Augmenting the Long-term Water Supply for the City of Dili via the Construction of Dams

LOCATION SNAPSHOT

Location & description

The use of dams is proposed to augment the long-term water supply for the city of Dili as per the ADB-funded Master Plan of 2017. It is believed by BTL, from previous studies[1], to be the only viable option to proceed, discounting the use of desalination. Two dams are proposed: first the Railaco dam, followed ca. 60 months later by the Gleno dam. These dams would run across the Municipalities of Dili, Liquica, Ermera and Aileu. The Railaco dam would lie on the Mota-hare river and the Gleno dam on the Gleno river. Both dams are within 26 km of Dili.

The dams would provide part of the water for a target 2050 Dili population (Dili had an urban population of 267,000 in September 2016). Water use would also involve other draws such as irrigation. The water demand in 2050 was projected to be 235,000 m3/d (235 MLD, with a 38% safety factor), of which the dams would provide 74%, existing surface water sources 6% and 20% would come from bore water.

The EIB funding project time limit of five years would mean that only the Railaco dam could be initially considered by the PPIP. The Gleno dam would have to fall into a subsequent five-year period.

PROJECT CONTEXT AND RATIONALE

Sector & Sub-sector(s)

Sector: **Water, Sanitation/Sewerage and Drainage**

The activity is classified under the following NACE codes:

E) Water supply; sewerage, waste management and remediation activities

36.00 – Water collection, treatment and supply

Rationale for PPIP intervention and IFI loan

The current Dili water system is extracted from the Comoro River and its tributaries and the Dili aquifer, that is mainly recharged by the Comoro River. The ADB 20-year Water Supply Investment Master Plan (2017) had water the Dili water sources as i) 26 boreholes with a production capacity of around 38 MLD and ii) 6 surface water intakes with 4 WTPs with a production capacity of about 15 MLD (or 15,000 m3/d) for a total capacity of 52.5 MLD.

Twelve percent (12%) of the total raw water was/is untreated. The system suffers from electrical problems and low producing boreholes that restrict the output to less than the aforementioned figures. There are 23 storage reservoirs with a capacity of about 13 ML, although the stated objective is to have a 50% storage of daily production or around 26 ML.

Water distribution is via 390 km of piping/reticulation of various ages, laid in various periods (some all the way back to the Portuguese) of asbestos cement, PVC and HDPE. Physical losses are high with

[1] Pre-feasibility of a Ground Water Resource Development Project for the Water Supply of Dili Metropolitan Area, Workshop held on 05 March 20, Team Group and other consultants (cannot read)

the piping difficult to access and there are significant illegal connections. Unaccounted for Water (UAW) consists of water losses from 70% leakage and 50% illegal connections (mostly unmetered).

During the wet season, nearly half of Dili's water supply is extracted from surface waters. Rain falls mainly in the upper catchment of the Comoro River, about 2.5 times more than in the lower catchment. Discharge of the Comoro River was considered less reliable than the Gleno River's base flow. In-stream storage on the Comoro River was therefore considered insufficient to secure Dili's long-term water supply. No large springs are known from the Comoro and Loes / Gleno catchments.

The evolution of the Dili City water balance (ADB Water MP, 2017) was thought to depend on i) reduction in physical leakage and ii) the increase in the number of connections or increase in production needs. Short and Medium-term increases in water production were envisioned to be realised from:

- *Groundwaters*: (Short Term) mobilise additional resources from the Dili aquifer via new bores and rehabilitation of existing as well by tapping the deeper confined aquifer.
- *Surface Waters*: (Short to Medium Term) – tapping the surface water and/or underflow the apex area of the Comoro fan via a collection or infiltration gallery. (Long Term) Inter-basin water transfer from the Gleno sub-basin to the upper Comoro basin was regarded as the most appropriate long-term solution to secure the water supply of Dili. The development of such a scheme would require a very long preparation and implementation phase or a Feasibility Study. Previous studies had assessed potential hydropower schemes, one at the Gleno River (dam height of 30m) and the other at the Comoro River (dam similar to Gleno River).
- *Seawater*: (Short to Medium Term) Desalination (possibly a containerised unit to be portable) was also considered due the time it could be put into operation. The main disadvantage was the O&M costs and the level of local expertise required.

The whole of the Dili system was suggested to be addressed in three time phases:

Phase 1. (Urgent) No increase in water production until the actual potential of the Dili aquifer is better assessed; during this phase, investments will be mainly directed to the improvement of the efficiency of the network and the quality of the service levels;

Phase 2. (Short-term)
a) Increase water production through increased access to elements of the Dili aquifer, subject to its actual potential.
b) If the potential of extraction from the Dili aquifer is determined to be already reached, mobilisation of an alternative [short-term] resource, most probably desalinated water; this phase would be envisaged as a temporary phase, until Phase 3 has been developed and can be operationally implemented, subject of course to its feasibility (failing which, Phase 2b would be considered as the long-term option); and

Phase 3. (Long-term) **Mobilisation of surface water resources from the Comoro and Gleno Rivers through a river basin transfer scheme (or dams)**.

It was noted the present criticality of the "distortion of the water balance" resulted from:

i) The very poor efficiency of the water supply system and

ii) The very high level of water losses creating a large gap between the demand and the production needs.

A substantial reduction in the water losses was thought to enable, without increasing the current production in the short-term, to supply the new customers that will be progressively connected to the system if taken in combination with the development of the new infrastructure proposed in the Investment Water Plan.

The Dili water system was evaluated in a workshop in Sept. 2016 to be best served via:

a) *Water demand*: connection to public system to be 100% by 2036, with domestic customers supplied indoors at 86% and those supplied outdoors at 15%.

b) *Transmission/storage/distribution*: creation of a system of reservoirs to provide a disconnect between transmission and distribution to provide maximum system rehabilitation advantages.

c) *Improvement of Water Quality*: Water supplied to have been treated to potable standards.

d) *Infrastructure to Access Additional GW*: Rehabilitation of existing boreholes and construction of two new boreholes near Comoro River

e) *Infrastructure for Other Water Resources*: This included i) an infiltration gallery, ii) new dams with inter-basin transfer to capture water from Gleno and Comoro Rivers to a new Dili WTP or iii) a desalination plant as a medium term/temporary solution.

The ADB (for the western Dili area) and the World Bank (for the eastern Dili area) are planning to commence NRW/rehabilitation/expansion water projects in early 2022 for Dili, based on the DED being prepared by Dongsung Eng. due by the end of 2021 or early 2022. The main objectives of the DED project are to:

- Rehabilitate (to reduce NRW) and expand the Dili Metropolitan area water supply system
- Establish fully functional water supply infrastructure that is effectively operated, maintained and manage to provide a minimum level of services and
- Achieve new or improved household connections in all households (by 2030) in the Dili Metropolitan areas.

A recent meeting with ADB verified that they are to provide a technical assistance to GoTL to prepare a water supply project for the western part of Dili and the World Bank is preparing a similar project for eastern Dili. The said project(s) are to be approved in the first quarter of next year (2022) with the main objective to rehabilitate and expand the water supply system in Dili and reduce illegal connections, NRW, etc.

The Ministry of Public Works (MPW), on behalf of the Government of the Democratic Republic of Timor-Leste (now through Bee Timor Leste), also contracted Dongsung Engineering Co. Ltd. in 22Aug19 to conduct a Feasibility Study (FS) for surface water resources development for the long-term water supply of the Dili metropolitan area (referred to herein as the "Dili Dam FS" or DDFS). The DDFS's objectives were to:

- Secure the future water resources of the greater Dili city area up to the year 2050;
- Confirm the possibility of extracting suitable surface water quantities from the Gleno and Railaco rivers;
- Confirm the possibility of hydropower generation from a Gleno and Railaco water resources as a secondary purpose,
- Confirm whether a Railaco dam and a Gleno dam could provide sufficient water for the aforementioned tasks.

There was a pre-feasibility study[2] conducted by the Team Group in 2020 that suggested that by 2036 the water consumption in Dili would be greater than 70 MLD from 467,000 residents consuming 150 L/d/person. This compares with 2019 population of 294,727 residents consuming 120 L/p/d for 35 MLD or 12.9 GL/year. This study was part of the GoTL Master Plan for water resources development and was reviewed as part of DDFS.

The DDFS has only recently been finalised as of September, 2021.

The DDFS built on the ADB Water MP (2017) that projected the water need for Dili to rise from 38.2 MLD in 2016 to be ca. **52 MLD** by the year 2030. The DDFS also included an Initial Environmental Examination or IEE, a Social Impact Report and an Economy and Financial Analysis Report.

The DDFS went on to project the requirement for supplemental water (existing groundwater sources can supply up to 47.5 MLD) for Dili to be ca. 86 MLD by the year 2040 and ca. 173 MLD by the year 2050. This projected **deficit** could only be filled by surface waters from the Railaco and Gleno dams. Permanent desalination is not favoured by BTL due its complexity and OPEX costs.

It is known from previous NRW projects in Dili that amongst the lessons learnt were: *A thorough assessment of government and institutional capacity to support proposed reform actions is required*[3]. An Institutional transformation has since taken place, through the promulgation by Presidential decree-law No. 41 /2020 dated 25 September 2020, that created a Public Company called Bee Timor-Leste (BTL), now the dams proponent, with the corporate objectives of (amongst others) that include:

[2] Pre-Feasibility Study of the Ground Water Resource Development Project for the Water Supply of Dili Metropolitan Area, Team Group *et al*., Powerpoint presentation for Workshop 05 March 2020
[3] ADB TA 4869-TIM: Technical Assistance to the Democratic Republic of Timor-Leste for Dili Water Supply Performance Improvement. Manila; ADB. 2007.

	i) promoting an efficient use of water, ensuring a reliable public water supply (through the design, construction, operation and management of water supply systems) and ii) establishing control and inspection measures for the prevention of illegal connections to the public water supply system. And Decree-Law No. 38/2020 that created the National Authority for Water and Sanitation (ANAS, I.P.), whose mandate includes (amongst others): i) regulation of the water supply and urban wastewater sanitation services and the quality of the service provided to users by management entities and ii) ensure the monitoring, inspection and licensing of the activity of entities managing water supply and sanitation systems, in accordance with the law
Relevance to Strategic Development Plan & overall planning framework	The Timor Leste Strategic Development Plan (SDP) 2011-2030 commits the government to providing all citizens with access to clean water and improved sanitation by 2030. The two most significant causes of infant and child mortality in Timor-Leste – lower respiratory infection and diarrhoeal disease – are directly related to a lack of water supply and poor sanitation and hygiene. The SDP states that "Proper sanitation will reduce the spread of communicable diseases transferred in waste and **improved water supplies** will reduce the amount [sic] of stomach-borne illnesses and infections". The investment in water and sanitation is supported in that "investment in sanitation is an investment in health, education, the environment and poverty reduction. Improved sanitation typically yields about $9 worth of benefits for every $1 spent, based on a reduction in direct and indirect health costs, better education, improved water supply and increases in tourism." In the 2010 census it was reported that 66% of Timorese have access to improved drinking water (35% of these have piped water according to the ADB) but only 39% have access to improved sanitation such as a pit latrine with slab, ventilated improved pit latrine or a pour/flush septic tank or pit. Issues with drainage are also cited in the SDP, particularly with stormwater pollution in Dili and district centres. Stated strategy and actions proposed are: "*We will continue to take action to overcome the many challenges involved in improving access to clean water and sanitation across Timor-Leste, including building a major sewerage collection system in Dili, providing a safe piped 24-hour water supply to households in 12 district centres and installing water systems and community latrines in rural areas as part of the Rural Water Supply and Sanitation Program. Our aim is that by 2030, all citizens in Timor-Leste will have access to clean water and improved sanitation.*"
Relevance to Sustainable Development Goals	The project contributes to the following Sustainable Development Goal(s): Goal 3: Ensure healthy lives and promote well-being for all at all ages Goal 6: Ensure availability and sustainable management of water and sanitation for all Goal 7: Ensure access to affordable, reliable, sustainable and modern energy for all
Project promoter(s)	The project promoter is: Ministry of Public Works, through BTL. Financing: EIB and another partner – to be determined but ADB is open to the idea. (GoTL/ADB/WB/Other?)
General institutional set-up	MPW transformed the Water and Sanitation Directorate to become an autonomous agency. This agency is responsible to assist the process of water and sanitation development in the future to be more effective and efficient. This institutional transformation came in effect when the President of the Republic promulgated the decree-law Nº 38 /2020 dated 23 September 2020, for the establishment of a Public Institution named **National Authority for Water and Sanitation** (ANAS). ANAS, I.P. is aimed at proposing, monitoring and ensuring the implementation of national policy in the field of water resources, in order to guarantee its sustainable and integrated management, as well as the supervision and inspection of the sectors of public water supply, sanitation of urban wastewater and urban solid waste. In particular, ANAS, I.P., is entitled to carry out the following duties:

a) support the Government in the definition of the water resources management, water supply and sanitation policy;
b) prepare proposals for water resources management plans to be submitted to the tutelage;
c) support the work of the Coordination Council for Integrated Water Resources Management;
d) promote the rational use of water through Water Resources Management Planning;
e) propose the creation of areas in the public water domain;
f) coordinate, at the national level, the adoption of exceptional measures in extreme drought or flood situations;
g) ensure the monitoring, inspection and licensing of the use of water resources in accordance with the law and water resource management plans;
h) propose to the Government the approval of regulatory norms related to the water resources sector, water supply and sanitation;
i) regulate water supply and urban wastewater sanitation services and the quality of the service provided to users by management entities;
j) ensure the monitoring, inspection and licensing of the activity of entities managing water supply and sanitation systems, in accordance with the law;
k) control the correct use of water supply and sanitation systems by consumers, etc.

Decree-law Nº 41 /2020 dated 25 September 2020 created a Public Company called Bee Timor-Leste (BTL) to manage the services related to the national water supply and sanitation network. The corporate object of **Bee Timor-Leste**, E.P. ("BTL, E.P.") includes, amongst others:

a) promoting an efficient use of water, ensuring public water supply (through the design, construction, operation and management of water supply systems),
b) ensuring public sanitation (through the design, construction, operation and management of wastewater sanitation systems) and
c) establishing control and inspection measures for the prevention of illegal connections to the public water supply system and injections into the public water sanitation system.

The establishment of these two institutions was considered vital for the development of water and sanitation sector in Timor-Leste and was also one of the requirements for the MCC investment in WTSD in Timor-Leste.

INVESTMENT PROJECT INFORMATION

Scope of proposed project and type of investment measures to be implemented

The proposed project is to augment surface water sources for the city of Dili for the 2050 population. The DDFS of Dongsung Eng. Co. Ltd. projected the water deficit for Dili to amount to **173 MLD** by the year 2050. The 2050 water demand for Dili would consist of 235 MLD (with a 38% safety factor), supplied 74% by the to be built dams Railaco and Gleno (this project), 6% by other surface water sources (i.e., the Comoro river) and 20% from bores into the Dili aquifer.

Concomitant water system rehabilitation projects will start in Dili in early 2022 by the ADB and WB to address NRW and general expansion and rehabilitation of the water system of Dili.

The DDFS also included a Draft Environmental Report, a Draft Social Impact Report and an Economy and Financial Analysis Report. The dams are to be constructed in two phases:

- Phase 1 (1st QTR 2021 to 4th QTR 2028 [60 months]): Railaco Dam to be constructed. Estimated cost would be **$110.4m** (USD). Maximum water conveyance to Dili of 0.5 m3/s or 43.2 MLD.
- Phase 2 (1st QTR 2031 to 4th QTR 2039 [60 months], outside of five-year EIB project timeframe) would consist of construction of Gleno dam/transfer tunnel/water transmission pipe (2nd & 3rd stages)/small 2.1 MW hydropower plant. Estimated cost would be **$246.6m** (USD)

Water demand and water production were modelled to follow the historical trend shown in **Figure 1**. The assumptions incorporated into this figure include:

- Maximum GW productivity is 47.5 MLD (current level)
- Surface water supplies from Comoro river basin maximise at 14.7 MLD, which was achieved in 2020
- Treated water production to maximise at 72.2 MLD by 2026 (to be equal with the water demand)
- Water from dams to go through new Comoro WTP
- Projected water demand of about 170 MLD by 2050. It is not clear, without more detailed study, whether reduction of NRW has been incorporated into this figure. Even if it has been, the long-term water supply (by 2050) of Dili could exceed what can be supplied by bores and the existing surface waters, even with a potentially zero NRW.
- Per capita water consumption of 120 L/cap/d with a 100% connection by 2030 (86% of those indoor connections)

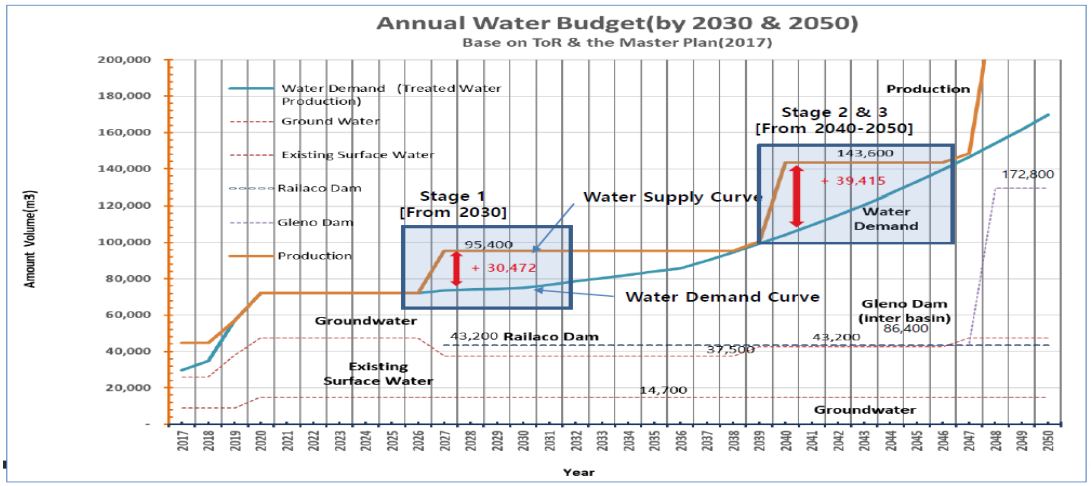

Figure 1. The projected annual water budget to the year 2050 for Dili by the DDFS

Draft Environmental Report

The proposed dams in the IEE were stated as "*may significantly impact the environment since the geographical area affected is quite large – 445ha and the Project Proponent is keen on addressing any adverse impacts*" (see excerpts from the Draft Social Impact Report below). These primary impacts would include ecological, oxygenation profile of new manmade lake, decay of inundated terrestrial vegetation, the possible promotion of malaria and hookworm and the socio-economic and cultural issues. These are commented upon in detail in the IEE, particularly in Tables 34 to 36. Proposed mitigation measure are shown in **Table 37** as reproduced from the IEE.

Table 37 (excerpted). Summary of mitigation and enhancement measures (IEE report)

Potential Impact	Proposed Mitigation and Enhancement Measures
Increase in local population	Local people will be given priority in employment.
Loss of cultural and historical assets	No cultural and historical site is present at the site and therefore no loss is expected
Loss of productive land	No mitigation required since the land belongs to the project proponent
Noise pollution	Noise pollution will be limited to construction phase.
public health	Operation of the dam will be done in a manner that will disrupt disease vectors such malaria
Soil Erosion	Designate buffer zones between settlement and water front
Erosion at construction site	Reforestation will be adopted to rehabilitate exposed areas after construction. Limit heavy machinery to designated routes
Distortion of flow patterns and sediment loads of river	Use of recommended devices to be taken care of during design of the dam. Recommended operating regimes will be adopted.
Distortion in landscape	Minimum access roads will be constructed and borrow pits will be rehabilitated using excess earth and applying reforestation
Air pollution (dust),	Dust will be minimised by regularly watering of construction area.
Destruction of vegetation	Unnecessary vegetation clearing will be prohibited. Re-forest disturbed areas
Loss of vegetation, wildlife habitat	Prohibit unnecessary cutting of trees and vegetation clearing
Spread of aquatic weeds in reservoir	Controlled usage of agro-chemicals to limit nutrient loading to the reservoir thus limiting proliferation of weeds
Fish mortality	Clear vegetation prior to dam filling Allow natural fish restocking
Spread of disease vectors in impoundment area	Disrupt disease vectors through controlled operations of reservoirs
Employment Opportunity	Give priority to local people
Economic growth	Effectively manage the irrigation scheme
Capacity Building	Conduct job on training
Change in river discharge	Observe Water Right regulatory requirements for downstream users and environment
Deterioration in water quality due to fertilizer use	control usage of agro-chemicals to standard
Increase in Sedimentation of reservoir	Buffer zones will be created and unnecessary tree cutting will not be permitted as this may lead to erosion enhancing sedimentation

The IEE also included a monitoring and environmental management plan (EMP) for purposes of addressing the identified adverse/positive impacts as shown in **Table 38**. Due consideration has been given to various factors that include increased pressure on upland areas above the dam, on-site environmental deterioration as well as decrease in water quality and increase in sedimentation rates in the reservoir resulting from clearing of forest land for agriculture, grazing pressures, use of agricultural chemicals, and tree cutting for timber or fuel wood.

An Emergency Response Action Plan (ERAP) within the IEE described the extent of the dam hazard area, identified those responsible for dam operation and implementation of the ERAP as well as describing the procedures for training staff, reviewing, testing and updating the plan. ERAP is primarily to safeguard lives and secondarily to reduce property damage of local communities who live within Railaco and Gleno catchment and beyond in an event of flooding caused by a large volume of runoff from or failure of Railaco and Gleno Dam. Table 40 in the IEE summarised this plan (not reproduced herein).

Draft Social Impact Report

The project is within the territorial jurisdiction of the municipalities of Dili, Alieu, Liquica and Ermera, within 6 Administrative Post and 12 Sucos. A project location map can be seen in **Figure 2**.

Figure 2. Areas involved with the Railaco and Gleno dams

The two water reservoirs: i) Railaco and i) the Gleno reservoir will potentially inundate areas of 210 ha and 235 ha, respectively. Railaco dam will displace 128 households with an average household size of 6.46 or 827 people. The Gleno dam will displace 48 households with an average household size of 6.83 or 328 people. A majority of the displaced people below to the age group of 15 to 64 years old, 60.3% of the female population and 59.8% of the male population. One-third of the displaced belong to the age group of 0 to 14 years old.

The bathroom of the households within the Railaco reservoir are mostly (66%) located outdoors and detached from the main building of the house. Some (20%) are even shared by two or more households. The type of toilet of half (50%) of the households in Railaco reservoir are made of PVC/Floor Type Septic Tank while still more than a quarter (27%) are using open spaces. More than half (59%) of houses in Railaco reservoir have access to public tap as a source of drinking water followed by those relying on river/streams (18%).

Half (50%) of the households in Gleno reservoir are located out of doors and detached from the main building of the house. A quarter (25%) of the households are also relying on river/pond when taking a bath. A quarter (27%) of the households in Railaco reservoir are using open spaces as their only toilet followed by those who are using PVC/Floor Type Septic Tank (17%). Most (67%) of houses in Gleno reservoir are relying on river/streams as a source of drinking water and only a small portion (13%) can access public tap.

The condition of the houses in both watersheds were deemed "moderate" with 98% of the houses owned by occupants.

The size of cultivated area of the majority (86.7%) of the households engaged in agricultural production in the Railaco reservoir area is less than a hectare, with 54.7% of these households engaged in backyard level of production. The size of cultivated area of the majority (62.5%) of the households engaged in agricultural production in the Gleno reservoir area is less than a hectare, with 58.3% of these households engaged in backyard level of production.

Almost half (49.7%) of the persons to be displaced due to the construction of the Railaco dam are employed. However, almost half (49.7%) also of the female population are economically inactive but almost half (49.9%) also of the male population are employed. More than half (55.8%) of the persons to be displaced due to the construction of the Gleno dam are economically inactive, although more than half (52.3%) of the male population are employed.

The type of resettlement will be involuntary and the affected persons (APs) are to receive compensation for:

a) Crop production Area (including estimated crop harvest for the next 3 productive years),
b) Transitional Cost (for 3 months),
c) Cost for Income Loss,
d) Special Allowance for PWD, Single Parents etc. and
e) Livelihood start-up allowance.

The APs will be relocated in a relocation area with road access, housing and community facilities (community center, school, park and playground, space for road network) and public services (electricity and water).

The APs will require 26,388 m2 for relocation from the Railaco reservoir area and 11,208 m2 for relocation from the Gleno reservoir area. The civil works costs of the facilities (living space, parks and playgrounds, schools, community facilities and roads) amount to $2.144M and $1.060M, respectively. Direct compensation APs for loss of productive lands (rice fields @ $9/m2 and other @ $6/m2) amounts to $8.597M for those displaced from the Railaco reservoir area and $3.317M for those displaced from the Gleno reservoir area. Direct allowances are also to be made (for income loss, transitional costs, transportation cost, special assistance and a livelihood grant) of the amount of $585,700 (to each of the 128 HH) and $222,000 (to each of the 48 HH) for those displaced from the Railaco reservoir and Gleno reservoir areas, respectively. The total resettlement cost for those displaced is $15.40M and $6.42M from the Railaco and Gleno reservoir areas, respectively.

Dams Construction Elements

The **Railaco Dam** is to be constructed during the **Phase 1** (1st QTR 2021 to 4th QTR 2028) of the project and would have a water transfer capacity of 0.5 m3/s via Route 1 in Phase 1. In Phase 2 (1st QTR 2031 to 4th QTR 2039), the maximum transfer capacity of 2.0 m3/s would be possible for the case when the inter basin Gleno Dam and transfer tunnel are implemented. The additional maximum transfer capacity of 1.5 m3/s is to be conveyed through the transfer tunnel and hydro power plant to the reservoir of Railaco dam. The outlet works would release water into the Railaco (Mota Hari River) for environmental requirements and in the case of emergency drawdown conditions. This would be controlled through a trifurcated manifold arrangement as shown in the **Figure 3**. A flow of 0.5 m3/s would be conveyed through Route 1, 1 m3/s for emergency release downstream of the dam and 1.5 m3/s for Route 2 and Route 3 water transfer in the year 2039 and 2049, respectively.

The **Gleno Dam** outlet works would release water into the Gleno River for environmental requirements. The outlet works would in this case be bifurcated for directing 3 m3/s to the **hydroelectric plant** and for an emergency 1 m3/s for release downstream of the dam.

A 5.2 km Transfer Tunnel will be constructed to convey water from the Gleno reservoir to the Railaco reservoir through the tunnel steel penstock and draft tube of hydropower plant.

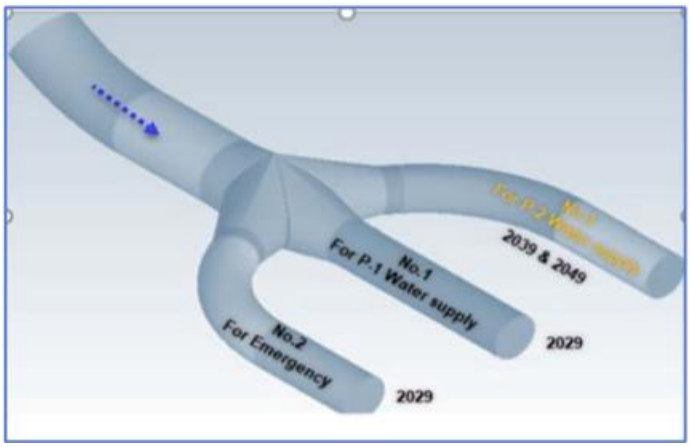

Figure 3. Proposed outlet flow control for Railaco Dam (each leg to be control-valved)

The Hydro Power Plant will be fed with Gleno dam water via a 3 m diameter tunnel at 1.5 m3/s (max) from a FSL of 677m to a TWL of 545m. Trash racks would preclude floating objects > 70 mm dia. Power will be produced by 3 units of 0.7 MW each for a total of 2.1 MW. The estimated power output would be 18.12 GWh/yr.

Both dams are proposed to be concrete: 118,000 m3 of concrete needed for the Railco dam and 242,500 m3 of concrete needed for the Gleno dam. Other associated works would be a 3m dia., 4.2 km underground transfer tunnel; a 3.8 km relocation road with two bridges; water pipeline; spillway; a 2.1 MW hydropower station; camp sites and development of relocation/resettlement areas.

Level of maturity

It is envisioned that the DDFS will need supplementation to meet many of the requirements of the EIB and the EU. Some preliminary areas that potentially could need amplification (not inclusive of all) include:

- *Nature Protection Areas*: Is the project site located within, or in close proximity, to areas designated nationally or internationally for nature protection purposes and/or are there any such areas downstream of the project site within the same river basin?

  Preliminary Assessment: The document GEF-6 Project ID Form (PIF), TheGEF.org, dated Sept. 2015, mentions…The Government of Timor-Leste has requested the support of Conservation International, the key conservation organization based in TL, in working with the relevant Government agencies to develop a scalable strategy for the establishment of a national protected area network. The dams areas appear not to be within these areas. This would have to be confirmed in a PFS or FS.

- *Integrated Water Resources Management (IWRM):* Water utilities and water resources management project should, as a rule, be properly embedded in a long-term holistic planning framework for water resources management (e.g., River Basin Management Plan) and, where appropriate, in relevant national, urban or regional planning frameworks.

  Preliminary Assessment: No studies were found on River Basin Management. This would have to be looked at in a PFS or FS.

- *Option Analysis*: Design of water utilities and water resources management projects and important project components should always include proper analysis of options for attaining the social, economic and environmental objectives of projects. Such analysis of options are also required in Environmental Impact Assessments. The options for a long-tern future water supply for Dii are restricted to an enhanced surface water supply and desalination. The Dili aquifer is already exploited overs its recharge capacity and available source waters are limited and seasonal.

  Preliminary Assessment: This would have to be studied more closely in a PFS or FS.

- *New Water Sources*: Development of new water sources (desalinated sea water or water from inter-basin transfers) is only supported by the EIB if all alternative demand side measures have been sufficiently considered and no better alternatives are available.

Preliminary Assessment: The demand side measures are small as only 30% of Dili's population is connected to reticulated water. There are studies that purport the limited options for the long-term water supply for Dili, including the ADB MP (2017). This would need to be verified in the PFS.

- *Climate Risk & Vulnerability Assessment (CRVA):* For projects and areas that are vulnerable to climate change impacts, the EIB requires promoters to consider climate risks and to incorporate adaptation measures into project planning, design and operation.

  Preliminary Assessment: This would have to be looked at in a PFS or FS.

- *Cost Recovery*: Appropriate cost recovery, taking account of affordability issues, needs to be in place, i.e., project-related revenues should cover revenues from tariffs, taxes or transfers should cover the full project cost. DDFS did look at costing but seemingly without NRW reduction inclusion.

  Preliminary Assessment: This would have to be looked at in greater detail in a PFS or FS.

- *Strategic Environmental Assessment*, where applicable, *Cumulative Impact Assessment*, *Integrated Water Resources Management Plan* or similar: These studies should include proper consideration and mitigation of any significant impacts on river flows, quality and morphology at the scale of the basin in order to protect ecological flows and water users. Draft Environmental Management Plan (EMP) included much of this but it will need further study.

  Preliminary Assessment: This would have to be looked at in a PFS or FS.

- *Flood Risk Management Plans*: With the exception of emergency reconstruction measures, all flood risk reduction measures should consider the integration of nature-based solutions and follow the preparation of flood risk assessment and management plans as required in the EU by its Floods Directive and respect the provisions of the Water Framework Directive.

  Preliminary Assessment: This would have to be looked in greater detail in a PFS or FS.

Approach chosen for project implementation

The proposed Institutional set-up for project implementation is as follows (refer to **Figure 4**):

PMU (Project Management Unit)	Implementing Agency: Established by the Promotor (Ministry of Public Works via BTL), comprising representatives from (possible future) town or Regional water/wastewater authorities, and supported by a Technical Assistance (TA) Consultant to oversee, monitor, and overall management of all components of the project in all phases
TA Consultant:	The TOR and tendering documents for the TA consultant would be prepared by the PPIP. Responsibilities would include tendering for contractors to deliver the water supply works. Works delivery would likely be via design and build (D&B) contract or even DBO (design, build, operate) contract for a limited time period to help with local capacity building. Other responsibilities would include Institutional Development; Tendering and Evaluation, Design Review, Monitoring, Capacity Building, Supervision and Public Education.
Private Contractors (Implementation phase):	Dam Construction: *Envision one Civil Contractor, who could subcontract many of the other items like mechanical/electrical/pipe laying etc. - Contract with the PMU *An alternative is two contracts: one for the dam and another for the piping or other such arrangement that suits – Contracts with the PMU
Private Contractors (Operation phase):	Could consider a PPP type of arrangement or even a private operator for the dams.

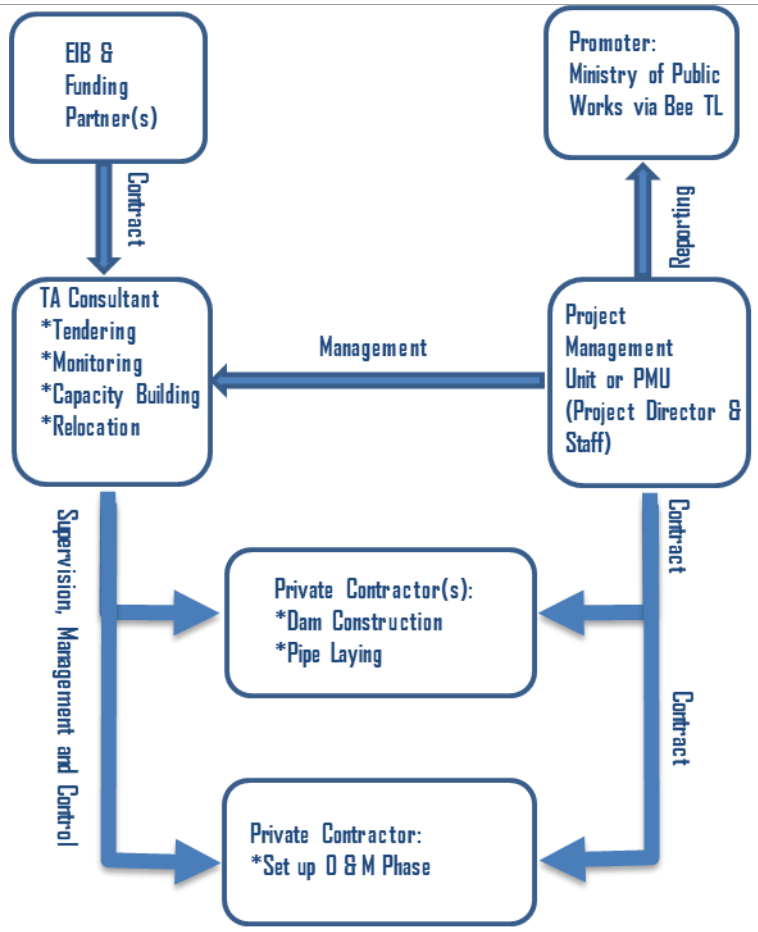

Figure 4. Proposed project delivery mechanisms

Identification of preliminary alternatives for the works	The only alternative water source, taking the demand management analysis as accurate (inclusive of the success of future NRW reduction projects), would be desalination. The Dili aquifer by itself will be unable to keep up with the city water demand. Already, the replenishment of the aquifer is less than the extraction. The Comoro river surface water fades during the dry season and is the only source for aquifer recharge. The demand management analysis would have to be verified. BTL has already indicated a preference for dams over desalination, due to the continued O&M costs. Desalination would have to use an outside operator and the expense of such a contract has given BTL some concerns about its overall sustainability. There are other water sources not considered by the DDFS such as the indirect use of treated wastewater but this depends on a fully functional WWTP and groundwater recharge. This could be considered further in a PFS.
Total estimated project investment costs	The DDFS costed the activities of this project in phases: • Phase 1 (1st QTR 2021 to 4th QTR 2028 [60 months]): Railaco Dam to be constructed. Estimated cost would be **$110.4m** (USD) • Phase 2 (1st QTR 2031 to 4th QTR 2039 [60 months]) would consist of construction of Gleno dam/transfer tunnel/water transmission pipe (2nd & 3rd stages)/small 2.1 MW hydropower plant. Estimated cost would be **$246.6m** (USD) It may well be that the EIB would consider only one phase, likely the first. The preliminary economic and financial analysis assumed: i) discount rate of 5%, ii) O&M cost of 0.4%/yr, iii) raw water tariff $0.15/tonne,

iv) power tariff of $0.17/kWh and
v) service period of 50 years are as follows:

The analysis yielded:

- B/C: 1.16 > 1, EIRR: 5.45% >DR
- NPV: $53.3 M > 1
- Payback Period: 7.5 years
- Variable IRR, depending on the water tariff.

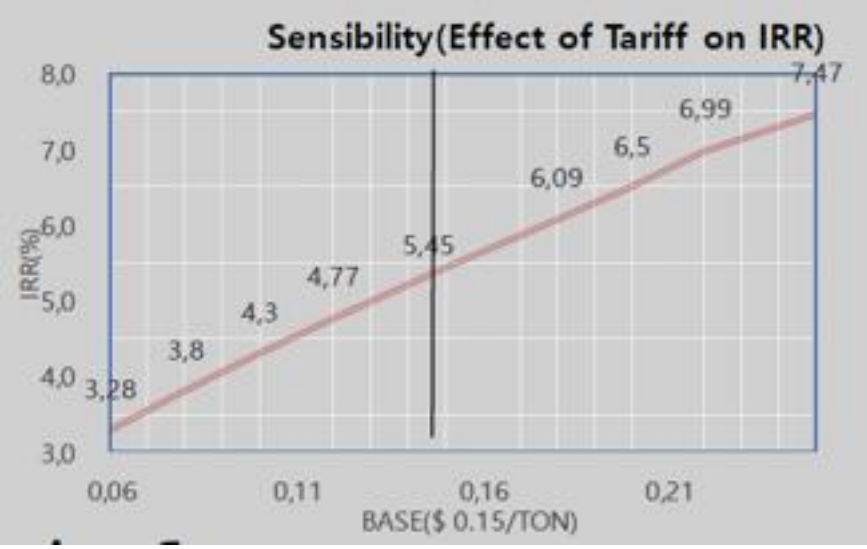

Figure 5. Sensitivity of IRR to water tariff

Approach to finance the project	Considering that the EIB's contribution to a project's cost is limited to 50% of the overall investment, the following financing sources have been identified: The ADB has indicated a potential willingness for co-financing the project if asked by the GoTL. Moreover, there is an existing cooperation agreement between the EIB and the ADB for projects. During operations phase, user payment under affordability constraints is anticipated; however, full-cost recovery may not be possible.

IMPLEMENTATION ARRANGEMENTS

Provisional schedule for project implementation	If it is assumed that one dam could be partially financed by EIB (ADB possibly the other half), say the first Railaco dam. The construction of the dam was projected to take 60 months. For the PPIP project to assist with the process, the recently completed Dongsung Eng. Feasibility Study could be followed by a brief PPIP PFS to confirm/add/ID whatever else is need for the EIB. A PPIP FS could subsequently provide these lacking components. Meanwhile the NRW projects would continue in Dili and be well advanced before the PPIP FS is completed. The provisional schedule for whole project implementation would be in excess of 60 months or 5 years, unless the construction of the Gleno dam is moved into a new five-year funding period. The PFS would be estimated to take about 6 to 8 months, the FS could take about 12 to 18 months. The dam would need to be designed, this could be done by the PPIP team drafting Terms of reference for a design contract or having the dam constructed with a Design and Build contract. The process would have to be fully compliant with the EIB taxonomy such that ESIA and RAP (and others) could

require amplification over the DDFS. TheDesign and Build option would be the quickest. In this case the FS would include the supply of international tendering documents.

Estimated time and resources for PFS and FS

The estimated time and resources required are as follows:

Phase	Time (months)	Level of Effort (person days – KE and Backstopping)	Level of Effort (person days - NKEs)
Pre-Feasibility study	6 to 8	80	250
Feasibility study and Preparation of International Tendering documents	24 to 32	200	825
Internal Tendering and Award	6 to 8	60	120
Total	36 to 48	340	1195

Main barriers to develop the project

The main barriers to develop and implement the project identified at this stage are:

- Financing sources, including tariff setting, fee collection, billing practices, (to be identified during Pre-Feasibility and Feasibility studies)
- Eligibility under EU Taxonomy and EIB criteria; to be considered in the PFS study.
- Institutional set-up, i.e., setting up structures and establish responsibility for operating regional structures (Operation of a dam and hydroelectrical power plant. To be outlined in PFS study and executed during Project implementation.

Estimation of required TA activities to implement the planned investment

The TA activities required to implement the investment include:

- International tendering for contractors to deliver the water supply works. Works delivery would likely be via design and build (D&B) contracts or even DBO (design, build, operate) contracts for a limited time period to help with local capacity building.
- Provision of a supervisory engineer(s), one for the dam, perhaps another for the piping activities which include review of designs and monitoring of progress.
- Institutional Development to assure that the infrastructure being delivered will be maintained and is financially sustainable and that there is sufficient emphasis on local capacity building.
- Public Education as to what is being provided and why.

SAFEGUARDS AND ELIGIBILITY

Environmental and Social issues, recommended ESIA needs

A screening of environmental and social aspects will be performed at the pre-feasibility stage; the environmental and social safeguards that may become relevant are listed below:

Assessment and management of environmental and social impacts and risks	Y	Involuntary resettlement	Y
Pollution prevention and abatement	Y	Rights and interests of vulnerable groups	Y
Biodiversity and ecosystems	Y	Labour standards	Y
Climate-related standards	Y	Occupational and public health, safety and security	Y
Cultural heritage	N	Stakeholder engagement	Y

Eligibility: Alignment with Paris Agreement

N/A

Eligibility: Alignment with EU Taxonomy

N/A

Eligibility: Clean Oceans Initiative	N/A

Relevant Sustainable Development Goals (SDGs) and indicators

Goals and targets	Indicators
Goal 3. Ensure healthy lives and promote well-being for all at all ages	
3.3 By 2030, end the epidemics of AIDS, tuberculosis, malaria and neglected tropical diseases and combat hepatitis, water-borne diseases and other communicable diseases	3.3.3 Malaria incidence per 1,000 population
	3.3.4 Hepatitis B incidence per 100,000 population
The project will provide: Reliant and regular supply and treatment of water for Dili. This will lessen water-borne diseases as well as pathogenic sources often in untreated wastewater.	
Goal 6. Ensure availability and sustainable management of water and sanitation for all	
6.3 By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally	6.3.2 Proportion of bodies of water with good ambient water quality
6.6 By 2020, protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes	6.6.1 Change in the extent of water-related ecosystems over time
The proposed downstream upgrade/rehabilitation of the water treatment plants proposed downstream of the dam will deliver a disinfected water to the people of Dili as well as provide water supply insurance.	
Goal 7. Ensure access to affordable, reliable, sustainable and modern energy for all	
7.2 By 2030, increase substantially the share of renewable energy in the global energy mix	7.2.1 Renewable energy share in the total final energy consumption
The hydropower plant, although small, will contribute inexpensive energy to the mix available for the residents of Dili.	