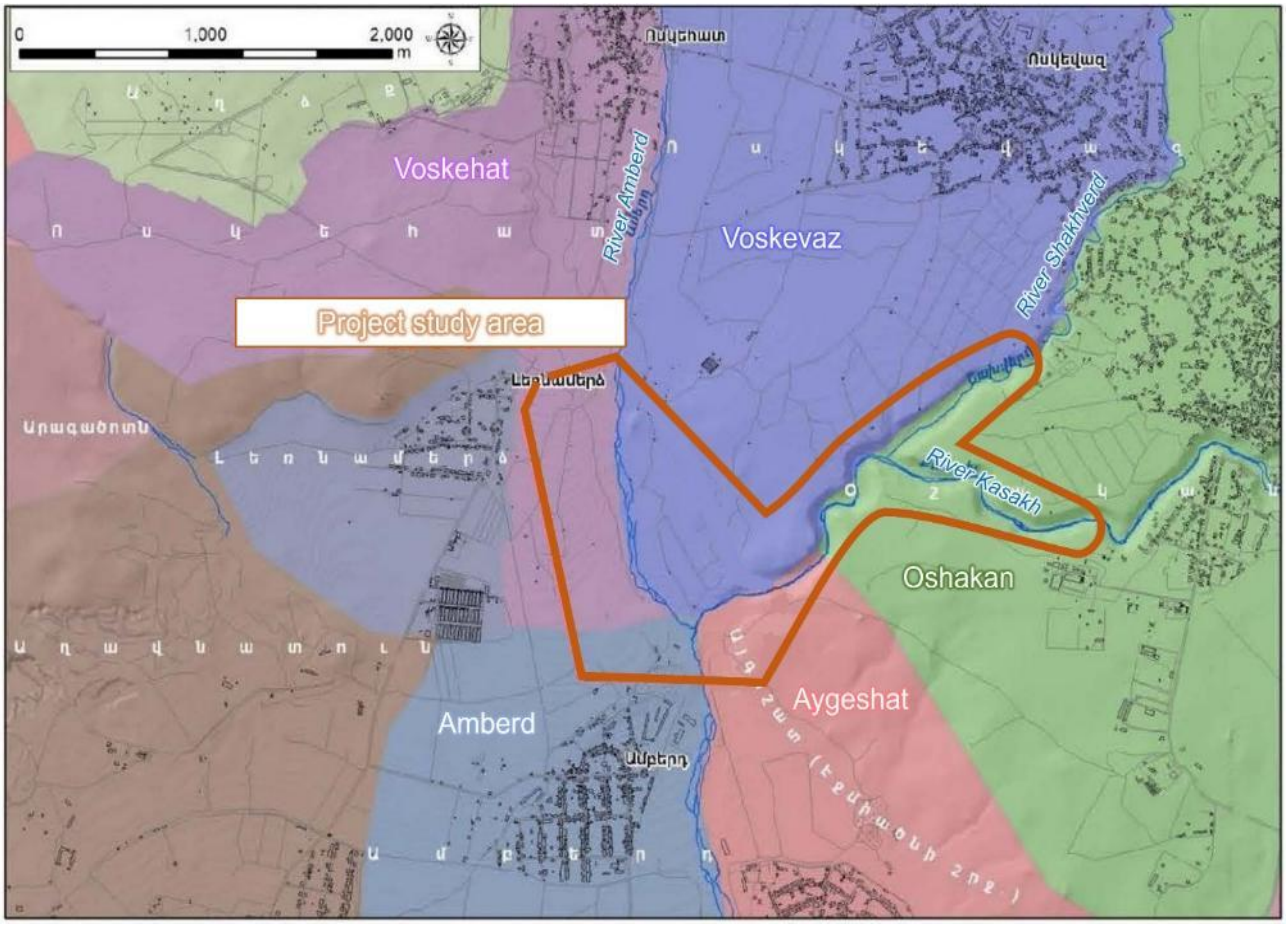
6.1 Physical Environment

6.1.1 Geography

The Kasakh Reservoir is planned to be constructed within the administrative boundaries of the villages of Voskehat, Voskevaz, and Oshakan (Ashtarak community, Aragatsotn Marz), as well as Amberd and Aygeshat (Khoy community, Armavir Marz), at the confluence of the Kasakh and Amberd rivers (**Figure 6-1**). The proposed site lies at an elevation of 950-980 masl and is primarily composed of community and privately owned agricultural lands, including pastures and arable fields.

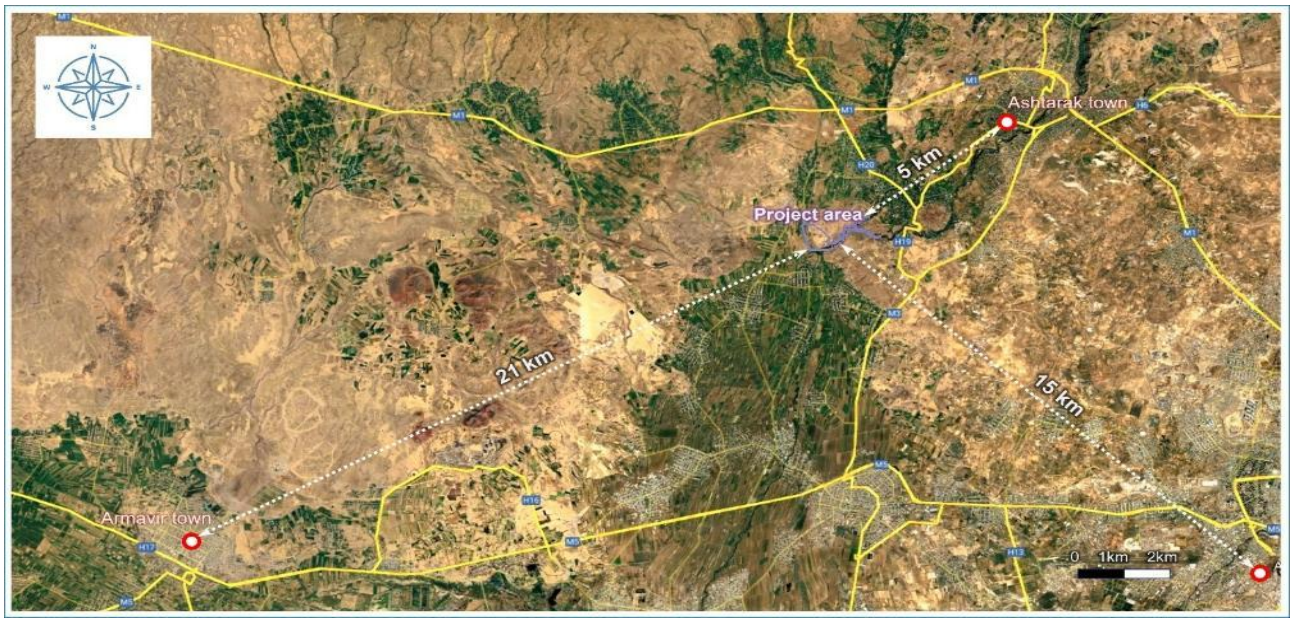
The reservoir site is located approximately 15 km northwest of Yerevan, the capital of Armenia. It lies about 5 km from Ashtarak, the administrative center of Aragatsotn Marz, and 21 km from Armavir, the administrative center of Armavir Marz (**Figure 6-2**). The distance from the Project site to the northern border of Turkey is approximately 23 km. Mount Aragats is located about 26 km to the north.

Figure 6-1. Situational Plan of the Project region



Water for the planned reservoir will be supplied by the Amberd River from the north and the Kasakh River from the east. Water from the reservoir will feed the Hrazdan Down Channel, which provides irrigation water to 21 settlements located downstream in Armavir Marz. These include Amberd, Leramerdz, Aragats, Aghavnatun, Ferik, Tsaghkalanj, Arshaluys, Aknalich, Haytagh, Geghakert, Hovtamej, Tsiatsan, Doghs, Tsaghkunq, Aygeshat, Mrgastan, Shahumyan, Echmiadzin, Artimet, Khoronk, and Griboyedov (see **Figure 2-1**).

Figure 6-2. Location of the Project in relation to the regional centers of Armavir and Aragatsotn Marzes



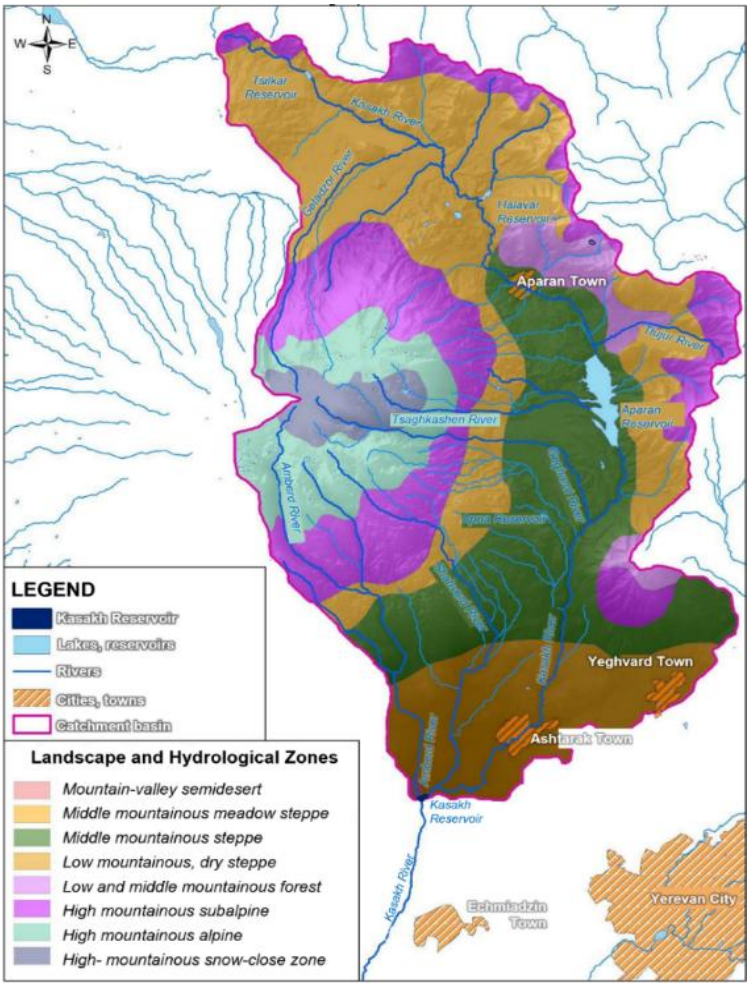
6.1.2 Relief, Landscape and Visual Amenity

The landscape zones of the Kasakh River basin are illustrated in **Figure 6-3**.

The highest point of the river basin is Mount Aragats at 4,090 masl, where the Amberd River originates, while the lowest point is at 830 masl. As a result, the following natural landscape zones can be found in the Kasakh River basin:

- Mountain-valley semi-desert, up to 1,000 masl. *The reservoir will be situated in this landscape zone*,
- Low mountainous, dry steppe. From 1,000 to 1,500-1,600 masl,
- Low and middle mountain forest. From 800 to 2,100-2,300 masl,
- Middle mountainous steppe. From 1,400 to 2,200-2,300 masl,
- Middle mountainous meadow steppe. From 2,200-2600 masl,
- High mountainous subalpine. From 2,400-2,800 masl,
- High mountainous alpine. From 2,800-3,400 masl,
- High-mountainous snow-close zone. 3,300-3,400 masl and high.

Figure 6-3. The landscape zones of the Kasakh River basin



The relief of the Project area is a combination of flat and hilly terrain, featuring valleys and canyons intersected by the rivers' network. It generally slopes toward the south. According to morphological classification, the area can be categorized as a weakly fragmented type.

Based on absolute elevation data, the surface elevations of the Project area range between 950 and 980 masl. The main water bodies are the Kasakh, Shakhverd, and Amberd Rivers, which converge within the reservoir area. These rivers are primarily fed by atmospheric precipitation and snowmelt.

From a geomorphological perspective, the Project area lies within the transitional zone between the southern slopes of the Aragats volcanic massif and the Ararat concavity.

The aerial view of some sections of the reservoir area is presented in **Figure 6-4**.

Figure 6-4. Aerial view of the Project site's different sections

*Area where the Shakhverd River joins the Kasakh River (see the eastern part of the reservoir contour in **Figure 6-1**)*

Area where the reservoir dam is to be constructed

Eight habitats are defined according to the classification for Armenia, developed on the basis of the EUNIS classification (see **Section 6.2.4**).

6.1.3 Geology and Hydrogeology

The engineering-geological survey was carried out by "Georisk" CJSC and consisted of both desktop and field investigation stages[72]. During the desktop study, available archival and literature-based engineering-geological data related to the project area were collected and analysed.

The Project region is primarily composed of Neogene to Lower-Middle and Upper Quaternary volcanic rocks, including basaltic andesites, trachytes, andesites, and dacitic tuffs. These are overlain by modern man-made and natural eluvial, deluvial, and alluvial-proluvial deposits consisting of clay, sand, gravel, and pebble-rich layers.

The geological section of the region is presented in stratigraphic order from bottom to top (**Figure 6-5**).

Quaternary formations $\beta\alpha,\beta\tau\alpha,\alpha,\tau\alpha Q_1$. These are represented by Lower Quaternary basaltic andesites, andesites, and trachyandesites, overlain by Middle Quaternary dacitic tuffs and friable deposits.

[72]Preparation of design and cost estimation documents for construction of Kasakh reservoir in Armavir Marz of the Republic of Armenia, Book 2 - Engineering geological surveys, 2024

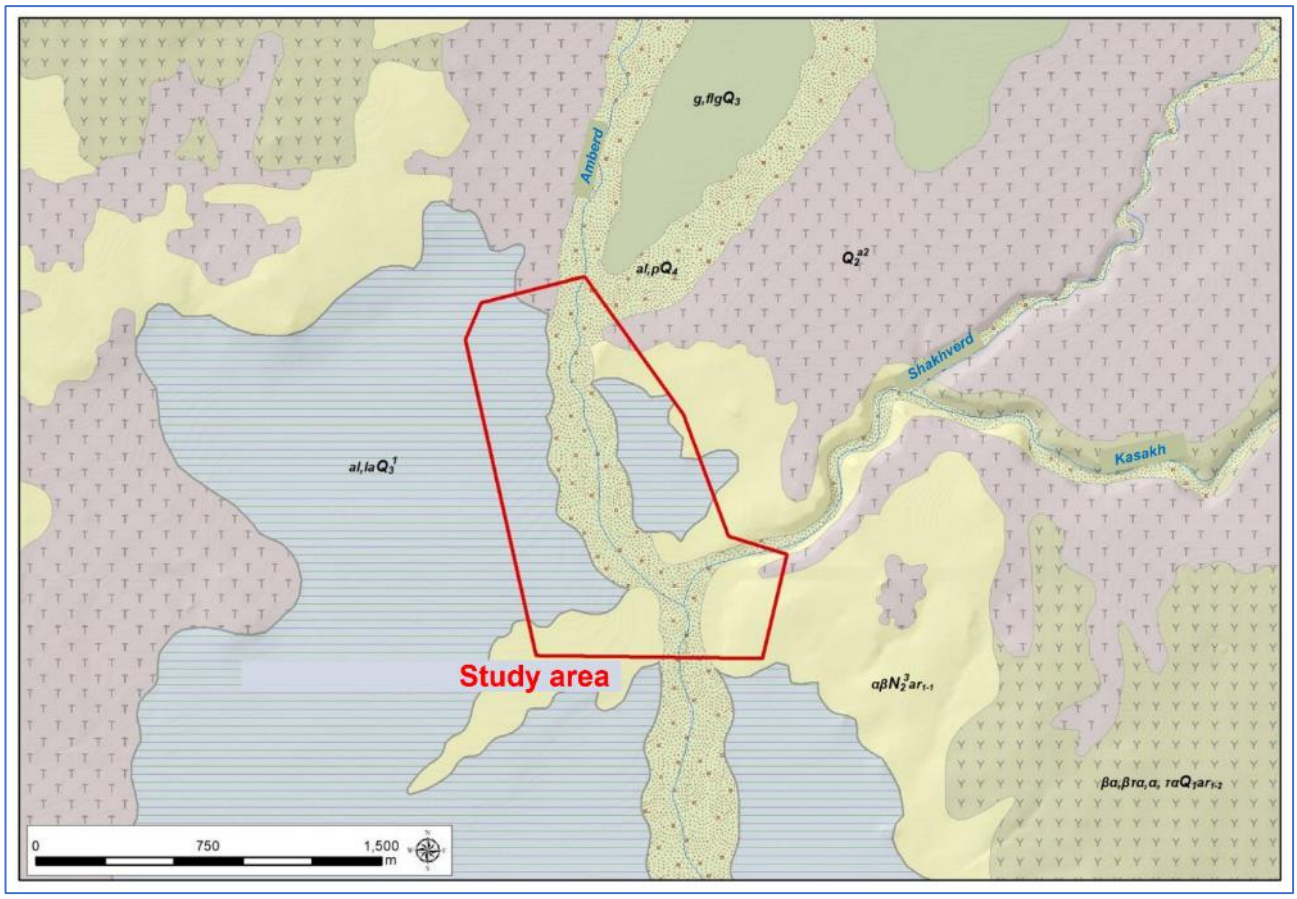
Quaternary formations Q_2. Represented by Middle Quaternary dark brown tuffs forming the upper crust.

Quaternary formations $g,flgQ_3$. Represented by Upper Quaternary pebble-gravel formations, observed at the northern edge of the Project area.

Modern formations al,la,pQ_{3-4}. These consist of Upper Quaternary to modern eluvial-deluvial and alluvial-proluvial deposits, including crushed stone, crushed stone-sand mixtures, pebble-gravel formations, clay, sand, and loamy fill materials. These deposits are widely distributed across the surface of the Project area.

Coarse boulder-pebble sediments, with a maximum thickness of up to 400 m, were previously encountered in boreholes near the villages of Agarak and Parni, at depths of 375-500 m and 215-550 m, respectively. The coarse boulders and pebbles are primarily composed of Eocene and Miocene effusive rocks and are weakly cemented by a reddish, grey or yellowish sand-clay matrix.

Figure 6-5. Geological map of the Project region



Field investigations were carried out in 2023. A total of 14 wells and 4 pits were drilled, with depths ranging from 5.4 m to 47.0 m. Soil sampling was conducted, including both disturbed and undisturbed samples, along with laboratory testing to determine the physical and mechanical properties of the soils. Additionally, experimental pumping tests were performed on selected wells. The map of field engineering-geological survey is presented in **Figure 6-6**.

Hydrogeological conditions

During the field investigations, the upper horizon of groundwater was recorded in wells BH-01, 02, 04, 09, and 13-18, at depths ranging from 1.2 to 3.6 m.

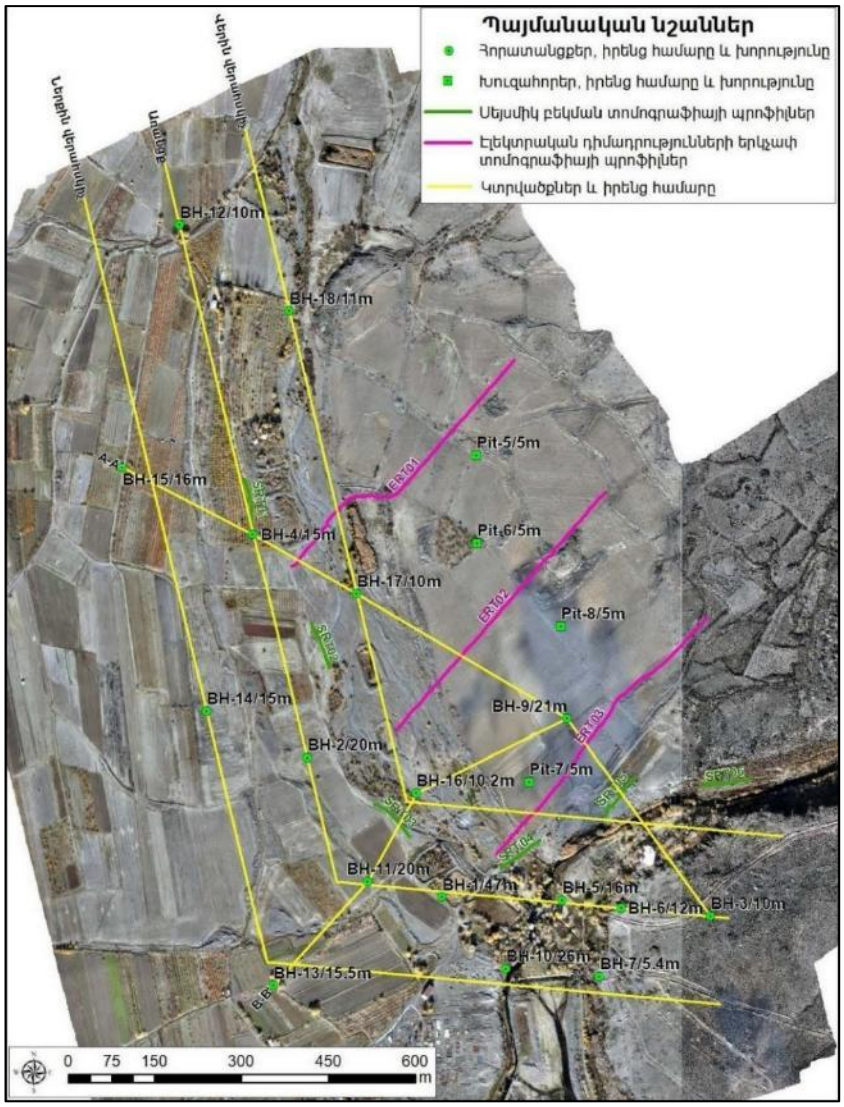
Atmospheric precipitation and the waters of the Kasakh, Shakhverd, and Amberd rivers, infiltrating through loose debris and gravelly formations, contribute to the formation of an intersurface water horizon. Most of the main groundwater accumulates above the regional aquifer, which is composed of clayey rocks from the Upper Miocene (Sarmatian stage). Based on their occurrence, recharge, and discharge conditions, this groundwater is classified as local groundwater.

According to archival data, the depth of the regional groundwater horizon exceeds 50 m.

Special soils

The special soils in the Project area include artificially filled soils and volcanic sands. Within the area of the proposed reservoir, these soils occur in limited distribution as lenses, with thicknesses ranging from 0.3 to 1.7 meters. Additionally, large-fragment soils, characterized by a high filtration coefficient, are also considered special soils. They are similarly limited in distribution, with a thickness of up to 2.0 m.

Figure 6-6. Map of field engineering-geological survey



The results of the engineering-geological survey conducted within the project area and its vicinity are summarized below:

1) The geological profile of the study area consists of Neogene-Quaternary volcanic rocks, including basaltic andesites, andesites, and dacitic tuffs. These are overlain by modern

natural and anthropogenic deposits, including eluvial, diluvial, and alluvial-proluvial formations composed of clay, sand, gravel, and gravel-pebble mixtures.

2) The upper horizon of groundwater was recorded in the following wells: BH-01, 02, 04, 09, and 13-18, at depths ranging from 1.2 to 3.6 m. According to archival data and geophysical materials, the main groundwater horizon is located at a depth greater than 50 m.
3) The results of field measurements of soil infiltration properties indicate that the permeability coefficients correspond to soils with both low and high-water permeability (see **Section 2.5**).
4) Six Geotechnical Elements (GTE) were identified in the study area:
   - GTE-1. Backfill soil and topsoil,
   - GTE-2. Pebble-gravel soil, gravel, river stones, sand, and sandy loam fill (15-40%),
   - GTE-3. Sandy loam, brownish, slightly moist, with gravel inclusions,
   - GTE-4. Gravelly sand and coarse soil with sand and sandy loam fill (30-40%),
   - GTE-5. Dense and porous basalt, medium to highly fractured,
   - GTE-6. Dacitic tuff, dark brown, dense, moderately fractured.
5) In terms of geological processes and phenomena, the engineering-geological conditions of the site are favourable; no landslide or mudflow activity has been observed.

6.1.4 Tectonics, Seismic Stability and Landslides

As per the RA CN 20.04 "Earthquake-resistant construction, Design norms"[73], Armenia is divided into 1st, 2nd and 3rd seismic zones, with the last the most seismically hazardous. The magnitudes of expected ground horizontal accelerations per seismic zones are:

Seismic zones	1st	2nd	3rd
Ground horizontal accelerations magnitudes a, cm/sec^2	300	400	500

The Project site (Kasakh settlement) is located in Seismic Zone 1 (**Figure 6-7**), where the expected seismic hazard is estimated at Amax = 0.3g. Thus, the Project is not situated within the highest seismic hazard zones of Armenia.

The Probabilistic Seismic Hazard Assessment (PSHA) was performed for the planned Kasakh Reservoir dam platform by the "Territorial Service of Seismic Protection" SNCO, Armenian Association of Seismology and Geophysics and "Terraform" LLC[74]. The R-CRISIS software was used for the PSHA, allowing consideration of input data uncertainties through the logic tree approach. Two seismotectonic models were used for the calculations.

To conduct the hazard assessment, R-CRISIS software was used. This software complies with all the requirements of the Probabilistic Seismic Hazard Assessment (PSHA) methodology, including 3D representation of earthquake sources, the use of alternative models for seismic wave attenuation, and the evaluation of uncertainties in input parameters.

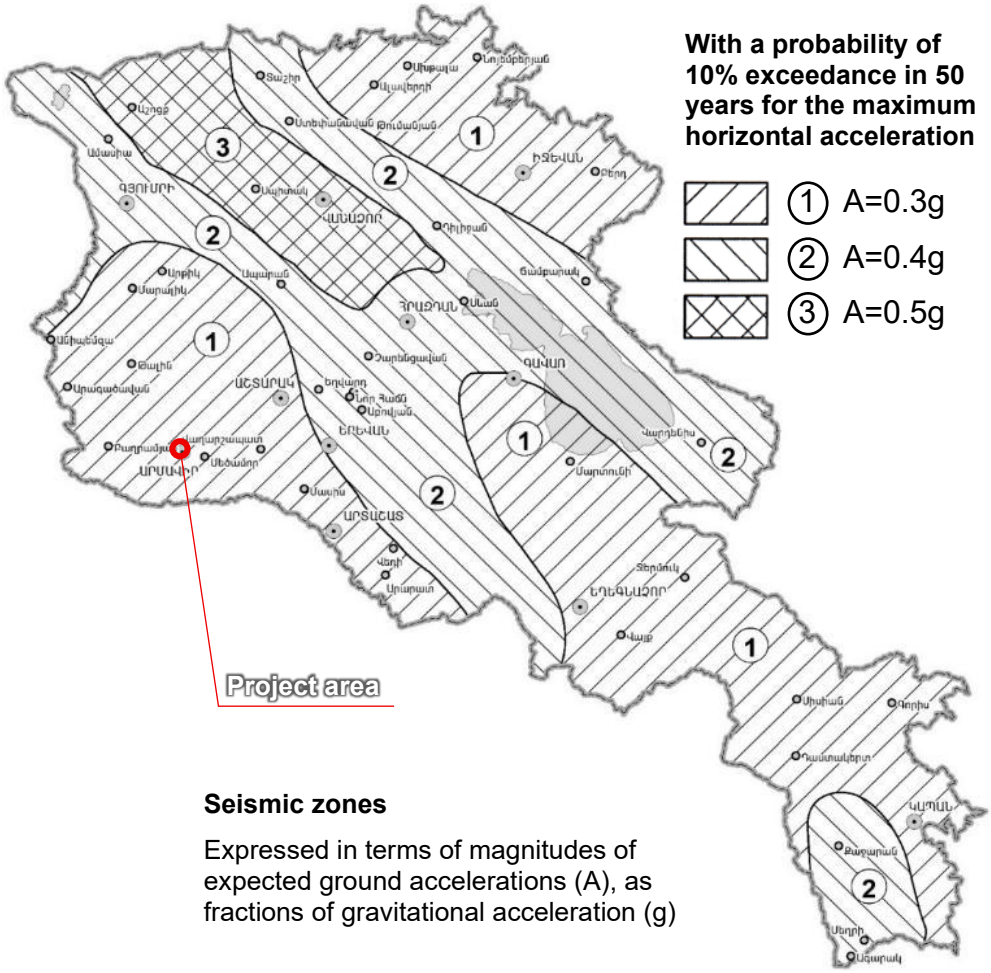
Two seismotectonic models were used in the calculations. The first includes both area and fault source zones within a 150 km radius of the reservoir. The second model includes only area source zones.

The PSHA was conducted for the Kasakh reservoir dam area (at coordinates 40.25°N and 44.27°E) using a shear wave velocity of Vs30 = 760 m/sec. According to the RA CN 20.04 *"Earthquake-*

[73] https://www.arlis.am/documentview.aspx?docid=172012
[74] Report on the Probabilistic Assessment of Seismic Hazard of the designed Kasakh Reservoir Dam Site, 2023

Resistant Construction: Design Norms", the dam is classified as a Category 2 structure. PSHA calculations were performed for annual probabilities of exceedance of 2.11×10^{-3} and 1.0×10^{-4}, corresponding to return periods of 475 and 10,000 years, respectively.

Figure 6-7. Map of zoning of probable seismic risks in the RA territory



The most significant seismic risk for the Kasakh reservoir is associated with the Yerevan Fault (YeF). Based on this, the risk posed by the Maximum Credible Earthquake (MCE) was estimated at 0.35g. This value is lower than the one obtained from the probabilistic method for a 10,000-year return period, which is 0.38g. The vertical ground acceleration is expected to be two-thirds of the horizontal component, equalling approximately 0.25g. The results of the deterministic and probabilistic assessments of peak ground acceleration are presented in **Table 6-1**.

Table 6-1. Deterministic and probabilistic assessment of maximum horizontal acceleration values

Risk determination methods	Dam	Average value (g)	84%
Deterministic	Kasakh	0.29	0.35
Probabilistic: return period of 475 years (Operating Basis Earthquake, OBE)	Kasakh	0.13	0.14
Probabilistic: return period of 10,000 years (Safety Evaluation Earthquake, SEE)	Kasakh	0.38	0.44

Taking into consideration the abovementioned stipulations of the ICOLD guidelines, it is recommended that the Peak Ground Acceleration (PGA) value corresponding to a 10,000-year

return period obtained from the probabilistic approach be used as the Maximum Credible Earthquake (MCE) seismic impact value for assessing dam safety. For the Kasakh Dam, this value is 0.38g.

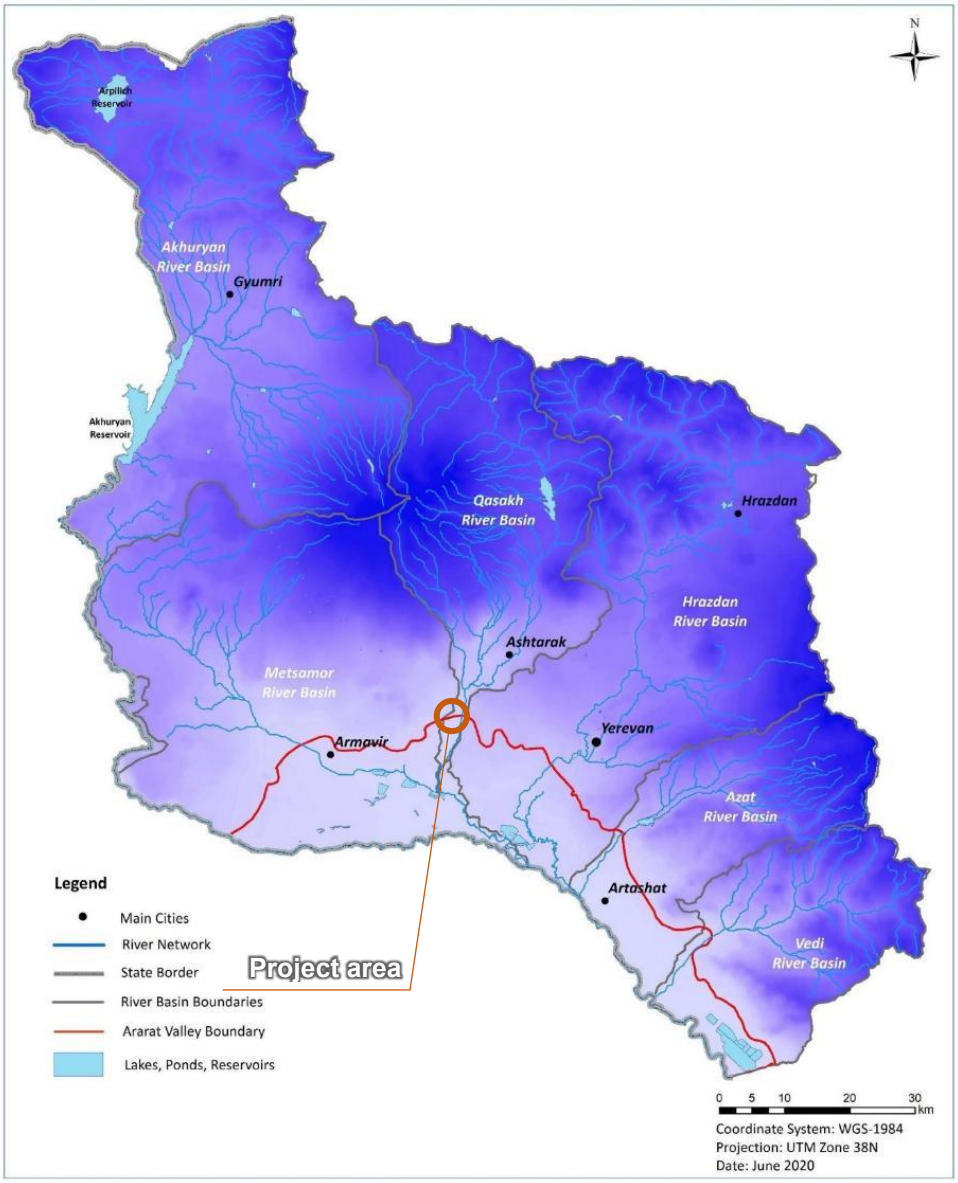
In terms of geological processes and phenomena, the engineering-geological conditions of the site are favourable; no landslide or mudflow activity has been observed (**Section 6.1.3**).

6.1.5 Hydrology (surface and groundwater resources)

Surface water

There are two surface watercourses that contribute to streamflow in the Project area: the Kasakh River and its tributary Amberd River. The Kasakh River is considered the main watercourse in the region, as it receives flow from all surrounding rivers that form the Kasakh River basin (**Figure 6-8**). The Amberd River is the most downstream tributary that joins the Kasakh River in the area designated for the construction of the Kasakh Reservoir. Approximately 21 km south of the reservoir site, the Kasakh River, together with flows from the Sevjur River, forms the Metsamor River that is a tributary of transboundary Araks River.

Figure 6-8. Map of river basins of the Northwestern part of Armenia



Source: Website of Hydrometeorology and Monitoring Centre

The Kasakh River flows from north to south through the west-central part of Armenia. It originates near Mount Aragats in Aragatsotn Marz, flows south into Armavir Marz, and eventually joins the Metsamor River, a tributary of the Araks River. The Araks River is considered transboundary, as it forms the border between Armenia and Turkey in the southwest, and between Armenia and Iran in the south. Therefore, it could potentially be affected by the operation of the Kasakh Reservoir (see **Sub-section 8.2.1**).

The Kasakh River's catchment basin extends up to 36 km from east to west and 73 km from north to south. The river itself is 89 km long, with a catchment area of 1,480 km^2.

The Kasakh River also provides water to the Aparan Reservoir, located approximately 26 km upstream the Kasakh Reservoir site. Between the operating Aparan Reservoir and the planned Kasakh Reservoir, the following rivers flow into the Kasakh River[75]:

- Gegharot River,
- Shakhverd River,
- Amberd River.

The Gegharot is a river in the Aragatsotn Marz and a right tributary of the Kasakh River. It originates on the eastern slope of Mount Aragats at an altitude of 3,600 masl and merges with the Kasakh River about 1 km southeast of Apnagyugh settlement. The river is 25 km long, with a catchment area of 66 km².

The Shakhvard is a river in the Aragatsotn Marz of Armenia. It begins on the southeastern slopes of Mount Aragats near the village of Voskevaz, then flows through the villages of Parpi and Bazmaghbyur, eventually joining the Kasakh River from the southwest. The river is 28 km long, and its waters are used for irrigation.

The Amberd River, the most downstream tributary of the Kasakh River, originates on the southern slope of Mount Aragats at an altitude of 3,700 masl. The river is 36 km long, with a catchment area of 141 km². Its valley is V-shaped in the upper reaches and becomes deep and S-shaped in the middle and lower reaches. The river has a mixed water supply, primarily from snowmelt and groundwater, with flooding typically occurring in late spring and early summer. The average annual flow is 1.05 m³/sec.

The RA Government Decree №75-N specifies the classification (categories) and environmental norms for surface water bodies (rivers). According to that Decree five water quality categories are defined for the river basins of Armenia: Class 1 - Excellent, Class 2 - Good, Class 3 - Fair, Class 4 - Poor, and Class 5 - Bad. The rivers within the Project area belong to the Kasakh River basin. Therefore, the environmental norms established by RA Government Decree № 75-N for the Kasakh River basin were applied to assess water quality in the streams located within the Project area.

Two samples were taken from the Kasakh River in April 2025: Sample N1 (upstream, before the reservoir site) and Sample N2 (downstream, after the reservoir site). The samples were analysed at the accredited laboratory of the "Hydrometeorology and Monitoring Centre" SNCO. The results of the water quality analysis and the corresponding water quality categories determined based on the analysed parameters are summarized in **Table 6-2**.

[75]EU4Environment, Quantitative water management planning pilot experience in Kasakh River basin, Armenia, 2024

Table 6-2. Results of water quality analysis and water quality categories

№	Analysed indicators	Unit	N1		N2	
			Result of analysis	Category	Result of analysis	Category
1	Colour	rank	20	2	20	2
2	Transparency	cm	31	*	31	*
3	Suspended solids	mg/l	57.2	3	59.8	3
4	pH (Hydrogen index)	-	8.19	1	8.18	1
5	Mineralization	mg/l	249	*	250	*
6	El. conductivity	μs/cm	383	2	384	2
7	Alkalinity	mg/l	143. 8	*	151. 3	*
8	COD (Chemical Oxygen Demand)	mgO/l	15	2	15	2
9	Fluoride ion	mg/l	0.281	*	0.304	*
10	Sulphate ion	mg/l	13.715	1	13.874	1
11	Chloride ion	mg/l	26.647	2	27.170	2
12	Nitrate ion	mg/l	7.163	4	7.261	4
13	Nitrite ion	mg/l	<0.013	2	<0.013	2
14	Ammonium ion	mg/l	0.137	2	0.0977	2
15	Total inorganic nitrogen	mgN/l	1.724	2	1.715	2

*the environmental norm for this water quality indicator has not been specified

The results of the chemical analyses of water samples taken from the Kasakh River indicate that the water quality mostly complies with the criteria for Class 1 (Excellent) and Class 2 (Good), with the exception of suspended solids and nitrate ions concentrations, which fall under Class 3 (Fair) and Class 4 (Poor) accordingly.

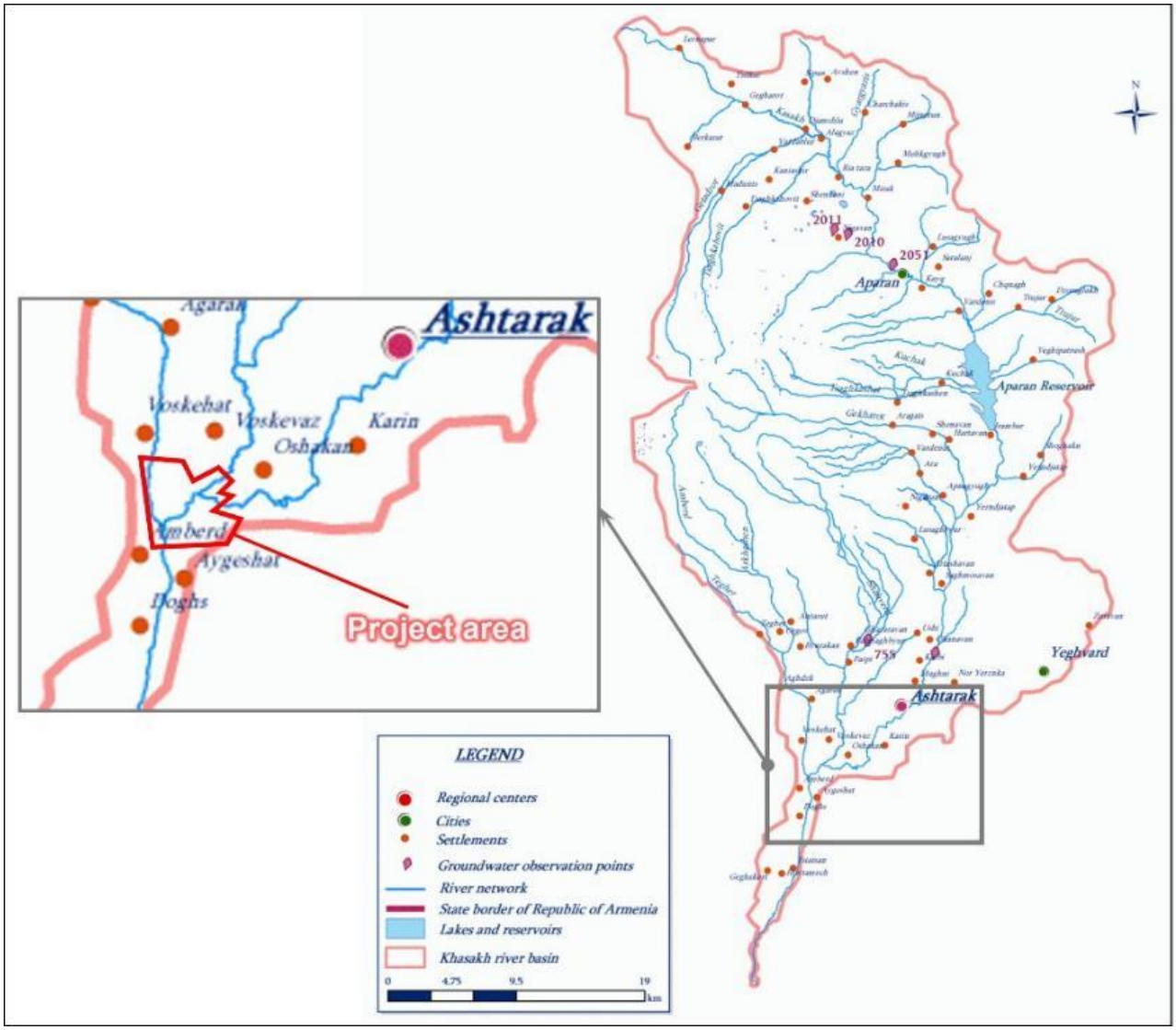
Groundwater Resources

According to the map of the underground freshwater monitoring network of the Kasakh River basin, there are no groundwater monitoring springs or wells in the vicinity of the Project area (**Figure 6-9**). The nearest groundwater monitoring (observation) point is located approximately 7.5 km north to the planned reservoir site, near Ghazaravan settlement (observation point 755).

The Hydrometeorology and Monitoring Centre under the Ministry of Environment (ME), as the state environmental monitoring body, conducts regular groundwater monitoring in Armenia. According to the *Report on Monitoring of the National Groundwater Network of the Republic of Armenia for 2023 and 2024*[76], the flow rate at observation point 755 remained stable and consistent throughout 2023 and 2024, maintaining a rate of 2.9 l/sec.

[76] https://armmonitoring.am/public/admin/ckfinder/userfiles/files/hydro/M_G_W_2024.pdf

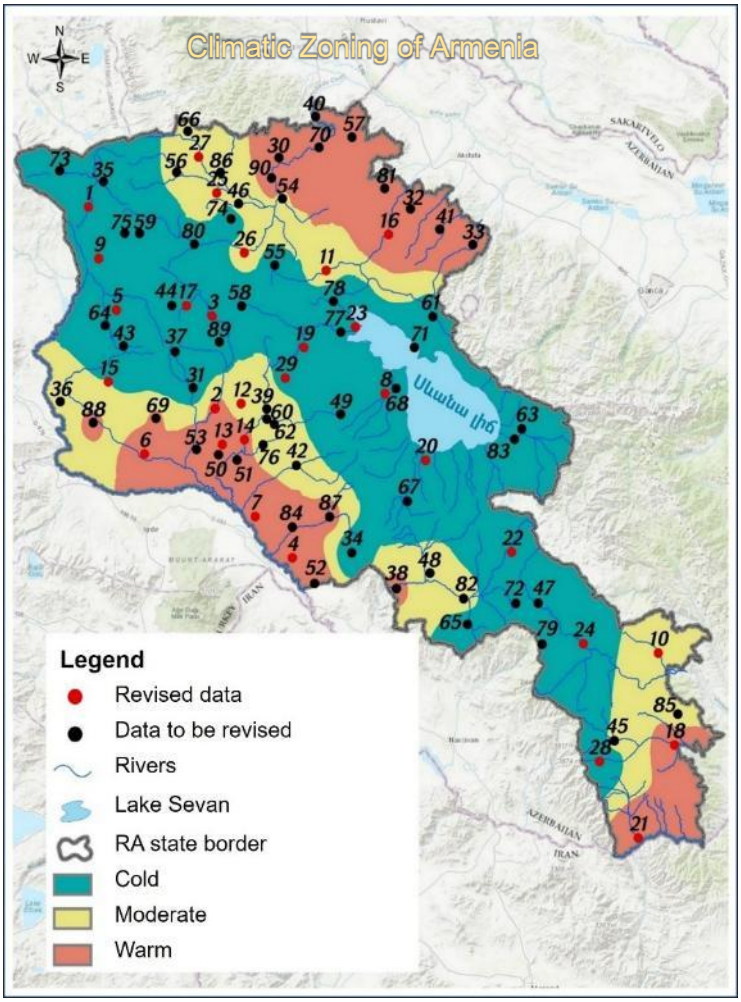
Figure 6-9. Map of underground freshwater monitoring network of the Kasakh River basin



Source: Website of Hydrometeorology and Monitoring Centre

6.1.6 Climate and Meteorology

According to the RA Construction Norms CN 22-01-2024 "Construction Climatology"[77] the Project site (located between points №2 and №53) is situated within the warm climatic zone (see the map of climatic zoning of Armenia to the right).



The nearest meteorological station is located in Ashtarak community, approximately 5 km north of the Project site. Based on data from the Ashtarak meteorological station, the average annual air temperature in the Project region is 11.9°C, with an average of -3.2°C in January and 25.2°C in July-August. The absolute minimum temperature of -24.5°C was recorded in January, while the absolute maximum of 41.2°C was observed in July.

The average annual relative humidity is 65%, and total annual precipitation amounts to 377 mm. The highest rainfall occurs in April-May, contributing up to 114 mm. The average number of days with snow cover per year is 48, while the maximum recorded soil freezing depth is 70 mm.

The average temperature, relative humidity, precipitation, wind velocity in different directions and snow cover data observed at the 'Ashtarak' meteorological station, derived from CN 22-01-2024 "Construction Climatology", are summarized in **Tables 6-3** to **6-7**, respectively.

Table 6-3. Average air temperature

Meteorological station	Average temperature by month, °C												Average annual, °C	Absolute minimum, °C	Absolute maximum, °C
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII			
Ashtarak	-3.2	-0.1	5.8	11.7	16.5	21.5	25.2	25.2	20.5	13.6	6.2	-0.2	11.9	-24.5	41.2

[77] https://www.arlis.am/DocumentView.aspx?DocID=188846

Table 6-4. Relative humidity

Meteorological station	Air relative humidity by month, %												Average annual	Humidity of the coldest month, %		Humidity of the hottest month, %	
														Average monthly	Average monthly at 3 p.m.	Average monthly	Average monthly at 3 p.m.
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII					
Ashtarak	79	71	64	64	64	57	54	54	57	66	72	80	65	79	72	54	44

Table 6-5. Precipitation

Meteoro-logical station	Amount of precipitation by month, mm average monthly daily maximum												Yearly	November-March, mm	April-October, mm
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII			
Ashtarak	27	30	36	55	59	33	20	11	13	34	29	30	377	152	225
	24	24	28	39	45	30	45	22	32	43	40	22	45		

Table 6-6. Snow cover

Meteoro-logical station	Snow cover			
	Maximum ten-day height	The number of days with snow cover in a year	Maximum amount of water in snow, mm	Maximum depth of soil freezing, mm
Ashtarak	55	48	198	70

Table 6-7. Wind

Monitoring station	Months	Repeatability, % Average velocity, m/s, in directions								Tranquility repeatability, %	Average monthly velocity, m/s	Prevailing direction in June-August	Minimum average velocity among the directions in July, m/s	The prevailing direction in December-February	Minimum average velocity among the directions in January, m/s
		Northern	North-Eastern	Eastern	South-Eastern	Eastern	South-Western	Western	North-Western						
Ashtarak	January	4	21	22	11	16	12	10	4	-	2.0	Eastern	3.3	Eastern	2.2
		1.6	2.0	2.2	2.3	2.0	1.8	2.0	2.1						
	April	4	18	23	12	15	13	11	4	-	2.7				
		3.7	2.8	2.6	2.8	2.8	2.7	2.9	2.8						
	July	4	26	23	11	12	11	9	4	-	3.2				
		4.4	3.5	3.3	3.2	3.2	2.6	2.7	3.2						
	October	4	24	26	12	13	10	9	2	-	2.2				
		1.7	2.1	2.3	2.4	2.3	2.1	2.1	2.2						

6.1.7 Climate Risk Profile

Background

According to the Armenia's Fourth National Communication on Climate Change (2020)[78] over the past decades a significant increase in temperature has been observed in Armenia. Particularly, over

[78] https://unfccc.int/sites/default/files/resource/NC4_Armenia_.pdf

the period of 1929-1996, the annual mean temperature increased by 0.4°C, during 1929-2007 - by 0.85°C, during 1929-2012 - by 1.03°C, and during 1929-2016 - by 1.23°C. The ambient air temperature change has had different trends in different seasons. During the period of 1966-2016, the average summer temperature increased by about 1.3°C; moreover, over the last century, extremely hot summers were observed in Armenia within the last 20 years.

During the period of 1935-1996, the average annual precipitation decreased by 6% and in 1935-2016 - by about 9%. The spatial distribution of precipitation is quite irregular. During the period of 1935-2016 the climate in the north, south and central regions of the country has become more arid, while precipitations have increased in the Shirak plain, in the Lake Sevan basin and in Aparan-Hrazdan regions.

The frequency and intensity of natural disasters has increased significantly. Over the period of 1975-2016, the total number of observed hazardous phenomena increased by about 40 cases, as compared to the average of 1961-1990 (168 cases). The highest number of hailstorms was observed in the Shirak plain, the maximum number of cases with heavy rainfall occurred in Tashir and Ijevan regions, and frosts - in the Ararat valley and foothill regions. According to drought indices, the number of days with strong and very strong droughts during the period of 2000-2017 increased by 33 days, as compared to the 1961-1990 average (87). In recent years, the upper boundary of the drought zone has expanded and includes mountainous areas, with an earlier timed start of drought.

Climate change scenarios for Armenia

The results of the CCSM4[79] Global Climate Model used and reported in the NC3[80] were reviewed for the projection of changes in air temperature and atmospheric precipitation, as well as high resolution METRAS (12×12 km) regional climate model was applied.

The average annual temperature across the territory of Armenia is projected to increase by up to 1.6°C by 2040, by 3.3°C - by 2070 and by 4.7°C - by 2100, relative to the baseline annual average (5.5°C) for 1961-1990. As for atmospheric precipitations, these are projected to decline by up to 2.7% by 2040, 5.4% - by 2070 and 8.3% - by 2100, relative to the baseline annual average (592 mm) for 1961-1990.

The projected climate change is expected to have negative effects on the country's water resources, energy, agriculture, ecosystems, human health, settlements and infra structures, as well as a number of other climate-sensitive sectors, including tourism.

Water resources

River flow. Analysis of water resources vulnerability in Armenia was carried out using the CCSM4 model data with the emission scenarios of RCP8.5[81] and RCP6.0, as well as the METRAS model with the RCP8.5 scenario. The vulnerability of the river flow to climate change varies across different river basins, due to the differences in natural and climatic conditions of the basins, and the various factors that impact on the flow formation. The vulnerability of the annual river flow assessed with the above-mentioned climate models and scenarios for 2040, 2070 and 2100 are summarized in **Table 6-8**.

Table 6-8. Vulnerability of the river flow to climate change in Armenia

Scenario	Time period	River flow studied, mln. m^3	Change in flow	
			mln. m^3	%
CCSM4	1961-1990	6,279.9	0	0

[79]CCSM4 - Community Climate System Model, version 4
[80]NC3 - Third National Communication
[81]RCP - Representative Concentration Pathway

Scenario	Time period	River flow studied, mln. m^3	Change in flow	
			mln. m^3	%
RCP6.0	2011-2040	5,760.4	-519.5	-8.27
	2041-2070	5,450.5	-829.4	-13.2
	2071-2100	5,037.9	-1,242.0	-19.8
CCSM4 RCP8.5	2011-2040	5,513.5	-766.4	-12.2
	2041-2070	5,148.2	-1,131.7	-18.0
	2071-2100	4,165.1	-2,114.8	-33.7
METRAS RCP8.5	2011-2040	5,433.4	-846.5	-13.5
	2041-2070	4,547.9	-1,732.0	-27.6
	2071-2100	3,832.0	-2,447.9	-39.0

Lake Sevan. The assessment of the water balance of Lake Sevan under the predicted climate change scenarios was implemented through a multifactor correlation analysis of the annual inflow into the Lake and multi annual observation data of atmospheric precipitation and air temperature at the meteorological stations of the basin. Based on the RCP8.5 and RCP6.0 emission scenarios used with the CCSM4 climate model and the RCP8.5 scenario used with the METRAS model, changes in the river inflow into the Lake Sevan for 2040, 2070 and 2100 were projected (**Table 6-9**).

Table 6-9. Projection of the Lake Sevan water balance elements

Scenario	Time period	River flow, mln. m^3	Precipitation, mln. m^3	Evaporation, mln. m^3
CCSM4 RCP6.0	1961-1990	783.8	503.9	1074.5
	2011-2040	712.6	519.0	1194.9
	2041-2070	681.6	513.9	1246.2
	2071-2100	646.4	524.0	1316.9
CCSM4 RCP8.5	2011-2040	693.7	508.9	1203.3
	2041-2070	648.0	529.1	1326.0
	2071-2100	552.8	513.9	1467.1
METRAS RCP8.5	2011-2040	687.5	488.7	1186.1
	2041-2070	597.0	478.7	1335.4
	2071-2100	519.0	463.6	1467.1

The analysis of climate change scenarios shows a negative impact for the Lake's habitat; and under the pessimistic scenario a decrease in the total river inflow into Lake Sevan by about 34% (265 mln. m^3) by 2100 is projected. In addition to the anthropogenic impact, the quality of the Lake water is significantly affected by climate change. Along with the air and water temperature increase, the biomass of phytoplankton in the Lake is increasing, which leads to an abrupt deterioration of the Lake's water quality and the acceleration of eutrophication processes.

Reservoirs. The vulnerability of the river inflow during spring (April-June) months was estimated for the strategically significant reservoirs - Akhuryan, Aparan, Azat and Marmarik, for 2040, 2070, and 2100. The impact of climate change on the river inflow into the reservoirs during spring will be particularly significant for the Akhuryan and Marmarik reservoirs. Based on the assessment by the METRAS model and the RCP8.5 scenario, a decrease of around 60% can be projected for the river inflow during the spring months in 2100.

Agriculture

The vulnerability of the agriculture sector to natural hazards is relatively high, and it considerably varies across land zones and specific crops. It is more evident in low-lying and medium-altitude zones in the country. About 80% of the territory of Armenia is exposed to various degrees of

desertification, which is not only the consequence of anthropogenic activity, but is also affected by natural factors, such as water and wind erosion of soils, hot dry spells, drought, lack of humidity, landslides, natural salinization, alkalization, etc. Climate change, along with various anthropogenic phenomena, contributes to the vulnerability of organic carbon reserves in soils. According to climate change forecasts for Armenia over the next 100 years, the following changes are expected in the field of agriculture:

- Decrease in the level of soil moisture by 10-30%, decrease in soil moisture provision for various agricultural crops by 7-13%,
- Shortage of water for irrigation, increase of soil water deficit by 25-30%,
- Reduced productivity of irrigated land by about 24%,
- Degradation of lands and natural pastures; decrease in overall pasture area and productivity by 4-10% by 2030, decrease in pasture yield by 7-10%, decrease in fodder production volumes,
- Crop yield decline by 8-14% by 2030.

Hailstorms, frosts, heat waves, and drought have a particularly significant impact on the loss of agricultural crop yields due to hazardous hydrometeorological phenomena. In recent years, annual damage caused to agriculture by drought, hail, floods, spring frosts and mudflows has been estimated at about 15-30 billion AMD. In particular, the largest share in the damage caused is attributable to hailstorms. According to climate change scenarios, the frequency of thunderstorms and weather fluctuations accompanied by hailstorms is likely to increase in spring and summer.

6.1.8 Soil

The Project region has the following soil types (**Figure 6-10**), as per the Water Resources Atlas of Armenia.

- Alluvial-meadow saline lands and alkali soils,
- Alluvial-meadow soils irrigated in the past,
- Mountain-fulvous soils of dry steppes.

During the national EIA study, samples of soil were taken from the area of planned Kasakh reservoir in March 2024. Soil samples were analysed using the ISO 17294-2:2016 standard method at the accredited laboratory of the "Hydrometeorology and Monitoring Centre" SNCO. Results of the soil analyses compared to the Admissible Concentration Limits (ACL) for chemical elements in soil set out in the Sanitary Rules and Norms №2.1.7.003-10 "Hygienic requirements for soil quality"[82] are given in **Table 6-10**.

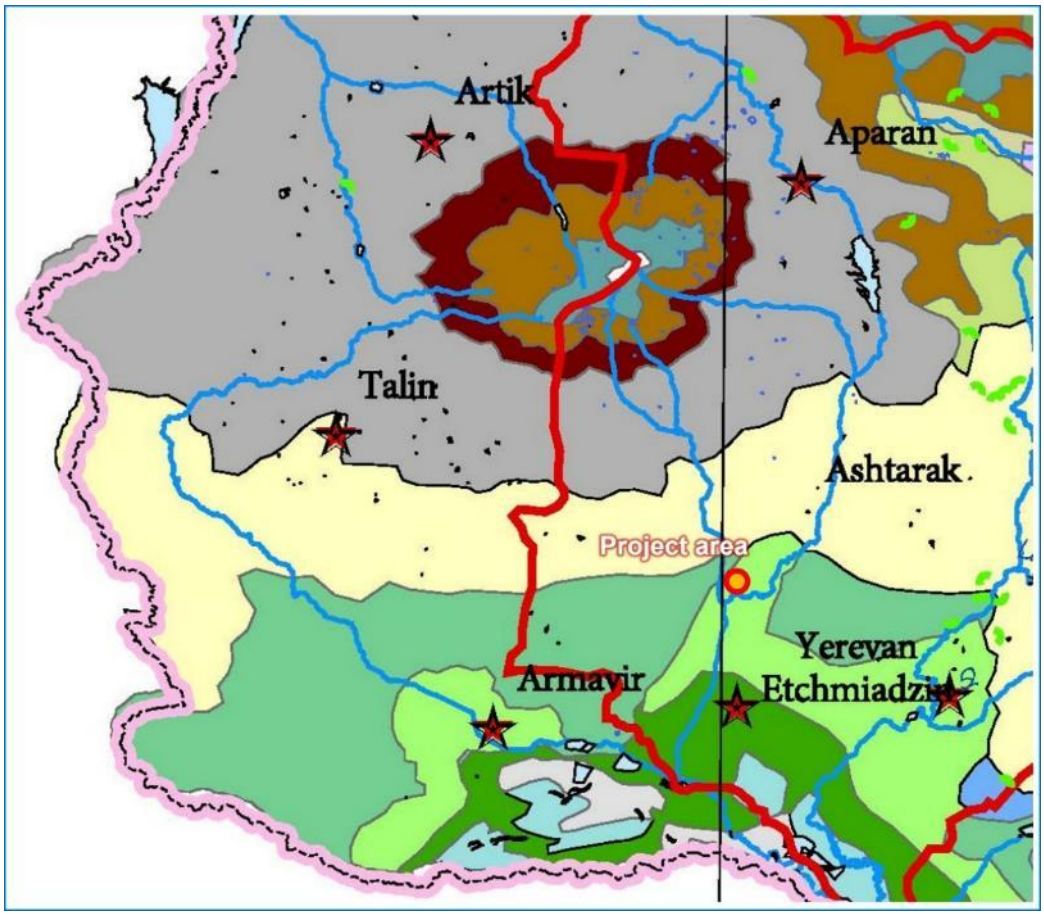
Table 6-10. Concentrations of chemical elements in soil samples taken from the Project site compared with the Armenian ACLs

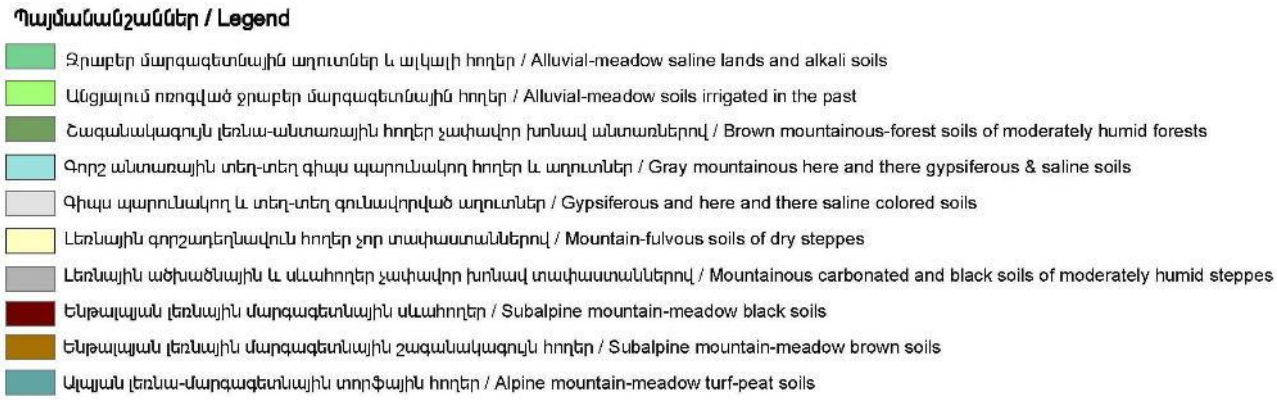
№	Chemical elements	Unit	Results of analysis	ACL of chemicals in soil
1	Lithium	mg/kg	0.0187	-
2	Beryllium	mg/kg	0.00158	-
3	Boron	mg/kg	0.0307	-
4	Sodium	mg/kg	18.76	-
5	Magnesium	mg/kg	8.331	-
6	Aluminium	mg/kg	45.55	-
7	Total phosphorus	mg/kg	1.966	-
8	Potassium	mg/kg	20.24	-

[82] https://www.arlis.am/DocumentView.aspx?docid=146741

№	Chemical elements	Unit	Results of analysis	ACL of chemicals in soil
9	Calcium	mg/kg	36.077	-
10	Titanium	mg/kg	7.828	-
11	Vanadium	mg/kg	0.15	150
12	Chrome	mg/kg	0.0709	6
13	Iron	mg/kg	38.46	-
14	Manganese	mg/kg	0.871	1500
15	Cobalt	mg/kg	0.0235	5
16	Nickel	mg/kg	0.0648	4
17	Copper	mg/kg	0.0507	3
18	Zinc	mg/kg	0.121	23
19	Arsenic	mg/kg	0.0127	2
20	Selenium	mg/kg	0.00745	-
21	Strontium	mg/kg	0.187	-
22	Molybdenum	mg/kg	0.00255	-
23	Cadmium	mg/kg	0.000409	-
24	Tin	mg/kg	0.00111	-
25	Antimony	mg/kg	0.000535	4. 5
26	Barium	mg/kg	0.254	-
27	Lead	mg/kg	0.0122	32
28	Bismuth	mg/kg	0.000104	
29	Uranium	mg/kg	0.00136	

Figure 6-10. Map of soil types in the Project region





Source: Water Resources Atlas of Armenia, Yerevan, 2008

The concentrations of none of the chemical elements in the soil sample exceed the ACLs set by national sanitary rules and norms.

6.1.9 Ambient Air Quality

There are no industrial facilities operating in the Project region, apart from a borrow pit situated approximately 750 m northwest of the Project site. The nearest residential houses are located at the following distances:

- 450 m in Amberd village,
- 1300 m in Aygeshat village,
- 450 m in Oshakan village,
- 1200 m in Voskevaz village,
- 850 m in Voskehat village,
- 500 m in Lernamerdz village[83].

Taking into account the absence of significant air emission sources, the Hydrometeorology and Monitoring Centre does not monitor air quality in the Project region. The main sources of gaseous emissions within the designated Project area and its vicinity are agricultural machinery and infrequent vehicle traffic; however, their impact on air quality is considered negligible. Dust emissions (PM2.5 and PM10[84]) may occur during land cultivation activities, particularly during ploughing in spring and autumn seasons.

During the national EIA study, instrumental measurements of dust (PM2.5 and PM10) concentrations as well as equivalent and maximum noise levels were performed. The map indicating dust and noise measurement points is presented in **Figure 6-11**.

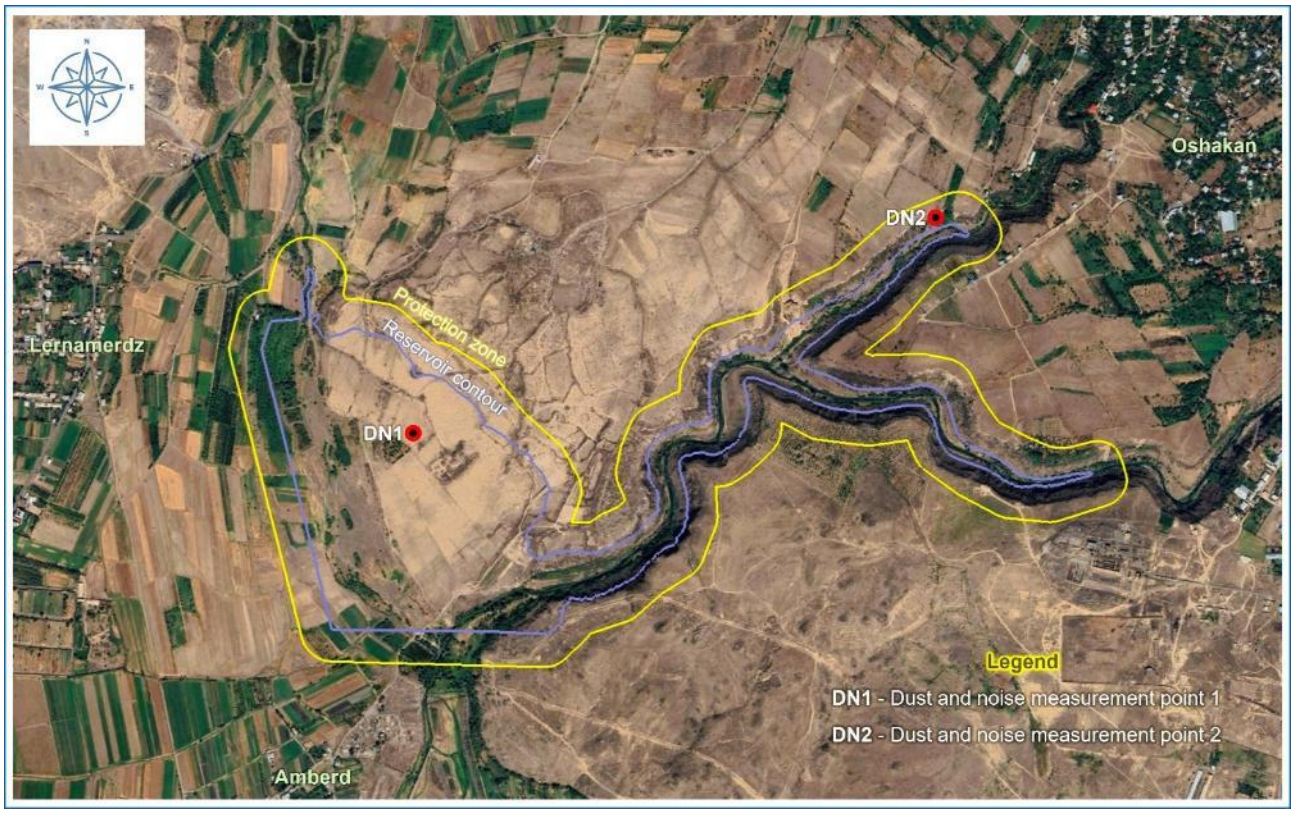
PM2.5 and PM10 instrumental measurements are carried out during the daytime. Duration of each measurement was 20 minutes. The results of the PM2.5 and PM10 are provided in **Table 6-11**. Ambient air quality standards for residential areas in Armenia are set by RA Government Decree №160-N and the World Health Organization's (WHO) Air Quality Guidelines - Global Update 2021.

[83]The reservoir and its infrastructure do not extend into the administrative territory of Lernamerdz village
[84]Particle Metters

Table 6-11. The results of PM2.5 and PM10 instrumental measurements

Point		Dust actual concentrations, mg/m³	Maximum permissible concentration (MPC) for dust, mg/m³		
			Daily average	Maximum value	IFC/WHO[85] (24 hours)
Point: DN1	PM2.5	0.007	0.035	0.16	0.025
	PM10	0.006	0.06	0.3	0.05
Point: DN2	PM2.5	0.009	0.035	0.16	0.025
	PM10	0.009	0.06	0.3	0.05

Figure 6-11. Dust (PM2.5 and PM10) and noise measurement points



The conclusion is that the actual concentrations of PM2.5 and PM10 within the Project area are below the MPC established by both national standards and IFC/WHO guidelines.

6.1.10 Noise and Vibration

Threshold Limit Values (TLVs) for equivalent (average) and maximum noise/sound levels set by the RA Sanitary Norms №2-III-11.3 "Noise in the workplaces, in residential and public buildings and housing in construction areas"[86] are comparable with the IFC Environmental, Health, and Safety General Guidelines (2007)[87] and WHO Guidelines for Community Noise (1999). The national TLVs and IFC/WHO guidelines for noise are presented in **Table 6-12**.

[85]IFC refers to the World Health Organization (WHO). Air Quality Guidelines Global Update, 2021
[86]https://www.arlis.am/hy/acts/163246
[87]https://www.ifc.org/content/dam/ifc/doc/2000/2007-general-ehs-guidelines-en.pdf

Table 6-12. Threshold limit values (TLV) for noise

№	Premises and territories, receptors		TLV, dBA		
			National		IFC/WHO
			Equivalent to sound level	Maximum sound level	One-hour equivalent sound level
1	Workplace		80		85
2	Shops, trading halls, airport and railway stations waiting rooms, drop-off points of public service providers		60	75	
	Industrial, commercial				70
3	Territories adjacent to residential buildings, clinics, ambulatories, rest houses, care homes, disabled persons homes, libraries, kinder gardens, schools and other educational facilities	day-time[88]	55	70	55
		night-time[89]	45	60	45

The main sources of noise and vibration within the Project area and its vicinity are the operation of agricultural equipment and vehicles used by local residents to access their agricultural land plots. These activities are infrequent but can generate some noise. Equivalent and maximum noise levels were measured during the national EIA study. The results of the noise measurements are compared with the threshold limit values (TLVs) established by Sanitary Norms №2-III-11.3 and are summarized in **Table 6-13**.

Table 6-13. Equivalent and maximum noise measurement results (baseline)

Noise №	Sound levels, dB(A)		Threshold limit value, dB(A)		
			National		IFC standards night-time/day-time
	Equivalent to sound level, Leq	Maximum sound level, Lmax	Equivalent to sound level	Maximum sound level	
DN1	56.6	60.2	*	*	*
DN2	48.8	58.1	*	*	*

**there are no sensitive receptors near the locations where the noise measurements were conducted; therefore, the TLVs are not presented in the table above*

Before the commencement of construction works, the construction contractor will conduct instrumental noise and vibration measurements to establish a baseline against which the impact of project implementation on sensitive receptors will be regularly assessed and mitigated, if necessary (see **Section 8.2.10**).

6.1.11 Natural Hazards

Armenia is prone to several natural hazards due to its geological, topographical, and climatic conditions. Here are the main natural hazards typical to Armenia:

1. Earthquakes

- Armenia is located in a seismically active zone (part of the Alpine-Himalayan seismic belt).
- Strong earthquakes have historically caused significant damage (e.g., the 1988 Spitak earthquake).
- Earthquake risk is high in northern and central parts of the country.

[88]between 07:00 and 23:00
[89]between 23:00 and 07:00

2. **Landslides**
   - Common in mountainous and hilly areas, especially where there is deforestation, road construction, or heavy rainfall.
   - Southern and northeastern regions are particularly vulnerable.
3. **Floods and Flash Floods**
   - Caused by intense rainfall, rapid snowmelt, or dam breaches.
   - More frequent in spring and early summer.
   - Rivers like the Arpa, Debed, and Vorotan can flood surrounding areas.
4. **Mudflows (Debris flows)**
   - Occur in mountainous river valleys, especially during heavy rains.
   - Common in the Lori, Tavush, Syunik, and Vayots Dzor regions.
5. **Droughts**
   - Particularly affect the Ararat Valley and other agricultural regions.
   - Reduced water availability impacts farming and hydropower.
6. **Hailstorms**
   - Can occur during spring and summer, causing severe damage to crops.
   - Agriculture in regions like Armavir, Ararat, and Shirak is often affected.

6.2 Biological Environment

6.2.1 Biodiversity

The biodiversity baseline presented in this section is based on the key findings of the national EIA report for the Kasakh Reservoir, including data from field surveys conducted in April-May 2024. These findings are further supplemented with additional studies, including field surveys conducted in Spring-Summer 2025.

6.2.2 Vegetation and Flora

Methods

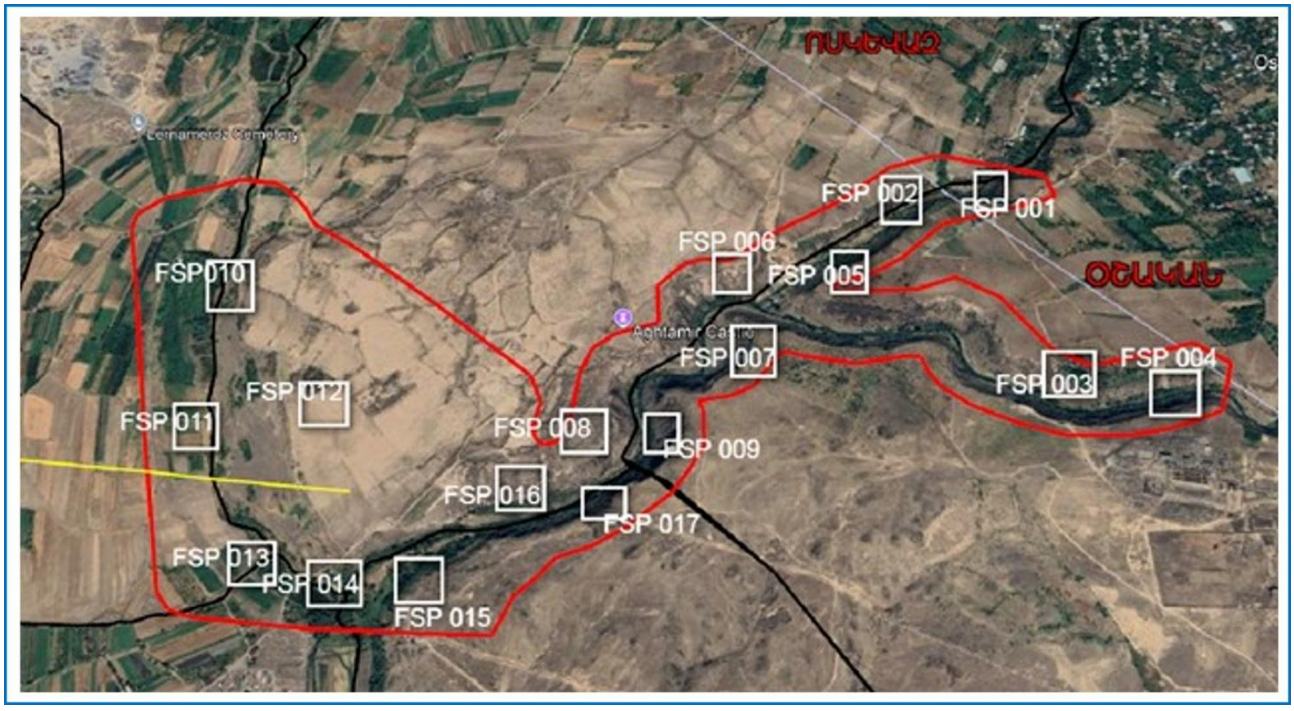
The types of vegetation within the Project-affected area were determined and categorized based on the results of field surveys conducted as part of the national EIA.

The surveys employed itinerary and semi-stationary geospatial research methods. The study area was divided into sampling plots based on the main biotopes, taking into account the site's terrain and landscape features. A total of 17 flora sampling plots (FSPs), each measuring 100×100 meters, were established (**Figure 6-12**). A complete inventory of plant species was carried out in each FSP, with all habitats and plant species documented and digitally photographed.

Most plant species were identified visually in the field. Species requiring laboratory identification were collected, preserved in herbariums, and subsequently analyzed. Vegetation descriptions were developed based on these surveys.

The flora study focused on identifying the diversity of higher vascular plants. Species identification was guided by the Flora of Armenia book (11 volumes, 1954-2009). Scientific plant names are presented in accordance with S. Tcherepanov's manual (Tcherepanov, 1995).

Figure 6-12. Flora sampling areas



Vegetation types

Based on the floristic divisions by A.L. Takhtajyan (1954), the proposed site for the Kasakh reservoir falls within the Yerevan floristic region. The site is situated in the gorge of the Kasakh River at the confluence of Amberd and Shaghvard tributaries with Kasakh at absolute altitude of 960-1010 m. The river valley mostly is V-shaped; however, it widens in some places.

The vegetation is mainly of semi-desert type (**Figure 6-13**), with the symbiosis of wormwood and various species of Poa (meadow grass), and some occurrence of drought-tolerant tragacanths. There are private orchards on the site area located in semi-desert sections of the banks of Kasakh River gorge and its tributaries. Most of the area is rocky; there is petrophilic vegetation on the rock cliffs and screes (**Figure 6-14**), the flora here is very poor.

There are also species of wetland vegetation (**Figure 6-15**). The river's green belt is represented by mesophyll vegetation, the composition of which is not diverse. The dendroflora species may be seen on the banks of Kasakh, Amberd and Shahvard rivers and on the gorge slopes.

Figure 6-13. The view of the Kasakh River valley: semi-desert vegetation (right: with orchards)

Figure 6-14. The view of the Kasakh River valley: petrophilic vegetation

Figure 6-15. The view of the Kasakh River valley: wetland vegetation with dendroflora species

Flora

Species of the higher vascular plants found in the Project area are listed in **Table 6-14**. The flora is presented by 63 species of 30 families.

Table 6-14. List of plant species registered in the study area

Family (number of species)	Flora sampling plots	Latin names of species
Asteraceae (8)	FSP 6; 9	Achillea millefolium L.
	FSP 4; 13; 15	Cichorium intybus L.
	FSP 3; 7; 12	Artemisia fragrans Willd.
	FSP 12; 15	Crepis sancta (L.) Babc.
	FSP 6; 12	Xanthium spinosum L.
	FSP 3	Xanthium italicum
	FSP 3; 11	Tanacetum argyrophyllum (K.Koch) Tvzel.
	FSP 3; 4; 12	Chondrilla juncea L.
Poaceae (11)	FSP 9; 12;	Poa bulbosa L.
	FSP 6; 9; 12	Koeleria kurdica Ujhelyi
	FSP 12	Agropyron pectinatum (M.Bieb.) P. Beauv.
	FSP 12; 13	Bromus japonicus ssp. anatolicus (Boiss. et Heldr.) Penzes
	FSP 3; 11	Agrostis stolonifera L.
	FSP 3; 7	Tragos racemosus (L.) All
	FSP 7	Elytrigia repen s (L.) Nevski
	FSP 7; 9	Festuca pratensis Huds.
	FSP 9; 11	Festuca sclerophylla Boiss. ex Bisch.
	FSP 9, 14	Eremopoa songarica (Schrenk) Roshev
	FSP 2, 10	Phleum paniculatum Huds.
Fabaceae (6)	FSP 6	Medicago sativa L.
	FSP 3; 11; 13	Astragalus microcephalus Willd.
	FSP 7	Medicago lupulina L.
	FSP 7; 9	Trifolium repens L.
	FSP 9	Triolfium pratense L.
	FSP 3	Alhagi pseudoalhagi (Bieb.) Desv.
Chenopodiaceae (2)	FSP 3	Atriplex micrantha C.A.Mey.

Family (number of species)	Flora sampling plots	Latin names of species
	FSP3; 9	Chenopodium album L.
Peganaceae (1)	FSP 3; 7	Peganum harmala L.
Zygophyllaceae (1)	FSP 7	Zygophyllum fabago L.
Cuscutaceae (1)	FSP 4; 17	Cuscuta cesattiana
Scrophulariaceae (1)	FSP 10	Veronica gentianoides Vahl.
Lamiaceae (3)	FSP 3; 6; 11	Thymus kotcshyanus Boiss. et Hohen.
	FSP 2; 17	Mentha longifolia (L.) Huds.
	FSP 6; 11	Ajuga orientalis L.
Polygonaceae (3)	FSP 14	Polygonum aviculare L.
	FSP 4; 15	Atraphaxis spinosa L.
	FSP 14	Polygonum hydropiper L.
Apiaceae (1)	FSP12	Eryngium campestre L.
Rubiaceae (1)	FSP 12; 13	Galium humifusum M. Bieb.
Convolvulaceae (1)	FSP 17	Convolvulus arvensis L.
Caryophyllaceae (1)	FSP 6; 11	Dianthus aristatus Boiss.
Euphorbiaceae (3)	FSP 6	Euphorbia boissieriana (Woronow) Prokh.
	FSP 9	Euphorbia seguierana Neck.
	FSP 9; 13	Euphorbia marschalliana Boiss.
Primulaceae (1)	FSP 3; 12	Androsace maxima L.
Hyacinthaceae (1)	FSP 7	Ornithogallum montanum Cirillo
Ranunculaceae (1)	FSP 6; 11	Ceraticephala falcata (L.) Pers
Boraginaceae (1)	FSP 4	Anchusa arvensis (L.) M.Bieb.
Ramnaceae (1)	FSP 3;4;15	Rhamnus pallasii Fisch. & C.A. Meyer
Salicaceae (4)	FSP 4; 14; 17	Salix caprea L.
	FSP4; 14; 17	Salix excelsa, S.G.Gmel.
	FSP 14; 17	Salix babylonica L.
	FSP 4; 14; 17	Populus nigra L.
Ulmaceae (1)	FSP 3; 15	Ulmus minor Mill.
Oleaceae (1)	FSP 15	Fraxinus excelsior L.
Rosaceae (2)	FSP 3; 15	Spiraea hypericifolia L.
	FSP 3; 4; 15	Cerasus incana (Pall.) Spach.
Plantaginaceae (1)	FSP 14; 17	Plantago major
Portulacaceae (1)	FSP 14	Portulaca oleracea L.
Brassicaceae (1)	FSP 6; 12	Rorippa islandica (Oeder) Borbas
Tamaricaceae (1)	FSP 3; 15	Tamarix ramosissima
Geraniaceae (1)	FSP 14; 15	Erodium cicutarium (L.) L`Her.
Caprifoliaceae (1)	FSP 3; 15	Lonicera iberica M.Bieb.

There are 141 plant species included in the RA Red Book (2010)[90] that can be found in the Yerevan floristic region. Among them, two plant species are found in the vicinity of Kasakh site (**Table 6-15**). These plant species were not found within the site area during the field surveys.

[90]The Red Book (second edition of 2010) includes the Red Book of Animals and Red Book of Plants, are together called the Red Book in this ESIA

Table 6-15. Protected plant species registered in the vicinity of Kasakh site (according the RA Red Book)

№	Family	Latin name	Category in the IUCN Red List	Category in the RA Red Book
1	Iridaceae	Iris elegantissima Sosn.	-	EN
2	Alliacea	Nectaroscordum tripedale (Trautv.) Grossh.)	-	EN

6.2.3 Fauna

Terrestrial mammals

Methods

The data from the previous studies conducted in the area, and the available scientific information related to this region was used during the desktop research, and included articles, reports, and collections of the Armenian Institute of Zoology. Namely, it covered the literature materials at our disposal (Dal 1954, Geptner et al. 1967, Martirosyan & Papanian 1983, Bibikov 1985, Agadzhanyan 1986,1993, Kasabyan 1986, 2001,2014, Popov 2003, Avagyan 2010, RA Red Book (1987, 2010), and the preliminary data for the Emerald network in the RA (2016)).

Encounters with vertebrates in nature are mainly accidental; much more often, traces of their vital activity are observed. During the field trips to the site as part of the national EIA, all signs of the animals presence were registered including footprints in dust, mud, traces associated with animal feeding (gnawing, food residues, etc.), visually seen faeces, excrements, shelters (burrows, colonies, nests); in addition some mammals were observed by chance.

Results

Based on the abovementioned sets of data, the list of mammalian species that are found or expected to be found in this area is listed in **Table 6-16**.

Table 6-16. Mammalian species of the study area

№	Armenian Name	English name	Scientific names	1	2	3	4	5	6	7
Erinaceidae										
1	Սպիտակափորն ոզնի	Southern white-breasted hedgehog	Erinaceus concolor	+	+					
Soricidae										
2	Սովորական գորշատամ	Common shrew	Sorex araneus	+	-					
3	Շելկովնիկովի կուտորա	Transcaucasian water shrew	Neomys teres (schelkovnikovi)	+	-	LC	EN			
Leporidae										
4	Նապաստակ	European hare	Lepus europaeus	+	+					
Mustelidae										
5	Քարակզաքիս	Beech marten	Martes foina	+	+					
6	Աքիս	Least weasel	Mustela nivalis	+	+					
7	Գորշուկ	Badger	Meles meles	+	+					
8	Ջրասամույր	Eurasian otter	Lutra lutra	+	-	NT	EN	+	+	+
Canidae										

№	Armenian Name	English name	Scientific names	1	2	3	4	5	6	7
9	Գայլ	Gray wolf	Canis lupus	+	-			+	+	+
10	Չախկալ	Jackal	Canis aureus	+	+					
11	Սովորական աղվես	Red fox	Vulpes vulpes	+	+					
Felidae										
12	Անտառային կատու	European wildcat	Felis silvestris	+	-	LC	VU			+
13	Եղեգնակատու	Jungle cat	Felis chaus	+	+					
Cricetidae										
14	Մոխրագույն համստերիկ	Gray dwarf hamster	Cricetulus migratorius	+	+					
15	Սովորական դաշտամուկ	Common vole	Microtus arvalis	+	+					
16	Թփուտային դաշտամուկ	Major's pine vole	Microtus majori	+	-+					
17	Եվրոպական ջրառնետ	European water vole	Arvicola terrestris	+	+					
Gerbillidae										
18	Փոքրասիական ավազամուկ	Tristram's jird	Meriones tristrami	+	-					
Muridae										
19	Փոքր անտառային մուկ	Ural field mouse	Sylvaemus uralensis	+	+					
Vespertilionidae										
20		Pipistrelle bats	Pipistrellus sp. ?		+					+

Keys to Table 6-16

Column titles:
1 - Information from various sources
2 - Data from field studies
3 - IUCN Red List
4 - Red Book of the RA
5 - Resolution 6 of Bern Convention
6 - Annex II of the Habitats Directive
7 - Annex IV of the Habitats Directive

Signs:
+ listed or registered
- not registered
no sign - not listed
? – species not identified

Conservation status
in IUCN Red List, column 3:
NT - Near Threatened
LC - Least Concern
In Red Book of the RA, column 4:
EN - endangered
VU - vulnerable

As shown in **Table 6-16**, the area is home to **20 mammal species** belonging to **10 families**. The largest group is the group of predatory mammals, followed by rodents.

The species can be grouped into several groups based on their lifestyle:

- predatory group, mainly all species of the group use this area as a transit area, that is, they visit it either when moving around the region or when searching for food,
- species that are largely present the area throughout the year; among them, we can distinguish Beech Marten, Least Weasel, and Badger; in rare cases, when searching for food, they can leave the given area for a certain period of time,
- semiaquatic mammals, including water shrew and Eurasian otter,
- all small rodents as well as terrestrial insectivores which are mainly permanent residents of the area designated for the reservoir, since all habitats of the riverbed meet their vital activity requirements,

- flying mammals – bats, that use the area for foraging; flying bats were visually observed during field survey but it was not possible to identify bat's species; therefore, focused bat field study has to be done at the pre-construction phase.

Of the 20 identified species, one (Transcaucasian water shrew) is classified as Priority Biodiversity Feature under EBRD PR6, Criterion 12(ii), as it is listed in the Red Book of RA, category Endangered.

Two more species are classified as Priority Biodiversity Features under EBRD PR6, Criterion 12(ii), as they are listed in Resolution 6 of the Bern Convention and Annex II of the EU Habitats Directive (see **Table 6-16**). These species and their habitats are also qualified as Critical Habitat under EBRD PR6, Criterion 14(ii), as they are listed in Annex IV of the EU Habitats Directive.

In addition, the European wildcat (Felis silvestris) and its habitat is qualified as Critical Habitat on the same basis.

It shoud be mentioned that the presence of the representatives of these three species (which are as well listed in the Red Book) were not recorded during the survey. Their inclusion in the summary table was determined by obtaining less reliable information from literary sources and sometimes from local residents.

The bat species, although not identified, is qualified as Critical Habitat under EBRD PR6, Criterion 14(ii), as *Pipistrellus* genus belongs to *Microchiroptera* suborder that is listed in Annex IV of the EU Habitats Directive.

Birds

Methods

Data collection included methods of transect count and count of breeding pairs.

Transect counts were conducted along routes that were 200 m long and 200 m wide (extending 100 m on each side of the central line). The counts were carried out from 6:00 to 11:00, when most uniformly distributed species are active.

The count of breeding pairs of large-ranged and colonial species was implemented opportunistically when such species appeared. In such cases, the breeding behaviour of the species was observed to identify the highest possible breeding code (Voříšek et al. 2008).

Data processing included visualization of the bird community in the form of a table that also shows priority species and estimation of their abundance. The priority species are those listed either in the RA Red Book, in the IUCN Red List, in the Resolution 6 of the Bern Convention, in the Annex I of EU Birds Directive, or are considered Restricted Range species[91].

Estimation of the abundance of uniformly distributed species was done through computation of their density per one ha and multiplication of the density on the area of typical habitat. The estimation of abundance of large-ranged and colonial species was done through the direct count of breeding pairs (pairs with high breeding codes).

Results

The bird's diversity of the study area is presented in **Table 6-17** below and includes 120 species. Among those, there are 64 bird species, which breed in the area, 7 species, which breed in proximity

[91]For terrestrial vertebrates and plants, restricted-range species are defined as those species that have an extent of occurrence (EoO) of less than 50,000 km^2. Source: Guidance Notes to the EBRD PR 6 (March, 2023)

to the site and use the area as a part of their foraging range, and 49 species, which pass the area during the seasonal migration.

The breeding of several (non-priority) species, for example, the Eurasian Woodcock (*Scolopax rusticola*), mentioned in the previous biodiversity study, is questionable, although cannot be completely excluded.

Among breeding birds, there is one species listed in the RA Red Book and 9 species included in the Resolution 6 of the Bern Convention, and Annex 1 of the EU Birds Directive.

Among the large-ranged birds, which use the area as a part of their foraging range during the breeding season, there are three species listed in the RA Red Book and five species included in the Resolution 6 of the Bern Convention, and in Annex 1 of The EU Birds Directive.

Among migratory and wintering birds, which use the area for stopover (to get a rest) and foraging in non-breeding period, there are 12 species listed in the RA Red Book and 16 species included in Resolution 6 of the Bern Convention, and in Annex 1 of the EU Birds Directive.

One species (Mountain Chiffchaff, *Phylloscopus sindianus)* is restricted range species.

From the 120 identified species, 32 species are assessed as the Priority Biodiversity Features according to the EBRD PR6 criterion 12-ii as 30 species are listed in the Resolution 6 of Bern Convention and Annex I of the EU Birds Directive, one species (Mountain Chiffchaff, *Phylloscopus sindianus*) is a regularly occurring range-restricted species and one species (White-throated Robin, *Irania gutturalis*) is included into the RA Red Book (VU) and identified by as significant biodiversity feature (**Table 6-17**).

Table 6-17. Bird species of the Kasakh site area

№	Armenian names	English names	Scientific names	Occurrence Status in Armenia	Occurrence Status in Project site	Unit	Number	IUCN	RDB RA	Bern Res6	BD Annex 1	RR species
Anatidae												
1	Մոխրագույն բադ	Gadwall	*Mareca strepera*	B - regular	Migratory	ind	NA	LC				
2	Կռնչան բադ	Mallard	*Anas platyrhynchos*	B - regular	Migratory	ind	NA	LC				
Phasianidae												
3	Քարակաքավ	Chukar	*Alectoris chukar*	Yr - regular	Breeding	pair	5-8	LC				
4	Մոխրագույն կաքավ	Grey Partridge	*Perdix perdix*	Yr - regular	Migratory	ind						
5	Լոր	Common Quail	*Coturnix coturnix*	B - regular	Breeding	pair						
Ardeidae												
6	Փոքր ջրցուլ	Little Bittern	*Botaurus minutus*	B - regular	Breeding	pair	1-2	LC		+	+	
7	Եգիպտական տառեղ	Western Cattle-Egret	*Ardea ibis*	B - regular	Migratory	ind	10-25	LC				
Ciconiidae												
8	Սև արագիլ	Black Stork	*Ciconia nigra*	B - regular	Migratory	ind	1-2	LC	VU	+	+	
9	Սպիտակ արագիլ	White Stork	*Ciconia ciconia*	B - regular	Migratory	ind	3-15	LC		+	+	
Accipitridae												
10	Կրետակեր	European Honey-buzzard	*Pernis apivorus*	M - regular	Migratory	ind	100-500	LC		+	+	
11	Գիշանգղ	Egyptian Vulture	*Neophron percnopterus*	B - regular	Foraging	ind	1-2	EN	EN	+	+	
12	Սպիտակագլուխ անգղ	Eurasian Griffon	*Gyps fulvus*	Yr - regular	Foraging	ind	1-2	LC	VU	+	+	
13	Օձակեր արծիվ	Short-toed Snake-eagle	*Circaetus gallicus*	B - regular	Migratory	ind	1-2	LC	VU	+	+	
14	Դաշտային մկնաճուռակ	Hen Harrier	*Circus cyaneus*	M - regular	Wintering					+	+	
15	Տափաստանային մկնաճուռակ	Pallid Harrier	*Circus macrourus*	M - regular	Migratory	ind	5-30	NT	VU	+	+	
16	Մարգագետնային մկնաճուռակ	Montagu's Harrier	*Circus pygargus*	B - regular	Migratory	ind	70-250	LC	VU	+	+	
17	Լորաճուռակ	Eurasian Sparrowhawk	*Accipiter nisus*	Yr - regular	Wintering	ind	10-20	LC				

№	Armenian names	English names	Scientific names	Occurrence Status in Armenia	Occurrence Status in Project site	Unit	Number	IUCN	RDB RA	Bern Res6	BD Annex 1	RR species
18	Եվրոպական ճնճղաճուռակ	Levant Sparrowhawk	*Tachyspiza brevipes*	B - regular	Migratory	ind	30-90	LC	VU	+	+	
19	Մեծ ճուռակ	Common Buzzard	*Buteo buteo*	B - regular	Migratory	ind	1000-5000	LC				
20	Տափաստանային ճուռակ	Long-legged Buzzard	*Buteo rufinus*	Yr - regular	Foraging	ind	50-100	LC		+	+	
21	Փոքր ենթաարծիվ	Lesser Spotted Eagle	*Clanga pomarina*	B - regular	Migratory	ind	200-500	LC	VU	+	+	
22	Տափաստանային արծիվ	Steppe Eagle	*Aquila nipalensis*	M - regular	Migratory	ind	10-50	EN	VU	+	+	
23	Գաճաճ արծիվ	Booted Eagle	*Hieraaetus pennatus*	B - regular	Migratory	ind	100-300	LC	VU	+	+	
			Falconidae									
24	Սովորական հողմավար բազե	Common Kestrel	*Falco tinnunculus*	Yr – regular	Breeding							
25	Արտույտաբազե	Eurasian Hobby	*Falco subbuteo*	B – regular	Foraging	ind	1-2	LC				
26	Սապսան	Peregrine Falcon	*Falco peregrinus*	Yr - regular	Migratory	ind	1-2	LC	VU	+	+	
			Phasianidae									
27	Քարակաքավ	Chukar	*Alectoris chukar*	Yr – regular	Breeding							
28	Լոր	Common Quail	*Coturnix coturnix*	B – regular	Breeding							
29	Մոխրագույն կաքավ	Grey Partridge	*Perdix perdix*	Yr - regular	Wintering							
			Rallidae									
30	Եղեգնահավ	Eurasian Moorhen	*Gallinula chloropus*	Yr - regular	Breeding	pair	1-3	LC				
			Gruidae									
31	Գեղանի կռունկ	Demoiselle Crane	*Anthropoides virgo*	M - regular	Migratory	ind	300-2000	LC	VU	+	+	
			Charadriidae									
32	Փոքր քարադր	Little Ringed Plover	*Thinornis dubius*	B - regular	Breeding	pair	1-2	LC				
			Scolopacidae									
33	Կարմրաոտ կտցար	Common Redshank	*Tringa totanus*	Yr - regular	Migratory	ind						

№	Armenian names	English names	Scientific names	Occurrence Status in Armenia	Occurrence Status in Project site	Unit	Number	IUCN	RDB RA	Bern Res6	BD Annex 1	RR species
34	Սևուկ կտցար	Green Sandpiper	*Tringa ochropus*	Yr - regular	Migratory	ind						
35	Սպիտակավիզ կտցար	Common Sandpiper	*Actitis hypoleucos*	B - regular	Breeding	ind	3-5					
36	Անտառակտցար	Eurasian Woodcock	*Scolopax rusticola*	Yr - regular	Breeding	ind	NA					
Laridae												
37	Սովորական որոր	Black-headed Gull	*Chroicocephalus ridibundus*	Yr - regular	Migratory	ind						
38	Հայկական որոր	Armenian Gull	*Larus armenicus*	Yr - regular	Migratory	ind	300-1000	LC				
39	Փոքր ջրածիծառ	Little Tern	*Sternula albifrons*	B – regular	Migratory	ind	NA	LC	VU	+	+	
Columbidae												
40	Թխակապույտ աղավնի	Rock Pigeon	*Columba livia*	Yr - regular	Breeding							
41	Անտառային աղավնի	Common Woodpigeon	*Columba palumbus*	Yr - regular	Breeding							
42	Օղակավոր տատրակ	Eurasian Collared-Dove	*Streptopelia decaocto*	Yr - regular	Migratory							
Cuculidae												
43	Սովորական կկու	Common Cuckoo	*Cuculus canorus*	B - regular	Breeding							
Strigidae												
44	Բվեճ	Eurasian Eagle-owl	*Bubo bubo*	Yr - regular	Foraging	ind	1-2	LC	VU	+	+	
45	Եվրոպական բվիկ	Common Scops-owl	*Otus scops*	B - regular	Breeding							
46	Ականջավոր բու	Long-eared Owl	*Asio otus*	Yr - regular	Breeding							
47	Տնային բվիկ	Little Owl	*Athene noctua*	Yr - regular	Breeding							
Caprimulgidae												
48	Այծկիթ	Eurasian Nightjar	*Caprimulgus europaeus*	B - regular	Breeding	pair	1-2	LC		+	+	
Apodidae												
49	Սև մանգաղաթև	Common Swift	*Apus apus*	B - regular	Breeding							
Alcedinidae												

№	Armenian names	English names	Scientific names	Occurrence Status in Armenia	Occurrence Status in Project site	Unit	Number	IUCN	RDB RA	Bern Res6	BD Annex 1	RR species
50	Երկնագույն ալկիոն	Common Kingfisher	*Alcedo atthis*	Yr - regular	Breeding	pair	1-2	LC		+	+	
Meropidae												
51	Ոսկեգույն մեղվակեր	European Bee-eater	*Merops apiaster*	B - regular	Breeding							
52	Ներկարար	European Roller	*Coracias garrulus*	B - regular	Breeding	pair	1-2	LC	VU	+	+	
Upupidae												
53	Հոպոպ	Eurasian Hoopoe	*Upupa epops*	B - regular	Breeding							
Picidae												
54	Սիրիական փայտփոր	Syrian Woodpecker	*Dendrocopos syriacus*	Yr - regular	Breeding	pair	2-3	LC		+	+	
Alaudidae												
55	Անտառային արտույտ	Wood Lark	*Lullula arborea*	B - regular	Breeding	pair	5-9	LC		+	+	
56	Փուփուլավոր արտույտ	Crested Lark	*Galerida cristata*	Yr - regular	Breeding							
57	Դաշտային արտույտ	Eurasian Skylark	*Alauda arvensis*	Yr - regular	Breeding							
Hirundinidae												
58	Ժայռային ծիծեռնակ	Eurasian Crag-martin	*Hirundo rupestris*	B - regular	Breeding							
59	Գյուղական ծիծեռնակ	Barn Swallow	*Hirundo rustica*	B - regular	Breeding							
60	Քաղաքային ծիծեռնակ	House Martin	*Delichon urbica*	B - regular	Breeding							
Motacillidae												
61	Դեղին խաղտտնիկ	Yellow Wagtail	*Motacilla flava*	B - regular	Migratory							
62	Լեռնային խաղտտնիկ	Grey Wagtail	*Motacilla cinerea*	Yr - regular	Breeding							
63	Սպիտակ խաղտտնիկ	White Wagtail	*Motacilla alba*	Yr - regular	Breeding							
64	Անտառային ձիաթռչնակ	Tree Pipit	*Anthus trivialis*	B - regular	Migratory							
65	Դաշտային ձիաթռչնակ	Tawny Pipit	*Anthus campestris*	B - regular	Breeding	pair	1-2	LC		+	+	

№	Armenian names	English names	Scientific names	Occurrence Status in Armenia	Occurrence Status in Project site	Unit	Number	IUCN	RDB RA	Bern Res6	BD Annex 1	RR species
Cinclidae												
66	Ջրաճնճղուկ	White-throated Dipper	*Cinclus cinclus*	Yr - regular	Breeding							
Troglodytidae												
67	Եղնջաթռչնակ	Winter Wren	*Troglodytes troglodytes*	Yr - regular	Wintering							
Prunellidae												
68	Անտառային նրբագեղիկ	Dunnock	*Prunella modularis*	Yr - regular	Wintering							
Muscicapidae												
69	Արշալուսիկ	European Robin	*Erithacus rubecula*	B - regular	Breeding	pair						
70	Սովորական սոխակ	Thrush Nightingale	*Luscinia luscinia*	M - regular	Migratory	ind						
71	Հարավային սոխակ	Common Nightingale	*Luscinia megarhynchos*	B - regular	Breeding	pair						
72	Կապտափող սոխակ	Bluethroat	*Luscinia svecica*	B - regular	Migratory	ind	50-300	LC		+	+	
73	Սպիտակափող սոխակ	White-throated Robin	*Irania gutturalis*	B - regular	Breeding	pair	3-5	LC	VU			
74	Մոխրագույն ճանճորս	Spotted Flycatcher	*Muscicapa striata*	B - regular	Migratory							
75	Կիսասպիտակավիզ ճանճորս	Semicollared Flycatcher	*Ficedula semitorquata*	B - regular	Migratory	ind	5-20	LC	DD	+	+	
76	Սևուկ կարմրատուտ	Black Redstart	*Phoenicurus ochruros*	B - regular	Breeding							
77	Սովորական կարմրատուտ	Common Redstart	*Phoenicurus phoenicurus*	B - regular	Migratory							
78	Մարգագետնային չքչքան	Whinchat	*Saxicola rubetra*	B - regular	Migratory							
79	Սիբիրյան սևագլուխ չքչքան	Siberian Stonechat	*Saxicola maurus*	B - regular	Breeding							
80	Եվրոպական սևագլուխ չքչքան	European Stonechat	*Saxicola rubicola*	B - regular	Migratory							
81	Պարող քարաթռչնակ	Isabelline Wheatear	*Oenanthe isabellina*	B - regular	Breeding							

№	Armenian names	English names	Scientific names	Occurrence Status in Armenia	Occurrence Status in Project site	Unit	Number	IUCN	RDB RA	Bern Res6	BD Annex 1	RR species
82	Սովորական քարաթռչնակ	Northern Wheatear	*Oenanthe oenanthe*	B - regular	Migratory							
83	Սևախայտ քարաթռչնակ	Eastern Black-eared Wheatear	*Oenanthe melanoleuca*	B - regular	Breeding							
84	Խայտաբղետ քարակեռնեխ	Rufous-tailed Rock-thrush	*Monticola saxatilis*	B - regular	Migratory							
85	Կապույտ քարակեռնեխ	Blue Rock-thrush	*Monticola solitarius*	B - regular	Breeding							
Turdidae												
86	Սպիտակախածի կեռնեխ	Ring Ouzel	*Turdus torquatus*	Yr - regular	Wintering							
87	Սև կեռնեխ	Eurasian Blackbird	*Turdus merula*	Yr - regular	Breeding							
88	Սոսնձակեռնեխ	Mistle Thrush	*Turdus viscivorus*	Yr - regular	Wintering							
Scotocercidae												
89	Լայնապոչ եղեգնաթռչնակ	Cetti's Warbler	*Cettia cetti*	B - regular	Breeding							
Sylviidae												
90	Սևագլուխ շահրիկ	Eurasian Blackcap	*Sylvia atricapilla*	B - regular	Migratory							
91	Այգու շահրիկ	Garden Warbler	*Sylvia borin*	B - regular	Migratory							
92	Մոխրագույն շահրիկ	Greater Whitethroat	*Curruca communis*	B - regular	Breeding							
93	Մորու շահրիկ	Lesser Whitethroat	*Curruca curruca*	B - regular	Breeding							
94	Ճուռականման շահրիկ	Barred Warbler	*Curruca nisoria*	B - regular	Migratory							
Phylloscopidae												
95	Գարնանային գեղգեղիկ	Willow Warbler	*Phylloscopus trochilus*	M - regular	Migratory							
96	Ծնկլտան գեղգեղիկ	Common Chiffchaff	*Phylloscopus collybita*	B - regular	Migratory							

№	Armenian names	English names	Scientific names	Occurrence Status in Armenia	Occurrence Status in Project site	Unit	Number	IUCN	RDB RA	Bern Res6	BD Annex 1	RR species
97	Կովկասյան գեղգեղիկ	Mountain Chiffchaff	*Phylloscopus sindianus*	B - regular	Migratory	ind	50-100					+
Paridae												
98	Մեծ երաշտահավ	Great Tit	*Parus major*	Yr - regular	Breeding							
Sittidae												
99	Ժայռային փոքր սիտեղ	Western Rock-nuthatch	*Sitta neumayer*	Yr - regular	Breeding							
Remizidae												
100	Ճոճահավ	Eurasian Penduline-Tit	*Remiz pendulinus*	Yr - regular	Breeding							
Oriolidae												
101	Պիրոլ	Eurasian Golden Oriole	*Oriolus oriolus*	B - regular	Breeding							
Laniidae												
102	Ժուլան	Red-backed Shrike	*Lanius collurio*	B - regular	Breeding	pair	2-4	LC		+	+	
103	Սևաճակատ շամփրուկ	Lesser Grey Shrike	*Lanius minor*	B - regular	Breeding	pair	1-2	LC		+	+	
Corvidae												
104	Անտառային կաչաղակ	Eurasian Jay	*Garrulus glandarius*	Yr - regular	Breeding							
105	Սովորական կաչաղակ	Black-billed Magpie	*Pica pica*	Yr - regular	Breeding							
106	Կարմրակտուց ճայ	Red-billed Chough	*Pyrrhocorax pyrrhocorax*	Yr - regular	Foraging	ind	2-4	LC		+	+	
107	Մոխրագույն ագռավ	Hooded Crow	*Corvus corone*	Yr - regular	Breeding							
108	Սև ագռավ	Common Raven	*Corvus corax*	Yr - regular	Breeding							
Sturnidae												
109	Սովորական սարյակ	Common Starling	*Sturnus vulgaris*	Yr - regular	Breeding							
110	Վարդագույն սարյակ	Rosy Starling	*Pastor roseus*	B - regular	Foraging							
Passeridae												
111	Ժայռային ճնճղուկ	Rock Sparrow	*Petronia petronia*	Yr - regular	Breeding							
112	Տնային ճնճղուկ	House Sparrow	*Passer domesticus*	Yr - regular	Breeding							

№	Armenian names	English names	Scientific names	Occurrence Status in Armenia	Occurrence Status in Project site	Unit	Number	IUCN	RDB RA	Bern Res6	BD Annex 1	RR species
113	Դաշտային ճնճղուկ	Eurasian Tree Sparrow	*Passer montanus*	Yr - regular	Breeding							
Fringillidae												
114	Ամուրիկ	Eurasian Chaffinch	*Fringilla coelebs*	Yr - regular	Wintering							
115	Կարմրակատար	European Goldfinch	*Carduelis carduelis*	Yr - regular	Breeding							
116	Կանեփնուկ	Eurasian Linnet	*Linaria cannabina*	Yr - regular	Breeding							
117	Լեռնային վշասարեկ	Twite	*Linaria flavirostris*	Yr - regular	Wintering							
Emberizidae												
118	Լեռնային դրախտապան	Rock Bunting	*Emberiza cia*	Yr - regular	Breeding							
119	Սևագլուխ դրախտապան	Black-necked Bunting	*Emberiza melanocephala*	B - regular	Breeding							
120	Կորեկնուկ	Corn Bunting	*Emberiza calandra*	Yr - regular	Breeding							

Keys to the Table 6-17

Keys to column titles: IUCN - status in IUCN Red List, RDB RA - status in the RA Red Book, Bern Res6 - presence in Resolution 6 of Bern Convention, BD Annex 1 - presence in Annex 1 of the EU Bird Directive, RR - Restricted Range species.

Keys to signs: + listed; no sign – no data or not listed

Key to occurrence status

- b - breeding
- m - migrant
- w - wintering
- yr - year-round resident
- yv - year-round visitor
- a - accidental visitor
- ex - extinct
- un - presence unconfirmed

Key to conservation status

- CR - Critically Endangered
- EN - Endangered
- VU - Vulnerable
- NT - Near Threatened
- LC - Least Concern
- DD - Data Deficient
- NE - Not Evaluated

Key to units

- ind - number of individuals
- pair - number of breeding pairs

Amphibians and Reptiles

Methods

Data from previous studies conducted in the area, along with other available scientific information related to the region, were used during the desktop research. This included articles, reports, and collections from the Armenian Institute of Zoology. Additionally, data from the national EIA report (including field survey results) were also considered. During the field survey, reptiles and amphibians were observed visually. Reptiles were also searched for under stones, while amphibians were additionally surveyed using acoustic methods.

Results

The list of reptiles and amphibians presented in **Table 6-18**.

Table 6-18. Reptiles and Amphibians of the study area

№	Armenian name	English name	Scientific names	1	2	3	4	5
Reptilia								
Gekkonidae								
1	Կասպիական գեկոն	Caspian thin-toed gecko	Tenuidactylus caspius	-	+			
Agamidae								
2	Կովկասյան ագամա	Caucasian agama	Laudakia caucasia	+	+			
Anguidae								
3	Դեղնափորիկ	Pallas's glass lizard	Pseudopus apodus	+	+			+
Scincidae								
4	Երկարատոն սցինկ	Schneider's skink	Eumeces schneideri	+	+	LC	VU	
Lacertidae								
5	Շտրաուխի մողեսիկ	Strauch's racerunner	Eremias strauchi	+	+			
6	Շերտավոր մողես	Caucasus emerald lizard	Lacerta strigata	+	+			
7	Միջին մողես	Medium Lizard	Lacerta media (Lacerta viridis)	+	-			+
Boidae								
8	Արևմտյան վիշապիկ		Eryx jaculus	+	+			+
Colubridae								
9	Սովորական լորտու	Grass snake	Natrix natrix	+	-			
10	Ջրային լորտու	Water snake	Natrix tessellata	+	-			+
11	Սովորական պղնձօձ	Smooth snake	Coronella austriaca	+	-			+
12	Կապարագույն սահնօձ	Coin-marked snake	Hemorrhois nummifer (Coluber nummifer)	+	+			+
13	Նյարդային սահնօձ	Dahl's whip snake	Platyceps najadum	+	-			
Viperidae								
14	Կովկասյան գյուրզա or Գյուրզա	Levant viper	Vipera (Macrovipera) lebetina	+	+			
Amphibia								
Bufonidae								
1	Կանաչ դոդոշ	European green toad	Bufo viridis	+	+			+
Hylidae								
2	Փոքրասիական ծառագորտ	Middle East tree frog	Hyla savigny	+	-			
Ranidae								

№	Armenian name	English name	Scientific names	1	2	3	4	5
3	Լճագորտ	Marsh frog	Rana ridibunda	+	+			
4	Փոքրասիական գորտ	Long-legged wood frog	Rana macrocnemis	+	+			

Keys to the Table 6-18

Column titles:

1 - Information from various sources
2 - Data from field studies
3 - IUCN Red List
4 - Red Book of the RA
5 - Resolution 6 of Bern Convention
Any of the species are not listed in Annex II of the Habitats Directive, Annex IV of the Habitats Directive

Signs:

+ listed or registered
- not registered
no sign - not listed

Conservation status

in - IUCN Red List, column 3:
LC - Least Concern
In Red Book of the RA, column 4:
VU - vulnerable

Based on the above, 14 species of reptiles can potentially inhabit the area, including seven species of lizards and seven species of snakes, and four species of amphibians. Of interest in this area is the presence of the Caspian thin-toed gecko, which entered the territory of Armenia several years ago and is expanding its habitat. Until recent years, there were no records of it in the area proposed for the reservoir.

The Schneider's skink (*Eumeces schneideri*) is listed in the IUCN Red List (ver. 3.1) as Least Concern and in the Red Book (2010) as Vulnerable VU B1ab(iii)+2ab(iii). During one day of research, only two individuals were encountered, on different slopes of the riverbed and twice under large stones in the uppermost parts of the area.

Of the 18 identified reptilian species, one species (Schneider's skink, *Eumeces schneideri*) is included into the RA Red Book (VU) and identified by as significant biodiversity feature, six species and their habitats are qualified as the Critical Habitat according to the EBRD PR 6 criterion 14-ii as they are listed in Annex IV of the EU Habitats Directive (**Table 6-18**). One species of amphibian - European green toad *(Bufo viridis)* and its habitat is qualified as the Critical Habitat on the same basis.

Ichthyofauna

The composition of fish species found in the Kasakh River is presented in **Table 6-19**. This assessment is based on the review and analysis of existing literature, complemented by the field survey observations.

Table 6-19. The composition of fish species in the Kasakh river

Barach, 1940	Dadikyan, 1986	Gabrielyan, 2001	Lievin, Rubenyan, 2010	Pipoyan 2012	Pipoyan, 2018 -2024
Salmo trutta fario	Salmo trutta fario	Salmo trutta fario	-	Salmo trutta fario	Trout (Salmo trutta fario)
	Salmo caspius	Salmo trutta trutta	-	-	-
-	-	-	-	-	Rainbow trout (Oncorhynch us mykiss)
Capoeta capoeta sevangi	Capoeta capoeta ssp.	-	Capoeta capoeta sevangi	Capoeta capoeta sevangi	Caucasian scraper (Capoeta capoeta)

Barach, 1940	Dadikyan, 1986	Gabrielyan, 2001	Lievin, Rubenyan, 2010	Pipoyan 2012	Pipoyan, 2018 -2024
-	-	-	-	-	Aras scraper (Capoeta kaput)
Barbus cyri	Barbus cyri	Barbus cyri	-	-	Kura barbel (Barbus cyri)
-	Squalius orientalis	Squalius orientalis	Squalius orientalis	Squalius orientalis	European chub (Squalius orientalis)
	Chndrostoma cyri				Kura nase (Chondrosto ma cyri)
	Luciobarbus capito*			Luciobarbus capito*	Bulatmai barbel (Luciobarbus capito)*
	Luciobarbus mursa			Luciobarbus mursa	Mursa (Luciobarbus mursa)
	Alburnus filippii	Alburnus filippii	Alburnus filippii		Kura bleak (Alburnus filippii)
	Alburnoides eichwaldii	Alburnoides eichwaldii	Alburnoides eichwaldii	Alburnoides eichwaldii	South Caspian sprilin (Alburnoides eichwaldii)
	Cyprinus carpio				Common carp (Cyprinus carpio)
	Oxynoemache ilus angorae	Oxynoemacheilu s angorae			Veysel's loach (Oxynoemach eilus veyseli)
	Sabanejewia aurata	Sabanejewia aurata			
		Barbatula barbatula caucasica			
	Silurus glanis				
				Pseudorasbora parva	Topmouth gudgeon (Pseudorasbo ra parva)
				Carassius gibelio	Prussian carp (Carassius gibelio)
Total number of species/subspecies:					
3	14	9	4	8	15

**Species Bulatmai barbel (Luciobarbus capito) included in the IUCN Red List category "Vulnerable"*

When comparing the present fish populations of the Kasakh River with those of past years, three distinct groups can be identified:

1. Species that have historically resided and continue to inhabit the Kasakh River,
2. Species that have vanished from the Kasakh River,
3. Species that have recently appeared in the Kasakh River.

Currently, the main fish species in the middle and upper reaches of the Kasakh River include the Trout, Caucasian scraper, Kura barbel, Kura bleak, European chub, South Caspian sprilin. These species are native to the local fish community. In addition, there are invasive species such as Topmouth gudgeon, Prussian carp, and Rainbow trout. Notably, the Topmouth gudgeon and Prussian carp, which were introduced in the 1960s and 70s, adapted well to various conditions, gradually expanding their presence and displacing native species from their ecological niches. The Topmouth gudgeon, in particular, has become one of the most populous fish in the middle stretches of the Kasakh River, second only to the South Caspian sprilin.

On the other hand, due to poaching and illegal fishing, several native species, especially the Trout, have nearly disappeared from the main channel of the Kasakh River and are now mostly found in some of its tributaries, namely Amberd. Rainbow trout, by contrast, is found sporadically and in small numbers. Unlike the Topmouth gudgeon and Prussian carp, these species do not breed in the Kasakh River.

From the 15 identified species, one species (Bulatmai barbel, Luciobarbus capito) is assessed as the Priority Biodiversity Feature according to the EBRD PR6 criterion 12-ii as this is listed in the IUCN Red List category «Vulnerable» (**Table 6-19**).

Terrestrial invertebrates

Methods

Data collection included a Pollard Walk for butterflies and an active search for visual sightings of beetles in the grass, on the ground, and under stones.

Data processing included visualization of the insects' community in the table form that also shows priority species. The priority species are those listed either in the RA Red Book, in the IUCN Red List, in the Resolution 6 of the Bern Convention, or are considered Restricted Range species.

Results

The results of the survey of the invertebrates' diversity are presented in **Table 6-20** and include 75 species.

Table 6-20. Terrestrial invertebrates of the study area

№	Latin names	RDB AM	Regional endemic	Bern Res 6
	LEPIDOPTERA			
	Hesperiidae			
1	Erynnis tages			
2	Erynnis marloyi			
3	Carcharodus alceae			
4	Carcharodus lavatherae			
5	Spialia orbifer			
6	Pyrgus serratulae			
7	Ochlodes sylvanus			

№	Latin names	RDB AM	Regional endemic	Bern Res 6
	Papilionidae			
8	Iphiclides podalirius			
9	Papilio machaon			
	Pieridae			
10	Leptidea sinapis			
11	Anthocharis cardamines			
12	Anthocharis gruneri		X	
13	Euchloe ausonia			
14	Aporia crataegi			
15	Pontia edusa			
16	Pieris pseudorapae			
17	Pieris ergane			
18	Pieris rapae			
19	Pieris brassicae			
20	Colias sareptensis			
21	Colias crocea			
22	Gonepteryx farinosa			
	Lycaenidae			
23	Armenia ledereri		X	
24	Armenia hyrcanica		X	
25	Nordmannia spini			
26	Nordmannia abdominalis		X	
27	Callophrys chalybeitincta			
28	Lycaena phlaeas			
29	Lycaena thersamon			
30	Cupido osiris			
31	Celastrina argiolus			
32	Pseudophilotes vicrama			
33	Glaucopsyche alexis			
34	Plebeius argus			
35	Plebejides sephirus			
36	Aricia agestis			
37	Plebejidea loewii			
38	Lysandra bellargus			
39	Lysandra corydonius			
40	Meleageria daphnis			
41	Polyommatus (icarus) icarus			
42	Polyommatus thersites			
43	Polyommatus (Agrodiaetus) demavendi		X	
	Nymphalidae			
44	Libythea celtis			
45	Lasiommata megera			
46	Lasiommata maera			
47	Melanargia larissa			
48	Coenonympha pamphilus		X	

№	Latin names	RDB AM	Regional endemic	Bern Res 6
49	Hyponephele lycaon			
50	Hyponephele lupina			
51	Maniola jurtina			
52	Hipparchia pellucida			
53	Hipparchia syriaca		X	
54	Hipparchia statilinus			
55	Satyrus amasinus		X	
56	Pseudochazara pelopea		X	
57	Pseudochazara thelephassa			
58	Chazara briseis			
59	Chazara persephone			
60	Thaleropis ionia		X	
61	Limenitis reducta			
62	Neptis rivularis			
63	Vanessa atalanta			
64	Vanessa cardui			
65	Polygonia c-album			
66	Polygonia egea			
67	Aglais urticae			
68	Argynnis pandora			
69	Argynnis niobe			
70	Issoria lathonia			
71	Euphydryas aurinia			X
72	Melitaea didyma			
73	Melitaea cinxia			
74	Melitaea arduinna			
COLEOPTERA				
Carabidae				
75	Carabus maurus			
76	Cicindela campestris			

Keys to 6-20

Column titles:
RDB AM - Red Book of the RA
Regional endemic - endemic of Caucasus region
Bern Res 6 - Resolution 6 of the Bern Convention

Signs:
X regional endemic of listed in Resolution 6 list of the Bern Convention
no sign - not endemic or not listed

Conservation status (in - Red Book of the RA):
VU - vulnerable
EN - endangered

From the 76 identified species, 10 species are assessed as the Priority Biodiversity Features according to the EBRD PR6 criterion 12-ii – 9 species as they are range-restricted species of the Caucasian region, and one species (Euphydryas aurinia) as this species is included to the Resolution 6 of the Bern Convention.

Habitats

Habitats identified at the Kasakh site are listed in **Table 6-21**. They are presented according to the habitat classification for Armenia, developed based on the EUNIS classification system. The identified habitats are assessed for overlap with those listed in the Resolution No. 4 of the Bern

Convention and Annex I of the EU Habitats Directive, in order to identify any Priority Biodiversity Features and Critical Habitats.

Twelve habitats are identified according to the habitat classification for Armenia (**Table 6-21**). Eight habitats did not correspond to any habitat listed in the EU lists. Each of the other four habitats corresponds to one habitat from the Annex 1 of the EU Habitats Directive (in three cases, to Resolution No.4 of the Bern Convention as well).

Of the twelve identified habitats, one (namely Armenian habitat F3.1 Temperate thickets and scrub = 40A0* Subcontinental peri-Pannonic scrub, in Annex I of the EU Habitats Directive) is assessed as the Critical Habitat according to the EBRD PR 6 criterion 14-i as this is marked as priority habitat in Annex I of the EU Habitats Directive.

Three habitats are assessed as the Priority Biodiversity Features according to the EBRD PR6 criterion 12-i as they are listed in the both lists mentioned above.

Map of the twelve identified habitats in the footprint area is shown in the **Figure 6.16**. Map of the four habitats listed in the Annex I of the EU Habitats Directive is shown in the **Figure 6.17**.

The following areas of the four priority habitats (**Figure 6.17**) are defined in the footprint area (the first name is from the habitat classification for Armenia, the second name – a name of similar habitat from the Annex I of the EU Habitats Directive:

- F3.1 - Temperate thickets and scrub = 40A0 Subcontinental peri-Pannonic scrub, 11.36 ha,
- F9.12 - Lowland and collinear riverine willow scrub = 3280 Constantly flowing Mediterranean rivers with Paspalo-Agrostidion species and hanging curtains of Salix and Populus alba, 3.08 ha,
- G1.11 - Riverine willow woodland = 92A0 Salix alba and Populus alba galleries, 2.83 ha,
- H3.1 - Basic and ultra-basic inland cliffs = 8210 Calcareous rocky slopes with chasmophytic vegetation, 3.07 ha.

Figure 6-16. Map of the habitats identified in the footprint area

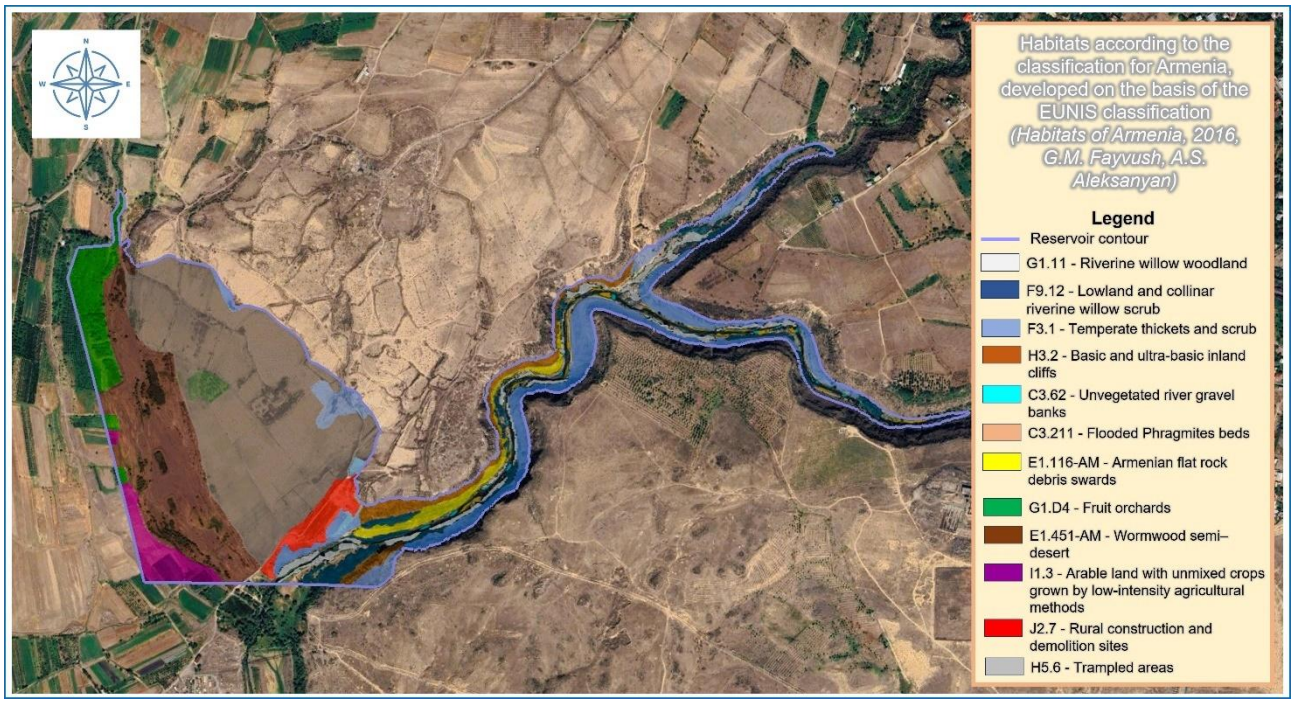


Figure 6-17. Habitat Map according to Annex I EU Habitat Directive Classification in the footprint area

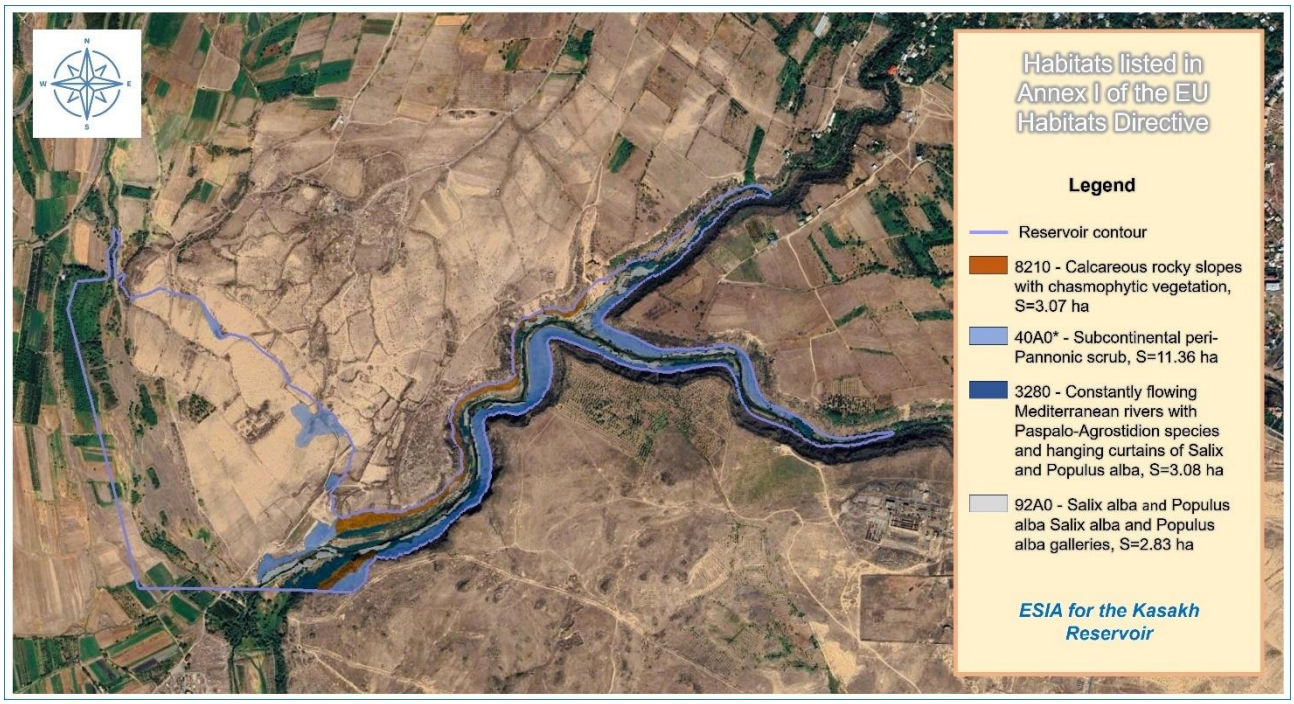


Table 6-21. Habitats identified in the Kasakh site area

Objects	Habitat according to the classification for Armenia, developed on the basis of the EUNIS classification (Habitats of Armenia, 2016, G.M. Fayvush, A.S. Aleksanyan)		Habitat (in accordance with Resolution №4 of the Bern Convention)		Habitat (in accordance with Annex 1 of the EU Habitats Directive)		Spreading, dominated plant species
Kasakh	*Code*	*Name*	*Code*	*Name*	*Code*	*Name*	
	C3.211	Flooded Phragmites beds	-	-		-	Phragmites australis Very common habitats in Armenia
	C3.62	Unvegetated river gravel banks.	-	-	-	-	Widespread habitats were formed in the lower, middle and upper reaches of many rivers
	E1.116-AM	Armenian flat rock debris swards.	-	-	-	-	Habitats are very wide distributed in Armenia from lower to alpine belt, but occupied not very big areas. They are common in all floristic regions. Sedum spp., Saxifraga spp., Sempervivum transcaucasicum Poa bulbosa, Erophila verna, Androsace maxima, Androsace chamaejasme usually dominate in these communities]
	F3.1	Temperate thickets and scrub	-	-	40A0*	Subcontinental peri-Pannonic scrub	Cerasus incana, Amygdalus fenzliana, Genista tinctoria, Rhωmnus cathωrtica, Crataegus ssp.m etc.
	F9.12	Lowland and collinear riverine willow scrub.	F9.1	Riverine scrub	3280	Constantly flowing Mediterranean rivers with Paspalo-Agrostidion species and hanging curtains of Salix and Populus alba	Common Habitats in Armenia are limited to the lower reaches of most large rivers
	G1.11	Riverine willow woodland	G1.11	Riverine Salix woodland	92A0	*Salix alba* and *Populus alba* galleries	Salix alba, S. excelsa, Populus alba, P. nigra, P. canescens,

Objects	Habitat according to the classification for Armenia, developed on the basis of the EUNIS classification (Habitats of Armenia, 2016, G.M. Fayvush, A.S. Aleksanyan)		Habitat (in accordance with Resolution №4 of the Bern Convention)		Habitat (in accordance with Annex 1 of the EU Habitats Directive)		Spreading, dominated plant species
							Lycopus europaeus, Lysimachia vulgaris and Urtica dioica.
	G1.D4	Fruit orchards.	-	-	-	-	Rosaceae are Common Habitats in Armenia
	H3.2	Basic and ultra-basic inland cliffs	H3.2	Basic and ultra-basic inland cliffs	8210	Calcareous rocky slopes with chasmophytic vegetation	They are common habitats in Armenia
	E1.451-AM	Wormwood semi-desert	-	-	-	-	Habitats are very wide distributed in lower mountain belt of Armenia; Artemisia fragrans is a dominant in these communities. Xeranthemum squarrosum, Taeniatherum crinitum, Euphorbia marschalliana, Kochia prostrata, Koelpinia linearis, Ceratocephala falcata are common species. In Darelegis and Yerevan floristic regions there are communities where Artemisia araxina is a dominant]
	I1.3	Arable land with unmixed crops grown by low-intensity agricultural methods	-	-	-	-	
	J2.7	Rural construction and demolition sites	-	-	-	-	
	H.5.6	Trampled areas	-	-	-	-	Bare, trampled soils resulting from trampling by humans or other vertebrates, including birds.

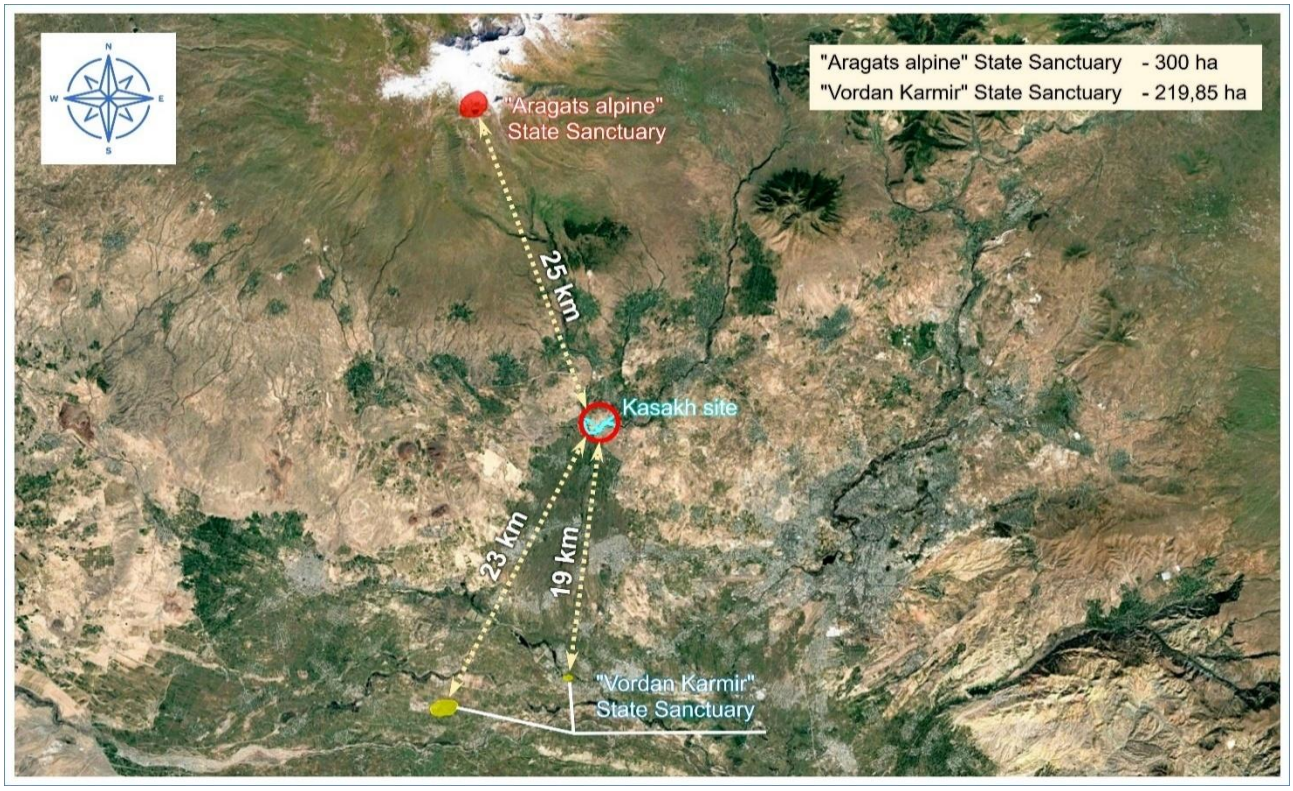
6.2.4 Specially Protected and Internationally Recognized Areas and Forests

National sites

Armenia is rich in Specially Protected Areas of Nature (SPAN). There are 34 officially registered SPANs in Armenia, of which: 3 state reserves - Khosrov Forest, Shikahogh, and Erebuni, occupying a total area of 35,439.6 ha (1.19% of Armenia's territory); 4 national parks - Sevan, Dilijan, Lake Arpi, and Arevik, covering 236,802.1 ha (7.96% of the country's area); 27 state sanctuaries and 232 natural monuments together occupying 114,812.7 ha (3.95% of Armenia's territory).

The planned Kasakh Reservoir site does not fall within any SPAN. The nearest SPANs, the *Aragats Alpine* State Sanctuary (in Aragatsotn Marz) and the *Vordan Karmir* State Sanctuary (in Armavir Marz), are located approximately 25 km and 19 km from the Project site, respectively (**Figure 6-18**).

Figure 6-18. Location of the SPANs in the vicinity of the Project site



The natural monuments located in Aragatsotn and Armavir Marzes as per the RA Government Decree №967-N On Approving the List of Nature Monuments of the Republic of Armenia are listed in **Table 6-22**.

Table 6-22. Natural monuments in Aragatsotn and Armavir Marzes

№	Types of natural monuments	In Aragatsotn Marz	In Armavir Marz
1	Geological monuments	10 units	
2	Hydrogeological monuments	4 units	
3	Hydrographic monuments	4 units	1 units
4	Natural historical monuments	5 units	
5	Biological monuments	-	2 units
Total		**23 units**	**3 units**

In total, 26 natural monuments are registered in the project-affected Aragatsotn and Armavir Marzes; however, none of them is located within the project area or its immediate vicinity. The nearest natural monuments to the project site are the hydrogeological monument *Jaghaci* water spring, located in Ghazaravan village (Aragatsotn Marz), approximately 7.5 km to the north, and the biological monument *Avazaser* (psammophilous vegetation), located in Etchmiadzin city (Armavir Marz), around 9.0 km to the south.

Internationally Recognized Areas

Armenia signed the Bern Convention in 2006 and ratified in 2008. Since then, the country has worked on establishing the Emerald Network and listed more than 110 species requiring protection and habitat conservation, according to the Bern Convention Resolutions №4 (1994) and №6 (1998).

As of June 2025, Armenia had not officially adopted any Emerald Network sites. However, 23 sites within the territory of the Republic of Armenia had been officially nominated as candidate Emerald Sites (last confirmation of the candidate sites list was done at the 44th meeting of the Standing Committee of the Convention on the Conservation of European Wildlife and Natural Habitats, December 2024)[92].

At the same time, as a reaction to the immediate challenges identified by the Ministry of Environment (MoE), the Emerald Network database was completely revised and optimized by the World Bank under the European Union for Environment (EU4Environment) Action Program[93]. The proposed set consists of 30 Emerald sites, covering 707,739.22 ha (23.8 percent of the national coverage, almost a third less than previously)[94]. However, this revision has not been approved yet.

The nearest candidate Emerald Sites to the Project site are the "Arailer" area (AM0000022), located approximately 13 km to the northeast, and the "Metsamor" area (AM0000017), located about 14 km to the southwest. Another candidate Emerald Site - the "Aragats Alpine" area (AM0000010) is located approximately 22 km to the northwest of the Project site (**Figure 6-19**).

The nearest internationally recognised area of biodiversity value to the Project site is the Arax River Key Biodiversity Area (KBA) (**Figure 6-20**). It is located 7,1 km south of the planned reservoir area and covers approximately 1031.54 km².

Species that meet the KBA criteria in this area include birds – Great Bastard (Otis tarda), Marbled teal (Marmaronetta angustirostris), mammals - Mehely's horseshoe bat (Rhinolophus mehely), Eurasian otter (Lutra lutra), reptilian - Common Tortoise (Testudo graeca) and plant - endemic of Armenian highland, Tigran's elder (Sambucus tigrani).

Another recognized site of biodiversity value is the Artashavan KBA. It is located 9 km north of the planned reservoir area and covers approximately 38.46 km². Species that meets the KBA criteria in this area is Tigran's elder (Sambucus tigrani).

[92] https://rm.coe.int/pa18e-2024-draft-candidate-list-emerald-network-sites-2779-8956-4427-1/1680b27e33

[93] EU4Environment. 2024. Recommendations for Review of the Candidate Emerald Sites in Armenia. Washington DC: World Bank. https://www.eu4environment.org/app/uploads/2024/11/Recommendations-for-Review-of-the-Candidate-Emerald-Sites-in-Armenia.pdf

[94] Ibid

Figure 6-19. Location of the Candidate Emerald Areas in the vicinity of the Project site

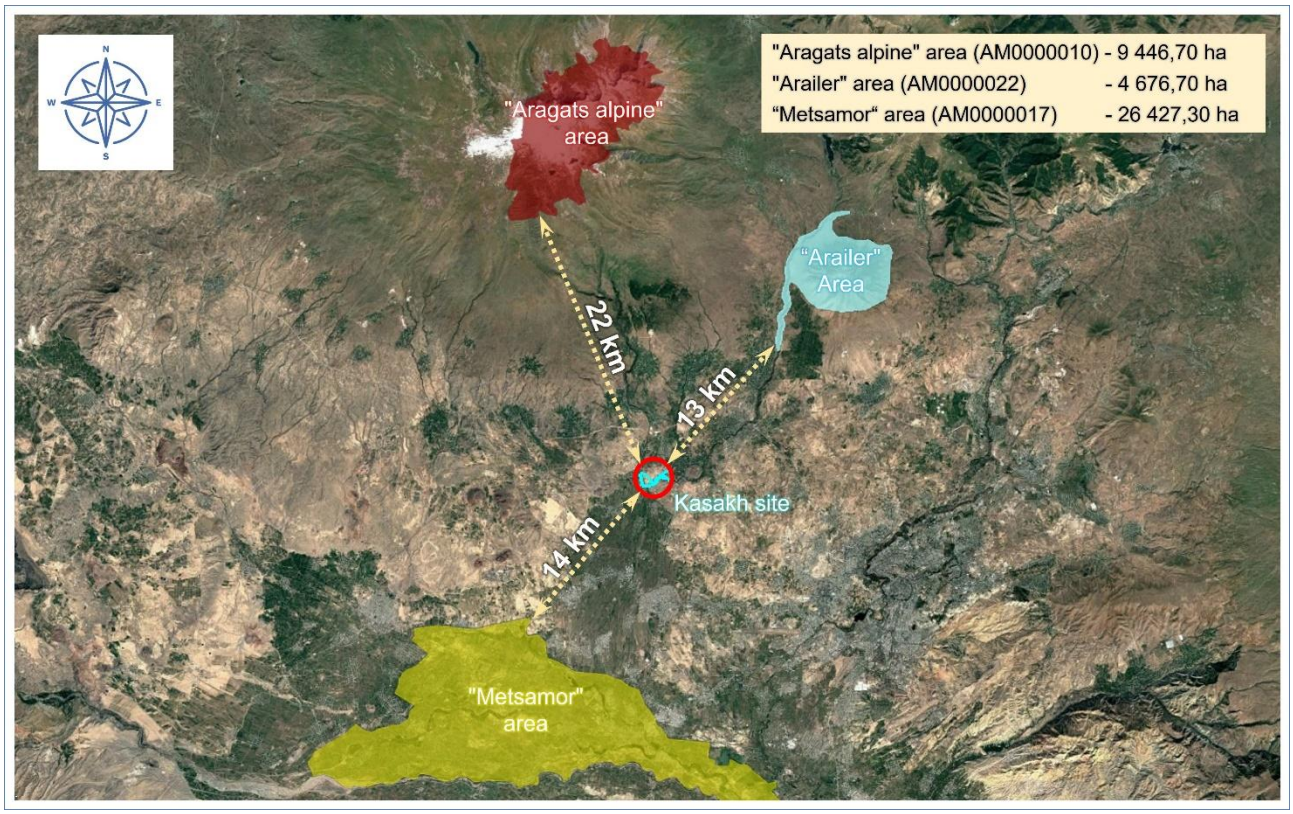
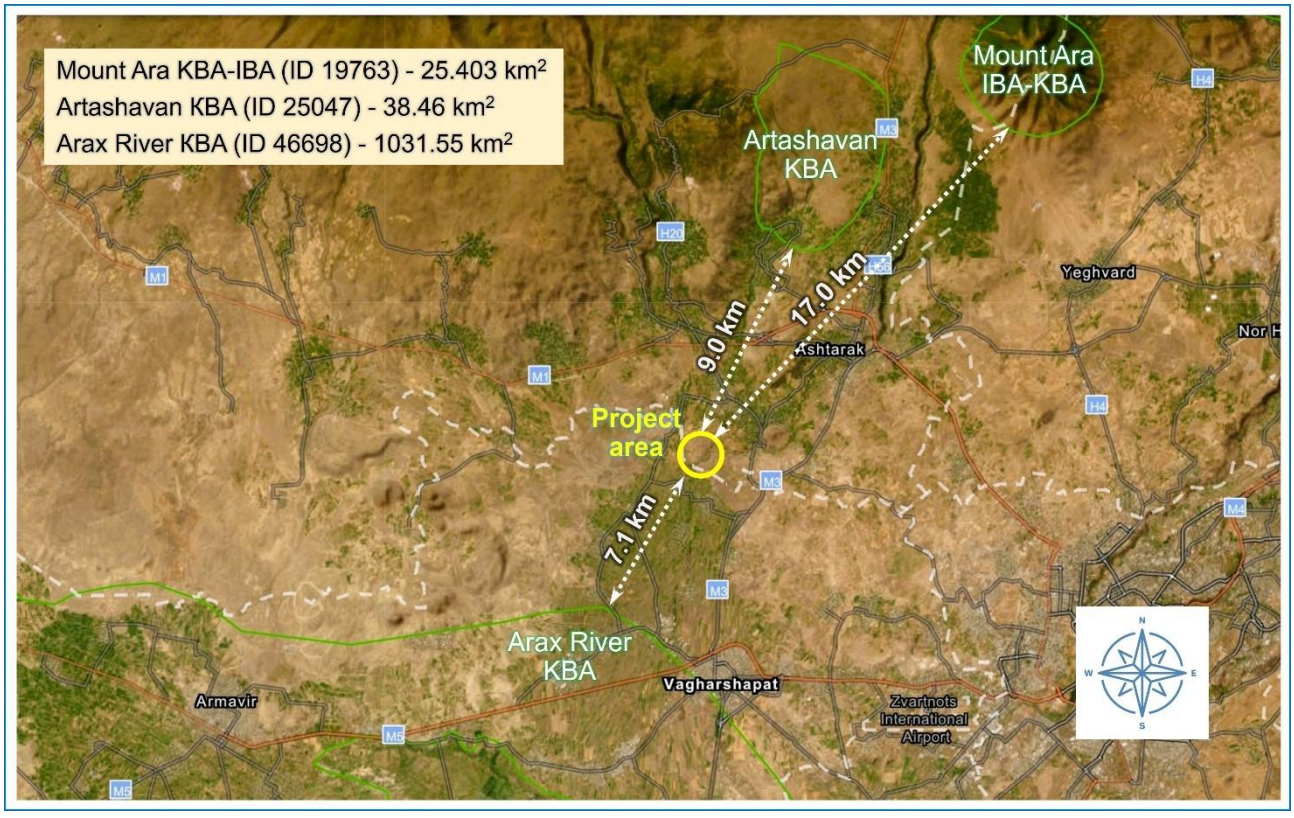


Figure 6-20. Location of the KBAs / IBAs in the vicinity of the Project site



6.2.5 Critical Habitat Assessment Findings

Among the 12 habitats, 63 flora species, and 249 fauna species identified during biodiversity surveys, the following features (see **Table 6-23)** have been assessed as triggering Priority Biodiversity Feature (PBF) or Critical Habitat (CH) according to the EBRD PR6. PBFs include 3 habitats and 45 species - 1 mammal species, 32 bird species, 1 fish species, 1 reptile species and 10 insect species, CHs - one habitat and 11 species - 4 mammal species, 6 reptile species, 1 amphibia.

Table 6-23. Summary Table of Priority Biodiversity Features and Critical Habitats Identified in the footrpint area[95]

№	Criterion	Features (Habitats/species)
Priority Biodiversity Features as per EBRD PR6 (§12)		
i	12.i.a EAAA[96] is habitat type listed in Annex I of the EU Habitats Directive and Resolution 4 of the Bern Convention	Habitats (×3) 3280 Constantly flowing Mediterranean rivers with Paspalo-Agrostidion species and hanging curtains of *Salix* and *Populus alba,* 92A0 *Salix alba* and *Populus alba* galleries, 8210 Calcareous rocky slopes with chasmophytic vegetation.
ii	12.ii.a EAAA for species and their habitats listed in Annex II of the Habitats Directive, Annex I of the Birds Directive, or Resolution 6 of the Bern Convention	Birds (×30) *Botaurus minutus (LC)* *Ciconia nigra (LC)* *Ciconia Ciconia (LC)* *Pernis apivorus (LC)* *Tachyspiza brevipes (LC)* *Buteo rufinus (LC)* *Aquila nipalensis (EN)* *Hieraaetus pennatus (LC)* *Falco peregrinus (LC)* *Anthropoides virgo (LC)* *Sternula albifrons (LC)* *Bubo bubo (LC)* *Lullula arborea (LC)* *Luscinia svecica (LC)* *Neophron percnopterus* (EN) *Clanga pomarina* (LC) *Gyps fulvus* (LC) *Circaetus gallicus* (LC) *Circus cyaneus* *Circus macrourus* (NT) *Circus pygargus* (LC) *Caprimulgus europaeus* (LC) *Coracias garrulus* (LC) *Alcedo atthis* (LC) *Anthus campestris* (LC) *Dendrocopos syriacus* (LC) *Ficedula semitorquata* (LC)

[95]In case a species would trigger several criteria in the PBF and CH, the species is listed in this table only as the highest conservation concern, which is CH.

[96] EAAA - ecologically appropriate area of analysis

№	Criterion	Features (Habitats/species)
		Lanius collurio (LC) *Lanius minor* (LC) *Pyrrhocorax pyrrhocorax* (LC) Insects (×1) *Euphydryas aurinia*
	12.ii.b EAAA supports < 0.5% of global population OR < 5 reproductive units of a CR or EN species	Birds (×1, already triggering ii.a and ii.d) *Neophron percnopterus* (EN)
	12.ii.c EAAA supports VU species	Fishes *Luciobarbus capito (VU)*
	12.ii.d EAAA for regularly occurring nationally or regionally listed EN or CR species	Mammals (×1) *Neomys teres (schelkovnikovi) (LC)* listed in the Red Book of RA as EN Birds (×1, already triggering cr.12 ii.a and ii.b) *Neophron percnopterus* (EN)
	12.ii.e EAAA for regularly occurring range-restricted species	Birds (×1) *Phylloscopus sindianus* Insects (×9)
iii	12.iii Significant biodiversity features identified by a broad set of stakeholders or governments	Birds (×1) *Irania gutturalis* (LC) listed in the Red Book of RA as VU Reptiles (×1) *Eumeces schneideri* listed in the Red Book of RA as VU
Critical Habitats as per EBRD PR6 (§14)		
i	14.i.a EAAA is habitat type listed in Annex IV of the EU Habitats Directive	Habitats (×1) 40A0 Subcontinental peri-Pannonic scrub
ii	14.ii.a EAAA for species and their habitats listed in Annex IV of the Habitats Directive	Mammals (×3) *Canis lupus* *Lutra lutra (NT)* *Felis silvestris (LC)* *Pipistrellus sp.* Reptiles (×6) *Pseudopus apodus* *Lacerta media (Lacerta viridis)* *Eryx jaculus* *Natrix tessellata* *Coronella austriaca* *Hemorrhois nummifer (Coluber nummifer)* Amphibians (×1) *Bufo viridis*

6.3 Social and Socio-economic Environment

The sections below are informed by the review of primary and secondary sources, such as publications and bulletins of the Statistical Committee of the RA, focus group discussions and

interviews with the heads of the villages held in August 2024, and ESIA Consultant's observations during the site visit and socio-economic studies.

6.3.1 Overview of the Project area

According to the design document, Kasakh reservoir will be built within administrative territories of Amberd and Aygeshat villages of Khoy community, Armavir Marz and Oshakan, Voskevaz and Voskehat villages of Ashtarak community, Aragatsotn Marz.

The nearest to the planned reservoir body residential houses are located at the following distances:

- 450 m in Amberd village,
- 1300 m in Aygeshat village,
- 450 m in Oshakan village,
- 1200 m in Voskevaz village,
- 850 m in Voskehat village.

Amberd and Aygeshat villages of Khoy community, Armavir Marz

Armavir Marz is a province in the western part of Armenia, it covers an area of 1,242 km^2 (4.2% of the country's total area), making it the smallest province of the country in terms of the total area. In the north it borders Aragatsotn Marz, in the east - the country's capital Yerevan, in the south-east - Ararat Marz, and in the west, it borders the Republic of Türkiye. Armavir Marz is divided into 8 communities, the Khoy community includes 16 villages[97].

Amberd (known as Franganots until 1978) and Aygeshat villages are located in the Khoy community, Armavir Marz, ca. 30 km northeast from the Marz capital Armavir city, and ca.10 km from the Marz largest city Vagharshapat. The villages lay at the intersection of Amberd and Kasakh rivers, at an altitude of about 950 masl, on the southern slope of Mount Aragats descending to the Ararat valley. The surrounding settlements are Aghavnatun, Lernamerdz, Aygeshat, and Doghs villages of Armavir Marz, as well as Oshakan, Voskevaz and Voskehat villages of Aragatsotn Marz.

Oshakan, Voskevaz and Voskehat villages of Ashtarak community, Aragatsotn Marz

Aragatsotn Marz is a province in the northwestern part of Armenia, it covers an area of 2,756 km^2 (9.3% of the total country's area), making it the fourth largest province of the country in terms of the total area. The Marz is bordered by Shirak and Lori Marz in the north and northeast, Kotayk Marz in the east, and Armavir Marz and Yerevan city in the south. The Akhurian River in the west separates Aragatsotn from the Kars province of the Republic of Türkiye. Aragatsotn Marz is divided into eight communities, Ashtarak community includes 29 settlements[98].

Oshakan village is located 3 km southwest from the Marz capital and largest city Ashtarak. The village is located in the Kasakh River valley, which runs through the village, at an altitude of 1020 masl (**Figure 6-21**).

[97]Ministry of Territorial Administration and Development of the Republic of Armenia, Armavir Marz: http://armavir.mtad.am/about-communities/200/

[98]Ministry of Territorial Administration and Development of the Republic of Armenia, Aragatsotn Marz: http://aragatsotn.mtad.am/about-communities/

Figure 6-21. Medieval bridge over Kasakh River

Source: from Wikipedia

Voskehat village is located in the lower part of the Amberd River, at an altitude of about 1,025 masl, 7 km from Ashtarak city.

Voskevaz village is located on the right bank of the Kasakh River, at an altitude of about 1,040 masl, 5 km from Ashtarak city. The village is home to Voskevaz winery founded in 1932 (**Figure 6-22**).

Figure 6-22. Voskevaz winery in Voskevaz village

Source: from Wikipedia

6.3.2 Demography[99]

Armavir Marz is the smallest, but most densely populated Marz in the RA - 211 people per km^2 (the higher population density is only in Yerevan, which is granted special administrative status as the country's capital). Population of the Marz as of the beginning of 2024 is 259.7 thousand people, of whom 51% are women. Around one-third of the Marz population is urban, while two-thirds are rural.

The population of Aragatsotn Marz as of January 2024 is 131.8 thousand people, of whom 50% are women. The population density is significantly lower compared to Armavir, around 48 people per km^2. About a quarter of the Marz population is urban, and three quarters are rural.

The number of people residing in the villages located in the reservoir's area of impact is presented below. As per interviews with the heads of villages, the out migration is low in these settlements.

Table 6-24. Population of the project affected villages, persons (2024)

Village	Population, persons	Women, persons	Households
Armavir Marz			
Amberd	1646	903 (54.9%)	323
Aygeshat	1750	922 (52.7%)	325
Aragatsotn Marz			
Oshakan	6000	3250 (54.2%)	2750
Voskevaz	4649	2335 (50,2%)	2314
Voskehat	1130	680 (60.2%)	450

6.3.3 Regional and Local Economy

Armavir Marz is known for its agriculture and industry in the RA. The geographical position and climatic conditions of the Marz are favourable for both plants growing (perennial food plants and other vegetables), and livestock breeding. Namely, farming of cattle, sheep, goats, and poultry is developed, and in crop production - growing of grains, vegetables, fruits and grapes, with a noticeable focus on wine and brandy production.

Electricity generation, production of building materials, food and beverage manufacturing are the main industrial sectors in the region. The Armenian nuclear power plant, the only one in the South Caucasus region, is located in the Marz, 36 km west of Yerevan. Its distance from the proposed reservoir site is ca.30 km.

Highways M3 (Yerevan - Georgia state border), central to the region M5 (Yerevan - Vagharshapat[100]-Armavir), and M9 (Talin-Vanand, runs parallel to the border with Türkiye) are crossing the marz. Regional roads H12, H15, H16, H17, H18 connect the settlements with the highways. International year-round Yerevan-Tbilisi railway runs through the territory of the Marz via Armavir. However, transportation by road is by far the dominant mode for both freight and passenger transportation within the country. The main international airport of Armenia "Zvartnots" is also located in the Marz, 10 km west of Yerevan.

[99] Information for this sub-section was mainly extracted from the website of Armstat's publication RA Armavir Marz in figures, 2024 available at https://armstat.am/en/?nid=978 and RA Aragatsotn Marz in figures, 2024 available at https://armstat.am/en/?nid=975

[100] *Vagharshapat is also referred to as Etchmiadzin in this report*

Main income sources for Amberd and Aygeshat villagers are agriculture and employment in the cities of Ashtarak and Yerevan. Village residents are engaged in agriculture: to a greater extent in plants growing, and to a lesser extent - animal husbandry. According to the head of Aygeshat village, residents don't cultivate their lands fully due to lack of irrigation water. For example, they cannot grow a second harvest, which could contribute to the household income, as the first harvest only covers the expenses. There are farmers who have hectares of orchards, but due to water shortage, the fertile land became deserted.

Agriculture is the dominant economic sector in *Aragatsotn Marz*. It contributes significantly to Armenia's overall agricultural output, particularly in grain and fruit production, with grapes being a particularly important crop. Dairy cattle breeding is also common, especially in the highlands around Mount Aragats.

Aragatsotn Marz industry is characterized by food processing, alcoholic beverage production, and the extraction of building materials. While it contributes only a small percentage to Armenia's total industrial output, the province has several notable factories, including dairy and cheese producers, wine and spirit manufacturers, and companies that produce building materials like crushed stone and perlite. While less prevalent, the province also has industries involved in the manufacture of electrical products, rubber and plastic products, and jewellery.

There are three highways of republican importance which run through the territory of the Aragatsotn Marz: M1 connects Aragatsotn with northwestern Armenia, M3 that connects to the Georgian border, and section of M9 which runs parallel to the border with Türkiye. Yerevan-Tbilisi railway runs through the Marz territory parallel to H75 regional road.

The main economic activity for Oshakan, Voskevaz, and Voskehat villagers is agriculture. The residents are engaged in viticulture, fruits, vegetables and berry growing. Animal husbandry is also common, however according to the focus group interviews the number of livestock has declined. There is a poultry farm "Ashtarak Dzu" in the village of Voskehat. Other sources of income for the residents include public sector and work in construction.

During the focus group interviews in the villages of Armavir Marz the problem of unsatisfactory condition of irrigation canals within the community was emphasized. While according to the focus group interviews the main social economic issues in the villages of Aragatsotn Marz include water scarcity, poor condition of the roads, and lack of sports facilities among other.

6.3.4 Poverty and Unemployment, Incomes and Expenditures[101]

As seen from **Table 6-25**, unemployment rates in both marzes are lower that the country's average, with Armavir registering higher numbers of unemployed compared to Aragatsotn. At the same time, the percentage of poor and extremely poor population in Armavir Marz is higher than the country's average level. Data for Aragatsotn Marz shows very positive dynamics, claiming that extreme poverty has been eradicated, and the proportion of poor population decreased significantly.

Table 6-25. Poverty and unemployment rates in Armavir and Aragatsotn Marz

Indicators	RA		Armavir Marz		Aragatsotn Marz	
	2020	2023	2020	2023	2020	2023
Unemployment rate	18.2	12.4	12.6	6.1	10	4
Poor population	27	23.7	32.2	25.9	32.9	9.2
Extremely poor population (in % of poor)	0.7	1.1	2.3	1.6	1.2	-

[101]Information for this section was mainly extracted from the website of Armstat's publication RA Gegharkunik Marz in figures, 2024 available at https://armstat.am/en/?nid=984

Information at the village level is provided in Table 6-26. The variation in the reported unemployment rates can partially be attributed to the difference in methodology, when self-employed farmers are accounted as officially unemployed.

Table 6-26. Unemployment rate and monthly income (dram) in the affected villages

Indicators	Khoy community of Armavir region		Ashtarak community of Aragatsotn region		
	Amberd	Aygeshat	Voskevaz	Voskehat	Oshakan
Unemployment rate	5%	30 %	20-30 %	20 %	5%
Average monthly nominal income	~140000	~ 140000	100000-200000	100000-200000	~ 100000

Information on expenditures of households by marzes is shown in in Table 6-27 in Table 6-28.

Table 6-27. Per capita consumer expenditures of the household on food (monthly average, dram)

Indicators	2019	2020	2021	2022	2023
National average	19 377	20 715	23 532	24 498	23 569
Aragatsotn Marz	15 049	17 834	20 803	31 867	24 643
Armavir Marz	14 971	15 272	18 004	16 402	15 430

Table 6-28. Nominal per capita consumer expenditures of the household (monthly average, dram)

Indicators	2019	2020	2021	2022	2023
National average	47 324	51 907	49 999	52 679	54 988
Aragatsotn Marz	31 707	36 863	36 865	58 838	52 789
Armavir Marz	46 951	51 406	43 397	41 358	46 600

6.3.5 Ethnic Minorities

Armavir Marz has a significant number of Yezidis, the largest ethnic minority group in the country. The village of Aknalich in Armavir hosts the world's largest Yazidi temple, opened in 2012. Armavir is also home to a smaller Assyrian community. The national minorities are predominantly settled in rural communities; however, Russians, Yezidis, and Ukrainians also reside in urban areas.

There are five households (20 persons) and six households (38 persons) of Yezidis in Amberd and Aygeshat villages respectively.

In Aragatsotn Marz, the primary ethnic minorities are Yezidis and Kurds, with some smaller communities of Assyrians, Russians, and Greeks. Significant Yezidi populations are found particularly along the Aragats mountain. There are 23 households (116 persons) and 50-60 households (311 persons) of Yezidis in Voskehat and Oshakan villages respectively. Kurds are present in the village of Alagyaz, which is around 60 km from the planned reservoir.

6.3.6 Social Infrastructure

Both provinces benefit from social infrastructure aimed at improving public access to essential services (Table 6-29).

Table 6-29. Social infrastructure facilities in Armavir and Aragatsotn Marz

Provinces	Pre-School institutions	General schools	Higher education	Libraries	Sports organizations	Museums
Armavir Marz[102]	108	119	2	69	5	3
Aragatsotn Marz[103]	34	121	1	51	4	1

Each Project affected village has one school (two schools in Oshakan), a medical unit or a first-aid station with one paramedic, and a post office. Village residents have access to gas, electricity, and water.

6.3.7 Gender Issues

According to the National Statistical Committee, 52% of women in Armenia are not employed and are not seeking employment[104]. A major reason for women's absence from the labour market is their engagement in unpaid household activities. The gender pay gap in Armenia was 39.2% in 2022. National gender problems such as female underrepresentation in labour market and decision-making processes, gender pay gap, etc. prevail in the project affected villages as well. The poorest households in the country tend to be women-headed households.

In general, women's participation in decision-making at the community level, especially in rural communities is low. The principal reasons for their limited involvement in community leadership include public opinion, men's lack of acceptance of women's leadership, women's fear of expressing themselves, and a lack of self-confidence among women[105]. Women underrepresentation remains also a problem in the Water Users Associations.

Furthermore, the construction of the reservoir may increase the risk of gender-based violence (GBV), including sexual harassment, exploitation, and domestic violence, particularly affecting women and girls in nearby communities. These risks often arise from the influx of non-local male workers and temporary worker accommodation sites located near rural settlements.

In the Armenian context, where traditional gender roles remain strong and rural women may have limited access to protection or reporting mechanisms, the presence of a large, predominantly male workforce can heighten vulnerabilities. Women engaged in small businesses, agriculture, or service provision around the construction area may face risks of harassment or coercion.

As per the focus group discussions, the shortage of water in the area negatively affects women in the villages. One participant highlighted that women's work in the field is difficult: the rain showers and hailstorms disturb and spoil the crops. All female participants believe that availability of water will positively affect work opportunities for women, i.e. they will put greenhouses which will help to protect the crops from the hail, some might further seek employment.

6.3.8 Socially Less Protected / Vulnerable Population

The following information on the social vulnerability of the residents was provided during interviews with the heads of affected villages (**Table 6-30**).

[102] https://armstat.am/file/Map/Armavir.pdf
[103] https://armstat.am/file/Map/Aragats.pdf
[104] European Union. 2024. Country Gender Profile Armenia. Eu4genderequality Reform Helpdesk. Available at: https://euneighbourseast.eu/wp-content/uploads/2024/04/eu4genderhelpdesk_armenia_countrygenderprofile_2024-cgp_v3compressed.pdf
[105] Ibid

Table 6-30. Socially vulnerable population of the affected villages

Affected village	Socially vulnerable (SV)*	Internally displaced**		Refugees from Artsakh (Karabakh)	
	persons	persons	households	persons	households
Voskevaz	678 (14.6%)	126	26, incl. 1 SV	119	24
Voskehat	20 (1.8%)		10, incl. 3 SV		
Oshakan	120 (2%)	220	59, incl. 10 SV		
Amberd	no information		16, incl. 10 SV	80	16
Aygeshat	no information		17, all SV	90	20

**SV groups are defined by factors like low-income, disability, refugee status, or being in a pre-retirement age, among others.*
***including refugees from Artsakh (Karabakh)*

6.3.9 Public Health and Safety

In Armavir and Aragatsotn Marz, similarly to the national level, cardiovascular diseases are a leading cause of death and illness. Other significant health issues include cancer, diabetes, and chronic respiratory diseases. Additionally, infectious diseases such as brucellosis, tularaemia, and vector-borne diseases like Leishmaniasis are also a concern.

Water borne infectious diseases are another public health concern caused by contaminated water sources or inadequate sanitation practices. No confirmed cases of cholera and polio were registered in Armenia in this millennia. At the same time, as of 2024 Armenia is categorized as a country with a high-intermediate prevalence of Hepatitis A. Bacterial dysentery is another public health concern at the national and regional levels.

Cardiovascular disease, diabetes, and cancer are a major public health risk in the affected villages as well. No detailed information on the prevalence of waterborne diseases was available for the affected villages.

The Sexually Transmitted Infections (STIs) within the project-affected settlements are not expected. This is largely attributed to the traditional, family-oriented lifestyle prevalent in rural areas of Armenia, where long-term marital relationships and close-knit community structures are common. These social characteristics tend to limit high-risk sexual behaviors and, consequently, reduce the potential for STI transmission.

There are 59 institutions providing primary healthcare services in Armavir Marz[106], and 24 institutions in Aragatsotn Marz[107]. The number of beds per 10 000 population of Marz is 14.5 in Armavir and 13.7 in Aragatsotn (2023)[108]. This is significantly lower than the country's average level of 41.7 beds per 10 000 population.

Each project affected village has a medical unit with one paramedic, therefore the local capacities are limited. The nearest hospitals are in Vagharshapat and Ashtarak.

6.3.10 Land Use Issues

Land resources data divided by the categories for the villages is shown in **Table 6-31**.

[106] https://armstat.am/file/Map/Armavir.pdf
[107] https://armstat.am/file/Map/Aragats.pdf
[108] https://armstat.am/file/doc/99553213.pdf

Table 6-31. Land resources of the villages, ha

Parameters	Amberd	Aygeshat	Voskevaz	Voskehat	Oshakan
Total	**452.3**	**567.95**	**939.80**	**533.49**	**1694.33**
Agricultural	329.50	274.88	643.40	387.41	1081.87
Residential	96.11	108.08	253.17	81.64	313.336
Industrial	5.72	6.94	16.13	18.56	136.94
Energy, transport, communications, utilities	1.86	0.03	0.11	0.84	24.95
Cultural heritage	5.24	132.45	16.52	31.30	108.65
Forest	0	23.37	0	0	0
Water	13.87	22.2	10.47	13.74	18.59

6.4 Cultural Heritage

6.4.1 Tangible Cultural Heritage

The historical-cultural and archaeological surveys, consisting of both desktop and field studies, were conducted in 2024 as part of the national EIA study by an expert team from the Institute of Archaeology and Ethnography under the RA National Academy of Sciences.

Desktop studies were performed based on:

1) The RA Government Decree № 628 dated 29.05.2002 "On approval of the State List of Immovable Historical and Cultural Monuments in the RA Aragatsotn Marz",
2) The RA Government Decree № 1589-N dated 03.10.2002 "On approval of the State List of Immovable Historical and Cultural Monuments in the RA Armavir Marz",
3) The RA Government Decree № 385-N dated 15.03.2007 "On Approval of the List of State-owned Immovable Historical and Cultural Monuments that are not subject to Alienation/Acquisition".

Field archaeological investigations were conducted in May 2024 through walkover surveys within the designated reservoir area and surrounding protection zone, supplemented by aerial drone imaging. As a result, 30 cultural heritage units were identified within the reservoir contour area and protection zone, of which 14 are located within the reservoir impoundment area and are likely to be impacted during Project implementation. These cultural heritage units include:

- Eight archaeological monuments,
- Four historical-architectural and spiritual monuments,
- One natural monument,
- One geological monument.

The map of the cultural heritage sites identified during the field archaeological survey within the Project area and surrounding protection zone is shown in **Figure 6-23**.

As shown in **Figure 6-23**, the identified cultural heritage sites are concentrated along both banks/ slopes of the Kasakh River (**Figure 6-24**). Aerial views of selected archaeological, natural, geological, historical-architectural and spiritual monuments identified during the survey are presented in **Figure 6-25**.

Figure 6-23. Cultural heritage sites identified during the archaeological study

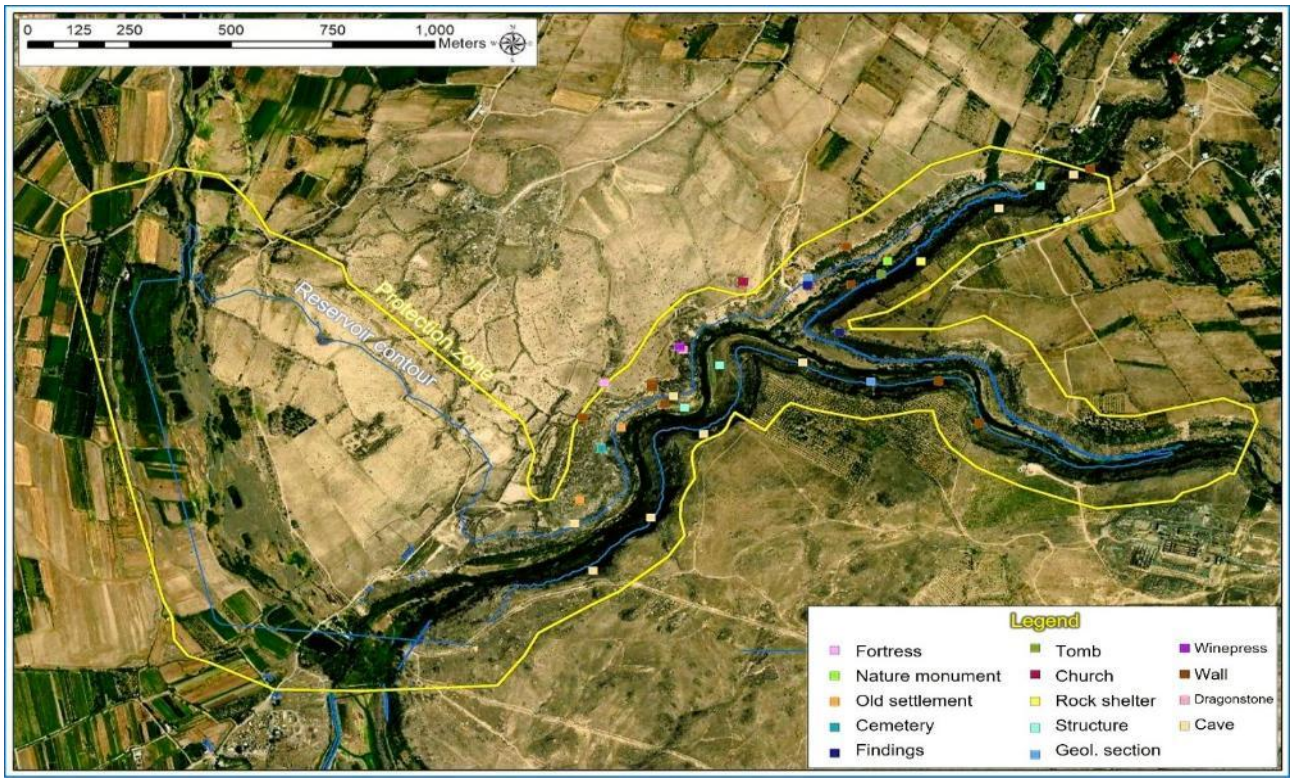


Figure 6-24. Aerial view to the banks of the Kasakh River where cultural heritage units were identified

Figure 6-25. Aerial view of the banks of the Kasakh River where cultural heritage units were identified *(note: not all identified units are shown)*

Nature monument | *Geological structure*

Nature monument

Rock shelter

Winepress

Dragonstone

6.4.2 Intangible Cultural Heritage

The Intangible Cultural Heritage (ICH) in the context of the Project is considered at both the national (**Sub-section 6.4.2.1**) and community (**Sub-section 6.4.2.2**) levels.

6.4.2.1 National Context

Armenia is one of the oldest countries in the world, known for its ancient history and unique culture. Scientific research, numerous archaeological discoveries, and ancient manuscripts indicate that the Armenian Highlands are one of the Cradles of Civilization. References to Armenia and the Armenian people are preserved in Sumerian, Assyrian, Persian, Egyptian, and other ancient texts. Today, the Republic of Armenia is located in the northeastern part of the Armenian Highland and occupies about one-tenth of its historical territory. Armenia's rich archaeological heritage dates back 2 million years and includes remains from the Paleolithic, Neolithic, and Chalcolithic periods, as well as the Bronze and Iron Ages, Hellenistic period, and Middle Ages. The world’s oldest leather shoe (5,500 years old), sky observatory (7,500 years old), depictions of agriculture (7,500 years old), and a wine-making facility (6,100 years old) have all been discovered in Armenia.

Armenia is often referred to as the Land of Noah, based on biblical scriptures. According to the Bible, Noah’s Ark came to rest on Mount Ararat, which at that time was part of historical Armenia. Some of his sons and grandsons are believed to have settled in the region. It is commonly accepted that Armenians are direct descendants of his son Japheth.

Armenia was the first country in the world to adopt Christianity as a state religion in 301 A.D. Since then, Christianity has played a critical role in shaping the Armenian people. Religion has been an essential part of Armenian identity and has significantly influenced the course of the nation's history.

Armenia has eight elements inscribed on the UNESCO Representative List of the Intangible Cultural Heritage of Humanity[109]:

1) **Duduk and its music** (2008): The distinctive Armenian woodwind instrument made of apricot wood, traditionally played in pairs.
2) **Armenian cross-stones art: symbolism and craftsmanship of Khachkars** (2010): carved memorial steles bearing crosses and intricate motifs.
3) **Performance of the Armenian epic "Daredevils of Sassoun" (David of Sassoun)** (2012): oral storytelling of the national heroic epic.
4) **Lavash: the preparation, meaning and appearance of traditional bread** (2014): the communal baking of flatbread in clay ovens.
5) **Kochari, traditional group dance** (2017): a vigorous circle dance embodying bravery and unity.
6) **Armenian letter art and its cultural expressions** (2019): the decorative art of the Armenian alphabet, created by Mesrop Mashtots.
7) **Pilgrimage to the St. Thaddeus Apostle Monastery** (2020): a joint Armenian-Iranian nomination honouring historic religious pilgrimages.
8) **Tradition of blacksmithing in Gyumri** (2023): the local craft of forging iron objects central to Gyumri's identity.

The photos of the Armenian ICH values registered in the UNESCO Representative List of the Intangible Cultural Heritage of Humanity are presented in **Figure 6-26**.

Figure 6-26. Photos of Armenia's elements inscribed on the UNESCO Representative List of the Intangible Cultural Heritage of Humanity

1) 2) 3) 4)

5) 6) 7) 8)

In addition to the eight intangible cultural heritage elements inscribed on UNESCO's Representative List, Armenia also has ICH elements of national significance. According to the latest amendment (dated 31.10.2024) to Annex 2 of RA Government Decision №310-A[110], the national list currently includes 68 ICH elements, including the eight internationally recognized ones. These encompass traditional songs and musical instruments, dances, ethnic cuisine, handicrafts (such as carpet

[109] https://ich.unesco.org/en/state/armenia-AM?info=elements-on-the-lists
[110] https://www.arlis.am/hy/acts/199058

weaving, knitting, embroidery, woodwork, pottery, forging, etc.), winemaking, ceremonies (including weddings, funerals, Christmas, New Year, Easter, baptisms, and more), pilgrimages, regional dialects, and other cultural expressions.

6.4.2.2 Community Context

According to Annex 2 of RA Government Decision №310-A, around ten of the 68 nationally registered Intangible Cultural Heritage (ICH) elements are practiced across all regions of Armenia. These include: (i) the preparation of lavash, inscribed on both the UNESCO and national ICH lists, which is an integral part of Armenian cuisine; (ii) the tradition of producing tondir (underground clay ovens), used for baking lavash and other traditional dishes, recognized as an ICH element of national significance; (iii) the making and playing of the duduk; (iv) the Kochari dance; (v) the celebration of Christmas, New Year, and Easter, among others.

The project-affected rural settlements of the Ashtarak and Khoy communities are primarily engaged in agricultural activities, namely viticulture, orchard farming, and vegetable cultivation. No specific rituals or celebrations have been identified in the affected villages, apart from the settlement of Oshakan, which is well known to historians and pilgrims of the Armenian Apostolic Church as the site of the grave of Mesrop Mashtots, the inventor of the Armenian alphabet. Between 08 and 14 of October every year, the Feast of the Holy Translators is celebrated in Oshakan settlement in St. Mesrop Mashtots church. *The Feast of the Holy Translators dedicated to a group of literary figures and saints of the Armenian Apostolic Church who created the Armenian alphabet, translated the Bible, and initiated a movement to write and translate important works into the Armenian language*.

Figure 6-27. St. Mesrop Mashtots church where the Feast of the Holy Translators is celebrated

Christmas, New Year, and Easter are widely celebrated in the rural settlements of Ashtarak and Khoy community, typically with family gatherings at home. The "Trndez" ritual is also included in the national list of ICH elements. Rooted in Armenian pagan tradition, Trndez is celebrated annually on February 13. The purifying qualities of fire were central to pre-Christian Armenian beliefs. According to several sources, people believed that the strength of the fire could drive away the winter cold and ensure fertile land and a prosperous harvest. Couples, especially newlyweds, would jump over the Trndez flames for luck, prosperity, and fertility.

Weddings, funerals, and baptisms in the villages of the Areni community are also carried out with respect to local traditions and customs.

6.4.2.3 Cultural Landscape[111]

Recognized types of cultural landscapes are:

[111]Cultural landscapes include tangible and intangible characteristics, such as natural systems and features, spatial organization and land use. Cultural landscapes are historically significant places that show evidence of human interaction with the physical

- **Designed** (planned gardens, estates),
- **Associative** (spiritually or culturally meaningful landscapes),
- **Evolved** (traditional agricultural areas like vineyards),
- **Vernacular** or **Ethnographic** (day-to-day or group-specific traditional use),
- **Agricultural** or **Working** (subtype often included under evolved or vernacular landscapes).

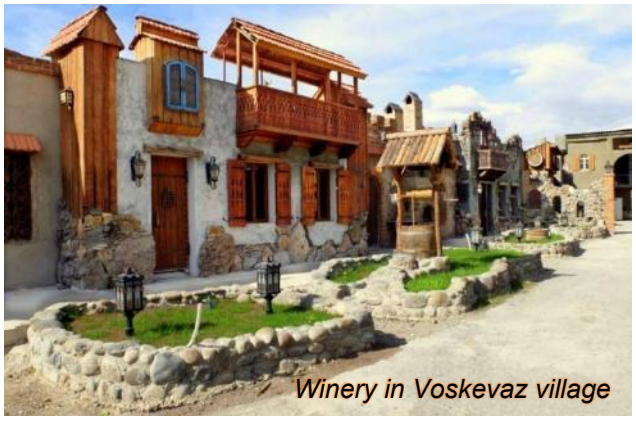
The residential areas within the rural settlements of Oshakan, Voskehat, Voskevaz, Amberd, and Aygeshat are characterized by a vernacular cultural landscape, while the agricultural lands outside the settlements represent a combination of organically evolved and working cultural landscapes (**Figure 6-28**). Of the 503 ha of agricultural land to be irrigated as a result of the Project, it is expected that 139.5 ha will be planted with fruit orchards and 94.8 ha with vineyards (**Section 2.2, Table 2-3**). Project implementation may lead to an increase in fruit orchard areas due to improved access to irrigation water. For the same reason, the area under vegetable cultivation is expected to increase by 115.7 ha. These newly cultivated areas may be characterized by a combination of designed and organically evolved cultural landscapes.

Figure 6-28. Combination of vernacular, organically evolved and working cultural landscape in the Project affected rural settlements

a) Oshakan village

b) Voskehat village

environment. Their authenticity is measured by historical integrity, or the presence and condition of physical characteristics that remain from the historic period.



c) Voskevaz village

d) Aygeshat village

e) Amberd village

7. Stakeholder Consultation

7.1 Introduction

This chapter provides the overview of the Project stakeholder engagement and consultation activities carried out to date as part of both the national EIA and this ESIA study and summarizes their key findings. The stakeholder identification and engagement process for the Project was initiated in accordance with the RA Law on Environmental Impact Assessment and Expert Examination, the Procedure on Public Notification and Discussions approved by RA Government Decree №1325-N[112], as well as the stakeholder identification approach recommended by the EBRD.

Two stages of public discussions and consultations were conducted for the Project up to now:

1) Four public discussions conducted within the national EIA study. These discussions were caried out by the national EIA consultant according to the RA Government decree 1325-N (for details see **Section 7.3**),
2) Consultations with project stakeholders during the Socio-Economic Studies conducted by the Consultant team (for details see **Section 7.4**).

7.2 Stakeholder Identification

The identification of stakeholders relevant to the Project was conducted according to the following criteria:

- **Impact:** the implementation of the Project may significantly affect a certain social group (stakeholders),
- **Influence:** the social group may have the capacity to significantly influence the process of Project implementation,
- **Partnership:** there are opportunities for building partnerships between the Project proponent and the given social group, and
- **Expressed Interest:** a social group or individuals not necessarily directly affected by the Project may (or may not) show interest in it.

On the other hand, the RA Law on Environmental Impact Assessment and Expert Examination defines **stakeholders** or the **stakeholder society** as individuals or legal entities that are directly or potentially affected by Project implementation or who show interest in decisions related to the Project. The same law also defines **participants of the EIA process** as state and local self-government bodies, individuals, and legal entities, including the affected community, affected settlements, and the interested public who in accordance with the Law participate in the assessment or expert examination process.

Stakeholder engagement requires the identification of stakeholders considering the above noted national and international criteria and the definition of appropriate methods for engagement with them. Different stakeholders have varying interests and influence in any project. Generally, those with low interest and low influence are to be kept informed, while those with high interest and high influence should be collaborated with.

[112]The procedure for public notification and discussions was amended by the RA Government Decree №1343-N, dated 28.12.2023. However, at the time the first public notification was initiated, the previous version of the public notification and discussions procedure was still in force.

The Project stakeholders can be grouped into two major categories: namely, external stakeholders and internal stakeholders (Water Committee, its staff, consultants and contractors).

For the purposes of effective and tailored engagement, the external stakeholders of the Project have been clustered into the following groups:

- Potentially affected parties,
- Vulnerable groups,
- Governmental authorities,
- Local self-governing bodies,
- Private sector and business,
- Other interested parties (civil society organizations, mass media, academia, etc.).

7.3 Public Discussions during the National EIA

In accordance with the procedure established by RA Government Decree №1325-N, four public discussions/hearings must be conducted as part of the national EIA and expert examination process in the project-affected community or settlement. The date, location and agenda of each of the four public discussions are outlined below:

1st public discussions

Date: 20.12.2023

Location: Amberd settlement

Agenda:

- Presentation of the Project objective and main components,
- Environmental and social framework,
- Initial consent of the affected community.

2nd public discussions

Date: 26.03.2024

Location: Amberd (at 10:00) and Voskevaz (at 12:00) settlements

Agenda:

- Key findings of the preliminary environmental impact assessment,
- Draft Terms of Reference to be issued by the State Authorized Body (ME).

3rd public discussions

Date: 29.05.2024

Location: Amberd (at 11:00) and Voskevaz (at 15:00) settlements

Agenda:

- Key findings of the EIA studies,
- Recommended mitigation and monitoring measures.

4th public discussions

Date: 20.08.2024

Location: Amberd (at 10:00) and Voskevaz (at 12:00) settlements

Agenda:

- Main outputs of the EIA report,
- Feedback to the comments raised by the EIA process participants and stakeholders,
- Draft environmental impact expert examination conclusion.

The details and phases, as well as the main concerns and recommendations raised by stakeholders (participants) during the four public discussion events described above, are summarized in **Table 7-1**. These were taken into account by the national EIA developers during both the preliminary and main EIA studies. However, if any concern was not addressed in the national EIA report, it has been reviewed and, if relevant, considered in this ESIA report.

Table 7-1. Summary of public discussion events conducted as a part of national EIA study

Moderation and presentation	Date, time	The place	Number of participants (women)	Participants	Questions and suggestions raised
1st public discussions - Presentation of the Project objective and main components, - Environmental and social framework, - Initial consent of the affected community.					
Discussion moderator: Administrative head of Amberd settlement The project was presented by: representatives of design company and EIA developers ('Modul' LLC and 'Consecoard' LLC)	20.12.23 10:00	Residence of the administrative head of Amberd settlement, (Khoy community, Armavir Marz)	15 (3)	Administrative head of Amberd settlement, representatives of Armavir regional administration, representatives of "Modul" LLC and "Consecoard" LLC, affected population	- Reference was made to the benefits expected from the Project implementation, particularly in relation to addressing a social issue. - Special attention should be paid to historical, cultural, and natural monuments. - A positive response was noted regarding the plan to carry out archaeological work in the Project area. - Questions were raised about the location of the reservoir construction site, its volume, and the extent to which it will affect the Amberd settlement. - Concerns were expressed about how the private land alienation will be performed. - Inquiries were made about the planned timeline for reservoir

Moderation and presentation	Date, time	The place	Number of participants (women)	Participants	Questions and suggestions raised
					construction and the expected duration of the construction activities. ***Conclusion**: All concerns and questions of the participants were addressed. In conclusion, there were no objections from the participants. They welcomed the project initiation and implementation.*
2nd public discussions - Key findings of the preliminary environmental impact assessment, - Draft Terms of Reference to be issued by the State Authorized Body (ME).					
Discussion moderator: Administrative head of Amberd settlement The project was presented by the representatives of EIA developers	26.03.24 10:00	Residence of the administrative head of Amberd settlement, (Khoy community, Armavir Marz)	18 (5)	Administrative heads of Amberd and Aygeshat settlements, representatives of Khoy municipality, representatives of Environmental Impact Assessment Center (EIEEC) and "Consecoard" LLC, affected population	- What environmental risks may arise during the construction works, and what mitigation measures are planned to reduce them? - How will access roads to the Project site for construction machinery be arranged? - It was proposed to improve the bypass road around the village to prevent construction machinery from entering the village. - It was also suggested to wash the wheels of vehicles leaving the construction site to reduce emissions of dust. - Will the riverbed be altered? - What is the water source for the planned reservoir? - When will the construction be started and how

Moderation and presentation	Date, time	The place	Number of participants (women)	Participants	Questions and suggestions raised
					many workplaces will be created during the construction phase? - Will there be any issues with water shortages downstream of the dam? - Are there any historical or cultural monuments discovered in the Project area? ***Conclusion:*** *All voiced questions and concerns were properly addressed.*
Discussion moderator: Administrative head of Voskevaz settlement The project was presented by the representatives of EIA developers	26.03.24 12:00	Residence of the administrative head of Voskevaz settlement, (Ashtarak community, Aragatsotn Marz)	16 (4)	Administrative head of Voskevaz settlement, representatives of Ashtarak municipality, Voskehat and Oshakan settlements, EIEEC and "Consecoard" LLC, affected population	- What positive impacts will the construction of the reservoir have on the community? - When will the construction works be started? - What are the potential environmental risks during the construction of the reservoir, and what measures are planned to mitigate them? - Are there any historical or cultural monuments in the Project area, and is it planned to conduct additional studies in this regard? - It was recommended to ensure the structural strength of the dam during construction to prevent future issues. - How will access roads for construction equipment to the

Moderation and presentation	Date, time	The place	Number of participants (women)	Participants	Questions and suggestions raised
					project site be arranged? - It was proposed to improve the existing dirt road. - Are there any private lands within the Project area? - When is the third public hearing scheduled to take place? ***Conclusion:*** *All voiced questions and concerns were properly addressed.*
3rd public discussions - Key findings of the EIA studies, - Recommended mitigation and monitoring measures.					
Discussion moderator: Head of the Agriculture and Environmental Protection Department of the Ashtarak Municipality The project was presented by the representatives of EIA developers	29.05.24 11:00	Residence of the administrative head of Amberd settlement, (Khoy community, Armavir Marz)	9 (2)	Administrative heads of Amberd and Aygeshat settlements, representatives of Khoy municipality and "Consecoard" LLC, affected population	- Will cadastral or market values be taken into account during land acquisition? - It was noted that one of the streams feeding into the reservoir is in an emergency condition. ***Conclusion:*** *The participants raised no objections. The participants welcomed the planned activities.*
Discussion moderator: Administrative head of Amberd settlement The project was presented by the representatives of EIA developers	29.05.24 15:00	Residence of the administrative head of Voskevaz settlement, (Ashtarak community, Aragatsotn Marz)	10 (2)	Administrative heads of Voskevaz, Voskehat, Oshakan settlements, representatives of Ashtarak Municipality and "Consecoard" LLC, affected population	- It was suggested to provide a map of the planned reservoir, if possible. - What positive impacts will the construction of the reservoir have on the village? - Tree cutting will be carried out due to the construction of the reservoir; as compensation, tree planting will take

Moderation and presentation	Date, time	The place	Number of participants (women)	Participants	Questions and suggestions raised
					place after the works are completed. - It is necessary to prioritize the overriding interests of society over those of individuals. ***Conclusion:*** *The participants raised no objections. The participants welcomed the planned activities.*
4th public discussions - Main outputs of the EIA report, - Feedback to the comments raised by the EIA process participants and stakeholders, - Draft environmental impact expert examination conclusion					
Discussion moderator: Administrative head of Amberd settlement The project was presented by the representatives of "Consecoard" LLC and "Modul" LLC	20.08.24 10:00	Residence of the administrative head of Amberd settlement, (Khoy community, Armavir Marz)	15 (5)	Administrative heads of Amberd and Aygeshat settlements, representatives of Khoy municipality, EIEEC, "Modul" LLC and "Consecoard" LLC, affected population	- How many trees will be cut and planted, and how will they be maintained? - What social issues will be solved as a result of the Project implementation? - What are the potential alternatives for the fishway? - What will be the designed structure of the reservoir dam? - Which roads will be used during the construction works? - How will the garbage that accumulates in the reservoir be managed? - How will the land acquisition process be managed? - How will land valuation be conducted? ***Conclusion:*** *All voiced questions and concerns were properly addressed. There were no objections from the participants.*

Moderation and presentation	Date, time	The place	Number of participants (women)	Participants	Questions and suggestions raised
Discussion moderator: Head of the Department of Agriculture and Environmental Protection of Ashtarak Community The project was presented by the representatives of "Consecoard" LLC and "Modul" LLC	20.08.24 12:00	Residence of the administrative head of Voskevaz settlement, (Ashtarak community, Aragatsotn Marz)	14 (4)	Administrative heads of Voskevaz, Voskehat and Oshakan settlements, representatives of Ashtarak municipality, EIEEC, "Alta Vip" LLC, "Modul" LLC and "Consecoard" LLC, affected population	- Is the construction of a hydroelectric power plant planned? - Is it possible to build a pumping station to irrigate the lands of Voskehat and Voskevaz villages? - It was proposed to include the construction of a pumping station in the Project. - When is the construction of the reservoir planned to start? - How will the land valuation be conducted? ***Conclusion:*** *All voiced questions and concerns were properly addressed. There were no objections from the participants.*

7.4 Consultations with Project Stakeholders during the Socio-Economic Studies

Consultation meeting with the head of the Khoy community and the administrative heads of the Amberd and Aygeshat rural settlements were held on 09.08.2024 at the Khoy community municipality. The deputy head and other representatives of the Khoy community also participated in the event.

The consultations meeting with the representatives of Ashtarak community, namely two deputy heads and head of staff were conducted on 06.09.2024 at the municipality of Ashtarak community. Meetings with the administrative heads of Voskevaz, Voskehat and Oshakan rural settlements were held on 13.09.2024.

Prior to the consultations, the Consultant submitted official letters to the heads of Khoy and Ashtarak community requesting socio-economic information and providing an introduction to the upcoming activities, including:

i) the Project and its components,
ii) current status of the Project implementation process,
iii) the scope of the environmental and socio-economic studies,
iv) potential land use limitations, land acquisition and compensation issues,
v) the list of officials and groups of Project Affected Persons (PAPs) to be consulted.

The main topics discussed with the managers of the Khoy and Ashtarak municipalities included: the overall socio-economic situation in the affected communities and rural settlements; socio-economic programs to be implemented both in the communities as a whole and in the affected rural settlements in particular over the coming years; the risks and benefits associated with the Project's implementation at the community level; and the main livelihood and income sources of the Project-Affected Persons (PAPs).

The agenda of the consultations conducted with the administrative heads of Amberd, Aygeshat, Veskevaz, Voskehat and Oshakan rural settlements covered issues related to the villages' socio-economic and environmental profiles, including:

- The total area of the settlement, types of land, and land use,
- Engagement of residents in the EIA consultations and discussions, and concerns related to environmental impacts,
- Population dynamics, migration trends, residents' main occupations, and vulnerable groups,
- People likely to be affected by the Project's implementation and issues of economic displacement,
- Restrictions within the protection zones around the planned reservoir area.

The attitude of the heads of the Khoy and Ashtarak municipalities as well as administrative heads of Amberd, Aygeshat, Veskevaz, Voskehat and Oshakan rural settlements toward the Project's implementation is positive. They believe that the Project will create temporary jobs for local residents during the construction phase and permanent employment opportunities during the reservoir's operational stage.

7.5 Summary of Stakeholders Concerns, Questions and Recommendations

During the public discussion and stakeholder consultation events conducted within the national EIA disclosure requirements and for the development of the Resettlement Framework, participants highlighted the following questions and concerns that may arise from the Project's implementation. Where relevant, these concerns and questions have been addressed in the appropriate sections of this ESIA report:

- Cutting of trees within the planned reservoir footprint,
- Whether a water shortage will occur downstream of the reservoir dam,
- Potential environmental risks during the construction of the reservoir and the measures planned to mitigate them,
- Measures to be implemented to minimize the Project impact on air quality,
- How the garbage that accumulates in the reservoir will be managed,
- Which roads will be used during construction works, possibility of restoring the bypass road around the villages to prevent construction machinery from entering the villages,
- Types of socio-economic benefits the affected settlements will receive as a result of the Project implementation, potential temporary employment opportunities during the construction phase,
- Possibility of building a pumping station to irrigate the lands of Voskehat and Voskevaz villages,
- Expected start date of construction activities and commencement of reservoir operation,
- Historical, cultural, and natural values within the Project's area of influence, and how these values will be preserved.

7.6 Planned Stakeholder Engagement

The next round stakeholder consultation meetings will be conducted during the 120-day public disclosure period for the ESIA report and its supporting documents. Two public consultation events are planned: in Khoy Municipality with participation of stakeholders from Amberd and Aygeshat settlements and Ashtarak Municipality, involving participants from Voskevaz, Voskehat and Oshakan settlements. Another consultation will be held in Yerevan city, where representatives of relevant state authorities, Non-Governmental Organizations (NGOs) and other stakeholders will be invited. These events are tentatively scheduled for the third quarter of 2026. This component will be led by the ESIA Consultant, with support from the Water Committee.

The Stakeholder Engagement Programme has been developed as part of the SEP to ensure effective engagement with all identified stakeholders, foster and maintain respectful relationships between the Water Committee and stakeholders, and help prevent potential conflicts. It covers the Project's design, pre-construction, and construction stages.

The Programme will be reviewed and updated at least once a year after the start of the construction stage and again prior to the commissioning of the Kasakh reservoir. It provides a detailed action plan outlining responsibilities and a timeframe for the implementation of the proposed activities. Should there be any changes during Project implementation that necessitate modifications to the engagement mechanisms, or if new stakeholders are identified, the Programme will also be updated accordingly.

Stakeholder engagement will continue in parallel with the ESIA information disclosure process and will include several components aimed at facilitating ongoing meaningful consultation and providing timely information on the Project and its E&S implications.

8. Environmental and Social Impacts, Benefits and Opportunities, Mitigation Measures

8.1 Introduction

This Chapter provides a summary of the environmental and social impacts and benefits identified during the national EIA study, which were further updated through supplementary surveys and analyses conducted by the Consultant. These efforts were undertaken to align this ESIA study report with the requirements of the EBRD ESP and provisions of the applicable GIPs. This process helps ensure that the E&S information used for decision-making presents a comprehensive picture of the potential effects of the proposed Project, including issues of particular concern to affected groups and individuals. The methodology used for the impact assessment and management is described in detail in **Chapter 5** of this ESIA report.

8.2 Environmental Impacts and Benefits, Mitigation Measures

8.2.1 Transboundary Impact

The construction of the Kasakh reservoir is not planned on transboundary water resources. The Kasakh River flows through the west-central part of Armenia from north to south. It originates near Mount Aragats in Aragatsotn Marz, flows south into Armavir Marz, and eventually joins the Metsamor River, which is a tributary of the Araks River. The latter forms the border between Armenia and Turkey in the southwest and between Armenia and Iran in the south. Hence, the reservoir will be built on a tributary of transboundary river.

The hydrological impact assessment[113] has been undertaken comparing the average and dry year flows at the boundary with relevant neighbouring countries, with and without the project. The hydrology baseline considered for this assessment was that defined using the SWAT+ model established for the purpose of the present study[114]. The main conclusion is that it is unlikely that the Project generates significant hydrological impacts.

In theory, the Kasakh Reservoir could contribute to sediment impacts, as it is located furthest downstream. However, the flow ratio between the reservoir and the corresponding site (2.7%) indicates that any such impacts would be negligible. Therefore, it is highly unlikely that the project will have significant impacts on sediment load or soil stability.

The operation of the Kasakh Reservoir may have a localized impact on fish movement. However, considering the preferred habitats and documented movements of the fish species identified at the selected assessment point, where the Kasakh River joins the Araks River, it is unlikely that the alteration can be considered as significant impact.

The construction and operation of the Kasakh Reservoir are expected to impact key native species, while invasive species are likely to increase within the reservoir. A bypass channel and fishway, designed to mimic natural river conditions, are planned during the construction phase to support fish migration.

However, the EIA does not include provisions for maintaining the fishway during the operational phase. As a result, the Project is expected to impede fish migration for a significant portion of its lifetime. This limitation is not clearly stated in the national EIA, and no mitigation measures have

[113]SLR Consulting. Armenia reservoirs Project: Transboundary Impact Assessment Report, Revision A, June 2025.
[114]Ibid

been proposed to address it. In summary, the Kasakh Reservoir is expected to cause local ecological impacts, particularly during its operational phase. Nevertheless, since no vulnerable or endangered migratory fish species were identified during the fish surveys, it is unlikely that these local effects will lead to significant impacts on fish resources or aquatic habitats.

A conservative evaluation of the planned reservoir' impacts has been made possible through basic hydrological modelling (SWAT+) and expert judgment. The assessment indicates that the Kasakh reservoir is unlikely to have significant downstream impacts. This conclusion is primarily based on the upstream positions relative to existing lakes or reservoirs, and the relatively small size of the rivers they impound.

8.2.2 GET Assessment[115]

8.2.2.1 Introduction

The Project is assessed as aligned with the goals of the Paris Agreement[116] based on the directly financed methodology. Specific assessments for climate adaptation and climate mitigation have been undertaken for the Kasakh reservoir site and outlined below.

8.2.2.2 Paris Alignment Assessment

Alignment with the mitigation goals of Paris Agreement: general screening

The Project is on the aligned list under the water supply and wastewater category[117]. No Project activities have been identified as on the 'non-aligned list'.

Alignment with the mitigation goals of Paris Agreement: specific assessments

Review against Nationally Determined Contribution (NDC) and Low Emission Development Strategy

In the case of Armenia, the NDC outlines an intention to achieve an unconditional Greenhouse Gas (GHG) emissions reductions target of at most 2.07 t CO2eq/capita by 2050. These are reflected in Armenia's Draft Long Term - Low Emission Development Strategy (LT-LEDS). Armenia's LT-LEDS outlines improvements in water supply and irrigation as a priority area to reduce energy consumption, with an estimated total GHG emissions reduction of 8.946 Gg CO2eq until 2050.

As such, the Project does align with some of the targets outlined in Armenia's draft LT-LEDS and, therefore, the country's NDC in that it is designed to improve water supply and efficiency in irrigation. However, it is noted that GHG emission estimates at this stage show net positive carbon emissions for reservoir over 100 years.

Review against energy policies in Armenia

In 2022, the International Energy Agency, in partnership with the European Union, produced an in-depth review of the energy policies of Armenia which sets the path for the sector's transition through 2040 including guidance on energy efficiency and security of supply. Water supply, construction and agriculture do not feature explicitly in this review. However, the economic assessment identifies that the Project will result in an annual decrease in energy costs due to decreased pumping costs. Therefore, the Project is concluded to align with Armenia's energy transition policies through to 2040.

Carbon lock-in test

[115]This GET Assessment has been prepared based on the Chapter 5 and Section 8.3 of the *Armenia Water Reservoirs - Technical, Economic and Green Due Diligence Gap Analysis, Draft Final Report*, 2023-2024, Ove Arup & Partners

[116]https://unfccc.int/sites/default/files/english_paris_agreement.pdf

[117]Implementing the Green Economy Transition Technical Guide, EBRD, March 2024 and Annexes to Implementing the Green Economy Transition - Technical Guide, EBRD, March 2024

Carbon lock-in occurs when technical, economic or institutional factors mean an asset will continue to operate in an emissions-intensive way, even when there are feasible and economically preferable lower carbon options that could replace it. The risk of lock-in is considered low if the project entails investment in assets that will cease to operate in an emissions-intensive way in the near future or the project credibly demonstrates low-carbon readiness.

A review of the Project has not identified (at this stage) the use of any low-carbon alternatives and use of renewable energy sources. However, there are still opportunities to embed low-carbon alternatives into the design of the Project and there are no barriers identified to the use of renewable energy in the operation of the project. Therefore, the risk the Project's overall lock-in risk can be considered low.

Economic viability test

An economic viability test has not been completed as the CO2 emissions assessment has not identified that any of the individual reservoirs exceeds the 'significant' emissions thresholds outlined in the EBRD Methodology to determine the Paris Agreement alignment of EBRD investments.

Conclusion: The Project is assessed as aligned with the mitigation goals of Paris Agreement (BB1 aligned).

Alignment with the adaptation goals of Paris Agreement

Internal screening of the Project has identified increased heat stress, increased water stress and drought / flooding / sea-level rise / mass movement[118] / forest fires / erosion as potentially material physical climate risk(s) for the Project location.

A climate risk assessment was conducted as part of the Project's technical due diligence[119] (**Sub-section 8.2.2.3**). In response, the Project incorporates adaptation measures to ensure the assets are resilient to the identified material risks:

- Extreme heat (affecting the reservoir and dam),
- Heavy precipitation and flooding (affecting the reservoir, dam, and spillway).

The Project is unlikely to undermine climate resilience of the system in which it operates. Although it is noted that uncertainties regarding downstream flood impacts mean that, at this stage, the downstream receptors remain potentially at high risk to heavy precipitation and flooding. This also takes into account the fact that the reservoir is primarily designed to address future water storages and support agriculture.

Potential high risks are also identified for extreme high temperatures and forest fires for ecological receptors downstream. This is a conservative rating applied in the absence of information on the ecological receptors, and also the vegetation clearing and planting approach for the reservoirs.

8.2.2.3 Climate Change Adaptation and Mitigation Assessment

Climate adaptation (Climate change risk assessment)

Step One: Current and future baseline

To define the current and future baseline the assessment has utilised historical climate data and climate projections from national, regional and site-specific sources where available. This provides an overview of the climate hazards relevant at a national level in Armenia in addition to more specific

[118]The assessment of mass movement considers it occurring as a result of heavy rainfall/storms, i.e., as a climatic factors. Seismic risk is covered by the technical review

[119]*Armenia Water Reservoirs - Technical, Economic and Green Due Diligence Gap Analysis, Draft Final Report*, 2023-2024, Ove Arup & Partners

trends in current and future climate conditions in proximity to the reservoir. A summary of the current and future climate conditions for Armenia is provided in Table 8-1.

Table 8-1. Summary of current and future climate trends for the Kasakh reservoir

Climate hazard	Baseline	Projected change[120]		
		2020-2039	2040-2059	2060-2079
Average temperature	Upstream of the river basin, the average annual temperature is 4.7°C, according to measurements taken at the Aparan meteorological station. Downstream of the river basin, the average annual temperature is 11.4°C, according to measurements taken at the Ashtarak agrometeorological station.	↑ For both the SSP2-4.5 and SSP5-8.5 scenarios average temperatures are projected to increase in the Armavir region.		
Extreme high temperatures	Upstream, average maximum temperatures in July are 23.6°C. Downstream, average maximum temperatures in July are 31.76°C. The extreme heat hazard rating for the Etchmiadzin municipality is assigned as low, meaning that there is between a 5% and 25% chance that at least one period of prolonged exposure to extreme heat, resulting in heat stress, will occur in the next five years.	↑ For both the SSP2-4.5 and SSP5-8.5 scenarios average maximum surface air temperatures are projected to increase in the Armavir region, with the greatest increases occurring in July and August.		
Extreme low temperatures	Upstream, average minimum temperatures in January are -13.9°C. Downstream, average minimum temperatures in January are -7.2°C. For the Armavir region, between 1990 and 2014 the average number of frost days was 119 and the average number of ice days was 24.	↑ For both the SSP2-4.5 and SSP5-8.5 scenarios, the average minimum surface air temperature is projected to increase in the Armavir region. ↓ For both the SSP2-4.5 and SSP5-8.5 scenarios, the average number of frost and ice days is projected to decrease in the Armavir region.		
Wildfire & Forest Fires	The wildfire hazard rating for the Etchmiadzin municipality is assigned as high.	↑ Modelled projections indicate a likely increase in the frequency of fire weather across Armenia.		
Extreme wind	Data available on wind is limited. Data from The Global Wind Atlas indicates an average wind speed of 3.04 m/s for the top 10% windiest areas in the location of the Kasakh reservoir.	Changes in wind speed as a result of climate change are difficult to predict and are affected by high levels of uncertainty.		
Average precipitation	Annual precipitation ranges between 1007 mm (according to High- mountain Aragats meteorological station), 723 mm (according to Aparan meteorological station) and 382 mm (according to Ashtarak agrometeorological station).	↓↑ For both the SSP2-4.5 and SSP5-8.5 scenarios, both increases and decreases are projected in monthly average precipitation compared to baseline conditions. The greatest increased across all time periods and scenarios are projected in March.		
Heavy precipitation and flooding	The river flood hazard rating for the Etchmiadzin municipality is assigned as medium, meaning there is a chance of more than 20% of potentially damaging and life- threatening river floods occurring in the next 10 years. The urban flood hazard rating for the Etchmiadzin municipality is assigned as low, meaning there is a less than 1% change of potentially damaging and life-threatening floods occurring in the next 10 years.	↑↓ For both the SSP2-4.5 and SSP5-8.5 scenarios, increases of up to 5mm in average largest 5-day cumulative precipitation are reported for all months	↑↓ For both the SSP2-4.5 and SSP5-8.5 scenarios, increases of up to 5mm in average largest 5-day cumulative precipitation are reported for all months	↑↓ For both the SSP2-4.5 and SSP5-8.5 scenarios, increases of up to 6mm in average largest 5-day cumulative precipitation are reported for all months

[120]Preparation of design and cost estimation documents for construction of Kasakh reservoir in Aragatsotn and Armavir Marzes of the Republic of Armenia, Explanatory Note, 2024

Climate hazard	Baseline	Projected change[120]		
		2020-2039	2040-2059	2060-2079
		except between July and September.	except between July and September. For both scenarios, an increase of above 5mm is also projected for February.	except between July and September. For SSP5-8.5, an increase of above 6mm is also projected for November.
Drought and water scarcity	The water scarcity hazard rating for the Etchmiadzin municipality is assigned as low, meaning that there is up to 1% chance droughts will occur in the coming 10 years.	↑ The current low hazard rating for the Etchmiadzin municipality may increase in the future due to climate change.		
Drought	The water scarcity hazard rating for the Vayots Dzor Marz is assigned as low, this means that there is up to 1% chance droughts will occur in the coming ten years.	↑ The current low hazard rating for the Vayots Dzor region may increase in the future due to climate change.		
Erosion	Localised data on current and future erosion patterns has not been identified.			
Mass movement[121]	The landslide hazard rating for the Etchmiadzin municipality is low, meaning that the occurrence of localised landslides is uncommon. In addition, on the basis of the DTM provided by Modul, the Kasahk reservoir is located in an area with relatively uniform terrain unlikely to be impacted by mass movement.	Climate change is likely to alter slope and bedrock stability through changes in precipitation and/or temperature. However, it is difficult to determine future locations and timing of large rock avalanches, as these depend on local geological conditions and other non-climatic factors.		

Step Two: Definitions of exposure of impacts to climate change

Table 8-2 outlines the definitions used to rate the exposure of the Kasakh reservoir to relevant climate hazards. The rating considers current and future climate conditions that may occur across the Project lifecycle. On the basis of the exposure assessment, the mass movement hazard is not considered further for the Kasakh Reservoir.

Table 8-2. Exposure ratings for the Kasakh reservoir

Climate hazard	Exposure rating
Extreme high temperatures	Probable
Extreme low temperatures	Probable
Forest fires	Plausible
Extreme wind	Plausible
Heavy precipitation and flooding	Plausible
Drought and increased water stress	Plausible
Erosion	Plausible
Mass movement	Not likely

Step Three: Definition of sensitivity impacts to climate change

Table 8-3 outlines the definitions used to rate the sensitivity of the Kasakh reservoir to relevant climate hazards. The rating considers current and future climate conditions that may occur across the Project lifecycle.

[121]The assessment of mass movement considers it occurring as a result of heavy rainfall/storms, i.e., as a climatic factors. Seismic risk is covered by the technical review

Table 8-3. Sensitivity ratings for the Kasakh reservoir

Climate hazard	Sensitivity rating		
	Reservoir and Dam	Spillway	Guard house and instrumentation
Extreme high temperatures	Medium	Low	Low
Extreme low temperatures	Low	Low	Low
Forest fires	Low	Low	Medium
Extreme wind	Medium	Medium	Low
Heavy precipitation and flooding	High	High	Medium
Drought and increased water stress	Low	Low	Low
Erosion	Medium	Medium	Low

Table 8-4 outlines the definitions used to rate the sensitivity of receptors located downstream of Kasakh reservoir to relevant climate hazards and considering the potential impact that the Project will have on these downstream receptors. The rating considers current and future climate conditions that may occur across the Project lifecycle.

Table 8-4. Sensitivity ratings for receptors located downstream of the Kasakh reservoir

Climate hazard	Sensitivity rating		
	Agricultural land	Water users (including farmers)	Ecological receptors
Extreme high temperatures	Low	Low	Medium
Extreme low temperatures	N/A - The Project is not anticipated to impact on the sensitivity of the receptors to extreme low temperatures.		
Forest fires	Low	Low	Low
Extreme wind	N/A - The Project is not anticipated to impact on the sensitivity of the receptors to extreme winds.		
Heavy precipitation and flooding	High	High	High
Drought and increased water stress	Low	Low	Medium
Erosion	Low	Low	Medium

Heavy precipitation and flooding hazard

The design company has applied the Armenian dam hazard classification system to select the Safety Check flood as a 1 in 1000-year return period. The safety check should be selected based on the downstream hazard posed by an uncontrolled release of water from the dam. However, at this stage no consequence assessment has been undertaken. Probable Maximum Flood analysis has also not been completed.

The choice of Armenian dam category appears reasonable based on the descriptions in the standard but is lower than typically expected for the likely consequences when compared with other international dam safety flood standards. An allowance has not been made for climate change in the selection of the Safety Check flood. This is not unusual for extreme flood events of 1 in 1000-year and above and there is little to no firm guidance on how this should be implemented although it is considered to be good practice.

The design report for the Kasakh reservoir notes that future climate change projections anticipate a decrease in river flows by the year 2100 under multiple climate change scenarios. However, the projections quoted are provided at a national level and, in the event that river flows show an overall decreasing trend, climate change may still increase the frequency and magnitude of flood events

that do occur. Therefore, the Kasakh reservoir, dam and spillway and downstream receptors are identified as having a "High" sensitivity to heavy precipitation and flooding.

Step Four: Definition of a risk assessment level

Table 8-5 outlines the risk ratings for the Kasakh reservoir for relevant climate hazards. The rating considers current and future climate conditions that may occur across the Project lifecycle.

Table 8-5. Risk ratings for the Kasakh reservoir

Climate hazard	Risk rating (Exposure × Sensitivity)		
	Reservoir and Dam	Spillway	Guard house and instrumentation
Extreme high temperatures	High	Medium	Medium
Extreme low temperatures	Medium	Medium	Medium
Forest fires	Low	Low	Medium
Extreme wind	Medium	Medium	Medium
Heavy precipitation and flooding	High	High	Medium
Drought and increased water stress	Low	Low	Low
Erosion	Medium	Medium	Low

Table 8-6 outlines the risk ratings for receptors located downstream of Kasakh reservoir for relevant climate hazards. The rating considers current and future climate conditions that may occur across the Project lifecycle.

Table 8-6. Risk ratings for receptors located downstream of the Kasakh reservoir

Climate hazard	Risk rating (Exposure x Sensitivity)		
	Agricultural land	Water users (including farmers)	Ecological receptors
Extreme high temperatures	Medium	Medium	High
Forest fires	Medium	Medium	Medium
Heavy precipitation and flooding	High	High	High
Drought and increased water stress	Low	Low	Medium
Erosion	Low	Low	Medium

Step Five: Identification of recommended climate resilience measures

For the purpose of this assessment, risks identified as "High" are considered material and accordingly resilience measures are identified to reduce the materiality of these risks.

Reservoir, dam and spillway

To mitigate potential impacts of heat on reservoir and dam structures, construction materials should be selected that have a proven track record in performing under high temperature conditions. During operation, inspections should also be completed more regularly during and immediately after heat wave events to identify and resolve any issues associated heat induced expansion and other impacts.

As part of the risk-based approach, undertake Probable Maximum flood analysis and sensitivity testing to determine how downstream consequences are affected by the occurrence of floods with a

greater magnitude as a result of climate change. Expert judgement should then be applied to determine if an allowance is required for climate change in determining the Safety Check Flood.

Downstream receptors

In relation to extreme high temperatures and ecological receptors, this reflects a conservative approach undertaken in the absence of knowledge of the ecological species located in proximity to the reservoir. This risk should therefore be re-evaluated following ecological surveys and assessment to determine whether it remains material and if so, what resilience measures should be implemented.

The measures outlined above would address the risks posed to downstream receptors by heavy precipitation and flooding.

Climate change mitigation: CO2e impact analysis

The data inputs to the G-res tool relied on the design report for the reservoir, from which the key information is summarised in **Table 8-7**. The reservoir site and catchment area were delineated in Google Earth Engine for assessment of upstream catchment and reservoir datasets.

Table 8-7. G-res data inputs for the Kasakh reservoir

Upstream catchment					
Catchment area		1 356.5		km2	
Population in catchment		52 026		persons	
Catchment annual runoff		54		mm. yr	
Landcover and mineral soils					
Bare areas	0%	**Croplands**	32%	**Forest**	3%
Grassland/ shrubland	60%	**Settlements**	5%	**Waterbodies**	0.11%
River area before impoundment	2.42 km				
Area to be inundated by reservoir					
Climate zone		Temperate			
Reservoir area		89.7		ha	
Reservoir volume		10		MCM	
Water level		978.524		masl	
Maximum depth		31		m	
Annual wind speed		3.04		m/s	
Mean air temperature		11.6		°C	
Main landcover		Grassland			
Reservoir					
Primary service		Irrigation			
Secondary service		Flood control		Environmental flow	
Earth removed		1,494		m^3	

The outputs indicate the post-impoundment areal emissions are limited. Pre-impoundment emissions are higher due to the pre-impoundment area land cover including forest. The reservoir emission over 50 years is 127.4 tCO2e/yr (**Table 8-8**).

Table 8-8. G-res outputs for the Kasakh reservoir

Total net GHG footprint

Total reservoir emissions per year	9	tCO2e/yr
Total reservoir emissions at year 1	595.5	tCO2e/yr
Total reservoir emissions at year 50	127.4	tCO2e/yr
Reservoir net GHG footprint by pathway		
Emission rate of which CO_2	9	tCO2e/yr
Emission rate of which CH_4	0	tCO2e/yr

GET assessment

Table 8-9 outlines the GET outcomes anticipated for the Kasakh reservoir.

Table 8-9. GET Climate Resilience Outcomes (CROs) for the Kasakh reservoir

GET Outcome	Valorisation of GET CRO[122]	CRO ratio (CRO/Capex)
Increased agricultural potential (€/year)	€3 637 299[123] Excluding consideration of Capex	5.5%
Increased water availability (€/year)	€1 914 674	2.9%

It is considered that there is double counting between the increased agricultural potential and the increased water availability outcomes. Therefore, it is proposed that only the highest of these two figures is reported, i.e. 5.5% for the Kasakh reservoir.

At an earlier stage of the Project, potential was identified for the Project to reduce damage from flooding as a result of improving control of floodwaters. Through further review, it has been identified that whilst the Kasakh reservoir will be designed to attenuate flows to an extent it is not anticipated that this will have any measurable impact on flood risk receptors downstream.

No GET outcomes were identified under the "Other environmental benefits" category at this stage.

8.2.3 GHG Emissions

The CO2e impact analysis relied on the use of the GHG Reservoir Tool (G-res Tool), which is based on principles agreed upon by the IPCC[124] for assessing net reservoir emissions. When calculating CO2e for a reservoir, a whole-catchment approach was followed to account for terrestrial areas that act as net carbon sinks. Net GHG emissions caused by a reservoir are defined as the difference between the total CO2e emissions fluxes in the river basin before and after the reservoir's creation. The G-res tool is built on this principle of estimating net anthropogenic GHG emissions, i.e., what the atmosphere "sees" when a new, man-made reservoir is introduced into the landscape.

This assessment calculates the net GHG footprint using the following formula:

$$Net\ GHG\ Footprint = \frac{Post\text{-}impoundment\ GHG\ balance\ from\ catchment\ after\ introduction\ of\ reservoir}{Pre\text{-}impoundment\ GHG\ balance\ of\ catchment\ before\ introduction\ of\ reservoir}$$

The pre-impoundment GHG balance relied on an assessment of the landscape. The G-res tool assesses the overall pre-impoundment GHG balance by multiplying the surface area of each land cover sub-unit with a specific emission factor appropriate for both CO2 and CH4. These are then summed over a 100-year assessment period and averaged to obtain a mean rate over the entire surface area to be occupied by the reservoir.

[122]Cumulative Results Overview
[123]Please note this figure accounts for the fact that in the absence of the project there would be an 11% reduction in agricultural potential by 2030 compared to baseline.
[124]Intergovernmental Panel on Climate Change

The post-impoundment GHG balance relies on an analysis of semi-empirical models based on existing datasets. These relate to annual CH4 diffusive emission, predicted gross annual emission and estimating the CO2 emissions rightfully attributed to the reservoir. The post-impoundment emissions are expressed in the G-res as areal emissions (gCO2e/m2/yr) and as reservoir wide emissions (tCO2e/yr) merged as GHG emissions, but also separately as CO2 and CH4. A global warming potential for 100 years was used to obtain CH4 emissions as CO2e.

The total GHG emissions in the shape of CH4 from the planned reservoir at year 1 are estimated 9 tCO2e/yr, while at year 50 - 127.4 tCO2e/yr (**Table 8-8**).

8.2.4 Impact on Air Quality

Construction phase

During the construction stage the following activities / operations are considered as potential sources (stationary and mobile) of air emissions:

- Site clearance,
- Access road construction and temporary facilities setup,
- Excavation of reservoir basin and spillway channels,
- Dam construction (backfill and concrete works),
- Grading and compaction of soil,
- Loading, transportation and unloading of friable materials,
- Drilling works (for the installation of OTL pillars),
- Welding and painting works,
- Operation of construction equipment and machinery.

Air emissions expected during the Project's construction phase from both stationary and mobile sources, along with their estimated volumes, were calculated and presented in the national EIA report. The calculations were based on the CORINAIR methodology[125] for vehicles and construction machinery, and the guide for calculating unorganized air emissions from the construction industry for dust emissions. The calculated air emissions (in g/sec and ton/year) from the reservoir construction activities are provided in **Table 8-10**.

Table 8-10. Calculated volumes of air emissions

№	Name of emitted substance	Emissions, ton/ construction phase
1	Dust	160.0
2	Nitrogen dioxide	9.6
3	Carbon oxide	2.22
4	Hydrocarbons	11.17
5	Solid particles	1.13
6	Sulphur anhydride	1.06
Total		**185.18**

Approximately 85% of the total air emissions from construction activities consist of dust particles (PM2.5 and PM10). Instrumental measurements conducted within the Project site during the

[125]The methodology is based on the classification of vehicles in accordance with the "Core Inventory of Emissions in Europe" (hereinafter referred to as CORINAIR), which is part of the "Base Inventory of Atmospheric Emissions in Europe" methodology

baseline data collection study (**Table 6-11**) indicate that PM2.5 and PM10 concentrations were approximately 4 to 10 times lower than the maximum permissible concentrations (MPC) established by both national environmental standards and IFC/WHO guidelines.

Given that the Project implementation is expected to span 39 months, and assuming that appropriate mitigation measures outlined in **Table 8-12** are effectively applied, it is unlikely that peak dust emissions during the construction phase will significantly affect ground-level dust concentrations. A similar conclusion applies to gaseous emissions, which are also projected to remain within acceptable limits and pose minimal risk to ambient air quality.

The total air emissions are estimated at approximately 185.18 tons over the 39-month construction period, averaging about 4.75 tons per month.

Operation phase

The potential sources, causes and environmental impacts from the operated reservoir are outlined in **Table 8-11**.

Table 8-11. Sources, causes and impacts from the reservoirs

Source	Cause	Impact
AIR POLLUTANTS		
Volatile Organic Compounds (VOCs)		
Volatile organic compounds are emitted in small amounts from reservoirs, particularly if the water is affected by pollutants or chemicals in the surrounding environment.	VOCs can be released from aquatic plants, algae, or even from chemicals used in water treatment, runoff, or industrial activities near the reservoir.	VOCs can contribute to local air pollution, causing smog formation and having potential health impacts. They also contribute to the formation of ground-level ozone and other secondary pollutants.
Ammonia (NH_3)		
Ammonia can be emitted from water reservoirs, especially if the water quality is influenced by agricultural runoff or other sources of nitrogenous compounds.	Ammonia is often released as a result of the breakdown of organic nitrogen in the water. It can also evaporate from surface waters where nitrogen-rich fertilizers or waste runoff have been deposited.	Ammonia can be toxic to aquatic life at high concentrations and, when released into the atmosphere, can contribute to the formation of fine particulate matter.
Dust and Particulate Matter		
Dust and particulate matter can be emitted from areas surrounding the reservoir, especially in arid or semi-arid regions.	Even wind erosion can cause particulate matter to be emitted from the reservoir's surrounding landscape.	Dust can affect local air quality, contribute to respiratory problems in humans, and have ecological impacts.
Sulphur Compounds (e.g., H_2S)		
In reservoirs with high organic material and low oxygen (anaerobic conditions), sulphur compounds like hydrogen sulphide (H_2S) can form.	Sulphate-reducing bacteria in the water may produce hydrogen sulphide when they break down organic matter in low-oxygen conditions. It may also occur in sediments at the bottom of the reservoir.	Hydrogen sulphide has a foul odour and can be toxic at high concentrations. It may also contribute to the formation of other sulphur-related compounds that can impact air and water quality.

Source	Cause	Impact
AIR POLLUTANTS		
Phosphorus Compounds		
Although phosphorus is typically considered a water pollutant, in some cases, phosphorus compounds can be emitted to the air, particularly in the form of aerosols or particulates.	Phosphorus compounds may volatilize or become airborne when sediment is disturbed or if water quality management practices like aeration are implemented.	Phosphorus itself isn't a greenhouse gas, but it can contribute to nutrient pollution, leading to eutrophication, algal blooms, and subsequent methane emissions.
GHG EMISSIONS (discussed in **Section 8.2.3**)		
Methane (CH_4)		
Methane is one of the most significant greenhouse gases emitted from water reservoirs. It is produced through the anaerobic (oxygen-free) decomposition of organic matter at the bottom of the reservoir, where conditions are conducive to methane production.	Organic matter like plants, algae, and other organic material decomposes in the absence of oxygen, producing methane as a byproduct. This is most common in deeper, more eutrophic (nutrient-rich) reservoirs.	Methane is a potent greenhouse gas, with a global warming potential many times higher than carbon dioxide (CO_2). Its release into the atmosphere contributes significantly to climate change.
Nitrous Oxide (N_2O)		
Nitrous oxide is a trace greenhouse gas that can be emitted from reservoirs, typically in areas where nitrogen compounds are present.	N_2O emissions can result from the nitrification and denitrification processes, where nitrogen from agricultural runoff or wastewater undergoes biological transformations. This process often occurs under anaerobic conditions in sediment or water, producing N_2O as a byproduct.	Nitrous oxide is a potent greenhouse gas, with a global warming potential over 250 times that of CO_2. Although it is typically released in smaller amounts than methane, it still plays a role in climate change.
Carbon Dioxide (CO_2)		
Carbon dioxide is another common emission from reservoirs, resulting from aerobic (oxygen-present) decomposition of organic material in the water. It can also be released through respiration by aquatic organisms.	When organic material in the water decomposes in the presence of oxygen, it breaks down into carbon dioxide. Additionally, photosynthesis by aquatic plants and algae can lead to CO_2 release.	While CO_2 is a less potent greenhouse gas than methane, it still contributes to the greenhouse effect and global warming.

The volume of air emissions from the reservoir during the operational phase will be minimal and will primarily depend on the climatic conditions in the Project region. Theoretically, these emissions can be controlled solely through the implementation of a defined operational regime and the application of technical measures; however, given the small quantities of air emissions, such measures are often considered unfeasible. Nevertheless, a set of technical measures that could potentially be considered in the Project design documentation is outlined in **Table 8-12**.

Some minor air emissions may occur during the maintenance activities of the operated reservoir. The types of emissions will be similar to those generated during the construction phase; however, their quantities will be significantly lower and can be considered negligible.

Impact assessment and mitigation measures

Assessment and mitigation of impacts on air quality during the reservoir construction and operation phases are summarised in **Table 8-12**.

Table 8-12. Summary of air emissions impact and mitigation measures for the Project construction and operation phases

Receptor	Assessed Impact	Mitigation / management measures	Residual impact
CONSTRUCTION PHASE			
Workers, nearby population, soil and water resources, flora and fauna	Moderate	1) Use modern construction machinery equipped with engines compliant with at least Euro IV standards, with emission control and minimal noise characteristics, 2) Perform regular technical maintenance of used construction machinery and heavy vehicles, 3) While transporting friable materials keep the body of heavy vehicles covered, 4) Minimizing dust from open area sources, including storage piles and top-soil storage areas, by using control measures such as installing enclosures and covers, and increasing the moisture content, 5) Restrict excavation and earthworks during the periods of strong winds, 6) Siting of construction facilities and construction machinery must also consider prevailing wind directions, 7) Apply regular watering to on-site and off-site dirt roads, especially during the excavation and other earthworks, 8) Minimize the period between excavation and backfilling works, 9) Prohibit construction materials and waste burning.	Low
Monitoring: According to the Air, water and soil quality monitoring plan			
OPERATION PHASE			
Nearby population, soil and water resources, flora and fauna	Low	***Maintenance works*** 1) Use modern construction machinery equipped with engines that comply with at least Euro IV standards, featuring emission control systems and low-noise characteristics, 2) Perform regular technical maintenance of all construction machinery, 3) If maintenance services are outsourced, contractors will be required to use modern, well-maintained equipment that complies with all applicable technical requirements.	Negligible

Receptor	Assessed Impact	Mitigation / management measures	Residual impact
		Incorporate cost-effective technical measures in the Project design documentation and reservoir operation plans: 1) Installing aeration systems to oxygenate water and suppress anaerobic methane production, 2) Installing surface aerators or diffused air systems to increase dissolved oxygen, 3) Maintenance to remove decaying vegetation, crop residues, or debris from the reservoir and inflows, 4) Keeping banks and inflow channels clear to reduce organic loading, 5) Establishing buffer zones with vegetation to absorb nutrients before they reach the reservoir.	

8.2.5 Impacts on Landscape and Visual Amenity

Construction phase

The central part of the area designated for the construction of the Kasakh Reservoir is characterized by a steppe landscape (**Figure 8-1**), except for the eastern part of the reservoir body, which is represented by a canyon through which the Kasakh River flows into the Project site (**Figure 8-2, a**). Approximately 1,000 meters before entering the reservoir area, the Shakhverd and Kasakh Rivers converge, and their gorges merge into the Kasakh River canyon (**Figure 8-2, b**). The planned reservoir area is bordered to the north, west, and south by orchards, vineyards, and vegetable cultivation areas. The Kasakh reservoir will be located downstream to Oshakan, Veskevaz and Voskehat villages, but upstream the Amberd and Aygeshat rural settlements.

All Project supporting facilities, except for the loam (clay) borrow pit located 35 km from the Project area, will be situated within the construction site (see also **Sub-section 2.6.7**). The main sources of visual disturbance include construction machinery, heavy vehicles, borrow pits, topsoil stockpiles, storage areas for construction materials and oil products, and other temporary infrastructure.

Figure 8-1. View of the Project site from west to east

Figure 8-2. Aerial view of the canyons of the Kasakh and Shakhverd Rivers

a) Kasakh River canyon *b) Location where Shakhverd and Kasakh Rivers converge*

The nearest residential houses are located at a considerable distance from the Project site (450-850 m) and are therefore unlikely to be affected visually, except by those who cultivate agricultural lands around the reservoir area and/or use these plots for cattle grazing. Hence, while the Project's impact on visual amenity is unavoidable, it will be short-term (limited to the construction period) and will affect only a small number of residents.

Prior to the start of construction, the planned reservoir area will be cleared of all vegetation, including approximately 520 trees. These include *Salix excelsa* S.G. Gmel., *Populus nigra* L., *Ulmus minor* Mill., and *Tamarix ramosissima*. According to calculations conducted as part of the national EIA study, approximately 1,840 trees will be planted as a compensatory measure. This will be carried out in accordance with the Tree Management Plan, which will be prepared by the construction contractor and implemented near the end of the construction phase.

Operation phase

During the operation phase the landscape of the Project area will experience a permanent transformation due to the formation of the reservoir and the presence of supportive infrastructure. Main impacts include:

1) Permanent change in land cover

The original steppe terrain, rivers flow and cultivated plots will be replaced by a standing water body, altering the natural character and visual identity of the area.

2) New visual elements

The reservoir, dam structure, and supportive facilities will become dominant and permanent features in the landscape.

3) Potential aesthetic value

The reservoir will enhance the visual appeal of the area, depending on how well it integrates with the surrounding environment.

4) Landscape alteration

Natural regeneration and vegetation growth around the reservoir perimeter may gradually soften visual contrasts and help the area blend with the surrounding environment.

Overall, the visual impact during the operation phase is long-term, but generally more stable and potentially less intrusive than during the construction phase. Effective landscaping and

environmental integration can help mitigate negative visual effects. Over time, the Project's visual impact may even become positive.

The irrigation of currently uncultivated 503 hectares of agricultural land using reservoir water is also expected to have an indirect positive effect on the visual amenity of the Project region by promoting greener and more cultivated landscapes.

The Project implementation may also have a positive impact on the cultural landscape. The vineyards, orchards, and other cultivated land in the affected villages are an integral part of the combined rural vernacular and organically evolved landscape. Given the cultural heritage value of the villages of Oshakan, Voskehat, and Voskevaz, and the presence of wineries in the region, expanding vineyard areas will serve as an additional driver of economic development (see **Sub-section 8.4.2**).

Impact assessment and mitigation measures

Assessment and mitigation of visual impacts during the reservoir construction and operation phases are summarised in **Table 8-13**.

Table 8-13. Summary of visual impact and mitigation measures for the Project construction and operation phases

Receptor	Assessed Impact	Mitigation / management measures	Residual impact
Impact on natural landscape			
CONSTRUCTION PHASE			
Shepards, visitors	Moderate	***Pre-construction phase*** 1) Develop Tree Management (TrMP) and obtain approval from the Supervising engineer and agreement from the affected community. ***Construction phase*** 2) Conduct the planting of 1,840 trees in areas agreed upon with the heads of Ashtarak and Khoy municipalities and ensure their aftercare for a period of two years *(aftercare may be carried out during the reservoir operation phase)*. 3) The proposed types of trees to be planted are: • *Acer campestre* L. • *Amygdalus fenzliana* (Fritsch) Lipsky • *Salix excelsa* S.G. Gmel. • *Salix triandra* L. • *Populus nigra* var. *italica* Duroi • *Elaeagnus angustifolia* L. var. *culta* Sosn.	Low
OPERATION PHASE			
Population, visitors	Significant	Ensure maintenance and aftercare of the planted trees for two years. *Over time, natural regeneration and vegetation growth along the reservoir's perimeter may reduce visual contrasts and facilitate the integration of the area into the surrounding landscape.*	Low Can be positive (after 3-5 years)

Receptor	Assessed Impact	Mitigation / management measures	Residual impact
		If well integrated with the natural landscape, the reservoir may contribute positively to the area's overall visual character.	
Impact on cultural landscape			
Population, landowners, visitors, tourists	Neutral	***Construction and operation phases*** Consult the heads of affected settlements and landowners who will gain access to irrigation water as a result of the project implementation, regarding the design solutions for establishing orchards and vineyards based on modern cultivation and irrigation technologies. *This may transform the organically evolved cultural landscape, characterized by traditional vineyards and orchards, into a designed cultural landscape.*	Positive

8.2.6 Impact on Geology

Construction phase

The main impacts on the geological structure within the Project area are associated with the following construction activities:

1) Vegetation clearance and removal of topsoil,
2) Excavation and earthworks,
3) Soil erosion in the construction site, topsoil and spoil temporary storage areas.

The impact of vegetation clearance and topsoil removal is minor and is unlikely to generate significant erosion processes as these works deal with the ground surface layer (up to 0.2 m) only.

Excavation and earthworks will involve the movement of a certain amount of soil (including topsoil and excavated subsoil), which may potentially trigger landslides, mass movements, and other erosion processes. Improper practices in the storage of topsoil and spoil, particularly: (i) excessive height of stockpiles and steep slope gradients, (ii) location of storage sites near watercourses and roads, and (iii) open storage without vegetation cover or protective sheeting, can negatively affect the geology of the Project site and surrounding areas. These aspects and the relevant mitigation measures are discussed in detail in **Section 8.2.8**.

Another potential impact of the Project on geological erosion is the temporary destabilization of disturbed soils due to precipitation and surface runoff. These effects on the soil, along with resulting changes in topography, may create conditions that lead to temporary erosion and sedimentation. The proposed mitigation measures are presented in **Table 8-14**.

Operation phase

During the operation phase, impacts on the geological conditions of the Project area may result from:

1) Water infiltration from the reservoir body and the dam base, potentially affecting groundwater,
2) Coastal erosion around the entire perimeter of the reservoir due to water encroachment during the initial years of operation.

Water infiltration aspects were considered as part of the Project's engineering-geological study (Section 2.6). As part of this study, the infiltration properties of the upper soil layer near the dam of the reservoir area were analysed. The estimated annual water infiltration from the reservoir body is 19,441,795 m^3/year, which is nearly twice the designed capacity of the Kasakh Reservoir and indicates the need for anti-infiltration measures. These measures are described in detail in the Project design documentation. Implementation of the proposed anti-infiltration measures is expected to reduce water infiltration from the reservoir to 12,659 m^3/year, which is within the acceptable range of losses.

The management and mitigation of the second impact also require technical and technological solutions. Some of these are likely addressed in the Project design documentation; however, additional mitigation measures may be recommended by the Consultant to minimize embankment erosion during the early years of reservoir operation. These measures (Table 8-14) are optional, can be discussed with the Client and the EPC contractor and incorporated into the Project design documentation, if deemed relevant:

1. **Bioengineering / Vegetative Measures**
   - **Revegetation of embankment:** Planting native grasses, shrubs, and trees to stabilize soil through root systems and reduce erosion,
   - **Use of geotextiles:** Biodegradable or synthetic mats that support vegetation growth while preventing initial soil loss.
2. **Embankment Stabilization Measures**
   - **Riprap (rock armouring):** Placing layers of large, durable stones along vulnerable embankments to dissipate wave energy and prevent erosion,
   - **Revetments:** Sloped structures placed on banks to absorb and deflect the energy of incoming water.
3. **Reservoir Operation Management**
   - **Controlled filling rates:** Gradually filling the reservoir to allow embankment soils to stabilize and minimize sudden saturation that can lead to collapse,
   - **Water level fluctuation control:** Avoiding large, rapid fluctuations in water level during early years to reduce destabilization of new embankments.
4. **Erosion Monitoring and Adaptive Management**
   - **Regular monitoring:** Using drones, surveys, or satellite imagery to detect early signs of erosion and assess the effectiveness of mitigation measures,
   - **Adaptive management plans:** Revising and enhancing embankment protection measures based on ongoing monitoring results,
   - **Erosion-sensitive zoning:** Identifying high-risk areas and applying stricter protection or engineering controls there.

Impact assessment and mitigation measures

Assessment and mitigation of impacts on geological conditions during the reservoir construction and operation phases are summarised in Table 8-14.

Table 8-14. Summary of geological impacts and mitigation measures for the Project construction and operation phases

Receptor	Assessed Impact	Mitigation / management measures	Residual impact
CONSTRUCTION PHASE			

Receptor	Assessed Impact	Mitigation / management measures	Residual impact
Soil resources	Moderate	1) Diversion ditches or berms: redirect surface runoff away from disturbed areas, 2) Proper grading: ensures slopes are stable and directs water flow in controlled paths, 3) Slope breakers: break long slopes into smaller segments to reduce erosion potential, 4) Phased construction: limits the area of exposed soil at any one time, 5) Avoid earthworks during rainy seasons, where feasible, to reduce erosion risk.	Low
Monitoring: - Regular site inspections: Especially after rainfall, to check for erosion signs and repair damaged controls, - Maintenance of sediment control measures: Ensure ditches, berms and drains are functioning properly.			
OPERATION PHASE			
Soil resources	Moderate	***Optional measures:*** 1) Bioengineering / Vegetative Measures - Planting native grasses, shrubs, and trees to stabilize soil through root systems and reduce erosion, - Biodegradable or synthetic mats that support vegetation growth while preventing initial soil loss. 2) Shoreline Stabilization Measures - Placing layers of large, durable stones along vulnerable shorelines to dissipate wave energy and prevent erosion, - Sloped structures placed on banks to absorb and deflect the energy of incoming water. 3) Reservoir Operation Management - Gradually filling the reservoir to allow the slope soils to stabilize and minimize sudden saturation that can lead to collapse, - Avoiding large, rapid fluctuations in water level during early years to reduce destabilization of new shorelines. 4) Erosion Monitoring and Adaptive Management	Low Negligible (after 3-5 years of operation)
Monitoring: - Using drones, surveys, or satellite imagery to detect early signs of erosion and assess the effectiveness of mitigation measures, - Revising and enhancing shoreline protection measures based on ongoing monitoring results, - Identifying high-risk areas and applying stricter protection or engineering controls there.			

8.2.7 Impact on Water Resources

The potential impacts of the Project on surface water resources during the construction and operation phases are described in **Subsection 8.2.7.1-8.2.7.3**.

8.2.7.1 Water Quality / Water Contamination

Construction phase

The results of the water quality analysis of the Kasakh River, compared with the environmental norms established by RA Government Decree №75-N, are presented in **Section 6.1.5** of this ESIA report. The analysis indicates that, aside from elevated concentrations of suspended solids and nitrate ions, the water quality can be categorized as 'excellent' or 'good'. However, in terms of suspended solids and nitrate ion content, the water quality is classified as 'fair' and 'poor', respectively.

The water samples were collected in April, during the snowmelt period, when runoff mixed with soil particles was feeding into the Kasakh River. This seasonal phenomenon likely explains the relatively high levels of suspended solids. The elevated concentration of nitrate ions is typically attributed to agricultural runoff, particularly from the use of fertilizers.

During the construction phase, contamination of the Kasakh River and of the lower reaches of Amberd and Shakhverd rivers is expected due to the deposition of dust and exhaust gas emissions (from construction machinery and heavy trucks), spills of hazardous materials, and improper management of storage areas. Surface water quality may also deteriorate as a result of soil erosion and runoff caused by rainfall or snowmelt.

Earthworks and improper transportation or storage of topsoil, spoil, friable construction materials, and oil products, as well as loading/unloading operations, can lead to pollutants partially settling into nearby surface watercourses and/or potentially infiltrating into groundwater, thereby degrading overall water quality. Additionally, potential spills or leakages of oil and lubricants from construction machinery may be carried by runoff and discharged into downstream surface waters.

The removal of topsoil, excavation, and other earthworks will disturb the soil and vegetation cover within the Project area, potentially triggering or intensifying soil erosion. This erosion may cause soil to migrate into waterways via surface runoff, increasing turbidity and silting of water bodies, ultimately leading to further deterioration in surface water quality.

In can be concluded that the implementation of mitigation measures presented in **Sections 8.2.4**, **8.2.6** and **8.2.8**, supplemented by the measures proposed in **Table 8-15** will significantly minimise the impact of the construction works on water quality.

Operation phase

During the operation phase, the water quality of the Kasakh, Amberd and Shakhverd rivers upstream of the reservoir is not expected to change, as the reservoir operation will not cause contamination of upstream watercourses.

Within the reservoir, several natural processes contribute to the self-purification of water. These include sedimentation of suspended solids, adsorption and precipitation of nutrients and metals, microbial degradation of organic matter, and nutrient uptake by aquatic vegetation. Together, these ongoing processes help to maintain and improve water quality, supporting the long-term sustainability of irrigation activities. As a result, the quality of water downstream of the reservoir, including both environmental flow and irrigation water, is expected to improve due to the implementation of the Project.

However, one important precondition must be taken into account: soil erosion along the perimeter (shoreline) of the reservoir, particularly during the early years of operation, as well as stormwater and agricultural runoff into the Kasakh River and reservoir must be minimized (see **Section 8.2.6**).

In addition, any manmade inflows from domestic or industrial activities into the reservoir must be eliminated.

8.2.7.2 Changes to Hydrological Regime

The following parameters are characterizing the hydrological regime of the reservoir:

1) Flow Regulation

Before the construction the Amberd and Kasakh rivers flow naturally with seasonal variations, with high flows during snowmelt or rainy seasons, and low flows during dry periods. After construction the reservoir regulates flow, reducing peak discharges during floods and augmenting flow during dry periods. Therefore, the regulation of the water flow may benefit irrigation, but affect the natural water flow seasonal fluctuations downstream.

2) Alteration of Flow Timing

Reservoir operation often changes the timing of downstream flows, releasing water based on demand rather than natural cycles. This can shift peak flows from spring (due to snowmelt) to summer or autumn (due to irrigation needs), disrupting ecological processes.

3) Reduction in Peak Flows and Flood Frequency

Controlled releases from the reservoir reduce peak flood events downstream. This can lower the risk of flood damage but also impact floodplain ecosystems that depend on periodic flooding for nutrient cycling and habitat renewal.

4) Evaporation Losses

Large surface areas of reservoirs increase evaporation, especially in arid or semi-arid climates. This can lead to reduced downstream water availability compared to pre-reservoir conditions.

5) Environmental Flow Modification

Without proper planning, minimum environmental flows downstream may not be maintained. Therefore, environmental flow requirements must be included in the reservoir operation plan to support aquatic ecosystems and community needs.

In can be concluded that particularly the operation phase of the Project will significantly alter the hydrological regime of the Kasakh River. These changes include the regulation of natural flow variability, reduction of peak discharges, changes in flow timing, and sediment retention. While these changes support improved water availability for irrigation, they may also impact downstream ecosystems and groundwater dynamics. To mitigate adverse effects, the implementation of irrigation water and environmental flow releases management plan is recommended.

8.2.7.3 Water losses

Construction phase

No changes in water losses compared to the baseline situation are expected during the construction phase.

Operation phase

Water losses can occur from the reservoir body, dam, irrigation offtake and channels. Calculations of water infiltration from the reservoir body and the dam, along with proposed anti-infiltration measures, are presented in the Project design document and summarised in **Section 2.6** of this ESIA report. It can be assumed that the proposed mitigation measures will reduce water infiltration rate to the acceptable level (12,659 m³/year).

The current operational condition of the Stage-2 Hrazdan Down Channel is unknown. Therefore, potential water losses from the channel through which 503 ha of agricultural land in 21 rural settlements will be irrigated cannot be estimated. It is assumed that, once the reservoir is constructed and operational, water losses through the Stage-2 Hrazdan Down Channel will be negligible. Consequently, water losses from the irrigation system are expected to occur only in the event of incidents or technological breakdowns. This underscores the need for regular technical maintenance of the reservoir's supporting infrastructure, in accordance with the Reservoir Operation and Maintenance Plan (see also **Section 8.4**).

In the meantime, the Consultant recommends conducting a technical audit of the Stage-2 Hrazdan Down Channel and, if necessary, implementing required rehabilitation measures to minimise irrigation water losses, preferably before the commissioning of the reservoir.

Impact assessment and mitigation measures

Assessment and mitigation of impacts on water resources during the reservoir construction and operation phases are summarised in **Table 8-15**.

Table 8-15. Summary of impacts on water resources and mitigation measures for the Project construction and operation phases

Receptor	Assessed Impact	Mitigation / management measures	Residual impact
CONSTRUCTION PHASE			
Water resources	Moderate	***Construction phase - Water Contamination*** 1) Construct intermediate collection pools between runoff-generating surfaces and downstream watercourses to regulate flow to water bodies. These pools will allow soil particles to settle at the bottom, thereby reducing the turbidity of the runoff, 2) Limit excavation and other earthworks near the Amberd and Kasakh Rivers during the rainy season, 3) Prohibit the discharge of any untreated wastewater effluent into surface water bodies, 4) Where practical, construct local perimeter drains around working areas (e.g., storage and parking areas) to collect suspended runoff and prevent its discharge into surface water resources.	Low
Monitoring: According to the Air, water and soil quality monitoring plan			
OPERATION PHASE			
Water resources	Low	***Operation phase - Water Contamination*** 1) Minimize potential stormwater and agricultural runoff release to the Amberd and Kasakh Rivers, 2) Eliminate manmade inflows from domestic or industrial activities into the reservoir.	Positive
Water resources, irrigation water users, ecosystems downstream the reservoir	Significant	***Pre-operation phase - Hydrological Regime*** Develop irrigation water and environmental flow releases management plan to: - Ensure reliable and efficient delivery of irrigation water to agricultural areas,	From moderate to low

Receptor	Assessed Impact	Mitigation / management measures	Residual impact
		- Maintain minimum environmental flows to support the health of downstream aquatic and riparian ecosystems, - Prevent over-extraction and degradation of water resources, - Comply with national water use regulations and environmental protection standards. ***Operation phase - Hydrological Regime*** 1) Review the irrigation water and environmental flow releases management plan annually, or after major hydrological events, to incorporate new data, regulatory changes, and operational experience, 2) In the event of low reservoir levels or critical drought conditions, implement a prioritization protocol that protects environmental flows up to a predefined minimum threshold before allocating water for irrigation.	
Monitoring: - Real-time monitoring to adjust schedules based on demand and supply conditions, - Monthly reports on water releases for irrigation and environmental purposes must be submitted to the Water Committee, - Regular ecological monitoring downstream to evaluate the adequacy of flow for habitat maintenance.			
Water resources, irrigation water users,	Low	***Pre-operation phase - Water losses*** 1) Develop Reservoir Operation and Maintenance Plan, 2) Conduct technical audit of the Stage-2 Hrazdan Down Channel and, if necessary, implement required rehabilitation measures to minimise irrigation water losses, preferably before the commissioning of the reservoir. ***Operation phase - Water losses*** Carry out technical maintenance of the reservoir's supporting infrastructure to eliminate incidents and breakdown in accordance with the Reservoir Maintenance Plan.	Negligible

8.2.8 Impact on Soil

8.2.8.1 Topsoil Management

Construction phase

Construction works will begin with vegetation clearance and topsoil removal. According to the Project design study, approximately 106,774 m^3 of topsoil will be stripped and removed from the construction site, including areas designated for borrow pits, construction materials storage areas, construction camp, etc.

If not properly managed, the removed topsoil can be damaged through mixing with subsoil (spoil) and/or other materials. Additionally, the topsoil may lose its physical and biological properties due to compaction by heavy machinery both within and outside the construction site. Losses may also occur

during transportation to temporary stockpile areas, as well as through wind and water erosion while in storage. Furthermore, the quality of the topsoil may deteriorate if the stockpiles are not properly maintained during the storage period.

According to the national legislation, topsoil management shall be regulated by the *Procedure for Topsoil Use*, approved by the RA Government Decree №1396-N, and the *Requirements for Determining Topsoil Stripping Norms and for the Preservation and Use of Stripped Topsoil*, approved by the RA Government Decree №1404-N. These documents define:

- Organizational aspects, including the procedure for permit issuance for soil removal, transportation and storage,
- Technical aspects, such as the prescribed norms (thickness) of topsoil to be stripped and removed,
- Technological and environmental aspects, including conditions and specifications for topsoil storage, preservation and use.

Topsoil removal from the construction site, along with its transportation, storage, and reuse, should be carried out by the construction contractor in accordance with the requirements of the above-mentioned documents and the supplementary mitigation measures proposed in **Table 8-17**. The topsoil will later be used for landscaping (see **Section 8.2.5**). The construction contractor shall also develop and implement a Topsoil Management Plan (TsMP).

Operation phase

No impacts on topsoil are expected during the Project operation phase.

8.2.8.2 Soil Excavation and Disposal

Construction phase

According to the RA Law on Waste, and particularly the *List of Wastes Generated in the Republic of Armenia*, approved by Order №342-N of the RA Minister of Environment, excavated material (subsoil or spoil, waste code: 31401101 01 00 5) is classified as non-hazardous waste. Since the excavated spoil materials will be used as backfill, the permanent disposal of this material is not addressed in this section (see also **Section 8.2.9**).

Operation phase

No impacts associated with soil excavation and disposal are anticipated during the reservoir operation phase.

8.2.8.3 Management of Hazardous Materials

Construction phase

The list of hazardous materials that may potentially be used during the construction of the reservoir and its infrastructure, along with their associated hazards, is presented in **Table 8-16**.

Table 8-16. Hazardous materials to be used during the reservoir construction, their uses and associated hazards

№	Materials	Use	Hazards
1	Fuels (diesel, petrol)	Powering construction machinery, generators, and heavy trucks.	Flammable, risk of spills leading to soil and water contamination.

№	Materials	Use	Hazards
2	Lubricants and oils	Machinery operation and maintenance (e.g., excavators, loaders, vehicles).	Toxic to aquatic life, potential for soil contamination.
3	Concrete and additives	Enhancing performance of concrete (e.g., accelerators, retarders).	May contain hazardous chemicals (e.g., formates, chlorides), skin and eye irritants.
4	Paints and coatings	Corrosion protection of metal structures, tanks, and pipelines.	May contain solvents and heavy metals; volatile organic compounds (VOCs).

Leakages and accidental spills of hazardous materials, along with their management measures, are discussed in **Sub-section 8.2.8.4**. The impacts of hazardous materials on health and safety, as well as fire risks, are outlined in **Section 8.3.6**. Before the commencement of construction works, the construction contractor shall develop a Hazardous Materials Management Plan (HMMP). Additional mitigation measures are presented in **Table 8-17**.

Operation phase

Only a few types of hazardous materials, and in small quantities, will be used during the maintenance of the reservoir and its infrastructure. Their potential impacts are negligible; therefore, they do not require mitigation measures.

8.2.8.4 Soil Contamination

Construction phase

Accidental spills of friable materials, leakages of oil, fuel, and other liquid chemicals during the field works within the construction site as well as their transportation, storage, and use, may inevitably occur and lead to soil contamination. Improper waste management can also result in littering and further soil pollution (see **Section 8.2.9**). Therefore, the handling of hazardous materials, including their transportation, storage, and use, must be carefully managed.

The use of old or technically outdated construction machinery and heavy trucks for the Project shall be strictly prohibited. Friable materials shall be transported using trucks fitted with waterproof canvas covers. Oil products and chemicals must be stored separately in clearly marked drums or tanks, placed on secondary containment systems or spill trays. During refuelling or the transfer of oil, fuel, or other chemicals, protective berms shall be used (**Figure 8-3, a)**). Excavated topsoil shall be stored and managed in accordance with the procedures outlined in **Sub-section 8.2.8.1**.

Facilities designated for the storage of oil and chemicals, as well as heavy trucks used to transport such materials, shall be equipped with appropriate spill kits (**Figure 8-3, b)**). Construction and other friable materials shall be stored in separately allocated, fenced areas covered with waterproof sheeting. In addition, it is recommended to regularly monitor soil quality near potentially contaminated areas, in accordance with the Air, Water, and Soil Quality Monitoring Plan. All of the specified measures, along with others, shall be consolidated into the Spill Prevention and Management Plan (SPMP).

Figure 8-3. Recommended tools and kits for prevention or mitigation of spillages and leakages

a) Secondary containments or trays for storage and refilling of oil products and chemicals

b) Spill kits for oil products and chemicals

Provided that the measures recommended in **Table 8-17** are implemented, the Project's impact on soil contamination during the construction phase can be assessed as low.

Operation phase

Some small-scale accidental spills of oil products and friable materials can be expected during routine maintenance of the reservoir body, dam, and supporting infrastructure, as well as during regular cleaning of the irrigation channel. These leaks (spills) can be prevented or minimised through the implementation of some administrative and organizational measures, such as outsourcing of the maintenance works to the contractors equipped with modern and technically serviced equipment.

Impact assessment and mitigation measures

Assessment and mitigation of impacts on soil during the reservoir construction and operation phases are summarised in **Table 8-17**.

Table 8-17. Summary of soil impacts and mitigation measures for the Project construction and operation phases

Receptor	Assessed Impact	Mitigation / management measures	Residual impact
CONSTRUCTION PHASE			
Soil and water resources, flora and fauna	Moderate	***Pre-construction phase*** 1) Develop Topsoil Management Plan (TsMP) and obtain approval from the Supervising engineer, 2) Obtain required permit for topsoil transportation and storage operations, 3) Develop Hazardous Materials Management Plan (HMMP) and obtain approval from the Supervising engineer, 4) Develop Spill Prevention and Management Plan (SPMP) and obtain approval from the Supervising engineer.	Low

Receptor	Assessed Impact	Mitigation / management measures	Residual impact
		Construction phase - Topsoil management 1) Carry out the removal, transportation, storage, and use of topsoil in accordance with RA Government Decrees №1396-N and №1404-N, 2) Store topsoil separately to prevent mixing with subsoil, maintaining it in a condition that preserves the natural seed bank, until construction works are completed, 3) Locate topsoil stockpiles at least 50 m away from watercourses to prevent water siltation, 4) Avoid placing topsoil stockpiles near planned excavation areas, 5) Limit the height of stockpiles to a maximum of 3 m, and ensure the slope gradient does not exceed 25º, 6) Clearly label all topsoil stockpiles to ensure easy identification, 7) Cover topsoil stockpiles to prevent soil erosion, where natural revegetation has not occurred, 8) Fence off topsoil stockpiles to prevent unauthorized access and compaction by Project vehicles, 9) Reuse the stored topsoil for landscaping the disturbed areas and/or tree planting within the Project area and vicinities near the end of the construction phase. ***Construction phase - Hazardous materials*** 1) Store all hazardous materials in clearly labelled, secure, and ventilated areas, 2) Hazardous materials containers to be clearly labelled according to contents and hazards, 3) Equip sites with spill response kits and train workers on emergency response, 4) Maintain Material Safety Data Sheets (MSDS) for all hazardous materials on-site, 5) Incompatible hazardous materials must not be stored together, 6) Hazardous materials storage areas will be equipped with eye wash kits and fire extinguishers, 7) Use appropriate PPE. ***Construction phase - Soil contamination*** 1) Transport friable materials using trucks equipped with waterproof canvas covers, 2) Store construction and other friable materials in separately designated areas that are fenced and covered with waterproof tents, 3) Store oil products and chemicals separately, in special drums or tanks placed on secondary containment systems or trays having 110% of the volume of the container,	

Receptor	Assessed Impact	Mitigation / management measures	Residual impact
		4) Carry out refuelling of oil, fuel, and other chemicals only on specially prepared protective berms, 5) Equip storage facilities for oil and chemicals, as well as heavy trucks transporting these materials, with appropriate spill kits, 6) Immediately stop work in the event of uncontrolled spillage of fuel, engine oil, or chemicals. Remediate contaminated soil by removing the affected layer (to be treated as hazardous waste) and replacing it with clean soil, 7) Train all staff on the safe execution of construction works and on response procedures for environmental incidents such as spills and leaks, 8) Ensure spoil piles do not exceed 3 m in height, and maintain slope gradients not exceeding 25º. Manage spoil piles to prevent erosion and runoff.	
Monitoring: According to the Air, water and soil quality monitoring plan			
OPERATION PHASE			
Soil and water resources, flora and fauna	Low	Outsource the maintenance of operational reservoirs to contractors who are equipped with modern, well-maintained equipment and have relevant experience and qualified personnel.	Negligible

8.2.9 Waste Generation and Management

Construction phase

Typically, the construction of the reservoir, dam, and associated components is accompanied by the generation of industrial and household wastes, including:

- Excavated material (spoil) from excavation and other earthworks,
- Construction waste (residues of concrete, sand, gravel, used wood materials, etc.),
- Used oil and lubricants,
- Oily rags and soil contaminated with oil products,
- Used tires,
- Used lead-acid batteries,
- Ferrous and non-ferrous metal scraps, welding electrode slag,
- Empty containers of fuel, oil products and chemicals,
- Used packaging materials (cardboard and paper),
- Household waste.

475,558 m³ of spoil material will be generated during excavation and earthworks that will totally be used as backfill material for the reservoir and dam body (**Section 2.6.7**, **Table 2-11**). Therefore, designated Spoil Disposal Areas will not be required for the Project.

It is estimated in the national EIA report that 92,250 m^3 of construction waste will be generated during the Project implementation phase. The main sources of this waste will be old and/or partially demolished structures that need to be dismantled and cleared from the construction site. These wastes can be disposed of in a landfill. The Consultant recommends that the construction waste

generated by the Project be disposed of in the landfill located in Sasunik village, within the Ashtarak community, approximately 2.5-3.0 km from the reservoir area.

However, in line with the waste management hierarchy, it is preferable to crush and reuse the construction waste as backfill material for the dam construction, where technically feasible. This recommendation is optional and should be considered by the construction contractor, if deemed relevant.

There are no information relating to the volumes of household waste to be generated during the construction provided in the design document.

According to the World Bank Project - *Armenia SWM Sector Assessment and Reform Plan, Sector Assessment Report* (2024), the current household waste generation rate is 219 kg/capita/year (or 18.25 kg/capita/month) for Armenian settlements with populations under 40,000 residents. Taking into account that 99 workers (see **Section 2.6.7**) will be engaged in construction activities, it can be assumed that the monthly amount of household waste will be 18.25 × 99 = 1,807 kg (or approximately 1.81 tonnes). Over the entire reservoir construction period (39 months × 1.9 tonnes), around 70.6 tonnes of household waste will be generated. The volumes of other types of waste remain unknown.

The types, hazard classes and codes of industrial and household waste to be generated during the construction phase as well as recommended waste management actions as per waste hierarchy, are presented in **Table 8-18**.

Table 8-18. Types, hazard classes and codes of wastes generated during the construction works

№	Types of waste	Hazard Class	Hazard Code[126]	Recommended management actions
1	Excavated material (spoil)	V (non-hazardous)	31401101 01 00 5	Use as a backfill material, the residual part will be disposed of in the SDA
2	Construction waste	IV	91200601 01 00 4	Use as a backfill material, the residual part will be disposed of in the landfill
3	Used oil and lubricants: - Industrial oil - Engine oil - Hydraulic oil - Diesel oil	III	54100205 02 03 3 54100201 02 03 3 54100213 02 03 3 54100203 02 03 3	Store under special conditions and transfer to the licensed companies specialised in oil refining
4	Oily rags	III	58200600 01 01 4	Store under special conditions and transfer to the licensed companies for the treatment
5	Soil contaminated with oil products	III	31402303 01 03 4	
6	Used tires	IV	57500200 13 00 4	Periodically transfer to the licensed companies for the treatment
7	Used lead-acid batteries	II	92110100 13 01 2	Store under special conditions and transfer to licensed companies for the recycling
8	Ferrous metal scrap, empty metallic containers	IV	35131100 01 00 4	

[126]According to the list of waste generated in the Republic of Armenia (https://www.arlis.am/hy/acts/100155)

№	Types of waste	Hazard Class	Hazard Code[126]	Recommended management actions
	of fuel, oil products and chemicals			Can be periodically transferred to specialised companies for the recycling
9	Welding electrode slag	IV	31404800 01 99 4	
10	Non-ferrous metal scrap: - Copper scrap - Aluminium scrap	III V (non-hazardous)	35310301 01 01 3 35310105 01 99 5	Can be transferred to specialised companies for the recycling
11	Used packaging materials: - Cardboard - Paper	V (non-hazardous)	18710202 01 00 5 18710300 01 00 5	Can be transferred to specialised companies for the recycling
12	Household waste	IV	91200400 01 00 4	Shall be disposed of in the landfill

Proper management of the waste streams to be generated during the construction phase will be ensured through a detailed Waste Management Plan (WMP), to be prepared by the appointed construction contractor prior to the start of construction works. The WMP as a minimum shall include:

- Waste storage locations, containers and conditions,
- Environmental, fire, health and safety of the waste storage facilities,
- Actions to be implemented to ensure the provisions of waste management hierarchy (prevention, minimization, reuse, recycling, energy recovery and disposal, see also Table **8-18**),
- Safe transportation of waste,
- Response to the accidents (leakages of liquid waste, spills of friable materials, etc.) (see also **Sub-section 8.2.9**),
- Requirements and responsibility of the engaged personnel,
- Waste inventory and records, etc.

All required permits and normative documents regulating waste management in Armenia shall be obtained by the construction contractor prior to the commencement of construction. These documents shall include, at a minimum: (i) hazardous waste passports, (ii) waste generation norms, and their disposal limits, (iii) waste generation register, etc., (iv) waste primary registration log-books, etc.

Operation phase

During the Kasakh reservoir operation phase, the main types of waste generated will be associated with the maintenance of the reservoir, dam, and supporting infrastructure (e.g., irrigation channels, spillways, etc.), including:

- Debris and general litter,
- Metal scraps from repair works,
- Used oil and lubricants,
- Sludge (sediment) resulting from dredging operations,
- Household waste (including small quantities of oily rags, which can be collected together with household waste due to their minimal volume).

Currently, it is unclear whether the volume of sediment accumulated in the reservoir will periodically require removal from the reservoir bottom through dredging operations. However, if required, disposal at a landfill or the use of dredged sediment as fertilizer shall be considered.

Although only small volumes of waste are expected to be generated from maintenance operations, they should be properly managed by the operator of the Kasakh reservoir, most likely "Jrar" CJSC under the MTAI. Taking into account that "Jrar" CJSC also manages other first and second category reservoirs[127] in Armenia, the company should have a corporate Waste Management Plan (WMP) in place for the maintenance of all reservoirs under its control.

All waste-related permits required for the construction phase are also applicable to the operation phase and must, therefore, be obtained by "Jrar" CJSC. These provisions will also be included in the Project's Environmental and Social Action Plan (ESAP).

Impact assessment and mitigation measures

Assessment and mitigation of the reservoir construction and operation related waste impacts are summarised in **Table 8-19**.

Table 8-19. Summary of waste-related impact assessment and mitigation measures for the construction and operation phases

Receptor	Assessed Impact	Mitigation / management measures	Residual impact
CONSTRUCTION PHASE			
Workers, nearby population, soil and water resources, flora and fauna	Moderate	***Pre-construction phase - Waste management*** 1) Obtain all required permits and normative documents regulating waste management in Armenia, as a minimum including: - hazardous waste passports, - waste generation norms, and their disposal limits, - waste generation register, etc., - waste primary registration log-books. 2) Prepare and put into effect the Waste Management Plan (WMP) for the Project. ***Construction phase - General*** 1) Train the workers engaged in waste management on provisions of the WMP, 2) Apply waste hierarchy approach (prevention, minimization, reuse, recycling, energy recovery, disposal) while implementing the construction activities, 3) Elaborate and implement waste handling procedures for the construction operations, 4) Equip the construction site and construction camps with the waste separate collection / storage containers and locations, 5) Furnish the waste storage / collection facilities with fences, fire extinguishers, secondary containment trays, oil and chemicals spill clean-up kits, etc.,	Low

[127] *Armenia Water Reservoirs - Technical, Economic and Green Due Diligence Gap Analysis, Draft Final Report*, 2023-2024, Ove Arup & Partners

Receptor	Assessed Impact	Mitigation / management measures	Residual impact
		6) Store liquid waste in leak-proof, sealed containers. 7) Sign contracts with the licensed waste handling (recycling, treatment, disposal) companies to hand them over the generated wastes. ***Construction phase - Waste transportation*** 1) Transport all types of wastes using adequate, sealed and covered trucks to avoid the leakage or dispersal of the waste on roads and surroundings, 2) Ban abandoning the wastes on the route and/or fly tipping waste in unauthorized locations, 3) Select the routes involving the least risk for the transportation from the area of its generation to its storage and recycling / disposal area, 4) Instruct the waste truck drivers on waste transportation on safety rules. ***Construction phase - Household waste management*** 1) Equip the construction site with household collection containers / bins, 2) Sign a contract with the communal company for the regular removal of household waste from the construction site and construction camps.	
Workers of the construction contractor	Moderate	In addition to the measures listed above: enforce the use of PPE and in particular, the protective clothes, shoes, gloves, respirator / masks for the workers dealing with the waste.	Low
Monitoring: According to the Waste Management Plan and Spoil Disposal Management Plan			
OPERATION PHASE			
Workers of the reservoir operator	Low	1) Obtain all required permits and regulatory documents relevant to the operation of reservoirs in Armenia, as required by local waste-related legislation (can be done at the corporate level), 2) Develop and implement WMP for the operation and maintenance of the reservoir (can be done at the corporate level), 3) Apply waste hierarchy approach (prevention, minimization, reuse, recycling, energy recovery, disposal) for the generated waste, 4) Equip the site with waste collection and storage containers and areas, 5) Sign contracts with the licensed waste handling (recycling, treatment, disposal) companies to hand them over the generated wastes, 6) Sign a contract with the communal company for the regular removal of household waste from the reservoir site.	Negligible
Monitoring: According to the operation phase Waste Management Plan			

8.2.10 Noise and Vibration Impact

Construction phase

The main sources of noise and vibration during the construction phase are:

1) Operation of construction machinery within the construction site,
2) Movement of heavy trucks along community and regional roads, as well as within the construction site,
3) Operation of the construction camp and borrow pits,
4) Noise-generating activities such as excavations, loading and unloading of soil and construction materials, etc.

The dominant source of noise from most construction equipment is the engine, which typically runs on diesel and may lack adequate muffling. However, in some cases, noise generated by construction processes may exceed that produced by the equipment itself. Noise levels during construction will vary depending on the specific activities, schedule, and combination of equipment in use.

There are no residential areas in the immediate vicinity of the Project site; therefore, construction noise and vibration are not expected to affect the local population. However, minor noise impacts on residents of the Amberd, Aygeshat, Voskehat, Voskevaz, Dasht, Monteavan, and Oshakan rural settlements may occur when heavy trucks transport construction and other materials along community and access roads to the Project site. Construction contractor personnel may also be exposed to noise and vibration during work activities. Additionally, construction noise may affect local wildlife, cattle grazing in the areas surrounding the Project site, and residents cultivating nearby agricultural lands.

It is evident that the typical noise levels emitted by construction equipment exceed the national hygienic standard of 80 dBA. Therefore, several mitigation measures, including the provision of Personal Protective Equipment (PPE) for workers, should be implemented (**Table 8-20**). These measures, along with other mitigation efforts, will help reduce noise exposure for workers, shepherds guiding cattle to grazing areas and farmers.

The analysis of similar projects and the Consultant's experience indicate that construction-related vibration impacts are localized and typically confined to 40 m of the source. Given that the nearest residential houses are located at a considerable distance from the Project site, it can be concluded that there will be no vibration impacts on sensitive receptors. Furthermore, construction vibrations will not affect the seismic stability of existing buildings and structures. Only operators of construction equipment and machinery may be exposed to vibration; therefore, appropriate Personal Protective Equipment (PPE) should be provided to the relevant workers.

Operation phase

No significant noise or vibration exposure is expected from the operation of the reservoir. Only periodic maintenance activities may generate noise, which is anticipated to be negligible.

Impact assessment and mitigation measures

The assessment and mitigation of noise and vibration impacts during the construction and operation phases of the reservoir are summarised in **Table 8-20**.

Table 8-20. Summary of noise and vibration impacts and mitigation measures for the Project construction and operation phases

Receptor	Assessed Impact	Mitigation / management measures	Residual impact
CONSTRUCTION PHASE			
Workers, population of Amberd, Aygeshat, Voskehat, Voskevaz, Dasht, Monteavan, and Oshakan villages, shepherds and farmers	Moderate *(in case of heavy trucks movement)* Low *(in case of operation of construction machinery)*	1) Keep all diesel-powered vehicles and equipment (such as generators and air compressors) at a high level of maintenance. This will particularly include the regular inspection and, if necessary, replacement of intake and exhaust silencers, 2) Machinery/vehicles that are used intermittently will be shut down or throttled back during periods when not in use, 3) Whenever possible: enclose noisy equipment, restrict non-stop operation of noisy equipment, avoid simultaneous operation of noise generating equipment, 4) Avoid unnecessary idling times, 5) Minimising the need for equipment to reverse. This will reduce the frequency at which disturbing but necessary reverse warnings will occur, 6) Avoid unnecessary horn hooting from the used construction machinery, 7) Limit truck speeds - not to exceed 40 km/h, when driving through local community roads, 8) Inform residents of Amberd, Aygeshat and Voskehat settlements of the schedule and duration of construction activities, particularly where these are likely to generate high noise levels, 9) Movement of heavy trucks along the communal roads will be strictly prohibited between 10 PM and 6 AM near residential areas.	Low
Construction workers	Moderate	In addition to the measures listed above: 1) Enforce the use of PPE and in particular, the protective devices capable to reduce the sound level at the ear to acceptable levels, 2) Ensure that all workers exposed to local vibration are provided with and use appropriate PPE, 3) Provide employees engaged in 'noisy' operations with additional 15 minutes break per 2 hours.	Low
Monitoring: According to the noise and vibration monitoring plan			
OPERATION PHASE			
Maintenance workers	Negligible	No action required	

8.2.11 Traffic Impacts

Construction phase

Access to the planned reservoir area will be via community roads passing through the villages of Amberd, Aygeshat, Voskehat, Voskevaz, Dasht, Monteavan, and Oshakan. The roads of Amberd, Aygeshat and Voskehat villages within the built-in areas are asphalt-paved; however, as the routes

approach Project site, these roads are transformed into earthen roads. Construction activities will significantly increase the movement of heavy trucks due to the transportation of:

- Approximately 256,000 m^3 of loam (clay) from a borrow pit located in the Gay community of the Etchmiadzin region to the construction site,
- Around 92,250 m^3 of construction waste from the construction site to the landfill (disposal) area,
- Approximately 11,130 tons of reinforced concrete to the construction site,
- Construction materials, oil products and chemicals to the construction site,
- Industrial and household waste to landfills or specialized companies, etc.

The community roads of Amberd, Aygeshat and Voskehat villages will be used to transport local workers to the construction site. These roads will also be used to deliver construction machinery to the site. The Project design document envisions construction of the two earthen access roads. The current status of the land designated for the construction of these roads is unknown and will be assessed later within the RAP study.

The implementation of the Project will have a significant impact on the traffic intensity within the rural settlements of Amberd, Aygeshat and Voskehat. However, the construction of the access roads described above will serve as bypass routes for the transportation of materials, thereby reducing the negative traffic impacts associated with the Project. The increase in traffic intensity is also connected with higher noise levels; therefore, the mitigation measures proposed in **Section 8.2.10** are partially applicable to traffic-related impacts.

Moreover, the construction contractor shall develop a Traffic Management Plan, that will be approved by the Supervising engineer and Client as well as relevant regional authorities and road police.

Operation phase

No significant traffic impacts are expected during the reservoir operation phase.

Impact assessment and mitigation measures

The assessment and mitigation of traffic impacts during the construction and operation phases of the reservoir are summarised in **Table 8-21**.

Table 8-21. Summary of traffic impacts and mitigation measures for the Project construction and operation phases

Receptor	Assessed Impact	Mitigation / management measures	Residual impact
CONSTRUCTION PHASE			
Population of Amberd, Aygeshat, Voskevaz, Voskehat, Dasht, Monteavan, and Oshakan villages	Significant	***Pre-construction phase*** 1) Develop a Traffic Management Plan inclusive of identification of sensitive receptors and management of impacts to them, which will be approved by the Supervision engineer and Client as well as relevant regional authorities and road police, 2) Prior to the commencement of construction works, the condition of community roads to be used for project purposes shall be inspected and documented by the representatives of the construction contractors and representatives from the affected settlements. In the event that significant damage is caused by the	Low

Receptor	Assessed Impact	Mitigation / management measures	Residual impact
		Project, the Construction Contractor shall restore the roads to at least their pre-construction condition. ***Construction phase*** 1) Construct the access roads as envisioned in the Project design document, 2) Implement the Traffic Management Plan, 3) Train drivers of heavy vehicles on the key requirements of the Traffic Management Plan, Inform local residents of anticipated construction traffic impacts at least two weeks prior to the start of construction, 4) Equip roads used by Project vehicles with appropriate road safety signs and posters, 5) Provide additional crossings for cattle where necessary.	

8.2.12 Impact on Biodiversity

This sub-section contains an assessment of the potential impacts on biodiversity due to the Project-related construction and operations activities.

Impacts from the Project will occur within the footprint areas (dam, reservoir),situated within the Construction site (see **Figure 2.7**), and within a potential 500 m influence zone around the footprint areas. The current assessment covers biodiversity located within the footprint areas and the 500 m area around.

The impacts are considered and assessed taking into account EBRD PR 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources (2019) and Guidance Notes to the EBRD PR 6 (March, 2023), as well as applicable RA national legislation.

8.2.12.1 Impacts of the Project

As presented in the **Section 6.2**, the Project will be implemented in an area of relatively high biodiversity where valued (priority) habitats and species were identified (4 habitats and 54 priority species - see **Sub-section 6.2.5**).

The impacts of the Project on biodiversity will occur during both construction and operation phases. The construction phase includes preparatory works, dam building and reservoir filling. The methodology of impact assessment, including the matrix of impact characteristics and significance is detailed in **Section 5** "ESIA Methodology and Approach". Furthermore, sensitivity of the species (receptors) was taken into account during assessment.

Potential impacts on biodiversity (including priority biodiversity features and critical habitats) derive from the Project implementation activities during:

1. Construction phase and include:
    - Destruction (loss) of habitats (vegetation clearance, removal of top-soil, excavation, quarrying, movement and placement of topsoil and quarried materials, reservoir filling),
    - Flora species loss (vegetation clearance, including trees cutting, removal of top-soil, quarrying, movement and placement of topsoil and quarried materials, reservoir filling),

- Disturbance of fauna species by noise, vibration and light pollution (construction and mining machinery, traffic, lighting of the building area),
- Destruction of sedentary animals' habitats and a risk of their death (removal of top-soil, excavation, quarrying, movement and placement of topsoil and quarried materials, reservoir filling)
- Loss of foraging habitats for transit species of mammals (vegetation clearance, removal of top-soil, excavation, quarrying, movement and placement of topsoil and quarried materials, reservoir filling),
- Loss of breeding and foraging habitats for birds (vegetation clearance, removal of top-soil, quarrying, excavation, movement and placement of topsoil and quarried materials reservoir filling),
- Loss of breeding, foraging and wintering habitats of invertebrates and a risk of death of their overwintering stages (vegetation clearance, removal of top-soil, quarrying, excavation, movement and placement of topsoil and quarried materials reservoir filling,
- Destruction of the habitats of the aquatic and semi-aquatic species and a risk of the species death
- Obstacle to migration of the aquatic species (blocking the river native water flow by the construction site)
- Impact on protected areas and internationally designated areas.

2. Operational phase and include:
   - Emergence of new habitats (water, riparian),
   - Increased access to the area,
   - Obstacle to migrations of aquatic species (blocking the native water flow by the dam).

The negative impacts occur mainly at the construction phase and are caused by the type of required activities. Some positive impacts on biodiversity occur during the operational phase; they are linked with the emergence of new habitats - large water surface and riparian vegetation which will attract some species of animals.

The assessment is completed for each predicted impact at the construction and operation phases and per group of the biodiversity receptors (terrestrial and aquatic/semi-aquatic), which were combined based on their ecological characteristics; in some cases, when possible, impacts on individual species are assessed.

8.2.12.2 Construction phase

Impact on terrestrial habitats and species

Destruction (loss) of habitats

Land clearance, excavation and earthworks will result in full loss of of the habitats located within the dam and reservoir footprints[128]. At first, habitats will be impacted during clearance of the dam footprint area, then - by removal of top-soil, quarrying, movement of topsoil and quarried materials, building of the dam. Subsequently, habitats located in the flooded part of the river valley will be lost during the reservoir filling.

Habitat biodiversity values with defining their areas lost include:

[128]The actual area of the destructed habitats will be slightly larger than the footprint as habitats are located on the slopes of the river valleys

Three Priority Biodiversity Features (PBF) (in brackets - code and name of habitat in accordance with Annex 1 of the EU Habitats Directive):

- F9.12 - Lowland and collinar riverine willow scrub (=3280 Constantly flowing Mediterranean rivers with Paspalo-Agrostidion species and hanging curtains of *Salix* and *Populus alba*) - 3.08 ha,
- G1.11 - Riverine willow woodland (=92A0 *Salix alba* and *Populus alba*, *Salix alba* and *Populus alba* galleries) - 2.83 ha,
- H3.2 - Basic and ultra-basic inland cliffs (=8210 Calcareous rocky slopes with chasmophytic vegetation) - 3.07 ha,

and one Critical Habitat (CH):

- F3.1 - Temperate thickets and scrub (= 40A0* Subcontinental peri-Pannonic scrub) - 11.36 ha.

Totally, area of the lost habitats is 20.34 ha. Currently, the habitats are not disturbed, they are in natural conditions.

The riverine habitats will be lost during the reservoir filling; however, these habitats (or rather similar to them) will restore along the reservoir coasts. Other two habitats will be lostwithin the boundaries of the dam and reservoir, but similar habitats are present higher up the slopes.

Flora species loss

Land clearance, excavation and earthworks will result in vegetation cutting in the same areas where habitats will be destructed (see above). According to the national EIA report, 520 trees[129] of four species (*Salix excelsa S.G. Gmel., Populus nigra L., Ulmus minor Mill., Tamarix ramosissima*) will need to be cut during the construction of the reservoir. No protected (nationally or internationally) plant species are registered in the Project area.

Disturbance of fauna species

Terrestrial animals can be divided in two groups in relation to their reaction to disturbance - those that run away from disturbance areas and those that hide where they live. Below, the identified mammals, birds, reptiles, and amphibians are analysed in terms of their reaction to disturbance.

According to the baseline study, the identified terrestrial mammals were classified into four groups by lifestyle. The first group includes species permanently inhabiting the area, rodents and insectivores. The second group includes species that more or less present in the area throughout the year; among them, Beech Marten, Least Weasel, Badger and Red Fox. These species in rare cases, when searching for food, can leave the given area for a certain period of time. The third group includes predatory species that use this area as a transit area, visiting it either when moving around the region or when searching for food. The fourth group is flying mammals – bats. The animals have been observed during the field survey but species not identified. Bats use the area along the river for foraging, although the presence of their roosting places around the area cannot be ruled out. Permanent resident species (rodents, insectivores) usually hide (in burrows, for example) in response to disturbances, they do not run away from their homes. This behavior in the context of the Project will result in death of the animals due to the destruction of their homes; potential impacts on this group of animals are considered in the sub-section below.

[129]see footnote 135

Species of the second group will move away in case of constant and cosiderable disturbance; at the same time, they are significantly more sedentary in the period of birth and feeding cubs. Accordingly, construction works should not be start during this period.

Third mammal group of temporary visitors usually move away or avoid disturbance areas.

Identified birds (classified in three groups - i) breeding in the Project area, those ii) breeding in proximity to the site and using the area as a part of their foraging range, and iii) passing the area during the seasonal migration) will also move away or avoid disturbance zones.

Identified reptiles and amphibians are permanently present species; they would choose the same hiding strategy as the sedentary mammals (see above), so they will be in danger of dying. Potential impacts on this group of animals are considered below.

Noise and soil vibration caused by cutting trees and clearance will be the first impact factors in the Project construction area. Impact distance (for noise) can vary from about 100 m to 500 m and more depending on species sensitivity[130, 131]. As a result, the dam footprint area and adjoining areas will be abandoned by the most of animals.

Second set of impacts including noise, lighting, soil vibration and air-pollution will be caused by the beginning of construction works – removal of top-soil, excavation, quarrying, movement of quarried materials. These impacts will manifest in the western part of the reservoir footprint area and result in animals leaving the area.

Next phase of the construction phase will involve dam construction and water filling; thus, such impact factors as vibration, noise, air-pollution, lighting will manifest. As most of the animals will have already left the area by this time, these factors will affect only an insignificant number of animals.

The last source of disturbance for animals during the construction phase will be localised in the Kasakh and Shakhverd river valleys, in the eastern part of the reservoir footprint area (see **Figure 2.7**). In these areas, sedentary species may not feel impacts and not react until water filling reaches their shelters; during the reservoir filling, shelters can be flooded and animals will perish. But if the water rises slowly there is a chance that some animals can leave the area.

Loss of sedentary animals' habitats and a risk of their death

There are two groups of permanent terrestrial residents which were identified - small mammals (rodents, terrestrial insectivores), and reptiles and amphibians. Animals of these groups use different kind of shelters (e.g., holes, rocks, hollows, etc.) and hide there in case of danger or disturbance. Such impact as noise will make them hide. Intensive vibration can drive the animals out of their shelters, but they will not run far away trying to find temporary shelter and come back when the impact disappears.

Thus, habitats of these two groups are most likely to be impacted during the construction works at the dam footprint area and in the western part of the reservoir footprint area where quarry, borrow pits, and storage areas will be located (see **Figure 2.7**).

The same negative impact can occur during the filling of the reservoir area - the shelters can be flooded and most of animals would perish.

[130]Senzaki, M., Yamaura, Y., Francis, C. et al. Traffic noise reduces foraging efficiency in wild owls. Sci Rep 6, 30602 (2016). https://doi.org/10.1038/srep30602

[131]Shilling, F.; Collins, A.; Louderback-Valenzuela, A.; Farman, P.; Guarnieri, M.; Longcore, T., et al. (2018). Wildlife-Crossing Mitigation Effectiveness with Traffic Noise and Light. UC Davis: National Center for Sustainable Transportation. Retrieved from https://escholarship.org/uc/item/8893d8zw

The following eight biodiversity values were identified among sedentary species (in brackets – preliminary estimated number of individuals affected and whose habitats will be destructed or reduced):

Reptiles

- Pallas's glass lizard *Pseudopus apodus*, CH (10-50 individuals),
- Medium Lizard *Lacerta media*, CH (20-100 individuals),
- Javelin sand boa *Eryx jaculus,* CH (5-20 individuals),
- Water snake *Natrix tessellata*, CH (the flooded area will increase the periphery of the coastline and thus, will increase the habitat of the species)
- Smooth snake *Coronella austriaca,* CH (the presence of the species should be re-checked),
- Coin-marked snake *Hemorrhois nummifer (Coluber nummifer),* CH (10-50 individuals),
- Schneider's skink, *Eumeces schneideri*, PBF, RDB of RA (20-100 individuals),

Amphibia

- Variable toad/ green toad *Bufo viridis*, CH (the flooded area will increase the periphery of the coastline and thus, will increase the habitat of the species).

As the first mitigation step regarding the six reptile species, which are negatively affected by the construction, the quantitative survey of the species in the dam and reservoir footprint areas is suggested at the beginning (April) or end (September) of the species' activities season (at the pre-construction phase) Such survey allows to estimate an approximate number of individuals of each species and their locations.

To compensate the reduction of the habitats for these reptile species it is suggested to provide restoration of the critical features of the species' habitats in the proximity of the flooded area. These features can include but not limited to additional rocky outcrops and screes, increased number of planted native tree and bush species. The features should be large enough to support the species populations. Before the flooding, as many as possible individuals of these species should be caught and relocated to the prepared habitats.

It is also suggested to introduce a sustainable grazing practice in the areas that surround the planned reservoir, as the improved quality of the habitats can provide higher and diverse food supply, thus supporting the increase in the density of the snake and lizard species.

Such permanent residents of the mammals group as badger and red fox, use burrows; however, they can leave them in case of disturbance and move to other habitats. To avoid killing these animals it is necessary to find their burrows before the construction works begin and monitor if they leave the shelters; if not, special measures to scare them away have to be implemented.

Loss of foraging habitats for transit species of mammals

Transit predators will move away or avoid anxiety once the site clearance and construction work start. The main deterrent impact is noise.

The following two biodiversity values were identified among these groups:

- Gray wolf *Canis lupus* - CH,
- European wildcat *Felis silvestris* - CH.

These two species may pass through the area, with some occasional hunting. But the species were not recorded during the field visits, therefore their inhabitance is doubtful. Especially, it is true for

Felis silvestris, which rarely inhabits transformed dry mountain steppes, riparian scrubs and woodlands.

There are no impacts predicted on these two species, and, therefore, no mitigation measures are required. But to be sure the species' dens are not located in the area, the pre-construction survey is recommended.

Loss of breeding and foraging habitats for birds

Of the 120 bird species registered in the Project area, 32 are classified as biodiversity values (PBF) - 30 species are protected under the Bern Convention and Birds Directive (16 of them incuded into the Red Book of the RA too), one species is protected under the Red Book of the RA and one species is migratory range-restricted (see **Table 6-17**).

Due to the anticipated flooding of the territory, the loss of breeding habitats[132] is expected for the following numbers of the species (breeding pairs), protected under the Bern Convention (marked as Res 6) and the Red Book of the RA (marked as RDB AM):

1. European Roller *Coracias garrulus* 1-2 pairs (Res 6 & RDB AM)
2. Syrian Woodpecker *Dendrocopos syriacus* 2-3 pairs (Res 6),
3. Tawny Pipit *Anthus campestris* 1-2 pairs (Res 6),
4. Wood Lark *Lullula arborea* 5-9 pairs (Res 6),
5. White-throated Robin *Irania gutturalis* 3-5 pairs (RDB AM),
6. Red-backed Shrike *Lanius collurio* 2-4 pairs (Res 6),
7. Lesser Grey Shrike *Lanius minor* 1-2 pairs (Res 6).

The flooding can temporarily affect the breeding ranges of the following species:

1. Little Bittern *Botaurus minutus* 1-2 pairs (Res 6),
2. Common Kingfisher *Alcedo atthis* 1-2 pairs (Res 6).

The low impact is justified by adaptability of these species under the water reservoir conditions, as this can be seen in other examples in Armenia. During construction of the reservoir these species might temporarily stop breeding (e.g. for one year), but will recolonize the habitat again after the construction is complete.

The flooding can somewhat restrict the individual breeding territories for the following numbers of the species, protected under Bern Convention (marked as Res 6):

1. Long-legged Buzzard Buteo rufinus 1 pair (Res 6),
2. Red-billed Chough Pyrrhocorax pyrrhocorax 1 pair (Res 6).

One more priority species is Eurasian Nightjar (*Caprimulgus europaeus*) (Res 6). The impact on it is expected to be negligible. Even if the breeding sites of the species are located within the flooding zone, it is anticipated that the species can easily shift its breeding sites above the reservoir. At the same time, the existence of the reservoir will increase the fauna of dipterous insects, thus increasing the food supply for Eurasian Nightjar.

The area of the proposed reservoir does not contain breeding sites of restricted range species.

The flooding will not affect the large ranged and colonial species, protected under the Bern Convention and the Red Book of the RA:

[132]Any activity of the Project has to be implemented before the breeding season or after, and thus we do not assume that any birds will die

1. Egyptian Vulture *Neophron percnopterus,*
2. Eurasian Griffon *Gyps fulvus,*
3. Eurasian Eagle-owl *Bubo bubo,*
4. Rosy Starling *Pastor roseus.*

The justification is that these species don't critically depend on the area that is planned for restriction.

Furthermore, the flooding will not affect the migratory and wintering species, protected under the Bern Convention and the Red Book of the RA, including those which make relatively high congregations during the migration:

1. Black Stork *Ciconia nigra,*
2. White Stork *Ciconia ciconia,*
3. Little tern *Sternula albifrons,*
4. European Honey Buzzard *Pernis apivorus,*
5. Short-toed Snake-eagle *Circaetus gallicus,*
6. Hen Harrier *Circus cyaneus,*
7. Pallid Harrier *Circus macrourus,*
8. Montagu's Harrier *Circus pygargus,*
9. Levant Sparrowhawk *Tachyspiza brevipes,*
10. Lesser Spotted Eagle *Clanga pomarine,*
11. Steppe Eagle *Aquila nipalensis,*
12. Booted Eagle *Hieraaetus pennatus,*
13. Peregrine Falcon *Falco peregrinus,*
14. Demoiselle Crane *Anthropoides virgo,*
15. Semicollared Flycatcher *Ficedula semitorquata,*
16. Bluethroat *Luscinia svecica.*

Also, the flooding will not affect the migratory restricted-range species:

1. Mountain Chiffchaff *Phylloscopus sindianus.*

The low impact is justified by the following. All the raptor, tern, storks and crane species mostly do not stop at the area and fly over it. The Semicollared Flycatcher, Bluethroat and the Mountain Chiffchaff make stopover points in the bushes along the river and will be able to make stopover points in the vegetation along the shore of the reservoir.

The flooding will create an additional water habitat, which can be colonized by some water birds, as well as water invertebrates and fishes. Therefore, it can be expected that the bird fauna can be enriched with such species as Green Sandpiper *Tringa ochropus*, Common Sandpiper *Actitis hypoleucos*, and possibly some ducks, herons, egrets, and other shorebirds.

It will also create additional foraging opportunities for some of the existing priority species, such as:

1. European Roller *Coracias garrulus,*
2. Peregrine Falcon *Falco peregrinus,*
3. Rosy Starling *Pastor roseus.*

Also, it might create better stopover conditions for the migrants, such as:

1. Demoiselle Crane *Anthropoides virgo,*
2. Semicollared Flycatcher *Ficedula semitorquata,*

3. Bluethroat *Luscinia svecica.*

However, attraction of waterbirds can cause attraction of hunters. Therefore, the biodiversity management plan should consider possible increase of illegal hunting in the area, which can affect not only game birds, but also priority bird species.

The following mitigation measures are suggested for the priority species:

1. Planting additional indigenous species of Poplar, Willow, and Walnut trees for Syrian Woodpecker along the shoreline of the planned reservoir.
2. Consider the introduction of sustainable grazing practices in the surrounding communities, which can improve the quality of grassland habitat, increase the number and diversity of invertebrates, and support the necessary food supply for European Roller, Tawny Pipit, Wood Lark, White-throated Robin, Red-backed Shrike, Lesser Grey Shrike, Red-billed Chough and Long-legged Buzzard, which may support in some increase of their density.
3. Plant additional thorny bush species as breeding spots for the White-throated Robin, Red-backed Shrike, and Lesser Grey Shrike, helping them to discover new breeding sites.

The quantitative parameters should be considered for the restoration of the habitats of the priority species. The numbers given below are preliminary, and if this approach to be applied the additional study is required.

1. European Roller *Coracias garrulus* 1-2 pairs, roughly about 7-10 ha per individual breeding range,
2. Syrian Woodpecker *Dendrocopos syriacus* 2-3 pairs, roughly about 3-5 ha per individual breeding range, with a tree density of at least 40-50 per ha,
3. Tawny Pipit *Anthus campestris* 1-2 pairs, roughly about 2-3 ha per individual breeding range,
4. Wood Lark *Lullula arborea* 5-9 pairs, roughly about 1-2 ha per individual breeding range,
5. White-throated Robin *Irania gutturalis* 3-5 pairs, roughly about 2-3 ha per individual breeding irange (orchards),
6. Red-backed Shrike *Lanius collurio* 2-4 pairs, roughly about 2-3 ha per individual breeding range,
7. Lesser Grey Shrike *Lanius minor* 1-2 pairs, roughly about 2-5 ha per individual breeding range.

Accordingly, totally minimum 20 ha (calculated from maximum European Roller affected pairs and necessary area for them: 2 pairs x 10 ha = 20 ha) of complex habitats for these species have to be created/conserved along the reservoir shoreline. They should include trees, shrubs and rocky plots at the top of the valleys' slopes (not flooded). Some of the mentioned species (as Syrian Woodpecker, White-throated Robin and Tawny Pipit) use fruit orchards and semi-desert plots located around the construction site as habitats; taking this into account proposed area is considered enough to offset the destructed habitats for the species. Required area can be part (or fully included) of the buffer/protection zone around the reservoir.

Loss of breeding, foraging and wintering habitats of invertebrates and a risk of death of their overwintering stages

The planned reservoir will partially destroy the habitats of 10 restricted-range species and the species included in the Res 6 of Bern Convention:

1. Anthocharis gruneri (RR),
2. Armenia ledereri (RR),
3. Armenia hyrcanica (RR),

4. Nordmannia abdominalis (RR),
5. Polyommatus (Agrodiaetus) demavendi (RR),
6. Hipparchia syriaca (RR),
7. Satyrus amasinus (RR),
8. Pseudochazara pelopea (RR),
9. Thaleropis ionia (RR),
10. Euphydryas aurinia (Res 6).

If the construction works start in May-August butterflies will leave the disturbance areas to look for other places for foraging and breeding; it is important that suitable habitats have been created in vicinity. But if the works start in October-April, overwintering stages of butterfly (caterpillar or pupa) can be affected by Project works and die.

The mitigation measures for the priority invertebrate species include several major steps:

1. To implement a study of the habitat requirements of the priority species and estimate areas of the habitats, which are lost by these species, (i.e. estimate the Net Loss areas and clarify what actions should be done to construct similar habitats; the required Net Gain area will depend on the state and conditions of the potential offset site – see the next point)
2. To develop similar habitats of proportionate size in the areas not to be flooded, in close vicinity of the existing populations, securing habitat connectivity (primarily includes planting forage plants for the species and in some cases improving soil conditions) (i.e select and develop the offset site),
3. Considering quite a large area in the vicinity of the reservoir occupied by arable lands, it is recommended to explore the potential of creation of mosaic habitats between the arable fields. Such an approach can become beneficial for the fauna of invertebrates, and the local communities, increasing the capacity of ecosystem services, such as pollination, accumulation of humidity, and biological pest control,
4. In addition, the introducing of the sustainable grazing practices can improve habitat quality and diversity.

Impact on protected areas and internationally designated areas

Due to large distances, there will be no negative impact on the nationally protected areas, Candidate Emerald sites and KBA/IBA areas.

Impact on Aquatic habitats and species

Destruction of the habitats of the aquatic/semi-aquatic species and a risk of the species death

Benthic river habitats will be fully lost oyed in the dam footprint area and other Project components (quarry, borrow pits, storage areas, etc.). The habitats in the area of the reservoir flooding will be changed because of changing river flow to stagnant reservoir water.

Destruction of the benthic habitats will trigger a reduction of foraging and breeding areas for some species of fish forcing them migrate up and down the river.

Aquatic (rather semi-aquatic) mammals - Transcaucasian water shrew and Eurasian otter, use riparian habitats. There is a risk of death of the water shrew during the riparian habitat destruction if the species live along the Kasakh and Amberd riverbanks in the dam construction area. Eurasian otter is more actively moving animal and will leave the disturbance areas.

Both species were identified as priority biodiversity features:

- Transcaucasian water shrew, *Neomys teres (schelkovnikovi),* PBF (RDB of RA, EN)
- Eurasian otter*, Lutra lutra*, CH.

Neither species were recorded during the field surveys, but they were listed in the reference literature. Accordingly, the pre-contruction survey to confirm the presence of species is suggested (the both species are active through the whole year but period April – September is preferred for survey).

Obstacle to migration of the aquatic species (blocking the river water flow by the construction site)

The construction and operation of the Kasakh Reservoir will impact the variety and behaviors of fish in this river section, particularly affecting their feeding, breeding, and migratory patterns.

Analysis indicates that construction of the Kasakh Reservoir can adversely affect several important local species such as Trout, Kura barbel, Caucasian scraper (in the middle reaches), Bulatmai barbel, and Mursa (in the lower reaches).

One fish species - Bulatmai barbel, *Luciobarbus capito*, is identified as priority biodiversity feature (PBF).

The constrion of reservoir on the Kasakh River is expected to span several years (three years according the construction work schedule, **Section 2.6**), during which it will be crucial to maintain conditions conducive to the survival and reproduction of fish species in the river. To this end, it is necessary to create bypass channels around the construction zone and a fishway that mimics the river's natural conditions throughout the construction period. This fishway, designed to closely resemble the natural riverbed, aims to facilitate safe migration for various fish species by replicating their native environment. If designed correctly, this structure will enable all fish species to migrate effectively. The fishway is constructed using natural river materials, primarily stones and rocks, with the addition of gravel and sand to decrease water flow velocity. The gravel also creates favorable conditions for fish spawning. The fishway's slopes should range from 2 to 5%.

The fishway should be constructed at the pre-construction phase to avoid disturbances of fish migratory patterns during the construction phase. Two construction (diversion) outlets are designed to convey river flows downstream during reservoir construction and to keep the construction site dry (see **Section 2.6**). Possibly, one of these outlets (apparently, the outlet 2 designed as an open channel) can be re-designed to meet the fishway requirements.

8.2.12.3 Operation phase

Emergence of new habitats (water, riparian)

The flooding will create additional water habitat, which can be colonized by some water birds. New riparian habitats will appear that will attract Water shrew and Eurasian otter, as well as some birds and invertebrates.

Therefore, it can be expected that the bird fauna can be enriched with such species as Green Sandpiper *Tringa ochropus*, Common Sandpiper *Actitis hypoleucos*, and possibly some ducks, herons, egrets, and other shorebirds.

Furthermore, additional foraging opportunities will be created for some of the existing priority species, such as:

1. European Roller *Coracias garrulus,*
2. Peregrine Falcon *Falco peregrinus,*
3. Rosy Starling *Pastor roseus.*

Also, better stopover conditions will form for the migrating species, such as:

1. Demoiselle Crane *Anthropoides virgo,*
2. Semicollared Flycatcher *Ficedula semitorquata.*

Furthermore, local fish species like the South Caspian sprilin and European chub may see population increases, potentially forming new lake-dwelling communities within the reservoir.

Alien Invasive Species proliferation

Construction of the reservoir is likely to promote a significant increase in the populations of invasive species, such as Topmouth gudgeon and Prussian carp, within the Kasakh River basin, as both species prefer stagnant or slowly flowing water.

Increased access to the area

Increase in waterbird diversity and numbers can attract hunters. Therefore, the biodiversity management plan should consider possible increase of illegal hunting in the area, which can affect not only game birds, but also priority bird species.

Obstacle to migrations of aquatic species (blocking the native water flow by the dam)

The existence of the reservoir will impact some fish species blocking their migrations along the river. The Kasakh Reservoir can adversely affect several local species such as Trout, Kura barbel, Caucasian scraper (in the middle reaches), Bulatmai barbel, and Mursa (in the lower reaches). As the species usually migrate to upper stretches of tributaries for spawning, the reservoir can change their breeding patterns; the species (for example, Bulatmai barbel[133]) can adapt to live or spawn in lakes and reservoirs. But competition with the invasive species (see above) will make such adaptation difficult.

As mitigation measure, it is necessary to create a fishway to provide safe fish migration. The fishway designed and built at the pre-construction phase (see above) can be kept as constant bypass during the reservoir operation.

Impact assessment and mitigation measures

Assessment and mitigation of impacts on biodiversity during construction and operation phases are summarized in **Table 8-22**. According to the mitigation hierarchy[134] four types of measures are applied - avoidance, minimization, restoration and offset. Excluding avoidance (as construction of the dam and reservoir at the footprint areas is already approved by the government) the measures are presented in the **Table 8-22**.

Table 8-22. Summary of impacts on biodiversity and mitigation measures for the Project construction and operation phases

Receptor	Assessed Impact	Mitigation / management measures	Residual impact
Overarching action: Develop a Biodiversity Action Plan (BAP)[135] during the pre-construction phase and incorporate mitigation activities of the pre-construction, construction, and operation phases. BAP will provide guidance for the development of the Biodiversity Management Plan, Riverine Habitats Construction			

[133] https://www.fishbase.se/summary/Luciobarbus-capito
[134] Guidance Notes to the EBRD PR 6 (March, 2023)
[135] Biodiversity Action Plan is developed and approved prior the tendering process for the Construction Contractor.
Other Biodiversity plans developed prior to construction by the Construction Contractor. Some specified mitigation measures are implemented at the pre-construction phase and some - throughout construction

Receptor	Assessed Impact	Mitigation / management measures	Residual impact
Plan, Offset Program. The below-listed mitigation and/or /management measures shall be included in the BAP.			
PRE-CONSTRUCTION AND CONSTRUCTION PHASES			
1. Habitats	Significant	***Pre-construction phase*** 1) Study the priority habitats (three PBFs, one CH) in the Project area, their plant composition and ecological structure, specify areas. 2) Develop a Riverine Habitats Construction Plan to plan construction and maintenance of the following two habitats (PBFs) along the reservoir's banks: F9.12 - Lowland and collinar riverine willow scrub (3280 Constantly flowing Mediterranean rivers with Paspalo-Agrostidion species and hanging curtains of Salix and Populus alba), G1.11 - Riverine willow woodland (92A0 Salix alba and Populus alba galleries). 3) Study the reservoir protection/buffer area as well as the upper parts of the Kasakh, Amberd and Shahvard river valleys and downriver from the reservoir, to define existing habitats similar to the following habitats: F3.1 - Temperate thickets and scrub (40A0* Subcontinental peri-Pannonic scrub), H3.2 - Basic and ultra-basic inland cliffs (8210 Calcareous rocky slopes with chasmophytic vegetation). 4) Develop an offset project to provide conservation of the both habitats (40A0 and 8210) in the most suitable for the conservation. *Preliminary quantative assessment* *Total lost area of the two riverine habitats (3280 and 92A0) is 5.91 ha. The reservoir perimeter potentially suitable for the riverine habitats, according our estimation, is about 7.5 km. If the minimum width of the habitats strip is estimated at 10 m, then a min 7.5 ha of the riverine habitats can be constructed along the reservoir shoreline (the minimal multiplier will be 1.23).* *Lost area of the habitat «8210 Calcareous rocky slopes with chasmophytic vegetation» is 3.07 ha. Taking into account that the reservoir buffer zone is 23.41 ha, there is possibility to conserve the habitat in the buffer zone boundaries (if this habitat is found there and of such or more area).* *Lost area of the habitat «40A0* Subcontinental peri-Pannonic scrub» is 11.36 ha. By excluding the riverine habitats minimum area (7.5 ha) and 8210 habitat area (3.07 ha, multiplier 1), from the buffer zone area the remaining area (12.84 ha) should be sufficient for achieving No Net Loss and the conservation of the 40A0* habitat (with multiplier 1). However, should the*	Moderate (after offset - no net loss / a net gain)

Receptor	Assessed Impact	Mitigation / management measures	Residual impact
		"net gain" approach for this Critical Habitat be applied, it will necessitate the use of other areas (located up and down the rivers) to achieve the Net Gain. *The protection /buffer zone and areas located up and down the rivers can be used as compensation/offset areas. The buffer zone is more suitable for the long-term offset implementation to be incorporated in the reservoir management plan.* *Proposals for the restoration and conservation of the habitats, including multipliers, should be developed in BAP.*	
OPERATION PHASE			
1. Habitats	No new impact, but the mitigation continues:	1) Implement the Riverine Habitats Construction Plan: construct and maintain the following two habitats (PBFs) along the reservoir's banks: F9.12 - Lowland and collinar riverine willow scrub (3280 Constantly flowing Mediterranean rivers with Paspalo-Agrostidion species and hanging curtains of Salix and Populus alba), G1.11 - Riverine willow woodland (92A0 Salix alba and Populus alba galleries). 2) Implement the offset project to conserve the following two priority habitats: F3.1 - Temperate thickets and scrub (40A0* Subcontinental peri-Pannonic scrub), H3.2 - Basic and ultra-basic inland cliffs (8210 Calcareous rocky slopes with chasmophytic vegetation).	-
Monitoring: according to the Riverine Habitats Construction Plan and the monitoring chapter of the offset program (project)			
PRE-CONSTRUCTION AND CONSTRUCTION PHASE			
2. Flora	Significant	**Offset measures** *Pre-construction phase* 1) Study plant composition and structure of the priority riverine habitats, 2) Develop a Riverine Habitats Construction Plan based on indigenous plant species, 3) Develop a Tree Management Plan (TMP). *Construction phase* 4) Plant 1840[136] trees and ensure their aftercare for a period of two years (aftercare may be carried out during the reservoir operation phase), The proposed species of trees to be planted are:	Moderate (after offset - no net loss / a net gain)

[136]According to calculations conducted as part of the national Environmental Impact Assessment (EIA) study, these trees are to be planted as a compensatory measure. A 1:1 replacement ratio was applied for trees with a trunk diameter (D) of less than 10 cm, and a 1:6 ratio for trees with D greater than 10 cm. The overall compensation multiplier is 3.54 (1840/520). Since the 520 trees being removed do not belong to priority species, the "no net loss" and "net gain" principles are not required to be applied.

Receptor	Assessed Impact	Mitigation / management measures	Residual impact
		- *Salix excelsa S.G. Gmel.,* - *Populus nigra L.,* - *Ulmus minor Mill.,* - *Tamarix ramosissima.*	
OPERATION PHASE			
2. Flora	No new impact, but the mitigation continues	Construct and maintain two riverine habitats along the reservoir's banks based on indigenous plant species (see above - the Section 1. Habitats).	Low
Monitoring: according to Riverine Habitats Construction Plan			
PRE-CONSTRUCTION AND CONSTRUCTION PHASES			
3. Fauna (other than those listed below)	Significant	**Minimization measures** *Pre-construction phase* 1) Develop the Worker Code of Conduct for employees of the Construction contractor to prevent poaching, 2) Survey the Project area to identify species of bats and, if so, possible bat roosts (can be found on trees, in hollows, crevices, foliage, caves) and estimate their number. If the bat roosts presence is confirmed, identify existing forest and rocky habitats which are potentially suitable for bat roosting in the vicinities of the flooded area (first of all, in the reservoir buffer/protection zone), built the bat boxes and hang them on trees to increase the habitat capacities for bats. *Construction phase* 3) Plan and begin construction works from one edge of the Project (dam) area (namely, from the south and western edges of the dam footprint area) moving to the north-east and up to the river valleys; this approach will provide time for animals to leave, 4) Begin the construction works before or after the breeding season - before May or after August; this will save lives of animals including offspring, 5) Monitor compliance with the Worker Code of Conduct of employee of the building company to prevent poaching, 6) Develop the Worker Code of Conduct for the operator of the reservoir to prevent poaching.	Low
OPERATION PHASE			
3. Fauna	Moderate	Monitor compliance of the reservoir's operator with the Worker Code of Conduct to prevent poaching during operations.	Negligible
Monitoring: according to the Biodiversity Management Plan			
PRE-CONSTRUCTION AND CONSTRUCTION PHASES			

Receptor	Assessed Impact	Mitigation / management measures	Residual impact
4. Sedentary animals	Significant	*Pre-construction phase* 1) Survey the dam and reservoir footprint areas to identify the priority reptile species at the beginning (April) or end (September) of the species' activities season. 2) Identify existing bush and rocky habitats which are potential habitats for relocation of snakes and lizards in the vicinities of the reservoir area, 3) Provide additional rocky outcrops, plant some indigenous tree and bush species in the vicinities of the areas to be flooded to increase the habitats capacity for snakes and lizards, 4) Survey the area to map inhabited burrows of badger and other burrowing animals as well as possible dens of the Gray wolf and Wild cat. *Construction phase* 5) Before tree cutting and top-soil removal in the dam footprint area and in the “triangle” – western part of the reservoir footprint area, survey the areas and capture as many individuals as possible including snakes and lizards, and move them to the safe habitats identified and/or arranged during the pre-construction phase, 6) Before filling the reservoir, survey the reservoir site and capture as many individuals as possible including snakes and lizards, and move them to the safe habitats identified and/or arranged during the pre-construction phase, 7) Before filling the reservoir, check the mapped residential burrows of badger and other animals; if the animals stayed, capture and relocate them to the safe habitats. If Gray wolf or/and Wild cat discovered, to take measures to scare away animals.	Low
OPERATION PHASE			
4. Sedentary animals	No new impact, but the mitigation continues	1) Introduce/support a sustainable grazing practice in the areas that surround the planned reservoir, as the improved quality of the habitats can provide higher and diverse food supply for reptilians, thus supporting the population increase of the protected snake and lizard species, 2) Maintain bush and rocky habitats in the vicinities of the flooded area to where snakes and lizards were relocated. *These habitats have to be included into the conserved priority habitats with scrub and cliffs, 8210 and 42A0 (see above the Table Section 1. Habitats)*	Low
Monitoring: according to the Biodiversity Management Plan			
PRE-CONSTRUCTION AND CONSTRUCTION PHASES			

Receptor	Assessed Impact	Mitigation / management measures	Residual impact
5. Birds	Moderate	*Pre-construction phase* 1) Plant additional indigenous species of Poplar, Willow, and Walnut trees for Syrian Woodpecker in the vicinity of the Project area, 2) Plant additional thorny bush species in the vicinity of the Project area as breeding spots for White-throated Robin, Red-backed Shrike, and Lesser Grey Shrike, helping them to discover new breeding sites, *Theses spots should include trees, shrubs and rocky plots at the top of the valleys' slopes. The spots have to be included into the constructed habitats under the Riverine Habitats Construction Plan and conserved habitats with thickets/scrub and cliffs, 8210 and 42A0 (see the Table Section 1. Habitats).* *Construction phase* 3) Maintain planted trees and bush species.	Low
OPERATION PHASE			
5. Birds	No new negative impact, but the mitigation continues Positive impact could manifest	1) Introduce/support sustainable grazing practices in communities around the reservoir, which can improve the quality of grassland habitat, increase the number and diversity of invertebrates, and support the necessary food supply for European Roller, Tawny Pipit, Wood Lark, White-throated Robin, Red-backed Shrike, Lesser Grey Shrike, Red-billed Chough and Long-legged Buzzard, which may support in some increase of their density, 2) Maintain planted trees and bush species for at least two first years of operations.	Low
Monitoring: according to the Biodiversity Management Plan			
PRE-CONSTRUCTION AND CONSTRUCTION PHASES			
6. Invertebrates	Significant	*Pre-construction phase* 1) Study the habitat requirements of the ten priority species and estimate areas of the habitats, lost by these species, 2) Develop similar habitats in not flooded areas and in close vicinity of the existing populations, securing habitat connectivity (primarily requires planting forage plants, including herbaceous plants, for the species and in some cases improving soil conditions), *These habitats have to be included to the constructed habitats under the Riverine Habitats Construction Plan and conserved habitats with thickets/scrub and cliffs, 8210 and 42A0 (see the Table Section 1. Habitats).* *Construction phase* 1) Maintain created habitats, primarily the species forage plants,	Low

Receptor	Assessed Impact	Mitigation / management measures	Residual impact
		2) Explore the potential of creation of mosaic habitats between the arable fields and orchards, support farmers/local communities in creation of such habitats.	
OPERATION PHASE			
6. Invertebrates	Moderate	1) Introduce/support sustainable grazing practices in communities around the reservoir, which can improve quality of grassland habitat, increase the number and diversity of invertebrates, 2) Maintain developed habitats with the priority species forage plants.	Low
Monitoring: according to the Biodiversity Management Plan			
PRE-CONSTRUCTION AND CONSTRUCTION PHASES			
7. Aquatic species	Significant	*Pre-construction phase* 1) Survey to confirm presence of the Transcaucasian water shrew and Eurasian otter along the Kasakh and Amberd riverbanks in the dam construction area. If the species presence is confirmed - capture the water shrew and relocate upriver to similar habitats; implement measures to scare away the otter and stimulate animals to relocate, 2) Construct the fishway to provide fish species with safe migration along the rivers during the construction phase. *Construction phase* 1) Monitor presence of the Transcaucasian water shrew and Eurasian otter along the river banks, 2) Maintain the fishway in working conditions.	Low
OPERATION PHASE			
7. Aquatic species	Moderate	Maintain the fishway in working conditions to provide fish species with safe migration along the rivers during the reservoir operation.	Low
Monitoring: according to the Biodiversity Management Plan			

8.3 Social Impacts and Benefits, Mitigation Measures

8.3.1 Impacts on the Local/Regional Economic Growth, Employment and Business / Investment Opportunities

Construction of the reservoir will increase the irrigated areas in the 21 rural settlements of Armavir Marz. Therefore, the local households will benefit from an increase in cultivated land, and the farmers' work will be eased. Furthermore, the vineyards, orchards and other cash crop farms can be expanded.

Construction Phase

During this stage involvement of skilled and unskilled labour will be required, thus creating employment opportunities for the residents of the nearby villages, and temporary increasing their

household's income. Influx of the construction workforce will create other temporary opportunities for villagers, such as provision of accommodation, food preparation and delivery, and cleaning services.

An influx of construction workers can also increase the risks of Gender Based Violence and Harassment (GBVH). Women, young people and economically disadvantaged residents are most vulnerable, particularly in rural communities with limited health infrastructure. Given the traditional, family-oriented lifestyle that characterizes rural settlements in Armenia, the incidence of STDs among the local population is expected to be negligible (see also **Sub-section 8.3.5**).

Operation Phase

Once completed, the reservoir will supply water to the beneficiary communities, improving their living conditions and potentially increasing the households' incomes. The households will be able to cultivate their lands more productively or will start cultivating new lands and produce more agricultural products. Large farmers will be able to increase their workforce involved in land cultivation, harvesting and crops processing.

According to the economic and financial analysis[137], the proposed investment in the Kasakh Reservoir will generate significant economic return. The estimated payback period of the investment in the reservoir construction is eight years.

8.3.2 Impacts on Public Facilities and Infrastructure

Construction stage

An additional pressure on local infrastructural facilities including power lines, roads, and healthcare facilities might occur due to the Project construction activities.

It is necessary to identify sensitive receptors (schools, hospitals, residential areas, other social infrastructure) along the transportation routes and develop mitigation measures where necessary (including avoidance, timing adjustments, additional traffic signs, reinforcement of the speed limit etc.). Therefore, a Traffic Management Plan (TMP) should be developed, and transportation routes should be disclosed to the public.

Regarding the healthcare facilities, the medical centres in the villages have limited capacities, both in terms of the personnel and equipment, to serve the Project workforce. Therefore, the nearest hospital - Ashtarak Medical Centre, located approximately 13 km away, should be considered for emergency situations.

Operation stage

No impacts on public facilities and infrastructure are envisioned during the Project operation stage.

Impact assessment and mitigation measures

The assessment and mitigation of impacts on public facilities and infrastructure during the construction phase of the reservoir are summarised in **Table 8-23**.

Table 8-23. Summary of impact assessment on and mitigation measures for public facilities and infrastructure

[137] *Armenia Water Reservoirs - Technical, Economic and Green Due Diligence Gap Analysis, Draft Final Report*, 2023-2024, Ove Arup & Partners.

Receptor	Assessed Impact	Mitigation / management measures	Residual impact
CONSTRUCTION PHASE			
Local and regional public facilities and infrastructure	Moderate	1) Develop a Traffic Management Plan aiming to minimise pressure on the reginal and local road infrastructure and avoiding as much as possible sensitive receptors, 2) Oblige the construction contractor to set up a medical post at the labour accommodation camp, 3) Consider the need for a constant presence of the ambulance at the construction site or sign an agreement with the Ashtarak Medical Centre to ensure emergency response when medical services are required for the contractor's workers. This should take into account the 10-12 minutes ambulance response time.	Low

8.3.3 Land Tenure Impacts

Construction Phase

Based on the preliminary Detailed Measurement Survey (DMS) and the valuation of the affected assets, the Project will permanently acquire a total of 1,452,605.4 m² of land (280 land plots) in the Ashtarak (Voskehat, Voskevaz and Oshakan villages) and Khoy (Amberd and Aygeshat villages) communities of Aragatsotn and Armavir Marz, impacting a total of 123 households.

There are eight buildings/structures impacted by the Project. Among them one is residential building (not used for residence, so no residential loss) with total area of 156 m^2, and seven non-residential structures (two incomplete structures, two foundations, two patios, and one shed) totalling 637.64 m^2. Thus, the Project will not result in physical displacement of PAPs (relocation or loss of housing).

In addition, there are two fences with total area 16.87 m^2 impacted by the Project.

The Project is also expected to affect 640 fruit/berry bushes and 15,928 fruit trees (of which about 14% are not yet productive/are seedlings) on the community- and privately-owned land plots. Additionally, 7,474.90 m^2 of crops on two land plots may be affected by the Project.

It is estimated in the preliminary Resettlement Plan, that among the land-owners and users affected by the resettlement impact, 19 can be vulnerable households (roughly 15% of all affected households) and further 20 households will lose more than 10% of their agricultural income, which is considered as significant impact for these affected households.

Impact assessment and mitigation measures

The assessment and mitigation of land tenure impact during the construction phase of the reservoir is summarised in **Table 8-24**.

Table 8-24. Summary of land tenure impact assessment and mitigation measures

Receptor	Assessed Impact	Mitigation / management measures	Residual impact
CONSTRUCTION PHASE			

Receptor	Assessed Impact	Mitigation / management measures	Residual impact
Residents of the affected villages	High	***Pre-construction phase*** 1) Ensure that public consultations with AHs are conducted in all affected communities during the Project development to present the Project's aims, stages of land acquisition and compensation process, a concept of "cut-off date", basic eligibility and entitlements, survey timelines, resettlement timelines, 2) Establish a Grievance Mechanism to deal with the Project-related concerns, 3) Develop a Resettlement Plan for the Project in line with the approved Resettlement Framework, ensure necessary mitigation measures for all the affected communities, including vulnerable households are included and implemented.	Low to Moderate
Community land	Moderate	Develop and implement the Resettlement Plan to ensure that the compensation for community land is fully provided prior to any construction works on site.	Low

8.3.4 Impact on Vulnerable Groups

Construction Phase

During the stakeholders screening process, the following vulnerable groups within the project affected communities were identified: women headed households, elderly households, and households below the poverty line. In addition, there are internally displaced people, mainly from Artsakh (Karabakh). These groups require special attention and meaningful engagement during project-related consultation process. Meaningful stakeholders' engagement foresees consultations, collaboration and empowerment of stakeholders, and the two-way communication. Special information and communication materials will be prepared and disseminated among the vulnerable groups and separate meetings can be held with the representatives of those groups to reveal their opinions about the project, concerns and specific needs.

Women may have less opportunities for temporal employment during the construction phase. At the same time, if they are involved in construction activities and/or in services provision, their salaries may be lower than those of men. Therefore, equal access to job opportunities and equal pay should be ensured during the project implementation to the extent possible.

Operation Phase

The construction of the reservoir will have positive impact on the residents' standards of living, including vulnerable households. The Project implementation will support food security in the households engaged in the subsistence agriculture and might enable accumulation of a larger surplus for sale. At the same time, the price of the irrigation services should account for the affordability to the low-income households.

Furthermore, stable availability of water will benefit women who play an essential role in the provision, use and management of water in the households. However, women can face barriers in the access to the irrigation infrastructure due to their limited involvement in the decision-making processes. They might be also not well informed and equipped to connect to the infrustructure Similarly, households made of elderly people/ pensioners may face the same issues. Therefore, it is important to regulate and ensure equal access to the Project benefits for women and elderly.

Impact assessment and mitigation measures

The assessment and mitigation of impacts on vulnerable groups during the construction phase of the reservoir is summarised in **Table 8-25**.

Table 8-25. Summary of impact assessment on vulnerable groups and mitigation measures

Receptor	Assessed Impact	Mitigation / management measures	Residual impact
CONSTRUCTION PHASE			
Vulnerable households of the affected villages	Low	Implement the SEP to ensure that information about the Project and its opportunities is widely available and communicated to vulnerable households, including the female-headed and elderly households engaged in agricultural activities, households below the poverty line.	Low
Women	Low	Equal employment opportunities and payment for men and women should also be ensured during the Project construction stage.	Low

8.3.5 Impact on Community Health and Safety

Construction Phase

Although the construction of the reservoir will bring benefits the local communities, it will also increase the communities' exposure to risks and impacts arising from temporary labour influx to the project area, increased traffic in the project area, security provisions, and potential emergency situations at the construction site.

Construction areas present physical hazards, including the risk of falls, injuries, and drowning, particularly for vulnerable groups such as children. There is also a risk of animals or livestock entering the construction site and falling into excavations or other hazardous zones. Unauthorized access to the area further increases the likelihood of accidents. These risks should be mitigated through the implementation of controlled access measures, installation of fencing and warning signage, and continuous community awareness activities to inform residents about potential hazards and safety requirements during construction.

Furthermore, an influx of construction workers can increase the risks of GBVH. Women, young people and economically disadvantaged residents are most vulnerable, particularly in rural communities with limited health infrastructure.

Given the traditional, family-oriented lifestyle that characterizes rural settlements in Armenia, the incidence of STDs among the local population is expected to be negligible.

Operation stage

Potential impacts can occur during the maintenance works and emergency situations that exceed the limits of the Project site and can have significant impacts on the downstream communities. Therefore, an Emergency Preparedness and Response Plan should be in place, and potentially affected communities should be informed and trained accordingly.

Impact assessment and mitigation measures

The assessment and mitigation of impacts on community health and safety during the construction and operation phases of the reservoir is summarised in **Table 8-26**.

Table 8-26. Summary of community health and safety impact assessment and mitigation measures

Receptor	Assessed Impact	Mitigation / management measures	Residual impact
CONSTRUCTION PHASE			
Residents of the villages	Moderate	***Pre-construction phase*** 1) Develop and implement the Traffic Management Plan (TMP) that will contain at least: - Avoiding community access roads if possible and documenting quality of roads prior to their use, - Optimised routes and times of the day for transporting materials to site, especially bulky equipment parts (e.g., pipes) agreed with the traffic police and local administrations, - Identification of the sensitive receptors (schools, hospitals, residential areas, other social infrastructure) along the transportation routes and development of the mitigation measures where necessary, 2) Screen worker influx for communicable disease and provide treatment, as appropriate, to reduce exposure to local population, 3) Conduct information campaigns on STDs among the workers and local community. 4) Develop and implement Emergency Preparedness and Response Plan for the whole project lifecycle (see **Section 8.4**). 5) Implement and communicate the grievance mechanism for communities and external stakeholders in line with EBRD's requirements, to include, inter alia, anonymous and confidential grievance channels and redress. It shall also include: - Confidential reporting pathways for GBVH grievances, - Designated staff experienced in GBVH response, - Protection of complainants and witnesses from retaliation or adverse consequences, etc. *The enhanced GM shall be communicated to workers and communities and become fully operational prior to commencement of construction.*	Low
OPERATION PHASE			
Residents of the villages	Moderate	1) Monitor the technical conditions of the reservoir, provide timely maintenance, 2) In case if heavy machinery or large number of vehicles is needed for the performance of the maintenance works, a Traffic Management Plan should be developed, accounting for the recommendation outlined above, 3) Update and implement the Emergency Preparedness and Response Plan for the Project operation stage (see **Section 8.4**). 4) Continue to operate the grievance mechanism.	Low

8.3.6 Health and Safety Impact

Construction phase

The main health and safety risks during the Project construction are associated with earthworks and excavation activities, use of the construction machinery and equipment, and delivery of construction materials to the site.

Some of the major physical hazards include: falls from heights when working on scaffolding, or steep slopes around the dam site; trips and slips on wet, uneven, or muddy surfaces; entrapment or impact from the operation of the construction machinery, such as cranes, bulldozers, concrete mixers, etc; exposure to increased noise levels due to machinery operations. Additional risk to workers laying water pipes is posed by the presence of other underground services such as electric cables or gas pipes. Inadequate human resource practises and isolation from family can contribute to mental strain, causing fatigue and stress and should also be considered by the workforce managers. Among natural hazards are extreme weather events, contact with the wildlife (snakes, insects).

To prevent accidents at the construction site, an OHS Management Plan (OHSMP) should be developed by the construction contractor and should at least cover the following:

- Allocation of OHS roles and responsibilities,
- Identification of OHS risks relevant to the Project,
- Development of OHS procedures for different types of work / professions,
- Workers' regular OHS briefing / training,
- Performance of the high-hazard activities, inter alia: earthworks, works at height, with high voltage etc.,
- Provision of workers (including sub-contractors) with Personal Protective Equipment (PPE),
- Initial and periodic medical examination of workers, including the staff of sub-contractors,
- Recording and investigation of safety accidents.

Additionally, the contractor must define proper management procedures for the following activities:

- Storage and handling of materials and chemicals, including hazardous,
- Fire prevention and the maintenance of the firefighting equipment,
- Provision of the first aid,
- Heat stress management,
- Prohibition of drugs use and alcohol consumption,
- Site safety signs, posters and registers,
- Monitoring of construction noise, vibration and air emissions.

Site-specific hazards should be considered in the OHSMP, such as exposure to extreme heat weather temperatures, works on or close to the open waterbodies, works with pressurized systems, as well as the risk of the spread of waterborne diseases and other.

Regular monitoring of the safety performance of the construction workers should be conducted. It should cover both monitoring of work practices, and the working environment.

Operation phase

OHS risks during the Project operation stage are associated with the workers performing maintenance and repair works. The OHS maintenance and repair works procedure/instruction should be developed and followed. The procedure should be based on the applicable risks identified

for the construction stage, and lessons learned from the OHS performance during the construction activities.

Impact assessment and mitigation measures

The assessment and mitigation of the OHS impacts during the construction and operation phases of the reservoir are summarised in **Table 8-27**.

Table 8-27. Summary of occupational health and safety impact assessment and mitigation measures

Receptor	Assessed Impact	Mitigation / management measures	Residual impact
CONSTRUCTION PHASE			
Project workforce	Moderate	***Pre-construction phase*** 1) Develop an Occupational Health and Safety Management Plan (OHSMP), covering the key elements of the OHS performance management during the construction stage, including: - Allocation of OHS roles and responsibilities - Identification of OHS risks and hazards, - Induction, briefing, training and knowledge check, - OHS procedures and regulations, including the Permit to Work procedure - Medical examination, - Emergency response, - Management of hazardous materials, chemicals and oil / fuel, - Fire safety and emergency response, - Performance of high hazard tasks - Use of PPE, - Supervision of sub-contractors, - Investigation of safety accidents, - Responsibilities for non-compliance, etc. ***Construction phase*** 1) Implement the provisions of the Occupational Health and Safety Management Plan, 2) Conduct regular audits of the construction site to monitor the OHS performance of the contractors.	Low
Monitoring: *OHS daily, weekly and monthly inspections and monitoring as per the OHSMP (to be performed by the Construction contractor, the Supervision engineer, the Client and invited consultants)*			
OPERATION PHASE			
Workers performing technical maintenance of the reservoir and related structures	Moderate	1) Develop an OHS procedure/instruction for the maintenance and repair works, 2) Comply with the requirements of the relevant national OHS legislation.	Low

8.3.7 Workers' Rights and Working Conditions Related Impacts

Construction stage

Contractors should be required, through contractual clauses, to comply with national labour regulations, EBRD PR2 and EBRD/IFC joint guideline of worker accommodation[138]. One construction camp will be set up for the construction of Kasakh reservoir, and will be located within the site's buffer zone. Therefore, monitoring of the HR practices should be performed among the workers on site (work schedule and shift duration, full rest days, provision of paid sick leave, payments above the minimum required level etc.), and in the labour accommodation camp (freedom of movement, availability and conditions of sanitary facilities, sufficient private space, dining facilities etc.) as well as sanitary and rest amenities at the construction area.

The contractor should be obliged to maintain the workers grievances mechanism, including an opportunity to submit anonymous complaints. In case of doubt, the PIA should extend their grievance mechanism to contractors' workers (the responsibility for responding to the grievances in this case stays with the direct employer).

Operation stage

N/A.

Impact assessment and mitigation measures

The assessment and mitigation of the impacts on workers' rights and working conditions during the construction and operation of the reservoir are summarised in **Table 8-28**.

Table 8-28. Summary of OHS impact assessment and mitigation measures

Receptor	Assessed Impact	Mitigation / management measures	Residual impact
CONSTRUCTION PHASE			
Project workforce	Moderate	***Pre-construction phase*** 1) Include requirements related to the compliance with the national labour regulations and EBRD PR2, and EBRD/IFC joint guideline of worker accommodation in the contractual clauses with the Construction contractor, including provisions related to GBVH and audit and monitoring regime. 2) Develop a Labour and Working Conditions Management Plan well in advance of construction commencement to allow sufficient time for review and implementation. 3) Develop and implement a Construction Camp Management Plan, including sub-plans for Camp Code of Conduct and Camp Management, with requirements for worker accommodation in compliance with the Armenian labour, sanitary and health standards, EBRD PR 2 requirements, EBRD/IFC guidance on worker accommodation (2009), ILO Workers' Housing Recommendation 1961 (No. 115), and gender-specific provisions. ***Construction phase***	Low

[138]Workers' accommodation: processes and standards - a guidance note by IFC and the EBRD (2009). Available at: https://documents.worldbank.org/en/publication/documents-reports/documentdetail/604561468170043490/workers-accommodation-processes-and-standards-a-guidance-note-by-ifc-and-the-ebrd.

Receptor	Assessed Impact	Mitigation / management measures	Residual impact
		1) Set up and maintain grievance mechanisms available to all project workforce, including the opportunity for anonymous complaints, 2) If a large-scale maintenance is planned, oblige the Maintenance Contractor to develop a Labour and Working Conditions Management Plan and Worker Code of Conduct (if needed) in line with Armenian labour laws and EBRD PR2 at least a month before any maintenance works, and implement it.	
Monitoring: Daily, weekly and monthly inspections and monitoring of the human resource practises, as well as working and living conditions at the construction site and construction camp (to be performed by the Construction contractor, the Client and invited consultants). Points to be monitored should include, among others: work schedule and shift duration, full rest days and shift breaks, provision of payments above the minimum required level, availability and conditions of sanitary facilities, as well as living conditions in the labour accommodation camp (freedom of movement, sufficient private space, dining facilities etc.).			

8.3.8 Gender-Based Violence and Harassment

Construction stage

Local women in the project affected area might be exposed to the risks and impacts from labour influx. A Worker Code of Conduct and GBVH Policy should be developed and conveyed to all construction workers and contractors. A grievance mechanism with a specific mandate on GBVH should be developed and disclosed, a dedicated person to manage / oversee it should be appointed.

Operation stage

Women (especially single women headed households) can face obstacles in the access to the irrigation infrastructure due to their limited involvement in the decision-making processes. Related GBVH cases might occur, and therefore the Project's implementing agency and the local governing authorities should employ appropriate measures to monitor and prevent such cases.

Impact assessment and mitigation measures

The assessment and mitigation of the GBVH impact during the construction and operation phases of the reservoir are summarised in **Table 8-29**.

Table 8-29. Summary of GBVH impact assessment and mitigation measures

Receptor	Assessed Impact	Mitigation / management measures	Residual impact
CONSTRUCTION PHASE			
Female residents of the project affected village	Moderate	***Pre-construction phase*** 1) Develop GBVH Policy and assign focal points responsible for handling GBVH incidents within the workforce and external communities. ***Construction phase*** 2) Conduct mandatory and regular training for workers on required lawful conduct in local community, the	Low

Receptor	Assessed Impact	Mitigation / management measures	Residual impact
		Code of Conduct and GBVH Policy and consequences for failure to comply with the above, 3) Implement and maintain a grievance mechanism, which includes a specific mandate on GBVH, 4) Organize information and awareness raising campaigns for community members, specifically women and girls, 5) Provide information to communities on how to use the grievance mechanism to report GBVH issues.	
OPERATION PHASE			
Female residents of the villages benefiting from the Project	Moderate	1) Monitor access to the irrigation infrastructure following the Project completion. 2) Maintain the grievance mechanism during the Project operation, including the GBVH cases.	Low

8.4 Emergency Situations and Response

Construction stage

Various emergency situations can occur during the reservoir construction, triggered by the natural hazards, use of hazardous materials, in particular during the blasting operations, or other man-made accidents and disasters.

In accordance with the World Bank's (WB's) Good Practise Note (GPN) on Dam Safety (2020)[139], emergencies include flow release that can threaten downstream life, property, or economic activities that depend on the river flow levels, intentional or accidental water release, and dam failure.

The GPN requires development of the Emergency Preparedness Plan (EPP) and Emergency Response Plan (ERP) during construction of the High Dam (Kasakh reservoir dam is classified as a High Dam). The EPP should be prepared not less than one year before starting reservoir filling. An effective EPP should provide clear and concise guidance on emergency actions: (a) how to identify an emergency as early as possible, (b) how to classify the emergency, and (c) how to respond to the emergency. Furthermore, the EPP should be coordinated with other key entities, such as the national and regional emergency or disaster management agencies and downstream districts and communities.

Operation stage

In addition to the above, the Operation and Maintenance Plan is required under the WB's GPN, which should cover reservoir operation procedure, structural dam safety assurance (periodic inspection and dam safety review), as well as downstream notification and warning procedure.

Impact assessment and mitigation measures

The assessment and mitigation of the emergency situations during the construction and operation phases of the reservoir are summarised in **Table 8-30**.

[139]Good Practice Note on Dam Safety and Technical Notes (WB 2020). Available at: https://www.worldbank.org/en/topic/watersupply/publication/good-practice-note-on-dam-safety-new-guidance-on-managing-risks-associated-with-dams

Table 8-30. Summary of emergency situations impact assessment and mitigation measures

Receptor	Assessed Impact	Mitigation / management measures	Residual impact
CONSTRUCTION AND OPERATION PHASES			
Residents of the downstream communities	Moderate	1) Conduct Dam Integrity Risk Assessment, 2) After completion of the dam integrity risk assessment and flood safety check, consider the need of an early-warning system and provision of the life-saving equipment in the local communities, with the requirement of regular maintenance and emergency evacuation drills. 3) Firefighting equipment and first aid kits should be available and maintained at all construction sites and project-related delivery vehicles. Selected workers should be trained on their usage.	Low
Monitoring: *According to the Emergency Preparedness and Response Plan*			

8.5 Cultural Heritage Impact

8.5.1 Impact on Tangible Cultural Heritage

Construction phase

As discussed in **Section 6.4.1**, fourteen cultural heritage sites have been identified within the Project footprint (designated reservoir area and the surrounding protection zone). These are newly discovered sites and, as such, are not included in the State list of registered cultural heritage units. They consist of archaeological, natural, geological, historical-architectural, and spiritual monuments that could potentially be impacted as a result of Project implementation (**Table 8-31**).

Table 6-31. List of the identified cultural heritage sites that are likely to be impacted during Project implementation

№	Name of the monument	Potential to be impacted	State registration status	Type of the CH monument
1	Fortress	likely	newly discovered	archaeological
2	Nature monument	likely	newly discovered	natural
3	Old settlement	likely	newly discovered	historical-architectural and spiritual
4	Cemetery	likely	newly discovered	archaeological
5	Findings	likely	newly discovered	archaeological
6	Tomb	likely	newly discovered	archaeological
7	Church	likely	newly discovered	historical-architectural and spiritual
8	Rock shelter	likely	newly discovered	archaeological
9	Structure	likely	newly discovered	archaeological
10	Geological section	likely	newly discovered	geological
11	Winepress	likely	newly discovered	historical-architectural and spiritual
12	Wall	likely	newly discovered	archaeological
13	Dragonstone	likely	newly discovered	historical-architectural and spiritual
14	Cave	likely	newly discovered	archaeological

The depth of the archaeological survey conducted as part of the national EIA study is not sufficient to determine the sensitivity of the potentially affected cultural heritage sites and/or to propose appropriate mitigation measures taking into account the following considerations:

- Some sites partially fall within the Project area (located at the border of the Project footprint, see **Figure 6-23**) and have been preliminarily assessed as likely to be impacted. However, additional field measurements and delineations are required to determine their exact locations and the extent of potential impact.
- It is unclear whether some of the identified archaeological monuments contain any underground structures or features (e.g., burial complexes, remnants of fortresses, churches and shrines, other surface finds or traces) that may extend into the Project footprint. Test excavations will be required to estimate the site boundaries and assess their exposure to project-related activities.
- The technical and financial feasibility of relocating the identified natural and archaeological monuments need to be assessed.
- The size, spread and rarity / availability of similar artifacts/sites in the vicinities and region also shall be assessed in combination with the above noted aspects in order to determine a sensitivity of the potentially affected sites.

Based on the considerations outlined above, the archaeological survey team recommends that, prior to the commencement of construction works, the selected construction contractor conduct an additional detailed archaeological survey and fieldwork, including:

1) Conducting test excavations (trial trenching).
2) Delineating the impacted areas, identifying the surface area and volume requiring safeguard excavations, and carrying out such excavations to preserve the affected units, if relevant.
3) Assessing the possibility of relocating monuments to areas outside the reservoir impoundment but within the protection zone.
4) Proposing specific protection measures to prevent damage during construction activities.
5) Recommending appropriate preservation measures for each of the identified cultural heritage sites.

According to the archaeological survey team, the cost of the proposed measures above is estimated at 270,000 EUR.

The proposed archaeological survey could form part of the site-specific Cultural Heritage Management Plan (CHMP), to be developed by the Construction contractor and agreed upon by the Supervision engineer, the Client, and the Authorized state body (Ministry of Education, Science, Culture and Sport). Implementation of the CHMP shall be supervised by a cultural heritage expert to be engaged by the construction contractor, who will be present on-site during earthworks and will support the implementation of the measures specified in the CHMP.

Operation phase

No adverse impacts on tangible cultural heritage sites or units are anticipated during the Project's operation phase. On the contrary, the presence of the reservoir may generate positive synergistic effects by enhancing the area's attractiveness and potentially increasing visitor interest in the historical monuments located in the affected rural settlements (Amberd, Aygeshat, Oshakan, Voskehat, and Voskevaz), as well as in the cultural heritage sites identified during the archaeological survey and potentially relocated to the areas surrounding the reservoir.

Impact assessment and mitigation measures

The assessment and mitigation of the tangible cultural heritage impact during the construction and operation phases of the reservoir are summarised in **Table 8-32**.

Table 8-32. Summary of tangible cultural heritage impact assessment and mitigation measures

Receptor	Assessed Impact	Mitigation / management measures	Residual impact
CONSTRUCTION PHASE			
Local communities, site visitors, custodians	Significant	***Pre-construction phase*** 1) Carry out a detailed archaeological survey before the start of construction works, including: - Conduct test excavations (trial trenching), - Delineate the impacted areas, identify the surface area and volume requiring safeguard excavations, and carry out such excavations to preserve the affected units, if relevant, - Assess the possibility of relocating monuments to areas outside the reservoir impoundment but within the protection zone, - Propose specific protection measures to prevent damage during construction activities, - Recommend appropriate preservation measures for each of the identified cultural heritage sites. 2) Develop a Cultural Heritage Management Plan (CHMP) for the Project, to be agreed upon by the supervision engineer, the Client, the Bank and the authorized state body (the CHMP may include the measures proposed in item 1 above), 3) Hire a qualified cultural heritage expert from an authorized institution to be present during the construction works and implement archaeological surveillance for all construction sites, as well as to help implement all heritage focused mitigations and reporting to Client/Bank, 4) Prior to construction works, develop a Chance Finds Procedure (CFP)[140] for the Project and train the relevant workers in applying it (so that they can identify the chance finds, stop the works and notify the management); keep the training log up to date and include reporting on it in monitoring reports, ***Construction phase*** 1) Implement the CHMP, 2) Implement CHP, 3) Deliver regular briefing to all workers involved in implementing heritage focused mitigations.	Low
OPERATION PHASE			

[140]A template of this procedure can be found in the 2023 EBRD's guidance note for PR8 at https://www.ebrd.com/documents/environment/guidance-note-performance-requirements-8-cultural-heritage.pdf. In addition, the regulations with regards to 'chance finds' are defined by the RA Law №HO-261 (1998) "On the protection and use of immovable historical and cultural monuments and historical environment". Particularly, according to Article 11 of the Law, if during the construction, agricultural and other works, the unknown historical and cultural monument/heritage is discovered, the above-mentioned works must be stopped and the authorized state body must be immediately informed by the local self-government bodies.

Local communities, site visitors, custodians	Neutral	The presence of the reservoir may generate positive synergistic effects by enhancing the attractiveness of the area and potentially increasing visitor interest in the historical monuments.	Positive

8.5.2 Impact on Intangible Cultural Heritage

Construction and operation phase

The implementation of the Project will not have any negative impact on intangible cultural heritage elements registered in both the UNESCO and national lists of ICH. During the construction phase, the local population of Amberd, Aygeshat and Voskehat rural settlements will need to plan celebrations such as Christmas, New Year, Easter, and Trndez, as well as weddings and baptisms, with consideration for increased traffic along the community roads. However, this impact is expected to be temporary and negligible provided that the provisions of the Traffic Management Plan are communicated with the local residents.

The Project will not negatively impact the annual celebration of the Feast of the Holy Translators in Oshakan village, as the communal roads will not be used for Project-related activities.

On the other hand, the Oshakan rural settlement is rich in historical and cultural monuments, including the Church of Saint Mesrop Mashtots, remnants of a fortress and tomb, the Morik Kaiser monument, the Tukh Manuk shrine, a five-arched midievial bridge, and a tower symbolizing the Armenian alphabet, among others (**Figure 8-4**). Therefore, the Kasakh Reservoir could become an additional sightseeing destination alongside the cultural and historical landmarks shown in **Figure 8-4**, attracting not only the local population, but also members of the Armenian diaspora, as well as visitors and cultural custodians arriving in Armenia to explore the country's rich heritage.

Additionally, elements of intangible cultural heritage, such as Lavash baking, duduk crafting and performance, and Armenian letter art with its cultural expressions, can be promoted to support the development of tourism and local trade in the Project region.

To enhance this potential, consultations should be held with the relevant staff of the Ashtarak community, the administrative heads of the Oshakan, Voskehat, and Voskevaz villages, as well as with local cultural NGOs, tourism organizations, winery owners, and other relevant stakeholders. These discussions should focus on the development of tourist routes that include visits to cultural heritage sites and wine tasting tours, particularly at Voskevaz Winery.

Table 8-4. Cultural and historical monuments in the area of Oshakan village

Tukh Manuk shrine

Remnants of fortress

Tomb

Medieval bridge

Morik Kaiser monument

Tadevos Apostol shrine

The assessment of the Project impact on cultural landscapes is embedded in **Section 8.2.5** 'Impacts on Landscape and Visual Amenity'.

Impact assessment and mitigation measures

The assessment and mitigation of the intangible cultural heritage impacts during the construction and operation phases of the reservoir are summarised in **Table 8-33**.

Table 8-33. Summary of intangible cultural heritage impact assessment and mitigation measures

Receptors	Assessed Impact	Mitigation / management measures	Residual impact
CONSTRUCTION PHASE			
Local residents	Low	Communicate the provisions of the Traffic Management Plan and construction schedule to the population of Amberd, Aygeshat and Voskehat rural settlements to help them plan Christmas, New Year, Easter, Trndez, weddings, and other celebrations and to avoid additional nuisance.	Negligible
OPERATION PHASE			
Local residents, tourists and visitors, custodians, cultural NGOs, tourism organizations, heads of settlements, owners of wineries	Neutral	Conduct consultations with the relevant staff of the Ashtarak community, the administrative heads of the Oshakan, Voskehat, and Voskevaz villages, as well as with local cultural NGOs, tourism organizations, winery owners, and other relevant stakeholders. These consultations should focus on developing tourist routes that include visits to cultural heritage sites and wine tasting tours, particularly at Voskevaz Winery.	Positive

8.6 Cumulative Impact Assessment

8.6.1 Introduction

This section presents the findings of the Cumulative Impact Assessment (CIA), which considers the E&S impacts of the Project, as well as those of other projects or activities that are currently being implemented or planned in the foreseeable future within the Project's area of influence. The CIA considers human developments for which sufficient publicly available information exists to identify potential interactions with the Project over time and/or space and to assess the resulting cumulative effects.

The CIA methodology follows a step-by-step process outlined in the IFC *Cumulative Impact Assessment and Management - Guidelines for the Private Sector in Emerging Markets* (2013)[141], and is aligned with the requirements of the EIA Directive. In accordance with these Guidelines, the CIA is carried out in six steps:

Step 1 - Identification of Valued Environmental and Social Components (VEC)[142], establishment of spatial and temporal assessment boundaries,

Step 2 - Identification of other projects / activities affecting VECs included into the assessment,

Step 3 - Collecting data on and establishment of the baseline conditions of the identified VECs (this information is presented in Chapter 6 and is not repeated in the current section,

Step 4 - Assessment of the cumulative impacts on the identified VECs,

Step 5 - Assessment of significance for the predicted cumulative impacts,

Step 6 - Management of the cumulative impacts.

8.6.2 Step 1 - Identification of VECs, and Establishing Spatial and Temporal Assessment Boundaries

VECs are valuable or sensitive processes and components whose viability or sustainability might be affected by the Project; the focus of CIA is on 'ultimate recipients of impacts' (IFC, 2013). For this CIA, the VECs are defined as E&S receptors of Project's impacts identified in **Sections 8.2, 8.3** and **8.5**. Only VECs associated with adverse residual impacts of low to moderate significance and positive residual impacts are likely to be affected by cumulative effects and included into CIA.

The VECs identified for the CIA include:

- **Surface water resources (the Kasakh River and lower reaches of the Amberd and Shakhverd rivers)** in terms of:
  - potential adverse impact on the river water quality of contaminated surface runoff from the Construction site (see **Section 2.6.7**) (applicable to all affected water courses),
  - change of the hydrological regime of the Kasakh River at the operation phase that affect downstream ecosystems,
  - positive impact on Kasakh River's water quality river water quality downstream the reservoir at the operation phase.
- **Soil resources** due to
  - topsoil disturbance and striping, soil excavation and disposal at the Project sites (including the Construction site and the site of the supporting borrow pit in the Gay community)) during the construction phase,
  - potential soil contamination at the Project sites as a result of accidental spills of friable materials, leakages of oil, fuel, and other liquid chemicals as well as waste generation and accumulation at the construction sites,
  - coastal erosion around the entire perimeter of the reservoir due to water encroachment during the initial (three to four) years of the operations.
- **Vegetation** / flora of the Project sites that will be destructed and lost as a result of teh construction works.

[141] https://www.ifc.org/wps/wcm/connect/topics_ext_content/ifc_external_corporate_site/sustainability-at-ifc/publications/publications_handbook_cumulativeimpactassessment.

[142] VECs may include: a) physical features, habitats, wildlife populations, b) ecosystem services, natural processes (e.g., water flow, microclimate), c) social conditions (e.g., health, income), or d) cultural aspects (e.g., recreation habits, local traditions).

- **Terrestrial wildlife** / fauna will be relocated to the safe area (sedentary species) or forced to migrate off the Project sites and their vicinity (birds, large mammals, invertebrates, and aquatic mammals) at a result of construction works; during the operations no new negative impacts are envisioned but negative impacts of the construction phase may persist for a while,
- **Terrestrial habitats** at the Project sites that will be destroyed or lost due to construction works. Compensation and offsetting measures will be implemented to ensure that the Project achieves no Net Loss and Net Gain (this will be clarified once the biodiversity impact assessment section is updated based on the necessary supplementary studies),
- **Aquatic animals** (mammals and fish) inhabiting the Kasakh River and lower reaches of the Amberd and Shakhverd Rivers), whose environment will be transformed due to the Project.
- **Natural landscape** of area of the the Construction site (located between Veskevaz, Voskehat, Oshakan, Amberd, Aygeshat and Lernarmerdz villages) and site surroundings, which will be modified by creation of new landscape forms (as a result of excavation works and borrow pits creation) and presence of industrial facilities during the construction phase.
- **Cultural landscape of the Project area** may be improved as a result of expanding areas occupied by vineyards and orchards**.**
- **Construction workers** exposed to:
    - Occupational safety risks associated with:
        - performing high-hazard works at the construction sites (earthworks, works at height, with high voltage, outdoors works at extremely hot weather conditions, works on or close to the open waterbodies, works with pressurized systems),
        - handling of chemicals and materials including hazardous ones (e.g. fuels and oils) at the construction sites,
    - Occupational health risks associated with:
        - dust and ICE emissions and polluted air in the work zone,
        - noise and vibration from operation of the construction machinery and equipment,
        - potential spread of waterborne diseases if construction activities disrupt the river, leading to stagnant water conditions that favor the growth of bacterial pathogen,
        - potentially insufficient sanitation at the construction sites / the construction camp.
- **Residents of villages in the vicinity of the Kasakh reservoir site**:
    - Occasional visitors of the site vicinities (shepherds and those who cultivate agricultural lands close to the reservoir site) to be affected by noise and vibration and visual effects of the construction works,
    - Residents of streets used for transportation of construction materials and equipment to the Project sites, who are affected by the emissions and noise from heavy vehicles,
    - All village residents particularly the elderly and children to be affected by increased road safety risks related to Project-related traffic across the village at the construction phase,

  - All village residents affected by the increased risk of exposure to diseases including socially significant diseases related to migrant worker influx at the construction phase,
  - Owners/users or residential and non-residential structures and land plots subject to acquisition during pre-construction works (NB: in total 123 households from to be affected; the acquired properties include one residential house and seven non-residential structures).
  - Female residents of the nearby villages exposed to security risks related to migrant worker influx at the construction phase.
  - Female households can face obstacles in the access to the irrigation infrastructure due to their limited involvement in the decision-making processes
- **Irrigation water users** (including farmers) from 21 settlements of Armavir Marz supplied from Stage-2 Hrazdan Down Channel listed in **Section 2.1** who would benefit from the sustainable supply of irrigation water for agriculture production.
- **Residents of downstream communities** (primarily Amberd and Aygeshat villages) exposed to the risk of accidental flow release can threaten downstream life, property, or economic activities.
- **Users of roads** comprising the main Project transportation routes (potentially M-1, M-3, M-5, H-19 roads, and community roads crossing Amberd, Aygeshat, Voskevaz, Voskehat, Dasht, Monteavan, and Oshakan villages) exposed to increased risks of road traffic accidents as these roads are Project transportation routes at the construction phase.
- **Local and regional infrastructure facilities** to be exposed to additional loads related to the Project activities at the construction phase; the following elements is the infrastructure will be affected:
  - Power supply lines - by temporary increase in electricity consumption to ensure activities at the main construction site including operation of the construction camp,
  - Healthcare facilities - by influx of migrant workers engaged to high-hazard works and potential increase in demand for medical service in the Project area,
  - Roads comprising the main Project transportation routes: M-1, M-3, M-5, H-19 roads and community roads crossing Amberd, Aygeshat, Voskevaz, Voskehat, Dasht, Monteavan, and Oshakan villages - by increased traffic of heavy vehicles used for transportation of construction materials and equipment which lead to road deterioration.
- **Local workforce** that would benefit from Project-related new employment opportunities for skilled, semi-skilled, and unskilled construction workers during the construction phase,
- **Local and regional economies** that would benefit from:
  - Increased demand for certain goods and services is expected to allow some local and regional businesses to become Project suppliers at the construction phase (e.g. provide the meal preparation and delivery and housekeeping services to the construction camp residents, provide construction machinery maintenance and repair service, construction waste transportation service, etc.);
  - Due to improved availability of irrigation water local farmers are expected to cultivate additional land, diversify crops and thus increase agriculture

production, which would enhance economic opportunities for the local communities.

- Increased attractiveness of the Project area for tourists (as the reservoir may become a spot for water sports, fishing, hiking, and/or camping); increased tourist flow into the Project area would create additional opportunities for development of the service sector (e.g. accommodation, catering, guide service, etc.) in the Project area.

- **Tangible cultural heritage** within the Project footprint (designated reservoir area and the surrounding protection zone) (see **Section 8.5.1**) may be affected by the construction works phase.
- **Intangible cultural heritage** (incl. Lavash baking, duduk crafting and performance, and Armenian letter art with its cultural expressions) would be acknowledged and promoted by tourists attracted to the Project area by a created reservoir; it may become one more tourist destination supplementing known historical and cultural landmarks (e.g. those of Oshakan, Voskevaz, and Voskehat rural settlement) which are of interest not only for local population but for members of the Armenian diaspora and foreigners.

The following VECs **were not included into** CIA as the residual significance of the Project impacts on them is predicted to be negligible or low to negligible:

- Groundwater resources to be affected by water infiltration from the reservoir body dam base,
- Intangible cultural heritage of the Project may be affected during the construction phase,
- Maintenance workers of the reservoir operator,
- Residents of nearby villages in terms of air emissions, noise and vibration impacts from on-site operations and Project-related transportation (at the operation phase),
- Visitors of the reservoir vicinity after 5th year of operation (in terms of impact on visual amenity of the landscape);
- Water resources during operations in terms of water losses;
- Wildlife / fauna of the affected areas during operation phase (as no adverse impacts are expected from the reservoir operation also migration of species caused by construction works may continue).
- Shepherds from the reservoir surrounding villages who can currently use reservoir site area as pasture land but do not use it due to low quality of vegetation.

The CIA **spatial boundaries** are assumed to coincide with the boundaries of Armavir and Aragatsotn Marzs.

The CIA **temporal boundaries** are assumed to include Project construction and operation phases. The duration of the construction phase is estimated as 39 months (see **Section 2.6.7**).

In general, well-designed and properly maintained reservoirs can have a lifespan of several decades to over a century. For the purposes of the current CIA, the duration of the operation phase is assumed to be 50 years.

8.6.3 Step 2 - Identification of Other Activities/Projects for the Inclusion in the CIA

The current CIA will consider interaction of the Project with the existing and planned activities, which overlap with the Project temporarily and spatially, or affect the same selected VECs as the Project does. The following other projects/activities were identified and reviewed:

1. **Associated facilities (**see **Section 2.7** for details):

   No associated facilities are identified for the Project; all supporting infrastructure is considered as part of the Project.

2. **Concurrent projects in the Project area:**

   The sources of information on such activities were as follows:

   - A database on EIAs for projects to be implemented in Project area,
   - The Strategy of Armavir Marz Development for 2017-2025,
   - The Strategy of Aragatsotn Marz Development Strategy for 2017-2025,
   - Media search for any planned development activities in Armavir Marz and Khoy Community and Aragatsotn Marz and Ashtarak Community in particular.

   The list of identified concurrent Projects includes planned construction / reconstruction of the following social and communal infrastructure facilities:

   2.1. Asphalt pavement works in Geghakert, Monteavan, Aygeshat, Lernamerdz, Doghs and Aghavnatun settlements (Khoy Community) (2022-2026),

   2.2. Extension of street lighting network in Arshaluys settlement and construction of street lighting network in Shahumyan settlement (2022-2026),

   2.3. Reconstruction of kindergartens in Haythagh and Aygeshat settlements (2022-2026),

   2.4. Construction of parks-monuments in Monteavan and Aragats settlements (2022-2026);

   2.5. Reconstruction of water wells in Arshaluys, Haytagh, Tsaghkunq, Mrgastan, Amberd and Tsaghkalanj settlements and construction of internal irrigation network in Tsiatsan settlement (2022-2026),

   2.6. Construction of gas supply pipelines in Arshaluys, Aghavnatun and Monteavan settlements (2022-2026).

At the time of writing specific locations of sites / routes of the concurrent activities are not known.

No relevant projects for 2026 onwards have been identified for the Ashtarak Community.

3. **Local and regional development projects/programmes:**

   3.1. European Union (EU) / French Development Agency (AFD) supported project “Irrigated Agriculture Development in Ararat & Armavir (IADAAM) (2024-2026)”[143],

The planned construction and reconstruction of social and communal infrastructure in the villages of Khoy Community nearby the Construction site (Amberd, Lernamerdz, and Aygeshat) include asphalt pavement works (in Lernamerdz villages), reconstruction of water wells (in Amberd), reconstruction of a kindergarten (in Aygeshat), and construction of a park-monument (in Aygeshat). These activities are assumed to take place within built-in areas of the abovementioned village and all on-site activities are confined to the Construction site.

The minimum distances from the Construction site to the residential areas (northern edge of Amberd and eastern edge of Lernamerdz) is about 450-500 m. Therefore, the spatial overlap between impacts of air emissions, noise and vibration from the construction works at the Construction site and asphalt pavement works in Lernamerdz is highly unlikely. Cumulative visual impacts are not expected. Aygeshat village is in 1.2km from the Construction site and therefore, no direct overlaps

[143] https://sda.am/en/projectportfolioeng/irrigated-agriculture-development-in-ararat-and-armavir-marzes-iadaam/

between reconstruction of a local kindergarten and construction of a park-monument and works at the Construction site and cumulative effects are expected.

The supporting loam borrow pit in Gay Community is in ca. 35km from the Construction site and outside the Khoy Community. Therefore, no spatial overlap between works at the borrow pit site and a) concurrent activities in Khoy Community and b) at the Construction site can occur.

The implementation timeline of the concurrent projects listed above partly overlaps with the Project construction phase as the start of the Project construction works is tentatively planned for the second half of 2026.

Community roads of several villages of the Khoy Community are likely to be used for transportation of construction materials and machinery and extracted loam from the supporting borrow pit to the Construction site. Although Project transportation routes are not determined, they are likely to include Amberd, Aygeshat, Dasht, Monteavan and Shahumyan villages. The transportation routes for concurrent projects are also not known but they may partly overlap with the Project's transportation routes. Such overlaps may result in aggregated construction traffic impacts on the road infrastructure (local and regional roads), safety of road users, health and safety of residents of Amberd, Aygeshat, Dasht, Monteavan and Shahumyan villages.

Following the conservative approach, all the concurrent projects implemented in 2022-2026 in Khoy Community are included into the current CIA.

The Irrigated Agriculture Development in Ararat & Armavir (IADAAM) project targets the same VECs as the Project (local farmers / irrigation water users, and local economy (namely its agricultural sector)). However, it may have temporal overlap only with construction phase of the Project, and therefore, it is not included into the current CIA.

8.6.4 Step 3 - Collecting data on and establishment of the baseline conditions of the identified VECs

This information is provided in **Chapter 6** and is therefore not repeated in the current section.

8.6.5 Steps 4 and 5 - Assessment and Evaluation of the Key Cumulative Impacts

Construction phase

During the construction phase, cumulative impacts may result from the overlap between Project activities and concurrent projects related to the construction/reconstruction of infrastructure facilities in selected villages of Khoy community.

The current CIA indicates that many of the Project's impacts are not significantly amplified by those of other activities or projects. As a result, the cumulative impacts are expected to be of a similar level of significance as the Project's residual impacts. Such cumulative impacts include:

- Adverse impacts of low significance:
    - Cumulative impact on the water quality of the Kasakh River due to contaminated surface runoff from the Construction site, and sites of asphalt pavement works in Aygeshat and Lernamerdz,
    - Cumulative impacts on soil resources at the Construction site, the site of the supporting loam borrow pit, parks-monuments sites in Monteavan and Aragats settlements, sites of the proposed internal irrigation network channels in Tsiatsan settlement, and routes of the gas supply pipelines in Arshaluys, Aghavnatun and Monteavan settlements,

- Cumulative impact on sedentary animals and invertebrates due to construction works at the Construction site, the site of the supporting loam borrow pit, and sites of the proposed internal irrigation network channels in Tsiatsan settlement (after the relocation to safe areas);
- Cumulative impact on birds and large mammals due to destruction of foraging and/or breeding habitats as a result of construction works at the at the Construction site, the site of the supporting loam borrow pit, and sites of the proposed internal irrigation network channels in Tsiatsan settlement.
- Occupational health and safety risks for construction workers across the Construction site, the site of the supporting loam borrow pit and sites of concurrent Projects,
- Cumulative impact on tangible cultural heritage due to excavation and other construction works the Construction site, the site of the supporting loam borrow pit, parks-monuments sites in Monteavan and Aragats settlements, sites of the proposed internal irrigation network channels in Tsiatsan settlement, and routes of the gas supply pipelines in Arshaluys, Aghavnatun and Monteavan settlements
- Increased load on the power supply infrastructure due to aggregated demand from the Project and concurrent construction activities;

- Adverse impacts of moderate significance:
  - Loss of habitats as a result of construction works at the at the Construction site, the site of the supporting loam borrow pit, parks-monuments sites in Monteavan and Aragats settlements, sites of the proposed internal irrigation network channels in Tsiatsan settlement, and routes of the gas supply pipelines in Arshaluys, Aghavnatun and Monteavan settlements,
  - Loss of vegetation / flora as a result of construction works at the Construction site, the site of the supporting loam borrow pit, sites of the proposed internal irrigation network channels in Tsiatsan settlement.

    Note: after biodiversity offset application no Net Loss / a Net Gain is expected.

In addition, there are cumulative impacts resulting from the amplification of Project-related impacts by those of other activities or projects. The significance of these cumulative impacts is assessed as low to moderate. These impacts include:

- Cumulative adverse impact on residents of residents of Amberd, Aygeshat, Dasht, Monteavan and Shahumyan villages living along community roads used for the transportation of construction materials and equipment, due to nuisance from emissions and noise generated by heavy vehicles. This impact arises from activities at the Construction site, the site of the supporting loam borrow pit, and sites of concurrent activities within the affected villages,
- Road safety risks for residents of Amberd, Aygeshat, Dasht, Monteavan and Shahumyan villages, particularly the elderly and children, due to increased traffic of heavy vehicles passing through the village,
- Risk of road traffic accidents for all users of the roads designated as main transportation routes for both the Project and concurrent activities,
- Cumulative adverse impact on the condition of roads used as primary transportation routes by the Project and concurrent construction activities,

- Positive aggregated impact on the local workforce, through the creation of new employment opportunities for skilled, semi-skilled, and unskilled construction labour.
- Positive aggregated impacts on local and regional economic development, driven by increased demand for goods and services provided by local and regional businesses (e.g., meal preparation and delivery for construction workers, maintenance and repair of construction machinery, transportation of construction waste, etc.).
- Positive aggregated impact on the cultural landscape of the Project area from the Project and proposed internal irrigation network channels in Tsiatsan settlement as a result of expanding areas of vineyards and orchards.

Operation phase

No concurrent activities have been identified for the Project operation phase. Therefore, no cumulative impacts are expected from the overlap between Project operations and other activities.

8.6.6 Step 6 - Cumulative Impacts Management

As explained above, possible cumulation of impacts on the VECs included into CIA either did not change only slightly changed the significance of the residual impacts of the Project. **The CIA did not identify neither high not moderate adverse cumulative impacts.**

Recommended Impact Prevention / Mitigation Measures to Reduce Adverse Cumulative Impacts

- The routes for the Project-related transportation have not been determined at this stage of the Project development. The Construction Contractor will identify such routes based on consultations with the traffic police and local administrations of affected communities. After the Construction Contractor should:
  - Arrange reconnaissance drives along the selected routes to evaluate and document current road conditions and identify sensitive receptors (schools, hospitals, residential areas, other social infrastructure facilities) and their current integrity status;
  - Select optimised daily time slots for transporting construction materials / equipment to the Project site, especially bulky equipment parts (e.g., pipes) based on consultations with the traffic police and local administrations;
  - Develop a Construction Traffic Management Plan, informed by the abovementioned studies, which would consider traffic flows of concurrent activities to minimise overlapping. The Plan should propose specific mitigation measures to reduce cumulative traffic effects on identified sensitive receptors including avoidance (where possible), timing adjustments, additional traffic signs, reinforcement of the speed limits, etc. The Plan should be ap by traffic police.
- Disclose the proposed transportation routes and the Plan to the public.

The implementation of these measures **will reduce the significance of adverse cumulative impacts related to construction traffic to minor**.

8.7 Summary of E&S Impacts, Benefits and Opportunities

1) The Kasakh River flows through the west-central part of Armenia from north to south. It originates near Mount Aragats in Aragatsotn Marz, flows south into Armavir Marz, and eventually joins the Metsamor River, which is a tributary of the Araks River. The latter forms

the border between Armenia and Turkey in the southwest and between Armenia and Iran in the south.

2) A conservative evaluation of the planned reservoir' impacts has been made possible through basic hydrological modelling (SWAT+) and expert judgment. The assessment indicates that the Kasakh reservoir is unlikely to have significant downstream impacts. This conclusion is primarily based on the upstream positions relative to existing lakes or reservoirs, and the relatively small size of the rivers they impound.

3) The Project is assessed as aligned with the goals of the Paris Agreement and is included on the aligned list under the water supply and wastewater category. No project activities have been identified on the 'non-aligned list'. The Project is also assessed as aligned with the mitigation goals of the Paris Agreement (BB1 aligned).

4) The Project does align with some of the targets outlined in Armenia's draft LT-LEDS and, therefore, the country's NDC in that it is designed to improve water supply and efficiency in irrigation. However, it is noted that GHG emission estimates at this stage show net positive carbon emissions for reservoir over 100 years. The total GHG emissions in the shape of CH4 from the planned reservoir at year 1 are estimated 9 tCO2e/year, while at year 50 - 127.4 tCO2e/year.

5) Approximately 85% of the total air emissions from construction activities are expected to consist of dust (PM2.5 and PM10). However, dust and gaseous emissions are expected to remain below acceptable limits and pose minimal risk to ambient air quality. There are no residential houses in the immediate vicinity of the construction site, construction camps and borrow-pits. Therefore, air pollutants, as well as noise and vibration from construction machinery and operations, are not expected to affect the local population, although some negative impact on workers employed by the contractors may occur.

   The air emissions from the operated reservoir will be minimal and will primarily depend on the climatic conditions in the Project region. The noise and vibration impact during the Project operation phase is negligible.

6) All Project supporting facilities, except for the loam (clay) borrow pit located 35 km from the Project area, will be situated within the construction site. The main sources of visual disturbance include construction machinery, heavy vehicles, borrow pits, topsoil stockpiles, storage areas for construction materials and oil products, and other temporary infrastructure. The nearest residential houses are located at a considerable distance from the Project site (450-850 m) and are therefore unlikely to be affected visually. While this impact is unavoidable, it is considered short-term and limited to the construction period.

7) As a result of the Project implementation, the landscape of the Project area will undergo a permanent transformation due to the formation of the reservoir and the presence of associated infrastructure. Overall, the visual impact during the operation phase is long-term and permanent. However, effective landscaping and environmental integration measures can help mitigate negative visual effects. Over time, the Project's visual impact may even become positive.

8) The Project implementation may also have a positive impact on the cultural landscape. The vineyards, orchards, and other cultivated land in the affected villages are an integral part of the combined rural vernacular and organically evolved landscape. Given the cultural heritage value of the villages of Oshakan, Voskehat, and Voskevaz, and the presence of wineries in the region, expanding vineyard areas will serve as an additional driver of economic development.

9) Excavation and earthworks will involve the movement of a certain amount of soil (including topsoil and excavated subsoil), which may potentially trigger landslides, mass movements, and other erosion processes. Improper practices in the storage of topsoil and spoil, particularly: (i) excessive height of stockpiles and steep slope gradients, (ii) location of storage sites near watercourses and roads, and (iii) open storage without vegetation cover or protective sheeting, can negatively affect the geology of the Project site and surrounding areas and shall be mitigated through a set of mitigation measures.

10) According to the results of the engineering-geological study, the estimated annual water infiltration from the reservoir body is significant, indicating the need for anti-infiltration measures, which are described in detail in the Project design documentation. Implementation of the proposed measures is expected to reduce water infiltration from the reservoir to an acceptable level of 12,659 m^3 per year.

11) During the construction phase, contamination of the Kasakh River and of the lower reaches of Amberd and Shakhverd rivers is expected due to the deposition of dust and exhaust gas emissions (from construction machinery and heavy trucks), spills of hazardous materials, and improper management of storage areas. Surface water quality may also deteriorate as a result of soil erosion and runoff caused by rainfall or snowmelt.

12) During the operation phase, the water quality of the Kasakh, Amberd and Shakhverd rivers rivers upstream of the reservoir is not expected to change, as the reservoir operation will not cause contamination of upstream watercourses. Within the reservoir, several natural processes contribute to the self-purification of water. These include sedimentation of suspended solids, adsorption and precipitation of nutrients and metals, microbial degradation of organic matter, and nutrient uptake by aquatic vegetation. Together, these ongoing processes help to maintain and improve water quality, supporting the long-term sustainability of irrigation activities.

13) According to the Project design study, approximately 106,774 m^3 of topsoil will be stripped and removed from the construction site, including areas of designated as borrow pits, construction materials storage areas, construction camp, etc. This topsoil will be reused during the landscaping of the reservoir surroundings. No impacts on topsoil are expected during the Project operation phase.

14) 475,558 m^3 of spoil material will be generated during excavation and earthworks that will totally be used as backfill material for the reservoir and dam body. Therefore, designated Spoil Disposal Areas will not be required for the Project.

15) 92,250 m^3 of construction waste will be generated during the Project implementation phase. The main sources of this waste will be old and/or partially demolished structures that need to be dismantled and cleared from the construction site. These wastes can be disposed of in a landfill.

16) All required permits and normative documents regulating waste management in Armenia shall be obtained by the construction contractor prior to the commencement of construction. These documents shall include, at a minimum: (i) hazardous waste passports, (ii) waste generation norms, and their disposal limits, (iii) waste generation register, etc., (iv) waste primary registration log-books, etc. Proper management of the waste streams to be generated during the construction phase will be ensured through a detailed Waste Management Plan.

17) Potential impacts on biodiversity (including priority biodiversity features and critical habitats) as a result of the Project implementation activities include:

Construction phase

- Destruction (loss) of habitats (vegetation clearance, removal of topsoil, excavation, quarrying, movement and placement of topsoil and quarried materials, reservoir filling),
- Flora species loss (vegetation clearance, including trees cutting, removal of topsoil, quarrying, movement and placement of topsoil and quarried materials, reservoir filling),
- Disturbance of fauna species by noise, vibration and light pollution (construction and mining machinery, traffic, lighting of the building area),
- Destruction of sedentary animals' habitats and a risk of their death (removal of topsoil, excavation, quarrying, movement and placement of topsoil and quarried materials, reservoir filling),
- Loss of foraging habitats for transit species of mammals (vegetation clearance, removal of topsoil, excavation, quarrying, movement and placement of topsoil and quarried materials, reservoir filling),
- Loss of breeding and foraging habitats for birds (vegetation clearance, removal of topsoil, quarrying, excavation, movement and placement of topsoil and quarried materials reservoir filling),
- Loss of breeding, foraging and wintering habitats of invertebrates and a risk of death of their overwintering stages (vegetation clearance, removal of topsoil, quarrying, excavation, movement and placement of topsoil and quarried materials reservoir filling,
- Destruction of the habitats of the aquatic and semi-aquatic species and a risk of the species death,
- Obstacle to migration of the aquatic species (blocking the river native water flow by the construction site),
- Impact on protected areas and internationally designated areas.

Operational phase

- Emergence of new habitats (water, riparian),
- Increased access to the area,
- Obstacle to migrations of aquatic species (blocking the native water flow by the dam).

18) Negative impacts on biodiversity are primarily associated with the construction phase and result from project implementation activities. In contrast, some positive impacts may occur during the operational phase, associated with the creation of new habitats, such as a large water surface and riparian vegetation, that are likely to attract various animal species.

19) Three Priority Biodiversity Features and one Critical Habitat (CH) will be impacted durign the Project implementation. Totally, area of the lost habitats is 20.34 ha. Currently, the habitats are not disturbed, they are in natural conditions. The riverine habitats will be fully destructed by the reservoir filling; however, these habitats (or rather similar to them) will restore along the reservoir coasts.

20) Land clearance, excavation, and earthworks will result in vegetation removal in the same areas where habitats will be destroyed. According to calculations conducted as part of the national EIA study, 1,840 trees are to be planted as a compensatory measure for the 520 trees to be removed. A 1:1 replacement ratio was applied for trees with a trunk diameter (D) of less than 10 cm, and a 1:6 ratio for trees with D greater than 10 cm. The overall compensation multiplier is 3.54 (1840/520). Since the 520 trees to be removed do not belong to priority species, the "no net loss" and "net gain" principles are not required to be applied.

21) No protected (nationally or internationally) plant species are registered in the Project area. No negative impacts on the nationally protected areas, Candidate Emerald sites and KBA/IBA areas are identified.

22) The implementation of the Project is expected to significantly increase traffic intensity within the rural settlements of Amberd, Aygeshat, and Veskehat. However, the construction of access roads will provide bypass routes for material transportation, thereby helping to mitigate the negative traffic impacts associated with the Project. A comprehensive Traffic Management Plan will be required.

23) The Project impacts on the socio-economic receptors of the Project area are mostly positive during both construction and operation phases. The residents might be positively impacted by the new employment opportunities during the Project construction phase, thereof increasing the households' income. The residents and local businesses will have an opportunity to be engaged in the service sector, namely meal preparation and delivery, as well as housekeeping and other services. Local and regional businesses may join the project supply chain - in areas including transportation, and provision of goods and services.

24) Reliable water supply from the Kasakh Reservoir, delivered via the Stage-2 Hrazdan Down Channel, will encourage farmers in 21 rural settlements to invest in modern irrigation systems and water-saving technologies, contributing to a more sustainable irrigation network. In addition, consistent water availability will enable the cultivation of additional land, diversification of crops, and increased agricultural production, thereby enhancing economic opportunities for the local communities.

25) The construction of the reservoir will have a positive effect on the families' standards of living, including socially vulnerable households. The Project implementation will support food security in the households engaged in the subsistence agriculture and might enable accumulation of a larger surplus for sale. At the same time, the price of the irrigation services should account for the affordability to the low-income households.

26) The Project will permanently acquire a total of 1,452,605.4 m² of land (280 land plots) in the Ashtarak (Voskehat, Voskevaz and Oshakan villages) and Khoy (Amberd and Aygeshat villages) communities of Aragatsotn and Armavir Marz, impacting a total of 123 households. There are eight buildings/structures impacted by the Project. Among them one is residential building (not used for residence, so no residential loss) with total area of 156 m^2, and seven non-residential structures (two incomplete structures, two foundations, two patios, and one shed) totalling 637.64 m^2. Thus, the Project will not result in physical displacement of PAPs (relocation or loss of housing).

27) The impacts of physical factors, such as air and noise emissions, soil contamination, and wastewater discharge, on the health and safety of populations in the project-affected settlements are expected to be low, provided that appropriate management and monitoring plans are developed and effectively implemented. The labour influx may increase the risk of community exposure to diseases, including socially significant illnesses and elevate safety and security concerns. Additionally, emergency situations may pose risks to the local population during both the construction and operational phases. All construction activities must be carried out in compliance with an Occupational Health and Safety Management Plan.

28) The Project Implementation Unit (PIU) should require compliance with the national labour regulations from the contractors via contractual clauses. Monitoring of the human resources practices should be performed among the workers on site (work schedule and shift duration, full rest days, provision of paid sick leave, payments above the minimum required level etc.),

and in the labour accommodation camps (freedom of movement, availability and conditions of sanitary facilities, sufficient private space, dining facilities etc.).

29) A Worker Code of Conduct and Gender-Based Violence and Harassment (GBVH) Policy should be developed and conveyed to all construction workers and contractors. A grievance mechanism with a specific mandate on GBVH should be developed and disclosed, a dedicated person to manage / oversee it should be appointed.

30) As a result of detailed field investigations and designated on-site surveys conducted in 2024 as part of the national EIA study, 14 cultural heritage sites have been identified within the Project footprint (including the designated reservoir area and surrounding protection zone). These are newly discovered sites and are therefore not yet included in the State Register of Cultural Heritage. They encompass archaeological, natural, geological, historical-architectural, and spiritual monuments that could potentially be affected by Project implementation. Given these findings, a detailed archaeological survey and fieldwork must be carried out prior to the commencement of construction activities. In addition, the construction contractor is required to develop and implement a Cultural Heritage Management Plan.

31) The implementation of the Project will not have any negative impact on elements of intangible cultural heritage registered on both the UNESCO and national ICH lists. It will neither adversely affect local rituals associated with wedding and baptism ceremonies nor traditions specific to the region.

32) The Cumulative Impact Assessment prepared for the Project did not identify any major negative cumulative impacts.

33) E&S Monitoring Plans for construction and operation phases will be developed, agreed with the Supervision engineer and Lender, and implemented by the Construction contractor (during construction phase) and the Client (during the operation phase). Both observational and instrumental monitoring will be conducted as per the Monitoring Plans. Appropriate human and material resources for their implementation will be allocated.

9. Environmental and Social Management and Monitoring

9.1 Introduction

The Project's Environmental and Social Management Plan (ESMP) is a standalone document associated with this ESIA Report. It comprises a set of mitigation and management measures, criteria for their effective implementation, and institutional arrangements to be undertaken throughout the Project's life cycle to prevent, reduce and compensate adverse E&S impacts to acceptable levels. The ESMP has been prepared based on the findings of this E&S appraisal to ensure that the Project is implemented in compliance with applicable national E&S laws and regulations, the EBRD ESP (2019), relevant EU directives, and Good International Practices (GIP).

The ESMP is a key document that outlines the E&S requirements, including those related to cultural heritage (both tangible and intangible), land tenure, emergency situations, and community and occupational health and safety risks, and specifies the operational procedures necessary to manage significant issues that may arise during Project implementation.

The ESMP will be implemented during the construction (including pre-construction) and operation (including maintenance) phases of the Project. As such, it can be used as a standalone document throughout the different phases of the Project by key stakeholders, including:

- **Construction contractor(s)** - during the pre-construction and construction phases,
- **The Supervision engineer** - during the construction phase,
- **The Client (Water Committee with its PIU)**, in its capacity as Project owner and developer - throughout the Project construction phase,
- **"Jrar" CJSC**, in its capacity as reservoir operator - throughout the Project operation phase,
- **The Contractors** engaged by the Client or reservoir operator ("Jrar CJSC" under the MTAI) - during the maintenance phase,
- **EBRD** - during the active period of the loan agreement,
- **Other governmental authorities** (MTAI, ME) and inspection bodies,
- **Local self-governmental bodies** - Ashtarak and Khoy municipalities, administrative heads of Amberd, Aygeshat, veskehat, Voskevaz and Oshakan rural settlements.

The Client holds the overall responsibility for the implementation and supervision of the E&S management and mitigation measures outlined in the Project's ESMP. The further development and effective implementation of these measures prior to and during the construction phase will be delegated to the Construction contractor(s) and supervised by the Supervision engineer, who will be appointed by the Client. The Client or the water reservoir operator - "Jrar" CJSC, will be responsible for and take ownership of the measures relevant to the operation and maintenance phase of the Project.

This chapter outlines the key objectives and fundamental principles of the ESMP, as well as its structure and content.

9.2 Objectives of Environmental and Social Management

E&S management and monitoring measures represent the primary outputs of the Project's ESIA process. They are intended to address identified E&S impacts and risks and to reduce them to acceptable levels in line with national regulatory and EBRD ESP requirements. The key objectives of the E&S management/monitoring are to:

- **Integrate environmental and social considerations** into all phases of Project design, construction and operation (maintenance),
- **Ensure compliance** with national legal requirements, EBRD PRs, and other applicable international standards,
- **Avoid, minimize, or mitigate adverse impacts** on the environment, workers, and affected communities through effective planning and implementation of mitigation measures,
- **Establish clear roles, responsibilities, and procedures** for the implementation of E&S mitigation and monitoring measures, as outlined in the Project's ESMP,
- **Promote continuous improvement** in E&S performance through adaptive management, regular monitoring, and corrective actions,
- **Enhance transparency and accountability** by ensuring timely reporting to the Client, EBRD, competent authorities, and other relevant stakeholders,
- **Facilitate stakeholder engagement** by ensuring that the concerns and expectations of affected communities and other stakeholders are considered and addressed throughout the Project life cycle.

9.3 Principles of Environmental and Social Management across the Project Life Cycle

Pre-construction Phase

Any requirement arising from the process of obtaining specific Project-related decisions (such as approvals, permits, or consents) from national and/or local self-governmental bodies (e.g., ministries, communities, inspection bodies, agencies) and/or the Client and EBRD during the pre-construction stage will be incorporated into the final construction documentation.

Construction Phase

In principle, the implementation of the key E&S mitigation measures related to the construction phase will be delegated to the Construction contractor(s). This delegation will be governed by the ESMP, which will form part of the tender documents, procurement process, and the Construction contractor's contract.

The Construction contractor(s) will develop their own Construction Environmental and Social Management Plans (CESMP), which must be aligned with this ESIA Report and the associated ESMP. The CESMP will include Site-Specific Environmental and Social Management and Monitoring Plans (SSESMPs) or procedures to address E&S issues during the construction period. The Supervision engineer, appointed by the Client, shall review and approve these documents.

It will be the responsibility of the appointed construction contractor(s) to further elaborate on the issues addressed in the ESMP as the Project planning progresses, both prior to and during construction. This includes, but is not limited to, the establishment of construction zones, temporary facilities for the workforce, details for storing construction and other materials, traffic and transport management, environmental protection and waste management, labour management, occupational and community health and safety, emergency preparedness, and other relevant matters.

Operational Phase

The operation phase will commence following the full commissioning of the reservoir and supporting infrastructure. At that stage, all works will have been handed over by the Construction contractor to the reservoir operator ("Jrar" CJSC), who will be responsible for implementing the majority of E&S management measures to ensure continued compliance with the Project's mitigation strategy. These

measures will be managed through "Jrar" CJSC's Environmental and Social Management System (ESMS), in alignment with applicable regulations and guidelines.

In addition, the implementation of key E&S mitigation measures related to maintenance activities may be delegated to a designated contractor (i.e. the reservoir maintenance contractor). Such delegation will be governed by specific contractual arrangements.

All mitigation measures specified in **Chapter 8** of this ESIA report are included in the relevant sections of the ESMP prepared for the Project.

9.4 Site-Specific Environmental and Social Management and Monitoring Plans

The Consultant recommends a set of specific operational, management, and monitoring plans that should be prepared by the construction contractor in line with the Project's ESMP and implemented during the pre-construction and construction phases to effectively manage E&S impacts. At a minimum, the proposed SSESMPs shall include:

- Traffic Management Plan,
- Tree Management Plan,
- Topsoil Management Plan,
- Hazardous Materials Management Plan,
- Spill Prevention and Management Plan,
- Waste Management Plan,
- Occupational Health and Safety Management Plan,
- Labour and Working Conditions Management Plan,
- Construction Camp Management Plan, including Sub-plans for Camp Code of Conduct and Camp Management,
- Worker Code of Conduct;
- Local Employment and Procurement Plan,
- Emergency Preparedness and Response Plan,
- Borrow Pit Management Plan,
- Cultural Heritage Management Plan,
- Chance Find Procedure,
- Air, Water, and Soil Quality Monitoring Plan,
- Noise and Vibration Monitoring Plan,
- Stakeholder Management Plan (that shall be updated at least once a year),
- Resettlement Plan.

9.5 Organizational Structure of Environmental and Social Management

The organizational structure of the Project's E&S management is presented in the **Figure 9-1**.

The source documents include:

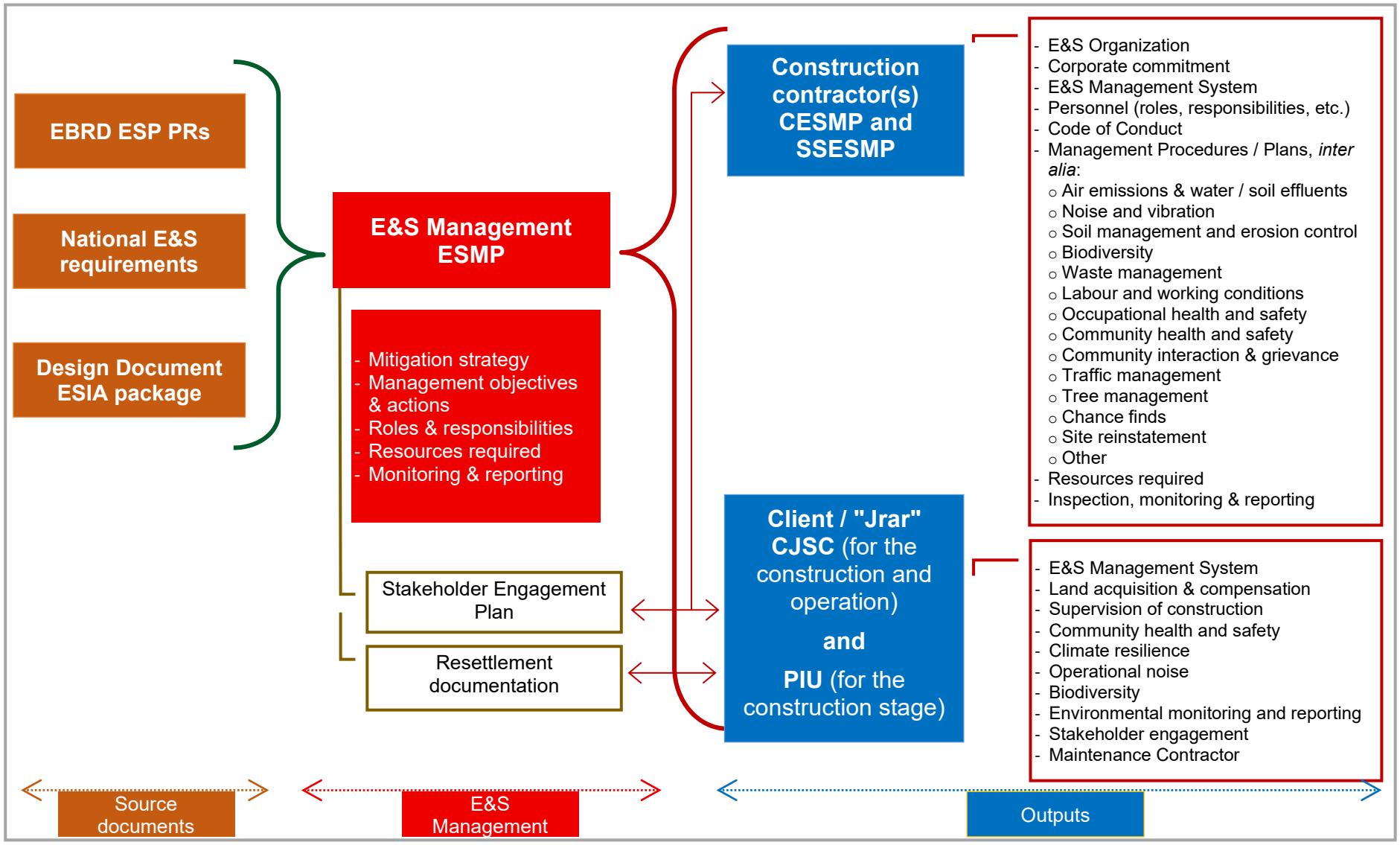
- National legal act and regulations,
- EBRD ESP, applicable EU directives and GIPs,

- Design documents - to be prepared to meet national regulations as well as the best international practice,
- ESIA report (this document) and the accompanying documents (ESIA package), and upcoming updates.

The output documents are:

- The CESMP and SSESMPs to be prepared by the Construction contractor(s) to achieve the E&S performance objectives during the Project's construction phase,
- The Client's or PIU's ESMS, required to implement and monitor the management actions described in the ESMP,
- Detailed E&S management procedures necessary to address the mitigation and compensation measures identified through this E&S assessment, and
- Various documents to be produced and disclosed during Project implementation to provide information on construction and operation activities, as well as the results of E&S monitoring.

Figure 9-1. Structure and organization of the Project's Environmental and Social Management



11968

Annex 1

ՀԱՍՏԱՏՈՒՄ ԵՄ՝
Շրջակա միջավայրի նախարար
Հակոբ Սիմիդյան

«01» 11 2024թ.

ՊԵՏԱԿԱՆ ՓՈՐՁԱՔՆՆԱԿԱՆ ԵԶՐԱԿԱՑՈՒԹՅՈՒՆ

ՇՐՋԱԿԱ ՄԻՋԱՎԱՅՐԻ ՎՐԱ ԱԶԴԵՑՈՒԹՅԱՆ ՓՈՐՁԱՔՆՆՈՒԹՅԱՆ

ԲՓ № 233 - 24

Նախաձեռնող՝ **«Քոնսեկոարդ» ՍՊԸ**
ք. Երևան, Սեբաստիայի փողոց 31/2

Գործունեությունը՝ **Քասախի ջրամբարի կառուցում**
Արմավիրի մարզ

Առդիր՝ 11 թերթ

ՊԵՏԱԿԱՆ ՓՈՐՁԱՔՆՆԱԿԱՆ ԵԶՐԱԿԱՑՈՒԹՅՈՒՆ

ՇՐՋԱԿԱ ՄԻՋԱՎԱՅՐԻ ՎՐԱ ԱԶԴԵՑՈՒԹՅԱՆ ՓՈՐՁԱՔՆՆՈՒԹՅԱՆ

ԲՓ № 233 - 24

«01» Նոյեմբերի 2024թ.

Արմավիրի մարզի Խոյ համայնքում Քասախի ջրամբարի կառուցման շրջակա միջավայրի վրա ազդեցության գնահատման հաշվետվություն

Նախաձեռնող՝	«Քոնսեկոարդ» ՍՊԸ
Ներկայացված նյութեր՝	Շրջակա միջավայրի վրա ազդեցության գնահատման հաշվետվություն, նախագիծ
Գործունեության տեսակ՝	«Ա» կատեգորիա
Տեղադրման վայրը՝	Արմավիրի մարզի, Խոյ համայնքի, Ամբերդ, Այգեշատ բնակավայրեր, Արագածոտնի մարզի, Աշտարակ համայնքի, Ոսկեհատ, Ոսկեվազ, Օշական բնակավայրեր

Ներածական մաս. «Քոնսեկոարդ» ՍՊ ընկերության /այսուհետ՝ Ընկերություն/ կողմից փորձաքննության ներկայացված նախագծային փաթեթով նախատեսվում է Արմավիրի մարզի Խոյ համայնքի Ամբերդ, Այգեշատ և Արագածոտնի մարզի Աշտարակ համայնքի Ոսկեվազ, Ոսկեհատ և Օշական բնակավայրերի վարչական տարածքներում կառուցել Քասախի ջրամբարը: Ներկայացվող ծրագրի պատվիրատուն ջրային կոմիտեն է, որը ֆինանսավորվում է Վերակառուցման և զարգացման եվրոպական բանկի /ՎԶԵԲ/-ի կողմից :

Համաձայն «Շրջակա միջավայրի վրա ազդեցության գնահատման և փորձաքննության մասին» (ՀՕ-150-Ն) օրենքի 12-րդ հոդվածի 3-րդ մասի 11-րդ կետի ա ենթակետի՝ նախատեսվող գործունեությունը հանդիսանում է «Ա» կատեգորիայի գործունեության տեսակ: Նախատեսվող գործունեության համար հիմք են հանդիսացել պատվիրատուի հայտը, Արմավիրի մարզի Խոյ համայնքի ղեկավարի կողմից 03/08/2023թ-ին տրված № 99 ճարտարապետահատակագծային առաջադրանքը:

Նկարագրական մաս. ՀՀ Կառավարությունը ԵՄ աջակցության «Վերականգնում, դիմակայունություն և բարեփոխում. Արևելյան գործընկերության առաջնահերթությունները 2020թ-ից հետո» նախաձեռնության «Լրացուցիչ «Բ» նախաձեռնության» շրջանակներում նախատեսում է կառուցել 17 ջրամբարներ: Ծրագրի իրականացման արդյունքում ոռոգման համակարգերը մեխանիկականից կփոխարինվեն ինքնահոսի՝ ինչը կնպաստի 1 մ^3 ոռոգման ջրի ինքնարժեքի զգալի նվազեցմանը, որն իր դրական ազդեցությունը կունենա գյուղատնտեսական արտադրության վրա: Քասախի ջրամբարը նախատեսվում է կառուցել Արմավիրի մարզի Ամբերդ և Այգեշատ, ինչպես նաև Արագածոտնի մարզի Աշտարակ համայնքի Ոսկեվազ, Օշական և Ոսկեհատ բնակավայրերի վարչական տարածքներում

Քասախ և Ամբերդ գետերի միացման հատվածում՝ հեղեղային ելքերը 950.0-980.0մ բացարձակ նիշերում կուտակելու և 6215 հա գյուղատնտեսական հողատեսքերը ոռոգման ջրով ապահովելու նպատակով: Գեոմորֆոլոգիայի տեսանկյունից, հետազոտվող տեղամասը զբաղեցնում է Արագած հրաբխային զանգվածի հարավային լանջերի եզրամասի և Արարատյան գոգավորության սահմանային գոտին: Նկարագրվող շրջանը կազմված է հիմնականում նեոգեն-ստորին, միջին և վերին չորրորդական հասակի հրաբխային բազալտային անդեզիտներով, տրախիտներով, անդեզիտներով և դացիտային տուֆերով, որոնք ծածկված են տեխնածին և բնական ժամանակակից էլյուվիալ, դելյուվիալ, ալյուվիալ-պրոլուվիալ կավային, ավազային, խճա-խճավազային և ճալաքարա-կոպճային գոյացումներով: Երկրաբանական պրոցեսների և երևույթների առումով տեղամասի ինժեներաերկրաբանական պայմանները բարենպաստ են, սողանքային կամ սելավային պրոցեսները բացակայում են: Ռելիեֆը հարթավայրաբլրային է, ձորակային, մասնատված է գետային ցանցով, ունի դեպի հարավ կողմնորոշված ընդհանուր թեքություն: Ձևաչափական դասակարգմամբ, տեղանքը կարելի է դասել թույլ մասնատված տեսակի: Ներկայացվող ծրագիրն իրականացվում է Կառավարության քաղաքականության և որոշումների հիման վրա, ուստի քննարկվել են ջրամբարի ցուցանիշների և կառուցման եղանակների տարբերակները: Ջրամբարի համար առաջարկվող տարածքները հանդիսանում են մասամբ համայնքային հողեր, իսկ մյուս մասը՝ սեփականաշնորհված: Հողամասերը գյուղատնտեսական նշանակության են՝ արոտավայրեր կամ վարելահողեր: Ջրամբարի ջրածածկման տարածքի կորդինատները՝ ARM WGS-84 կորդինատային համակարգով հետևյալն են՝

Հ/Հ	X [մ]	Y [մ]
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3	4458561.9129	8438097.2857
4	4458577.9259	8438199.1891
5	4458726.5212	8438214.5813
6	4458569.8444	8438219.4295
7	4458509.5297	8438270.5582
8	4458425.2672	8438537.7029
9	4458390.1006	8438545.0405
10	4457874.8904	8438892.5869
11	4457838.8129	8438948.5501
12	4457857.9042	8439139.0314
13	4458060.9496	8439268.5249
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15	4458470.2380	8439642.5603
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20	4458073.9357	8440634.1804
21	4458282.2257	8439826.1873
22	4458374.9763	8439566.1577
23	4458167.5743	8439516.0814
24	4457858.9066	8439322.0508
25	4457593.7913	8438943.9655

Ջրամբարի լրիվ ծավալը 10 մլն մ^3 է, օգտակար ծավալը՝ 8.9 մլն մ^3, մեռյալ ծավալը՝ 1.1 մլն մ^3, պատվարի բարձրությունը՝ 31 մ: Ջրամբարի հիմնական հիդրոտեխնիկական կառույցը՝ պատվարն է, որի առանցքի տեղադիրքի ընտրությունը կատարվել է հաշվի առնելով հետևյալ էական հանգամանքները՝ Քասախ և Ամբերդ գետերի միացման հատվածից գետի հոսանքի ուղղությամբ 150 մ հեռավորության վրա գտնվում է գոյություն ունեցող ստորին Հրազդանի 2-րդ հերթի ջրանցքի գործող գլխամասը, Քասախ և Ամբերդ գետերի միացման հատվածից պատվարի առանցքը գետի հոսանքին հակառակ ուղղությամբ տեղաշարժելու դեպքում ջրամբարի ծավալը կստացվի 10.0 մլն.մ^3 -ից փոքր:

Ջրամբարը ծառայելու է գետի հեղեղային ելքերը կուտակելու և սակավաջուր ամիսներին գյուղատնտեսական հողատեսքերը ոռոգման ջրով ապահովելու նպատակով: Ջրամբարի կառուցման նպատակն է Ստորին Հրազդանի 2-րդ հերթի ջրանցքին դոտացիա տալը:

Նախատեսվող պատվարային հանգույցը բաղկացած է՝

- պատվարից,
- ոռոգման-շինարարական ջրթողից (ստորասրահ),
- հեղեղային ջրհեռից:

Պատվարի մարմինը նախատեսվում է իրականացնել տեղական շինարարական նյութերով՝ կոպճա-ճալաքարային բնահողի պրիզմաներով: Ջրամբարի թասի մակերեսը կազմելու է 89.7 հա: Ջրամբարի թասում առկա են բազմաթիվ ենթակառուցվածքներ, ոռոգման և խմելու ջրագծեր, որոնք ենթակա են ապամոնտաժման և տեղափոխման ջրամբարի թասից դուրս: Պատվարի մարմնի համար անհրաժեշտ կոպճա-ճալաքարային շինանյութը նախատեսվում է վերցնել ջրամբարի թասից, որի ծավալն ըստ նախնական հաշվարկների, կազմում է 1.494 մլն մ^3: Հաշվի առնելով ջրամբարի առաջարկվող ծավալն և տեղանքի ռելիեֆի առանձնահատկությունները, հանվող հողագրունտի ծավալը ընդունվում է մոտավորապես՝ 2.8 մլն. մ^3, որն ամբողջությամբ տեղադրվելու է պատվարի մարմնում, ավելցուկային բնահող չի գոյանալու:

Քասախի ջրամբարի, պատվարի և նրա օժանդակ կառուցվածքների տակ ընկնում է 92.14 հա հողատարածք: Նախատեսվող գործունեության տարածաշրջանում գերակշռում են կիսաանապատային գորշ խճաքարային տիպիկ տեղ-տեղ կարբոնատային ցեմենտացած հողային տիպերը, որոշ մասերում նկատվում են ոռոգելի մնացորդային մարգագետնային գորշ հողային տիպերը: Մթնոլորտային տեղումների և Քասախ, Շախվերդ և Ամբերդ գետերի ջրերը, փուխր բեկորային և ճալաքարա-կոպճային գոյացումների միջոցվ ներթափանցելով առաջացնում են միջմակերեսային ջրային հորիզոն: Հիմնական ստորգետնյա ջրերի մեծ մասը կուտակվում է վերին միոցենի (Սարմատի դարաշրջան) կավային ապարներով ներկայացված՝ տարածաշրջանային ջրամերժ շերտի վերևում: Ըստ տեղադրման, սնման և բեռնաթափման պայմանների, ստորգետնյա ջրերը վերաբերվում են գրունտային ջրերին: Գրունտային ջրերի տեղադրման խորությունը ըստ ֆոնդային նյութերի տվյալների ավելի քան 100 մետր է:

Կախված բարձրությունից տարեկան միջին ջերմաստիճանը և տեղումների քանակը խիստ տարբեր են: Արագածի գագաթամերձ շրջանում տեղումները տարեկան հասնում են 1000 մմ, իսկ ցածրադիր (1000 մ) բարձրություններում՝ 300 մմ:

Գետավազանի տարածքի բարձրադիր մասերում (հատկապես Ապարանի ու Արագածի տարածաշրջաններում) տեղումների քանակը համեմատաբար շատ է, ձմեռը տևում է երկար՝ գրեթե 7 ամիս: Տարածքի ստորին մասերում մթնոլորտային տեղումների քանակը խիստ անբավարար է, այդ պատճառով արհեստական ոռոգումը վճռական դեր է խաղում գյուղատնտեսությունում:

Ուսումասիրվող տեղամասն ունի չոր ցամաքային, շոգ ամառներով և ցուրտ ձմեռներով կլիմա:

- օդի առավելագույն բացարձակ ջերմաստիճանը կազմում է՝ + 41°C:
- օդի նվազագույն բացարձակ ջերմաստիճանը կազմում է՝ - 24°C:
- օդի միջին տարեկան ջերմաստիճանը կազմում է + 11.9°C:
- մթնոլորտային տեղումների միջին տարեկան գումարը կազմում է 377 մմ:

Ձնածածկույթի առավելագույն տասնօրյակային բարձրությունը կազմում է 55 սմ, գրունտի սառչման առավելագույն խորությունը 70 մմ:

Ձմռանը գերիշխում են արևելյան ուղղության քամիները՝ 2.2 մ/վրկ արագությամբ, իսկ ամառը՝ 3.3 մ/վրկ արագությամբ արևելյան ուղղության քամիները: Նախատեսվող ջրամբարի տարածքում մթնոլորտային օդն աղտոտող խոշոր արտադրական ձեռնարկություններ չկան, հիմնականում ավտոտրանսպորտի արտանետումներն են: Տարածաշրջանին բնորոշ են էլյուվիալ և էլյուվիալ-դելյուվիալ նստվածքային տիպերը՝ արտահայտված «Սպիտակահող» կարբոնատա-կրաքարային կուտակումներով, ոչ միատար ավազակավերով և կավավազներով: Տարածաշրջանի հողերի էրոզվածության աստիճանը V-րդ կարգի է՝ 45-70%: Գործունեության տարածքում հողաբուսական շերտը խճավազի և ճալաքարերի պարունակությամբ է:

Նախագծման փուլում կատարված հաշվարկների արդյունքում գետի ջրի միջին տարեկան հոսքը կազմել է՝ 115.23 մլն. մ³/տարի, ջրամբարի կառուցումից հետո կկազմի 79 մլն. մ³/տարի: Տեղանքի հիմնական ջրային ռեսուրսը Քասախ գետն է իր վտակներով: Քասախի ավազանը ներառված է Հրազդան ջրավազանային կառավարման տարածքում: Քասախ գետի ջրհավաք ավազանի տարածքում գետային ջրաբանական դիտարկումները սկսվել են 1913 թվականից՝ գետաբերանից 29 կմ հեռավորության վրա Աշտարակի դիտակետում, որը գործում է մինչ օրս: Տարբեր տարիներին գործել է 10 հիդրոլոգիական դիտակետ, սակայն այսօր Քասախ գետի ավազանն ունի 6 դիտակետ, այդ թվում՝ գետի 5 դիտակետ և մեկ ջրամբարի:

Ջրամբարի տեղամասում հիդրոլոգիական հաշվարկների կատարման համար հիմք են հանդիսացել Քասախ-Աշտարակ հիդրոլոգիական դիտակետի տվյալները: Սակայն Աշտարակի դիտակետում չեն գրանցվել Ապարանի ջրամբարում տրանսֆորմացված առավելագույն ելքերը: Առավելագույն ելքերի վերականգնման համար 1966 թվականից հետո Աշտարակի դիտակետում գրանցված ելքերին գումարվել է Ապարանի ջրամբար մուտք գործած (դիտակետ Վարդենիս) և բաց թողնված (դիտակետ Հարթավան) ելքերի տարբերությունները:

Աշտարակ դիտակետում առավելագույն ելքերի հաշվարկների համար օգտագործվել են 48 տարվա տվյալների շարք: Գրանցված առավելագույն ելքը եղել է 188 մ³/վ (1953թ. ապրիլ), իսկ վերականգնվածը՝ 200,1 մ³/վ (1972թ. մայիս): Միջինում առավելագույն ելքը կազմում է 61,48 մ³/վ, միջին քառակուսային շեղումը կազմում է՝ 41,84:

Քասախի ջրամբարի բնապահպանական թողքի հաշվարկի համար հիմք է հանդիսացել «Հրազդանի ջրավազանային կառավարման տարածքի 2022-2027 թվականների կառավարման պլանը հաստատելու մասին» Կառավարության 2022 թվականի դեկտեմբերի 8-ի № 1909-Ն որոշմամբ սահմանված Քասախ գետի համար Աշտարակ դիտակետի, իսկ Շահվերդ վտակի համար՝ Փարպի դիտակետի տվյալները: Իսկ Ամբերդ վտակի համար բնապահպանական թողքի հաշվարկ չի իրականացվել, քանի որ 1968-1973թթ. և 1979 թվականին ամառվա սեզոնին հոսք չի գրանցվել:

Բնապահպանական թողքը Քասախի ջրամբարի գետահատվածքում

Գետահատվածք	Բնապահպանակ թողք, մ³/վ											
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
գ. Քասախ - դ. Աշտարակ	1.44	1.4	1.95	1.7	1.3	1.07	1.1	1.16	1.42	1.39	1.63	1.88
գ. Շահվերդ - դ. Փարպի	0.3	0.3	0.3	0.32	0.33	0.31	0.25	0.24	0.24	0.24	0.24	0.24
Քասախի ջրամբարի պատվար	1.74	1.7	2.25	2.02	1.63	1.38	1.35	1.4	1.66	1.63	1.87	2.12

Այսպիսով, Քասախի ջրամբարի բնապահպանական թողքի նվազագույնը պետք է լինի 1,35 մ³/վ հուլիս ամսին, իսկ առավելագույնը մարտին՝ 2,25 մ³/վ: Բնապահպանական թողքն իրականացվելու է իրրիգացիոն ջրթողից (հնարավոր է ակտիվ ջրառի դեպքում ջրի մակարդակն իջնի մեռյալ ծավալի մակարդակից ցածր և ջրթող իրականացվի հատակային ջրթող-խողովակով): Ջրթողերի վրա տեղադրվելու են ջրաչափեր, որոնք թույլ կտան վերահսկել բաց թողնվող ջրի ելքերը:Ինչպես և բոլոր հունային ջրամբարները, Քասախի ջրամբարի դեպքում ևս գետային կոշտ հոսքը ջրի շարժման արագության անկման պատճառով նստում է ջրամբարի հատակին: Ջրաբերուկներով ջրամբարի լցվելը կբերի ջրամբարի տղմակալման: Տղմակալման ծավալից և ժամկետից ելնելով՝ ջրամբարի համար որոշվել է մեռյալ ծավալը: Ջրաբերուկների տարեկան միջին արժեքը Աշտարակ դիտակետում դիտակետում 1,34 կգ/վ է, որը Քասախի ջրամբարի գետահատվածքում՝ 50% ապահովվածության դեպքում կկազմի տարեկան 14,969 մ³:

Նախատեսվող գործունեությունն իր բացասական ազդեցությունները կունենա շրջակա միջավայրի վրա, որոնք կկրեն ժամանակավոր բնույթ: Շինարարության փուլում մեծ ծավալի հողային գրունտ կհանվի և կտեղափոխվի: Հանվող բուսահողի ծավալը հաշվարկվել է 126940 մ³, որը նախատեսվում է օգտագործել Ամբերդի հողապատնեշին կից ստեղծվող 4.4 հա հողամասի, ջրամբարի շուրջն օտարվող տարածքում՝ 10.7 հա բազմամյա խոտաբույսերի դաշտերի և 9.6 հա այգիների հիմնադրման համար:

Հողային աշխատանքների ընթացքում ջրամբարի թասից հանվելու և հեռացվելու է 85000 մ³ ճահճային հող, որոնք կհեռացվեն Խոյ և Աշտարակ համայքների կողմից հատկացված վայրեր: Հանվող հողային զանգվածների ընդհանուր ծավալներն՝ ըստ նախնական գնահատման կկազմեն 2,5 մլն.մ³:

Բուսահողը պահեստավորվելու է և հետագայում կօգտագործվի՝ ըստ գործող օրենսդրության պահանջների:

Հողային աշխատանքներ իրականացնելիս կառաջանա փոշի, որը կարող է ցրվել քամու միջոցով՝ փորման աշխատանքների տեղամասից 100 մ տարածքի վրա: Օդի որոշակի աղտոտում տեղի կունենա նաև շինարարական նյութերի փոխադրման ընթացքում՝ մանրախճով պատված մոտեցող ճանապարհներով բեռնատար մեքենաների տեղաշարժից: Շահագործման փուլում օդի որակի վրա ազդեցություն չի լինի:

Մեխանիզմների և տրանսպորտային միջոցների աղմուկի մակարդակը շինարարության ընթացքում էականորեն տարբերվում է և կախված է առաջացող աղմուկի տեսակից և գործունեության մակարդակից: Շահագործման փուլում աղմուկի ազդեցությունը կլինի աննշան:

Շինարարության փուլում ջրային ռեսուրսների վրա (մակերևութային/ստորերկրյա ջրեր) կլինեն հետևյալ հնարավոր բացասական ազդեցությունները՝

- ստորգետնյա ավազանի աղտոտում՝ շինհրապարակից հոսող կեղտաջրերի միջոցով,

- մակերևութային ջրերի հոսքի և դրանց որակի փոփոխություններ՝ աղտոտիչների արտահոսքի պատճառով,
- գետի ջրի որակի փոփոխություն՝ ոչ պատշաճ կերպով պահված շինարարական նյութերի և թափոնների, կենցաղային թափոնների արտանետումների, վառելիքի արտանետումների, յուղերի և քսանյութերի արտահոսքից:

Շինարարության փուլում հողի աղտոտման պատճառ կարող են հանդիսանալ նավթամթերքի արտահոսքը, նավթամթերքի ոչ ճիշտ պահեստավորումը, նավթի և վառելիքի չհեռացված թափոնները՝ ներառյալ օգտագործված յուղերի, հիդրավլիկ թունավոր հեղուկների, դատարկ նավթի տարաների ոչ պատշաճ հեռացումը: Թափոնների վատ կառավարումը կարող է հանգեցնել հողի աղտոտման: Բույսերի կորուստը շինհրապարակի մաքրման հետևանքով կարող է հանգեցնել բնական միջավայրի և կենդանական աշխարհի տեսակների կորստի: Թռչունների և փոքր կենդանիների անհանգստացնելը կարող են հանգեցնել բնակության վայրի կորստի: Քասախի ջրամբարի կառուցման համար նախատեսվող տարածքում կատարված դաշտային այցելությունների դիտարկումների համաձայն՝ բուն ջրամբարի և մերձակա տարածքներում առանձնահատուկ պահպանության կարիք ունեցող, վտանգված, խոցելի, անհետացման եզրին գտնվող և ՀՀ Կարմիր գրքում կամ ԲՊՄՄ կարմիր ցուցակում գրանցված այլ բուսատեսակները և կենդանիները բացակայում են:

Շինարարական աշխատանքների իրականացման ժամանակ Քասախի ջրամբարի կառուցման համար անհրաժեշտ կլինի հատել մոտավորապես 520 ծառ, որոնք գտնվում են պատվարի կատարի նիշից 980 մ բ.ծ.մ.-ից ցածր: Հասցված վնասը փոխհատուցելու նպատակով՝ հատված ծառերի փոխարեն համայնքի կողմից տրամադրված վայրերում կիրականացվի ծառատունկ՝ մեկը հինգի հարաբերակցությամբ: Տնկվող ծառերի քանակը հաշվարկվել է հետևյալ կերպ՝ մինչև 10 սմ բնի հաստությամբ հատվող ծառերի դիմաց տնկել 1 : 1 հաշվարկով, իսկ 10 սմ գերազանցող դեպքում՝ 1 : 5 հաշվարկով: Այսպիսով, ծառերի թիվը կկազմի՝ մինչև 10 սմ բնով հատվող ծառերի թիվը՝ 190 հատ, 10 սմ գերազանցող՝ 330 հատ: Ծառատունկի և դրանց խնամքի համար ծախսերի խոշորացված հաշվարկը կկազմի 11,151,060 ՀՀ դրամ:

Ջրամբարի կառուցման շինարարական աշխատանքների ընթացքում նախատեսվում է իրականացնել **բնապահպանական ազդեցությունները մեղմող հետևյալ միջոցառումները՝**

Շինարարական հրապարակում առաջացած փոշու և աղմուկի նվազեցման նպատակով նախատեսվում է՝

- շինարարական նյութերի և թափոնների տեղափոխման համար անհրաժեշտ է օգտագործել փակ կամ ծածկով բեռնատար մեքենաներ.
- հողային աշխատանքներն ըստ հնարավորության, կատարել փոշեորսիչով կահավորված տեխնիկական միջոցներով և սարքավորումներով.
- տրանսպորտային միջոցները և տեխնիկան պարբերաբար ստուգել, կարգավորել և ապահովել ձայնի խլացուցիչներով.
- շինարարական տարածքը և մոտեցնող ճանապարհները պետք է պարբերաբար ջրել, իսկ խիճը, պահեստավորված և տեղափոխվող հողային զանգվածները խոնավացնել՝ փոշին նվազեցնելու նպատակով (բացի ձմեռային և տեղումներով առատ ամիսներից):

Ջրային ռեսուրսների վրա հնարավոր բացասական ազդեցությունները շինարարության ընթացքում մեղմելու կամ կանխարգելելու, վնասակար նյութերի արտահոսքը բացառելու համար նախատեսվում է՝

- փոշենստեցման համար ջրցանը կատարել ըստ անհրաժեշտության՝ հնարավորինս չառաջացնելով մակերևութային հոսքեր,

- քսայուղերի և այլ նյութերի համար հատկացված վայրերի հատակները բետոնապատել,
- անձրևաջրերի և արտադրական հոսքաջրերի հեռացման և հավաքման համար նախատեսել ժամանակավոր պարզարաններ,
- շինարարական տրանսպորտային միջոցների և սարքավորումների սպասարկումը կատարել մոտակա մասնագիտացված կետերում,
- ավտորտանսպորտային միջոցների անիվների լվացումը կատարել փրփուրային եղանակով՝ կանխելու համար աղտոտված արտահոսքի ներթափանցումը ջրային ռեսուրսներ,
- որպես ափապաշտպան միջոցառում՝ շինարարական գալերեայի ելքամասում և հեղեղային ջրհեռի վերջում, ջրի էներգիան մարելու և գետի հունը ողողումից պաշտպանելու նպատակով, նախատեսված են ջրծեծ հորեր, որոնց շեպերն ու հատակն ամրացվում են քարով,
- դեպի Քասախ գետ կեղտաջրերի արտահոսքը կանխելու նպատակով՝ շինարարության փուլում աշխատողների համար տարածքում կտեղադրվեն կեղտաջրերի հավաքման հոր կամ բիոզուգարան, որի մաքրումը կատարելու է համապատասխան մասնագիտացված կառույցների կողմից՝ պայմանագրային հիմքունքներով:

Կենսաբազմազանության վրա ազդեցությունը մեղմելու նպատակով նախատեսվում է՝

- ըստ հնարավորության՝ բացառել ծառահատումները, առկա թփերի մաքրումը կատարել մասնագետների մասնակցությամբ,
- գործունեության և հարակից տարածքներում ՀՀ Կարմիր գրքերում գրանցված բուսատեսակների նոր պոպուլյացիաների կամ կենդանիների բնադրավայրերի հայտնաբերման դեպքում դադարեցնել շինարարական աշխատանքները,
- շինարարական աշխատանքներն իրականացնել ցերեկային ժամերին՝ որոշ կենդանիների կենսակերպի վրա ազդեցությունից խուսափելու համար,
- հնարավորինս նվազեցնել տարածքի գիշերային լուսավորությունը՝ կենդանիների որոշ տեսակների բնականոն վարքին չխանգարելու նպատակով:

Շինարարական աշխատանքների ժամանակ ՀՀ Կարմիր գրքում գրանցված բուսատեսակների պոպուլիացիաների հայտնաբերման դեպքում դրանց պահպանության նպատակով նախատեսվում է.

- Կարմիր գրքում գրանցված բուսատեսակների նոր պոպուլյացիաների կենսունակության ապահովման նպատակով առանձնացնել պահպանվող գոտիներ:
- ժամանակավորապես սահմանափակել առանձնացված պահպանվող գոտիներում տնտեսական գործունեության որոշ տեսակներ, երե դրանք կարող են բերել նշված բուսատեսակների աճելավայրերի վիճակի վատթարացման ու պոպուլյացիաների կենսունակության խաթարմանը, տեղափոխել պահպանվող բույսերի առանձնյակները տվյալ տեսակի համար նպաստավոր բնակլիմայական պայմաններ ունեցող որևէ բնության հատուկ պահպանվող տարածք կամ բուսաբանական այգիների տարածք, կամ Կարմիր գրքում որպես տվյալ բույսի աճելավայր գրանցված որևէ տարածք, իսկ բույսերի սերմերը տրամադրել համապատասխան մասնագիտացված կազմակերպությանը՝ գենետիկական բանկում պահելու և հետագայում տեսակի վերարտադրությունը կազմակերպելու նպատակով: Աշխատանքները կիրականացվեն՝ ՀՀ Կարմիր գրքում գրանցված բուսական աշխարհի օբյեկտների պահպանության և բնական պայմաններում վերարտադրության նպատակով դրանց օգտագործման կարգը սահմանող որոշման (31 հուլիսի 2014 թվականի N 781-Ն) հիման վրա:

Շինարարական և հողային աշխատանքներ իրականացնելու ժամանակ օգտագործվելու է ջրցան՝ փոշենստեցման նպատակով, ինչն աղտոտումից կպահպանի օդային ավազանը և բնական էկոհամակարգերը, մասնավորապես՝ տեղի բուսականությունը: Ջրամբարի շինարարությունից հետո նախատեսվում է իրականացնել կանաչապատման աշխատանքներ՝ հատուցելով տարածքին հասցված վնասը, կանաչապատման ծրագիրը կմշակվի շինարարության կապալառուի կողմից՝ համայնքի կողմից հատկացված տեղամասերի համար:

Նախատեսվող շինարարական աշխատանքների իրականացման ընթացքում, ծրագրի ազդակիր տարածքում առաջացող տարբեր տեսակի թափոնները կարող են բացասաբար անդրադառնալ շրջակա միջավայրի վրա, մասնավորապես՝ առաջացնելով լանդշաֆտի փոփոխություն, աղտոտել ջրային և հողային ռեսուրսները և մթնոլորտային օդը, ինչպես նաև ազդել մարդկանց առողջության վրա:

Հողային ռեսուրսների պահպանության հիմնական միջոցառումը բերրի հողաշերտի պահպանումն է: Ջրամբարի թասից դուրս՝ պաշտպանիչ գոտում կազմակերպվելու է բերրի հողի պահեստներ՝ ծածկի տակ շրջանցող առուներով: Բերրի հողն ամբողջությամբ օգտագործվելու է տարածքի բարեկարգման և կանաչապատման նպատակով:

Հողային ռեսուրսների վրա հնարավոր բացասական ազդեցությունները և վերջինիս մեջ վտանգավոր նյութերի և քսայուղերի ներթափանցումը կանխելու նպատակով նախատեսվում է՝

- ճանապարհից դուրս տեղակայվող սարքավորումների վայրում փռել ավազ կամ մանրախիճ,
- բուն գործունեության տարածքում յուղի, վառելիքի կամ այլ վտանգավոր հեղուկների պահման տեղամասեր չնախատեսել,
- շինարարական նյութերը տեղադրել հատուկ տակդիրների վրա,
- հողային գրունտը տարածքում պահպանել ծածկված վիճակում՝ անջրթափանց թաղանթով,
- առաջացող շինաղբը տեղափոխել համայնքի կողմից նախատեսված աղբավայր,
- հանվող հողային զանգվածն օգտագործել որպես հետլիցք և տարածքի բարեկարգման համար,
- շինարարության փուլում օգտագործվող տրանսպորտային միջոցների լիցքավորումը և տեխնիկական սպասարկումը կատարել տարածքից դուրս՝ հատուկ մասնագիտացված կազմակերպություններում:

Շինարարական աշխատանքերի ընթացքում, առաջացող թափոնատեսակներն են՝ կենցաղային աղբ /ծածկագիրը՝ 9120040001004/, որը կհավաքվի աղբամաններում, շինարարական աղբ /ծածկագիրը՝ 9120060101004/, կհավաքվի համապատասխան կոնտեյներներում և չաղտոտված հող /ծածկագիրը՝ 3140110008995/: Շինարարական թափոնները և կենցաղային աղբն ամբողջությամբ կանոնավոր կերպով կտեղափոխվի համայնքի կողմից հատկացված աղբավայր: Հաշվի առնելով տարածքի զգայուն էկոհամակարգը՝ շինարարական տեխնիկայի և ավտոտրանսպորտի բոլոր սպասարկման աշխատանքները, քսայուղերով և վառելիքով լիցքավորումը կիրականացվի մասնագիտացված կայաններում, ինչը թույլ կտա բացառել վտանգավոր թափոնների առաջացումը:

Իրականացվող ծրագրի տեղամասերում աշխատանքների մեկնարկն իրականացվելու են հնագետի հսկողությամբ: Շինարարական աշխատանքների ընթացքում որևէ անհայտ հնագիտական շերտի, անհայտ ծագման իրերի, բնության հուշարձանի հայտնաբերման դեպքում շինարարական ախատանքներն անմիջապես դադարեցվելու

են և տեղեկացվելու է համապատասխան պետական մարմնին՝ հետագա գործողությունները ՀՀ գործող օրենսդրությանը համապատասխան կազմակերպելու համար:

Ռիսկերի նվազեցումը կարելի է ապահովել՝ իրականացնելով մի շարք բնապահպանական և սոցիալական միջոցառումներ, որոնց արդյունավետության ապահովման նպատակով պետք է կազմակերպել աշխատանքների մշտադիտարկումներ:

Հաշվի առնելով նախատեսվող ջրամբարի տարածքի ռելիեֆային և բնահողային պայմանները, նախատեսվող պատվարի բարձրությունը (31մ), ինչպես նաև ծկնաբանի կողմից իրականացված ուսումնասիրությունները և տրված եզրակացությունը (որոնք առկա են գնահատման հաշվետվության մեջ,) և այն հանգամանքը, որ ջրամբարը նախատեսվում է կառուցել ոռոգման նպատակով, հետևաբար ջրի հորիզոնը կլինի փոփոխական, ուստի նախագծող կազմակերպության կողմից հիմնավորվել է, որ ջրամբարի ընտրված տարածքում ձկնուղին տեխնիկապես հնարավոր չէ այնպես նախագծել, որ ապահովվի ձկների միգրացիան:

Պատճառաբանական մաս. ՀՀ օրենսդրությանը համապատասխան՝ հանրային ծանուցումը և քննարկումները իրականացվել են Արմավիրի մարզի Խոյ համայնքի Ամբերդ և Արագածոտնի մարզի Աշտարակ համայնքի Ոսկեվազ բնակավայրերում: Ամբերդ և Ոսկեվազ համայնքների ղեկավարների նստավայրում, անցկացված հանրային լսումներում գործունեության իրականացումը մասնակիցների կողմից արժանացել է հավանության: Հաշվետվության վերաբերյալ փորձաքննական գործընթացում ստացվել են կարծիքներ՝ առողջապահության, ներքին գործերի, կրթության, գիտության, մշակույթի և սպորտի նախարարություններից, քաղաքաշինության կոմիտեից, կադաստրի կոմիտեից, ինչպես նաև շրջակա միջավայրի նախարարության ստորաբաժանումներից: Ստացված դիտողությունները և առաջարկությունները հաշվի են առնվել գնահատման հաշվետվության լրամշակումներում: Ամփոփելով հաշվետվության բնապահպանական և սոցիալական ազդեցությունների վերլուծությունները՝ կարելի է եզրահանգել, որ նախատեսվող գործունեության իրականացման արդյունքում շրջակա միջավայրի վրա հնարավոր բացասական ազդեցությունները, որոնք առնչվում են շինարարական աշխատանքների հետ, կկրեն ժամանակավոր և տեղայնացված բնույթ և կլինեն թույլատրելի նորմայի սահմաններում: Դրանք կարող են բացառվել կամ մեղմվել գործունեության ընթացքում բնապահպանական միջոցառումների արդյունավետ իրականացմամբ: Քասախի ջրամբարի կառուցմամբ հնարավոր կլինի ապահովել սակավ ոռոգման ջրի կայուն և արդյունավետ օգտագործում՝ խթանելով գյուղատնտեսության զարգացումը, ինչպես նաև նվազեցնելով թիրախային խմբի խոցելիությունը կլիմայական փոփոխությունների ազդեցության հանդեպ: Ծրագրի իրականացումը հնարավորություն կտա լուծել մի շարք արմատական հիմնախնդիրներ՝

- կուտակել գետի օգտագործելի հոսքի մի մասը, կարգավորել ջրահոսքերը՝ ապահովելով բնապահպանական թողքերը,
- հրաժարվել մեխանիկական եղանակով ոռոգման ջրի մատակարարումից և հողերի ոռոգումը փոխադրել ինքնահոս եղանակի, խնայել զգալի չափով էլեկտրաէներգիա, կրճատել շահագործման ու պահպանման ծախսերը,
- բարձրացնել ներկայումս ինքնահոս եղանակով ոռոգվող հողերի ջրապահովվածությունը՝ ապահովելով կայուն ջրամատակարարում ողջ ոռոգման շրջանում:

Փորձաքննական պահանջներ

1.Շինարարության ընթացքում ապահովել բնապահպանական կառավարման և մոնիթորինգի պլաններում նախատեսված միջոցառումների իրականացումը սահմանված ժամանակահատվածում:

2.Շինարարական աշխատանքների իրականացման ընթացքում առաջացող մնացորդային գրունտի, շինաղբի և տարբեր տեսակի թափոնների հեռացումն ու տեղափոխումն անհրաժեշտ է իրականացնել ՀՀ օրենսդրությամբ սահմանված կարգով՝ տեղական ինքնակառավարման մարմինների կողմից հատկացված վայր:

3.Կանաչապատումն անհրաժեշտ է իրականացնել տարածաշրջանին և տեղի կլիմայական պայմաններին բնորոշ ծառաթփային բուսականությամբ՝ Կառավարության 2018 թվականի փետրվարի 8-ի N108-Ն որոշման պահանջներին համապատասխան:

4.Կառուցապատման աշխատանքների ընթացքում պահպանել «Մթնոլորտային օդի պահպանության մասին» օրենքի 11-րդ հոդվածով սահմանված պահանջները:

5.Առաջնորդվել ՀՀ կառավարության 2005 թվականի հունվարի 20-ի «Ջրաէկո–համակարգերի սանիտարական պահպանման, հոսքի ձևավորման, ստորերկրյա ջրերի պահպանման, ջրապահպան, էկոտոնի և անօտարելի գոտիների տարածքների սահմանման չափորոշիչների մասին» N 64-Ն որոշման պահանջներով:

6. Շինարարական աշխատանքների իրականացման ընթացքում հողաբուսական շերտի (հողի բերրի շերտ) հեռացումը և պահպանումը կատարել ՀՀ Կառավարության 08.09.2011թ-ի թիվ 1396-ն և Կառավարության 02.11.2017թ-ի թիվ 1404-ն որոշումների պահանջներին համապատասխան:

8.Աշխատանքների իրականացման ընթացքում անհրաժեշտ է առաջնորդվել ՀՀ կառավարության 2002 թվականի ապրիլի 20-ի N 438 որոշման 43-րդ կետի պահանջով՝ աշխատանքների կատարման ժամանակ պատմական, գիտական, գեղարվեստական և այլ մշակութային արժեք ունեցող հնագիտական և մյուս օբյեկտների հայտնաբերման պահից դադարեցնել աշխատանքները և դրա մասին անհապաղ հայտնել լիազորված մարմնին:

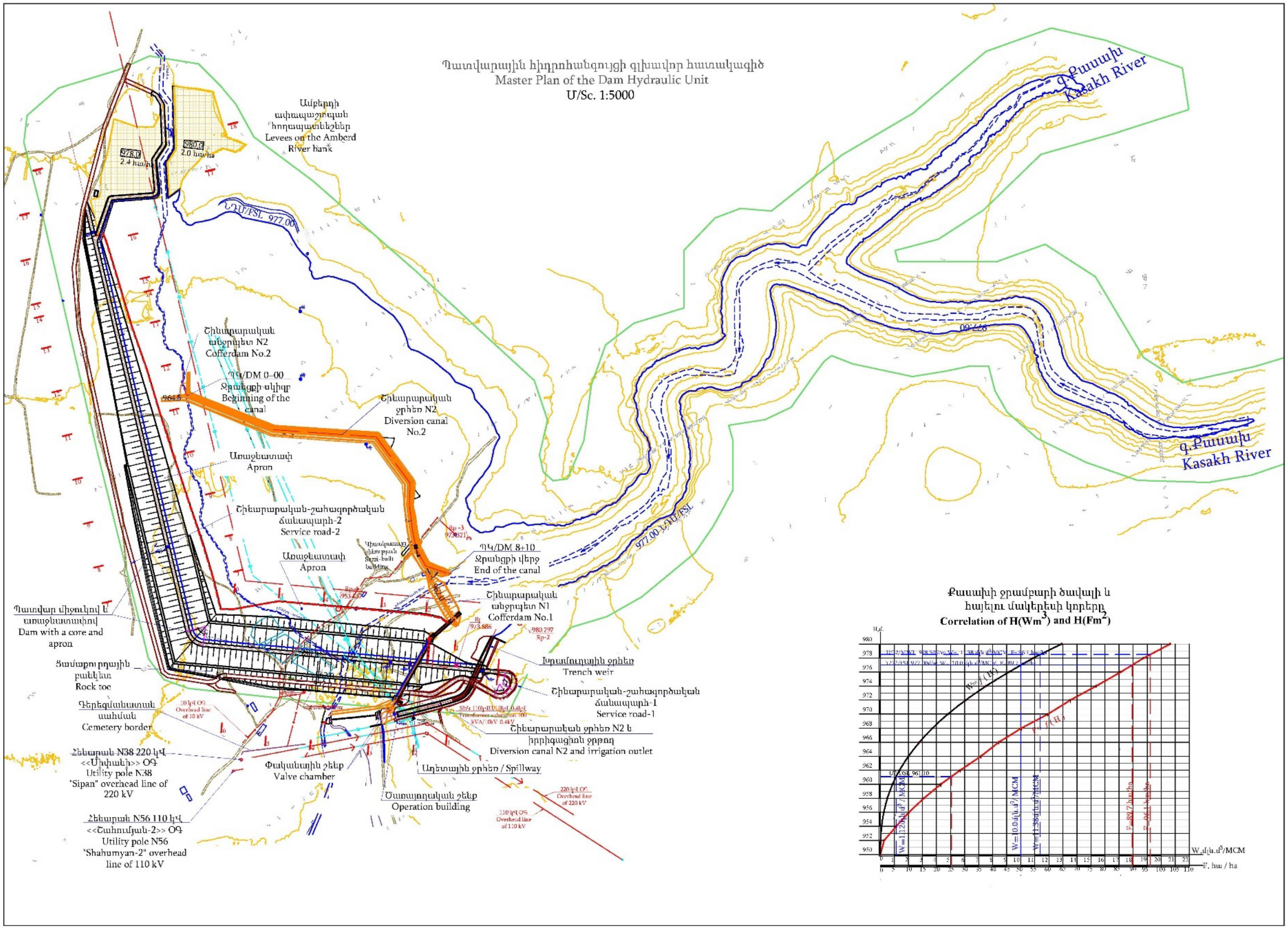
ԵԶՐԱՓԱԿԻՉ ՄԱՍ

«Քոնսեկոարդ» ՍՊԸ-ի կողմից փորձաքննության ներկայացված Արմավիրի մարզի Խոյ համայնքում Քասախի ջրամբարի կառուցման շրջակա միջավայրի վրա ազդեցության գնահատման հաշվետվությանը տրվում է դրական եզրակացություն՝ վերը նշված փորձաքննական պահանջների պարտադիր կատարման պայմանով:

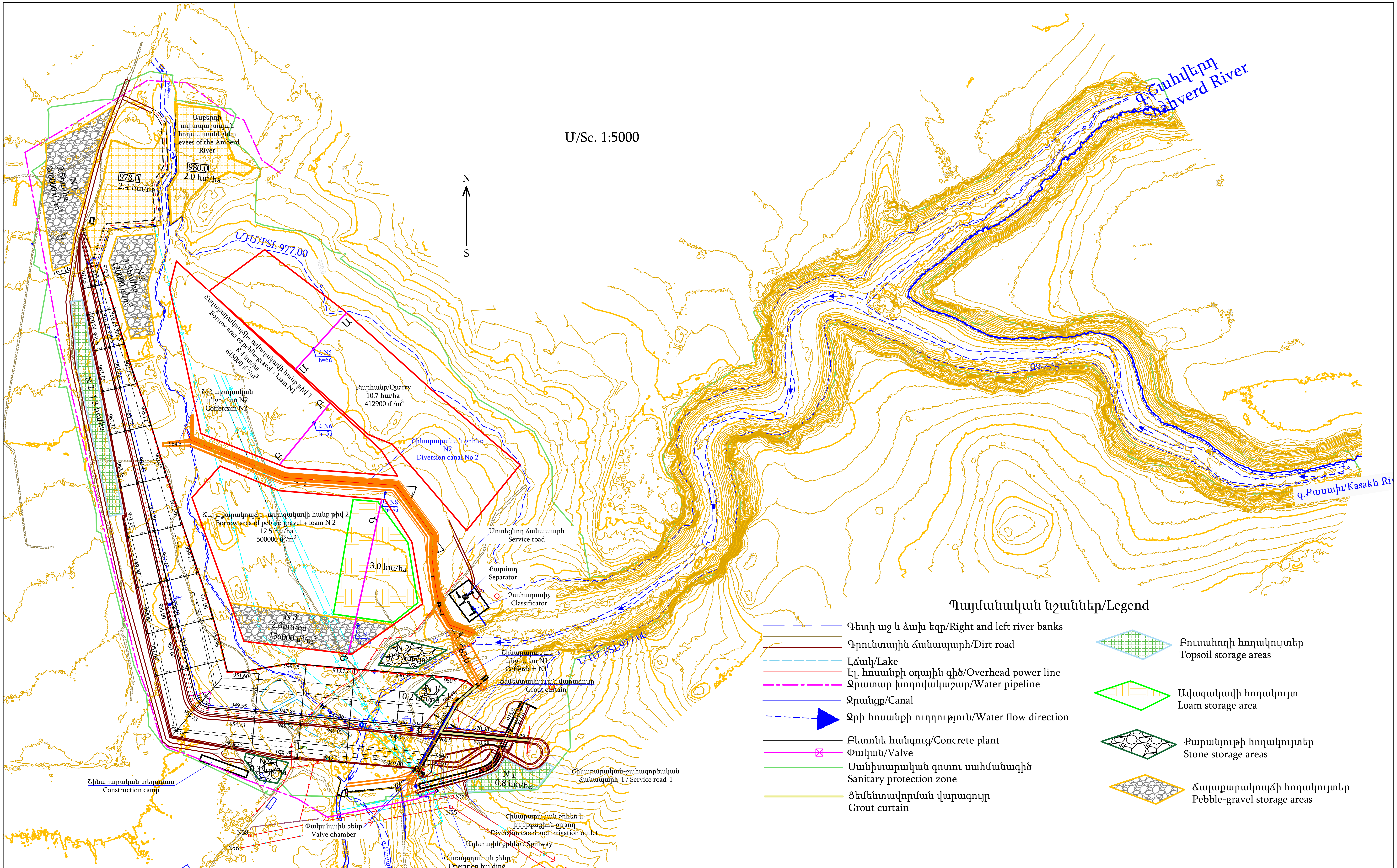
Շրջակա միջավայրի վրա ազդեցության փորձաքննական կենտրոն» ՊՈԱԿ-ի տնօրեն՝ Խաչիկ Մարտիրոսյան

«Շրջակա միջավայրի վրա ազդեցության փորձաքննական կենտրոն» ՊՈԱԿ-ի տնօրենի տեղակալ՝ Հերիքնազ Մկրտչյան

«Շրջակա միջավայրի վրա ազդեցության փորձաքննական կենտրոն» ՊՈԱԿ-ի գլխավոր մասնագետ՝ Հովակիմ Ֆրունզիկյան


Պատվարային հիդրոհանգույցի գլխավոր հատակագիծ
Master Plan of the Dam Hydraulic Unit
U/Sc. 1:5000
Levees on the Amberd River bank
Cofferdam No.2
ПК/DM 0-00
Beginning of the canal
Diversion canal No.2
Apron
Service road-2
ПК/DM 8+10
End of the canal
Cofferdam No.1
Dam with a core and apron
Rock toe
Trench weir
Service road-1
Cemetery border
Diversion canal N2 and irrigation outlet
Utility pole N38 "Sipan" overhead line of 220 kV
Valve chamber
Spillway
Operation building
Utility pole N56 "Shahumyan-2" overhead line of 110 kV
Kasakh River
Correlation of H(Wm3) and H(Fm2)
W=10.0 MCM
W=11.38 MCM
F, ha

Annex 3



ՊԱՅՄԱՆԱԳԻՐ/CONTRACT № ՋԿ-ԲՄԽԾՁԲ-22/5-Ն

ՀՀ Արմավիրի մարզում Քասախի ջրամբարի կառուցման նախագծանախահաշվային փաստաթղթերի կազմում
Preparation of Design and Cost-estimation Documents for Construction of Kasakh Reservoir in RA Armavir Province

Հանքերի տարածքներ
Borrow Areas

Հանքերի և հողակույտերի տարածքների հատակագիծ
Plan of Borrow and Earth Storage Areas

Փուլ/Phase	Թերթ/Layout	Թերթեր/Layouts
ԱՆ DD	1	3

Փոփ. Rev.	Քանակ Quantity	Թերթ Layout	Nփաստ. Doc.N	Ստորագր. Signature	Ամսաթ. Date
ՆՓՃ CDE	Հ. Հակոբյան H. Hakobyan				
Նախագծեց Designed by	Ն. Թոփլաղալցյան N. Toplaghaltsyan				

«ՄՈԴՈՒԼ» ՍՊԸ
MODUL LLC

Annex 4

Հանքերի տարածքների հատակագիծ
Plan of Borrow Areas
Մ/Sc. 1:2000

Փոխ. Rev.	Քանակ Quantity	Թերթ Layout	Ծածկագիր Doc.N	Ստորագր. Signature	Ամսաթիվ Date
ՆԳՃ CDE		Հ. Հակոբյան H. Hakobyan			
Նախագծեց Designed by		Ն.Թոփալղալցյան N. Toplaghaltsyan			

ՊԱՅՄԱՆԱԳԻՐ/CONTRACT № ՋԿ-ԲՄԽՇՁԲ-22/5-Ն

ՀՀ Արմավիրի մարզում Քասախի ջրամբարի կառուցման նախագծանախահաշվային փաստաթղթերի կազմում
Preparation of Design and Cost-estimation Documents for Construction of Kasakh Reservoir in RA Armavir Province

Հանքերի տարածքներ
Borrow Areas

Փուլ/Phase	Թերթ/Layout	Թերթեր/Layouts
ԱՆ DD	2	3

Հարստացուցիչ տեղամասի հատակագիծ
Plan of separation site

«ՄՈԴՈՒԼ» ՍՊԸ
MODUL LLC

Ճալաբարակոպճի հանք N1
Borrow area of pebble-gravel N1
8.4 հա/ha
645000 մ³/m³

Քարհանք/Quarry
10.7 հա/ha
412900 մ³/m³

Շինարարական ջրհեռ N2
Diversion canal N2

Մուտեցնող ճանապարհ
Service road

Ճալաբարակոպճի հանք N2
Borrow area of pebble-gravel N 2
12.5 հա/ha
500000 մ³/m³

Ժապավենային փոխակրիչ
Conveyor

Քարմաղ
Separator

70

Չափադասիչ
Classificator

50

Ալոճ
Canal

գ.Քասախ
Kasakh River

Կամուրջ
Bridge

962.0

Շինարարական անջրպետ N1
Cofferdam N1

Շինարարական ջրհեռ N1
Diversion canal N1