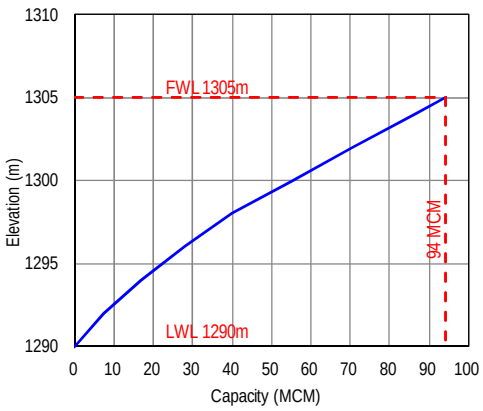
6-6 Drawings

6-6-1 Specification of Facilities

Table 6-6-1.1 Specification of Reservoir and Dams

Item		Specification				Capacity Curve (H-V curve)
Reservoir		Catchment Area		-*1	km²	
		Reservoir area		8.08	km²	
		Reservoir Capacity		94	MCM	
		HWL		EL. -	m	
		FWL		EL. 1,305.00	m	
		LWL		EL. 1,290.00	m	
Dams	Dam No.1	Type		Inclined core type		
		Height		25.55	m	
		Crest Length		1,140	m	
		Volume*2		923,000	m³	
		Elevation	Crest	EL. 1,307.55		
			Top of Core zone	EL. 1,307.00	m	
		Slope Angle	Upstream	1:3.50		
			Downstream	1:2.50		
	Dam No.2	Type		Inclined core type		
		Height		14.05	m	
		Crest Length		2,610	m	
		Volume*2		394,000	m³	
		Elevation	Crest	EL. 1,307.55		
			Top of Core zone	EL. 1,307.00		
		Slope Angle	Upstream	1:3.50		
			Downstream	1:2.50		
Spillway*3		Nil				

*1: Since all the water is supplied from Hrazdan River through Arzni-Shamiram Canal, reservoir does not have own catchment area.
*2: Volume newly constructed in this project (not including existing dam volume)
*3: Since all the water is supplied after controlled its volume by Hrazdan Intake and inlet of Feeder Canals and flood water does not flow into reservoir, spillway is not required.

Table 6-6-1.2 Specification of Irrigation Facilities

Name of Facilities		Purpose	Type	Specification			Target Discharge
Feeder Canals	Feeder Canal 1	Inflow to Reservoir	Pipeline	Diameter	φ=	1.60(1.6km), 1.72(1.94km)) m	1.11* - 9.00 m³/s *) Except Arzni-branch 0.39m³/s
				Length	L=	4.70=1.16(approach canal)+ 3.54(pipe) km	
	Feeder Canal 2	Inflow to Reservoir	Open Canal	Width	B=	ave. 4.00 m	2.20 - 13.00 m³/s
				Length	L=	0.33 km	
Outlet Canals	Outlet Canal 1	Outflow to Yeghvard WUA	Pipeline	Diameter	φ=	1.20 m	0.22 - 2.33 m³/s
				Length	L=	0.73 km	
	Outlet Canal 2	Outflow to Kasakh River	Pipeline and canal	Diameter	φ=	1.72 m	0.16 - 12.82 m³/s (for irrigation purpose) Maximum 13.7m³/s (in case of emergency)
				Length	L=	4.70(pipe)+0.5(dissipater) km	

6-6-2 Drawings of Reservoir Plan

Figure 6-6-2.1 General Plan of the Project

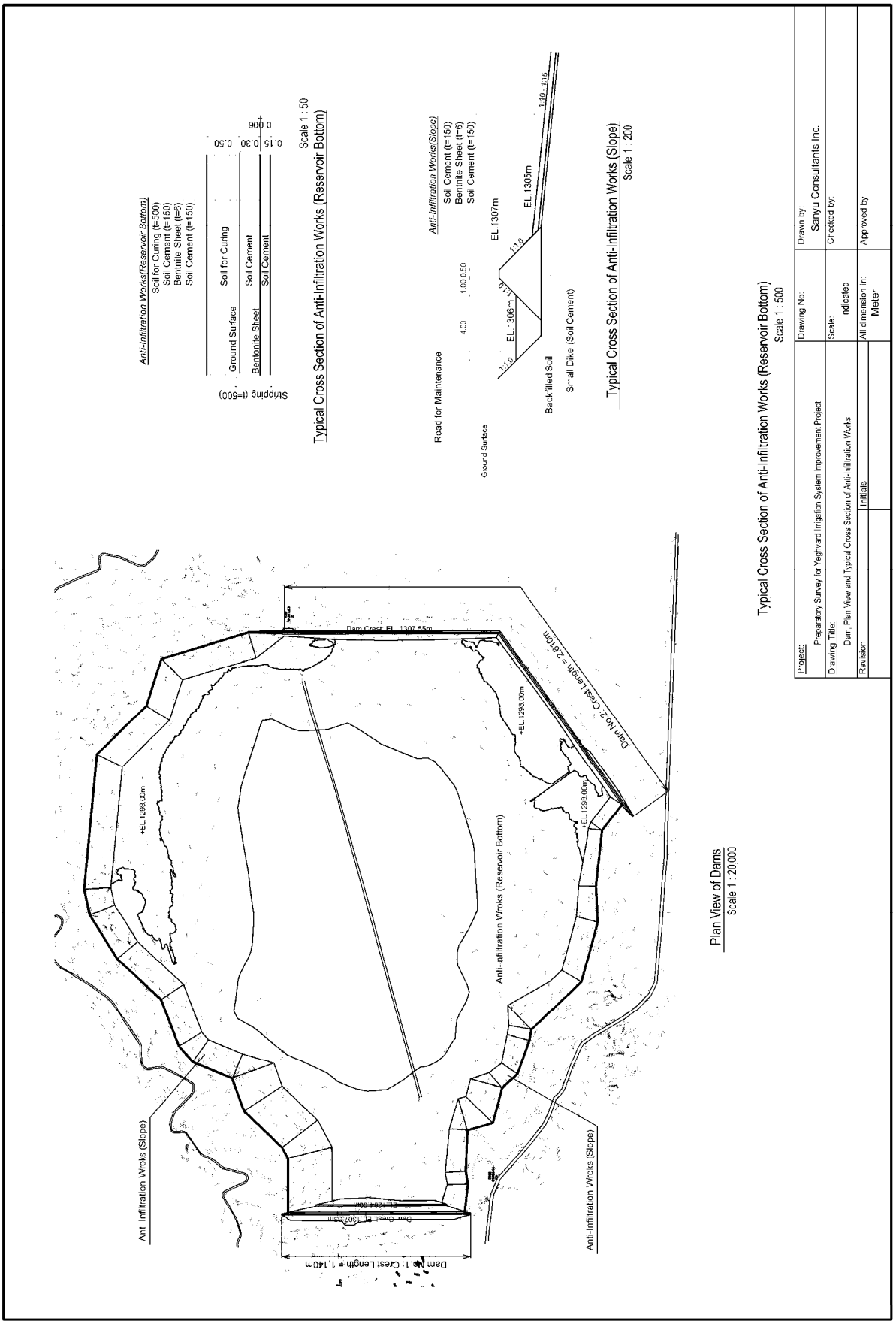


Figure 6-6-2.2 Plan View of Dams and Typical Cross Section of Anti-Infiltration Works

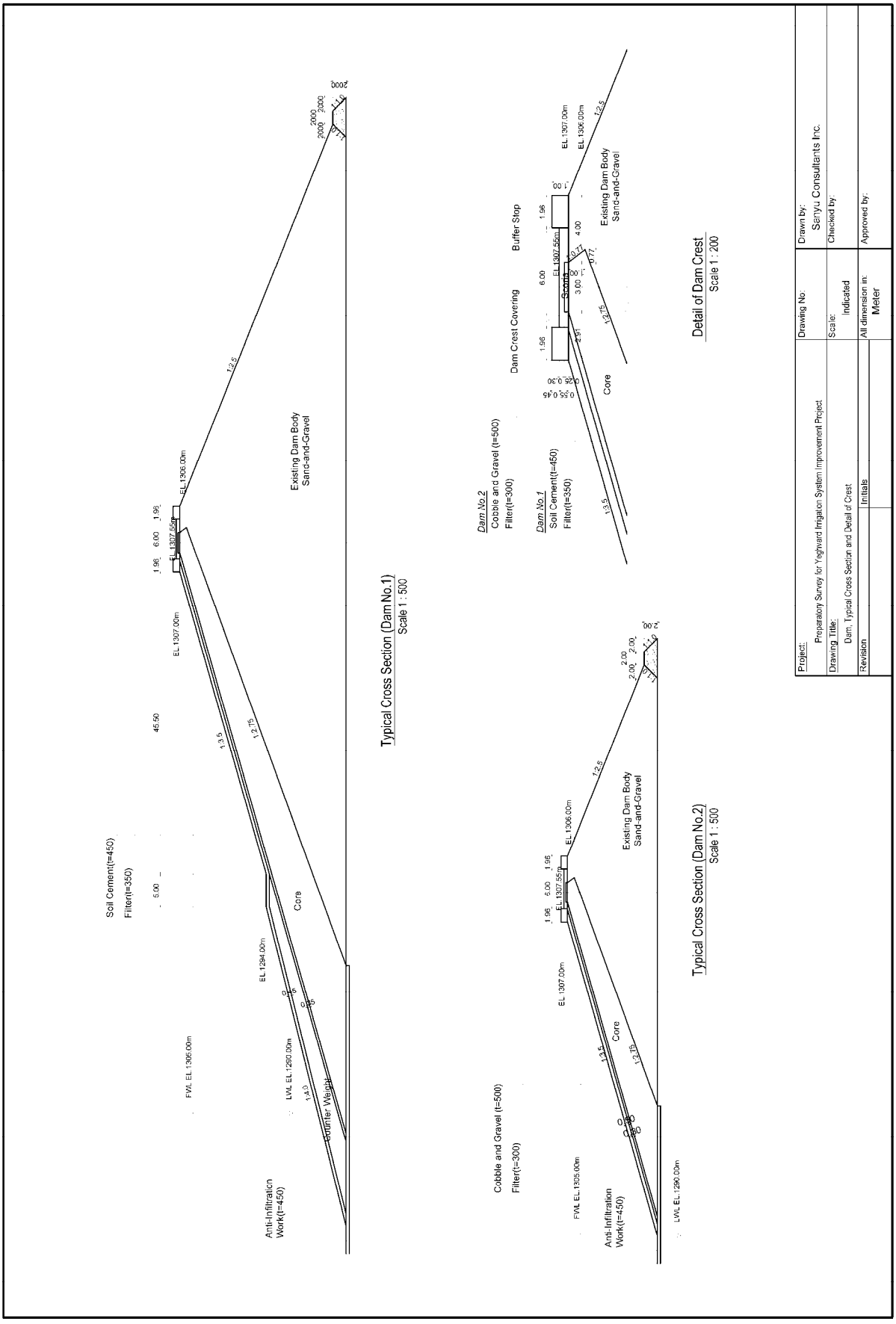


Figure 6-6-2.3 Typical Cross Section of Dams and Detail of Dam Crest

6-6-3 Drawings of Irrigation Plan

(1) Feeder canal 1 and outlet canal 1

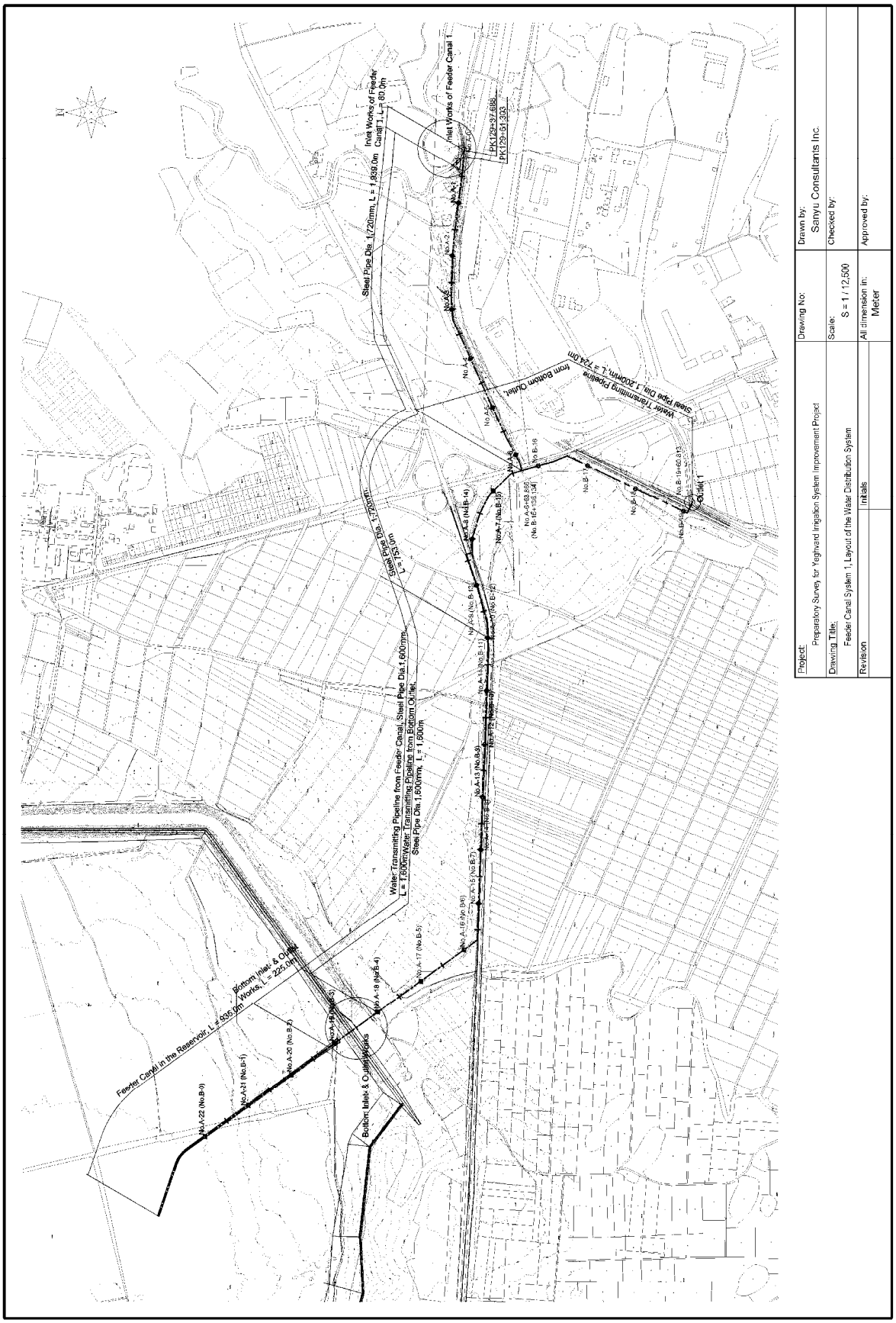


Figure 6-6-3.1 Layout of the Water Distribution System

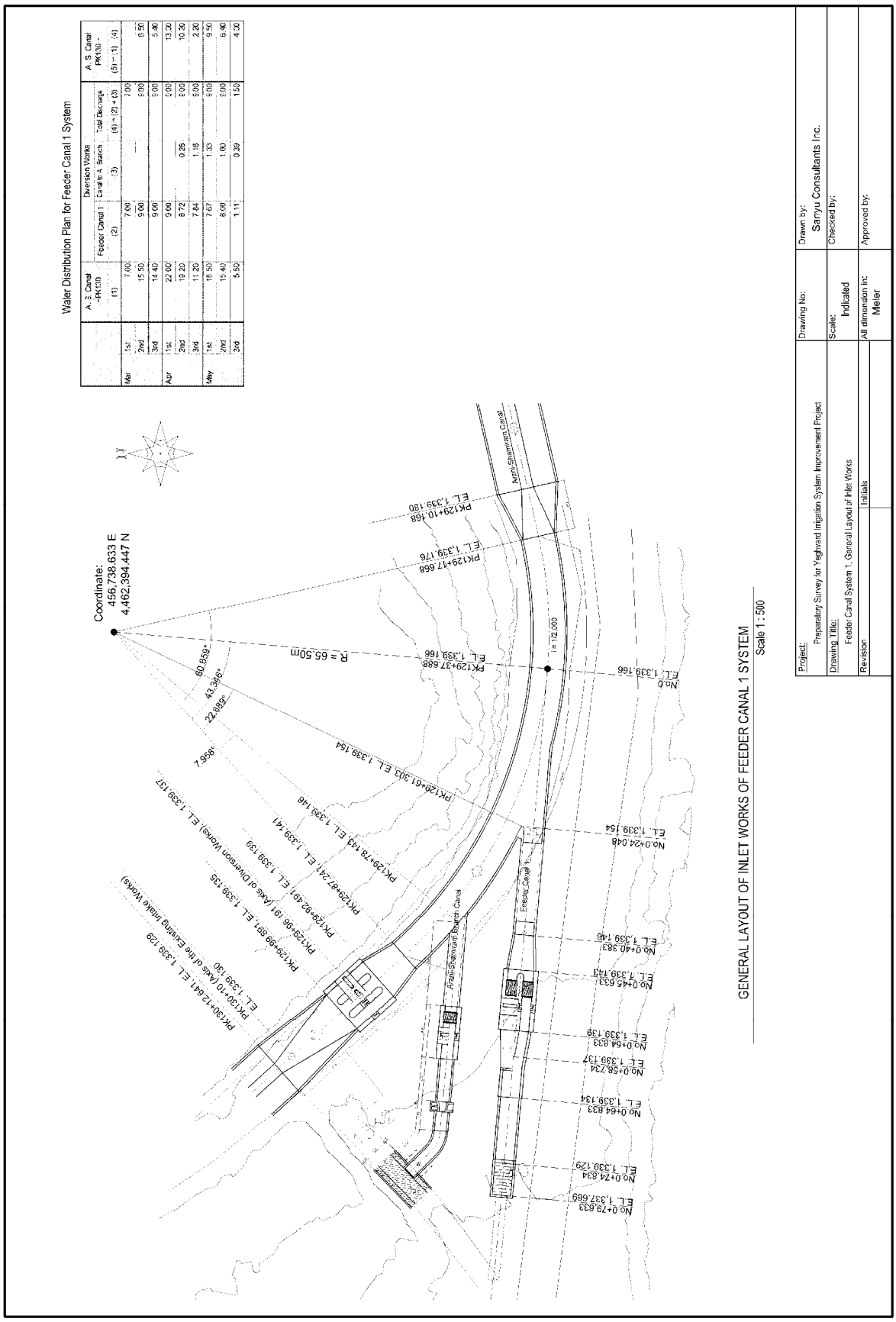
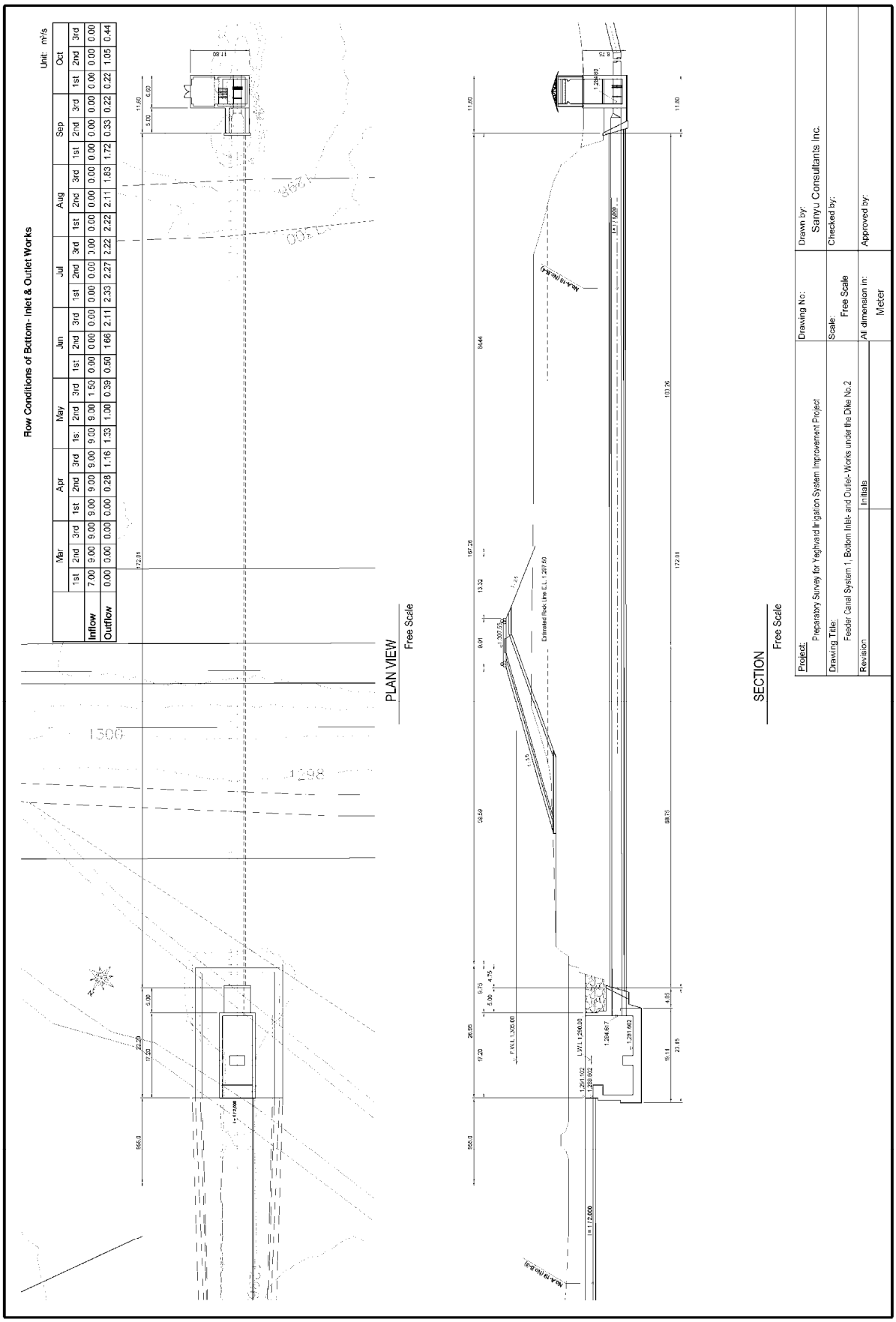


Figure 6-6-3.2 Layout of Inlet Works



	Mar			Apr			May			Jun			Jul			Aug			Sep			Oct		
	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
Inflow	7.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	1.50	0.00	0.00	0.00	0.00	0.00	3.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Outflow	0.00	0.00	0.00	0.00	0.28	1.16	1.33	1.00	0.39	0.50	166	2.11	2.33	2.27	2.22	2.22	2.11	1.83	1.72	0.33	0.22	0.22	1.05	0.44

Figure 6-6-3.3 Bottom Inlet and Outlet Works under Dam No.2

(2) Feeder canal 2

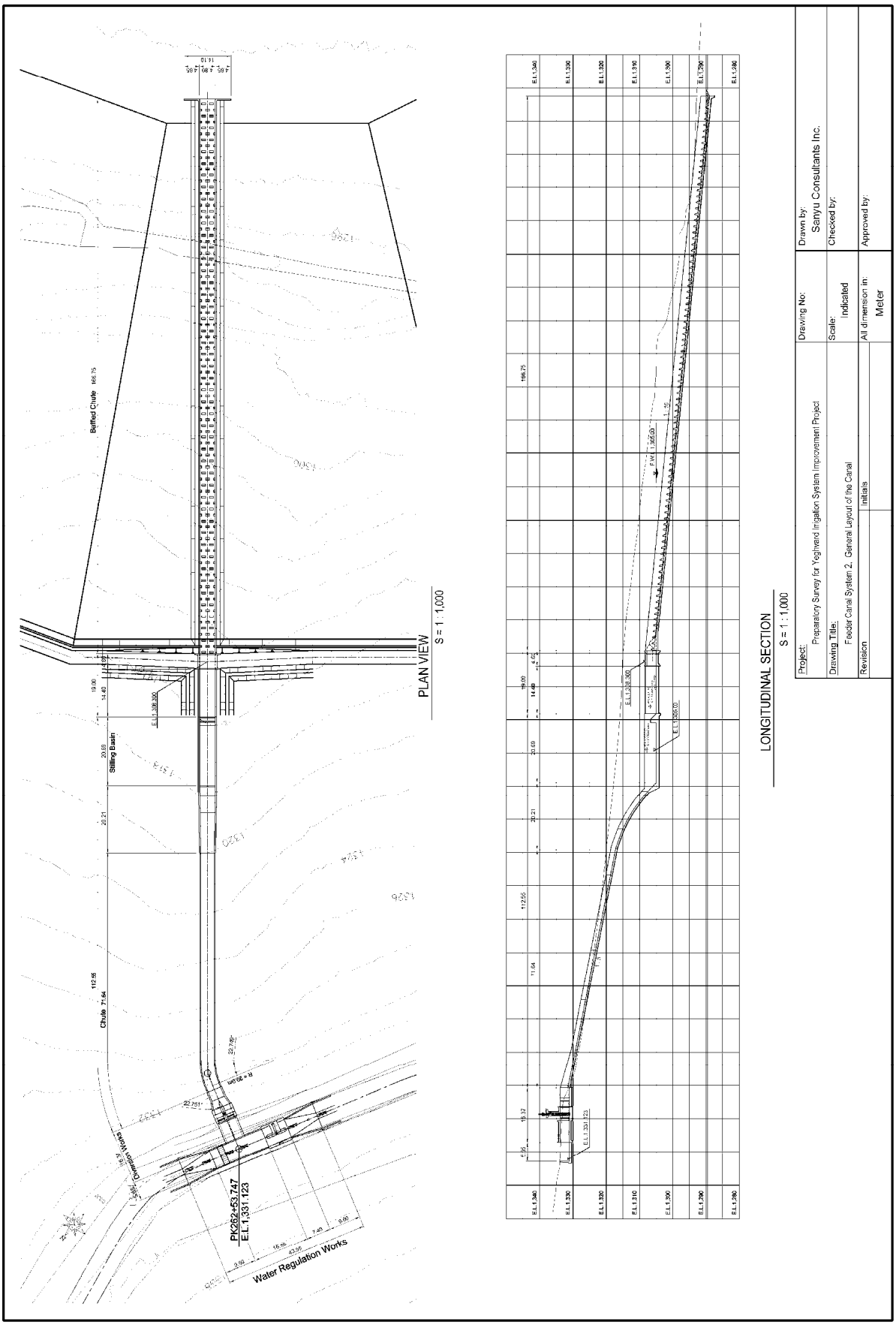


Figure 6-6-3.4 General Layout of Feeder Canal 2

(3) Outlet canal 2

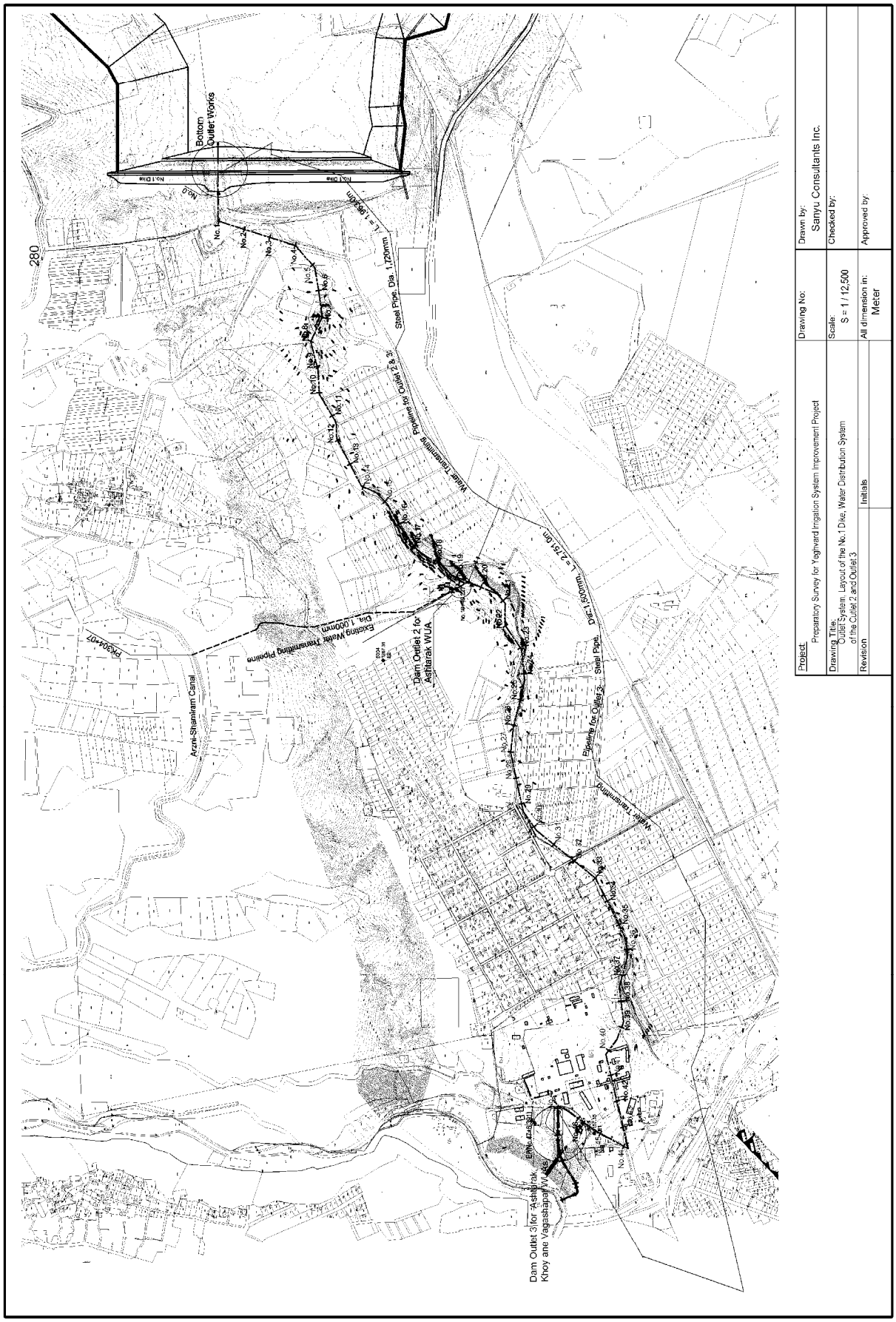
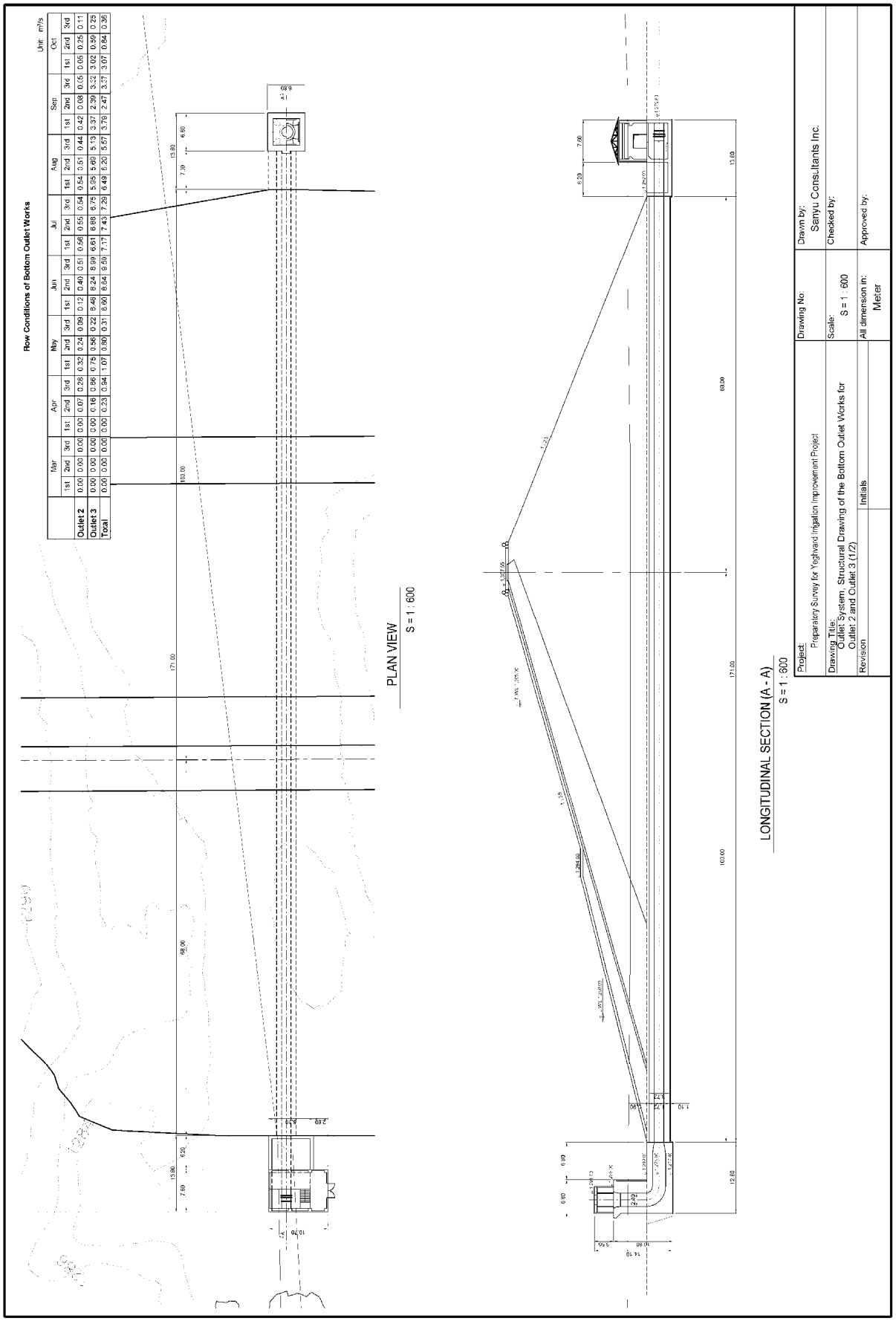


Figure 6-6-3.5 General Layout of Outlet Canal 3



	Mar			Apr			May			Jun			Jul			Aug			Sep			Oct		
	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
Outlet 2	0.00	0.00	0.00	0.00	0.07	0.28	0.32	0.24	0.09	0.12	0.40	0.51	0.56	0.55	0.54	0.54	0.51	0.44	0.42	0.08	0.05	0.065	0.25	0.11
Outlet 3	0.00	0.00	0.00	0.00	0.16	0.86	0.75	0.56	0.22	8.48	8.24	8.99	6.61	6.88	6.75	5.35	5.93	5.13	3.37	2.39	3.32	3.02	0.59	0.25
Total	0.00	0.00	0.00	0.00	0.23	0.94	1.07	0.80	0.31	8.60	8.64	9.50	7.17	7.43	7.29	6.49	6.20	5.57	3.79	2.47	3.37	3.07	0.84	0.36

Figure 6-6-3.6 Structural Drawing of the Bottom Outlet Works

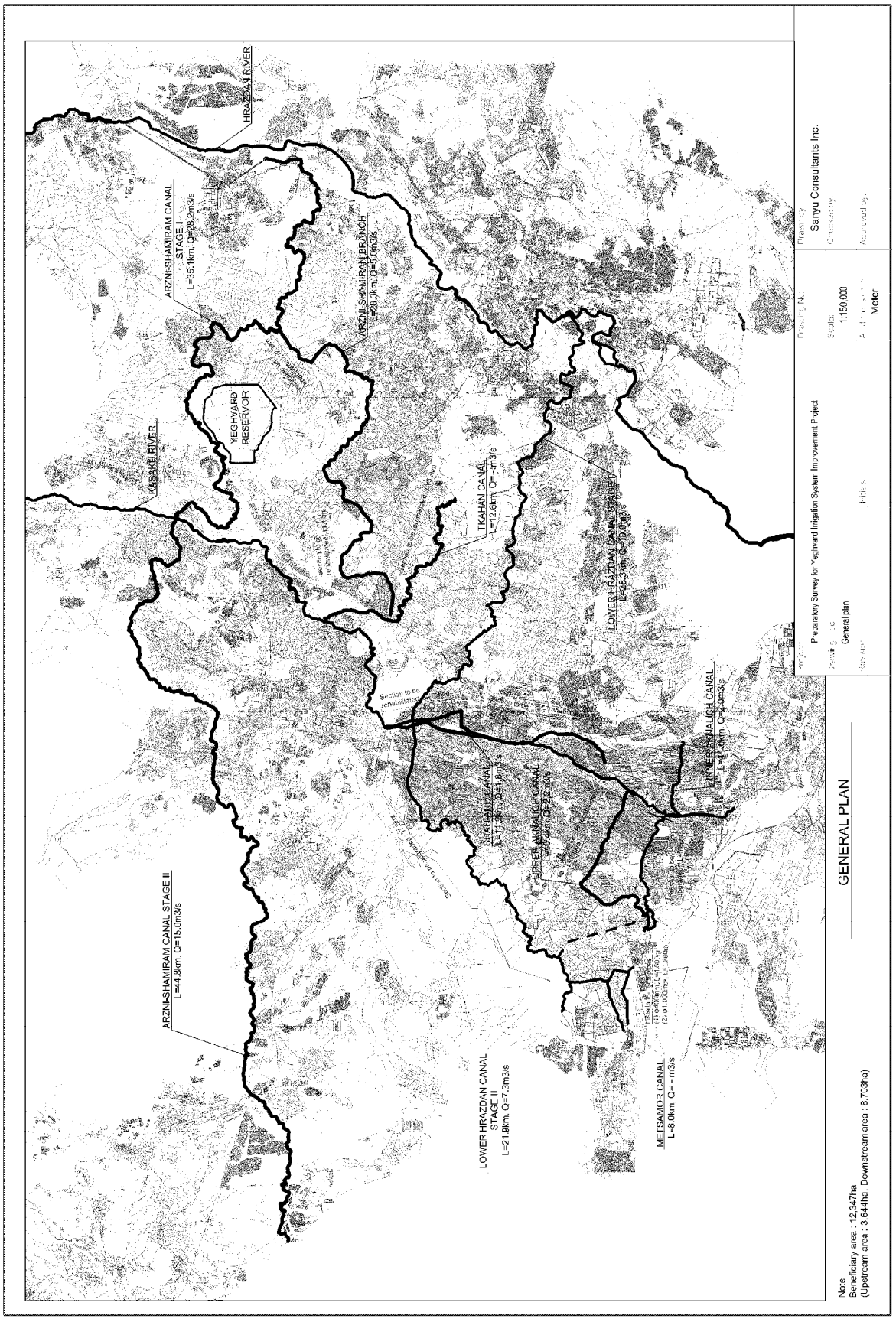


Figure 6-6-3.7 General Plan of Target Canals

6-7 Project Cost Estimation

6-7-1 Summary and Policy of Cost Estimation

Project cost is estimated according to the current regulatory systems and norms of Armenia. The estimate was developed for each of following contents.

(1) Reservoir bottom anti-infiltration works
(2) Rising and surface protection of existing Dam No.1 and Dam No.2
(3) Feeder canals and Outlet canal
  1) Feeder canal 1(Arzni-Shamiram canal to Dam No.2)
  2) Feeder canal 2(Arzni-Shamiram canal to reservoir)
  3) Outlet canal 1(Dam No.2 to Arzni-Branch canal)
  4) Outlet canal 2(Dam No.1 to Kasakh river)
(4) Irrigation systems
  1) Rehabilitation of Arzni-Shamiram canal (N9)
  2) Connection canal Lower Hrazdan canal part 2
  3) Arzni-Branch canal, BP. to PK120
  4) Arzni-Branch canal, PK120 to EP (PK165+19)
  5) Takahan canal
  6) Shah-Aru canal
  7) Upper Aknalich canal

For the decision of the construction method of the reservoir bottom anti-infiltration works, following 4 methods are considered. The drawing of each method is shown in Figure 6-7-1.1.

(1) Bentonite sheet
(2) Soil-cement coverage
(3) Bentonite-soil mixture
(4) Soil-cement with a sandwiched bentonite sheet

Project cost is estimated and compared above 4 methods.

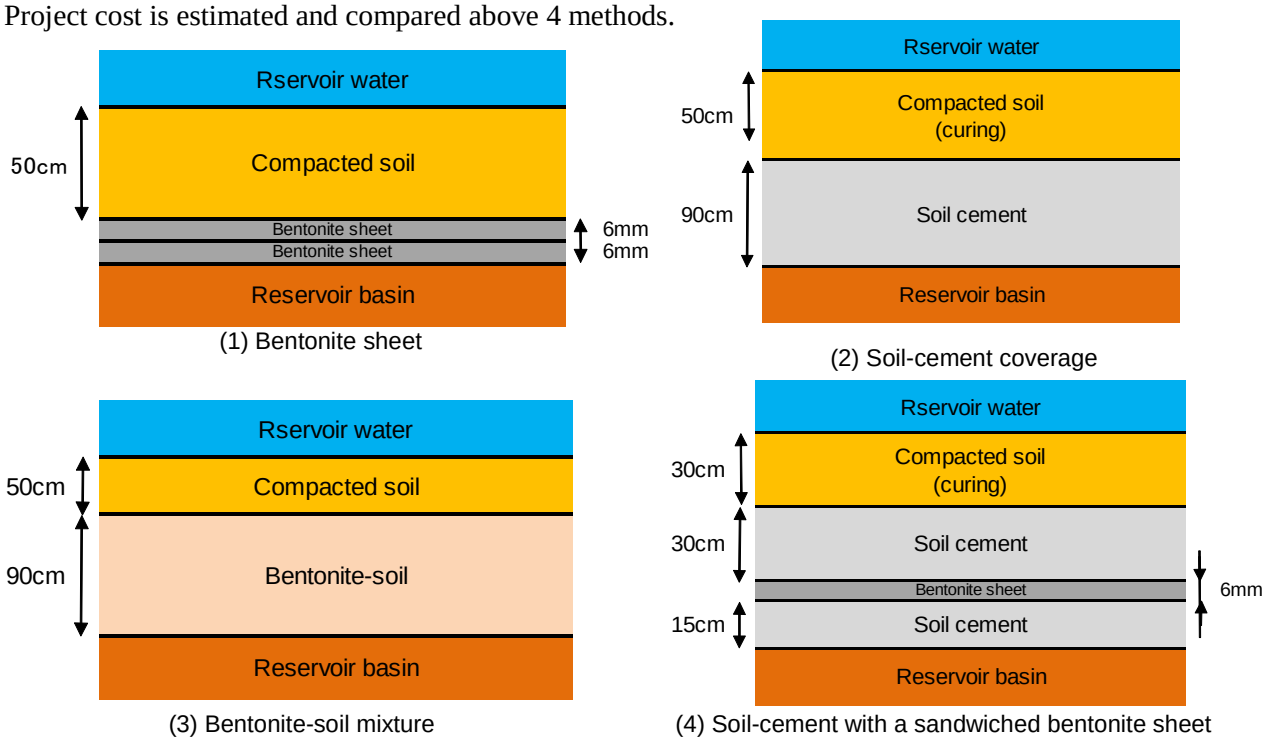


Figure 6-7-1.1 Anti-infiltration Method

6-7-2 Project Cost

Estimated project costs of 4 construction method are shown in Table 6-7-2.1. Among the 4 method, The method of "Soil-cement with a sandwiched bentonite sheet" is selected due to economical advantage.

Table 6-7-2.1 Project Cost

Contents (Unit: Million USD)		1. Bentonite sheet (2 layers)		2. Soil-Cement coverage		3. Bentonite-soil mixture		Soil-Cement with a Sandwiched Bentonite sheet					
								4. Total		5. Excepted irrigation system		6. Irrigation system only	
		Project Cost (million USD)	%	Project Cost (million USD)	%	Project Cost (million USD)	%	Project Cost (million USD)	%	Project Cost (million USD)	%	Project Cost (million USD)	%
R. Bottom Anti-Infiltration		80.6	66.8	111.8	73.6	83.3	67.6	78.3	66.2	78.3	75.1	0	0.0
Exisiting Dam (No.1, No.2)		6.8	5.6	6.8	4.5	6.8	5.5	6.8	5.7	6.8	6.5	0	0.0
Feerder canal, Outlet canal		17.6	14.6	17.6	11.6	17.6	14.3	17.6	14.9	17.6	16.9	0	0.0
Irrigation system, other works		15.6	12.9	15.6	10.3	15.6	12.7	15.6	13.2	1.6	1.5	14.0	100.0
Direct Construction Cost		120.6	100	151.8	100	123.3	100	118.3	100	104.3	100	14.0	100.0
Overhead expenses	13.3%	16		20.2		16.4		15.7		13.9		1.9	
sub-total		136.6		172.0		139.7		134.0		118.2		15.9	
Contractor profit	11.0%	15.0		18.9		15.4		14.7		13.0		1.7	
sub-total		151.6		190.9		155.1		148.7		131.2		17.6	
Expenses on Temporary buildings & Climate impact	4.1%	6.2		7.8		6.4		6.1		5.4		0.7	
Indirect expenses		37.2		46.9		38.2		36.5		32.3		4.3	
Construction Cost		157.8		198.7		161.5		154.8		136.6		18.3	
Consultant Service	6.0%	9.5		11.9		9.7		9.3		8.2		1.1	
sub-total		167.3		210.6		171.2		164.1		144.8		19.4	
Price Contingency	10.24%	17.1		21.6		17.5		16.8		14.8		2.0	
Physical Contingency	5.0%	8.4		10.5		8.6		8.2		7.2		1.0	
Sub-total		25.5		32.1		26.1		25.0		22.0		3.0	
Grand Total		192.8		242.7		197.3		189.1		166.8		22.4	
VAT	20%	38.6		48.5		39.5		37.8		33.4		4.5	
Grand Total with VAT		231.4		291.2		236.8		226.9		200.2		26.9	

6-7-3 Cost Reduction

From the results of geological survey, soil mechanical test and groundwater simulation, the loamy sand distributed in the center area of the reservoir has enough low permeability. Leakage from the center area is very low and allowable therefore it is judged that anti-infiltration works are not necessary at the center area of the reservoir. The cost of anti-infiltration works can be deduced from the Project cost. Reduction of direct cost of anti-infiltration works is about 51 million USD tabulated in Table 6-7-3.1.

Table 6-7-3.1 Cost Reduction of Anti-infiltration

Anti-infiltration work			Unit cost of Anti-infiltration (USD/m2) (4)	Direct cost of reduction (USD) (5)=(3)x(4)
Original area (m2) (1)	Necessary area (m2) (2)	Deducted area (m) (3)=(1)-(2)		
9,000,000	5,443,000	3,557,000	14.482	51,512,474

6-7-4 Construction Schedule

(1) Matters for Consideration on the Construction

During the construction, many construction vehicles are operated around Yeghvard reservoir therefore temporary land acquisition of surrounding private area is necessary. Land owners have to stop their productive activities even though land acquisition is temporary, compensation for the acquisition is also necessary. After completion of construction work, these lands will be back to the land owners.

(2) Quality Control Plan

Quality control for the construction is on the initiative of contractor and the consultant of the Project is checked and confirmed. Structure and contents of quality control is shown in Figure 6-7-4.1.

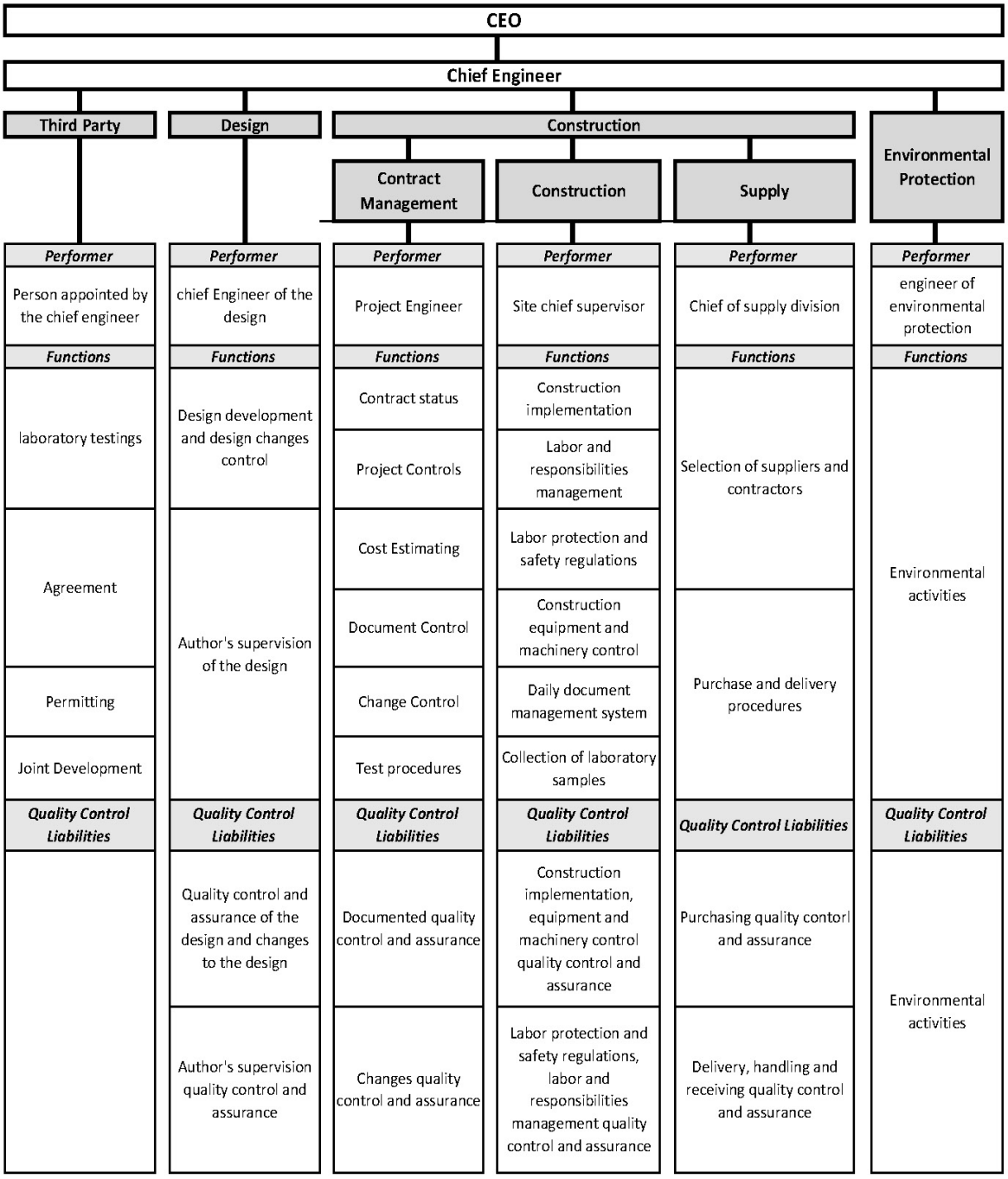


Figure 6-7-4.1 Quality Control Structure

(3) Safety Control Plan

1) Local standards and norms related to safety and quality control

Construction work in Armenia has to obey several safety regulations. These regulations define not only safety measures during several kinds of construction works but method of safety management like safety training. Table 6-7-4.1 shows standards and norms related to safety.

Table 6-7-4.1 Standards and Norms Related to Safety and Quality Control

Standard and norm	Related contents of standard and norm
HHSHN 33-01-2014: General conditions of construction norm for hydraulic structures	- Safety assurance of structures and effectiveness - Safety requirements during construction - Safety requirements during maintenance - Safety requirements during reconstruction or removal
N 074-N Safety rules for engineers in water resources management systems.	- Safety rules for maintaining organizations of hydraulic structures - Training about safety rules - Procedure of knowledge test about safety rules - Norm and rules of safety assurance - Safety equipment and work protection process - Safety zone and requirements for workers
Building regulations SNIP III-4-80, Safety in Construction	- Safety in isolation works - Safety in earth works - Safety in concrete works

2) Departments in charge of safety and quality control in the Implementation Unit

In Armenian construction rule, safety control is planed and conducted by contractors and project engineer (consultant) checks and confirms it. Implementation unit has free of direct responsibility for safety. The person in charge of the Project in the implementation unit just confirms the situation of safety control by the contractor.

3) Assignment plan of safety control staff for the Japanese loan project

The person in charge of the Japanese loan project in the implementation unit confirms the safety control by the contractor.

4) Capacity and experience of staff in charge of safety and quality control

The responsible person in the implementation unit has several experiences to handle safety control in other similar projects.

5) Structure of confirming safety and quality control in the Implementation Unit

The responsible person in the implementation unit confirms the safety report from the project engineer. The implementation unit is not in a direct responsible position, however the responsible person usually goes on regular patrol in the construction site and checks as-built drawings and supplementary drawings voluntarily.

6) Organization control in the implementation unit to accidents

In the case of an accident, project engineer and contractor handle the accident response. After initial response, project engineer report to the responsible person in the implementation unit, then accident information is distributed in the implementation unit.

7) Method of a confirming training programs in safety and quality control by contractors

Contractor has to prepare the safety and quality control plan including safety training program and submit to the project engineer. Project engineer judged the appropriateness of the plan and approve of it. Project engineer confirms the safety plan submitted from the contractor.

8) Agencies having jurisdiction over safety issues

Public agency has jurisdiction over safety issues in Armenia is Ministry of Labor and Social Affairs.

(4) Procurement schedule

In Armenia, general construction materials and equipment is available in domestic market. However, bentonite sheet shall be imported for the Project. Some special construction equipment, valves and gates are to be procured from Europe or neighbor countries.

(5) Construction Schedule

1) Critical path of the construction

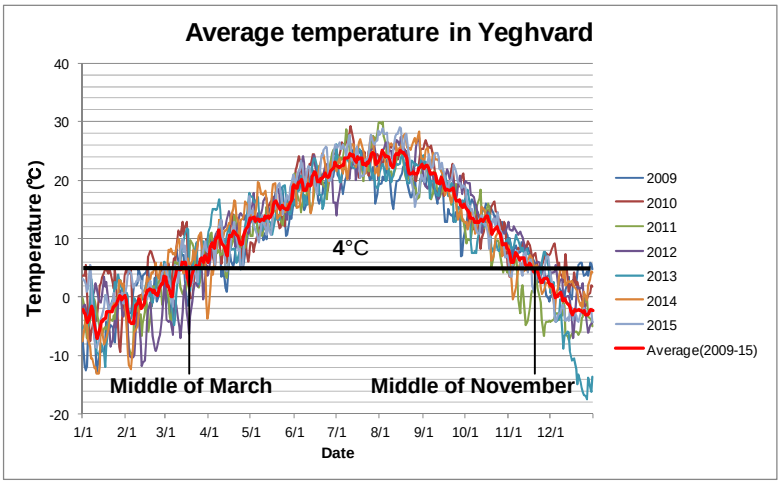
Construction works are divided into 4 parts. First is reservoir bottom anti-infiltration works. Second is earth filling of dam bodies. Third are feeder canals and outlet canals. Final is a rehabilitation of Arzni-Shamiram canal and irrigation system at the downstream. Among 4 construction works, reservoir bottom anti-infiltration works, which has the largest construction volume, is the critical path of the Project.

2) Workable days

Construction work is restricted weather condition such as temperature, rain fall and snow fall.

a) Temperature

For maintaining the quality of anti-infiltration works by soil-cement, management of temperature when casting soil-cement is important. High temperature exerts a bad influence on proper curing of soil-cement and deteriorates its stability and permeability. Special casting method correspond to cold temperature is necessary during soil-cement casting under 4°C. Soil-cement in the reservoir is required high anti-infiltration, therefore meticulous care to casting is indispensable. Average temperature in Yeghvard from 2009 to 2015 is shown in Figure 6-7-4.2. To prevent leakage from reservoir result from improper workmanship, soil-cement casting work is ceased in four months from the middle of November to the middle of March.

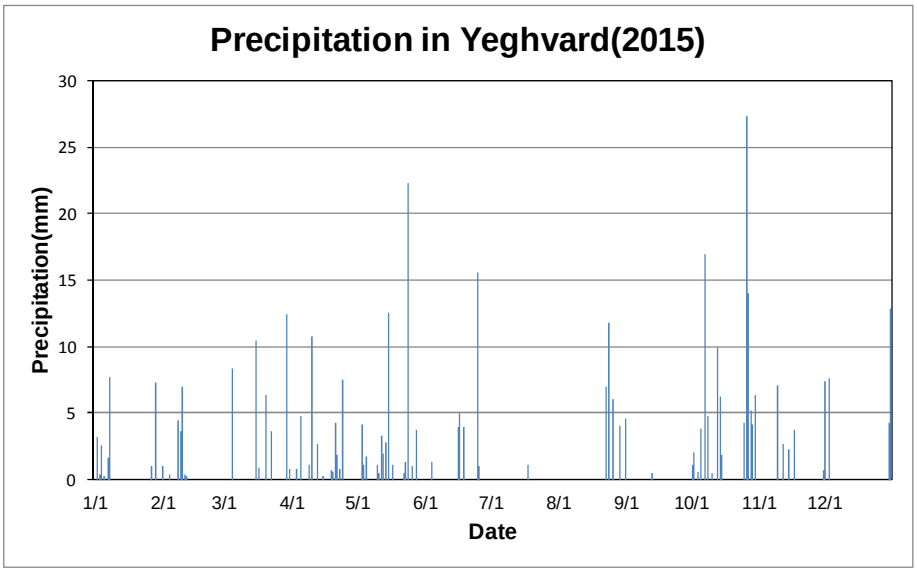


Source: Armenian State Hydrometeorological and Monitoring Service

Figure 6-7-4.2 Average Temperature in Yeghvard

b) Precipitation

Precipitation during casting soil-cement has an adverse affect on quality of soil-cement. In general, casting does not recommend when precipitation is over 4 mm/hour.



Source) Armenian State Hydrometeorological and Monitoring Service

Figure 6-7-4.3 Precipitation in Yeghvard

Precipitation in Yeghvard in 2015 is shown in Figure 6-7-4.3. The maximum precipitation is 27mm/day so that high intense precipitation which interferes with soil-cement casting does not continue long time. Therefore cessation of construction by precipitation is not considered.

c) Holiday

Considering safety of labors and maintenance of machineries, working days in a week is set as 6 days.

d) Number of workable days

From the consideration of ceasing of construction work, annual workable days are calculated as 206 days (see Table 6-7-4.2).

Table 6-7-4.2 Workable Days of Soil-cement Work

Annual days (1)	Constrain for work			Actual workable days (5)=(1)-(2)-(3)-(4)
	Construction of temperature (2)	Precipitation (3)	Holiday (4) = (2)x1/7	
360 days	30 days/month x 8 months = 240 days	0 day	34 days	206 days

3) Construction period

In anti-infiltration works, transportation of the raw materials of soil-cement such as sand and cement and also mixed soil-cement requires many trucks for the construction in the reservoir basin.

Calculation result of necessary number of trucks per 1,000 m^2 is shown in Table 6-7-4.3. Necessary number of trucks for soil-cement work per 1,000m^2 is 5.42.

Table 6-7-4.3 Necessary Number of Trucks for Soil-cement Work

No.	Materials	Transportation route	Operation hours of dump truck (hr/1,000m2)	Operation hour (hr/day)	Necessary Nos of dump truck (Nos/1,000m2)
1	Top soil	Basin to disposal	8.4	6	1.4
2	Quarry soil	Quarry to sieving machine	4.1		0.68
3	Sand & gravel	Sieving machine to mixing machine	6.9		1.15
4	Cement	Stock yard to mixing machine	0.69		0.12
5	Soil-cement mixture	Mixing machine to basin	2.6		0.43
6	Soil-cement mixture(1laye:15cm)	Basin	3.34		0.56
7	Soil-cement mixture(2layer:15cmx2)	Basin	6.5		1.08
	Total		32.53	-	5.42

Table 6-7-4.4 shows the necessary volume of soil-cement work and number of trucks. In the case of 3-year construction period, 48 trucks are needed in the site. These trucks concentrate to quarry site, disposal area and work place of anti-infiltration works and be forced to wait construction work. Work volume also is reduced.

In the case of considering 4-year construction period, 36 trucks are adequate for meeting required work volume. The movement of truck are not conflict each other and adequate work control is possible. Therefore, construction period is decided as 4 years.

Table 6-7-4.4 Necessary Volume of Soil-cement Work and Trucks

Construction area of soil-cement (m2) (1)	Yearly working days (day) (2)	Necessary daily work volume(m2/day) (3) = (1)/(2)x year		Necessary Nos of dump truck (Nos/1,000m2) (4)	Necessary Nos of dump truck (Nos/day) (5)=(3)x(4)
5,344,000	206	for 3 years	8,807	5.42	48
		for 4 years	6,606		36

(4) Implementation schedule

The Project will start from 2-year Detail Design and tender of construction after the Feasibility study. Then start 4-years construction. After completion of the reservoir and irrigation facilities, initial impoundment is plan to conduct taking 1 year. Total Project period is estimated 7 years as shown in Figure 6-7-4.4. The rehabilitation of canals such as Arzni-Shamiram and irrigation system is restricted to its construction period considering distribution of irrigation water in Armenia. Rehabilitation works are conducted in winter season preventing stopping water in irrigation season.

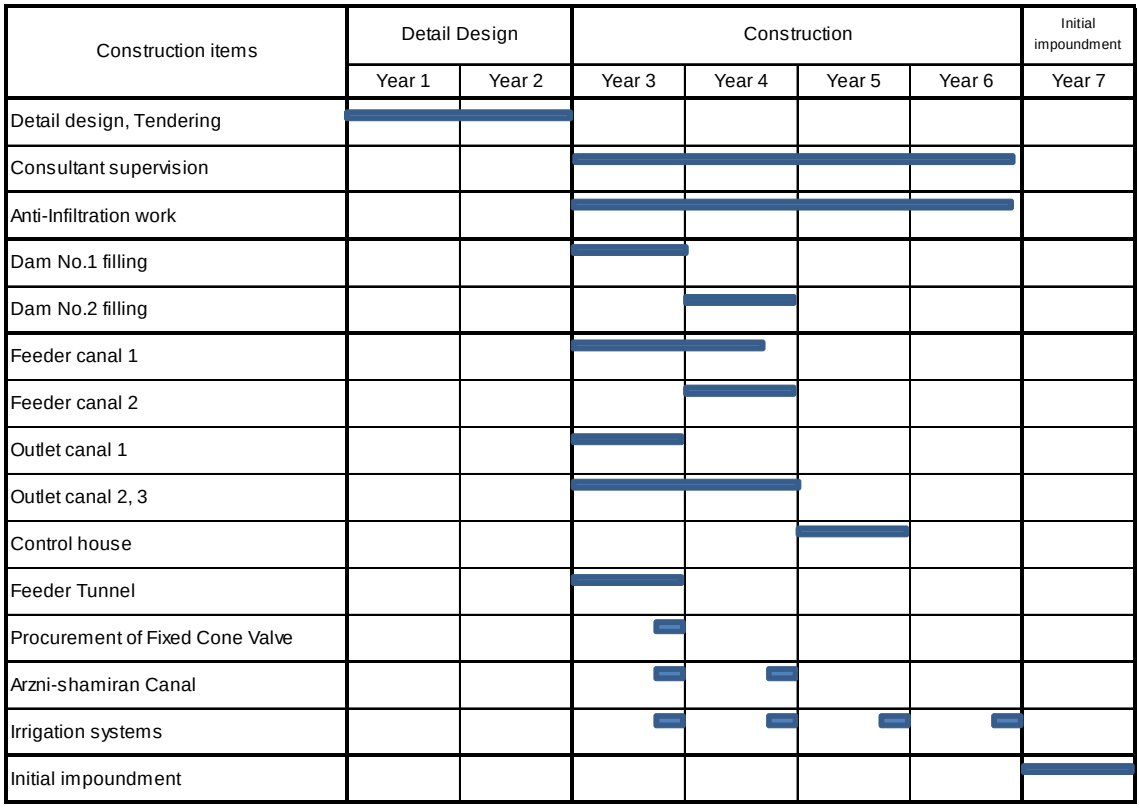


Figure 6-7-4.4 Implementation Schedule

6-8 Operation and Maintenance (O&M) Plan

6-8-1 O&M Plan of the Reservoir

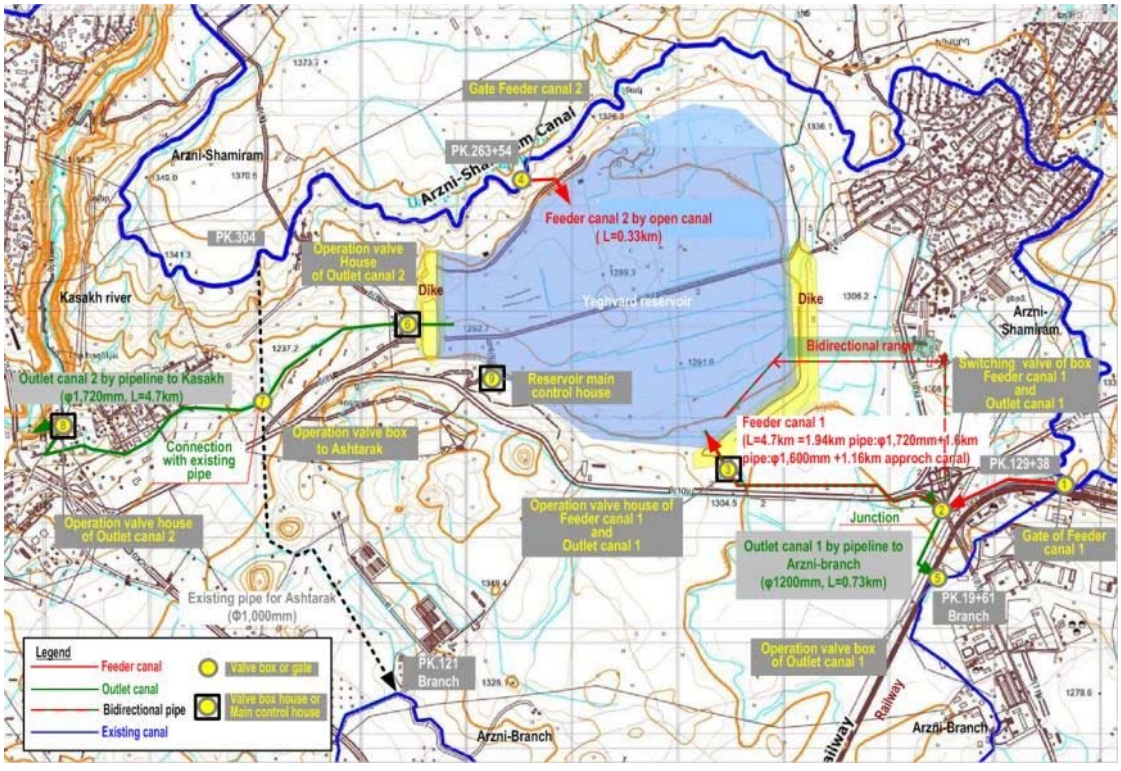
(1) Demarcation of operation and maintenance

Yeghvard reservoir will be administrated by the Sevan-Hrazdanyan-Jrar CJSC. The CJSC should be responsible for the operation and arrangement of staff for Yeghvard reservoir. Two Feeder canals and two Outlet canals should be demarcated to WSA and WUAs in the view of operation. However, the maintenance for the related facilities of reservoir shall be conducted by WSA because the integrated maintenance by single organization could be smooth and effective to interactive relation in each facilities of reservoir. **WSA shall be recommended to be main responsible agency for reservoir and related facilities.**

The suggested demarcation for operation is shown in Table 6-8-1.1.

Table 6-8-1.1 Operation Demarcation of Reservoir and Related Facilities around Yeghvard Reservoir

Facility	Conveyance	Maintenance	Operation				
		WSA	WSA	WUAs			
				Yeghvard	Ashtarak	Vagarshapat	Khoy
1.Gate of F.C. 1	Pipeline	●	●				
2.Switching valve box of F.C.1 and O.C.1	Pipeline	●	●				
3.Operation valve house of F.C.1 and O.C.1	Pipeline	●	●				
4.Gate of F.C. 2	OP.canal	●	●				
5.Operation valve box of O.C.1	Pipeline	●		●			
6.Operation valve box of O.C.2 at Dike 1	Pipeline	●					
7.Operation valve house of O.C.2 at connection	Pipeline	●			●		
8.Operation valve house of O.C.2 at Kasakh	Pipeline	●				●	●
9.Main control house of Yeghvard Reservoir		●	●				
Reservoir body		●	●	-			



(2) Operation unit of reservoir

Yeghvard reservoir as large irrigation facility could seriously affect to social environment, if an unexpected accident arises. To avoid these damages and serious situation, necessary persons shall be stationed at reservoir facilities to regular observation and report, in addition, unexpected situation shall be taken measure and/or secured safety by these assigned experts.

Especially, in case of consultation on engineering matters for reservoir, PIU should support and assist the operation unit.

Table 6-8-1.2 Recommended Experts of Operation Unit

Persons		Responsibility	
Operation and management	3	Resident persons for operating season and as required situation should be assigned. Manager(1), staff for feeder canals(1), staff for outlet canals (1)	General administration, such as report and record, should be conducted.
Dam Engineer	1	Person for operating season and as required situation should be assigned.	Regular and difference situation should be observed and investigated in accordance with monitoring plan in ordinary and extraordinary. Especially, in extraordinary, engineer should check dam body condition and internal facility of reservoir.
Electric Engineer	1	Person for operating season and as required situation should be assigned.	Regular and difference situation should be observed and investigated in accordance with monitoring plan in ordinary and extraordinary. Especially, in extraordinary, engineer should check all of electric facility.
Mechanical Engineer	1	Person for operating season and as required situation should be assigned.	Regular and difference situation should be observed and investigated in accordance with monitoring plan in ordinary and extraordinary. Especially, in extraordinary, engineer should check all of mechanical facility.

(3) Maintenance

(a) Maintenance in regular situation

To secure the safety situation of reservoir, following items should be observed by visual and/or equipment.

1) Leakage water volume from dam body and foundation

The facility for leakage measurement like collecting water structure should be stationed at edge of dam body. Prior to apply this method and facility, other water factor into measurement facility shall be ensured by actual observation or analysis. Since the observed water would include individual water source such as surface, spring, leakage from dam body and foundation. In addition, appeared muddy color water from dam body could be recognition of leakage or suction of core zone material (impervious maerial) . It would be identified by visual inspection.

2) Deformation of dike

In usual, targets to measure deformation of dam body are established on the surface of dam body. The surface should be stationed 10 - 15 bench marks to observe by topographic survey. The bench marks should be arranged to likely matrix with equal distance in order to dully and inclusively ensure the reaction of dike.

3) Pore water pressure inside of dam body and foundation

Pore water pressure could be measured in order to ensure quality control and inspection during

construction, in this case, it should be installed at a few section with interval of 10m. To make observation after construction for the purpose of dike safety, it should be stationed.

4) Water level in reservoir

To ensure and observe the stored volume, water level gauge shall be stationed at location which is enable to visual observe easily. In addition, Arzni-Shamiram canal, Arzni-Branch canal and Kasakh river at which are closed to and connected with Feeder canal and Outlet canal, should be stationed water gauge or SCADA system.

5) Water level in deep well around reservoir

This is in relation with observation of leakage water from reservoir. According to the geological condition of Yeghvard reservoir, the ground water level is at approx. 100m below surface. It could be affected to ground water by reservoir leakage. Deep wells are aim at observation for reaction of ground water.

6) Reaction of dike and foundation for earthquake

Equipment of seismometer should be stationed at edge and crest of dam body so that it would observe earthquake motion precisely. In addition, seismometer equip with the function to be able to measure maximum accretion.

7) Visual observation for pipeline

At most of pipeline is under ground, visual inspection of the most part is not easy. These ground section of the pipeline should be inspected at least before and after the irrigation season. The visual inspection should be performed by trained and qualified staff. In addition, every a few years or in case of unusual conditions, a complete inspection for pipeline should be conducted by qualified and experienced engineer , and using remote observation vehicles.

(b) Maintenance in unusual situation

In unusual situation, all of facilities in relation with reservoir shall be a inspected by eligible and experienced engineer. Especially, the inspection should be performed not only analyze measured value by equipment but also visual investigation.

(2) Operation of each Canal at reservoir

(a) Regular operation

To convey the irrigation water to irrigation filed, five of canals connected reservoir should be dully operated to in-flow and out-flow. These canals have the different discharge and have to be operated in accordance with following water allocation.

Table 6-8-1.3 Water Allocation of Feeder and Outlet Canals (m^3/s)

	Jan.			Feb.			Mar.			Apr.			May			Jun.		
	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
Arzni-Shami.note1)	0.00	0.00	0.00	0.00	0.00	0.00	7.00	15.5	14.4	22.0	19.2	11.2	18.5	15.4	5.50	7.00	5.00	6.00
Arzni-Branch note2)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.28	1.16	1.33	1.00	0.39	0.00	0.00	0.00
Feeder C. 1	0.00	0.00	0.00	0.00	0.00	0.00	7.00	9.00	9.00	9.00	8.72	7.84	7.67	8.00	1.11	0.00	0.00	0.00
Feeder C. 2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.50	5.40	13.00	10.20	2.20	5.90	3.40	0.00	0.00	0.00	0.00
total inflow	0.00	0.00	0.00	0.00	0.00	0.00	7.00	15.5	14.4	22.0	18.92	10.04	13.57	11.40	1.11	0.00	0.00	0.00
Outlet C. 1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50	1.66	2.10
Outlet C. 2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.28	0.32	0.24	0.09	0.12	0.40	0.51
Outlet C. 3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.16	0.66	0.75	0.56	0.22	6.48	8.24	8.99
total outflow											0.23	0.94	1.07	0.80	0.31	7.10	10.30	11.60
Operation	<-- no-operation -->						<-- Inflow to Reservoir -->											
											<-- Outflow from Reservoir -->							

	Jul.			Aug.			Sep.			Oct.			Nov.			Dec.		
	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
Arzni-Shami.note1)	6.00	7.00	13.0	13.0	13.0	13.0	8.00	8.00	8.00	5.00	5.00	5.00	0.00	0.00	0.00	0.00	0.00	0.00
Arzni-Branch note2)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Feeder C. 1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Feeder C. 2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
total inflow	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Outlet C. 1	2.33	2.27	2.22	2.22	2.11	1.83	1.72	0.33	0.22	0.22	1.05	0.44	0.00	0.00	0.00	0.00	0.00	0.00
Outlet C. 2	0.56	0.55	0.54	0.54	0.51	0.44	0.42	0.08	0.05	0.05	0.25	0.11	0.00	0.00	0.00	0.00	0.00	0.00
Outlet C. 3	6.61	6.88	6.74	5.94	5.68	5.13	3.36	2.39	3.33	3.03	0.59	0.25	0.00	0.00	0.00	0.00	0.00	0.00
total outflow	9.50	9.70	9.50	8.70	8.30	7.40	5.50	2.80	3.60	3.30	1.90	0.80	0.00	0.00	0.00	0.00	0.00	0.00
Operation	<--			Outflow from Reservoir						-->			<-- no-operation -->					

Note1) Arzni-Shamiram canal convey water to only Part2 section from 1st period June to3rd period October. Other area is irrigated by Reservoir water

Note2) Arzni-Branch canal of intake is available from 2nd period April to3rd period May to Yeghvard WUA.

(b) Emergency operation

Special attention has to be paid shortly after the earthquake and similar situation. To prevent the dangerous situation for reservoir, the emergency operation shall be executed. The detailed operation in emergency refers to "6-5-7 Basic Design Related Facilities (Emergency Discharge Structure)".

(3) Necessary observation facility and equipment

Yeghvard reservoir should be equipped with as following facilities and equipment.

Table 6-8-1.4 Recommended Facilities and Equipment

Items	Location and number
Pore water pressure-meter	3 section of dam body with interval of 10m for 1 section
Bench marks	15 marks on surface of dike
Water gauge	2 set : Yeghvard reservoir 4sets : Arzni-Shamiram canal at shortly US. and DS. of intake of Feeder canal 1(PK129+196) and at shortly US. and DS. of intake of Feeder canal 2(PK263+20) 2 sets : Arzni-Branch canal at PK16 and PK121 1 set : at connection with Kasakh river and Outlet canal 3
Flow meter	2 sets : Arzni-Shamiram canal at shortly US. of intake of Feeder canal 1 (PK129+196) and at shortly DS. of intake of Feeder canal 2(PK263+20) 1 set : At connection with Kasakh river and Outlet canal 3 2 set : Feeder canal 1 and 2 3 sets : Outlet canal 1, 2 and 3
Equipment of seismometer	2 set for Dam No.1 and No.2
Remote observation vehicle	1 set (inspection in the pipeline)
Vehicle	2 cars : At main control house
Small vessel	1 vessel : At reservoir
Record system computer	1 set : At main control house

(4) Observation

In order to operate reservoir and related facilities permanently, necessary maintenance works and regular inspection should be conducted periodically. After the irrigation season, the reservoir and conveyance pipeline will be emptied. The timing of regular inspection should be almost no irrigation season.

Table 6-8-1.5 Observation Plan

Action	Period	Subject
Vegetation control	Twice per year	Dam body and surrounding area
Inspection of erosion and damage by visual	Once per year	Dam body and bottom of reservoir and related facilities
Minor embankment, earthwork and erosion repair	as required	Dam body and bottom of reservoir
Erosion protection	as required	Dike and bottom of reservoir
Concrete repair	as required	Related facilities for reservoir
Trash rack cleaning	Once per year	Feeder canal 1 and 2 Outlet canal 2 and 3
Mechanical maintenance ・lubricate mechanical parts ・Paint or grease ferrous metal parts ・Fix loosen bolts and parts	Once per year	Pipe, gates and valves at Feeder canal 1 and 2 Pipe, gates and valves Outlet canal 1, 2 and 3
Electrical maintenance ・Check permanent power supply ・Emergency power supply	Once per year	Main control houses Valve houses
Calibrate monitoring equipment	as specified by suppler or maker	Main control houses Valve houses
Snow and ice clearing	as required, winter season	Feeder canal, Outlet canal and access road

All data regarding reservoir observation and maintenance records in digital should be documented as evidence of safe operation and maintenance. In addition, design construction document shall be stored in main control house in order to use as required.

6-8-2 O&M Plan of the Facilities in the Target Irrigation Area

In the targeted area, open canal, pipeline and distribution gates compose the irrigation system. Regular inspection and maintenance of these structures and facilities should be conducted. In the Project, some structures will be rehabilitated and reconstructed, but these works do not install new function and unseen structure. Most of structures succeed to the original function and structural form. One irrigation engineer is assigned at each WUA in general and those engineers can fix irrigation facilities if damaged. In addition, all WUA have established their own internal rules related to operation and maintenance of irrigation facilities. Therefore, present inspection and maintenance will be continuously implemented by WUAs. Format of inspection and record sheet to support current operation and maintenance activities is suggested as shown in Table 6-8-2.1;

Table 6-8-2.1 Inspection and Record Sheet

Picket distance

Filling Date: DD / MM /YY

General Information

Type: Open canal	Length: m	Height (inside): m	Width (inside): m
		Constructed Year:	Last Rehabilitated Year:

Canal

Damage

Condition			Measure
1. No damage			
2. Small damage on concrete surface		point(s)	Repair by concrete
3. Serious damage (e.g. appearance of steel bar)		point(s)	Request support to WSA or Gov.

Leaking

Condition			Measure
1. No leaking			
2. Small leaking from crack or construction joint		point(s)	Repair by cement mortar
3. Serious leaking from crack or construction join		point(s)	Request support to WSA or Gov.

Pipeline

Condition			Measure
1. No damage			
2. Small damage or leakage on surface		point(s)	Repair by welding
3. Serious damage (e.g. separated joint and large hole)		point(s)	Request support to WSA or Gov.

Gate and Gate Guide

Condition		Measure
1. No rust		
2. Some rust		Rub rust and paint
3. Many rust		Rub rust and paint
4. Hole(s) doe to rust		Change gate

Gate Shaft

Condition		Reason		Measure
1. Easy to operate				Apply oil or grease
2. Not easy to operate				Apply oil or grease
3. Difficult or impossible to operate		1. Rust on shaft		Change shaft
		2. Rust on or deformation of gate		Change gate
		3. Rust on or deformation of gate guide		Change gate guide

Water Tight Rubber

Condition				Measure
1. No deterioration				
2. Some deterioration		1. No leaking		
		2. Some leaking		Change rubber
3. Totally deteriorated				Change rubber

Canal Picture

Typical Cross Section

Special information

CHAPTER 7 PROJECT IMPLEMENTATION ASPECTS

7-1 Project Implementation Structure

7-1-1 Related Agencies to the Project Implementation

(1) State Committee of Water Economy (SCWE)

While SCWE is the state agency to take responsibility for the planning, implementation and operation of the large scale water infrastructures including reservoir, irrigation system and water supply/sanitation investments, the SCWE is placed as implementing body of this F/S of the Project and recognized as the undertaker on ESIA towards the Project implementation. As shown in Figure 7-1-1.1, the SCWE is mainly consisted of administrative office to the Chairman, 5 departments, namely; 1) water supply & sanitation systems, 2) irrigation collector drainage systems 3) real estate & investment, 4) financial economic & accounting and 5) legal & control and 3 divisions with 100 officials in total.

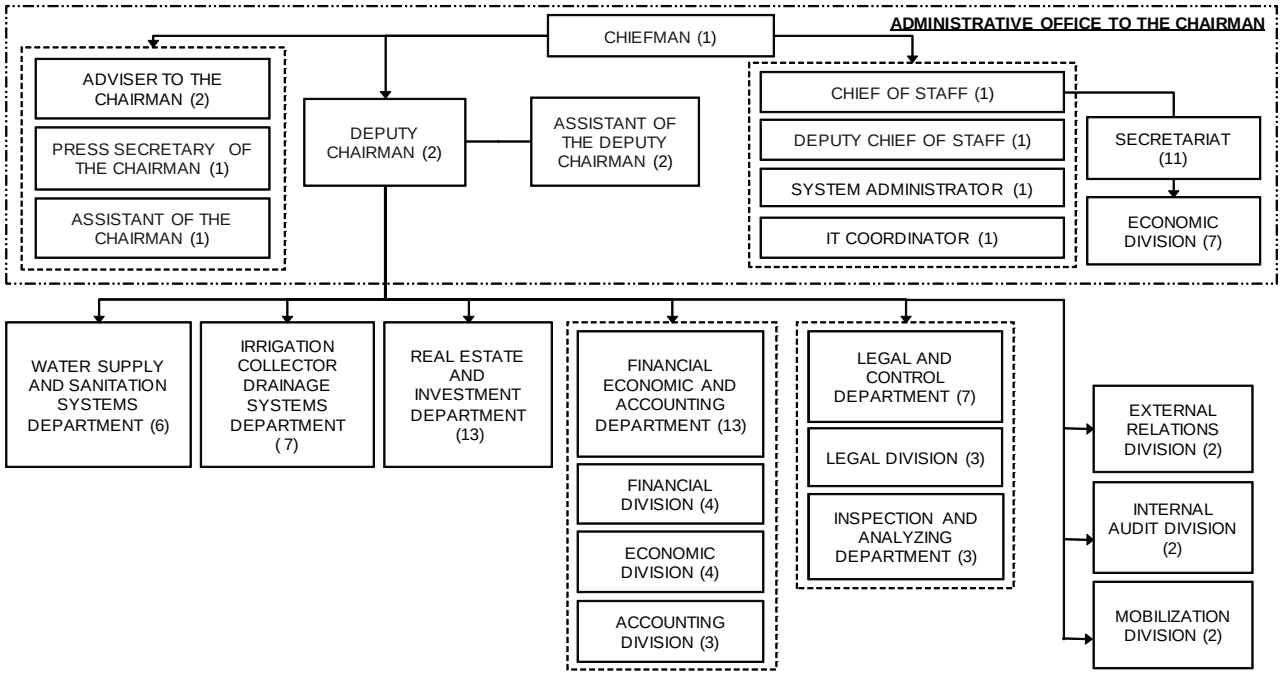


Figure 7-1-1.1 Organization Chart of State Committee of Water Economy (SCWE) as of April 2016

Table 7-1-1.1 Budget of SCWE in Recent Last 4 Years

1USD=486.99AMD Unit: thousand USD

Description	2013	2014	2015	2016
1. Recurrent budget				
1.1 SCWE maintenance	58	63	64	72
1.2 Salary	218	319	431	475
1.Sub-total	**276**	**382**	**495**	**548**
2. Development capital budget				
2.1 Projects, construction works	59,381	52,748	52,141	44,989
2.2 Subsidy	12,153	15,706	19,897	20,801
2.3 Drainage system maintenance	194	194	246	661
2.4 Surveys	23	24	24	24
2.Sub-total	**71,751**	**68,673**	**72,308**	**66,475**
Total (1+2)	**72,027**	**69,055**	**72,803**	**67,023**

Source) Website of SCWE, RA

And as shown in Table 7-1-1.1, budget of SCWE in recent last 4 years is steady with a level of 70 million USD annually.

(2) Water Sector Project Implementation Unit (PIU)

Water Sector PIU was created by the SCWE in 1994 supported by WB to manage the implementation of irrigation improvement projects mainly with dam/reservoir construction funded by international agencies, such as Kaps by KfW, Vedi by AFD, Mastara by EDB and other donors. Out of total number of 36 PIU staff currently, shown in Table 7-1-1.2, 12 specialists are engaged with financed by AFD loan, and 5 specialists and other staff are engaged their works with burden of Armenian national budget.

While PIU consists of 6 units, those are; 1) administration, 2) accountancy, 3) construction, 4) procurement, 5) design and 6) WUA support, main task of PIU are a) preparation of preliminary project schedule and cost estimate, b) assessment of planning and facility design, c) preparation of tender documents, tendering and its evaluation, d) construction supervision / monitoring of project implementation, e) quality control of construction works, f) assistance to ESIA and RAP assessment, g) assistance to applications for loan/grant projects, h) clarification for contents of loan agreement, etc.

Table 7-1-1.2 Number of Staff in Water Sector Project Implementation Unit (PIU) as of April 2016

Section/Unit	Position	Number
1. Administration unit	Director	1
	Head of irrigation system improvement project implementation	1
	Secretary / Computer operator	1
	Senior technical translator	1
2. Accountancy unit	A chief accountant and 3 accountants	4
3. Construction unit	Construction technical supervision engineers	3
4. Procurement unit	Senior experts in procurement & contracts	2
5. Design unit	Planning and design engineers	4
	Engineer (Geodesist)	1
	Engineer (Irrigation)	1
	Environmental specialist	1
	Social specialist	1
	GIS specialist	1
6. WUA support unit	Operation and maintenance engineer	1
	Support team coordinator	1
	Water accounting, planning and management specialist	2
	Institutional development specialist	2
	WUA governance bodies coordinator	1
	Electricity and pump station specialist	1
7. Support staff	Communication specialist	1
	IT expert	1
	Office management	1
	Driver	3
	Total	**36**

Source) PIU, SCWE

Table 7-1-1.3 shows budget of PIU. Since PIU staff engage with their tasks based on the project including international and national funded, allocation of the budget is fluctuant in annual. Since Marimaric Reservoir (24MCM) Project burden of national budget assisted by WB completed in 2012, development capital budget in 2013 was reached to the bottom. On the other hand, Geghardalich Reservoir Project (in Kotayk Marz) started in 2015, therefore, it changed to incremental trend in 2014. Accordingly, number of PIU staff also increased by 48 including 12 specialists assisted by AFD from 30 numbers in 2012.

Table 7-1-1.3 Budget of Water Sector PIU in Recent 4 Years

1USD=486.99AMD Unit: thousand USD

Description	2013	2014	2015	2016
1. Recurrent budget				
1.1 PIU maintenance budget	95	185	96	175
1.2 Salary	219	466	418	468
1.Sub-total	**314**	**651**	**514**	**643**
2. Development capital budget				
2.1 Construction works	1,436	2,803	8,930	18,334
2.2 Consulting services	0	973	471	6,375
2.3 Procurement	0	65	758	1,117
2.Sub-total	**1,436**	**3,841**	**10,159**	**25,826**
Total	**1,750**	**4,492**	**10,673**	**26,469**

Source) PIU, SCWE

(3) Water Supply Agency (WSA)

Two (2) WSAs, namely; Sevan-Hrazdanyan-Jrar and Akhuryan-Araks-Jrar CJSCs are currently selling water to users of irrigation systems, out of eight (8) WSAs existed in Armenia. Sevan-Hrazdanyan-Jrar (the WSA for the Project) is the one to take responsibility for water fee collection, water distribution as well as operation & maintenance in the Project area at present. And Table 7-1-1.4 shows composition of the WSA which covers 4 WUAs in the Project area and other irrigation schemes in the basins of Hrazdan and Kasakh Rivers. The composition indicates several types of work such as a) administration, b) water discharge measurement, c) regulator operation, d) maintenance of canal and pump station, e) water fee collection, etc.

Table 7-1-1.4 Number of Staff in WSA (Sevan-Hrazdanyan-Jrar CJSC)

	Staff	Permanent	Temporary	Total
1.	Management	4	-	4
2.	Administrator	38	-	38
3.	Head of section	16	-	16
4.	Hydraulic engineer	4	3	7
5.	Hydraulic assistant	17	4	21
6.	Electrical engineer	11	-	11
7.	Water measurement specialist	6	2	8
8.	Maintenance staff	14	-	14
9.	Mechanic	5	1	6
10.	Non-engineer	4	1	5
11.	Accountant	6	-	6
12.	Electrical operator	62	8	70
13.	Regulator operator	14	74	88
14.	Water dispatcher	4	5	9
15.	Sentry	17	-	17
16.	Driver	11	-	11
17.	Machine operator	7	-	7
18.	Other	20	3	23
	Total	**260**	**101**	**361**

Source) WSA, SCWE, RA

Table 7-1-1.5 Budget of Water Supply Agency (WSA) in Recent 4 Years

1USD=486.99AMD Unit: thousand USD

Description	2012	2013	2014	2015
1. Recurrent budget				
1.1 WSA Salary & maintenance	2,728	4,083	5,194	6,092
2. Development capital budget	0	0	0	0
Total (1+2)	**2,728**	**4,083**	**5,194**	**6,092**

Source) WSA, SCWE, RA

Table 7-1-1.5 indicates incremental trend of budget allocation to the WSA. Development capital budget is not allocated to the WSA while SCWE and PIU shoulder the allocation of water infrastructural development.

(4) Ministry of Agriculture (MOA)

MOA is a superstructure to agencies of SCWE and PIU, of which organization chart is shown in Figure 7-1-1.2. The MOA mainly consists of sections; 1) Staff of the Minister, 2) Staff of the Ministry, 3) Joint Stock Companies and 3) State Non-profit Companies. “2) Staff of the Ministry” as main body of the MOA composed of 10 departments and 9 divisions, carries agricultural planning, policy making and institutional arrangements such as a) agricultural development programs, b) plant growing /protection, c) livestock, d) agro-processing development, e) agricultural machinery, f) cooperative support, g) research/coordination of support center, h) land use/melioration and i) food security, etc. And “3) Joint Stock Companies” supports regional development for 10 Marzes and other specified subjects.

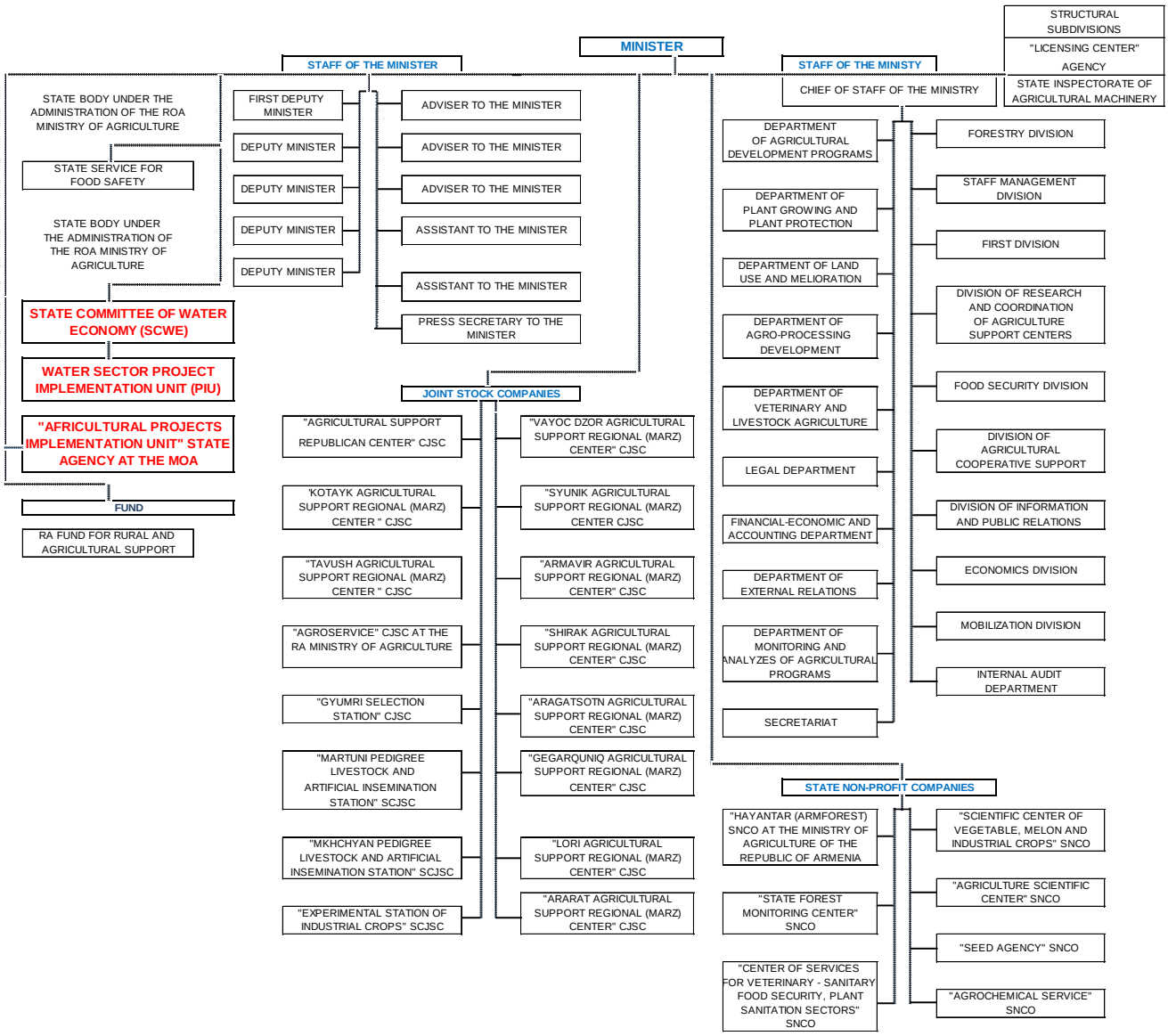


Figure 7-1-1.2 Organization Chart of MOA

It is suggested that the MOA should conduct following five (5) agricultural supporting projects by national fund or other sources, through "Agricultural Projects Implementation Unit" in accordance with the progress of implementation in order to be the Project sustainable and effective;

1) Pilot agricultural cooperatives development,
2) Enhancement of agricultural credit system,
3) Establishment of monitoring and inspection system of pesticide residue,
4) Enhancement of agricultural research to promote market oriented, and
5) Vitalization of agricultural extension.

Considering budget described in Table 7-1-1.6, it is recommended to allocate budget in appropriate timing for conducting agricultural supporting projects shown in the above.

Table 7-1-1.6 Budget of Ministry of Agriculture (MOA) in Recent 4 Years

1USD=486.99AMD Unit: thousand USD

Description	2013	2014	2015	2016
1. Recurrent budget				
1.1 MOA maintenance	152	159	156	159
1.2 Salary	609	890	1,161	1,153
1.Sub-total	**761**	**1,049**	**1,318**	**1,312**
2. Development capital budget				
2.1 Consultation for agricultural inputs	2,886	3,000	3,023	3,070
2.2 Consultation to farmers	2,332	2,971	3,555	3,561
2.3 Monitoring/supervision	112	112	112	112
2.4 Subsidy	2,432	2,921	8,733	8,733
2.5 International projects	3,442	4,230	5,061	5,734
2.Sub-total	**11,204**	**13,233**	**20,484**	**21,210**
Total	**11,965**	**14,282**	**21,802**	**22,522**

Source) Website of MOA, RA

7-1-2 Proposed Implementation Structure and Procedure

As described in Figure 7-1-2.1, project implementation agency as well as undertaker on ESIA will be SCWE in cooperation with PIU which will supervise international consultant to be selected by International Competitive Bidding (ICB). Since PIU has enough specialists within their office with experience of international funded projects, a new organization body is not required to mobilize for the Project implementation.

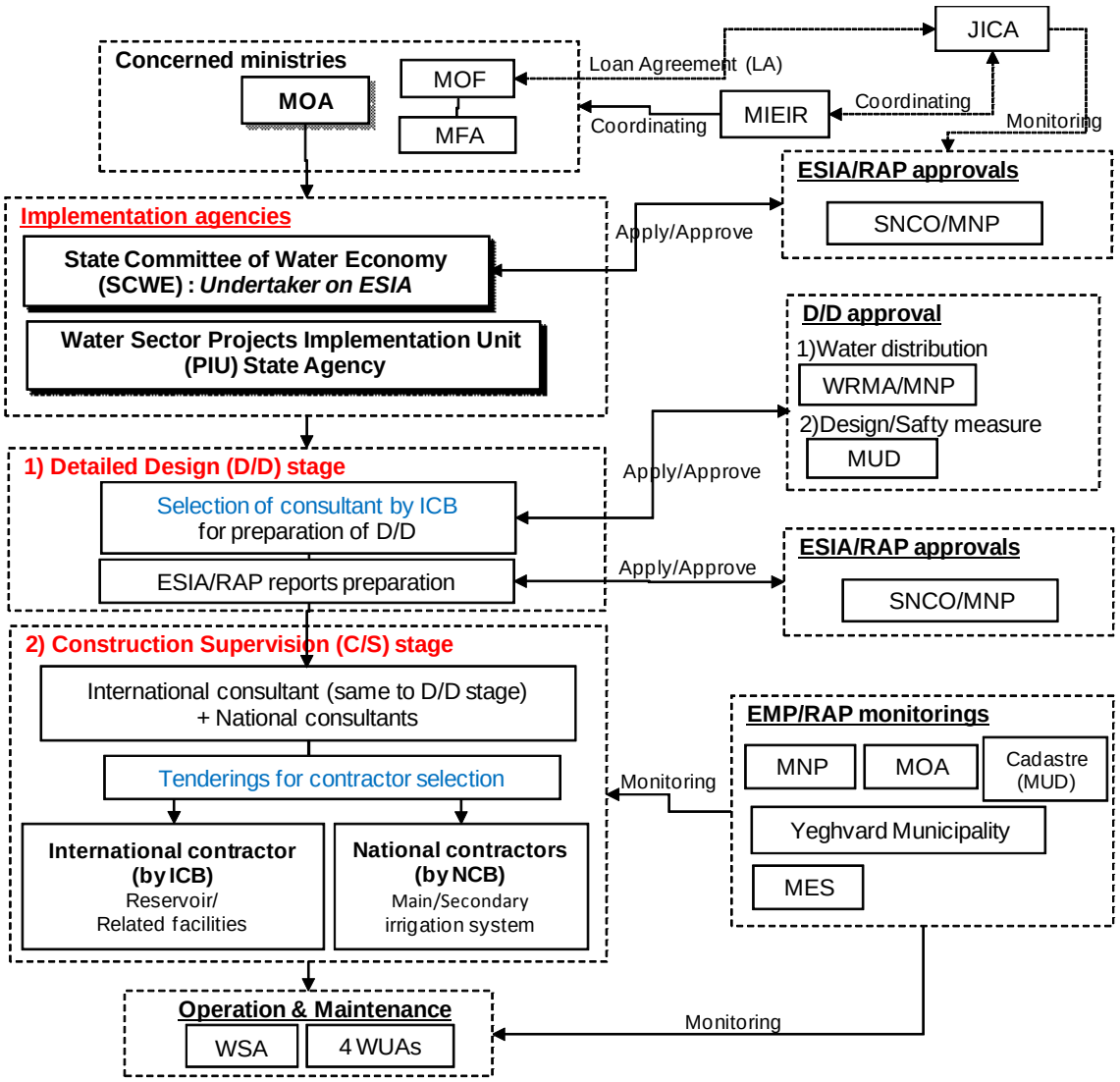
Concerned ministries to the Project implementation, those are; Ministry of Finance (MOF), Ministry of Foreign Affairs (MFA) and MOA will assist to SCWE in coordination with Ministry of International Economic Integration & Reforms (MIEIR) after the Loan Agreement signed by and between MOF and JICA which will be financial agency to disburse Japanese ODA Loan.

Contents of Detailed Design (D/D) including design, drawing, cost estimate, construction schedule and so on to be prepared by the selected consultant, will be applied for their approval by Water Resource Management Agency (WRMA)/MNP and Ministry of Urban Development (MUD). Also, ESIA and RAP reports to be prepared by the international consultants will be applied for their approval by SNCO/MNP.

Tender documents for the selection of construction contractors for both international and national will be prepared by the international consultant through the consultation of PIU. And tendering will be carried out by PIU assisted by the international consultant so that contractors will be selected through ICB and National Competitive Bidding (NCB). It is recommended that Yeghvard reservoir and related

facilities around would be under the ICB and rehabilitation of Arzni-Shamiram canal including other main/secondary canals under the NCB respectively.

In Construction Supervision (S/C) stage, Environmental Management Plan which prepared by international consultant and approved by SNCO/MNP and RAP will be monitored by MNP, MOA MES and Yeghvard municipality.



Abbreviations

MOF	:Ministry of Finance	WRMA	:Water Resources Management Agency (MNP)
MFA	:Ministry of Foreign Affairs	WSA	:Water Supply Agency
MIEIR	:Ministry of International Economic Integration & Reforms	WUA	:Water Users Associations
MOA	:Ministry of Agriculture	ICB	:International Competitive Bidding
MNP	:Ministry of Nature Protection	NCB	:National Competitive Bidding
MTAD	:Ministry of Territorial Administration Development	ESIA	:Environmental and Social Impact Assessment
MES	:Ministry of Emergency Situations	RAP	:Resettlement Action Plan
MENR	:Ministry of Energy & Natural Resources	EMP	:Environmental Management Plan
MUD	:Ministry of Urban Development	Cadastre	:State Committee of the Real Estate Cadastre
SNCO	:State Non-commercial Organization		

Figure 7-1-2.1 Proposed Implementation Structure

7-2 Cost Burden of the Armenian Government

Since most of consultant fee, cost of civil works will be eligible for Japanese ODA loan sponsored by JICA during D/D and C/S stages, 1) technical supervisor fees of EMP/RAP monitoring, 2) general administration expenses of Armenian staff, 3) Tax and duties including VAT, 4) compensation for resettlement/crops are non-eligible portions under the JICA guideline.

Also, it is recommended that the Government of Armenia shoulder the costs for; 1) agricultural supporting projects and 2) on farm level irrigation system improvement. The amount is estimated at 35 to 45 million USD.

Table 7-2.1 Eligible/Non-eligible Portions for Japanese ODA Loan and Cost Burden of Armenian Government

Portion	Contents	Source	Cost burden Armenia
1. Consultant fee	1) Consultant fee during Detailed Design (D/D) stage	Japanese ODA Loan	-
	2) Consultant fee during Construction Supervision (C/S) stage	Japanese ODA Loan	-
	3) Technical supervisor fee for Environmental Management Plan (EMP) during C/S	Japanese ODA Loan	-
	4) Technical supervisor fee for EMP during operation stage	Armenia	TBE[1)]
	5) Technical supervisor fee for Monitoring Plan during C/S	Japanese ODA Loan	-
	6) Technical supervisor fee for RAP Monitoring Plan during operation stage	Armenia	TBE[1)]
2. Cost of civil works	1) Reservoir construction	Japanese ODA Loan	-
	2) Main Irrigation system construction/Rehabilitation	Japanese ODA Loan	-
	3) Secondary canal system construction/Rehabilitation	Japanese ODA Loan	-
	4) On farm level irrigation system improvement	Armenia	1.8
3. Agricultural supporting projects		Armenia	TBE[1)]
4. Machinery Procurement	1) Soil cement mixing machinery, etc.	Japanese ODA Loan	-
5. Price escalation	1) Construction materials, fuel labor cost, etc.	Japanese ODA Loan	-
6. Physical contingency	1) Extreme weather phenomena earthquake, etc.	Japanese ODA Loan	-
	2) War, labor trouble, etc.	Japanese ODA Loan	-
7. General administration expenses such wage of organization/agencies related to the Project implementation		Armenia	TBE[1)]
8. Tax and duties	1) Value Added Tax (VAT), etc.	Armenia	35.4
9. Compensation for resettlement/crops, etc.		Armenia	0.9 (11.6)[2)]
Total (Million USD)			**38.1+ (48.8+)**

Notes) 1) TBE: To be estimated during detailed design
2) Including compensation cost of communal land

CHAPTER 8 PROJECT EVALUATION

Project evaluation is carried out in order to determine the economic viability of the Project. The analysis compares the situations "without" and "with" Project, and is carried out on the point of view of the national economy. As indicators of project efficiency, economic internal rate of return (EIRR), net present value (NPV), and benefit-cost ratio (B/C) have been calculated.

There are another important indicator; FIRR, which is an indicator evaluating projects on the point of view of private companies, however, the Project does not profit-oriented. In fact, the main proposed beneficiaries are farmers, on the other hand, Armenian government is planning to be fully responsible for initial investment, and WSA will be in charge of O&M of the reservoir and other main facilities. It means that the beneficiary is not consistent with the burdens. In this respect, the project cannot be evaluated in terms of financial costs and returns, therefore, FIRR is out of analysis in this evaluation.

8-1 Basic Conditions of Economic Evaluation

1) Following "conservatism principle" of ordinary project evaluation theory, all of benefit and cost has to be estimated conservatively.

2) Referring to similar projects in the agriculture sector in Armenia, the economic life of the Project is designed at 35 years.

3) Project costs and benefits are calculated in USD. The current exchange rate, as of averaging February- April 2016, is set at 1USD = 486.99 AMD (Central Bank of Armenia).

4) The opportunity cost of capital in Armenia is not established yet. Referring to similar projects, it is 8% in the WB (2013a)[1], 5-12% (three cases) in KfW (2014)[2], and 4% in AFD (2014)[3]. From the point of view of "conservatism principle", the highest ratio within the donors i.e. 12% is selected. The percentage "12%" is widely employed as a reference opportunity cost of capital by the WB, ADB and JICA in the sector of irrigation/agriculture development in the world.

5) Price escalation is not considered in economic analysis because the evaluation should be done in real price. Transfer items such as taxes (including VAT), interests, and subsidies are excluded from economic price since it is "zero-sum" when it is aggregated in whole economy.

6) Incremental operation and maintenance (O&M) cost is assumed at 1.00 % of initial investment referring to similar projects in the agriculture sector in the other country (See Appendix-M).

7) In addition to incremental O&M cost, large rehabilitation cost is considered in case of water leakage problem due to unexpected disaster such as earthquake.

   Assuming that 1 (one) large maintenance will be needed during the evaluation periods, for instance, due to a large earthquake. The rehabilitation cost is assumed 50% of initial investment of reservoir consisting of construction cost, indirect cost, consultant fee, price escalation, and physical contingency. Since there is a difficulty of forecasting when such large rehabilitation will be needed, therefore, uniform probability (i.e. 1/30 probability every year) is assumed. With these conditions, the expected rehabilitation cost per year is about 2.5 million USD (150 million USD/2/30), or almost equivalent to 1.0% of the Project costs shown in Table 8-2.1 – Table 8-2.4.

   Summing up incremental O&M cost and large rehabilitation cost, the annual O&M cost is 2.0%.

[1] World Bank (2013a), "*Project appraisal document on a proposed loan in the amount of US$30 million to the republic of Armenia for an irrigation system enhancement project*"
[2] KfW (2014), "*Integrated Water Resource Management/Akhouryan River – Construction of Kaps Reservoir and Gravity Irrigation System – Task I Update of feasibility study, Draft feasibility report.* "
[3] AFD (2014), "*Construction of the Vedi Reservoir for irrigation in the Ararat Valley – Task1: Feasibility Study*"

8) The percentage of accrued costs and benefits over the evaluation periods are summarized in Table 8-1.1.

- Increase in livestock production is supposed to be realized gradually over a 4-year period as on site-producers shift their agriculture systems step by step.
- Pumping irrigation system will be shifted to gravity irrigation system. Taking into account that it may take times to change the customs, it is assumed that it will pass 4 years to abolish the pump station completely.
- The amount of water distribution from Lake Sevan has been controlled by WSA so it is reasonable assumption that the benefit of conservation of Lake Sevan has been accrued just after the completion of construction.

Table 8-1.1 List of Percentage of Project Costs and Benefits accrued over the Evaluation Periods

Costs and Benefits over the periods		Year									
		2017	2018	2019	2020	2021	2022	2023	2024	2025	After 2026
(-)	Project Costs	4%	1%	38%	28%	20%	9%	0%	0%	0%	0%
(-)	O&M	0%	0%	0%	0%	0%	100%	100%	100%	100%	100%
(-)	Opportunity cost of HPPs	0%	0%	0%	0%	0%	100%	100%	100%	100%	100%
(-)	Land Compensation Cost	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%
(+)	Increase in Cropping Income	Calculated in Annual Cash Flow by Crops (See Appendix-M)									
(+)	Increase in Livestock Production	0%	0%	0%	0%	0%	25%	50%	75%	100%	100%
(+)	Net Saving in Pump O&M cost	0%	0%	0%	0%	0%	25%	50%	75%	100%	100%
(+)	Conservation of Lake Sevan	0%	0%	0%	0%	0%	100%	100%	100%	100%	100%

8-2 Estimated Project Costs

The Project cost by the option is already derived in the cost estimation. In order to carry out the economic analysis, the cost has to be divided into two partition: foreign currency and domestic currency. For the sake of applying appropriate specific conversion factors, domestic currency partition should be divided into material costs, skilled labor costs, unskilled labor costs, and equipment costs.

Table 8-2.1 to Table 8-2.4 show the Project costs by foreign currency and domestic currency. The economic project cost which has been applied in the economic analysis is shown in red color.

Table 8-2.1 Financial and Economic Costs (Bentonite Sheet)

Component	Cost Estimation	Financial Cost			Economic Cost			
		FC	LC	Total	FC	Conversion Factor	LC	Total
Material (a)	6.0	3.0	3.0	6.0	3.0	0.9	2.7	5.7
Labor (b = c + d)	41.5	2.1	39.4	41.5	2.1	-	34.5	36.6
c. Skilled Labor	24.1	1.2	22.9	24.1	1.2	1.0	22.9	24.1
d. Unskilled Labor	17.4	0.9	16.6	17.4	0.9	0.7	11.6	12.5
Equipment (e)	73.1	36.5	36.5	73.1	36.5	0.9	32.9	69.4
Direct Cost Total (A = a + b + e)	120.6	41.6	79.0	120.6	41.6	-	70.1	111.7
Indirect Expenses (B)	37.2	18.6	18.6	37.2	18.6	0.9	16.7	35.3
Construction Cost Total (C = A + B)	157.8	60.2	97.6	157.8	60.2	-	86.8	147.0
Consultant Service (D)	9.5	7.4	2.1	9.5	7.4	1.0	2.1	9.5
Base Cost (E = C + D)	167.3	67.6	99.7	167.3	67.6	-	88.9	156.5
Physical Contingency (F)	8.4	3.4	5	8.4	3.4	-	4.4	7.8
Economic Cost Components (G = E + F)	175.7	71.0	104.7	175.7	71.0	-	93.3	**164.3**
Price Contingency (J)	17.1	6.9	10.2	17.1	6.9	-	9.1	16.0
VAT (H)	38.6	15.6	23.0	38.6	15.6	-	20.5	36.1
Grand Total with VAT (K)	231.4	93.5	137.8	231.3	93.5	-	122.8	216.4

Source) JICA Survey Team

Table 8-2.2 Financial and Economic Costs (Soil-cement Coverage)

Component	Cost Estimation	Financial Cost			Economic Cost			
		FC	LC	Total	FC	Conversion Factor	LC	Total
Material (a)	7.6	3.8	3.8	7.6	3.8	0.9	3.4	7.2
Labor (b = c + d)	52.2	2.6	49.6	52.2	2.6	-	43.4	46.0
c. Skilled Labor	30.3	1.5	28.8	30.3	1.5	1.0	28.8	30.3
d. Unskilled Labor	21.9	1.1	20.8	21.9	1.1	0.7	14.6	15.7
Equipment (e)	92.0	46.0	46.0	92.0	46.0	0.9	41.4	87.4
Direct Cost Total (A = a + b + e)	151.8	52.4	99.4	151.8	52.4	-	88.2	140.6
Indirect Expenses (B)	46.9	23.5	23.5	46.9	23.5	0.9	21.1	44.6
Construction Cost Total (C = A + B)	198.7	75.9	122.9	198.7	75.9	-	109.3	185.2
Consultant Service (D)	11.9	9.3	2.6	11.9	9.3	1.0	2.6	11.9
Base Cost (E = C + D)	210.6	85.1	125.5	210.6	85.1	-	111.9	197.0
Physical Contingency (F)	10.5	4.3	6.3	10.6	4.3	-	5.6	9.9
Economic Cost Components (G = E + F)	221.1	89.4	131.8	221.2	89.4	-	117.5	**206.9**
Price Contingency (J)	21.5	8.7	12.8	21.5	8.7	-	11.4	20.1
VAT (H)	48.5	19.6	28.9	48.5	19.6	-	25.8	45.4
Grand Total with VAT (K)	291.2	117.7	173.5	291.2	117.7	-	154.7	272.4

Source) JICA Survey Team

Table 8-2.3 Financial and Economic Costs (Bentonite-soil Mixture)

Component	Cost Estimation	Financial Cost			Economic Cost			
		FC	LC	Total	FC	Conversion Factor	LC	Total
Material (a)	6.2	3.1	3.1	6.2	3.1	0.9	2.8	5.9
Labor (b = c + d)	42.4	2.1	40.3	42.4	2.1	-	35.2	37.3
c. Skilled Labor	24.6	1.2	23.4	24.6	1.2	1.0	23.4	24.6
d. Unskilled Labor	17.8	0.9	16.9	17.8	0.9	0.7	11.8	12.7
Equipment (e)	74.7	37.4	37.4	74.7	37.4	0.9	33.6	71.0
Direct Cost Total (A = a + b + e)	123.3	42.6	80.7	123.3	42.6	-	71.6	114.2
Indirect Expenses (B)	38.2	19.1	19.1	38.2	19.1	0.9	17.2	36.3
Construction Cost Total (C = A + B)	161.5	61.7	99.8	161.5	61.7	-	88.8	150.5
Consultant Service (D)	9.7	7.6	2.1	9.7	7.6	1.0	2.1	9.7
Base Cost (E = C + D)	171.2	69.2	102.0	171.2	69.2	-	90.9	160.1
Physical Contingency (F)	8.6	3.5	5.1	8.6	3.5	-	4.5	8.0
Economic Cost Components (G = E + F)	179.8	72.7	107.1	179.8	72.7	-	95.4	**168.1**
Price Contingency (J)	17.5	7.1	10.4	17.5	7.1	-	9.3	16.3
VAT (H)	39.5	16.0	23.5	39.5	16.0	-	20.9	36.9
Grand Total with VAT (K)	236.8	95.7	141.0	236.8	95.7	-	125.6	221.4

Source) JICA Survey Team

Table 8-2.4 Financial and Economic Costs (Soil-cement with a Sandwiched Bentonite Sheet)

Component	Cost Estimation	Financial Cost			Economic Cost			
		FC	LC	Total	FC	Conversion Factor	LC	Total
Material (a)	5.9	3.0	3.0	5.9	3.0	0.9	2.7	5.7
Labor (b = c + d)	40.7	2.0	38.7	40.7	2.0	-	33.8	35.8
c. Skilled Labor	23.6	1.2	22.4	23.6	1.2	1.0	22.4	23.6
d. Unskilled Labor	17.1	0.9	16.2	17.1	0.9	0.7	11.4	12.3
Equipment (e)	71.7	35.8	35.8	71.7	35.8	0.9	32.3	68.1
Direct Cost Total (A = a + b + e)	118.3	40.8	77.5	118.3	40.8	-	68.8	109.6
Indirect Expenses (B)	36.5	18.3	18.3	36.5	18.3	0.9	16.4	34.7
Construction Cost Total (C = A + B)	154.8	59.1	95.7	154.8	59.1	-	85.2	144.3
Consultant Service (D)	9.3	7.3	2.1	9.3	7.3	1.0	2.1	9.4
Base Cost (E = C + D)	164.1	66.3	97.8	164.1	66.3	-	87.3	153.6
Physical Contingency (F)	8.2	3.3	4.9	8.2	3.3	-	4.4	7.7
Economic Cost Components (G = E + F)	172.3	69.6	102.7	172.3	69.6	-	91.7	**161.3**
Price Contingency (J)	16.7	6.8	10.0	16.7	6.8	-	8.9	15.7
VAT (H)	37.8	15.3	22.5	37.8	15.3	-	20.1	35.4
Grand Total with VAT (K)	226.9	91.7	135.2	226.9	91.7	-	120.7	212.4

Source) JICA Survey Team

8-3 Expected Project Benefits

In the base analysis, three (3) major benefits are considered; a) benefit from yield and area increase in crop production; b) benefit from livestock production improvement; c) benefit from O&M cost reduction by abolishing pump stations. The analysis is called as “base 0” analysis.

On the top of base case, further benefit d) benefit from conservation of Lake Sevan is also taken into consideration. It is called as “base 1” analysis

In this sub-chapter, above mentioned four (4) benefit will be identified in economic terms. Firstly, specific conversion factors for economic pricing are calculated in Sub-Chapter 8-3-1.

8-3-1 Conversion Factors Employed in the Evaluation

It should be noted that conversion factors are not standardized in Armenia. Due to data and time limitation, calculation results from similar projects is applied. Followings are the calculation basis for specific goods and services;

(a) Skilled and Unskilled Labor

For skilled labor, generally “competitive market” is assumed. It means that the specific conversion factor for skilled labor is 1.000. In contrast to this, reflecting rural unemployment, 0.700 of the specific conversion factor for unskilled labor is employed, which is widely used in project evaluation.

(b) Fuel requiring works

On the one hand, fuel for the agricultural sector is subsidized 70 AMD/liter of the market price, and the fuel price subsidized is 350AMD/liter. Then, the subsidy-adjusted market price is 420AMD/liter or 20% higher than the one subsidized. On the other hand, fuel is taxed by 2.8 % of the market price, so the unbiased market price is 17.2% higher than the actual one (20% - 2.8%).

It is unclear how much percentage out of the cost for mechanized works can be explained by fuel charge, therefore, referring to similar project, it is assumed that 30% out of them is fuel charge.

From the above mentioned calculation basis, the specific conversion factor for fuel requiring works is; $\{1+0.3\times(70/350 - 0.028)\} \fallingdotseq 1.052$.

(c) Seeds

According to the interview to MOA, some seeds are subsidized. The market price and selling price to farmers with subsidies are shown in Table 8-3-1.1. Immediately, the specific conversion factors are 1.888 for wheat, 2.532 for barley, 1.797 for alfalfa and 2.663 for maize.

Table 8-3-1.1 Calculation of Conversion Factors for Subsidized Seeds

Seeds	(AMD/kg)			Conversion Factor 1+(B)/(C)
	Market Price (A)	Selling Price to farmers with subsidies (B)	Difference (C) =(A) - (B)	
Wheat	302.0	160	142.0	1.888
Barley	329.1	130	199.1	2.532
Alfalfa	2,695.0	1,500	1,195.0	1.797
Maize	932.0	350	582.0	2.663

Source) JICA Survey Team, data is provided by MOA

(d) Fertilizers

Conversion factors for some fertilizers subsidized are calculated as listed in Table 8-3-1.2. The specific conversion factors are 1.536 for nitrogenous fertilizer, 1.971 for phosphoric fertilizer and 1.971 for

potassic fertilizer.

Table 8-3-1.2 Calculation of Conversion Factors for Subsidized Fertilizers

Fertilizer	(AMD/kg)			Conversion Factor 1+(B)/(C)
	Market Price (A)	Selling Price to farmers with subsidies (B)	Difference (C) = (A) - (B)	
Nitrogenous	184.3	120.0	64.3	1.536
Phosphoric	276.0	140.0	136.0	1.971
Potassic	276.0	140.0	136.0	1.971

Source) JICA Survey Team, data is provided by MOA

(e) Water Fees

According to the WB (2013a), current averaged water cost is approximately 18.7 AMD per m^3 or 1.7 times larger than farmer's water fee 11.04 AMD per m^3. Therefore, the specific conversion factor is 1.700.

(f) Electricity

According to the WB (2013a), current electricity prices in Armenia (AMD 0.67/kw/h) are significantly lower than their real costs. Consequently, the specific conversion factor of electricity cost is 1.250.

(g) Crop pricing

Due to the data limitation, the survey team applies specific conversion factors calculated in KfW (2014). By using the result, it is estimated 1.020 for winter wheat, 0.720 for barley, 0.820 for maize, and 1.000 for other crops.

(h) Others

Standard Conversion Factor (0.90) has been applied for other economic pricing if it is necessary.

8-3-2 Increment in Cropping Income

In the existing irrigation areas (8,391ha), with the Project, the greater reliability and volume of water will enable farmers to produce crops more stably since they have been managed their irrigation water at the suitable time. In other words, the Project can mitigate the damages in yields due to extreme weather conditions such as irregular and random precipitation. Moreover, in the newly developed areas, additional irrigable areas (3,956ha) will be generated. The increment in agricultural income is the largest and most important benefit of the Project.

To estimate the benefit, valuation of costs and benefits of crop production was made by reference to the collected information in Table 8-3-2.1

Table 8-3-2.1 Information Sources for Costs and Benefits Valuation of Major Crops

Information	Main Source
1. Costs and benefits calculation basis, open field cultivation	Ministry of Agriculture, RA
2. Costs and benefits calculation basis, greenhouse cultivation	The Greenhouse Association, RA
3. Unit prices (inputs, labor, crops, etc.)	Survey result of the Survey Team
4. Productivity of crops	Community offices concerned WUA workshops
5. Farming practice of fruits and grapes	Experienced farmers

Source) JICA Survey Team

(1) Costs factors

a. Crop production costs

Unit production costs of major crops are shown in Table 8-3-2.2, while breakdown of the costs for each crop including conversion to economic costs is shown in Appendix-M. The crop production costs between the cases of without-project (present) and of with-project are same, as it is considered that crop management of individual farmers in the Project area will not change even after construction of the Yeghvard reservoir.

Table 8-3-2.2 Production Costs of Major Crops (per ha)

No.	Crop	Financial Costs (AMD/ha)	Economic Costs (AMD/ha)	Remarks
1	Wheat	344,000	416,394	1 crop
2	Barley	298,667	357,619	1 crop
3	Maize (grain)	468,800	523,462	1 crop
4	Alfalfa	3,783,000	3,553,503	6 years total
5	Potato	1,735,000	1,778,478	1 crop
6	Tomato, open	1,761,800	1,713,074	1 crop
7	Tomato, green-house	14,951,500	12,772,680	1 crop
	Greenhouse construction	38,000,000	38,000,000	20 years-life
8	Cucumber, open	1,533,200	1,490,021	1 crop
9	Cucumber, green-house	12,849,600	11,448,500	1 crop
	Greenhouse construction	38,000,000	38,000,000	20 years-life
10	Eggplant	1,746,600	1,708,581	1 crop
11	Sweet pepper	1,738,600	1,700,168	1 crop
12	Cabbage	1,420,200	1,404,204	1 crop
13	Water melon	1,550,000	1,596,869	1 crop
14	Grape (50 years average)	76,760,000	63,253,398	50 years total
15	Apricot (60 years average)	48,831,400	42,304,211	60 years total
16	Apple (30 years average)	38,699,200	33,968,055	30 years total

Source) JICA Survey Team

b. Additional initial costs for new cropping

The new cropped area is categorized into farmland in cadaster. According to the results of the field survey, a major part of the area is abandoned farmland with poor vegetation due to rather dry climate condition in the area. Most farmers will be able to start farming in the new cropped area without large-scale land reclamation works considering the present condition. Table 8-3-2.3 shows additional costs borne by individual farmers for starting farming in the new cropped area. The costs are only applicable to annual crops and alfalfa, since such costs for grapes and other fruits are included in the production costs as shown in Table 8-3-2.2.

Table 8-3-2.3 Additional Initial Costs for New Cropping

Inputs	Financial Costs (AMD/ha)	Economic Costs (AMD/ha)	Remarks
Land cleaning & stone collection	50,000	3,5000	Hired labor
Deep Tillage	70,000	73,640	Tractor
Land levelling	20,000	21,040	Tractor
Compost	80,000	80,000	10 ton/ha
Total	220,000	209,680	

Source: JICA Survey Team

(2) Crop farm-gate prices

Crop farm-gate prices as shown in Table 8-3-2.4 were collected through the survey and converted into economic prices using conversion factors referenced from KFW (2014).

Table 8-3-2.4 Crop Farm-gate Prices

No.	Crop	Financial Price (AMD/kg)	Economic Price (AMD/kg)	Remarks
1	Wheat	120	122	
2	Barley	-	-	Converted to livestock value
3	Maize (grain)	-	-	Converted to livestock value
4	Alfalfa	-	-	Converted to livestock value
5	Potato	110	110	
6	Tomato, open	120	120	
7	Tomato, green-house	250	250	
8	Cucumber, open	100	100	
9	Cucumber, green-house	220	220	
10	Eggplant	100	100	
11	Sweet pepper	170	170	
12	Cabbage	110	110	
13	Water melon	60	60	
14	Grape	150	150	
15	Apricot	200	200	
16	Apple	200	200	

Source) JICA Survey Team

It is expected that additional 3,956 ha will be irrigated with the Project. Assuming that 70% out of 3,956 ha will have started cultivation from just after the completion of Yeghvard reservoir (i.e. from 2023), and the other 20% and 10% of them will starting from 2nd year (2024) and 3rd year (2025) respectively.

The benefit calculation is done based on annual cash flow by each crops. Figure 8-3-2.1 shows that the annual agricultural benefit including both existing irrigable areas and newly developed areas. For more detail, see Appendix-M.

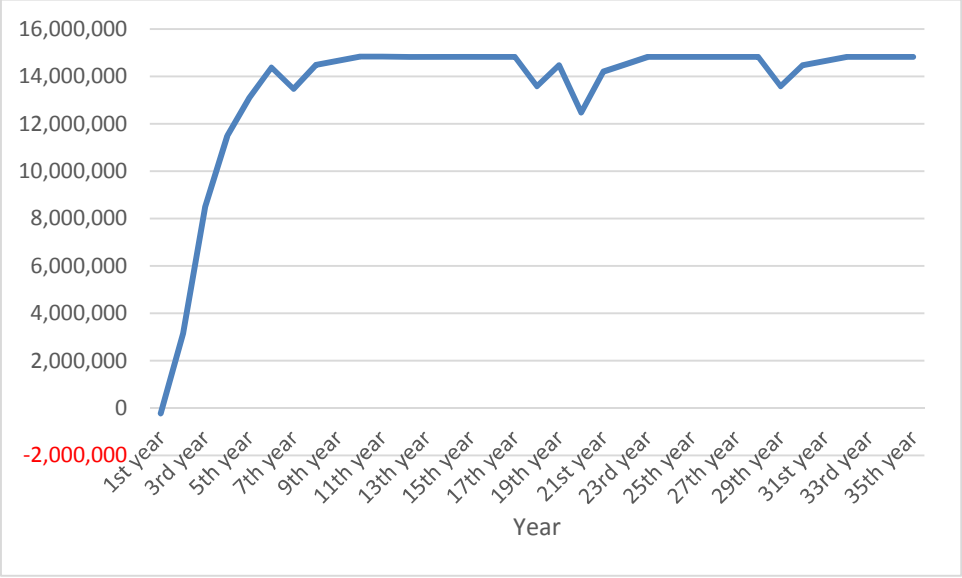


Figure 8-3-2.1 Annual Cash Flow of Agriculture Benefit (Unit: USD)

8-3-3 Increment in Livestock Production

It is said that fodder production is one of a bottleneck of livestock breeding. Since self-fodder production plays an important role of livestock breeding, it is expected that the increase in production of alfalfa and other fodder crops trigger the increase in number of livestock that farmers can produce.

Table 8-3-3.1 shows that the estimated number of cattle can be fed by farmer's self-produced forages in 2015 (without Project) and in 2023 (with Project). The benefit from increase in livestock production is 312,219 USD (Table 8-3-3.2).

Table8-3-3.1 Number of Cattles Fed by Produced Forages in 2015 and in 2023

Crop	Livestock Production in 2015			Livestock Production in 2023		
	Area (ha)	Yield (kg/ha)	Production (ton)	Area (ha)	Yield (kg/ha)	Production (ton)
Alfalfa	916	11.3	10.4	1,452	11.5	16.7
Barley	374	2.7	1.01	457	3.4	1.55
Maize (grain)	118	2.4	0.28	144	2.6	0.37
Total (ton)			11.7			18.62
Forage requirement per cattle (kg)			2.4			2.4
Cattles can be fed by forages (heads)			4,870			7,761

Source) JICA survey Team based on interviews to livestock producers

Table8-3-3.2 Aggregated Livestock Income in 2015 and in 2023

Livestock	Without (2015)			With (2023)			With - Without
	Heads	Net Profit (USD)	Profit (USD)	Heads	Net Profit (USD)	Profit (USD)	
Cattle	4,870	108	525,960	7,761	108	838,179	312,219

Source) JICA survey Team

8-3-4 Net Saving in Pump O&M Cost

With the Project, all of deep wells and pump stations operated by WUA and WSA in the Project target areas will be converted to gravity irrigation systems. It means that O&M cost of deep wells and pumps will be zero after the completion of abolishment. The O&M cost reduction is one of the main benefit of the project.

Table 8-3-4.1 Operation and Maintenance Cost of Pump Station Operated by WSA

Name of the pump station	O&M title	Unit	Years					
			2011	2012	2013	2014	2015	Average
Ranchpar 1	Electricity	thousand kWh	2,000.4	3,063.3	7,340.7	9,281.7	8,593.8	6,056.0
		thousand AMD	45,362.9	68,767.9	223,603.2	311,327.9	333,074.0	196,427.2
	Repair and maintenance	thousand AMD	9,450.0	8,125.2	10,221.0	10,620.0	15,000.0	10,683.2
Ranchpar 2	Electricity	thousand kWh	125.3	548.5	4,480.5	6,018.0	5,138.3	3,262.1
		thousand AMD	2,458.6	10,781.6	122,936.1	179,079.7	180,838.9	99,219.0
	Repair and maintenance	thousand AMD	6,725.0	7,120.5	5,840.0	9,720.0	12,000.0	8,281.1
Aknalich	Electricity	thousand kWh	2,202.2	1,983.6	1,550.9	1,779.9	1,183.5	1,740.0
		thousand AMD	49,729.9	44,563.7	43,879.7	59,355.7	45,456.3	48,597.1
	Repair and maintenance	thousand AMD	4,950.0	6,120.0	8,346.0	4,620.0	5,000.0	5,807.2
Total	Electricity	thousand kWh	4,327.9	5,595.4	13,372.1	17,079.6	14,915.6	11,058.1
		thousand AMD	97,551.4	124,113.2	390,419.0	549,763.3	559,369.2	344,243.2
	Repair and maintenance	thousand AMD	21,125.0	21,365.7	24,407.0	24,960.0	32,000.0	24,771.5

Source) WSA

Taking average by multiple year, the current annual electricity cost of three (3) large pump stations operated by WSA is 344,243.2 thousand AMD, while the repair and maintenance cost of them is 24,771.5 thousand AMD per year (Table 8-3-4.1).

On the other hand, there are large number of deep wells and small pump stations operated by WUA. The total electricity cost of them is estimated 611,058.2 thousand AMD per year, while the total repair and maintenance cost of them is estimated 68,861.1 AMD per year (Table 8-3-4.2).

Table 8-3-4.2 Operation and Maintenance Cost of Pump Station Operated by WUA

WUA	O&M title	Unit	Years			
			2013	2014	2015	Average
Vagharshapat	Electricity	thousand AMD	240,063.3	308,097.8	353,835.7	300,665.6
	P/S and D/W Rehabilitation	thousand AMD	19,840.4	22,245.4	76,775.2	39,620.3
Khoy	Electricity	thousand AMD	278,151.9	301,995.3	351,030.4	310,392.5
	P/S and D/W Rehabilitation	thousand AMD	21,922.2	43,360.4	21,698.9	28,993.8
Ashtarak	Electricity	thousand AMD	0.0	0.0	0.0	0.0
	P/S and D/W Rehabilitation	thousand AMD	0.0	0.0	0.0	0.0
Yeghvard	Electricity	thousand AMD	0.0	0.0	0.0	0.0
	P/S and D/W Rehabilitation	thousand AMD	53.0	648.7	39.1	246.9
Total	Electricity	thousand AMD	518,215.1	610,093.2	704,866.2	611,058.2
	P/S and D/W Rehabilitation	thousand AMD	41,762.6	65,605.8	98,474.1	68,861.1

Source) WUA

Using specific conversion factors (See Sub-Chapter 8-3-1), the benefit of O&M cost reduction is estimated 2,625,097.3 USD/year in economic terms (Table 8-3-4.3).

Table 8-3-4.3 Aggregated Saving Costs for Operation and Maintenance of D/W and P/S

Operation and Maintenance		Financial O&M		Conversion Factor	Economic O&M
		(thousand AMD)	(USD)		(thousand USD)
Electricity	WSA	344,243.3	706,879.6	1.25	883,599.5
	WUA	611,058.2	1,254,765.3	1.25	1,568,456.6
Repair and Maintenance	WSA	24,771.5	50,866.5	0.90	45,779.9
	WUA	68,861.1	141,401.5	0.90	127,261.4
Total		1,048,934.1	2,153,912.9	-	2,625,097.3

Source) JICA Survey Team

8-3-5 Conservation of Lake Sevan

Lake Sevan, the world's largest high-altitude lakes located in the central part of Armenia, has environmental, economic, and social significance and is an important multipurpose water reservoir for irrigation, hydropower and recreational uses. The Project target area is no exception since 50MCM/year out of irrigation water demand is now distributed from the Lake. To protect the Lake, Armenian government adapted two laws in 2001 that recognized the importance of Lake Sevan and targeted to raise the level 6 meters by 2030. From these reasons, it is essentially important to reduce the dependency of Lake Sevan in irrigation by developing another water resource within the Hrazdan river basin.

With the Project, snow melting water, which is now in no use in irrigation, will be utilized for irrigation purposes, and the water dependency from Lake Sevan is planned to be zero thanks to the Project. Since this "conservation of Lake Sevan" is consistent with Armenian national strategy, it is better to be estimated as the numerical value on the viewpoint of the national economy.

Since "water resource" is generally non-marketed goods, the benefit should be converted to monetary basis in some sort of ways. In order to do this, the benefit calculation applies the idea "alternative method" with necessary modification. The basic concept of it is that if "without the project", this conservation Lake Sevan shall be achieved by an alternative methods. In this case, additional cost is needed, for instance, construction of alternative facilities. It can be said that the cost of alternative methods are some kinds of saving cost thanks to the project.

In this analysis, three alternative methods are proposed with following conditions;

Alternative 1): without project, conservation of Lake Sevan will be achieved up to 50MCM of water per year thanks to extension of drip irrigation system somewhere outside of project areas.

Alternative 2): without project, construction of another reservoir has to be needed in order to stock same amount (50 MCM/year) of free water.

Alternative 3): without project, conservation of Lake Sevan will be achieved by constructing tunnel like Arpa-Sevan tunnel that transfers up to 50 MCM/year.

(1) The Cost of Alternative 1 (Introduce of Drip Irrigation)

Explanation: Without project, independence from Lake Sevan will be achieved by 50MCM/year of water saving thanks to extension of drip irrigation system;

1) Current irrigation water demand with furrow irrigation which *including* water loss during conveyance per ha is 12,472 m^3/ha (154 MCM/12,347 ha).

2) Current *net* irrigation water demand with furrow irrigation *not including* water loss during conveyance per ha is 5,837 m^3/ha (12,472 m^3/ha x 46.8 %).

3) Irrigation water demand with drip irrigation *including* water loss during conveyance per ha is 8,186 m^3/ha (5,837 m^3/ha / 71.3 %)

4) Taking difference, the volume of saving water by introducing drip irrigation is 4,286 m^3/ha (12,472 m^3/ha - 8,186 m^3/ha).

5) To save irrigation water up to the volume of 50 MCM, 11,666 ha of furrow irrigation system should be converted to drip irrigation (50,000,000 m^3 / 4,286 m^3/ha), which costs 13,357 million AMD or equivalent to 27.43 million USD. ---------- (A)

Note: Assume that the on-farm investment cost of introducing drip irrigation is 1,145,000AMD, referring KfW (2014).

Table 8-3-5.1 Capacity of Reservoir by Irrigation Area and Irrigation Method

Trial	Area		Irrigation Type	Conveyance Efficiency	Demand (MCM)	Yeghvard (MCM)
-	12,347		Furrow	46.8%	154	94
(i)	3,644		Furrow	46.8%	40	35
(ii)	12,347	9,949	Furrow	46.8%	146	84
		2,398	Drip	71.3%		
(iii)	12,347	8,397	Furrow	46.8%	140	79
		3,950	Drip	71.3%		

Source) This Report, Table 6-4-3.6

Note) The conveyance efficiency by furrow irrigation defines 46.8% which is calculated as 72% times 65%, and that of drip irrigation defines 71.3% which is calculated as 75% times 95%.

(2) The Cost of Alternative 2 (Reservoir Construction)

Explanation: Without project, construction of another reservoir has to be needed in order to stock 50 MCM of free water;

1) To employ the ordinal unit cost of water development in RA, WB (2015) is referred (Table 8-3-5.2).

2) The unit cost of water development is 1.82USD/m^3 (480.8 million USD/263.81 MCM).

3) To develop alternative reservoir with the volume of 50MCM, it is estimated that the cost is 91.0 million USD (1.82 USD/m^3 x 50MCM). ---------- (B)

Table8-3-5.2 Key Features of Priority Reservoirs

Reservoir name	*River basin*	*Marz (province)*	*Status*	*Total vol. (MCM)*	*Est. cost[a] (million US$)*
Kaps	Akhuryan	Shirak	Partially constructed; feasibility study is in progress for to 60 MCM reservoir option	60.00	44.0
Yegvard	Hrazdan	Kotayk	Partially constructed; feasibility study to be conducted	90.00	139.1
Vedi	Vedi	Ararat	Designed in Soviet times; feasibility study is ongoing; will be followed by preparation of final design for construction of dam	20.00	40.8
Apna	Kasakh	Aragatsotn	Partially constructed; final design was prepared in Soviet times	5.25	8.7
Karmir Guygh	Voskepar	Tavush	Partially constructed	8.50	33.0
Artik	Karkachun	Shirak	Partially constructed	1.69	3.5
Getik	Chichkhan	Lori	Partially constructed; preliminary design available	3.00	7.8
Lichk (Meghriget)	Meghriget	Syunik	New; preliminary design has been prepared by MCA	1.17	6.5
Oshakan (Kasakh)	Kasakh	Aragatsotn	New; feasibility study report is available	13.85	35.0
Argichi	Argichi	Gegharkunik	New dam; preliminary design is available, prepared by Millennium Challenge Corporation	5.50	4.2
Getikvanq	Elegis	Vayots Dzor	New; preliminary investigations have been implemented	23.00	54.0
Gegardalich 2	Yot Aghbyur	Kotayk	New; preliminary design is available	5.50	18.4
Hartavan	Gegharot	Aragatsotn	New; preliminary design is available	3.00	9.7
Khndzoreshk	Karkachun	Syunik	New; preliminary investigations have been implemented	5.20	13.0
Upper Sasnashen	Upper Sasnashen canal	Aragatsotn	New; preliminary investigations have been implemented	1.00	6.5
Elpin	Elpin	Vayots Dzor	New; final design is available	1.00	4.0
Khachik	Khachik canal	Vayots Dzor	New; preliminary investigations have been implemented	0.50	3.1
Astghhadsor	Astghhadsor	Gegharkunik	New; preliminary investigations have been implemented	1.25	2.3
Byurakan (Hamberd)	Hamberd	Aragatsotn	New; preliminary investigations have been implemented	2.70	8.7
Geghadzor	Geghadzor	Aragatsotn	New; preliminary design is available	1.50	6.5
Selav-Mastara	Selav-Mastara	Armavir	New; feasibility study was updated	10.20	32.0
Total				**263.81**	**480.8[b]**

Source) WB (2015) "Toward Integrated Water Resource Management in Armenia"

(3) The Cost of Alternative 3 (Tunnel Construction)

Explanation: To cope with the decreasing trend of the level of Lake Sevan, programs to stabilize the lake level had started in the 1980s. This includes the construction of Arpa-Sevan tunnels, which transferring up to 250 MCM. As the cost of alternative three (3), construction of another tunnel is derived from the project cost of Apra-Sevan tunnel.

1) The project cost of Arpa-Sevan Tunnel is estimated at 4.5 billion USD evaluated in the present monetary value.

2) Planted volume of water conveyance from Lake Arpa to Lake Sevan is 250MCM/year.

Therefore, the unit price of water development per m^3 is:

4,500 million USD/250MCM = 18.0 USD/m^3

The cost of similar tunnel with the water conveyance is up to 50 MCM/year is 900 million USD (18.0 USD/m^3 x 50MCM). ---------- (C)

(4) Annual Benefit Estimation

The comparison between alternative1-3 finds that the most efficient option is alternative one (1): introduce of drip irrigation. From the point of conservatism principle, alternative one (1) is applied as the saving cost of the Project.

Annual benefit is calculated as initial investment cost times discount factor (d_{in}) which is defined as following.

$$Discount\ Factor\ (d_{in}) = \frac{i \times (1+i)^n}{(1+i)^n - 1}$$

i: social discount ratio (12 % is assumed), n: design service life of the facilities (80 years is assumed)

Therefore, the annual benefit of conservation of Lake Sevan is;

The cost of Alternative1 ×Discount Factor = 27.43 Million USD ×0.12 ≒3.3 Million USD

8-3-6 Opportunity Cost of the Project

(1) Opportunity Cost of HPPs Operation

Taking irrigation water from the basin may negatively influence other sectors of the region. The most concerning sector is hydropower station of Sevan-Hrazdan cascade operated by Russian company.

There are seven hydropower stations which account for 10% of the country's electricity. The annual electrical energy production of seven (7) hydropower station is 535.283 million kWh on averaging 2011-2015. The opportunity cost of HPPs is calculated as following;

1) The average current annual production by the seven Sevan-Hrazdan cascade HPPs is 535.283 million kWh on averaging 5 years (2011-2015).

2) On the other hand, the total annual water flow from Hrazdan River connected with seven HPPs is 2,089.382 MCM on averaging 2011-2015.

3) It is assumed that taking 154MCM (104MCM as for irrigation water + 50MCM as for conservation of Lake Sevan) of irrigation water from Hrazdan river reduce the productions of HPPs following the same proportion of water volume: 7.3% (154MCM/2,089.382MCM × 100).

4) According to power tariff study in Armenia, cost-recovery tariff of Sevan-Hrazdan Cascade of HPPs is 4.578AMD/kWh.

Then, the annual opportunity cost of seven HPPs is estimated as 179.4 million AMD (535.283 million kWh × 4.578 AMD/kWh × 7.3%), or equivalent to 0.37 million USD.

(2) Land Compensation and Land Acquisition

According to JICA's guideline, "land compensation and acquisition cost" have to be considered as "opportunity cost" of the project. According to chapter 5, Land compensation cost of the project is

about 0.9 million USD in total.

8-4 Results of Economic Evaluation

Table 8-4.1 summarizes the economic evaluation by the options. As already mentioned, the economic Project cost consists of base cost and physical contingency. In the economic analysis, benefits and costs are standardized in economic terms using conversion factors. Three indicators have been applied: economic internal rate of return (EIRR), net present value (NPV), and benefit-cost ratio (B/C). NPV and B/C are calculated with 12.0% opportunity cost of capital.

All of the options cannot exceed 12.0% opportunity cost of capital which may reflect the little improvement in yield because the Project components consist only of irrigation systems, and not taking account any agricultural extension and/or other soft components. The Project might produce fruits more if there were other components such as agricultural extension to promote more-profitable but more water-intensive products such as vegetable and fruits.

Comparing the four (4) options, “soil-cement with bentonite sheet” marked highest on EIRR and NPV, indicating 5.15 % of EIRR with -59.7 million USD of NPV, and 0.50 of B/C in base 0 case. Still, it is not regarded as viable even the base 1 case (including the benefit from conservation of Lake Sevan) as the EIRR is 7.09% against 12.0% referenced opportunity cost of capital.

Table 8-4.1 Summary of the Economic Evaluation by the Options

Indicators	Options			
	Bentonite Sheet	Bentonite-Soil mixture	Soil-Cement	Soil-cement with bentonite sheet
Project Cost calculated in Cost Estimation				
Grand Total with VAT (Million USD)	231.4	291.2	236.8	226.9
Economic Analysis				
Economic Cost (million USD)	164.3	206.9	168.1	161.3
Incremental O&M Cost (million USD)	1.6	2.1	1.7	1.6
Total Benefit (Base 0) (million USD)	16.7	16.7	16.7	16.7
EIRR (Base 0, %)	4.94%	2.91%	4.74%	5.15%
B/C (Base 0)	0.49	0.39	0.48	0.50
NPV (Base0 , Million USD)	-62.7M$	-94.4M$	-65.6M$	-59.7M$
Total Benefit (Base1) (million USD)	19.0	19.0	19.0	19.0
EIRR (Base1, %)	6.86%	4.70%	6.64%	7.09%
B/C (Base1)	0.61	0.49	0.60	0.63
NPV (Base1, Million USD)	-47.7M$	-79.3M$	-50.5M$	-44.7M$

Source) JICA Survey Team

8-5 Other Qualitative Benefits

For economic evaluation, benefits have to be limited only on “direct”, ”quantitative”, and “not tentative” ones. Still, there are other important benefits originated from the Project so that it is better to be mentioned qualitatively in this sub-chapter. Following are other expected and recommended qualitative project benefits;

1) Cultivation of groundwater; In the Project target areas, there are some cases that WUAs have pumped up the groundwater and used it for irrigation purposes. The current situation of ground water

levels and the volumes of collected water by drain canal for irrigation purposes become worse year by year, especially in Ararat plain area. The abolishment of pumps and deep wells may lead to ground water recharge, which will contribute to protection of the ecosystem in the area.

2) Encourage some industries around the Yeghvard area: The Project area is characterized as a leading area of vegetables and fruits production in the country. Additional agricultural productions may encourage businesses in secondary and tertiary sectors such as food processing industries, packaging industries, agricultural inputs industry, and transportation industry.

3) Creating job opportunity: Although it is a tentative benefit limited only during the construction periods, additional job opportunity will be created on the Armenian labor market.

4) Contribution for climate change mitigation: As it is mentioned in Sub-chapter 5-3-5, the estimated reduction of GHG emission thanks to the Project is 16,575.02 t CO_2/year if all of irrigation purpose pump stations and deep wells in the Project target areas would be abolished. Although it is only secondary impact, the project implementation may reduce the vulnerability of climate change as mentioned in Sub-chapter 5-3-6.

5) Contribution for tourism and leisure industries: There are many types of leisure facilities should be considered for installation nearby the reservoir such as a boating park, a fishing pond, a skating rink etc. It may encourage tourism and leisure industries within Yeghvard areas.

8-6 Proposed Indicators

Several indicators should be established in order to monitoring the Project's status. There are two kinds of indicators: operational indicator and effect indicator.

Operational indicator is an indicator measuring whether the output of the Project has been operated and utilized appropriately, while effect indicator is an indicator that aims at measuring whether the Project impact has been realized as expected.

For the usage of these indicators, several indicators are established based on the plan of 5 years after the project implementation. In the plan, the year of the completion of construction is 2022, so the proposed indicators are evaluated in 2027.

(1) Proposed indicators of irrigation systems (Irrigable area Increase)

Currently, there are 8,391 ha of existing irrigated cropping areas, and additional 3,956 ha of irrigable cropping areas will be generated after the Project implementation. Table 8-6.1 summarizes the current and planned cropping areas.

Table 8-6.1 Operational and Effect Indicators of Irrigation Systems

Crops	Existing Irrigated Area (ha)		Newly Developed Area (ha)		Total Target Area (ha)	
	Baseline Value (2015)	Proposed Indicator (2027)	Baseline Value (2015)	Proposed Indicator (2027)	Baseline Value (2017)	Proposed Indicator (2027)
Wheat	1,535	1,535	0	366	1,535	1,901
Vegetables	2,844	2,844	0	798	2,844	3,642
Grape	1,060	1,060	0	1,221	1,060	2,381
Fruits	831	831	0	788	831	1,619
Alfalfa	916	916	0	536	916	1,452
Other Food and Forage	492	492	0	109	492	601
Potatoes	713	713	0	138	713	851
Total	8,391	8,391	0	3,956	8,391	12,447
Livestock (head)	4,213	6,620	0	3,696	4,213	10,316

Source) JICA Survey Team

However, there are some external conditions such as transformation on land usage, especially from agricultural land to non-agricultural land, acceleration of retirements in farming due to population aging, and lacks of successors in agricultural sector.

(2) Proposed indicators of irrigation systems (Yield Increase)

Improvement in water stability benefits to farmers not only for current irrigable areas, but also new irrigable areas. However, it may take several years to get profit enough in the newly developed area, especially for plantations. Considering this, the targeted yields are set as Table 8-6.2.

Table 8-6.2 Operational and Effect Indicators of Agriculture Supporting

Crops	Existing Irrigated Area (ton/ha)		Newly Developed Area (ton/ha)	
	Baseline Value (2015)	Proposed Indicators (2027)	Baseline Value (2015)	Proposed Indicators (2027)
Wheat	3.6	3.8	-	3.6
Barley	2.7	3.4	-	2.9
Maize (grain)	2.4	2.6	-	2.3
Alfalfa	11.3	11.5	-	11.8
Potato	36.3	41.8	-	38.0
Tomato, open	47.7	50.4	-	45.9
Tomato, green-house	100.0	100.0	-	100.0
Cucumber, open	38.4	42.0	-	38.0
Cucumber, green-house	80.0	80.0	-	80.0
Eggplant	49.8	53.7	-	50.4
Sweet pepper	38.9	41.4	-	38.1
Cabbage	29.7	32.6	-	29.1
Water melon	42.7	45.3	-	42.2
Grape	11.2	13.5	-	10.30
Apricot	7.1	7.6	-	0.00*
Apple	7.7	8.9	-	7.10

Source) JICA Survey Team

* The proposed annual cropping plan and expected yield is shown in Appendix-M

It is difficult to cultivate any fruits within the 5 year period after planting.

(3) Proposed indicators of gravity irrigation systems (energy saving)

All pump stations and deep wells in the target areas are expected be shifted to gravity irrigation system. The plan requires that there will be no running pump station nor deep wells by 4 years after the completion of construction (i.e.2026). Table 8-6.3 indicates the proposed indicators of gravity irrigation systems.

Table 8-6.3 Operational and Effect Indicators of Gravity Irrigation Systems

Operation unit	Name of WUA/PS	Baseline Value				Proposed Indicators (2027) (kWh)
		2013 (thousand kWh)	2014 (thousand kWh)	2015 (thousand kWh)	Average 2013-2015 (kWh)	
WSA	Ranchpar 1	7,340.7	9,281.7	8,593.8	8,405.4	0
	Ranchpar 2	4,480.5	6,018.0	5,138.3	5,212.3	0
	Aknalich	1,550.9	1,779.9	1,183.5	1,504.8	0
WUA	Yegvard	0	0	0	0	0
	Ashtarak	0	0	0	0	0
	Khoy	9397.0	9070.3	9212.3	8713.1	0
	Vagharshapat	7897.5	8980.6	9048.8	8001.6	0
Total		30,666.6	35,130.5	33,176.6	31,837.1	0

Source) JICA Survey Team

The most important external condition is the national policy of RA. Abolishment of pump irrigation is consistent with Armenian national strategies, which makes it easier to request corporations to stakeholders. The policy must have been kept to accomplish the target.

Another important external condition is the irrigation water demand outside of the Yegvard reservoir basin. In principle, all of pumps and deep wells in the area shall be abolished, still, the plan does not exclude the possibility of complementary usage of them in the case of argent needs of water, the water insufficient within the Hrazdan river basin due to very little precipitation or extremely hot summer, for example.

(4) Proposed indicators of water conveyance from Lake Sevan (Conservation of Lake Sevan)

One of the main contribution of the Project is the conservation of Lake Sevan by reducing its burdens on irrigation water. In the plan, the irrigation water in the Yeghvard basin will be distributed without any water supply from Lake Sevan as Table 8-6.4.

Table 8-6.4 Operational and Effect Indicators of Lake Sevan

Volume of Water Conveyance from Lake Sevan at 2015 (Baseline Value, MCM)	Volume of Water conveyance from Lake Sevan at 2027 (Proposed Indicator, MCM)
50	0

Source) JICA Survey Team

However, it should be noted that the plan is based on normal year so it might be difficult in the case if there would be unexpected additional irrigation water demands such as water shortage in other irrigation areas somewhere in the Hrazdan river basin.

CHAPTER 9 PROCUREMENT PLAN

9-1 Condition of Procurement and Contract

Procedure of the detailed design document approved by Armenian agencies

During detailed designs stage, there is an approval process to follow making documents of detailed design effective from the governmental agencies under the Ministry of Urban Development (MUD). For the environmental assessment, MNP takes responsibility on document of ESIA.

Two (2) ways; the one is inspected by independent expertise, the other one is done by state expertise due to technical level of the project. The documents to be prepared by the selected consultant through an international bidding shall apply for the approval to the private company who has the license issued by the governmental agency.

Which processes whether inspected by private company or government agency, are described in the contract to be signed by and between an implementation agency (PIU/SCWE) and the consultant.

9-2 Procurement of Consultant

The expected consultant service is mainly divided into the detailed design (D/D) and the construction supervision (C/S) stages. In case of applying Japanese Yen Loan, the borrower shall be in accordance with the "HANDBOOK for the Procurement under Japanese ODA Loans, April 2012". In addition, the Project shall be suitable harmony with FIDIC.

(1) Detailed Design (D/D) stage

The consultant for the Project should conduct the investigation, examination and design in this stage. In addition, the consultant should prepare the tender documents for the implementation as the result of D/D. The target facilities for designing are recommended separating by areas, namely; "Target Area 1" for reservoir and "Target Area 2" for irrigation system. Therefore, it is recommended having two packages, one is for "Target Area 1" by International Competitiveness Bidding (ICB), the other is for "Target Area 2" by National Competitiveness Bidding (NCB)

In addition, related ESIA works should be conducted by ESIA consultant selected by NCB with D/D consultant. Therefore, the recommended project packages are divided into three.

Table 9-2.1 Recommended Packages of the Project

Item	Target Area 1 by ICB	Target Area 2 by NCB	ESIA consultant by NCB
Targeted components	✓ Reservoir ✓ Feeder canal 1 and 2 ✓ Outlet canal 1, 2 and 3 ✓ Rehabilitation of Arzni-Shamiram canal	✓ Rehabilitation of Arzni-Branch canal ✓ Rehabilitation of Takahan canal ✓ Rehabilitation of Shah-Aru canal ✓ Rehabilitation of Upper Aknalich canal ✓ Rehabilitation of Lower Hrazdan(part2) canal	✓ Conduct the related ESIA and RAP and its necessary survey

The necessary services for the D/D are summarized as followings;

1) Topographical and geological/hydro-geological field investigations and laboratory test (refer to table below),
2) Review of preliminary designs done during the Feasibility Study (F/S) stage,
3) D/D includes all required hydraulic, structural and hydro-geological calculations, preparation of drawings such as reservoir, feeder, outlet canals and operation manual,
4) Preparation of the pre-qualification documents for tendering,
5) Preparation of tender documents,

6) Preparation of irrigation water management manual including Target area 1 and 2,
7) Preparation of reservoir operation manual, instrumentation of observation and emergency preparedness plans, and
8) Assistance to the conduction of ESIA.

In the D/D stage, the supplemental surveys for finalizing and updating the designs should be conducted due to the changed policy and other unexpected matters. The following table shows suggestions to supplemental surveys in the D/D, in comparison with F/S and D/D stages.

Table 9-2.2 Recommended Survey in Detailed Design Stage with Comparison of F/S

Survey	F/S	D/D
1. Boring	1) Monitoring well : 5 holes x approx. 120 m 2) Core boring（include PT）: 16 holes x approx. 30m, 50m and 100m	For dike, feeder and outlet canal Core boring（include PT）: 5 holes x approx. 30m along center of new dike
2. Soil analysis	1) Site test (Test pit) : 55 pits 2) Laboratory test :34samples 3) Preventive test for Hexavalent chromium elution : 1 set 4) Lavatory. test of infiltration measures : Mixed soil with Bentonite, Soil-cement 5) Common test : Moisture ratio, wet and dry density test, permeability test at Labolatory	1) Laboratory test : 10 samples 2) Preventive test for Hexavalent chromium elution for check F/S: 1 set 3) Common test : Moisture ratio, wet and dry density test, permeability test at Lab
3. Geophysical prospecting	53sites	at intervals of 1km along alignment of each feeder and outlet canal
4. Topographic survey	1) Reservoir area survey : 1,540ha, 1/2,000, 0.5m contour 2) 2 Feeder canals and 3 Outlet canals : 216ha, 1/2,000, 0.5m contour	1) Reservoir area survey: 1,540ha, 1/2,000, 0.25m contour 2) 2 Feeder canals and 3 Outlet canals 216ha, 1/2,000, 0.5m contour 3) Profile of canal alignment : Rehabilitation of Arzni-Shamiram canal : L=2.7km (approx. PK14 and PK17, PK28 and PK32, PK64 and PK69, PK85 and PK93, PK94 and PK96. PK96 and PK97, PK101 and PK105) Rehabilitation of Arzni-Branch canal : L=2.3km (BP and PK23) : L=12.1km (PK123 and PK234) Rehabilitation of Takahan canal : L=5.7km (PK69 and PK126) Rehabilitation of Shah-Aru canal : L=6.9km (BP. and PK31 PK62 and PK70, PK82 and PK112) Rehabilitation of inner Aknalich canal : plane survey for around new pipeline Rehabilitation of Upper Aknalich canal : L=9.8km (PK6 and PK104) : plane survey for around new pipeline Lower Hrazdan canal (part2) : L=17.8km (PK10 to PK188)

(2) Construction Supervision (C/S) stage

In the C/S stage, the consultant shall assist the undertaker in Armenian government for the tender procedure by preparing invitations for pre-qualifications and prior to short listing for the prospective bidders. The consultant shall then accompany the tender procedure and participate in the evaluation of the bids. As mentioned in (1) Detailed Design (D/D) Stage, two (2) packages in construction stage is suggested, hence bidding and supervision shall be conducted to each package. The necessary services for the construction stage are summarized as followings;

[Tendering]

1) Review of designs done in D/D, if necessity,
2) Preparation of the pre-qualification and tender evaluation reports,
3) Assistance and advice to the undertaker in Armenian government for evaluation of the bidder's

offer, and
4) Assistance to obtain required certificate from JICA, in relation with pre-qualification documents and tender and contract.

[Construction]

1) Evaluation and approval of safety plan submitted by the contractor, in compliance with JICA Guideline,
2) Evaluation and approval of construction plan submitted by the contractor,
3) Supervision of quality control, site testing and material specification,
4) Issue certificate and approval to contractor on construction works in accordance with technical specifications and contract with the client,
5) Monitoring of environmental and safety issues, and
6) Submit and keep proper report during construction and arrange the project completion report.

(3) ESIA consultant

The regal regulations for ESIA are derived for a number of international conventions in Armenia is a part of and regulated in the Law on Environmental Expert Examination (Law on EEE) adopted in 1995.

The timing for the ESIA is preferably during the early D/D stage to have effective results and to be taken into account before finalizing the designs. The activities of ESIA should be conducted by the international consultant. In the C/S stage, monitoring and procedure by stipulated in ESIA can be conducted by the construction supervision consultant or by the employed external expertise.

The necessary services for the ESIA consultant are summarized as followings;

1) Data collection and investigations such as natural and social conditions

   - Review related reports on environmental issues of region,
   - Supplemental data collection, and
   - Compile baseline data of ESIA.

2) Land acquisition and resettlement activities

   - Preparation of Resettlement Action Plan (RAP),
   - Disclosure of RAP and consultation meeting on RAP, and
   - Implementation of RAP.

3) Preparation of draft ESIA report

   - Preparation of draft ESIA report,
   - Preparation of mitigation measure, recommendations for the EMP,
   - Disclosure and consultation of drat ESIA report and EMP, and
   - Finalizing the EMP and ESIA report.

4) Monitoring of the EMP implementation

   - Data collection of ecological and, hydrological and social data,
   - Preparation of quarterly monitoring reports for PIU, supervision consultant and other stakeholders, and
   - Finalizing and distribution of annual monitoring report.

9-3 Procurement of Contractor

While procedure for selection of consultant and contractor has three (3) options under Japanese yen loans, namely; option-1) Ordinal, option-2) Engineering Services (E/S) and option-3) Special Terms for Economic Partnership (STEP), as shown in Figure 9-3.1, conditions of the Project implementation do not meet applying preconditions of E/S loan (option-2) and STEP (option-3). The Project shall be proceeded by applying; 1) Ordinal loan procedure which follows International Competitive Bidding (ICB) for the selection of both consultant and construction contractor.

Japanese yen loan is the base of request from the government of Armenia. After the request for the Project implementation, JICA will send a Fact Finding (FF) mission and plural appraisal missions prior to Exchange of Note (E/N) and Loan Agreement (L/A).

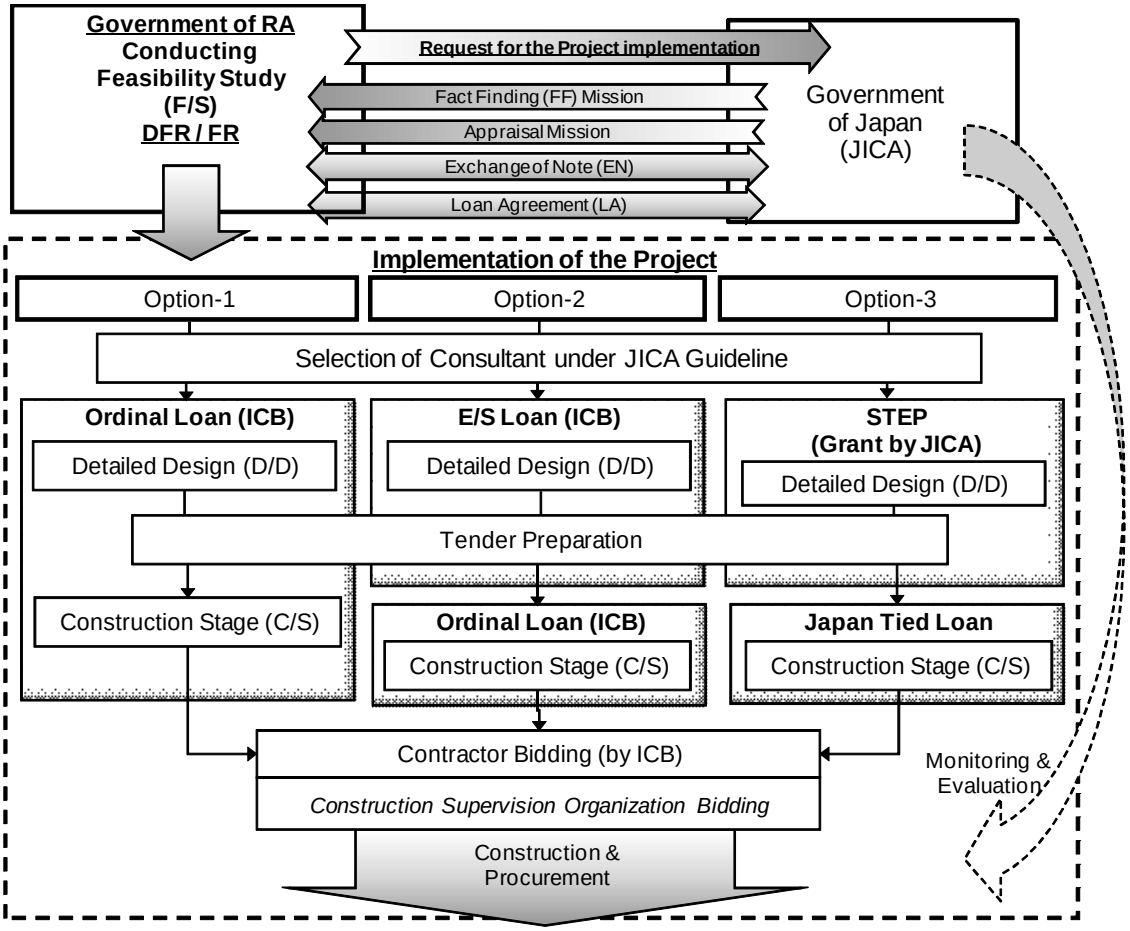


Figure 9-3.1 Options for Procedure of Japanese Yen Loan

CHAPTER 10 CONCLUSIONS AND RECOMMENDATIONS

10-1 Viability and Necessity of the Project Implementation

Government of Armenia places this Project; that is "Yeghvard Irrigation System Improvement" as one of the important projects to fulfill the national policies which are; 1) conservation of Lake Sevan being a fundamental source of the livelihood for Armenian people as well as the environmental circumstances, and 2) shifting pump-based to gravity irrigation system prior to reducing governmental subsidies to agricultural water users due to a high rate of electricity.

While one-third (1/3) of population in Armenia is living in the capital city of Yerevan, taking accessibility and marketing into considerations, agricultural activities in the Yeghvard directly connect not to only farmers' income generation, also food security for inhabitants of the capital because of its location within 20 km to the Yerevan.

Also, since Armenian agricultural development strategy towards promoting; 1) cooperated and competitive market-oriented and 2) export-oriented productions for international trading by shaping favorable conditions, farmers concerned in Yeghvard have much advantage to involve in opportunities obtaining agricultural training/information, extension/machinery services, credit and techniques such water saved irrigation through research institutes under MOA available in Yerevan.

Furthermore, while irrigation projects; Kaps in Shirak Marz and Vedi in Ararat Marz, assisted by KfW and AFD respectively, are under the process of detailed design and tendering stages prior to construction, government of Armenia will concur in developing infrastructural projects in relation to water resource on agriculture/irrigation sectors.

10-2 Conclusions

(1) Scale of the planned reservoir capacity

Alternatives to capacity of the Reservoir is limited since considerable factors for designing is narrowed by 1) demand of crop water requirement of agricultural land with 12,347ha, 2) availability of free water (snow melted water) from March through May in the Hrazdan River and 3) capacity of existing Arzni-Shamiram canal which is planned feeding water to the proposed Yeghvard Reservoir, while policies to the water resources made by the government of Armenia, i.e. 4) conservation of Lake Sevan and 5) shifting from pumping system to gravity irrigation. Capacity of the planned reservoir, therefore, is fixed with 94MCM from the initial stage of the Survey.

(2) Area of planned reservoir basin (900ha or 600ha)

Table 10-2.1 shows advantages and disadvantages in each case of the reservoir basin with 900ha and 600ha respectively.

Table 10-2.1 Advantage and Disadvantage by Options of Reservoir Basin Area in Cases of 900ha and 600ha

	900 ha	600 ha
1) Construction easiness	(Disadvantage) Since area of anti-infiltration work is larger than the case of 600ha, construction period of this work is longer comparatively.	**(Advantage)** Construction period of this work is shorter than the case of 900ha comparatively.
2) Environmental aspect	**(Advantage)** Swampy areas are not formed.	(Disadvantage) Enclosing southern and northern slopes by new dams might form swampy areas at those back side.
3) Acceptance of Armenian side	**(Advantage)** Both existing Dam No.1 and No.2 constructed at USSR era are reused so that past investments are fully utilized.	(Disadvantage) A part of existing Dam No.2 is not reused due to the planning of new dike construction.

While direct construction costs of planned reservoir are not much differed between options of 900ha and 600ha with area of reservoir basin, the one of 900ha is recommended adopting, because the case of 900ha has more advantages than the one of 600ha.

(3) Measure on anti-infiltration works to the reservoir basin

Given conditions geologically and hydro-geologically that the location of the proposed reservoir is located at its high permeability, the cost for anti-infiltration works is occupied approx. more than 60% of the direct construction cost, the Survey team has been conducting alternative studies carefully from the beginning of the Survey period, through investigation of drilling, its in-situ test as well as laboratory soil test, etc. in consideration with results of investigation done in USSR era. Also, simulation for water leakage rate estimation from the reservoir bottom was carried out prior to identifying the most cost-efficiency of necessity area for anti-infiltration works.

Table 10-2.2 summaries outline of the Project evaluation by examined options done during the Survey. Case by using soil-cement with a sandwiched bentonite sheet for anti-infiltration works is the most economical option, with 900ha of reservoir basin and capacity of reservoir with 94MCM.

Table 10-2.2 Outline of the Project Evaluation by Options

(Reservoir basin: 900ha)	Bentonite sheet with 2 layers	Bentonite soil mixture	Soil-cement	Soil-cement with a sandwiched bentonite sheet
Project cost with VAT (million USD)	231.4	291.2	236.8	226.9
EIRR (Base1: Including Lake Sevan) (Base 0: Not Including Lake Sevan)	6.86% (4.94%)	4.70% (2.91%)	6.64% (4.74%)	7.09% (5.15)%

10-3 Recommendations

10-3-1 Trial Construction for Anti-Infiltration Works

Although soil-cement with a sandwiched bentonite sheet is the best option for anti-infiltration works, some risks of leakage more than design value still remain. Additionally, there are no reservoirs having this structure as anti-infiltration works. Therefore trial construction to find appropriate measures to mitigate hazards of leakage risks and to identify difficult/important points to note on the construction shall be carried out before/during Detail Design stage.

10-3-2 Abolish of Existing Pump Stations

In accordance with national policy in Armenia, i.e. “shifting pump system to gravity irrigation”, the capacity of reservoir is designed in the Project including proposed new connection canals (by pipelines) and rehabilitation of existing main/secondary canals. While current irrigation system in some areas, however, is dependent on pumping, it is recommended that delays and/or gradual abolishing existing pump facilities with considering the effect of gravity irrigation, especially of deep tube wells should be allowed.

10-3-3 Pilot Farms for Water Saved Irrigation

Two (2) communities are recommended for pilot farms for water saved irrigation, one for fruit and the other one for vegetable cultivation. Water saved irrigation is not adopted in order to reduce water demand in the Project, however, they are recommended for new technology such as reducing an amount of fertilizer and chemical for decreasing expenditure of the agricultural inputs by sprinkler and/or drip as well as the climate changes in future as agricultural supporting projects.

10-3-4 Measures on Influences to Other Utilizations of Free Water (Snow Melted Water) at the Downstream of Hrazdan River

Even though it is evaluated that influences by taking free water with a volume of 103MCM including losses (canal conveyance and evaporation/infiltration from Yeghvard reservoir, etc. with 94MCM) through Arzni-Shamiram canal from March to May annually with the Project, would not be anticipated, by following findings, the Survey Team recommended that;

Since the Project is expected to contribute the conservation of Lake Sevan by reducing water use of approx. 50MCM annually, a part of water volume from the 50MCM is released to Hrazdan river in March to May annually as the substitution of diverting free water to the Project by taking consideration into the influences on the current ecology in the downstream of Hrazdan River.

<Findings why taking free water with 103 MCM does not influence to the downstream of Hrazdan River>

(1) Influence on hydro-power generation located along with Hrazdan River

Average annual hydro-power generation in Hrazdan river at the downstream of Arzni-Shamiram canal intake point is approx. 500 million kWh in during the last year while 1,875MCM of Hrazdan river flow in 2013 was used for power generation. Given that it is planned to take free water with 103MCM in Hrazdan river for the Project, an amount of power generation in Hrazdan river will be decreased by approx. 27.5 million kWh (500 million kWh x 103/1,875MCM) due to the Project. While the river flow of Hrazdan with decreasing ratio 5.5% after the implementation of the Project, simply calculated by 27.5/500 million kWh and also 27.5 million kWh is occupied only 0.35% calculated by 27.5/7,800 million kWh of which is total power generation in Armenia annually, are negligible. In the meanwhile, priority to utilizing for both waters from Lake Sevan as well as free water is given to agriculture, not hydro-power generation in the national law.

(2) Influence on current ecological conditions

Three (3) kinds of rare species at the downstream of Lake Yerevan are observed. Decrease of free water with a volume of 104MCM annually in March to May, however, would not change the inflow pattern of Lake Yerevan and the current ecological conditions there, while natural flow in the river of Hrazdan is dependant on Hydro-power station through artificial canals.

(3) Water right of Arzni-Shamiram Canal

Since Arzni-Shamiram Canal had been constructed in 1957, it continually has a water right of 320MCM for agricultural use in annual permitted of Ministry of Nature Protection (MNP) in Armenia through a document till now. Currently, a volume of approx. 160 MCM as actual is taken from Hrazdan river so that the Project can take an additional volume of water with 104MCM in official. In addition, as for volume of 160MCM and 104MCM, simply sum of them is within the water right of 320MCM, accordingly, the Project does not affect on present water allocation.

10-3-5 Emergency Discharge Facility

The Survey team suggests setting up an awareness program for emergency during the detailed design of the Project whenever the natural calamity occur such a large earthquake by establishing a structure of committee.

10-3-6 Compensation for Communities (RAP)

It is recommended that correspondence to compensation for communities of Yeghvard City and Nor-Yerznka Village for the land within the planned Reservoir should be discussed before the Loan Agreement (L/A) signed, while lands for the Project to be requisitioned by the government are currently belonging to those communities.

ATTACHMENT

Attachment-1: List of Parties Concerned in Armenia

Organization			Position	Name
Armenian Government Office				
Ministry of Agriculture			Minister	Sergo Karapetyan
			Deputy Minister	Armen Harutyunyan
	Department of Land Use and Amelioration		Head	Artur Baghdassaryan
	Department of Foreign Relations		Head	Andranik Petrosyan
	Department of Horticulture crop production and Plant protection		Head	Ashot Harutyunyan
			Head of Horticulture Development and Plant Protection Division	Karine Esayan
	Agricultural Support Centre Coordination Department		Head	Edgar Hakobiyan
	Department of Agricultural Development Programs		Head of Agricultural Planning Division	Artur Petrosyan
			Head of Infrastructure Development and Food Security Division	Armenak Aghajanyan
	Department of Agro Processing Development		Head	Gevorg Ghazaryan
	State Inspection of Agricultural Machinery		Head	Ghushchyan Vardan
	Agricultural Projects Implementation Unit		Director	Gagik Khachatryan
	Division of Agricultural Cooperative Support		Head	Marianna Khachatryan
	Division of Research and Coordination of Agriculture Support Centers		Chief Specialist	Hasmik Mkrtchyan
	State Service for Food Safety		Head of Phytosanitary Division	Artur Nikoyan
	State Committee of Water Economy (SCWE)		Chairman	Aram Harutyunyan
			Deputy Chairman	Volodya Narimanyan
			Deputy Chairman	Hakob Matilyan
			Adviser to the Chairman	Viktor Martirosyan
			Head of the Staff	Garik Saroyan
			Head of Economic Division	Anna Margaryan
			Head of the External Relations Division	Tigranuhi Baghdasaryan
			Head of Irrigation collector-drainage System Department	Karen Daghbashyan
			Head of Internal Audit	Garik Saroyan
			Head of Legal and Inspection Department	Harutyun Khachatryan
			Head of Mobilization Department	Artak Harutyunyan
		Sevan-Hrazdanyan Jrar Closed Joint Stock Company	Director	Samvel Hovhannisyan
			Head of Reservoir Exploitation Division	Rubik Andreasyan
			Chief engineer	Gagik Vardanyan
		Project Implementation Unit (PIU)	Director	Flelix Melikyan
			Deputy Director	Karen Grigoryan
			Engineer	Marzpet Tonoyan
			Engineer	Tigran Ishkhanyan
			Engineer	Khoren Tsarukyan
			Engineer	Varazdat Mkrtchyan
			Engineer	Zhora Tomrazyan
			Environmental Specialist	Martiros Nalbandyan
			Sociologist	Marine Vardanyan
Ministry of Finance			Minister	Gagik Khachatryan
Ministry of Urban Development			Minister	Narek Sargsyan

Organization			Position	Name
Ministry of Foreign Affairs			Deputy Minister	Sergey Manassaryan
			Second Secretary	Elina Mkrtchyan
Ministry of Nature Protection	Environmental Impact Expertize Center, State Non-Commercial Organization (SNCO)		Director	Vardan Sahakyan
			Deputy Director	Seyran Pahlevanyan
			Environmental Expert	Azganush Drnoyan
	Environmental Impact Monitoring Centre, SNCO		Director	Sasun Sahakyan
			Deputy Director	Gayane Shahnazaryan
	Climate Change Information Center		UNFCCC National Focal Point	Aam Gabrielyan
	Hydrogeological Monitoring Center, SNCO		Director	Karlen Hakobyan
			Chief Engineer	Hovik Aghinyan
	National Park “SEVAN”, SNCO		Deputy Director in Science	Vahe Gulanyan
	Water Resources Management Agency		Director	Vahan Davtyan
Ministry of Territorial Administration and Development	Department of Foreign Relations		Leading specialist	Ruben Khamoyan
	Department of the Local Self-Governme nt		Head	Ashot Giloyan
		Division of the Local Self-Government Affairs	Head	Karen Bakoyan
Ministry of Emergency Situations	Seismic Protection Service		Head	Hrachya Petrosyan
			Deputy Head	Ashkhen Tovmasyan
		Observation and Information Analysis Division	Head	Valery Arzumanyan
		Division on Seismic Resistance of Buildings and Construction	Head	Armen Antonyan
			Specialist	Anna Gevorgyan
WUAs				
WUAs	Ashtarak		Director	Arsen.Khachatryan
	Khoy		Director	Seyran Sargsyan
			Deputy Director	Hovhannes Sargsyan
			Engineer	Mamikon Avetisyan
			Engineer	Tigran Khevondyan
	Yeghvard		Director	MIhran Hovhannisyan
	Vagharshapat		Director	Surik Sedrakyan
			Deputy Director	Karapet Ter-Khachatryan
			Local Electric Specialist	Manaser Harutyunyan
			Local Head	Artash Asatryan
	Parpi		Director	Hovik Gevorgyan
	Nairi		Director	Armen Karapetyan
Cities				
Ashtarak			Mayor	Armen Antonyan
Yeghvard			Deputy Mayor	Karen.Harutyunyan
Yerevan			Chief Engineer Water Structures CJSC, Yerevan City	Vagharshak Vagharshkyan
Communities				
Armavir Marz	Aghavnatun		Deputy Head	Valeri Zohrabyan
	Aknalich		Deputy Head	Fezdinant Fidanyan
	Amberd		Head	Manvel Babayan
	Aratashen		Head	Vahzam Harutyunyan
			Deputy Head	Hovakim Nazaryan
	Aragats		Head	Ashot Kamavosyan
			Chief Specialist	Aram Hakobyan
			Representative	Aspet Movsesyan
	Arshaluys		Deputy Head	Gagik Shahgaldyan
	Artimet		Deputy Head	Manvel Sahakyan

Organization		Position	Name
Armavir Marz	Baghramyan	Head	Babken Shahbazyan
	Doghs	Chief Financial Specialist	Sveta Adamyan
	Ferik	Head	Norik Hayrapetyan
	Geghakert	Deputy Head of Community	Jahavir Amirkhanyan
		Chief Accountant Specialist	Susanna Galstyan
		Assistant Accountant Specialist	Kaline Movsesyan
	Griboyedov	Human Resources Specialist	Anahit Keshish Ghukasyan
		Jr. Specialist	Suzen Grigozyan
	Haytagh	Deputy Head	Meruzhan Muradyan
	Hovtamej	Head	Armen Sargsyan
	Khoronk	Head	Sargis Nahapetyan
		Deputy Head	Grisha Asatryan
	Lermamerdz	Deputy Head	Sahak Mirzoyan
	Mrgastan	Head	Rafik Khachatryan
		Human Resources Specialist	Susanna Gharibyan
		Financial Specialist	Gayane Yeghiazaryan
	Merdzavan	Deputy Head	Azevik Yesayan
		Director of Education & Science	Vemir Khurshudyan
	Norakert	Head	Shahen Karapeytan
		Chief Specialist/Accountant	Ashot Dovlatyan
	Taronik	Chief Accountant Specialist	Susanna Tsaghoyan
	Tsaghkalanj	Head	Manvel Mkrtehyan
		Senior Financial Specialist	Ashot Baghdasaryan
	Tsaghkunk	Deputy Head	Rafik Sargsyan
	Tsiatsan	Deputy Head	Khachik Gevorgyan
Aragatsotn Marz	Sasunik	Head	Arman Margaryan
		Representative	Vahagn Mkhitaryan
Kotayk Marz	Kasakh	Head	Sedrak Khachatryan
	Proshyan	Head	Arthuz Muradyan
		Jr. Specialist	Yurik Rzgoyan
	Zovuni	Deputy Head of Community	Suren Baghdasaryan
		Jr. Specialist	Yerjanik
	Nor-Yerznka	Head	Alina Harutyunyan
Related Organizations			
Aarhus Center of Yeghvard City		Coordinator	Ruzanna Manyan
		Coordinator	Anush Beybutyan
Institutions			
Institute of Geophysics and Engineering Seismology After A.NAZAROV, National Academy of Science of Armenia		Director	Jon Karapetyan
		Head of Department of Seismic Stable Construction	Sevada Hovhannisyan
		Head of seismic hazard assessment division	Styopa Karapetyan
		Scientific Secretary	Gohar Mkrtchyan
Institute of Water Problems and Hydraulic Engineering		Leading scientific engineer	Sergei Mkrtchyan
		Senior scientific engineer	Garnik Hovasapyan
Other Donors			
Asian Development Bank (ADB)		Associate Finance and Administration Officer	Zara Solakhyan
KFW		Local Representative	Zara Chatiyan
		Project Manager	Diniela Base

Organization	Position	Name
KFW	Principal Engineer	Thomas Wolf
UNDP	Component Manager	Baken BABAYAN
	Proect Manager	Vahan AMIRKHANYAN
UNIDO (United Nations Industrial Development Organization)	Results Manager	Margarita Gasparyan
WB	Operation Officer	Arusyak Alaverdyan
Private Companies		
ARGUMEMT Consulting Bureau LLC	Director	Vardan Aghbalyan
ATMS Solutions LLC	Ecological Specialist	Artak Ter – Torosyan
	Socialist	Suren Gyurjinyan
Ararat Cement	Director	Manuk A. Arakelyan
Armenian Mining Company CJSC	Duputy Director	Karen Simonyan
Artezia Scientific CJSC	Director	Hovik Mizakhanyan
FDA Lab	Staff and Constomer Service Manager	Elen Lopoyan
	Quality Manager	Anna Hakobyan
Georisk CJSSRC	Director	Hektor Babayan
	Translator	Yelena Abgaryan
GRP Systems CJSC	Director	Arkadi Gabrielyan
Hayjrnakhagits Institute CJSC	Director	Yuri Javadyan
Hidrogeosin LLC	President	A. Julkhakyan
Hydrogenergetica	President	Grigor Gabayan
“HYDRA TNT” LLC	Director	Tigran Tamrazyan
HYDROSCOPE	Head	Robert Minasyan
IKO Machinery LLC	Executive Director	Hayk Martirosyan
	Head of Sales Department	David Karamyants
	Account Specialist	Lilit Avagyan
ISOLUX CORSAN	Project Manager	Daniel Domingo Tabuena
Ijevan Bentonite Combinat	Technical Director	Anatoli Bairamyan
‘Modul 2015’ LLC	Director	Samson Gasparyan
Mtispiri Bentonite 2010	Executive Director	Sharashidze Tengiz
Ml Mining LLC	General Director	Margaryan Eduard
National University of Architecture and Construction of Armenia, Faculty of Urban Economy and Ecology, Chair of Hydraulics	Head of Chair, Professor	Albert Margaryan
Transimpex	Country Manager	Arman Ghazaryan
	Head of Logistics and Freight Forwarding Department	Rouben Gevorgyan
Non-governmental Organization		
ECOLUR (NGO for environmental conservation)	President	Inga Zarafian
JICA		
JICA Uzbekistan Office	Chief Representative	Katsutoshi Fushimi
JICA Armenia Liaison Office	Armenian Program Coordinator	Ruzan Khojikyan
Embassy		
Embassy of Japan	Ambassador	Eiji Taguchi
	Counselor	Kenichiro Sasame
	Second Secretary	Emiko Fujiyama
	Attache	Natsuko Fujii

Attachment-2: List of Collected Materials

No.	Name of Materials	Publishing Organization/ Source	Form	Type					Categorization	Remarks
				Collected materials	Created materials by Experts	Created materials by JICA	Text book	Other		
1. Policy, National Strategy, Laws, etc.										
1-1	The Constitution of the Republic of Armenia (with amendments)	The Government of the Republic of Armenia	Electronic	1					JR・CR( )・SC	
1-2	Armenia Development Strategy for 2014- 2025	The Government of the Republic of Armenia	Electronic	1					JR・CR( )・SC	
1-6	The Law of the Republic of Armenia on Alienation of Property for the Needs of the Society and the State	Government of the Republic of Armenia	Electronic	1					JR・CR( )・SC	
1-7	Civil Code of the Republic of Armenia	The Government of the Republic of Armenia	Electronic	1					JR・CR( )・SC	
1-8	Land Code of the Republic of Armenia	The Government of the Republic of Armenia	Electronic	1					JR・CR( )・SC	
3. Water Utilization (Lake Sevan, National Rivers)										
3-1	Water Code of the Republic of Armenia	The Government of the Republic of Armenia	Electronic	1					JR・CR( )・SC	
3-2	Discharge Volume of Lake Sevan	WSA	Electronic	1					JR・CR( )・SC	
3-3	Schematic Diagram of Sevan-Hrazdan Cascade	WSA	Copy	1					JR・CR( )・SC	
3-4	Inflow to Lake Sevan from Arpa-Sevan Conduit	WSA	Electronic	1					JR・CR( )・SC	
3-5	Discharge data of Arzmi-shamiram, Lower Hrazdan and Rancchapar P/S, Aknalich P/S, Aparan Reservoir	WSA	Electronic	1					JR・CR( )・SC	
3-6	Canal's dimensions and specifications (Arzni branch canal, Arzni canal I and II, Lower Hrazdan canal I and II, Shah-Aru Canal, Tkahan canal)	PIU	Electronic	1					JR・CR( )・SC	
3-7	List of Pump Station and Deep Well	WUA	Electronic	1					JR・CR( )・SC	

No.	Name of Materials	Publishing Organization/ Source	Form	Type					Categorization	Remarks
				Collected materials	Created materials by Experts	Created materials by JICA	Text book	Other		
3-8	Water Intake from Kasakh River to Lower Hrazdan Canal	WSA	Electronic	1					JR・CR( )・SC	
3-9	Water Source for Irrigation	WUA	Electronic	1					JR・CR( )・SC	
3-10	Water Permission of Arzni-Shamiram Canal	WSA	Electronic	1					JR・CR( )・SC	
3-11	Republic of Armenia Law on Fundamental Provisions of the National Water Policy	Government of the Republic of Armenia	Electronic	1					JR・CR( )・SC	
3-12	«SEVAN» NATIONAL PARK MANAGEMENTS PLAN 2007-2011	The Government of the Republic of Armenia	Electronic	1					JR・CR( )・SC	
4. Natural Condition										
4-1	Water Reservoir on Hrazdan River, Vol IV, Book 2 ENGINEERING-GEOLOGICAL & HYDROGEOLOGICAL CONDITIONS	USSR, State Design Institute (Arm Pod Proyect)	Electronic	1					JR・CR( )・SC	
4-2	Feasibility Study of the Design & Construction of a Reservoir on Hrazdan River, part II, Book 2, Engineering-Geology & Hydro-Geological Surveys & Studies	USSR, All-Union Design-Survey & Scientific-Research Union	Copy	1					JR・CR( )・SC	
4-3	Cadaster of Land Reclamation, Condition of the Irrigation & Drainage Land, As January 1st of 2012	AMELIORATION CJSC	Copy	1					JR・CR( )・SC	
4-4	DVD on Armenian Faults, Geological Map 600K68, Geological Map 600K71, Map references	Institute of Geological Science	Electronic	1					JR・CR( )・SC	
4-5	DVD on Landslide Map, Schematic Hydrogeological Map, Hidro-mineral Water Map	Institute of Geological Science	Electronic	1					JR・CR( )・SC	
4-6	Maximum Depth of Soil Freezing	PIU	Electronic	1					JR・CR( )・SC	
5. Natural Condition Data (Hydrology, Meteorology, etc.)										
5-1	Hydro-meteorological Data (Hrazdan River and Kasakh	“Hydromet service” SNCO, Ministry of	Electronic	1					JR・CR( )・SC	

No.	Name of Materials	Publishing Organization/ Source	Form	Type					Categorization	Remarks
				Collected materials	Created materials by Experts	Created materials by JICA	Text book	Other		
	River)	Emergency Situations, Republic of Armenia								
5-2	Water level and discharge of the Hrazdan River at Station Masis	"Hydromet service" SNCO, Ministry of Emergency Situations, Republic of Armenia	Electronic	1					JR・CR( )・SC	
5-3	International Energy Cooperation CJSC	International Energy Cooperation CJSC	Booklet	1					JR・CR( )・SC	
5-4	Volume of water that passed through HPPs in the Hrazdan River	International Energy Cooperation CJSC	Electronic	1					JR・CR( )・SC	
5-5	Seismic Zonation Map of the Republic of Armenia		Electronic	1					JR・CR( )・SC	
5-6	Precipitation (daily data of Yeghvard station)		Electronic	1					JR・CR( )・SC	
5-7	Temperature (daily data of Yeghvard station (max. min. ave.))		Electronic	1					JR・CR( )・SC	
5-8	Wind velocity and direction (Monthly data of Yeghvard station)		Electronic	1					JR・CR( )・SC	
5-8	Wind velocity data of Yeghvard Station (10 min. ave.)		Electronic	1					JR・CR( )・SC	
6. Design Standards for Reservoir and Irrigation Facilities										
6-1	Pipe line building code 2.05.06-2010	PIU	Copy	1					JR・CR( )・SC	
6-2	CN 474-75 Norms for allocation of lands for melioration channels.		Electronic	1					JR・CR( )・SC	
6-3	CN 551-82 Instruction on design and construction of anti-filtration devices of polyethylene film for		Electronic	1					JR・CR( )・SC	
6-4	CNaR 2.01.14-83 Definition of calculation hydrological characteristics.		Electronic	1					JR・CR( )・SC	

No.	Name of Materials	Publishing Organization/ Source	Form	Type					Categorization	Remarks
				Collected materials	Created materials by Experts	Created materials by JICA	Text book	Other		
	Instead of CN 435-72.									
6-5	CNaR 2.06.05-84* Dam from soil materials.		Electronic	1					JR・CR(　)・SC	
6-6	CNaR 2.02.02-85 Grounds of hydrotechnical constructions. Corrections are made.		Electronic	1					JR・CR(　)・SC	
6-7	CNaR 3.07.01-85 Hydrotechnical facilities of rivers.		Electronic	1					JR・CR(　)・SC	
6-8	CNaR 3.07.03-85* Melioration systems and facilities. Changes are made N1.		Electronic	1					JR・CR(　)・SC	
6-9	CNaR 2.06.01-86 Hydrotechnical constructions. Main provisions for design. Changes are made N1.		Electronic	1					JR・CR(　)・SC	
6-10	GOST 21.615-88 SDDC. Rules for performance of drawings of hydrotechnical facilities.		Electronic	1					JR・CR(　)・SC	
6-11	GOST 21.616-88 SDDC. Rules for performance of drawings of hydromelioration linear structures.		Electronic	1					JR・CR(　)・SC	
6-12	CNaR 2.01.15-90 Engineering protection of territories, buildings and structures from geological dangerous phenomena.		Electronic	1					JR・CR(　)・SC	
6-13	RACN II-6.01-96 (ICN(Interstate CN) 2-03-01-95) Geophysics of dangerous natural impacts.		Electronic	1					JR・CR(　)・SC	
6-14	RACN II-5.01-98 Loadings and impacts. Changes are made N1 (1997). Instead of CNaR II-6-74.		Electronic	1					JR・CR(　)・SC	
6-15	BC 33-01-2003		Electronic	1					JR・CR(　)・SC	

No.	Name of Materials	Publishing Organization/ Source	Form	Type					Categorization	Remarks
				Collected materials	Created materials by Experts	Created materials by JICA	Text book	Other		
	Hydraulic Engineering Structures Main Provisions									
6-16	RABC II-6.02-2006 Earthquake Resistant Construction Design Codes	Ministry of Urban Development	Electronic	1					JR・CR( )・SC	
6-17	GOST 25100-2011 Soils. Classification.		Electronic	1					JR・CR( )・SC	
7. Previous Design Document on Yeghvard Reservoir or Irrigation Facility										
7-1	Drawings on rehabilitation of Arzni-Shamiram canal	PIU	Electronic	1					JR・CR( )・SC	
7-2	Drawings on rehabilitation of Arzni-branch canal	PIU	Electronic	1					JR・CR( )・SC	
7-3	Drawings on rehabilitation of Shahi Aru canal	PIU	Electronic	1					JR・CR( )・SC	
7-4	Drawings on rehabilitation of Lower Hrazdan canal	PIU	Electronic	1					JR・CR( )・SC	
7-5	WATER SECTOR DEVELOPMENT AND INSTITUTIONAL IMPROVEMENTS PIU	PIU	Electronic	1					JR・CR( )・SC	
7-6	Specification of Arzni Branch Canal	Yeghvard WUA	Copy	1					JR・CR( )・SC	
7-7	Specification of Upper Canal	Khoy WUA	Copy	1					JR・CR( )・SC	
7-8	Specification of Inner Canal	Vagharshat WUA	Copy	1					JR・CR( )・SC	
7-9	Specification of Shahi Aru	Vagharshapat WUA	Copy	1					JR・CR( )・SC	
8. Facility Operation and Maintenance										
8-1	List of Canal's Dimensions and Specifications (Arzni-Branch, Tkahan, Shah-Aru, Lower Hrazdan)	PIU	Electronic	1					JR・CR( )・SC	
8-2	Annual Report on Maintenance Cost for canal in Yeghvard (2013-2015)	Yeghvard WUA	Copy	1					JR・CR( )・SC	
8-3	Annual Report on Maintenance Cost for canal in Ashtarak (2013-2015)	Ashtarak WUA	Copy	1					JR・CR( )・SC	
8-4	Annual Report on Maintenance Cost for canal in Khoy	Khoy WUA	Copy	1					JR・CR( )・SC	

No.	Name of Materials	Publishing Organization/ Source	Form	Type					Categorization	Remarks
				Collected materials	Created materials by Experts	Created materials by JICA	Text book	Other		
	(2013-2015)									
8-5	Annual Report on Maintenance Cost for canal in V Vagharshapat (2013-2015)	Vagharshapat WUA	Copy	1					JR・CR( )・SC	
9. Agriculture/ Marketing										
9-1	ARMENIA Country Development Cooperation Strategy FY 2013-2017	USAID	Electronic	1					JR・CR( )・SC	
9-2	Agriculture and Food Processing in Armenia, 2010	USAD & Center for Agribusiness ans Rural development	Electronic	1					JR・CR( )・SC	
9-3	Agro-Food Sector in Armenia	ArmeNWal	Electronic	1					JR・CR( )・SC	
9-4	Rapid Assessment of Value Chain Opportunities in Armenia	USAID	Electronic	1					JR・CR( )・SC	
9-5	Boosting Armenia's Agricultural Exports, Yerevan 2008	GLOBAL SPC	Electronic	1					JR・CR( )・SC	
9-6	Doing Business in Armenia: 2012 Country Commercial Guide for U.S. Companies	U.S. & Foreign Commercial Service	Electronic	1					JR・CR( )・SC	
9-7	Armenia: From Reliable Irrigation to Profitable Agriculture, 2011	Millennuim Challenge Corporation, USA	Electronic	1					JR・CR( )・SC	
9-8	Studies on the Agricultural and Food sector in central and Eastern Europe -Improving the function of the rural financial markets of Armenia	IAMO	Electronic	1					JR・CR( )・SC	
9-9	Assessment of the Potential; of the Armenian Greenhouse Cluster, 2007	USAID	Electronic	1					JR・CR( )・SC	
9-10	A Review of Organizational Change in the Armenian Agricultural Sector, 2005	INTAS Project	Electronic	1					JR・CR( )・SC	
9-11	The Role of Cooperatives in the Development of Agriculture in Armenia, Asian Countries & EU (Worldwide case studies), 2013	Institute for Cultural Diplomacy	Electronic	1					JR・CR( )・SC	
9-12	Apricot Value Chain in Armenia	Shen NGO	Electronic	1					JR・CR( )・SC	
9-13	Milestones of Organic Agriculture	Shen NGO	Electronic	1					JR・CR( )・SC	

No.	Name of Materials	Publishing Organization/ Source	Form	Type					Categorization	Remarks
				Collected materials	Created materials by Experts	Created materials by JICA	Text book	Other		
	in Armenia									
9-14	Armenia Dried Fruit Report, ASME Market Development Project	USAID	Electronic	1					JR・CR( )・SC	
9-15	Armenia Winemaking Sector Assessment, Development Strategy and Action Plan	GIZ	Electronic	1					JR・CR( )・SC	
9-16	Assessment of the Wheat , Barley and Emmer Wheat Value Chain in Armenia	GIZ	Electronic	1					JR・CR( )・SC	
9-17	Food Processing Sector in Armenia	America CJSC	Electronic	1					JR・CR( )・SC	
9-18	Increasing Presence of farmer Associations in Local and Export Markets: Case of Armenian Milk, Fruit and Vegetable Producers	Mr. Artur Grigoryan, ICARE, Armenian State Agrarian University	Electronic	1					JR・CR( )・SC	
10. Social										
10-1	Resettlement Policy Framework for Social Investment and Local Development Project and Social Investment and Local Development Trust Fund	World Bank	Electronic	1					JR・CR( )・SC	
10-2	ARM: North–South Road Corridor Investment Program - Tranche 3	Asian Development Bank	Electronic	1					JR・CR( )・SC	
10-3	ARM: Sustainable Urban Development Investment Program – Tranche 2	Asian Development Bank	Electronic	1					JR・CR( )・SC	
10-4	Handbook on Resettlement A Guide to Good Practice	Asian Development Bank	Electronic	1					JR・CR( )・SC	
10-5	Cadastral Map	State Committee of the Real Estate Cadaster, Republic of Armenia	Electronic	1					JR・CR( )・SC	
11. Environment										
11-1	Law on Environmental Impact Assessment and Expertise	Ministry of Nature Protection, Republic of Armenia	Electronic	1					JR・CR( )・SC	

No.	Name of Materials	Publishing Organization/ Source	Form	Type					Categorization	Remarks
				Collected materials	Created materials by Experts	Created materials by JICA	Text book	Other		
11-2	The Second National Environmental Action Programme of the Republic of Armenia	Ministry of Nature Protection, Republic of Armenia	Electronic	1					JR・CR( )・SC	
11-3	The third National Environmental Action Programme of the Republic of Armenia	Ministry of Nature Protection, Republic of Armenia	Electronic	1					JR・CR( )・SC	
11-4	Environmental Management Plan, November 2010	Armenia Community Agricultural Resource Management and Competitiveness Project	Electronic	1					JR・CR( )・SC	
11-5	Decree of the Government of RA N 71-N “about approval of the Red Book of animals of the Republic of Armenia” 2010	Ministry of Nature Protection	Electronic	1					JR・CR( )・SC	
11-6	Decree of the Government of RA N 72-N “about approval of the Red Book of plants of the Republic of Armenia” 2010	Ministry of Nature Protection	Electronic	1					JR・CR( )・SC	
11-7	Government Decree #160-N (Air pollution)	The Government of Republic of Armenia	Electronic	1					JR・CR( )・SC	
11-8	Decision of the Republic of Armenia about Definition of Norms for Ensuring Water Quality for Each Water Basin Control Area Depending on Local Characteristics	The Government of Republic of Armenia	Electronic	1					JR・CR( )・SC	
11-9	“Protocol of Government RA, 27.01.2011 27 N 75-N” (General Water Quality Parameters)	Environmental Impact Monitoring Center, Ministry of Nature Protection	Electronic	1					JR・CR( )・SC	
11-10	Order about Approving the Methodology of Calculation of Allowed Limit Discharge of Effluent to Water Resources	Ministry of Nature Protection	Electronic	1					JR・CR( )・SC	
11-11	National Atlas of Armenia Volume A	The State Committee of Real Estate Cadaster	Book	1					JR・CR( )・SC	

No.	Name of Materials	Publishing Organization/ Source	Form	Type					Categorization	Remarks
				Collected materials	Created materials by Experts	Created materials by JICA	Text book	Other		
11-12	Environment standards for Soil pollution by Hexavalent chromium	Ministry of Environment, Government of Japan	Electronic	1					JR・CR( )・SC	
11-13	Standards For Dissolution Test of Hexavalent Chromium in Mixed Soil	Japanese Ministry of Environment Ministry	Electronic	1					JR・CR( )・SC	
11-14	Environmental Quality Standards for Priority Substances and Certain Other Pollutants	European Union	Electronic	1					JR・CR( )・SC	
12. Other Projects on Reservoir Projects										
12-1	F/S report of Kaps	KfW	Electronic	1					JR・CR( )・SC	
12-2	F/S report of Vedi	AFD	Electronic	1					JR・CR( )・SC	
13. Projects Donated by other Donors										
13-1	Country Report Climate Risk Management in Armenia	UNDP	Electronic	1					JR・CR( )・SC	
13-2	The Socio-Economic Impact of Climate Change in Armenia	UNDP	Electronic	1					JR・CR( )・SC	
13-3	Building Resilience to Climate Change in South Caucasus Agriculture	World Bank	Electronic	1					JR・CR( )・SC	
13-4	Project Appraisal Document on a proposed loan in the amount of US$30 million to the Republic of Armenia for an irrigation system enhancement project	World Bank	Electronic	1					JR・CR( )・SC	
14. Others										
14-1	Population Data by Community in 2011	National Statistical Service	Electronic	1					JR・CR( )・SC	
14-2	Decree about Defining the Estimations of Water Demand and Nature Protection Discharges for Drinking-Household, Agricultural Purposes According to the Water Basin Territory of the Republic of Armenia	Government of the Republic of Armenia	Electronic	1					JR・CR( )・SC	
14-3	National Greenhouse Gas Inventory Report of the Republic of Armenia 2010	Ministry of Nature Protection, Republic of Armenia	Electronic	1					JR・CR( )・SC	

No.	Name of Materials	Publishing Organization/ Source	Form	Type					Categorization	Remarks
				Collected materials	Created materials by Experts	Created materials by JICA	Text book	Other		
14-4	Calculation of Grid Emission Factor for the Electricity System of the Republic of Armenia for 2012	Ministry of Nature Protection, Republic of Armenia	Electronic	1					JR・CR( )・SC	
14-5	Quality Assurance Techniques for Bentonite Mixture Soil Liner at Final Disposal Sites	Mitsui Sumitomo Construction Company Institute of Technology	Electronic	1					JR・CR( )・SC	
14-6	Study For Permeability And Its Evaluation of Mixed Gravel Sand And Bentonite	Kajima Con CO, Japan Society of Civil Engineer Vol. 64 No1s	Electronic	1					JR・CR( )・SC	
14-7	A study for permeability and Intensity Characteristic of Mixed Cement And bentonite	Ohbayashi Construction Company, Annual meeting report of JSCE	Electronic	1					JR・CR( )・SC	
14-8	A study for permeability of Mixed Soil And bentonite	Konoike Construction Company Technical Report	Electronic	1					JR・CR( )・SC	
14-9	A field Test Report of Mixed Soil And Bentonite	Kumagaigumi Construction Company, Annual meeting report of JJSCE	Electronic	1					JR・CR( )・SC	
14-10	Design materials of rubber sheet	Mistuhosi Rubber Belt Company	Electronic	1					JR・CR( )・SC	
14-11	Armenia: Background Study, November 2013	USAID	Electronic	1					JR・CR( )・SC	
14-13	FAO - Republic of Armenia Country Programme Framework 2012-2015	FAO and The Ministry of Agriculture, The Republic of Armenia	Electronic	1					JR・CR( )・SC	
14-14	Social Impact of Emigration and Rural-Urban Migration in central and Eastern Europe, Final Country Report, Armenia 2012	European Commission	Electronic	1					JR・CR( )・SC	

Attachment-3: Aide-Memoire (Kick-off Meeting, dated on June 16, 2015)

Japan International Cooperation Agency

Date: July 3, 2015
Ref. No.: R3CAC/F2015- 3/

Mr. Sergey Manassarian
Deputy Minister
Ministry of Foreign Affairs of Republic of Armenia

Re: the Preparatory Survey for Yeghvard Irrigation System Improvement Project in Armenia

Dear Mr. Manassarian ,

First of all, we would like to express our sincere gratitude for your continued cooperation on JICA projects in Armenia.

Regarding the Yeghvard Irrigation System Improvement Project (hereinafter referred to as "the Project"), we are pleased to inform you that we held a Kick-Off meeting of the preparatory survey on June 16, 2015 with you and/or other relevant ministries and organizations.

In this regard, I hereby send you an aide-memoire for our precise understanding and I would appreciate it .if you could share this with Ministry of Agriculture and State Committed of Water Economy of Ministry of Agriculture.

In case of inquiries, I would appreciate it if you could contact Ms. Khojikyan Ruzan, JICA coordinator in Armenia.

Address: JICA Armenia Liaison Office
25/14—4 Nalbandyan str. 0001 Yerevan, Armenia
Tel: + 374 10 568805 Mobile: + 374 77 710 760
Email: jica.arm.r@gmail.com

Your cooperation and assistance would be highly appreciated.

Sincerely yours,

Akihito NAGATA
Director,
Central Asia and the Caucasus Division
East and Central Asia and the Caucasus Dept.

Cc:
Ministry of Finance, Ministry of Economy, Ministry of Nature Protection of RA, State Committee of Water Economy of the RA Ministry of Agriculture
Dr. Grant Pogosyan, Ambassador Extraordinary and Plenipotentiary
Ms. Khojikyan Ruzan, JICA Coordinator in Armenia
JICA Uzbekistan Office

(End)

AIDE-MEMOIRE

on

Kick-off Meeting related to Inception Report (ICR)
of the Preparatory Survey for Yeghvard Irrigation Improvement Project
in the Republic of Armenia (RA)

Yerevan, June 16, 2015

The Japan International Cooperation Agency (JICA) sent a mission headed by Akiko WAKUI, Assistant Director of Central Asia and the Caucasus Division, East and Central Asia and the Caucasus Department (hereinafter referred to as "the Mission"), incorporated with a consultant team headed by Kazumitsu TSUMURA (hereinafter referred to as "the Survey Team") to Yerevan from June 9 through 19, 2015 for the Preparatory Survey (hereinafter referred to as "the Survey") for Yeghvard Irrigation System Improvement Project (hereinafter referred to as "the Project") in accordance with following backgrounds;

1. Backgrounds of dispatching the Mission and the Survey Team

1) After the request for Official Development Assistance (ODA) loan to the government of Japan was made by the Government of RA in June 2012, JICA had executed to gather information related to the construction of Yeghvard Reservoir by sending the contact missions as well as sending questionnaire in order to formulate the Project.
2) Based on the information that JICA obtained through the above 1), JICA proposed two-phased studies; a) Data Collection Survey on Agriculture and Irrigation Sectors in relation to the Project (Pre-feasibility Study: Pre-F/S) and b) Full-scaled Feasibility Study (F/S), and the Government of RA agreed the above mentioned proposal.
3) JICA dispatched a consultant team as place of the above a) Pre-F/S in June 2014. Then, the consultant team conducted a field survey including of data/information collection and had a series of discussions with related agencies in the RA from June through August 2014, and analyzed the collected information prior to prepare a draft final report (DFR) of the Pre-F/S in Japan during September to October 2014.
4) JICA sent a mission to Yerevan from November 2 through 6, 2014 for the purpose of explanatory discussion for the DFR of the Pre-F/S of the Project. Then, the government of RA accepted it.
5) JICA decided to dispatch a consultant team for the F/S of the Project and prepared its TOR and requested the Government of RA to confirm and provide comments and/or requests if there were any.

JICA sent the Inception Report (ICR) of the F/S of the Project to the government of RA prior to the dispatch of the consultant team; the consultant team was sent to conduct the F/S of the Project.

2. Results of the Kick-off Meeting of Full-scaled F/S

The Mission and the Survey Team have explained contents of Inception Report (ICR) to officials of the Government of RA, listed in the attachment. The Armenian officials have understood the approaches and methodologies as well as the schedule of the Survey shown in the ICR and in principle accepted the contents of it.

Main items discussed and agreed by the Armenian officials during the explanation of ICR are

described as follows;

2-1. Environmental and Social Impact Assessment (ESIA)

The Mission and the Survey Team explained the timing of completion and process of information disclosure for the ESIA as below;

1) SCWE shall support the Survey Team for his preparation of the draft of ESIA by introducing environmental experts/companies prior to completion of the ESIA.
2) The Survey Team will prepare the draft of ESIA in cooperation with SCWE.
3) SCWE shall finalize the draft of ESIA in cooperation with the Survey Team.
4) SCWE shall, within its competency and functions, take all necessary procedures to obtain approval for the ESIA from Ministry of Nature Protection (MONP) in Armenia prior to information disclosure of the ESIA to be done on JICA's website for the necessary next step.
5) The ESIA shall be completed at the timing of finalization of this Preparatory Survey (Full-scaled F/S).

2-2. Issues to be confirmed during the Survey (Full-scaled F/S)

The Survey Team rose following issues to be confirmed during the Full-scaled F/S.

1) Latest strategy for Yeghvard irrigation area of Ministry of Agriculture (MOA) in consideration with food security, export-oriented, saving irrigation, etc. prior to estimation of water demand for the Project.
2) Means of decision making due to "Law of Lake Sevan" for confirming water utilization of Lake Sevan which would affect the design capacity of the proposed Yeghvard Reservoir.
3) Actual water utilization from Hrazdan and Kasakh Rives for other irrigation schemes other than the Project.
4) Alternatives if the scale of the Project is to be made smaller due to high construction cost for reservoir basin, based on the result of geological / hydro-geological surveys.
5) Necessity of emergency water release system from the proposed Yeghvard Reservoir.
6) Preparation of corrective action plan for those who had already been resettled and expropriated due to the construction of Yeghvard reservoir under the Government of Soviet Union, if necessary.

End

(Attachment) List of participants

Ms. Akiko WAKUI
Assistant Director
Central Asia and Caucasus Division
East and Central Asia Department

Attachment-4: Memorandum of Understandings (Role and Responsibility)

Memorandum of Understandings
for
The Preparatory Survey for Yeghvard Irrigation System Improvement Project in the Republic of Armenia

Yerevan, October 02, 2015

Regarding Environmental and Social Consideration (ESIA) of the Preparatory Survey for Yeghvard Irrigation System Improvement Project (hereinafter referred to as "the Project"), State Committee of Water Economy of the Ministry of Agriculture (hereinafter referred to as "the SCWE") and the consultant team dispatched by Japan International Cooperation Agency since June 2015 (hereinafter referred to as "the Survey Team") discussed roles and responsibilities of the SCWE and the Survey Team. Mainly, they agreed that the SCWE should be the "Undertaker" for the ESIA report preparation while the Survey Team supports the SCWE. Detail contents are described in the following table:

Table Roles and Responsibilities of the SCWE and Survey Team for the ESIA Report Preparation

Contents	The SCWE	The Survey Team
1. Application form preparation of the Project	Making comments on the application form	Preparation of application form of the Project
2. Stakeholder meeting (before application form submission and ESIA report submission)		
2.1 Stakeholder analysis	Both sides analyze stakeholders of the Project.	
2.2 Public notice of the stakeholder meeting	Preparation of public notice Public notice in name of SCWE	Support SCWE to prepare public notice
2.3 Preparation of materials for the stakeholder meeting	Making comments on the materials prepared by the Survey Team	Preparation of draft materials for the stakeholder meeting
2.4 Arrangement of the stakeholder meeting	Arrangement of the stakeholder meeting such as venue reservation including securing of funds.	Support SCWE to organize stakeholder meetings.
2.5 Presentation of the Project outline and expected environmental impacts	Presentation of the project outline and summary of expected environmental impacts based on the materials Answer to questions from the participants	- Support of the presentation by the SCWE - Support SCWE for answering to questions from the participants
2.6 Preparation of minutes and participant list	Check of the minutes prepared by the Survey Team	Preparation of minutes and participant list
2.7 Shooting of the stakeholder meeting by using a video camera	None	Arrangement of necessary staff and equipment, and provision of financial support for shooting of the stakeholder meeting
3. Initial assessment application form submission of the Project to the Environmental Impact Expertise Center (EIEC) State Non Commercial Organization of the Ministry of Nature Protection	- Submission of the initial assessment application form to the EIEC in name of SCWE - Payment of application fee of the project to the EIEC	- Preparation for the initial assessment application form and support of the submission of the application form

1

Contents	The SCWE	The Survey Team
4. ESIA report preparation and submission, and acquisition of positive conclusion on the ESIA report from the EIEC		
4.1 Preparation of draft ESIA report	None	- Preparation of draft ESIA report - Provision of financial and technical support for the ESIA report preparation
4.2 Submission of the draft ESIA report to the SCWE	None	Submission of the draft ESIA report to the SCWE
4.3 Comment on the draft ESIA report by SCWE and modification based on the comments	Review of draft ESIA and making comments on the draft ESIA report	Modification of the draft ESIA report based on the comments from SCWE
4.4 Draft ESIA report submission to the EIEC	Submission of the draft ESIA report to the EIEC in name of SCWE	None
4.5 Modification of the draft ESIA report based on comments from the EIEC	Review of revised draft ESIA report	Modification of the draft ESIA report based on comments from the EIEC
4.6 Submission of the final ESIA report to the EIEC	Submission of the final ESIA report to the EIEC in name of SCWE	None
4.7 Acquisition of positive conclusion on the ESIA report from the EIEC	Acquisition of positive conclusion on the ESIA report from the EIEC	None

End

津村 和光

Kazumitsu TSUMURA
Team Leader,
JICA Survey Team,
Sanyu Consultants Inc. (SCI)

Aram HARUTYUNYAN
Chairman,
State Committee of Water Economy,
Ministry of Agriculture of the Republic of Armenia

5.10.2015

2

Attachment-5: Memorandum of Discussions (Interim Report Explanatory Meeting)

Memorandum of Discussions for Interim Report (ITR) Explanatory Meeting of the Preparatory Survey for Yeghvard Irrigation System Improvement Project in the Republic of Armenia (RA)

Yerevan, 4th of December 2015

Based on the letter, that JICA headquarters sent to Ministry of Foreign Affairs of RA dated on 17th of March 2015 regarding on "Consultant's TOR" for the Preparatory Survey on Yeghvard Irrigation System Improvement Project (hereinafter referred to as "the Survey"), and also the Minutes of Meetings for the Survey on Yeghvard Irrigation System Improvement Project (hereinafter referred to as "the Project") sighed by and among Ministry of Agriculture (MOA), State Committee of Water Economy (SCWE) and Japan International Cooperation Agency (JICA) dated on 30th of October 2015, a consultant team headed by Kazumitsu Tsumura (hereinafter referred to as "the Survey team") sent by JICA by scheduling June 2015 through May 2016, completed Interim Report (ITR) of the Survey. An explanatory meeting of the ITR has been held on 4th of December 2015.

1. Submission of the ITR

The Survey team submitted the following ITR to officials of the Government related to the Survey. And Armenian side received them;

1) 40 copies of Armenian version of the ITR, and
2) 10 copies of English version of the ITR

2. Explanatory meeting

The Survey team explained contents of the ITR to officials of the Government of RA, listed in the attachment by using power point materials. Main items explained and pointed out by the Armenian officials at the question and answer session are as follows;

2-1. Main items explained by the Survey team

Main contents explained by the Survey team are summarizes below;

Agriculture

1) Planed cropping calendar is made according to the cropping strategy of Sustainable Agriculture Development Strategy (SADS, 2010-2020), trends of last 5 years' changes and the results of interview survey at the project sites.

Water resources and utilization / Irrigation planning

2) A capacity of planed reservoir is designed 94 MCM and it is explained the possibility to reduce it by applying saved water irrigation and by depending on other water sources such as existing pump stations and Lake Sevan.
3) Some sections of existing irrigation canal should be rehabilitated due to shortage of their existing capacities and conditions to deterioration.
4) Partly, new canal extensions are required for connecting to irrigation areas in the case of abolishing existing pump stations and also further study is needed for their finalization.

Hydro-geology / Reservoir planning

5) 600 ha of a planned area for reservoir bottom is more economical rather than 900 ha of it with constructing new dikes to be connected the Dikes No.1 and No.2 in consideration with the area of anti-infiltration works.

6) Reducing planned area for anti-infiltration works is expected based on the results of in-situ permeability test of which additional investigation could be scheduled at next stage.

7) Reducing thickness and/or percentage such as bentonite sheet/powder mixture and soil cement for the anti-infiltration works is expected based on further considerations which are still on-going.

Project cost and evaluation

8) Project cost is estimated around 450 million USD including of contingencies and VAT with applying anti-infiltration works for reservoir bottom by either bentonote sheets or soil mixture at the level of interim stage.

9) Reducing of the project cost is expected by the further investigations and considerations shown in the above 6) and 7), and also phasing out of the Project with components, namely; a) reservoir and b) other facilities such irrigation system improvement, that will be reduced by 200 million USD approximately.

10) Since factor calculated from conservation of Lake Sevan of 50 MCM/year water usages at present level is occupied 45% to the total Project benefit, reducing project cost by minimizing capacity of the planned reservoir affects to the financial aspects.

Emergency discharge facilities

11) It was explained as the basic conditions, that seismic design for dam construction would be applied avoiding any damages by earthquake and other risks.

12) A concept of emergency discharge facilities under Japanese standard was introduced, which could not be made decision by the Survey team and it was suggested establishing a committee for further discussion among Armenian officials.

Environmental and social considerations

13) The 1st public hearing was held on 20th October 2015 by the name (undertaker) of SCWE, and the 2nd one is scheduled on March 2016 at the end of the Survey.

2-2. Main items pointed out by the Armenian officials

Followings are main items pointed out by the Armenian officials;

1) Planned area of the reservoir bottom either 900ha or 600ha should be examined in consideration with further studies in the Survey.

2) In case of 600ha for reservoir bottom, measures for back spaces between existing dikes and planned new dikes should be considered for not becoming swamp.

3) It was suggested considering active fault for dam design.

4) Risk assessment on dam safety by seismic design should be considered.

5) Armenian officials agreed to consider establishing a committee for discussing among agencies related to the emergency discharge facilities for the Project.

2-3. Comments on the ITR, added by PIU towards preparing Draft Final Report (DFR)

1) The official data, received from the Hydro-meteorological and State Monitoring Service of Armenia, should be presented as Appendixes in the DFR.
2) The information of field works, carried out by local subcontractors (geological, hydro-geological, topographic surveys, laboratory tests, etc.), should be presented as Appendixes in the DFR.
3) The economic efficiency by decreasing the area of the reservoir bottom, should be presented in detail in the DFR.
4) Options of anti-infiltration materials, particularly, bentonite sheet and bentonit-soil mixture should be presented in detail in the DFR.
5) Graphs, plans, sections, etc. shown in main report of the ITR, should be presented as Appendix by A3 size in the DFR.
6) It would be suggested that benefits with 15 million USD/year from conservation of Lake Sevan, not be included in the project benefits for the calculation of IRR, in case of 94 MCM of the reservoir capacity.
7) Since detailed cost estimation including rehabilitation of the irrigation systems is not mentioned in the ITR, it should be presented as Appendixes in the DFR.

2-4. Others

The Survey team requested to Armenian officials to give more comments on ITR towards preparing draft final report (DFR).

End

(Attachment) List of participants and memorandums

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Kazumitsu TSUMURA
Team Leader,
JICA Survey Team,
Sanyu Consultants Inc. (SCI)

Attachment: List of participants and memorandums

List of participants

No.	Name	Position
1	Aram Harutyunyan	Chairman, State Committee of Water Economy (SCWE), Ministry of Agriculture (MOA)
2	Volodya Narimanyan	Deputy Chairman, SCWE, MOA
3	Hakob Matilyan	Deputy Chairman, SCWE, MOA
4	Artak Harutyunyan	Head of Mobilization Department, SCWE, MOA
5	Karen Daghbashyan	Head of Irrigation collector-drainage Systems Department, SCWE, MOA
6	Araksya Harutyunyan (Ms)	Chief Specialist of Foreign Relations, SCWE, MOA
7	Sona Hayrapetyan (Ms)	Chief Specialist of Irrigation collector-drainage Systems Department, SCWE, MOA
8	Garik Saroyan	Chief of Staff, SCWE, MOA
9	Kamo Sargsyan	Head of Internal Audit, SCWE, MOA
10	Lilia Khzmalyan (Ms)	Project Administrator, SCWE, MOA
11	Nune Davtyan (Ms)	IT Coordinator, SCWE, MOA
12	Anna Margaryan (Ms)	Head of Economic Division, SCWE, MOA
13	Samvel Karapetyan	SCWE, MOA
14	Karen Dadoyan	SCWE, MOA
15	Naira Manukyan (Ms)	Chief Specialist of Secretariat, SCWE, MOA
16	Armen Balayan	Department of Water Supply and Sanitation Systems, SCWE, MOA
17	Artavazd Badalyan	Legal Division, SCWE, MOA
18	Elmira Papyan (Ms)	SCWE, MOA
19	Marapet Tonoyan	Project Implementation Unit (PIU), SCWE, MOA
20	Varazdat Mkrtchyan	Engineer, PIU, SCWE, MOA
21	Khoren Tsarukyan	Engineer, PIU, SCWE, MOA
22	Arthur Baghdasaryan	Head of the Department of Land Use and Melioration, MOA
23	Larisa Harutyunyan (Ms)	Ministry of Finances (MOF)
24	Askhen Tovmasyan (Ms)	Deputy Head of SSP, Ministry of Territorial Administration and Emergency Situations (MTAES)
25	Karo Karapetyan	Head of division, Rescue Service (RS), MTAES
26	Valeri Arzumanyan	Head of Division, Service for Seismic Protection (SSP), MTAES
27	Arkadi Cherchinyan	Chief Specialist, MTAES
28	Hripsime Babayan (Ms)	Chief Specialist, Department of Local self-government, MTAES
29	David Mejlumyan	Leading Specialist of Water Cadastre and Monitoring Division, Water Resources Management Agency (WRMA), Ministry of Nature Protection (MNP)
30	Nazik Khzmalyan (Ms)	MNP
31	Arthur Avagyan	Head of Hrazdan Territorial Basin Management Division, WRMA, MNP
32	Sevak Matilyan	Deputy Head of the Division of Basing Planning Management, WRMA, MNP
33	Mihran Hovhannisyan	Head of Yeghvard WUA
34	Gagik Ghazaryan	Chief engineer, ArmWaterProject Institute CJSC
35	Aleksey Tarverdyan	ArmWaterProject Institute CJSC
36	Varujan Tutzyan	ArmWaterProject Institute CJSC
37	Kenichiro Sasame	Counselor Embassy
38	Emiko Fujiyama (Ms)	Second Secretary Embassy
39	Elina Sahakyan (Ms)	Political and Economic Officer Embassy
40	Gayane Manukyan	Diplomat
41	Akiko Wakui (Ms)	Assistant Director, JICA Survey Team
42	Shotaro Ono	Assistant Director, JICA Survey Team
43	Ruzan Khojikyan (Ms)	JICA Armenia Liaison Officer
44	Kazumitsu Tsumura	Team Leader/ Irrigation Planning, JICA Survey Team
45	Kazuma Akiyoshi	Co-Team Leader/ Irrigation Planning, JICA Survey Team
46	Fusataka Arakawa	Irrigation Planning, JICA Survey Team
47	Haruo Hiki	Reservoir Planning, JICA Survey Team
48	Mamoru Hatano	Marketing/ Agricultural Organization
49	Shohei Natsuda	Economy and Financial Analysis/ Social Consideration, JICA Survey Team
50	Gevorg Gevorgyan	Assistant / interpreter, JICA Survey Team
51	Tamara Mirzoyan (Ms)	Assistant / interpreter, JICA Survey Team
52	Tatevik Minasyan (Ms)	Assistant / interpreter, JICA Survey Team
53	Christine Goroyan (Ms)	Assistant / interpreter, JICA Survey Team
54	Luiza Ohanyan (Ms)	Assistant / interpreter, JICA Survey Team
55	Haykuhi Asatryan (Ms)	Armenia TV
56	Karen Arzumanyan	Business Express newspaper

Memorandums during the question and answer session

1. Opening Remarks

(Tsumura/ JICA Survey team leader): Today is the interim report presentation day. I am sorry for such a small space in the meeting room. We didn't expect that we would have so many participants. And now Mr. Harutyunyan will make the opening remarks.

(Harutyunyan/ Chairman, SCWE): Ladies and gentlemen, the construction of reservoirs is very important for Armenia. Currently, we have 90 reservoirs in this country. The most important issue for us is the conservation of Lake Sevan. Its conservation measures should result in reduction of dependency on the lake. One of the main goals of the Project is the conservation of water resources of the lake. In addition, thanks to the Project, we will be able to save electricity through introducing gravity irrigation. We have other similar ongoing projects. The first one is Vedi reservoir – 29 MCM. Then, the second one is Kaps reservoir – 25 MCM in the first phase and 60 MCM in the second phase. They are followed by Selav-Mastara – 60 MCM and then this Yeghvard. We should ensure sustainable management of surface water, namely, usage of melted snow. Construction of Yeghvard reservoir will allow us to store the water resource. Only through Yeghvard reservoir, we will be able to save energy of 25 million kWh.

The target Project area is located in three (3) marzes and includes 27 communities. I am familiar with the works that have been carried out by the Survey team and want to thank them for comprehensive investigations. Now is the stage of feasibility study but it is very important for passing to the next stage. I also want to express my gratitude to JICA and the Japanese Government. Yeghvard reservoir was just a small throwback to the history. It was a more ambitious project during the USSR (Union of Soviet Socialist Republics) times. But the current format will ensure the most efficient use of water. From environmental point of view, reduction of dependency on Lake Sevan is very important. The first reservoir constructed after the independence was Marmarik reservoir – 24 MCM. The next positive outcome of the Yeghvard reservoir project will be abolishing the operation of a few dozens of pump stations and deep wells. The cost of agricultural products will decrease because of the abolishment.

Your opinions and remarks will be highly appreciated, as they are very important for the future course of the Project. All opinions and remarks will be considered in the planning. We should examine the peculiarity of our region, particularly the seismic activity. Our first meeting with the Japanese consultants lasted quite long and was very productive. After this preliminary stage, we will proceed to the main stage. And, after design works with expertise, construction will start.

Again this is a very important project. Thank you!

(Tsumura/ JICA Survey team leader): Thank you, Mr. Chairman. My name is Kazunitsu Tsumura, I am the JICA Survey team leader. Now we will start the presentation of the ITR.

2. Presentation of Interim Report

Refer to presentation materials

3. Question &Answer Session

Q1 **(Artur Baghdasaryan/ Ministry of Agriculture)**: Is the Survey team planning to construct both of the feeder canals that you presented or just one of them?

A1 **(Akiyoshi/ Survey team)**: We plan the construction of both of them.

Q2 **(Karo Karapetyan/ MTAES)**: When we say high radioactivity, how much do you mean, how many micro-roentgen/hour?

A2 **(Hiki/ Survey team)**: It exceeds the environmental radioactivity by three (3) times, which is not harmful to people's health.

Q3 **(Karo Karapetyan/ MTAES)**: Has the Survey team calculated the project cost?

A3 **(Tsumura/ Survey team)**: We have done some calculations but we still need to do more detailed recalculations.

Q4 **(Gagik Ghazaryan/ ArmVodProject)**: What is reservoir volume for three (3) different project costs, i.e., Bentonite sheet (1 layer), Soil cement, Bentonite soil mixture shown in slide #76, correspond to the same volume?

A4 **(Tsumura/ Survey team)**: Yes, they are corresponded to the same volume 94MCM.

Q5 **(Gagik Ghazaryan/ ArmVodProject)**: In case of a smaller area of reservoir bottom (600ha), are the existing embankments or will new ones be constructed?

A5 **(Tsumura/ Survey team)**: We design new embankments.

Q6 **(Gagik Ghazaryan/ ArmVodProject)**: Then, what about the existing embankments?

A6 **(Tsumura/ Survey team)**: We will use them and just make the space smaller. We will combine the existing and the new embankments.

Q7 **(Gagik Ghazaryan/ ArmVodProject)**: Won't these new dikes increase the project cost?

A7 **(Tsumura/ Survey team)**: We have compared the cases of 900ha and 600ha in consideration with area of anti-infiltration works and construction cost of new dikes. You can see the project cost for each of them.

Q8 **(Gagik Ghazaryan/ ArmVodProject)**: But you just said that the anti-filtration works will be reduced by 500ha (slide #74) due to anisotropy. Won't it affect the project cost?

A8 **(Tsumura/ Survey team)**: Allow us to make more detailed investigations.

Q9 **(Gagik Ghazaryan/ ArmVodProject)**: If you cover the slopes with soil-bentonite mixture, won't there be danger of this layer washed down by water during the decrease of water level?

A9 **(Tsumura/ Survey team)**: We plan to use soil-cement for the slopes.

Q10 **(Gagik Ghazaryan/ ArmVodProject)**: But you didn't introduce breakdown of project cost of bentonite and soil mixture for the bottom, and soil-cement for the slopes.

A10 **(Tsumura/ Survey team)**: We have done such calculations but allow us to make more detailed investigations and discuss the issue later.

Q11 **(Gagik Ghazaryan/ ArmVodProject)**: If we completely close the reservoir with embankments, don't you think that there may cause swamps on the other side of the dam? Because the different water head between inside and outside of reservoir, could make the swamp. Don't you think this might cause damage to the dam?

A11 **(Tsumura/ Survey team)**: We will make the design with consideration of such issues.

Q12 **(Gagik Ghazaryan/ ArmVodProject)**: If you completely surround the reservoir by embankments, how will it be used for recreational purposes?

A12 **(Tsumura/ Survey team)**: This is an agricultural and irrigation project and we have not considered issues related to recreation.

Q13 **(Gagik Ghazaryan/ ArmVodProject)**: Resettlement and land acquisition are mentioned as negative factors. But the lands in the reservoir community are possessed by community lands. Hence, we do not have resettlement and land acquisition issues.

A13 **(Tsumura/ Survey team)**: We have to follow not only by the Armenian legislation but also by the JICA guideline as well.

Comment (Karo Karapetyan/ MTAES): We would kindly ask you to involve us in these works. We have a lot of information.

Q14 (Valeri Arzumanyan/ MTAES): You have drilled 30m boreholes. At what depth can the basalt be found? And besides, are you going to strengthen the dam body or are you going to leave it as it is?

A14 (Hiki/ Survey team): In the center, the reservoir bottom is covered by 120m-thick sandy loam. Towards the slopes, it changes to basalt. That is why we plan to carry out anti-infiltration measures instead of strengthening the embankments.

Q15 (Gagik Ghazaryan/ ArmVodProject): How do you design anti-infiltration measures on the embankment?

A15 (Mr. Hiki/ Survey team): These are the same measures that were planned during the Soviet period.

Q16 (Volodya Narimanyan/ SCWE): There are certain norms for filling and drawdown of reservoirs. In case of quick drawdown of the reservoir, what is the risk of damage of the dam body?

A16 (Tsumura/ Survey team): As the basic conditions, we plan to make the design to avoid any damage by earthquake and other risk. However, if the design should be followed by Japanese legislation, it will result in sharp increase of the project cost, because of huge emergency facility. We should discuss it with SCWE and related agencies.

Q17 (Volodya Narimanyan/ SCWE): What justification of anti-infiltration did you use for planning three (3) layers of bentonite sheets and one sheet only? The same condition applies to soil and bentonite mixture? How did you justify between three (3) and one (1) layer as applied layer? Besides, if you exclude the irrigation system from the Project, the reservoir will become a meaningless structure.

A17 (Tsumura/ Survey team): Regarding the first question, laboratory tests showed lower permeability results than was expected by us. However, we have not finalized result yet, we still need to continue the detailed investigations. Regarding the bentonite sheet, the bentonite factory suggested a higher permeability coefficient than the data provided by the PIU. That is why it may be possible to use one layer. Regarding excluding the irrigation system from the project cost, the productivity will be decreased, if this components will not be included. We suggest demarcating the project components between Reservoir project and other project in order to reduce project size and cost. We don't know how the Government will try to find funds. Dividing the project into two (2) phases maybe more convenient for the Government.

Q18 (Ashkhen Tovmasyan/ MTAES): What impact on the seismic activity of the area does a big reservoir have? The investigations are testified that there may be relatively strong earthquakes due to the big reservoirs. The 2008 earthquake in China was occurred by a big reservoir. They had forgotten that there is an active fault nearby.

A18 (Hiki/ Survey team): In my experience, there is one related public report about an earthquake that occurred in 1950s due to the construction of a big reservoir (Mihoro dam). I heard about another one in Thailand, where I was engaged as a member of design team. According to the Japanese norms, if there is an active fault, it is allowed to construct a reservoir with keeping at least at a 300m distance from the fault. Several clear faults have been found around and near the reservoir area but they are judged not to be active faults because of their not cutting our targeted geological layers. We assume that the construction of the reservoir will not result in fault activity.

Comment (Ashkhen Tovmasyan/ MTAES): I want to draw your attention on the fact that the Armenian norms require constructing a reservoir 10km away from the fault. There is no map of active faults but there is a reference to it in the norms. There are two representative maps in this report, but they just give a general picture.

Q19 (Gagik Ghazaryan/ ArmVodProject): What norms have you used for calculating the construction cost? Each country has its own prices. What criteria have you used for calculation?

A19 (Tsumura/ Survey team): These are preliminary calculations, RA norms have been considered. An Armenian specialist was also involved in the cost estimation. But these are all preliminary

estimates. Allow us to continue. Of course the cost estimation should be in line with the Armenian norms.

Q20 (Volodya Narimanyan/ SCWE): I want to summarize our meeting as it is not possible to understand so much information in three hours and to organize a comprehensive discussion. I suggest that Armenian side openly submit your comments and remarks in written form. We will discuss them with the consultants.

I just have one remark. It would be more appropriate to change the word "Russian" for "USSR" when you speak about the investigations.

A20 (Tsumura/ Survey Team): We are still in Armenia and we can discuss any kind of remark. We have already replaced the word "Russian" in the slides, but we didn't have time to make this change in the report. We will revised all of words in DFR.

4. Closing Remark (Volodya Narimanyan/ Deputy Chairman, SCWE):

I want to thank the Japanese consultants for such detailed and serious studies. I also want to thank JICA and all the participants.

End

Attachment-6: Memorandum of Discussions (DFR Explanatory Meeting)

Memorandum of Discussions for the Draft Final Report (DFR) Explanatory Meeting of the Preparatory Survey for Yeghvard Irrigation System Improvement Project in the Republic of Armenia (RA)

Yerevan in Armenia, 5th of October 2016

Based on the invitation letter, which JICA headquarters sent to Ministry of Foreign Affairs of RA dated on 23rd of September 2016 regarding a Draft Final Report (DFR) explanatory meeting (hereinafter referred to as "the DFR Meeting") for the Preparatory Survey on Yeghvard Irrigation System Improvement Project (hereinafter referred to as "the Project"). The DFR Meeting has been held at the Erebuni Hall of Erebuni Plaza on 5th of October 2016.

1. Submission of the DFR

The Survey team submitted the following DFR to State Committee of Water Economy (SCWE) on 26th September 2016, who was requested in the letter to deliver DFR to the officials of the Government related to the Survey;

(1) Hardcopy of Main DFR: 10 copies for English and Armenian each
(2) Hardcopy of Appendix of DFR (English): 2 copies
(3) Hardcopy of Draft ESIA Report: 2 copies for English and Armenian each
(4) Hardcopy of Draft RAP: 2 copies for English and Armenian each
(5) Electric file in CD-ROM for English and Armenian each

2. The DFR Meeting

The Survey team explained contents of the DFR to the participating officials of the Government of RA, listed in the attachment, by using power point materials. Main items explained by the Survey team and the ones inquired/pointed out by the participating officials are as follows;

2-1. Main items explained by the Survey team

Main contents explained by the Survey team are summarizes below;

Agriculture

1) Planed cropping calendar is made according to the cropping strategy of Sustainable Agriculture Development Strategy (SADS, 2010-2020), trends of last 5 years' fluctuation and the results of interview survey at the Project sites.

Water resources and utilization / Irrigation planning

2) The capacity of planed reservoir is designed to be 94 MCM. The reservoir is expected to contribute to a reduction of the operation of existing pump stations and of consumption of Lake Sevan water for irrigation.
3) The two feeder canals and two outlet canals are designed as the inlet and outlet facilities, in addition, nine facilities for the reservoir operation such as the valve houses, box and a control houses are planned around the reservoir.
4) Some sections of the existing irrigation canals shall be rehabilitated due to shortage of capacities and deteriorated conditions.
5) Partly, new canal extensions are required for connecting the irrigation areas to the canal system in case of abolishing existing pump stations, however, their abolishment shall be conducted step by step.

Hydro-geology / Reservoir planning

6) After the careful considerations and studies of the reservoir design, the 900 ha plan of storage area is economical a little compared to the 600 ha plan where the construction of new dikes connecting Dam No.1 and Dam No.2 shall be required in both north and south side.

7) According to the estimation of leakage quantity by the three-dimensional seepage analysis based on the geological investigations and the permeability assessment of the ground, the approximate 260 ha area at around the center of the reservoir bottom is allowed to be the area not provided with the anti-infiltration works.

Project cost and evaluation

8) Project cost is estimated to be 227 million USD including of contingencies and VAT, where the cost of anti-infiltration works, soil-cement coverage with a sandwiched bentonite sheet, to the reservoir bottom and slopes occupies the main portion.

9) The Project EIRR is calculated to be 3.68%. When considering the reduction of 50 MCM/year consumption of Lake Sevan for irrigation, EIRR is estimated to be 5.72% as the total benefit.

Emergency discharge facilities

10) Emergency discharge facilities are considered nevertheless the dam body is designed to be the safe enough structure under the seismic design technology.

11) The emergency discharge is planned to be done to the River Kasakh through the outlet conduit provided to the basement of Dam No.1; and the circumstances caused by the discharge were explained. Details shall be decided in the Detail Design Stage.

Environmental and social considerations

12) The decrease of available water for hydro-power generation in the Hrazdan River by the Project does not seriously affect to the power generation. It is only 0.35% of the total power generation in Armenia. The expected impact on fish in the Hrazdan River by the Project is not severe. Since the newly available water in the Lake Sevan will be generated by the Project, this water from Lake Sevan could be available during March to May.

13) The 1st public hearing was held on 20th October 2015 by the name (undertaker) of SCWE, and the 2nd one is scheduled on 10th October 2016 at the end of the Survey by the same undertaker.

2-2. Main items pointed out by the Armenian officials

Followings are the main items inquired/pointed out by the participating officials;

1) Seismic design to the dam body and considerations to the emergency situation in the planned reservoir are very important from the view point of national safety in Armenia. The Armenian code of seismic design and the surrounding natural/social conditions are necessary to be taken into account.

2) The possibility of waterweed flourishing and sedimentation in the reservoir shall be carefully examined in order to avoid the environmental deterioration and the interference to the reservoir operation.

3) The reason for the bentonite sheet coverage method not to be applied as the anti-infiltration works to the reservoir bottom in spite of this method being most economical in the comparative table should be explained.

4) The provided EIRR of 3.68% is underestimated. Especially, 97% of irrigation ratio does not reflect the actual situation. In addition, the maximum yield among the records of the past 5 years' yield should be applied from the view point of the progress in cultivation conditions by irrigation; the approach of yield evaluation should be reconsidered.

5) The contract of ESIA consultant in the Detailed Design stage should be separated into the design consultant based on the suggestion by PIU.

2-3. Others

The Consultant showed the schedule for the finalization of report as follows and the participating officials accepted it.

5th October in 2016 ;The DFR meeting
28th October in 2016 ;Deadline of comments from the related Ministry and Agency in Armenia
11th November in 2016 ;Submission of Final Report for the Project to JICA

End

(Attachment) List of participants and memorandums

Kazuma AKIYOSHI
Co-Team Leader,
JICA Survey Team,
Sanyu Consultants Inc. (SCI)

Attachment: List of participants and memorandums

Date: 5th October, 2016

Place: Erebuni Conference Hall of EREBUNI Plaza

List of participants

No.	Name	Organization	Position
1.	S. Sahakyan	Ministry of Agriculture (MOA) of RA, Department of Land Use and Melioration	Head of Department
2.	Karen Grigoryan	Project Implementation Unit (PIU), State Committee of Water Economy (SCWE), MOA	Deputy Director
3.	Khoren Tsarukyan	PIU, SCWE, MOA	Engineer
4.	Varazdat Mkrtchyan	PIU, SCWE, MOA	Engineer
5.	Martiros Nalbandyan	PIU, SCWE, MOA	Environmental Specialist
6.	Marine Vardanyan (Ms.)	PIU, SCWE, MOA	Social Specialist
7.	Hovhannes Asatryan	PIU, SCWE, MOA	Hydro Engineer
8.	Ara Grigoryan	PIU, SCWE, MOA	Engineer
9.	Hasmik Ayvazyan (Ms.)	State Environmental Inspectorate (SEI), Ministry of Nature Protection	Senior Inspector
10.	Khachik Harutyunyan	Water Resources Management Agency (WRMA), Ministry of Nature Protection	Deputy Head of WRMA
11.	Karapet Karapetyan	Man-made Disaster Management Department, Ministry of Emergency Situations	Head of Department
12.	Elina Sahakyan (Ms.)	Embassy of Japan	Politically Economy Officer
13.	Akiko Wakui (Ms.)	JICA	Assistant Director, Central Asia and the Caucus, East and Central Asia and the Caucus Department
14	Kazuma Akiyoshi	JICA Survey Team	Co-Team Leader, Irrigation Planning
15.	Haruo Hiki	JICA Survey Team	Reservoir Planning/ Reservoir Facility Design, Cost Estimation/ Construction Planning/ Procurement
16.	Yasushi Fukuda	JICA Survey Team	Hydro-geology/ Groundwater Simulation, Cost Estimation/ Construction Planning/ Procurement
17.	Toru Nakagawa	JICA Survey Team	Earthquake-Resistant/Design/ Civil Design
18.	Rie Kitao (Ms.)	JICA Survey Team	Environmental Consideration
19.	Ayumi Shiga (Ms.)	JICA Survey Team	Social Consideration
20.	Ryo Inoue	JICA Survey Team	Economic and Financial Analysis/ Social Consideration
21.	Gevorg Gevorgyan	JICA Survey Team	Assistant/ Interpreter
22.	Kristine Goroyan (Ms.)	JICA Survey Team	Assistant/ Interpreter
23.	Tatevik Minasyan (Ms.)	JICA Survey Team	Assistant/ Interpreter
24.	Luiza Ohanyan (Ms.)	JICA Survey Team	Assistant/ Interpreter

Memorandums during the question and answer session

No.	Speaker	Question and Comment	Answer
1.	Ministry of Emergency Situations	When deciding the seismic force, please consider the strictest standards. If the Armenian standards are more strict and	Thank you for the suggestion. (JICA Survey Team)

No.	Speaker	Question and Comment	Answer
		demanding, my suggestion is to use the Armenian ones.	
2.	PIU	As your studies are later going to undergo expertise, it is better to consider our standards and building codes regarding seismic force.	Thank you for the suggestion. (JICA Survey Team)
3.	Ministry of Agriculture	How are you going to organize water circulation in the reservoir in order to ensure the ecological balance?	We do not have any specific program of circulation. We have discussed this issue with PIU and we heard that such a case has not been reported in other reservoirs of RoA. During the irrigation season, due to inflow and outflow of water in the reservoir, water flow will be caused. Therefore, there will be no problem with eutrophication. (JICA Survey Team)
4.	Ministry of Agriculture	I do not think so(reply to No.3) . One option is to circulate the dotation water from Arzni-Shamiram through Yeghvard reservoir. The reservoirs you mentioned are all located on rivers.	We will study that issue again though we think that the influence will not be considerable. (JICA Survey Team)
5.	Ministry of Agriculture	Have you calculated the loss from the reservoir caused by evaporation? By our calculations, that number is around 15mln. You probably need to review your calculations because evaporation in Armenia is very high.	Yes, we have. It is mentioned in our report. It forms around 50mm/ month. (JICA Survey Team)
6.	Ministry of Agriculture	I think 50mm is too small number. Generally, the average daily evaporation is 10mm and hence 300mm per month. Hence, 6-7 months loss will form 15MCM/yr.	By our calculations, the annual loss will be 5.4 MCM/yr. (JICA Survey Team) I have a comment on Mr. Sahakyan's point. 15MCM/yr loss is calculated for the hottest weather in summer. It is not correct to calculate in this way because there are many factors that have to be considered: the area, location zone, temperature, etc. It is not accurate to take the maximum value for the whole year. I am sure that the Japanese consultants have the justification for their calculations. (PIU)
7.	Ministry of Agriculture	During water inlet into the reservoir, some solid materials may be brought to the reservoir and deposited in the bottom. Have you calculated the decrease of annual reservoir volume?	We are not almost concerned about the deposited sand (sedimentation) at the reservoir bottom. We have surveyed the current situation in Arzni-Shamiram canal and we consider that there will be some deposits. It is very important to keep maintenance and to calculate the cost related to this issue. (JICA Survey Team)
8.	Mr. Karapetyan/ Ministry of Emergency Situations	I have a suggestion. One of the most important parts of a reservoir design is the Emergency Situations Action Plan. All the reservoirs in Armenia have such a plan. It is necessary for us to imagine the scope of work to be carried out to ensure the protection of the population in case of emergency situations. I know that you have paid attention to this issue and I would like to ask you to have a separate chapter for the plan, particularly inundation area, volume, settlements subject to inundation, number of population in the endangered area, notification issues, etc.). We will assist you in the remaining issues.	Thank you. We also attach a lot of importance to safety include the suggestion of emergency program. We will develop it in more detail during the Detailed Design stage. (JICA Survey Team)
9.	PIU	Who is going to implement the trial construction and when?	We plan to implement it through a local contractor in Armenia. Currently we are discussing whether it should be implemented before or during the D/D stage. (JICA Survey Team)
10.	PIU	Why are you planning to have two feeder canals?	Only Arzni-Shamiram is going to be supplied to reservoir. The water flow volume is limited

No.	Speaker	Question and Comment	Answer
			in Arzni-Shamiram and the available period of intake from the canal is also limited. Taking these factors into account, we have considered that two feeder canals are necessary. Constructing one bigger feeder canal results to be more expensive. (JICA Survey Team)
11.	PIU	Does the reservoir have a catchment basin for rainwater?	We have not considered a catchment basin in this project but only melted water (not floodwater) will be used. (JICA Survey Team)
12.	PIU	Does the outlet pipe 2 have an emergency lowering function?	The outlet 2 has two roles: conveyance of reservoir water to the beneficiary area and emergency discharge during emergency situations (JICA Survey Team)
13.	PIU	You said that pump stations will temporarily continue operating after the reservoir construction. Have you calculated the operation cost?	It will be difficult to abolish them immediately after the Project. We plan a step-by-step abolishment during 4 years. We have considered it in the form of income. (JICA Survey Team)
14.	PIU	The Consultants showed a table with standards for deciding the most effective anti-infiltration method. He mentioned that wind will be an obstacle for laying bentonite sheets during construction. But bentonite sheet is the cheapest option and it has a low permeability coefficient. So, is wind such an important factor as to refuse the bentonite sheet method?	Bentonite sheet has its weight – 5.5kg/m2, and it will be displaced or blown off in case of wind speed exceeding 8m/s. Bentonite has a swelling property when exposed to water. Hence, a weight should be put on the bentonite sheet. That is why, we propose the "sandwich" method. Apart from price, we have considered other criteria as well, such as easiness of construction and reliability. (JICA Survey Team)
15.	Varazdat Mkrtchyan/ PIU	Does the price of bentonite sheet include the preparation layer as well?	That plan includes two layers of bentonite sheet and a soil layer above them. Let us discuss the technical issues at PIU tomorrow (JICA Survey Team)
16.	PIU	How have you calculated the increase of yield, types of crops before and after the project and have you included all of that in the IRR? You mentioned that the increase of yield will take place after 10 years. Do you mean 10 years after starting or finishing the construction? We have crops that may have yield in a shorter period.	We mean 10 years after reservoir construction. Regarding crops, we have examined the tendency of the last 5 years, programs of the Ministry of Agriculture and made respective predictions. (JICA Survey Team)
17.	PIU	All my questions are related to IRR. The aim of feasibility study is to design accurate technical solutions and economic efficiency. The problem is in your approach. I would like to ask you to change it. Why 10 years and not 5? You cannot use the current tendency for the period after reservoir construction. Besides, I see that you have planned to increase wheat fields. But wheat is not profitable. Please replace it by more profitable crops. Today people do not grow profitable crops because they do not have stable water supply.	We have discussed this issue previously. Let us discuss it at PIU tomorrow. (JICA Survey Team)
19.	PIU	You have mentioned yield of 2010-2014 excluding the maximum and minimum. Why are you excluding the maximum yield for those years taking into account the fact that we currently have water shortage? We do not have a reservoir now and do not get the potential maximum yield.	According to our data, water supply in those areas is 97% and it will be difficult to surpass it. That is why, we have taken an average value with deduction of maximum and minimum yield records . We have discussed this issue with PIU as well but there are other opinions as well. So, we are continuing the discussions with PIU (JICA Survey Team)
20.	PIU	We do not have 97% supply. The statistical data without the existence of the reservoir cannot be applied to the statistics after the construction of the reservoir. Please revise	This issue is also subject to further discussion. (JICA Survey Team)

No.	Speaker	Question and Comment	Answer
		your approach.	
21.	Ministry of Emergency Situations	In case of inundation of Kasakh river, Araks river also inundates. And there are numerous villages, railway, structures of military importance along Araks river. I would like to ask you to also examine the issue of inundation of Araks river, of course within the boundaries of Armenia.	Thank you for the comment. (JICA Survey Team)
22.	Ministry of Emergency Situations	You said that you have found a dangerous pesticide in the reservoir area. In what quantity?	It is Chlorfenvinphos and it was detected through qualitative analysis, and we cannot show the quantitative data. It has been detected in the soil of farmlands. (JICA Survey Team)
23.	Ministry of Agriculture	As I understand, your studies have concentrated mainly on Hrazdan river and not on the reservoir area.	As the reservoir is not filled yet, we have done predictions only. (JICA Survey Team)
24.	Ministry of Agriculture	There is a danger that waterweeds will appear in the reservoir. For example, I am not able to use water from Arzni-Shamiram for drip irrigation because of seaweeds. This issue should be considered later.	We have studied Arzni-Shamiram but haven't found such the issue. If it is necessary, we will consider the matter in D/D stage. (JICA Survey Team)
25.	PIU	You have mentioned about preservation/ saving of water from Lake Sevan. How much is the amount that will be saved?	50 MCM/ year. (JICA Survey Team)
26.	PIU	Please be careful with issues related to land resources. The agencies mentioned by you are not authorized to carry out the transportation and distribution works of the fertile topsoil. Please study the legislative field related to this issue.	I understand that it is needed to involve the Ministry of Nature Protection (MNP) for soil transportation according to the law concerned. However, PIU/SCWE and community councils concerned are also requested to discuss the matter for equal soil distribution in collaboration with the MNP.
27.	Mr. Sahakyan/ Ministry of Agriculture	The most vulnerable issue is that of the voluntary allocation of the community lands for the project. I think that compensation should be given.	The communities requested the small scale project instead of cash compensation. While the final decision cannot been made before concluding loan agreement, it is needed to discuss between the State and the relevant communities after concluding loan agreement. (JICA Survey Team)
28.	PIU	In the preliminary stage, you received suggestion from PIU regarding the project structure. We had proposed to have a separate design consultant and ESIA consultant. If you have accepted that proposal, mention it clearly both in the slides and in the report.	Please refer to slide 184. We have discussed this issue with JICA and have added that point based on your suggestion. We agree with you, we will reflect it clearly in the report. (JICA Survey Team)

End of Memo.

Attachment-7: Minutes of Discussion

Minutes of Discussions with Project Implementation Unit (PIU) for the Preparatory Survey for Yeghvard Irrigation System Improvement Project in the Republic of Armenia (RA)

PIU Office in Yerevan, 7th of October 2016

Regarding the Project EIRR reported in the DFR distributed to PIU on 26th September 2016, PIU and JICA Survey Team (herein after "the Consultant") have discussed at the PIU office from 3rd to 7th of October 2016. The Consultant explained to PIU the reasons that EIRR was drastically reduced from the previous report in May 2016 as follows;

- ✓ As the irrigation satisfactory ratio without Project, which was calculated through; "water requirement divided by the actual supply volume" based on available data year from 2012 to 2014, was evaluated with 97 %, the yield under 100% irrigation satisfactory ratio with Project is not expected to increase at the existing area of 8,391 ha where irrigation has been operated.
- ✓ Therefore, agricultural benefits in EIRR were calculated almost only for the new irrigation area of 3,956 ha.
- ✓ While records of yield from 2010 to 2014 provided by communities were utilized for evaluation of yield with Project, the maximum and minimum values in that period were excluded to avoid the overestimation or underestimation. .
- ✓ It was judged that fluctuation of yield shown in the records provided by the communities were caused by weather factors such as temperature, sunshine, wind and so on, it did not have high relation with effectiveness of irrigation water.
- ✓ Under the conditions above, EIRR excluding the effect of conservation of Lake Sevan and that including the effect were calculated with 3.68% and 5.72%, respectively.

On the other hand, PIU strongly requested the Consultant to review and reconsider the conditions of EIRR evaluation with 3.68%, by taking into consideration of following matters. After the discussions for the 5 days, the Consultant agreed to report to the JICA Headquarters about them.

- ✓ In the previous presentation conducted on May 3rd 2016, the Cosultant reported EIRR excluding the effect of conservation of Lake Sevan and that including the effect are about 11% and about 15%, respectively. However those are changed to 3.68% and 5.72%, respectively in DFR. PIU concerned about the drastic decreasing of EIRR in DFR and they considered that such low values are not acceptable. PIU considered the main reason of decreasing was the process of estimation of agricultural effect. PIU confirmed the calculation process with the Consultant. As a result, PIU requests to review the following matters.

1. 97% of present irrigation satisfactory ratio at the existing irrigation area is not in conformity with the actual situation. In fact, irrigation water in the existing area is unstable and insufficient. It is requested to re-calculate present irrigation satisfactory ratio.
2. It is required to review the yield with Project. Since the maximum records of yield were recorded under the situations such unstable and insufficient irrigation water supply, yield with Project is expected to reach more than the maximum recorded value under stable and sufficient irrigation water supply.
3. As for Agriculture in Vagarshapat and Khoy WUAs, which is highly depending on pump facilities during the second half of the irrigation period in special, it is reported that efficiency of pump facilities has been becoming worse. One reason is due to deterioration on facilities of Aknalich and Metsamor pump stations. Another one is downslide of ground water level. Stable and sufficient water supply by the Project will improve this irrigation condition and this can be counted as a renewal benefit.

Furthermore, although it is considerably unrealistic to add the data in 2015 year in DFR from the view point of the time schedule, PIU strongly requested to do that, because water supply was sufficient and crop yield was generally high in 2015, so that the present agricultural situation can be evaluated reasonable.

End

Felix Melikyan
Director, Project Implementation Unit (PIU),
State Committee of Water Economy (SCWE),
Ministry of Agriculture

Kazuma AKIYOSHI
Co-Team Leader, JICA Survey Team,
Sanyu Consultants Inc. (SCI)