BINH THUAN DEPARTMENT OF AGRICULTURE AND RURAL DEVELOPMENT

PROVINCIAL PROJECT MANAGEMENT UNIT

TERMS OF REFERENCE
FOR
DETAILED ENGINEERING DESIGN

Subprojects: Upgrading Tra Tan irrigation system and Modernizing Du Du-Tan Thanh irrigation system in Binh Thuan province

Project: Water Efficiency Improvement in Drought-Affected Provinces

Binh Thuan, November 2019

LIST OF ABBREVIATIONS

ADB	The Asian Development Bank
ADF	The Asian Development Fund
ARP	Agriculture Restructure Policy
CMD	Construction Management Department
CPMU	Central Project Management Unit
CPO	Central Project Office
DARD	Department of Agriculture and Rural Development
DED	Detailed Engineering Design
DMF	Design and Monitoring Framework
DWR	Directorate of Water Resources
EA	Executing Agency
EMP	Environmental Management Plan
GoV	Government of The Socialist Republic of Vietnam
HVCs	High-Value Crops
IA	Implementing Agency
IMC	Irrigation Management Company
MARD	Ministry of Agriculture and Rural Development
MoF	Ministry of Finance
MPI	Ministry of Planning and Investment
O&M	Operation and Maintenance
PAM	Project Administration Manual
PPC	Provincial People's Committee
PPMU	Provincial Project Management Unit
PPTA	Project Preparatory Technical Assistance
RP	Resettlement Plan
SBV	State Bank of Vietnam
SCADA	Supervisory Control And Data Acquisition
TA	Technical Assistance
ToR	Terms of Reference
USD	United States Dollar
WEIDAP	Water Efficiency Improvement in Drought-Affected Provinces

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1. PROJECT BACKGROUND

- Project name in Vietnamese: “Nâng cao hiệu quả sử dụng nước cho các tỉnh chịu ảnh hưởng bởi hạn hán”.
- The Project name in English: ‘Water Efficiency Improvement in Drought-Affected Provinces’.
- Sponsor: The Asian Development Bank (ADB).
- Executing Agency: Ministry of Agriculture and Rural Development.
- Effectiveness Date: 26 June 2019.
- Project Implementation Period: From June 2019 to 31 December 2025.

1.1. Overview

The Water Efficiency Improvement in Drought-Affected Provinces Project integrates climate-resilient agricultural practices through a transformational shift in irrigation modernization, including (i) strengthening irrigation management to improve climate resilience, (ii) modernizing irrigation infrastructure, and (iii) supporting efficient on-farm water management practices. Specifically, the Project will modernize eight irrigation systems respectively eight Subprojects: Tra Tan, Du Du - Tan Thanh, Thanh Son - Phuoc Nhon, Nhon Hai - Thanh Hai, Cam Ranh -Suoi Dau, Dak Lak, Cu Jut, and Dak Mil in five drought-affected provinces: Binh Thuan, Dak Lak, Dak Nong, Khanh Hoa, and Ninh Thuan. The modernized systems will enhance the provinces' ability to manage climate variability, improve the water productivity of agriculture, and increase incomes by supporting farmers in growing high-value crops (HVCs) such as coffee, peppers, grapes, apples, dragon fruits, and mangoes.

1.2. Rationale

In Viet Nam, more than half of the irrigation systems operate below their potential capacity mainly because of the poor condition of the asset base. Inadequate and deferred maintenance is a leading cause of premature deterioration of irrigation infrastructure.

The southern central coastal and central highlands regions of Viet Nam are particularly vulnerable to climate change. A climate vulnerability assessment carried out for the project indicated that changes in precipitation will result in hotter and wetter wet seasons and hotter and drier dry seasons. The ENSO-induced drought in 2014−2016 was the most severe in 40 years. About 60,000 hectares of the central highlands was affected to varying degrees, including permanent loss of perennial crops such as coffee and pepper. The impact is most severe on smallholder farmers who rely on rainfed surface water sources for irrigation.

Water scarcity and economic factors have prompted farmers in the south central coastal and central highlands regions to grow HVCs that can withstand longer dry spells and are more suited to the changing agroecological environment. Notably, an increasing number of farmers are also adopting on-farm micro-irrigation practices such

as drip or sprinkler systems. They do so primarily to reduce input costs, including labor, electricity (mainly for pumping of water), and fertilizer. Irrigation systems supporting HVCs and micro irrigation must be sufficiently robust to support the desired level of service, and flexible (able to irrigate only when required), reliable (able to deliver water at a specified flow rate and duration), and accessible (with a point of delivery within 1 kilometer of the farm gate). However, many irrigation existing systems were originally designed for rice and are inappropriate for HVCs.

To address the issue, the Project will combine an innovative solution of pressurized piped irrigation systems with high level technology that meets the level of service required by farmers growing HVCs. These will function like domestic water supply systems and provide water on demand through a system of hydrants and control valves, thereby giving farmers greater flexibility to control the amount and duration of irrigation. Piped distribution systems also allow operators to control and measure water more effectively and apply volumetric water charges. These are necessary conditions to improve efficiency and sustainability, particularly in the operation and maintenance (O&M) of systems, including through third-party service contracts. Finally, piped systems are more resilient to extreme weather conditions and require less maintenance, making them more efficient and cost-effective in the long-term.

The uptake of on-farm micro-irrigation practices by farmers in the project areas is supporting a local micro-irrigation solutions industry. However, farmers lack awareness of and extension services to help them optimize micro-irrigation options and adopt good practices, including fertigation methods. The project will also strengthen the capacity of farmers to use and operate micro-irrigation techniques aimed at improving on-farm water productivity. Once the irrigation systems are fully operational, incremental production of HVCs such as dragon fruit, coffee, black pepper and mangoes are expected to boost incomes in the targeted provinces.

The Project aligns with key government policies, strategies, and laws, including (i) the government's agriculture restructuring plan; (ii) the Ministry of Agriculture and Rural Development strategy that calls for adopting advanced and water-saving irrigation techniques and technologies on 500,000 ha of upland crops by 2020 to improve productivity, decrease irrigation water use, and increase household incomes; (iii) the national climate change strategy; and (iv) the Law on Water Resources Engineering (2017), which allows for water pricing for irrigation services.

1.3. Impact and Outcome

The Project is aligned with the following impact: climate resilience and water productivity in agriculture improved.

The Project will have the following outcome: climate-resilient and modernized irrigation systems in five provinces established.

1.4. Outputs

Output 1: Irrigation management services strengthened

This output will support policy and institutional development measures to improve climate resilience of agriculture by strengthening irrigation management while taking social and gender dimensions in all relevant activities into consideration. Specifically, the Project will (i) install irrigation water allocation and delivery services, including (a) surface and groundwater assessments, (b) an irrigation water-sharing and allocation framework, and (c) areal-time decision support system for farmers to optimize crop water application; and (ii) improve maintenance of irrigation systems, including (a) developing an asset inventory and management database for each irrigation system supported by the project, (b) developing a systematic asset maintenance schedule with a rigorous approach to funding based on asset condition assessments, (c) developing a water charge pricing framework, and (d) assessing options for engaging third parties in O&M of irrigation systems.

Output2: Modern irrigation infrastructure developed

This output will modernize eight irrigation subprojects in the five provinces to provide water on-demand to farmers cultivating HVCs, reducing their vulnerability to climate change. The underlying principle of all systems is to provide a higher level of service - more flexible, reliable, and accessible supply of water to farmers than they currently receive. The infrastructure works include three broad categories:(i) pressurized pipe systems that connect canals or reservoirs with supply hydrants located in reasonable proximity to farmers' fields (enabling direct connection with a hose), with basic supervisory control and data acquisition systems to facilitate operations and monitoring of system flows; (ii) main system modernization, including canal lining, control structures, storage, and installation of flow control and measurement devices with remote monitoring; and (iii) new and improved weirs to replace temporary weirs constructed by farmers to provide storage from which farmers can pump to irrigate HVCs. Other works include upgrading culverts and farm roads to improve management of irrigation systems.

Output 3: Efficient on-farm water management practices adopted

This output will focus on improving on-farm water productivity in the subproject command areas to improve climate change resilience. Water productivity assessments conducted under output 1 will help determine suitable norms for different crops under different agroecological conditions. Based on this information, farmers will receive training and advisory services to improve on-farm water management to cope with climate variability. The service providers will consult with and provide technical advice to male and female farmers to identify and develop appropriate micro-irrigation systems that meet their individual requirements. Farmers will also be linked with private sector suppliers and provided O&M training on micro-irrigation systems.

2. INTRODUCTION TO TRA TAN AND DU DU-TAN THANH SUBPROJECTS

2.1. General information

- The name of Subprojects: Upgrading Tra Tan irrigation system and modernizing Du Du-Tan Thanh irrigation system in Binh Thuan province.
- Name of the Sponsor: The Asian Development Bank (ADB).
- Executing Agency: Binh Thuan Provincial People's Committee.
- Implementing Agency: Binh Thuan Department of Agriculture and Rural Development.
- Subproject Management Unit: Project management board for improving water use efficiency for the provinces affected by drought (ADB8) (PPMU)
- Implementation Period: From 2018 to 31 December 2025.
- The Feasibility Study resports on Tra Tan and Du Du-Tan Thanh subprojects in Binh Thuan province were approved by Binh thuan Provincial People's Committee at the Decision No. 1744/QĐ-UBND on July 06, 2018 and No. 1745/QĐ-UBND on July 06, 2018 respectvely.
- Binh Thuan Subprojects comprise Tra Tan subproject and Du Du-Tan Thanh subproject:
- Improving the efficiency of using water from Tra Tan reservoir by construction and non-structural measures to irrigate 1,090 ha of high-value crop land such as high-yield pepper and cashew in Tra Tan communes, Tan Ha, Dong Ha, Duc Linh District.
- Improving the efficiency of using water from existing irrigation systems in the Du Du-Tan Thanh subproject area to irrigate 1,960 ha of land for cultivation of high-value crops in flexible direction such as dragon fruits and a number of other crops in Thuan Nam town, Tan Thuan and Tan Thanh communes in Ham Thuan Nam District.

Figure 1: Locations of the two Subprojects

2.2. Tra Tan Subproject

Figure 2: Subproject location

2.2.1. General information

- Subproject name: Upgrading and modernization of Trà Tân reservoir irrigation system, Đức Linh district, BìnhThuận province.
- Financing Institution: Asian Development Bank (ADB).
- Executing Agency: Binh Thuan Provincial People's Committee.
- Subproject Owner: Department of Agriculture and Rural Development.
- Implementing Agency: PPMU of WEIDAP Project in Binh Thuan province.
- Implementation Period: From June 2019 to 31 December 2025.
- Subproject scope: Constructing the irrigation system for 1,090 ha of HVCs such as pepper, cashew, organic vegetables in Duc Linh district, Binh Thuan province.

2.2.2. Subproject objectives and tasks

- Objectives are to

+ Improve water efficiency of Tra Tan reservoir with structural and non-structural investments that support HVCs (pepper, cashew, etc.) in Tra Tan, Tan Ha and Dong Ha communes of Duc Linh district.

+ Modernize irrigation systems for climate change adaptation, following modality that most developed countries have adopted; directly support implementation of Agriculture Restructuring Scheme;

+ Support finalization of some criteria in New Rural areas Development program; create conditions for scale-up of water-saving irrigation technologies in Đức Linh district.

- Tasks: Ensuring reliable irrigation water resources for 1,090 ha of crop lands in Tra Tan, Tan Ha, Dong Ha communes of Duc Linh district.

The subproject comprises an existing storage reservoir and canal system, and a proposed new pumped pipe system pumping water directly from the reservoir. Modernization will line the main canal system and selected secondary canals, and support direct pumping by famers from these canals for HVC irrigation. Rice areas will continue to be supplied by gravity canal flow. Secondary canals which only supply areas within about 500 meter (m) of the main canal will not be constructed/lined. Small balancing storage tanks are recommended at the tail of the main and the longest secondary canal. The new pipe system will comprise a pumping station supplying water to a hill top header tank, from which a single pipeline will command a strip of land up to about 1.0 km wide. Hydrants at about 50 m intervals will command plots of land either side of the pipeline. To facilitate improved operation of the canal system, water levels shall be remotely monitored in the tail end balancing storage tanks, and inform flow releases from the reservoir. For the new pipe system, pressures and flows at key points shall be monitored - pumps shall turn on/off according to the water level in the hill top header tank.

Improved monitoring and management of water though a basic supervisory control and data acquisition (SCADA) system will enable more efficient and productive use of water. Improved supply, and allowing farmers to pump directly from the canals, will encourage farmers to invest in improved micro irrigation as well as reducing pumping costs.

2.2.3. Technical works proposed at the approved Feasibility level designs

The Tra Tan Subproject comprises two separate irrigation systems. Both will be supplied from the existing Tra Tan Reservoir. The schemes comprise: (i) modernization of the existing gravity open canal system, and (ii) construction of a new pumped piped system.

2.2.3.1. Upgrading/ Modernization of the existing gravity open canal system:

The feasibility design proposes that the 7,483.29 m long main canal shall be lined, together with 14 of the 22 secondary canals. The density of the lined canal network will be 21.0 m/ha.

Of the 854 ha service area, 380 ha (44%) will have access to canal water within 250 m, 322 ha (38%) will have access between 250 m and 500 m and only the remaining 152 ha (18%) will have access of over 500 m.

a. Upgrading and solidifying the main canal of Tra Tan reservoir:

Upgrading and solidifying the main canal of Tra Tan reservoir a present 7,483.29m length made from M200 cast-in-situ reinforced concrete and 1x2 stones; rectangular cross-sections; canal embankments are integrated with rural roads. Key specifications are shown in Table 1:

Table 1: Main specifications

No.	Section	L (m)	Q_{tk} (m/s)	B_k (m)	H_k (m)	i
1	K0+036.96 ÷ K0+099.96	63.00	1.20	1.80	1.70	0.0002
2	K0+099.96 ÷ K0+140.52	40.56	1.18	1.80	1.70	0.0002
3	K0+140.52 ÷ K0+155.85	15.33	1.18	1.80	1.70	0.00028
4	K0+155.85 ÷ K0+455.50	299.65	1.15	1.80	1.70	0.00028
5	K0+455.50 ÷ K0+988.15	532.65	1.14	1.80	1.70	0.00028
6	K0+988.15 ÷ K1+287.49	299.34	1.14	1.80	1.70	0.00028
7	K1+287.49 ÷ K1+372.69 (Existing aqueduct)	85.20	1.14	2.00	1.60	0.0020
8	K1+372.69 ÷ K1+588.72	216.03	1.14	1.80	1.70	0.00018
9	K1+588.72 ÷ K1+629.82	41.10	1.08	1.80	1.70	0.00018
10	K1+629.82 ÷ K1+773.11	143.29	1.08	1.80	1.70	0.00018
11	K1+773.11 ÷ K1+975.49	202.38	1.06	1.80	1.70	0.00018
12	K1+975.49 ÷ K2+228.68	253.19	1.05	1.80	1.70	0.00018
13	K2+228.68 ÷ K2+622.16	393.48	1.01	1.70	1.60	0.00018
14	K2+622.16 ÷ K3+451.71	829.55	0.96	1.70	1.60	0.00018
15	K3+451.71 ÷ K4+107.83	656.12	0.88	1.70	1.60	0.00018
16	K4+107.83 ÷ K4+937.14	829.31	0.88	1.70	1.60	0.00018
17	K4+937.14 ÷ K5+069.48	132.34	0.73	1.50	1.50	0.00018
18	K5+069.48 ÷ K5+424.18	354.70	0.52	1.50	1.50	0.00018
19	K5+424.18 ÷ K6+070.40	646.22	0.47	1.30	1.20	0.00018
20	K6+070.40 ÷ K6+095.38	24.98	0.41	1.30	1.20	0.00018
21	K6+095.38 ÷ K6+377.91	282.53	0.39	1.30	1.20	0.00018
22	K6+377.91 ÷ K6+465.63	87.72	0.34	1.10	1.10	0.00018
23	K6+465.63 ÷ K6+681.32	215.69	0.33	1.10	1.10	0.00018
24	K6+681.32 ÷ K7+250.95	569.63	0.29	1.10	1.10	0.00018
25	K7+250.95 ÷ K7+520.25	269.30	0.09	0.80	0.80	0.00018
Total		**7,483.29**				

b. Works on main canal of Tra Tan reservoir:

- Upgrade existing canal bridge from K1+287.49 to K1+372.69
- Constructions 38 new structures along main canal to measure flow, automatically regulate water, get water, flood drainage, facilitate vehicle access including: 03

works flows gauge, 03 automatic water regulation works, 17 constructions for water supply at the beginning of level 1 canals and canal get over level, 02 culvert to get water at the beginning of canal and combined with culverts under roads, 01 culvert cluster to get water at the beginning of canal and combined with culverts under roads, 01canal spillway, 03 water steps, 02 culverts under roads, 06 crude bridges over canals. Main structural composition are M200 reinforced concrete, 1x2 stones and precast centrifugal ducts.

- The existing aqueduct, where the main canal crosses the Tra Tan River, is considered adequate, and little work is required.

c. Upgrade, solidification and develop new primary canals canal get over level:

Upgrade, solidification 06 level 1 canals and canal get over level (N2, N3, N5, N7, N13 and VC6), develop 05 new primary canals (N4, N6, N9, N11, N15); total length is 9,176.43m; made from precast assembly concrete sections, rectangular cross-section; and 52 structures on canals. Technical specifications and number of works on canals are shown in Table 2:

Table 2**.** *Technical specifications of primary canals, canal get over level, and number of works on canals*

No.	Canal	L (m)	Q_{tk} (m/s)	B_k (m)	H_k (m)	i	Works on canals
1	N2	498.16	0.07	0.60	0.60	0.00029	03
2	N3	492.30	0.04	0.50	0.50	0.00029	02
3	N4	1,557.94	0.20	0.80	0.80	0.00029	05
4	N5	584.40	0.04	0.50	0.50	0.00029	04
5	N6	778.10	0.10	0.70	0.70	0.00029	05
6	N7	1,022.13	0.08	0.60	0.60	0.00029	05
7	N9	1,055.10	0.16	0.80	0.80	0.00029	09
8	N11	822.30	0.06	0.60	0.60	0.00029	04
9	N13	755.10	0.05	0.50	0.50	0.00029	05
10	N15	950.90	0.09	0.70	0.70	0.00029	05
11	VC6	660.00	0.01	0.50	0.50	0.00010	05
Total		**9,176.43**					**52**

2.2.3.2. Construction of a new pumped pipe irrigation supply system

a. Pumping station:

- Constructing 01 pumping station with 03 pump sets (01 of which is on standby mode); located at upstream of main dam of Tra Tan reservoir; pump capacity is 442.5 m3/h each; pump water head is 30m; length of suction pipe is 10.5m; length of discharge pipe is 430m, made of HDPE.

- Management building: Grade IV building; floor area 18m2; reinforced concrete columns and pillars; foundation made from rough stones; walls made from ducted bricks.
- Storage tank: Storage capacity is 1000m3; enclosed with fences having reinforced concrete pillars, brick footings and B40 steel meshes.
- Electric sub-station and 3-phase power lines: 01 sub-station and 40m 3-phase power line supplying electricity to the pumping station for pumping, lighting and domestic usage by managers and operators working at the pumping station.

b. Main supply pipeline from reservoir:

HDPE pipeline with L= 3,960.8 m, diameter D= (100 ÷ 450) mm, installed underground. On the left side of the pipeline, construct a 2m-wide access road with crossfall i = 2%; road surface is made from M200 concrete and 1x2 stones, underlined with a thin layer of nylon.

c. Works on pipeline:

Install 50 devices/ structures s along the pipeline to measure flow rates, flush out slurry and release air from the pipe, regulate water flows, supply water to irrigation areas:01 master flow meter at the storage tank, 04 wash out valves to flush out slurry, and 45 water supply hydrants-manifolds each with a fixed 5 l/s design discharge. Each hydrant has a ball (or gate) valve and a digital (ultrasonic) flow meter, and supplies a manifold to which each farmer can connect their hoses. Valves and cheap (local) read meters may be provided for each farmer along the manifold offtake for charging of farmers according to volume of water use. A constant flow valve (flow limiter) may be provided at each hydrant to ensure 5.0 l/s flows. These civil works are made from M200 reinforced concrete and 1x2 stones, mortar masonry stones, while the pipes shall be HDPE.

d. SCADA system:

A basic SCADA system was proposed to monitor and control flows along the canal system. Investing in procurement of equipment system and SCADA technology software applications to perform some of the following functions: supervise, control and collect data to serve the work management and operation.

2.2.4. Total investment costs, funding sources and financial arrangements

2.2.4.1. Investment cost

- Land acquisition and compensation:

+ Permanent land acquisition;
+ Temporary land acquisition during construction;
+ Loss of properties on land including structures, buildings, trees, crops etc.;
+ Supports for resettlement and livelihood restoration;
+ Cost of making resettlement plans (including compensations and supports);

+ Cost of implementing resettlement plans;

+ Other costs as stipulated in laws and regulations.

+ Costs related to construction preparation (site clearance) and civil works as stipulated in laws and regulations.

- Costs related to water level gauges/ meters, pipelines, pumps, substations and control devices in pumping stations etc.
- Project management costs from project preparation, implementation until project completion, commission and handover for operation.
- Payments to consultants recruited during project preparation and implementation, including surveys, designs, reviews, supervision and inspections…
- Costs related to UXO (Unexploded Explosive Ordinances) clearance, civil works insurance policies, surveys for structural deformations, audit, reviews, approvals of investment budget final accounting, eligible fees and charges etc.
- Contingencies including physical contingencies and price contingencies during construction time.
- Cost of Output 3 implementation (Efficient on-farm water management practices adopted)
- Cost of shared activities in 05 provinces.

Table 3. Technical specifications of primary canals, canal get over level, and number of works on canals

No.	COST ITEMS	AFTER TAXATION	FUND ALLOCATION	
			ODA fund	Counterpart fund
A	Output 2	140,189,913,707	113,600,801,944	26,589,111,763
I	Land acquisition	5,900,000,000		5,900,000,000
II	Civil works (CPXD)	97,171,908,029	88,338,098,208	8,833,809,821
III	Equipment (CPTB)	3,828,000,000	3,480,000,000	348,000,000
IV	Project management	1,750,971,133		1,750,971,133
V	Consultant services	6,915,067,830	1,499,349,259	5,415,718,571
VI	Other costs	8,741,290,766	5,844,558,160	2,896,732,606
VII	Contingencies	15,882,675,949	14,438,796,317	1,443,879,632
B	Shared activities for 5 provinces	5,847,750,000	4,661,250,000	1,186,500,000
C	Output 3	1,271,250,000	1,158,250,000	113,000,000

No.	COST ITEMS	AFTER TAXATION	FUND ALLOCATION	
			ODA fund	Counterpart fund
D	Interests	4,505,145,339	4,505,145,339	
Total investment cost		**151.814.059.045**	**123,925,447,283**	**27,888,611,762**
Total investment cost (rounded)		**151.814.000.000**	**123,925,000,000**	**27,889,000,000**

(In words: One hundred fifty one billion and five hundred fourteen million Vietnam dongs)

2.2.4.2. Funding sources

- Loan from Asian Development Fund in Asian Development Bank (ADB);
- Vietnam Government Counterpart fund include provincial state budget (Bình Thuận province) and central state budget in project preparation stage.

a. Loan:

- Official Development Aids (ODA) loan from ADB is used for project implementation. An ODA loan of 123,925,000,000 VND will cover costs of DED, civil works, equipment installation, insurance policies etc.
- Usage of ODA fund is based on commitments and MoU between the Government of Vietnam (GoV) and the Financing Institution, on demand for capital and reciprocal capacity of Binh Thuan province, on financial conditions of the Financing Institution, with reference to those of International Development Association (IDA), of which ADB is a member.

b. Counterpart fund:

- The counterpart fund by GoV from provincial state budget is about 27,889,000,000 USD, will cover costs of land acquisition and resettlement support, sub-project management, construction consultant services.
- The provinces participating in the Project will formulate, appraise and approve medium-term investment plans and commit to allocate sufficient fund.

2.2.4.3. Financial arrangements

- The subproject is a part of WEIDAP project that has been agreed by the Government so the financial arrangements of the subproject will comply with the project's financial arrangements regulated by the Government.
- Provincial People's Committee of Bình Thuận province is the investment decision maker. The subproject will be responsible for allocating provincial state budget to cover cost items in counterpart fund categories: land acquisition, compensation, support and resettlement, consultancy and subproject management. The subproject uses loan through state allocation and on-lending to implement activities that strengthen institutions and policies, develop technical and economic

norms; construct and install pipeline, establish water delivery clusters which connect to individual water users.

- Therefore, financial arrangements for the sub-project is proposed as follows:

+ *For the loan amount:*Total loan amount (ADB) is 123.925.000.000VND;

In which:

Allocation as central state budget 70% of total loan amount, equivalent to 86,747,500,000VND;

On-lending by provincial government 30% of total loan amount, equivalent 37,177,500,000 VND.

- *For the counterpart fund:* Counterpart fund from provincial state budget is 27,889,000,000 VND

2.3. Du Du-Tan Thanh Subproject

2.3.1. General information

- Sub-project name: Irrigation canal Du Du – Tan Thanh, Ham Thuan Nam district, Binh Thuan province, under WEIDAP/ADB8 Project.
- Financing Institution: ADB.
- Executing Agency: Binh thuan Provincial People's Committee (PPC).
- Project Owner: Department of Agriculture and Rural Development.
- Implementing Agency: Binh Thuan Provincial Project Management Unit.
- Implementation duration: 2018 to31 December 2025.
- Sub-project scope: Building irrigation system for 1,960ha of crop lands (mostly dragon fruits) in Tan Lap commune, Tan Thanh commune and Tan Thuan commune of Ham Thuan Nam district, Binh Thuan province.

2.3.2. Subproject objectives and tasks

- Objectives

+ Improving water efficiency of irrigation works in the sub-project areas that service 1,960ha of crop land with high-value crops (HVCs) with flexibility (e.g. irrigation water more or less on demand for dragon fruits and vegetables) in Thuận Nam town, TânThuận and TânThành communes, HàmThuận Nam district.

+ Modernizing irrigation system for climate change adaptation, following modality that most developed countries have adopted; directly support implementation of Agriculture Restructuring Scheme; improve environmental quality and address frequent water shortage due to drought; improve transportation infrastructure in the area.

- Tasks

+ The sub-project will ensure irrigation water supply for 1,960ha of crop land (mostly dragon fruits), improve environmental quality and address serious water shortage in the sub-project areas.

+ Modernize irrigation systems to ensure flexibility, meeting demands of water users and affordability of beneficiary farmers in 5 participating provinces.
+ Metigating salinity intrusion in the sub-project areas through reduction of groundwater extraction for irrigation.
+ Improve transportation infrastructure in the area.

2.3.3. Subproject Investment scope and activities

- Subproject location

Figure 3: Subproject Location

- Investment scope: Construct gravity water pipeline system in the sub-project area, including:

+ Constructing intake to get water from Tan Lap reservoir at a flow rate of around Q_{tk}= 1.1m^3/s.
+ Constructing water pipeline Tan Lap – Tan Thanh which irrigates 1960ha of crop land (dragon fruits and other HVCs);total length is 33km;install manifold hydrants along the pipeline so that farmers can get water from maximum distance of 500m, at Q_{tk}= 1.097m^3/s
+ Build transportation infrastructure in the sub-project areas; total L = 30.6km.
+ Install SCADA to facilitate operation and management of irrigation systems.
+ Constructing a managent building at the headworks of Tan lap reservoir

2.3.4. Technical works proposed at the approved Feasibility level designs

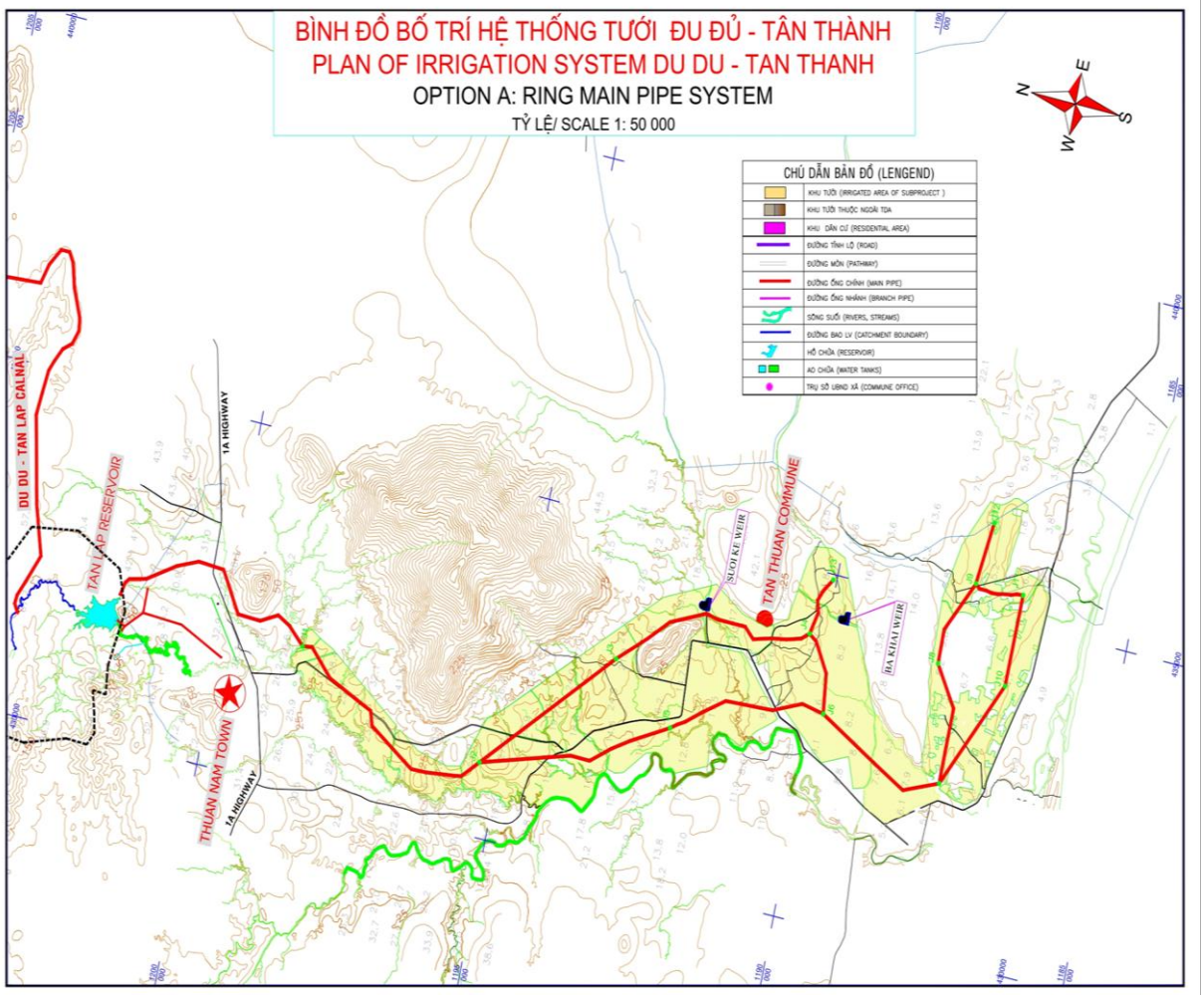

Figure 4: Diagram of pipeline system

2.3.4.1. Taking water from Tan Lap Lake:

Construction location at Tan Lap sub-dam, scale, main specifications are as follows:

- Design flow Q_{tk} = 1.10 m^3/s.
- Upstream intake: L = 9.25 m, bottom elevation +40.00 m, made from concrete and masonry stones 1x2 M200.
- Sewer body: Pre-cast centrifugal duct with ø120cm, L= 12m, bottom elevation (+40.00 ÷ +39.50)m.
- Balancing tank: Built behind intake body, measuring BxLxH = (2,3x3x6,25)m, bottom elevation +39.00 m, made from M250 reinforced concrete and 1x2 stones.
- Regulatory gates: Flat gates, form-steel frame, sheet-steel surface, operated with manual crank V10.

2.3.4.2. Pressurized pipe irrigation supply system

Construct irrigation water pipeline made of HDPE pipes installed underground; total length is 32,649.71 m, supplying water to irrigation areas through manifold hydrants. Key pipeline specifications are shown in Table 1.

Table 4*. Key technical specifications of pipeline*

Name	Length (m)	Diameter (mm)	Flow rate(l/s)	Irrigation area (ha)
R1-J1	3,946.46	1000	1,097.60	Deliver water for the entire pipeline
J1-J2	3,831.00	900	1,023.55	261.61
J2-J3	2,744.37	800	588.83	187.38
J3-J4	3,563.40	710	244.93	243.31
J2-J5	3,318.92	500	129.72	226.65
J5-J6	2,716.31	450	468.43	185.47
J4-J6	1,227.17	560	307.75	83.79
J6-J7	2,355.91	630	351.68	160.88
J7-J8	1,800.00	400	104.12	122.78
J8-J9	1,344.55	355	62.40	91.98
J7-J10	1,784.13	450	142.72	121.82
J10-J11	1,338.48	400	82.97	91.44
J11-J9	847.15	315	15.18	57.85
J9-J12	920.79	200	17.39	62.82
J4-J13	911.07	200	17.56	62.22
Total	**32,649.71**			**1,960**

2.3.4.3. Works on pipeline:

Construct 260 works along the pipeline to flush out slurry and to release air in the pipe, regulate water flows, supply water to irrigation areas, discharge floods safely over/ under the pipelines, facilitate road transportation, etc. These works include: 17 siphons and washout valves to flush out slurry, 28 (or more)air valves to release air, 09 shut-off valves, 179 water supply hydrant-manifolds complete with water volume measurement meters, constant flow valves/ limiters and on-off control valves, 17 siphons crossing creeks, and 10 culverts crossing roads. These works are made from M200 & M250 reinforced concrete and 1x2 stones, M75 mortar masonry stones, precast concrete ducts, HDPE pipes.

2.3.4.4. Management and construction access roads:

On top of the pipeline, an access road will be built for construction and management purposes; total road length is 30,592.01m; cross slope I = 2%; on both sides of the road are 0.4m-wide water trenches. Structural composition: Dirt road; road surface is 4.5m wide, filled with a 25cm-thick layer of selective grade-3 soil. Key road specifications are shown in table 2:

Table 5. *Technical specifications of management and construction access road*

Road route	Length (m)	B_{base} (m)	Location
R1-J1	3,946.46	5.90	Left side of pipeline
J1-J2	2,621.00	5.90	Left side of pipeline
J2-J3	2,744.37	5.90	Left side of pipeline
J3-J4	3,562.85	5.90	Left side of pipeline
J2-J5	3,318.92	5.50	Right side of pipeline
J5-J6	2,716.31	5.50	Right side of pipeline
J4-J6	1,227.17	5.50	Left side of pipeline
J6-J7	2,355.91	5.50	Left side of pipeline
J7-J8	1,798.20	5.50	Left side of pipeline
J8-J9	1,346.35	5.50	Left side of pipeline
J7-J10	1,784.13	5.50	Right side of pipeline
J10-J11	1,338.48	5.50	Right side of pipeline
J9-J12	920.79	5.50	Left side of pipeline
J4-J13	911.07	5.50	Left side of pipeline
Total	**30,592.01**		

2.3.4.5. Building the system management house

Grade IV building, built on an area of 157.5 m^2 (L= 21m, B= 7,5m), located at head word of TânLập reservoir. The building has reinforced concrete columns and pillars, foundation made from rough stones, walls made from ducted bricks, support beams made from box steel, roofed with metal sheets shaped as tiles.

2.3.4.6. SCADA system

A basic SCADA system shall be provided. Devices will be installed to facilitate operation and also metering for volumetric water charging. Pipe flows at key locations along the pipeline, and perhaps for (selected) hydrants, would be metered using clamp-on battery-operated ultrasonic digital meters (flow rate and volume) fixed around the pipes. Pipe pressures would also be monitored and would inform of any breach/ leakage in the pipeline. Flows to each farmer would require meters installed at the manifold on their individual pipe connection. It is envisaged that data from devices fitting with SIM cards will be transmitted over the cellular network and stored on computer at the control office.

Such a system still requires routine monitoring and maintenance and it is suggested that a private organization could be engaged. Although there are no pumps to operate (being a gravity-fed system), there is a need to monitor pressure gauges, flows and

where necessary, to close valves to sections of the piped system to repair breaches as they occur. Relying on irrigation management companies (IMCs) for a timely response to these situations, and to collect irrigation fees from farmers, may not achieve the proposed LOS and may jeopardize farmers' willingness to invest in HVCs or, for that matter, in micro irrigation. It is therefore suggested that responsibility for scheme operation and management (O&M) be assigned to a private irrigation operator under a publicprivate partnership (PPP). Such an arrangement will need to distinguish the respective roles of the IMC supplying water from the reservoir to the piped irrigation system and the PPP operator recruited for operational aspects.

2.3.5. Total investment costs, funding sources and financial arrangements

2.3.5.1. Investment cost

- According to the Memorandum of Understanding in 3/2016, the sub-project will finance investment items from headwork to delivery points to supply irrigation water to WUGs. In particular, cost items supported by the project include:

- Land acquisition and compensation:

+ Permanent land acquisition;
+ Temporary land acquisition during construction;
+ Loss of properties on land including structures, buildings, trees, crops etc.;
+ Supports for resettlement and livelihood restoration;
+ Cost of making resettlement plans (including compensations and supports);
+ Cost of implementing resettlement plans;
+ Other costs as stipulated in laws and regulations.

- Costs related to construction preparation (site clearance) and civil works as stipulated in laws and regulations.

- Costs related to water level gauges/ meters, pipelines, pumps, substations and control devices in pumping stations etc.

- Project management costs from project preparation, implementation until project completion, commission and handover for operation.

- Payments to consultants recruited during project preparation and implementation, including surveys, designs, reviews, supervision and inspections…

- Costs related to UXO (Unexploded Explosive Ordinances) clearance, civil works insurance policies, surveys for structural deformations, audit, reviews, approvals of investment budget final accounting, eligible fees and charges etc.

- Contingencies including physical contingencies and price contingencies during construction time.

- Cost of Output 3 implementation (Efficient on-farm water management practices adopted)

- Cost of shared activities in 05 provinces.

Table 6*. summing up costs for the DU DU-Tan Thanh subproject*

No	COST ITEMS	AFTER	FUND ALLOCATION

		TAXATION	ODA fund	Counterpart fund
A	Output 2	331,403,840,704	262,824,121,443	68,579,719,262
I	Land acquisition	24,173,000,000		24,173,000,000
II	Civil works (CPXD)	218,345,132,806	198,495,575,278	19,849,557,528
III	Equipment (CPTB)	16,500,000,000	15,000,000,000	1,500,000,000
IV	Project management	3,599,535,399		3,599,535,399
V	Consultant services	12,975,730,677	2,467,837,169	10,507,893,509
VI	Other costs	19,480,906,978	13,833,859,138	5,647,047,840
VII	Contingencies	36,329,534,844	33,026,849,858	3,302,684,986
B	Shared activities for 5 provinces	5,847,750,000	4,661,250,000	1,186,300,000
C	Output 3	1,271,250,000	1,158,250,000	113,000,000
D	Interests	10,297,854,661	10,297,854,661	
Total investment cost		**348.820.695.365**	**278,941,476,104**	**69,879,019,262**
Total investment cost (rounded)		**348.821.000.000**	**278,942,000,000**	**69,879,000,000**

(In words: Three hundred forty eight billion and eight hundred twenty two millions Vietnam dongs)

2.3.5.2. Funding sources

- Loan from Asian Development Fund in Asian Development Bank (ADB);
- Vietnam Government Counterpart fund includeprovincial state budget (BìnhThuận province) and central state budget.

a. Loan:

- Official Development Aids (ODA) loan from Asian Development Bank is used for project implementation. An ODA loan of 12,253,108 USD (equivalent to 278,942,000,000 VND), accounting for 80% of total investment cost, will cover costs of DED, civil works and equipment installation.

- Usage of ODA fund is based on commitments and memorandums of understanding (MoU) between the Government of Vietnam (GoV) and the Financing Institution, on demand for capital and reciprocal capacity of BinhThuan province, on financial conditions of the Financing Institution, with reference to the International Development Association (IDA), of which ADB is a member.

b. Counterpart fund:

- The counterpart fund by GoV from provincial state budget is about 3,069,580 USD (equivalent to 69,879,000,000 VND), accounting for 20% of total investment cost, will cover costs ofland acquisition and resettlement support, sub-project management, construction consultant services.
- The provinces participating in the Project will formulate, appraise and approve medium-term investment plans and commit to allocate sufficient fund.

2.3.5.3. Financial arrangements

- The subproject is a part of WEIDAP project that has been agreed by the Government so the financial arrangements of the subproject will comply with the project's financial arrangements regulated by the Government.
- Provincial People's Committee of BìnhThuận province is the investment decision maker. The subproject will be responsible for allocating provincial state budget to cover cost items in counterpart fund categories:land acquisition, compensation, support and resettlement, consultancy and subproject management. The subproject uses loan through state allocation and on-lending to implement activities that strengthen institutions and policies, develop technical and economic norms; construct and install pipeline, establish water delivery clusters which connect to individual water users.

Therefore, financial arrangements for the sub-project is proposed as follows:

- *For the loan amount*: Total loan amount (ADB) is 12,253,108 USD = 278,942,000,000 VND;

In which:

+ Allocation as central state budget 70% of totalloan amount, equivalent to 195,259,033,273 VND.

+ On-lending by provincial government 30% of total loan amount, equivalent to 83,682,442,831VND.

-*For the counterpart fund:*Counterpart fund from provincial state budget is 3,069,580 USD = 69,879,000,000 VND

3. OBJECTIVES, SCOPE AND TASKS OF CONSULTING SERVICES

3.1. Objectives

Objectives of consulting services are to prepare the Detailed Engineering Design for upgrading and modernizing Tra Tan and Du Du-Tan Thanh irrigation systems based upon the WEIDAP Guidelines for Detailed Engineering Design, and in order for

facilitating O&M, climate resilience and water productivity in agriculture improved, Irrigation management services strengthened (Output 1) and Efficient on-farm water management practices adopted (Output 3).

3.2. Scope of consulting services

The Scope of Consulting Services consists of, but not limited to the following:

- Studying further and Identifying, Proposing modifications/ options/ solutions for improving the feasibility study level designs.
- Carrying out necessary surveys.
- Attending the study tour in Australia to visit the systems in the Riverland region of South Australia where the policy and institutional framework has been established, to increase water use efficiency in agriculture and developed pressure piping systems and/or water-saving irrigation technologies to be installed in the system.
- Preparing the detailed engineering design documents for the Subproject.
- Updating the Resettlement Plan and Preparing the Environmental Management Plan for the Subproject.
- Supporting the PPMU in the process of submission and explanation of examinations and evaluation comments.
- Organizing design workshops to report design options and consult the experts.
- Cooperating closely with the project implementation support consultants, if recruited/ appointed in time.
- Regularly reporting the work progress to the Investor/ Binh Thuan PPMU.
- Providing the oversight of the detailed engineering design authors' right, etc.

3.3. Specific Tasks of the Consulting Services

The main tasks of the Detailed Engineering Design include, but not limited to the following:

- Studying further and Identifying, Proposing modifications/ options/ solutions for improving the feasibility study level designs.
- Determining what data to collect/survey and conducting surveys.
- Preparing the detailed engineering design.
- Updating changes in the detailed engineering design into the resettlement and environmental management plans, etc.

Overall requirements: The Detailed Engineering Designs shall be aligned with those in the approved Feasibility Study Reports and shall observe current design standards/ regulations. Specifically, designs of pressured pipe systems shall/ should observe the design standard: Water supply - Distribution pipeline system and facilities (TCXDVN 33:2006).

During the implementation process, the consultants must comply with the recommended standard frameworks for surveys and designs as listed in the Appendix 1.

The specific tasks of the Detailed Engineering Designs include, but not limited to the following:

3.3.1. Making the outlines for additional surveys and the detailed engineering designs

Before conducting the detailed engineering design, the consultants must prepare and submit outlines for additional surveys and detailed engineering design to the PPMU.
The outlines shall be based on the feasibility study reports.

3.3.2. Studying further and Identifying, proposing modifications/ options/ solutions for improving the feasibility study level designs

Construction sites and solutions: Construction sites and solutions were proposed during the feasibility study phase. At the detailed engineering design, when the basic documents are collected, more detailed and full surveys will be needed for confirming the optimization of the selected locations and solutions. In case of any changes in the feasibility study phase, there must be a valid argument. Also, basic documents/ data from the surveys and designed works must allow to ensure determining sufficient volume components.
For the pumped pipe systems, the pumped pipe system service (command) areas shall be further refined to ensure that only HVCs areas are included.
Other design improvements building on the feasibility study level designs are presented in the following appropriate sections. propose additional survey tasks

3.3.3. Evaluating the current available documents to propose additional necessary data collection and survey activities

- At the detailed engineering design, additional hydro-meteorological data collection, topographic and geological surveys, hydrogeological works and other data will be required. All work must comply with relevant technical standards, regulations and norms.
- Additional data collections shall be hydro-meteorological, hydraulic, hydrogeological and other data.
- The purpose of construction survey work aims to provide topographic, geological, meteorological and hydrological documents for the design of the technical design phase of construction of pumping stations and primary irrigation.
- Re-using the surface and altitude control that has been implemented during the FS phase to deploy the entire measurement areas. The control of the surface at class IV, grade 2, coordinate system VN2000, the control of the height of class IV
- Hon Dau (Hai Phong) in accordance with current standards.
- The work was carried out during the feasibility study of Du Du-Tan Thanh canal system:

S.N	WORK ITEM	UNIT	QUANTITY

I	Terrain survey volume for detailed technical design		
1	Elevation network survey, technical leveling, grade-3 topography	Km	32,65
2	Onland mapping at 1/1000 scale (1m contour), grade-3 topography	100ha	3,05
3	Onland lengitudinal profile measurement, grade-3 topography	100m	326,52
4	Onland cross-section measurement, grade-3 topography	100m	117,55
5	Onland mapping at 1/200 scale (1m contour), grade-3 topography	ha	22,00
6	Landmarking for land acquisition, grade-3 topography	point	653,00
7	Marking centerlines of hydraulic works, grade-3 topography	point	50,00

- The work was carried out during the feasibility study of Tra Tan canal system:

S.N	**WORK ITEM**	**UNIT**	**QUANTITY**
I	Terrain survey volume for detailed technical design		
1	Ground and height control grid		
-	Change road level 2. Level II terrain	point	7
-	Technical leveling. Terrain level. Level II	km	1.75
2	Measuring and mapping the plan of construction site locations		
	Terrestrial map, scale 1/200, contour line of 0.5m. Level II terrain	ha	3.55
3	Propulsion pipeline + medium-voltage electricity line of pump station (450m + 350m = 800m)		
-	Measurement and drawing of vertical sections on land Grade II	100m	8
-	Technical leveling. Level II terrain	km	0.8
4	Setting up landmarks		
-	Heart positioning (Including 40 S points on the main canal route + the beginning and ending points of the route)	point	42
-	Setting landmarks	landmarks	38
-	Installing landmarks of land clearance	landma	66

		rks	
II	Volume geological survey for detailed technical design		
	Main pipeline of pump station (300m/pit, 3.0m deep) + Plant, suction tank (3 10m-deep holes) + Storage tank (3 5m-deep holes)		
1	Rotary drilling pumps washed with on-land sample tubes, the depth of borehole from 0m to 30m, rock and soil grade I - III	m	57.3
2	Rotary drilling pump washed with a sample tube on land, the depth of the borehole from 0m to 30m, and rock and soil grade IV-VI	m	26.7
3	Water supply pumping in service of rotary drilling pumps washed on land (when water must be supplied to bores away from water sources at more than 50m or higher than the water intake at ≥ 9m), the depth of borehole is from 0m to 30m, soil and rock level I - III	m	57.3
4	Water supply pumping in service of rotary drilling pumps washed on land (when water must be supplied to boreholes away from water sources at > 50m or higher than the water intake at ≥ 9m), the depth of borehole is from 0m to 30m, soil and rock level IV - VI	m	26.7
5	Standardized penetration test (SPT), soil and rock grade I-III	time	12
6	Standardized penetration test (SPT), soil and rock grade IV-VI	time	3
7	The experiment to identify nine common mechanical and physical criteria of the whole soil sample	sample	12
8	Experiment to determine mechanical and physical properties of rock samples	sample	3

The consultant shall base on the quantity and quality of meteorological, topographic and geological documents surveyed, and others in the previous period to ***propose additional survey tasks*** in accordance with the accuracy requirements of documents in detailed construction engineering design stage.

3.3.4. Identifying survey components and quantities, and conducting topographic surveys

3.3.4.1. Data collection

- The work of collecting data is an important task which help the consultant have enough data to analyze and calculate in order to provide reasonable solutions when

conducting surveys and technical design of construction details and construction works:

- Data to be collected in the period of detailed engineering design include:

+ Topographic maps of all kinds of structure (pipelines, pumping stations, water storage tanks, canals and main pipelines).

+ Documents on control points (coordinates, altitudes, benchmarks).

+ Other relevant survey materials.

3.3.4.2. Identifying quantity of all topographic survey work items

- Horizontal control network: The horizontal control network in this phase is only built for measuring scale of 1/1000 with 1.0m contour line at the locations of materialyards.

- Technical leveling: The technical leveling is guided from the traverse network - grade 1 set up in the previous phase to the station points for the measurement of the topographic section of the construction items.

- Topography of material yards at the scale of 1/1000 and contour line h= 1.0m. The location of material yards handed over in the field by the geological survey team leader, the areas for earth embankment and the works must be surveyed to determine the area and boundaries of crops.

- Topography of benefit area:

+ Detailed engineering design consulting unit reviews and updates the survey data on the position map, the map shows the pipeline, irrigation canal and combined with the longitudinal and cross-section measurement data in the period serves the detailed design work.

+Proposing proposals if necessary.

- Measuring longitudinal sections: Measuring scope includes the system carrying water from the reservoir to the station, power lines, main pipelines, irrigation pipeline and the roads for management.

- Measuring cross sections: Cross-section measurement range includes the system carrying water from the reservoir to the station, the main pipeline, irrigation pipeline and the the roads for management.

- Positioning the center of the works: Installation of work items includes the beginning and the end points and the turning points.

- Determination of the boundary of land clearance: The benchmark system is to determine the boundary of land clearance. It is necessary to define the boundary of the system carrying water from the reservoir to the station, pumping station, power line, feeder pipeline, main pipeline, irrigation pipeline and the roads for management and for site clearance, make compensation fund.

- Ground accuracy determined by accuracy of grade 2.

- Height accuracy determined according to technical leveling.

- Benchmark size is 10x10x60cm concrete column with name and code number.

3.3.5. Identifying survey components and quantities, and conducting geological surveys

3.3.5.1. Collecting documents

The existing documents of the items are only guaranteed to be evaluated at the locations with boreholes and excavation surveys. The distance and the number of survey positions does not guarantee the assessment for the entire route. During this phase, additional surveys are needed at the locations of pumping stations, water storage tanks, discharge pipelines, main pipelines irrigation pipelines and the roads for management.

3.3.5.2. Identifying quantity of geological survey items.

- Digging the survey pit

+Excavation work is to determine stratigraphy, soil layer depth and take soil and rock sampling.

+The distance between excavated pits in the centerline of the pipeline is usually from 50 m to 75 m (at each of the abutments of the pressure pipe, manholes should have at least one survey pit) with a depth lower than the foundation expected process from 1m to 2m (or in medium weathered rock zone from 1 m to 2 m).

+The distance between excavated pits in the centerline of the road is 500 m. The depth of the surveyed pits must be deeper than the foundation expected from 2m to 3m.

+For mountainous canals with a flow of $Q \geq 0.5m3/s$, the distance of boreholes along the centerline of the canal is 100m to 200m/hole. The depth of boreholes, pit and pierced through the centerline of the canal should be lower than the canal bottom from 2m to 5m. In case the canal bottom is in soft and weak layer, the survey depth must pass that layer from 1m to 2m. If the weak soft layer is too thick, the survey depth must be greater than 2b (b is the width of the canal bank bottom) and greater than 1.5h (h is the height of the canal).

- Drilling work

+Drilling work is to determine stratigraphy, soil layer depth and take soil and rock sampling.

+The depth of boreholes must pass the foundation level of the works from 3 m to 10 m and greater than 1.5B (with B as the foundation width).

+In case of encountering soft soil layer, there must be at least 1 hole to pass through soft soil layer and into a good soil layer below that not less than 2 m. In all cases, the depth of borehole does not exceed 15 times of S (with S as the depth of foundation buried from its bottom elevation). In case of encountering ancient alluvial layer, the depth of borehole must be deep into this layer of 5 m to 7 m.In case of encountering rock, this value is from 3 m to 5 m.

+Drilling work is arranged at pumping stations, water storage tanks. The F/S phase was surveyed with each location of 1 to 2 drill holes. In this phase, boreholes should be arranged at positions not yet surveyed.

- Surveying at material yard

- Each material yard is expected to dig 3 pits.Each pit has a distance of 200m each and 4m deep. It is expected that each area will survey 01 material yard. The digging volume is as 7 areas x 3 pits/ area x 4m = 84m.

- Standard penetration test (SPT)

+ SPT testing aims to serve the calculation of the soil bearing capacity, to check the status and structure of soil at the site, to be carried out in top soil and strong weathering rock layers.

+ This testing is performed in the boreholes at the pumping station and water storage tank locations.

+ Pursuant to TCVN 8477: 2010 - 7.3.3.6 In-room and outdoor tests - Standard Penetration test (SPT) in the remaining soil layers under the works. At each soil layer there are no less than 05 SPT values. Expected to have 3 layers of soil and volume of 15 times.

- Testing sample with 9 criteria

+ The testing sample with 9 criteria is to provide physical and mechanical parameter to serve the calculation of the stability of the works.

+ Samples are taken in boreholes andpit. Samples to be taken must be representative of the entire stratum of the survey.

+ Based on TCVN 8477: 2010 - 7.3.4. Main waterways: canal routes, tunnels (tunnels), water pipelines and river bank protection embankments, 7.3.4.3 Water tunnel, water pipeline, pressure pipe and 7.3.5 Other works: Hydroelectric power plants, power distribution stations, management office, road serving for construction and electric lines. Testing soil samples from 6 to 10 samples each.

- Testing rock samples

Testing to determine standard compaction criteria, soil properties of material yards

+ Samples are taken at material yard locations. The sample is non-intact. Serving the earthworks at the lower elevations than the required elevation, each material yard is expected to have 1 usable layer of soil, each layer will take 3 compaction samples, 3 prepared samples. Survey quantity is as follows:

+ Standard compaction model: 24 samples

+ Preparation testing: 24 samples.

(The quantity composition of topographic and geological surveys conducted during the preparation of FS see Appendix 02 andAppendix 03)

3.3.6. Participating in the Study Tour in Australia

- A study tour will be held after recruiting Consultants for all subprojects.

- The study tour aims at learning about modern irrigation systems in the Riverland Region of South Australia. The study tour will be sponsored by the Australian Water Partnership (AWP).

- After the study tour, the Consultant will prepare and submit a PPMU report on findings, experiences/lessons learned and recommendations that can be applied in

the detailed technical design of the Irrigation System. of the two subprojects Tra Tan and Du du - Tan Thanh

3.3.7. Preparing the detailed engineering designs

Overall requirements for the detailed engineering designs:

At the detailed engineering design, there will be some opportunities to make further improvement to the design as well as firming up design details, quantities and costs, etc.

- Checking and repairing structural items, design criteria and design standards of approved items in the FSs;
- Confirming the optimization of the tasks and measures of items identified in the FSs;
- Carrying out additional design work to improve the technical works that are determined to be feasible: In case of need to adjust and supplement the tasks and structural measures of the project, it is necessary to recalculate and redefine requests for items in order to have explanations for such adjustments and additions;
- For the proposed technical solutions, it is necessary to study and find solutions to treat the ground in accordance with the geological conditions, select the size of the structure and measures according to the principle of making the best use of the local materials and easy construction;
- Designing and accurately arranging the layout of the main items, including pumping stations, power stations, low voltage lines, intake sump tanks, push pipes and discharge tanks, canals, input items, pipelines and related items according to the landscape architecture planning for works and in line with the road system, in the subproject area;
- Reviewing the location selections of items in the previous phase in the subproject areas to select the optimal locations;

+ Basis of choice: Characteristics of categories, natural and social conditions, management requirements...
+ Selecting places to design;
+ The overall layout of items according to each location's options;
+ Possibility of land acquisition and resettlement (if any);
+ Determining the basic size of items;
+ Calculation and analysis to select the optimal category positions.

- Selecting and approving on the best technical plan: Technical plans will be presented and approved by the relevant authorities as prescribed, then the detailed engineering design will be carried out. Based on the approved basic design in the preparation of the Feasibility Study Report, adjustments and additions to the project's structural tasks and measures (if any) and the optimal structural location select and give the main part of the pumping station: Based on the approved items in the step of preparing the feasibility study report, adjustments and supplements

to the tasks and structural measures of the project (if yes) and the optimal category position is selected, to calculate and select the optimal size and item of the works, item details and categories and items and select the optimal solution for foundation treatment.

- Checking to correct the ratio and basic dimensions of the structures, calculate the stability of the structures.
- Calculating the stability of items of pumping stations, suction tanks, propellers, roads and other auxiliary facilities.

3.3.7.1. Checking required hydrological and irrigation calculations

- Checking and evaluating the calculation data in the phase of preparing the FS report.
- Irrigation calculations are carried out for engineering items, pumping stations, hydraulic pressure pipes and dams, canal systems and related items to determine/confirm the size of items as well as to evaluate options/technical solutions to improve/modify FS level design.
- The required capacity may be reassessed/ confirmed at the detailed engineering designs.

3.3.7.2. Detailed Engineering Design for Tra Tan Subproject

The scheme comprises an existing canal system to be rehabilitated and modernized, and a new pressure pumped pipe system to be constructed and modernized.

a. Canal System

Design parameters include:

- Gross and net command areas of about 920 ha and 854 ha respectively. Net command crop areas comprise 140 ha of rice, and 714 of pepper and cashew.
- The total flow required/ Design flow for the canal system averages 1.41 l/s/ha for the crops cultivated giving a peak demand of 1.2 m3/s for the command area.

At detailed engineering design, the following is proposed:

- If funds are insufficient, reduce the extent of secondary canal lining by improving only three with a total length of 3.18 km (0.54 km, 0.98 km and 1.66 km). This would not substantially affect the modern level of service but would reduce the density of the improved canal network from 21 m/km to only 12.5 m/km.
- Provision of balancing storage tanks at the end of the main canal, and possibly at the end of the longer of the secondary canals in the tail of the system. This would facilitate operation, allow feedback from tank water levels to inform reservoir flow releases and reducing operational losses. Small farmer ponds would not perform this function.
- Provision of a flume structure with water level sensor for flow measurement at the head of the canal, or equivalent flow measurement device such as an ultrasonic velocity - flow depth equipment.

b. Pumped Pipe System

The consultants shall design the pressure pumped pipe system for serving the HVCs (pepper and cashew) area of 236 ha. Assumptions/ estimates can be made regarding water requirement and efficiency of the system and the number of hours operated in a day. The total flow required for the pipe distribution system is 0.94 l/s/ha giving 0.222 m3/s (796 m3/hr).

The proposed new pipe system comprises an onshore intake, pumping station, rising main, hill top header tank and single distribution pipeline supplying hydrants each with a discharge of about 5 l/s.

There shall be two options for the layout of headworks:

- Option 1 (FS proposed): Pumping into a header tank for subsequent gravity supply by a pressurized pipe system.
- Option 2: Direct pumping into a main pipeline of a pressurized pipe system. As part of the detailed engineering design, this additional option shall be costed and compared.

Selecting the optimal option for the layout of headworks shall be based on technical and economic arguments/ evaluations, and the requirements for irrigation water delivery services: Equity, Reliability and Flexibility in irrigation modernization projects. It is expected that header tanks will not be required and that the pumping stations shall deliver water directly into a HDPE pressurized pipe system supplying hydrants.

In case of selecting Option 2, a single small header tank may be located at the highest (and furthest) location in each pipe system, with pressures (or water levels) triggering pump operations. Alternatively, pump operations may be controlled by pressure sensors in the pipeline.

For the pumping station, the consultants will design one pumping station with 03 pump sets: one of which will be on standby mode, and one of two remaining pumps will be a VFD pump.

The feasibility design adopted an on-shore reinforced concrete pumping station with centrifugal pumps. Consideration shall be given to alternative pump station designs, together with possible adoption of submersible pumps.

The distribution pipeline meets the LOS standards developed and adopted for WEIDAP, with fields being within about 500 m from the pipeline. The service area excludes the area that may be irrigated by direct pumping from the canal system. It varies in width from less than 1.0 km to 1.5 km wide, and a single HDPE distribution pipeline 3.96 km long is proposed. The total length of pipeline is 4.39 km and this gives a pipe density of 18.6 m/ha for the 236 ha service area.

**** Requirements for hydraulic calculations of the pressurized pipe system***

The hydraulic design of the distribution pipe irrigation supplysystem must use the Epanet software or WaterGEMS unless otherwise approved.
Pipe drawings must include a long section showing HGL and available head under full flow.
Maximum velocity limits shall depend on pipe type and class, but will typically be 1.5 (1.7) m/s for uPVC pipes and 2.0 (2.5) m/s for HDPE pipes at full flow. Minimum velocity at design flows will be 0.3 m/s to ensure against sedimentation in the pipe. For pumped systems, the optimum flow velocity, from capital and energy cost considerations, is likely to be 0.7-1.2 m/s.
Adopt a hydrant flow of 5 l/s in pipeline design.
Design (residual) head at the hydrants should be a minimum of 2.5 m for gravity systems where constant flow valves are not required, and a minimum of 10.0 m for pipe pressured systems, for each hydrant operating at 5 l/s for the system operating at full flow. The operating and residual heads will be higher when the overall system flow is less than design maximum.
The maximum static head must not exceed the pressure rating for the pipe type and class used, and is not likely to be relevant.
Pipe layouts shall observe the level of service adopted for the Project, etc.

For the design flow of 0.222 m3/s, 45 hydrant – manifolds, each with a fixed 5 l/s design discharge will be provided. Each hydrant comprises a ball (or gate) valve and a digital (ultrasonic) flow meter, and supplies a manifold to which each farmer can connect their hoses. Valves and cheap (local) read meters may be provided for each farmer along the manifold offtake for transparent charging of farmers according to volume of water use. The consultants shall consider further two options of local and remote readings.

At the detailed engineering design, the following will also be considered further:

+ Size of rising main and capacity of storage tank,
+ Design of pump station and choice of pumps,
+ Distribution pipe, residual heads and hydrant – manifolds' design,
- Pipe service road,
- Electric connection/ supply, etc.

The feasibility design includes for a rising main designed for 0.222 m^3/s, the full required flow, and a header tank with eight hours of storage. This is unnecessary. Either the header tank capacity may be reduced, or the rising main designed for a smaller flow. The two options should also be compared and the cheaper option adopted.
The residual heads at the hydrants vary from 10 - 23 m. It may be appropriate to slightly reduce sizes of the distribution pipeline to reduce costs, subject to maximum velocity limits. If not, residual heads will remain quite high, and flow through some hydrants could be significantly higher than 5 l/s. Alternatively, the head could be burnt

off at the hydrants by adopting different hydrant sizes - smaller diameters would burn off more head - or by including a flow limiter for each hydrant in the design

The electric power requirements of the pumping station shall be firmed up, and cost determined including cabling for 3-phase connection, poles, transformers, electric meter, and so on.

c. SCADA System and System Operations

The Design of SCADA system includes identifications of sensors, meters, loggers, remote terminal units (RTUs), communication media (the Internet and the 5G universal mobile telecommunication systems or the latest mobile technology), databases and software, and costing of a basic supervisory control and data acquisition (SCADA) system for the canal and pipe system, including the following elements:

- Canal system operations: remote monitoring of water levels at key locations with data transmitted to a central office: tail of the canal in tail end storage tanks, in the Tra Tan reservoir, and in the head of the main canal at the measuring structure.
- Pump-pipe system operations:
- System so that pumps operations are linked to water levels in the header tank.
- System for remote monitoring of pumping and for safety of pumps.
- System for remote monitoring of flows from the head tank and from the hydrants
- Central control room (office) shall be located, rehabilitated and equipped as required with computer/ devices/ Internet connection and the 5G universal mobile telecommunication system (UMTS) or the latest mobile technology, software, database and so on.
- At the detailed engineering design, the consultants shall consider further:

(i) The transmission of data/ coded signals from sensors – loggers/ remote terminal units (RTUs) to central control offices and vice versa should use the Internet and the 5G universal mobile telecommunication system or the latest mobile technology;

(ii) Real time SCADA and applications of Internet of Things (IoT) technology shall be considered;

(iii) The Websocket protocol/ technology shall be applied for real time SCADA systems;

(iv) SQL Server and ArcGIS databases will be very useful for control and management as well as maintenance of pressure pipe systems, etc.

- To optimize operational efficiency, balancing storage tanks should be incorporated into the ends of the canal system. This is important for this scheme as the high-value crops are grown in tail end areas - if rice was cropped these balancing tanks would not be required, as the rice paddies would store and utilize the mismatch between demand and supply. For this scheme, two balancing storage tanks are proposed, at the ends of the 7.52 km long main canal and the 1.66 km long secondary canal located in the tail of the system. The total storage would be the travel time for flow from the reservoir to the tail of the system. This is about

four hours giving a volume of about 14,000 m3. Reservoirs of 3.0 m depth would have a combined area of 0.5 ha. The reservoir at the end of the main canal would be the larger reservoir (about 0.3 ha), while the reservoir at the end of the 1.66 km secondary canal would be about 0.2 ha.

- Firm up details and costs for flow control and metering.
-

d. Access roads

- If funds allow, consider gravel surfacing of the inspection road along the main canal to allow wet season access.
- Consider if a bridge crossing for the service road over the Tra Tan river would be cheaper than the proposed culvert - causeway design.
- The design also includes for a 2.0 m wide concrete, 160 mm thick, access road to facilitate operations and servicing along the length of the pipeline, about 4.39 km in length.
- The concrete service road follows high land and cross drainage will probably not be required. However, the land is steep approaching the storage tank on the hill, and the road may not be able to follow the pipeline, but traverse across the slope.

e. Drainage system:

- The low-lying service area includes heavy-textured soils suitable for rice cultivation. While the area appears quite well drained, it is possible that the expanded area of high-value crop production may benefit from improved drainage. Survey of drainage channels and check of capacity and any required re-sectioning works is proposed at detailed design.
- Confirmation that canal cross-drainage structures and drainage channels are adequate and if not include for their construction.

3.3.7.3. Detailed Engineering Design for Du du-Tan Thanh Subproject

- For Du Du a new ring main piped distribution system is proposed to supply surface water to farmers growing dragon fruit, reducing reliance in umped groundwater. The layout proposed at feasibility is attached. With this layout, 62% of farms are within 250 m of the pipeline, 34% within 500 m and just 4% over 500 m.
- Aspects to consider further at detailed engineering design shall include the following:
- Refine the pipe layout for further improvement to the LoS without significantly increasing costs, for example, provide a spur so that no land > 500 m from hydrant, and/ or perhaps consider three ring mains and eliminate spurs.
- The pipelines will cross about 12 stream beds. Safe crossing arrangements shall be designed; this is likely to entail calculation of scour depths to ensure the pipeline is buried to a safe depth and/ or protected.

+ Cost effective hydrant - manifolds designs shall be adopted so that hydrant flows are +5 l/s for a range of residual heads at design flow with metering and flow control devices. Direct fuse connections are envisaged between the main HDPE pipeline and the off taking pipe. Adequate protection against tampering shall be considered

+ The requirement for valves shall be firmed up at detailed design, and will include air valves at intervals/ high points along the pipeline, washout valves at one or more of the creek crossings, and flow control valves to allow parts of the pipeline to be isolated, for example for repair.

+ The SCADA system shall allow remote monitoring of pressures and flows in the pipe system and also flows at all/ selected hydrants.

+ Central control room (office) shall be located, rehabilitated and equipped as required with computer/ devices/ internet connection and the 4G/ 5G universal mobile telecommunication system (UMTS) or the latest mobile technology, software, database and so on.

+ Provision of spare parts/ hydrants/ valves and meters, etc.

+ Confirmation of extent that paved inspection roads are provided along the pipelines - currently about 17 km of paved road is proposed for 34 km of pipeline.

3.3.7.4. Detailed Engineering Design for access roads

a. Requirements for roads

- Determining the cross section for the road according to rural road standards - design requirements: TCVN10380-2014.
- Surveying to review the current status of the road to serve the design requirements based on the following principles:

+ The road must meet favorable connection with existing roads and construction items, serving for project management and operation.

+ Considering to make full use of the existing road and construction road to upgrade and expand to meet the design requirements before new construction.

+ Taking advantage of the available local materials (or on-site materials) into the road and structure.

- Regarding the roadbed compaction level, permissible settlement of the road bed must comply with current standards.
- Crossroads at intersections and crossroads need to be arranged with curved radius in accordance with the standard to ensure visibility for vehicles to run.
- Signaging pile system, road markings, protective guardrails, and metal structure detailed drawings (if any).
- For access roads, at least to reach of the pumping stations, shall be designed and costed.
- The main canal banks are largely unpaved sandy tracks. Inspection/ patrols would benefit from a paved road along one side of main canals. These may be funded if less is spent on canal lining.

3.3.7.5. Preparing Guidelines for the operation and maintenance

In order to develop processes for operation, management, exploitation, maintenance and protection of buildings, including:

- Instructions on O&M;
- Detailed scope of protection and management;
- Details of the item and architecture of the project to serve the operation and protection management of the project;
- Details of the monitoring and control network;
- Details of the communication system;
- The exact number and quantity of equipment and construction operation management system.

3.3.7.6. Updating the resettlement plan

Based on the resettlement plan, it is required to set up in the project investment phase, the consultants will update minor changes in the pipeline and canal design during the detailed design process, so that the plan is re- implemented. Settlement must be updated in accordance with technical amendments.

3.3.7.7. Updating the environmental management plan (EMP)

Items and contents of the EMP of the Subproject must be in accordance with Annex 2.10 in Circular No.27/2015/TT-BTNMT dated on 29/05/2015 issued by the Minister of Natural Resources and Environment on environmental assessment, strategies, environmental impact assessments and environmental protection plans. The main content is as follows:

- Measures and plans to minimize negative impacts on the environment during the preparation phase (if any) and the project construction phase, including:
- Minimize negative impacts on the surface water environment (if any)
- Minimize negative impacts on groundwater environment (if any);
- Minimize negative impacts on the air environment (if any);
- Minimize bad impacts due to noise and vibration (if any);
- Minimize negative impacts on the community (if any);
- Collection, temporary storage, transportation and disposal of waste;
- Minimize other negative impacts (if any).
- Planning to build environmental protection items for the operation phase -of the project (if any), including:
- Wastewater treatment works; Water treatment factory; Waste treatment works;
- Projects for storing and treating ordinary solid wastes and hazardous wastes;
- Plan for construction and installation of other environmental protection projects: The content of construction plans and installation of environmental protection works for the operation phase of the project must clearly show the expected construction time, installation and finishing.
- Environmental monitoring program during the construction phase of the project: The content of the environmental monitoring program should clearly state the

monitoring position, monitoring frequency, monitoring parameters and technical standards and regulationsapplied to assess environmental sample quality with approved sampling locations in environmental impact assessment reports.

3.3.8. Advising comments and adjusting the detailed engineering designs

- Organizing technical design workshops and advising comments/ suggestions/ recommendations with all related parties including consultants, PPMUs, PPC's representatives, experts, operation and maintenance units, local authorities, representatives of Subproject stakeholders, and the appraisal/ verification consultants, etc.
- Preparing a report on explaining the comments of related parties in the Design Workshop and adjusting the Detailed Engineering Design according to the comments/ suggestions and recommendations.
- The consultants will present the DEDs in a meeting before submitting the DEDs to the PPC.

3.3.9. Presenting the contents of the Detailed Engineering Designs at the meeting held by the PPC

- After receiving appraisal comments of the agencies, the PPC will hold a meeting to discuss about the DED. During the meeting, the Consultants will present about DED, explain the comments.
- Adjusting/ finalizing and completing the DED according to those comments and submitting the DED dossier for the approval.

3.3.10. Providing the supervisions of the detailed engineering designs' authors' right

- The consultants are responsible for providing the oversight of the authors'right according to the current regulations (Decree 46/2015/ND-CP on quality management and construction maintenance).
- Appointing the qualified specialist to supervise the authors'right during the construction process. The main tasks are as follows: responsible for explaining and clarifying construction design documents to the Investor and other contractors for management and construction in accordance with the design; modify the design for the content which is not consistent with the actual standards and conditions of the project; detect errors compared to the design, etc.

3.4. Essential Documents attached to the TOR needing to be observed and referred

3.4.1. The Guidelines for Detailed Engineering Design

The Guidelines for Detailed Engineering Design (Revised version 2019) is prepared to guide the detailed engineering design process, for use by MARD, DARDs, SPPMUs/PPMUs involved in the WEIDAP Project, and ADB, AWP, and will be included/ attached to the Terms of Reference for the procurement of services for detailed engineering designs with support from CPO/CPMU.

The Guidelines, which give the Key Design Principles for design of the Subprojects as well as specific guidance for Subprojects in each Province, shall be observed by the detailed engineering design consultants.

The Guidelines for Detailed Engineering Design can be downloaded at: http://onlinedroughtcontrol.com/FinalRevisedGuidelines4DED.pdf.

3.4.2. The Subproject Reports: Du Du – Tan thanh Subproject and Tra Tan Subproject

The consultants shall also review the following reports when preparing detailed engineering designs.

"Subproject Report: Tra Tan Subproject" at:
https://www.adb.org/sites/default/files/linked-documents/49404-002-sd-03.pdf"
and "Subproject Report: Du Du-Tan Thanh Subproject" at:
https://www.adb.org/sites/default/files/linked-documents/49404-002-sd-02.pdf"

These reports are linked documents to the ADB's Report and Recommendation to the President (RRP: VIE 49404-002) on the proposed loan, grant, and administration of grant to Viet Nam for the Water Efficiency Improvement in Drought-Affected Provinces Project.

3.4.3. The Design Principles for Subprojects

The Design Principles for Subprojects can be downloaded at: https://www.adb.org/sites/default/files/linked-documents/49404-002-sd-01.pdf

The Design Principles for Subprojects, especially the specific guidance for System Design Discharges shall be referred.

3.4.4. The Feasibility Study reports

The Feasibility Study Reports for Tra Tan and Du Du-Tan Thanh Subprojects were approved by Binh Thuan Provincial People's Committee at the Decision No. 1744/QĐ-UBND on July 06, 2018 and No. 1745/QĐ-UBND on July 06, 2018 respectively.

The design consultants shall review the Decisions at:

http://onlinedroughtcontrol.com/BThPPCsDcsTrTnFS.pdf,
http://onlinedroughtcontrol.com/BThPPCsDcsDuDuFS.pdf,

and the Feasibility Study Reports at:

http://onlinedroughtcontrol.com/TraTanBS.pdf,

http://onlinedroughtcontrol.com/DuDuBS.pdf.

4. IMPLEMENTATION DURATION

The Consulting Services for the detailed engineering designs are expected to begin just after signing the contract. Contract implementation duration is 180 days (06 months). The technical proposal of the Consultant will include an action plan with expected members of the consulting team and the progress of mobilizing experts and support staff:

+ Phase 1 (From the effective date of the contract to Day 90): Studying further for improving FSs level designs, Conducting geological and topographic surveys, Attending the Study Tour for learning experience in Australia (according to the .proposed plan of CPO and the Australian Water Partnership (AWP).

+ Phase 2 (From Day 91 to Day 150): Carrying out the detailed engineering designs.

+ Phase 3 (From Day 151 to Day 170): Organizing the Design workshops, acquiring the opinions of related parties to finalize the designs and submitting the detailed engineering design documents.

+ Phase 4 (From Day 171 to Day 180): Coordinating with the PPMU and related parties to report, explain and finalize the detailed engineering designs until it will be approved.

5. REPORTING REQUIREMENTS AND TIME SCHEDULE FOR SUBMISSIONS OF DELIVERABLES

5.1. Reporting requirements

The dossiers of the detailed engineering design must be prepared in accordance with the relevant sectoral norms, standards, and other relevant regulations and procedures of the Government, and the WEIDAP Guideline for Detailed Engineering Designs.

The main report and working papers: Composition and volume of reports must complying with the National Technical Regulation on the composition, contents of the technical design dossier and detailed engineering design of hydraulic works QCVN 04-02: 2010/BNN-PTNT.

Language of the dossiers and reports: Vietnamese and English.

The Dossier shall consists of:

(i) Main report

(ii)Specific working papers:

- Topographical report: complying with the standards on topography
- Geological report: complying with the standards on geology
- Hydro-meteorological - water balance report: complying with the standards on hydro-meteorological and water balance
- Structure design report
- Mechanical design report

- Electric design report
- Report on construction organization and measures
- Report on operation and maintenance rules

(iii) Drawings

- Site geological engineering drawings: complying with the promulgated regulations on the composition and volume of geological survey in the project planning and design stages.
- Drawings of structure status
- Structure design drawings: showing the entire contents of a detailed design of structures, including the location, size, details of elements, layout of equipment, construction measures, and measures to protect the ecological environment, operation, management and maintenance of structures. The design drawings must show full and accurate details to allow the practical construction on site in accordance with the design requirements; honestly reflecting the contents of the approved basic designs; presenting clearly, scientifically and easily to understand in the prescribed format.
- Mechanical design drawings
- Electrical design drawings
- Design drawings for construction organization.

5.2. Survey files and construction design drawings:

The results of consultancy services must fully reflect the contents and components of survey dossiers and detailed technical designs according to current regulations. The design dossier must be clear, accurate, complete, qualified and approved by competent authorities.

The number of submitted documents is 09 parts in Vietnamese, including:

- Part 1: Explanation of detailed technical design;
- Part 2: Summary report;
- Part 3: Specialized reports: Hydrological and hydraulic calculation report; construction design; mechanical design; electrical design; construction organization and construction measures;
- Part 4: Topographic survey report (notes, drawings and appendices)
- Part 5: Geological survey report (explanatory notes, drawings, testings, drill samples, drilling images ...)
- Part 6: Engineering design drawings;
- Part 7: Construction cost estimates;
- Part 8: Technical guidelines on construction method;
- Part 9: Operation and maintenance procedure.

Design consultants are responsible for translating design documents into English upon request of the Investor. Do not translate the entire dossiers but only translate the documents to serve the Sponsor's requirements and stakeholders.

Note: Attached to the USB, written the contents of detailed engineering design documents and data and original documents of construction survey documents (including all the data from the above part 1 to part 9 above).

5.3. Time schedule for submissions of the deliverables

Table 7. Progress of submitting the deliverables

No	Name of the dossier	Time of submission	
		Draft dossier	**Official dossier**
1	Surveying tasks	03 days	05 days
2	Survey report	25 days after the contract takes effect	30 days after the contract takes effect
3	Design records	90 days after the contract takes effect(This time includes: Sightseeing, workshops and consults the experts): DARD/SPPMU/PPMU submits detailed engineering design dossiers (review the drafts of detailed design drawings, reports and calculations) for MARD (CPO/CPMU) to review and comment, with the help of ADB and AWP	120days after obtaining MARD's comments: Submit final engineering design dossiers including full reports, specialized reports, maps, detailed design drawings, calculations, quantity and estimates; technical guidance for construction and installation, operating procedures etc. has been modified
4	Translating consulting products into English at the request of the parties involved.	Per request	
5	Editing consulting products and services at the request of appraisal agencies and Sponsor (if any)	Per request	
6	Summary report of consulting services	Per request	

6. QUALIFICATION REQUIREMENTS FOR CONSULTING FIRMS

6.1. Qualification requirements for consulting firms

The consulting firm must meet the eligibility requirements in accordance with current regulations of Vietnam.

The consulting firm must be a unit with full legal status and business registration in accordance with the scope of work; with a certificate of construction consulting activity in accordance with regulations;

The consulting firm has a strong financial capacity in the last 3 years (2016, 2017, 2018), with sufficient infrastructure and necessary equipment for surveying and designing and detailed specifications required;

Having registered information on the National Bidding Network, having a system of quality management and organization in accordance with the current regulations of the State.

The consultancy unit must have at least 03 years of experience in designing pressurized pipe irrigation supply systems for HVCs/ agriculture.

Any prospective consultants should attend a 'briefing workshop" before submitting tender.

If the Consultant is a joint venture, each member must satisfy the requirements as for independent consultant corresponding to the work undertaken.

6.2. Requirements on qualifications of key specialists

The Consultant must mobilize qualified and experienced experts in the proposed areas and one of them will be appointed as Consulting Team Leader to coordinate and implement the subproject.

Note that if the positions do not overlap, an ex ?pert can take on multiple positions. The minimum requirements on the number, qualifications and experience of key experts are as follows:

Table 8. *Requirements on qualifications and experience of consultants*

S.N	Expert	Quantity	Required qualifications and experience	Tasks	Implementation time (months)
1	Design Manager (Project manager)	01	- Having university degree majoring in irrigation works, preferably a master's degree specialized in irrigation works; Having a valid irrigation work designing practice certificate.	Managing the coordination of consultants, connecting with PPMU and stakeholders in organizing the implementation of the Subproject:	03

S.N	Expert	Quantity	Required qualifications and experience	Tasks	Implementation time (months)
			- Having over 15 years of working experience in the field of irrigation engineering design consultancy; - Having experience in conducting consultancy on design of 05 irrigation works with the role of Design chief or manager; - Having experience in leading or managing projects or designing ODA projects. - Priority is given to experience in consulting services in similar geographical areas.	- Being responsible for organizing the production, ensuring the progress and quality of reports and products, and coordinating with relevant agencies and consultants supported by ADB. - Supervising and evaluating the performance of the consultants; Supporting PPMU in coordination with MARD and WB in the implementation and approval of detailed engineering design. - Preparing and taking responsibility for the progress and quality of the works and products of the consultant services. - Guiding the collection and updating of documents related to the subproject prepared by other consultants. - Providing guidance and technical review proposed by member consultants on survey, detailed engineering design of component projects under the subproject. - Carrying out author supervision at the request of the project	

S.N	Expert	Quantity	Required qualifications and experience	Tasks	Implementation time (months)
				owner.	
2	Design chief	02	- Having university degree majoring in irrigation works, preferably a master's degree specialized in irrigation works; Having a valid irrigation work designing practice certificate. - Having over 15 years of working experience in the field of irrigation engineering design consultancy; - Having practical experience in conducting design consultancy for 05 irrigation works with the role of Design chief; - Priority is given to experience in consulting services in similar geographical areas.	- Managing design in compliance with the progress and quality of the reports and products. - Guiding the collection and updating of documents related to the subproject prepared by other consultants. - Providing guidance and technical review proposed by member consultants on survey, detailed engineering design of component projects under the subproject. - Coordinating and supporting Project manager in author supervision in accordance with regulations.	03
3	Hydrographic and hydraulic expert	02	- Having university degree specialized in irrigation works; preferably having a master's degree in hydrology. - Having over 15 years of working experience in the professional field. - Having participatory experience in 03 irrigation projects as a hydro/hydraulic expert; - Priority is given to experience in consulting services in similar geographical areas.	- Being responsible for conducting activities of collecting data and information and performing related calculations and hydrological and hydraulic calculations of the works. - Summarizing and preparing specialized hydro-and hydraulic reports.	03

S.N	Expert	Quantity	Required qualifications and experience	Tasks	Implementation time (months)
			- Having05 years of experience in using EPANET or WaterGEMS for DEDs		
4	Water expert	04	- Having university degree specialized in irrigation works; preferably having a master's degree in irrigation; having a practicing certificate for designing irrigation projects. - Having over 10 years of working experience in the field of irrigation engineering design consultancy; - Having participatory experience in 2 similar projects with the role of a hydro/engineering expert; - Having participatory experience in 02 projects of irrigation works as a construction expert; - Priority is given to experience in consulting services in similar geographical areas.	- Doing field work, analyzing documents, assessing the construction status. - Proposing and synthesizing structural and non-structural solutions, analyzing and evaluating overall stability, designing and calculating work items. - Participating in making detailed engineering design of the subproject, formulating plans to organize the construction and making reports on specialized hydraulic engineering. - Coordinating and supporting Project manager in author supervision in accordance with regulations.	03
5	Structural expert	04	- Having university degree specialized in irrigation works; preferably having a master's degree in irrigation; having a practicing certificate for designing irrigation projects. - Having over 10 years of working experience in the	- Analyzing and evaluating work stability, calculating structure of work items. - Coordinating hydraulic experts to establish computation appendices and design notes.	03

S.N	Expert	Quantity	Required qualifications and experience	Tasks	Implementation time (months)
			field of irrigation engineering design consultancy; - Having participatory experience in 02 consultancy projects on design of irrigation works with a role of calculating structural design; - Priority is given to experience in consulting services in similar geographical areas. - Use EPANET or WaterGEMS for design		
6	Expert in making technical instructions, setting up maintenance procedures	02	- Having university degree specialized in irrigation works; preferably having a master's degree in irrigation; having a practicing certificate for designing irrigation projects. - Having over 10 years of working experience in the field of irrigation engineering design consultancy; - Having participatory experience 02 similar projects with the role of an expert in making technical instructions, setting up maintenance procedures; - Having participatory experience in 02 projects of irrigation works as a construction expert; - Priority is given to experience in consulting services in similar geographical areas.	- Doing field work, collaborating with other experts in assessing the status of the work, analyzing relevant documents. - Coordinating with the Project Manager and other experts in formulating technical instructions and work maintenance procedures - Coordinating and supporting Project manager in author supervision in accordance with regulations.	03
7	Mechanical	02	- Having university	- Proposing and	03

S.N	Expert	Quantity	Required qualifications and experience	Tasks	Implementation time (months)
	expert		degree in mechanical engineering; preferably having a master's degree in mechanical engineering; having appropriate design practice certificate. - Having over 05 years of working experience in the field of design consultancy for irrigation/hydroelectric projects. -Having participatory experience in 02 similar projects as a mechanical expert	synthesizing solutions for designing mechanical structures of works. - Participating in detailed engineering design of the subproject, making plans and reporting on mechanical engineering. - Coordinating and supporting Project manager in author supervision in accordance with regulations.	
8	Electromechanic expert	02	- Having university degree in mechanical engineering; preferably having a master's degree in mechanical engineering; having appropriate design practice certificate. - Having over 05 years of working experience in the field of design consultancy for irrigation/hydroelectric projects. - Having participatory experience in 02 similar projects as a mechanical expert	- Proposing and synthesizing solutions for designing mechanical structures of works. - Participating in detailed engineering design of the subproject, making plans and reporting on mechanical engineering. - Coordinating and supporting Project manager in author supervision in accordance with regulations.	3
9	Economic experts, estimation expert	02	- Having university degree in economics/irrigation engineering; preferably having a master's degree in economics/irrigation works; having valuation engineer practice	- Reviewing Decrees, Circulars and Norms applied to the subproject. - Collecting and reviewing estimated data from the subproject's designs.	03

S.N	Expert	Quantity	Required qualifications and experience	Tasks	Implementation time (months)
			certificate. - Having over 10 years of working experience in the field of cost estimation, economic analysis, project effectiveness evaluation. - Having participatory experience in providing consultancy services in similar geographic areas.	- Taking charge of and calculating construction cost estimates.	
10	Topographic survey expert	02	- Having university degree in geodesy and cartography; have a topographic practice certificate. - Having over 10 years of working experience in construction surveying and surveying. - Having participatory experience in 02 similar projects as a topographic survey expert; - Having participatory experience in providing consultancy services in similar geographical areas.	- Taking chief charge of topographic surveys. - Preparing technical survey plans, topographic survey records as prescribed. - Formulating and handing over control landmarks. - Carrying out explanation upon request.	02
11	Geological survey expert	01	- Having university degree in engineering geology; having a geological survey practicing certificate. - Having over 10 years of working experience in the field of geological survey, construction surveying. - Having participatory experience in 02 similar projects as a geological survey expert; - Having participatory experience in providing consultancy services in similar geographical	- Taking chief charge of field geological surveys. - Making technical survey plans, geological survey records as prescribed. Proposing measures to treat foundations, bodies and roofs that cause project instability. - Carrying out explanation upon request.	01

S.N	Expert	Quantity	Required qualifications and experience	Tasks	Implementation time (months)
			areas.		
12	SCADA design	2	- Having university degree in appropriate majors. - Having more than 3 years of experience in SCADA design; - Priority is given to officials who have participated in the implementation of a similar project	- Taking chief charge of SCADA design.	03
13	Support staff	10	- Having university degree in appropriate majors. - Having more than 5 years of experience in conducting surveys, surveys, data collection, community consultations, designing irrigation works, supporting the implementation of consultancy tasks; - Priority is given to officials who have participated in the implementation of a similar project	- Supporting key experts in field surveys, information gathering, community consultation, quantitative and qualitative information processing. - Supporting key experts in the detailed engineering design and cost estimation. - Providing support related to administrative procedures, accounting, transactions, report synthesis. - Providing support related to editing, printing, document publishing.	03

7. COST ESTIMATES FOR CONSULTING SERVICES

7.1. Bases of preparing cost estimates for the consulting services

- Pursuant to Circular No. 02/2015/TT-BLDTBXH dated January 12, 2015 of the Ministry of Labor - Invalids and Social Affairs stipulating salaries for domestic consultants as a basis for estimating the bidding package for providing consultancy services on the form of time-based contract using state capital;
- Pursuant to Circular No. 40/2017/TT-BTC of the Ministry of Finance dated April 28, 2017, stipulating business trip allowances and conference costs applicable to state agencies, public and non-business units, political organizations, socio-political organizations and associations using state budget funds;
- Pursuant to Decision No. 79/QD-BXD dated February 15, 2017 defining the norms of project management costs and construction investment consultancy;
- Pursuant to Circular No.17/2013/TT-BXD of Ministry of Construction dated October 30, 2013 guiding determining and managing construction survey costs;
- Pursuant to Circular No. 05/2016/TT-BXD of Ministry of Construction dated March 10, 2016 guiding the determination of labor unit prices in construction investment cost management.

7.2. Implementation costs

Table 9: Cost estimates for consulting services

S.N	Item	Calculation method	Price (USD)	Note
I	**Survey costs**		**169.617,58**	
1	Funding for topographic and geological surveys		154,197.82	Annex 1, 2
2	Survey Contingency Expenses	Survey *10%	15.419,18	
II	**Expenses for designing construction drawings/ DEDs**		**225.009,25**	
1	Funding for making construction drawing design - cost estimation	Provisional (G1)	127,296.83	Annex 3
2	Management cost	45%*G1	57,283.57	
3	Other costs		16,617.65	
4	Pre taxed income	6%	11,074.82	
5	Estimated cost before taxation	G	212,272.88	
6	Design contingency cost	6% (Design)	12,736.37	
III	**Total cost for DEDs**		**400.307,58**	

8. COORDINATION AND OVERSIGHT

The Consultant must report to the PPMU on the progress of the monthly implementation, prepare the documents and attend meetings/workshops on the relevant issues as required by the Investor.

The Consultants will coordinate with the subproject implementation advisors and other stakeholders such as CPO and ADB/ AWP. Specifically, the discussions/inspections on milestones of subproject are required (as stated in the WEIDAP guidelines). The Consultant should closely coordinate and provide necessary data, information and reports for subproject implementation advisors and other stakeholders during the implementation process. The Consultant must participate in meetings and discussions with relevant agencies at the central and local levels.

The Consultants should work closely with community representatives (traditional and non-traditional way) to ensure the information collection during the FS phase, and accurately assess the impacts of the subproject as well as related issues on the environmental and social protection policies.

9. IMPLEMENTATION ARRANGEMENTS

During the implementation of the task, the Consultant will report directly to PPMU. PPMU will be responsible for providing the Consultant with the contact information of other agencies as required.

The Consultant must organize the implementation of the subproject. All relevant estimated costs must be anticipated in the bidding document and there will be no change in the total cost when signing the contract.

All costs related to fieldwork and data needed to meet the technical requirements of this consulting work must be fully considered in the proposal. Terrain and meteorological data and other information must be expected during the bidding process to ensure that the work is completed within the estimated total cost. For this purpose, the Consultant must estimate the corresponding workload and costs because there will be no change in the total cost of the subproject after signing the contract for any reason.

The Consultant will pay for all travel and accommodation related expenses (including field trips) for the entire consulting team during the contract period. The Consultant will also pay for all support staff (administrative, translators, office clerks, accountants) and field staff to perform the work for all data collection activities.

Technical reports and consulting products will be provided as described in the distribution section. The Investor will only accept the sub-project when subproject implementation advisors agree with the consulting products and ADB issues the Non Objection Letter (NOL).

10. RESPONSIBILITIES AND SUPPORTS FROM THE PROVINCIAL PROJECT MANAGEMENT UNIT

10.1. Responsibilities of the Consultants

- Implementing the consultancy service in accordance with the agreed content and workload, and regulations on the application of Vietnamese and ADB standards and regulations;
- Submitting the report to the Investor within the time limit required by ToR;
- Ensuring the mobilization and arrangement of personnel, offices and transport facilities;
- Ensuring that all consulting works implemented by the Consultant are in accordance with Vietnamese law.
- Implementing and being responsible for the quality of the consulting products;
- Participating in meetings related to consulting products when the Investor requests it during the implementation process, ensuring compliance with the regulations of MARD, PMU, PPC as well as the Sponsor; based on the Decision on approval of feasibility study report of the project and the subproject to recommends the Investor to supplement the missing contents according to the Decision;
- Commitment that the Consultant will appoint a competent representative to resolve any problems at any time at the request of the Investor.
- Complying with the direction and guidance of the investor, except for guidances or requirements that are contrary to the law or are not feasible.
- The Consultant shall not disclose any confidential or proprietary information relating to the consulting work, the contract or the work activities of the Investor without prior approval of the Investor in written document.
- The Consultant is responsible for searching and applying appropriate standards and regulations for the subproject. In the absence of such standards, the relevant international standards must be consulted and agreed by the Investor. Some key standards are expected to apply.

10.2. Responsibilities of the Provincial Project Management Unit

- The PPMU provides the Consultants with the documents of the feasibility studies and other relevant legal documents;
- Creating the best possible conditions for the Consultants to perform consulting works;
- Supporting and facilitating conditions for the Consultants to have access to the works location;
- Providing necessary documents according to the Consultant's proposals for the Consultants to perform the consulting works/ services. The PPMU is responsible for the accuracy and completeness of the documents provided;

- Reviewing the requirements and proposals of the Consultants regarding the implementation of consulting and approval work within a reasonable period of time so as not to delay the implementation of the consultancy;
- Pays for the Consultant firm as the contract price in accordance with the regulations;
- Answering in writing the proposals or requests of the Consultants;
- Appointing any qualified and professional individuals suitable to each job to work with the Consultants and specified in the specific decisions of the PPMU.

To clarify the information in this terms of reference, please contact the Binh Thuan provincial Project Management Unit with the following information:

Implementing Agency: Division of Agriculture and Rural Development, Binh Thuan DARD.

Address: No. 04 Hai Thuong Lan Ong street, Phu Trinh ward, Phan Thiet city

Provice: Binh Thuan

Country: Viet Nam

Telephone: +84 0252 3829 204

Email: danghongpt2008@gmail.com

APPENDIXES

Appendix 1: Legal Bases

- Law of Construction No.50/2014/QH13 dated on 18/06/2014 by the National Assembly session 13;
- Law of Bids No.43/2013/QH13 dated on 26/11/2013 by the National Assembly session 13;
- Law of Investment No.49/2014/QH13 dated 18/6/2014 by the National Assembly session 13;
- Decree No.63/2014/NĐ-CP dated on 15/10/2009 by the Government regulating in details the implementing the Law of Bids and bidder selection under the Law of Construction;
- Decree No.16/2016/NĐ-CP by the Government regulating the capital management and usage from the Official Development Assistant (ODA) source and other preferential loan from foreign Sponsors.
- Decision No.48/QĐ-TTg dated on 03/04/2008 regulating the Guidance on feasibility study report using ODA source from 5 banks (ADB, AFD, JBIC, KfW, WB).
- Document No.1101/BKHĐT-THdated on 02/ 03/2015 by the Ministry of Planning and Investment regulating on the approval of the undertakings and decision of investment on public project and program.
- Circular No.02/2015/TT-BLĐTBXH dated on 12/01/2015 by Ministry of Labor, Invalids and Social Affairs regulating the salary levels for local consultants as the basis to estimate the bid of supplying consulting services using State capital in contract form.
- Decision No.1476/QD-BTCdated on 28/6/2016 on the disapproval of some articles at Circular No. 219/2009/TT-BTC and Circular No192/2011/TT-BTC by the Ministry of Finance.
- Circular No.40/2017/TT-BTC dated on 28/4/2017by the Ministry of Finance regulating the regime of business allowance fee and seminar/meeting fees;
- Document No.1447/VPCP- HTQT dated on 02/3/2015 by the Government Office on upgrading the efficiency cooperation with Sponsors of ODA and preferential loan.
- Cent Memorandum of the Visiting Members to ADB8 Project by Asia Development Bank on 30/3/2016.

Decisions of the Ministry of Agriculture and Rural Development: No.3239/QĐ-BNN-TCCB dated on 22/10/2008 regulating functions, power, duties and organizational structuAppendix 1re of the Central Management Committee for the irrigation projects; No.110/QĐ-BNN-TCCB dated on 13/01/2009 issuing the Charter of Operation and Structure for the Central Management Committee;

- Decision No.727/QĐ-TTg dated on 28/4/2016 by the Prime Minister on the approval of lists of ADB8 Projects with loans at Asia Development Bank (ADB).

Annex 2: Terrain survey volume for detailed technical design

S.N	WORK ITEM	UNIT	QUANTITY	SUB-TOTAL	PRICE
I	**DuDu-Tan Thanh subproject**				
1	Elevation network survey, technical leveling, grade-3 topography	Km	32,65	74,63	2.436,63
2	Onland mapping at 1/1000 scale (1m contour), grade-3 topography	100ha	3,05	5.512,27	16.812,43
3	Onland lengitudinal profile measurement, grade-3 topography	100m	326,52	48,11	15.708,11
4	Onland cross-section measurement, grade-3 topography	100m	117,55	58,14	6.834,63
5	Onland mapping at 1/200 scale (1m contour), grade-3 topography	ha	22,00	423,64	9.320,09
6	Landmarking for land acquisition, grade-3 topography	mốc	653,00	77,96	50.910,87
7	Marking centerlines of hydraulic works, grade-3 topography	mốc	50,00	322,09	16.104,37
II	**Tra Tan subproject**				
1	Ground and height control grid				
-	Change road level 2. Level II terrain	point	7	129,68	907,77
-	Technical leveling. Terrain level. Level II	km	1.75	70,37	123,15
2	Measuring and mapping the plan of construction site locations				

	Terrestrial map, scale 1/200, contour line of 0.5m. Level II terrain	ha	3.55	419,39	1.488,82
3	Propulsion pipeline + medium-voltage electricity line of pump station (450m + 350m = 800m)				
-	Measurement and drawing of vertical sections on land Grade II	100m	8	45,49	363,93
-	Technical leveling. Level II terrain	km	0.8	70,37	56,30
4	Setting up landmarks				
-	Heart positioning (Including 40 S points on the main canal route + the beginning and ending points of the route)	point	42	353,52	14.847,93
-	Setting landmarks	landmarks	38	73,65	2.798,72
-	Installing landmarks of land clearance	landmarks	66	132,57	8.749,68
	Total				**147.463,43**

Annex 3.Volume geological survey for detailed technical design

S.N	WORK ITEM	UNIT	QUANTITY	SUB-TOTAL	PRICE
	Main pipeline of pump station (300m/pit, 3.0m deep) + Plant, suction tank (3 10m-deep holes) + Storage tank (3 5m-deep holes)				
1	Rotary drilling pumps washed with on-land sample tubes, the depth of borehole from 0m to 30m, rock and soil grade I - III	m	57.3	38,77	2.221,68
2	Rotary drilling pump washed with a sample tube on land, the depth of the borehole from 0m to 30m, and rock and soil grade IV-VI	m	26.7	58,80	1.570,03

3	Water supply pumping in service of rotary drilling pumps washed on land (when water must be supplied to bores away from water sources at more than 50m or higher than the water intake at ≥ 9m), the depth of borehole is from 0m to 30m, soil and rock level I - III	m	57.3	13,53	775,38
4	Water supply pumping in service of rotary drilling pumps washed on land (when water must be supplied to boreholes away from water sources at > 50m or higher than the water intake at ≥ 9m), the depth of borehole is from 0m to 30m, soil and rock level IV - VI	m	26.7	18,74	500,45
5	Standardized penetration test (SPT), soil and rock grade I-III	time	12	24,90	298,76
6	Standardized penetration test (SPT), soil and rock grade IV-VI	time	3	39,69	119,08
7	The experiment to identify nine common mechanical and physical criteria of the whole soil sample	sample	12	70,28	843,37
8	Experiment to determine mechanical and physical properties of rock samples	sample	3	135,21	405,64
	Total				**6.734,39**

Annex 3: Funding for making construction drawing design - cost estimation

No.	Expert	Number of expert	Monthly salary (USD)	Months	Price
1	Team leader	1	2,006.93	3	6,020.79
2	Co-Team leader	2	2,293.63	3	13,761.78
3	Hydraulics and hydrology expert	2	2,006.93	3	12,041.58
4	Hydraulic engineering expert	4	1,720.23	3	20,642.76
5	Structure expert	4	1,720.23	3	20,642.76
6	Construction engineering expert	2	1,720.23	3	10,321.38
7	Mechanical expert	2	1,146.82	3	6,880.92
8	Electromechanic expert	2	1,146.82	3	6,880.92

9	Economics and estimation expert	2	1,433.52	3	8,601.12
10	Topographic survey expert	2	1,433.52	2	5,734.08
11	Geological survey expert	1	1,433.52	1	1,433.52
12	SCADA design	2	1,433.52	3	8,601.12
13	Supporting staff	10	573.41	1	5,734,10
	Total	**36**		**34**	**127.296,83**

Annex 4*: Standards applied to the survey and design work*

No.	NUMBER	STANDARDS
I	**Standards used for survey work**	
1	QCVN 04 - 05: 2010/BNNPTNT	National technical regulation on irrigation works - the main regulations on design
2	QCVN 04 - 02: 2010/BNNPTNT	National technical regulations on composition, content of technical design documents and design of construction works of irrigation works.
3	TCVN 8478:2010	Irrigation works - Requirements on composition and quantity of topographic survey during project and design phases
4	TCVN 8224:2009	Irrigation works - The main regulations on net control of terrain
5	TCVN 8225:2009	Irrigation works - The main regulations on net control of terrain elevation
6	TCVN 8226:2009	Irrigation works - The main regulations on surveying cross-sections and topographic maps from 1/200 to 1/5000
7	TCVN 8477 : 2010	Irrigation works -Requirements on composition and quantity of geological survey in project planning and design phases
8	TCVN 9155-2012	Irrigation works - Technical requirements for machine drilling in geological survey work
9	TCVN 8352-2012	Construction land - Static test method
10	TCVN 8720-2012	Land for construction of irrigation works - Methods of taking, packing, transporting and preserving samples
11	TCVN 8868- 2011	Testing to determine non-cohesive shear resistance - non-draining and consolidation - drainage of soil adhesive on three-axis compression equipment
12	TCVN 9140-2012	Irrigation works - Required to preserve drilling samples in engineering geological survey work
13	TCVN 9351-2012	Construction land - Method of field Testing - Standard penetration test (SPT)
14	TCVN 4195:2012	Construction land - Methods for determining specific gravity in the laboratory

No.	NUMBER	STANDARDS
15	TCVN 4196:2012	Methods of determining humidity and moisture absorption in the laboratory
16	TCVN 4197:2012	Methods of determining the flow limit and plastic limit in the laboratory
17	TCVN 4198-2014	Construction land. Methods of particle composition analysis in the laboratory
18	14 TCN 4 – 2003	Composition, content, quantity of investigation and survey and hydro-meteorological calculation of the project development phases and design of irrigation works
II	**Standards for design work**	
1	TCVN 10380:2014	Rural roads - Design requirements
2	TCVN 8423:2012	Standard of irrigation works - Irrigation and drainage pumping stations - Requirements for designing hydraulic works
3	TCVN 4118:2012	Irrigation works - Irrigation systems - Design technical requirements
4	TCVN 8732:2012	Land for construction of irrigation works - Term and definition
5	TCVN 8218:2009	Hydraulic concrete - Technical requirements
6	TCVN 8228:2009	Hydro-concrete mixture - Technical requirements
7	TCVN 8636:2011	Irrigation works - Steel pressure pipe - Technical requirements in design, fabrication and installation.
8	TCVN 8412:2010	Irrigation works - Instructions on operating procedures.
9	TCVN 8299:2009	Irrigation works - Technical requirements in the design of valve gates and steel valve slots
10	TCVN 9141:2012	Standard of irrigation works - Irrigation and drainage pumping stations - Requirements of engine and mechanical equipment design
11	TCVN 2622:1995	Fire prevention and fire fighting for houses and buildings - design requirements
12	TCVN 8297:2009	Irrigation works - Earth dams - technical requirements in construction by compaction method
13	TCVN 9145:2012	Irrigation works - Process of calculating steel pipelines
14	TCVN 9162:2012	Irrigation works - Construction road - Design requirements
15	TCVN 9163:2012	Irrigation works - M&E drawings - Content requirements
16		Other relevant standards and regulations