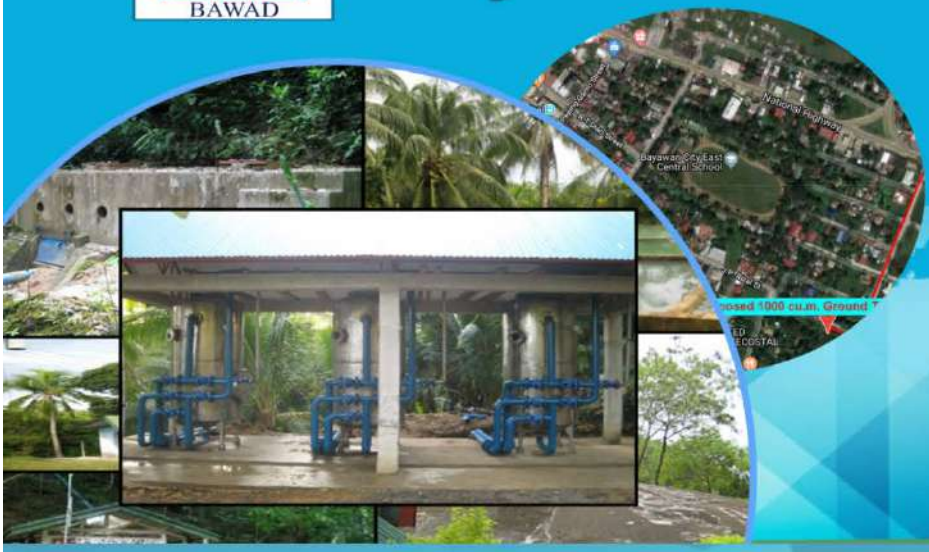
Bayawan Water District



WATER SUPPLY CONCEPTUAL DESIGN

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

I. THE PROJECT AREA AND NEED FOR THE PROJECT

1. Background

According to the WHO/UNICEF 2017, 2.1 billion people lack access to safely managed drinking water services. At least 1.8 billion people worldwide are estimated to drink water that is not protected against contamination from faeces. An even greater number drink water, which is delivered through a system without adequate protection against sanitary hazards.

Data from the UNICEF-WHO Joint monitoring Programme indicate that the Philippines with a population of more than 94 Million in 2011, 7.5 Million Filipinos has no access to improved water supply facilities and 24 million without access to improved sanitation. Roughly 8.3 million people still defecate in the open and just 3% are connected to centralized sewerage systems. The water and sanitation is not given a high priority on the national government agenda and annual allocations are inadequate to improve and expand access to services for the underserved poor. Only the urban water supply sub-sector enjoys a near-adequate level of funding. The inequalities in access to improved sanitation, as compared to only 27% the poorest quintile; and for water supply, 69% of the richest quintile enjoys piped house connections, while only 4% of the poorest quintile does. For other improved water sources the richest have near universal access, and the poorest quintile remains at 66%.

The Philippines is set to meet its Millennium Development Goal (MDG) targets for water supply and sanitation in 2025. The obstacles to achieving universal, sustainable access to improved water supply and sanitation services are primarily institutional and financial in nature.

2. Profile of the Project Area

a. Location

Bayawan, officially the **City of Bayawan**, or simply **Bayawan City**, is a 2nd class city in the province of Negros Oriental, Philippines. It is located 101 km south of Dumaguete city. Mabinay bounds it to the northeast, Santa Catalina to the east, Tanjay City to the southeast, Basay to the west, and it also shares a ,boundary with Kabankalan City of Negros Occidental on the northwest. The coastline is 15 km west to east, with 7 coastal barangays and 21 hinterland barangays. **Figure 1** shows the administrative and location map of Bayawan.

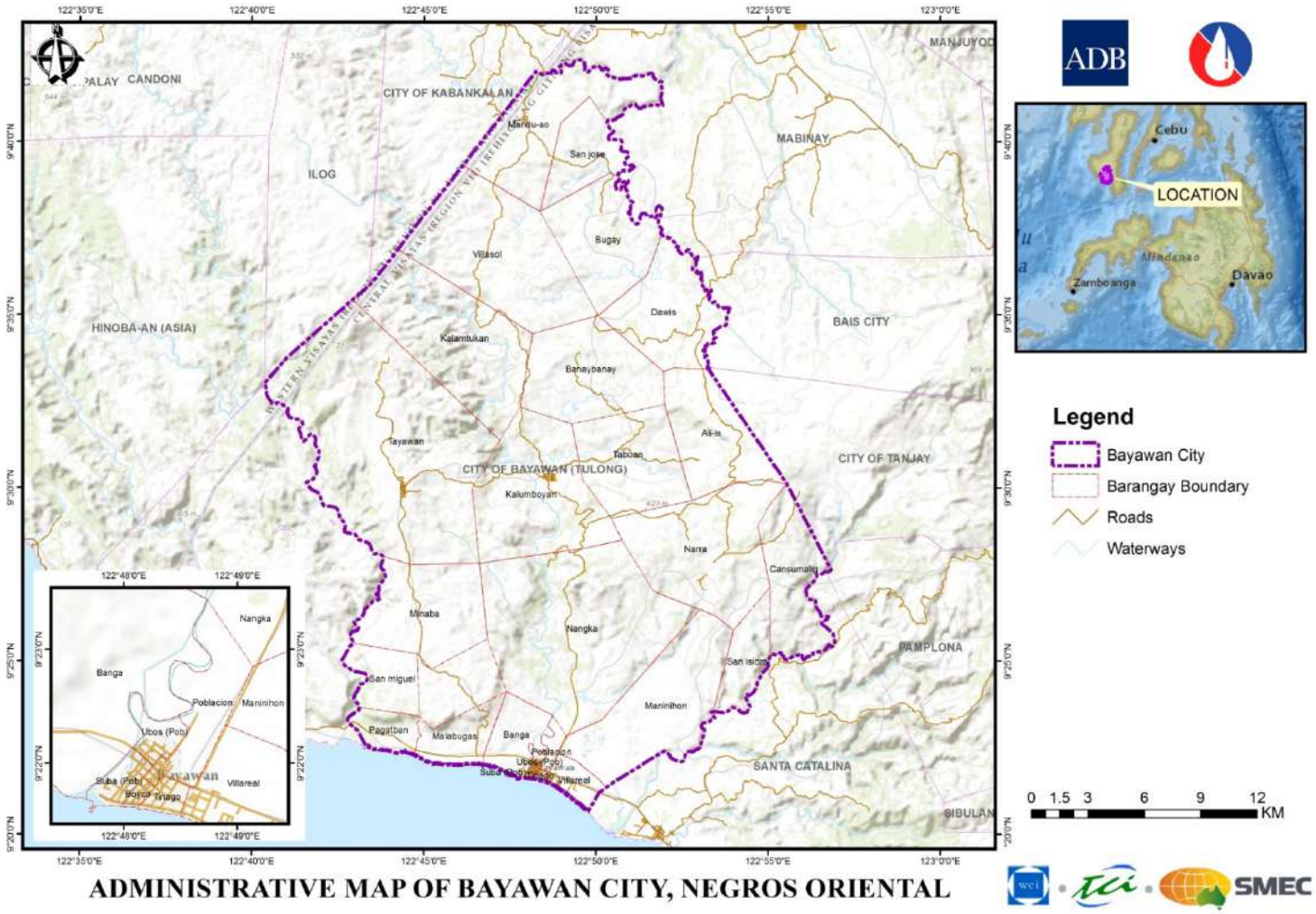


Figure 1
Bayawan City Administrative Map

b. Land Area

Bayawan City has a land area of 699.08 km², one of the largest in the Visayas. This accounts for 13% of the province's land area.

Bayawan City is subdivided into three development zones:

- The **urban area** constitutes only 2.3% (15.73 km²) of the city's total area and contains the main institutional, commercial and central business district of the city.

- The **sub-urban area** is about 14.7% (102.6 km²) of the total area and is set to contain the agro-industrial zones, industrial zones and human settlements. The existing industrial activity (sugar mills), the establishment of tourism zones , and the identified industrial zones in the area show the natural pattern of development. Residential zones are considered in the sub-urban area to provide settlements for the people in the commercial center and in the industrial zones.

- The **rural area** accounts for 83.1% of the total land area and is basically agricultural. However, some barangays are identified to contain a high level of commerce, trade and agro-processing industry being the economic growth nodes of the city. These growth nodes are singled out due to their strategic geographic location while other rural barangays are mainly agricultural production areas.

c. Number of Barangays and its Population

It is composed of twenty-eight (28) barangays with a total land area of 69,908 hectares, the largest in the province. Bayawan accounts for 13% of the province's total land area which is twice the size of the whole Siquijor Province (Island). It has a population of 114,074 with an average annual growth rate of 1.14%.

d. Local Economy (Income and Expenditures, Power, Development Thrust)

The major economic activity in the city is farming and fishing. This complements with the key landscape of the city which is agriculture and the approximated 15 kilometer coastline which is rich in coastal resources. Trade and industry are closely related to the two major sources of economic activities.

The development direction and guiding vision of the City of Bayawan is to make it as agri-industrial center and learning hub for environmental best-practices. Practically, most programs and thrust of the City Government is towards this mind set of the Bayawanon officials and constituency. The city although still in her early state of city hood takes the lead in the socio- political and economic development in the third district of Negros Oriental. It is identified as a major growth node for the Province of Negros Oriental.

According to the City Social Welfare and Development Office (CSWDO) of Bayawan City, 72.64% of the total population are poor. People are considered indigents/poor when income is below PhP7,890.00 per month as presented in **Table 1**. **Table 2** shows the income distribution by income group and by region.

Table 1
Income Classes in the Income Distribution, Income Thresholds and Sizes of Income Classes, 2012

Income Class	Definition	Range of Monthly Family Income (for a Family Size of 5 Members)	Size of Class (i.e. Number of Households)
Poor	Per Capita income less than official poverty threshold	Less than PhP7,890 per month	4.2 Million
Low Income (but not poor)	Per capita income between the poverty line and twice the poverty line	Between PhP7,890 to PhP15,780 per month	7.1 Million

Table 2
Income Distribution by Income Group and by Region, 2012

Region/Group	Poor	Low income but not poor	Lower Middle income	Middle Income	Upper Middle Income	Hign Income (but not rich)	Rich
Region VII Central Visayas	9.6	7.3	7.1	5.6	6.1	6.2	4.4

Note: Author's calculations on data sourced from 2012 Family Income and Expenditure Survey (FIES), Philippine Statistics Authority

Table 3
Income and Expenditure

Region/Group Income Class	Income		Expenditure	
	Total (in Millions)	Average (in Thousands)	Total (in Millions)	Average (in Thousands)
Region VII Central Visayas	329,415	209	258,635	164
Under 40,000	2,738	29	3,049	32
40,000-59,999	6,961	50	7,403	53
60,000-99,999	25,802	79	24,940	77
100,000-249,999	97,920	159	84,919	138
250,000 and over	195,994	487	138,324	344

3. Need for the Project and Scope

The Metro Bayawan Concept which is to unite the two Municipalities (Basay and Sta. Catalina) and one City (Bayawan City) for accelerated economic growth. The Replacement of old NAWASA Pipeline, Expanded Treatment Plant, Purchase of Pumps and Pipelaying is to augment the supply capacity and coverage of Bayawan Water District up to year 2022, capable of serving 10,000 connections with an estimated Population served of 50,000 capita.

Project I

Regarding **Project A**, we proposed to develop a new spring source and Water treatment located in Manampa, Pagatban Bayawan City to increase our water supply capacity.

Regarding **Project B**, we proposed for a Pipelaying of 9.6 km transmission Pipeline and 14.45 km distribution Pipeline, located in Bayawan service area and a portion going to the next Municipality of Sta. Catalina to expand our coverage and carrying capacity.

Regarding **Project C**, we proposed to purchase a Submersible Pump assembly with appurtenances to be used in our newly drilled well in Upper Cambulo, Malabugas, Bayawan City.

Regarding **Project D**, we proposed to construct three Reservoirs, a 500 cum Concrete Ground Reservoir located in Upper Malabugas, a 1000 cum Steel bolted with P.E. Liner Ground Reservoir located in annex to the BAWAD Office, and another 300 cum Elevated steel tank located in Brgy. Caranoche, Sta Catalina.

Regarding **Project E**, we proposed to purchase a 100 kva, 440V, 3phase brand new Generator to be the alternate power supply for Cambulo Pumping Station, Malabugas, Bayawan City.

Regarding **Project F**, we proposed power line extension.

Regarding **Project G**, we proposed to produce 500 connection materials to the service area.

Project II

A, we proposed to purchase the lot for the 1000 cum Ground Reservoir.

Table 4 presents the summary of project components.

Table 4
Scope of Work

Project Description
A. Source Development
B. Transmission/Distribution Pipelines, Fittings and Appurtenances
C. Pumping Station
D. Storage Facility
E. Generator Set
F. TPower Line Extension
G. Service Connection

II. THE EXISTING WATER DISTRICT OVERVIEW

Figure 2
Bayawan Water District Office

The building is the first home of Bayawan Water District, dedicated to consumers, clients and donors and benefactors.

1. History of Water District Formation

Bayawan Water District is a small water district located 100 km south of Dumaguete City, Negros Oriental Philippines. It has its humble beginnings, from a defunct NAWASA turning into a local Water District by virtue of Presidential Decree No. 198 otherwise known as the Local Water utilities Act of 1973. It was born into a district under SB Resolution No. 79, dated May 26, 1982, by then Honorable Mayor Felix Gudiel,Jr.

By October 4, 1982, it was formally recognized as a water utility and was correspondingly issued a Conditional Certificate of Conformance No. 221; thus, operating under the rules and regulations of PD 198 otherwise known as the Local Water Utilities Act of 1973.

As of September 2018 the district has twenty seven (27) regular personnel and 29 Job Orders serving 7,027 connections at almost 32,255 population. The service area includes the seven urban barangays and four hinterland barangay of Bayawan city. It already extended its service to the neighbouring barangay of Santa Catalina, Barangay Caranoche.

Currently, BAWAD is serving several barangays within the city as shown in **Figure 3**.

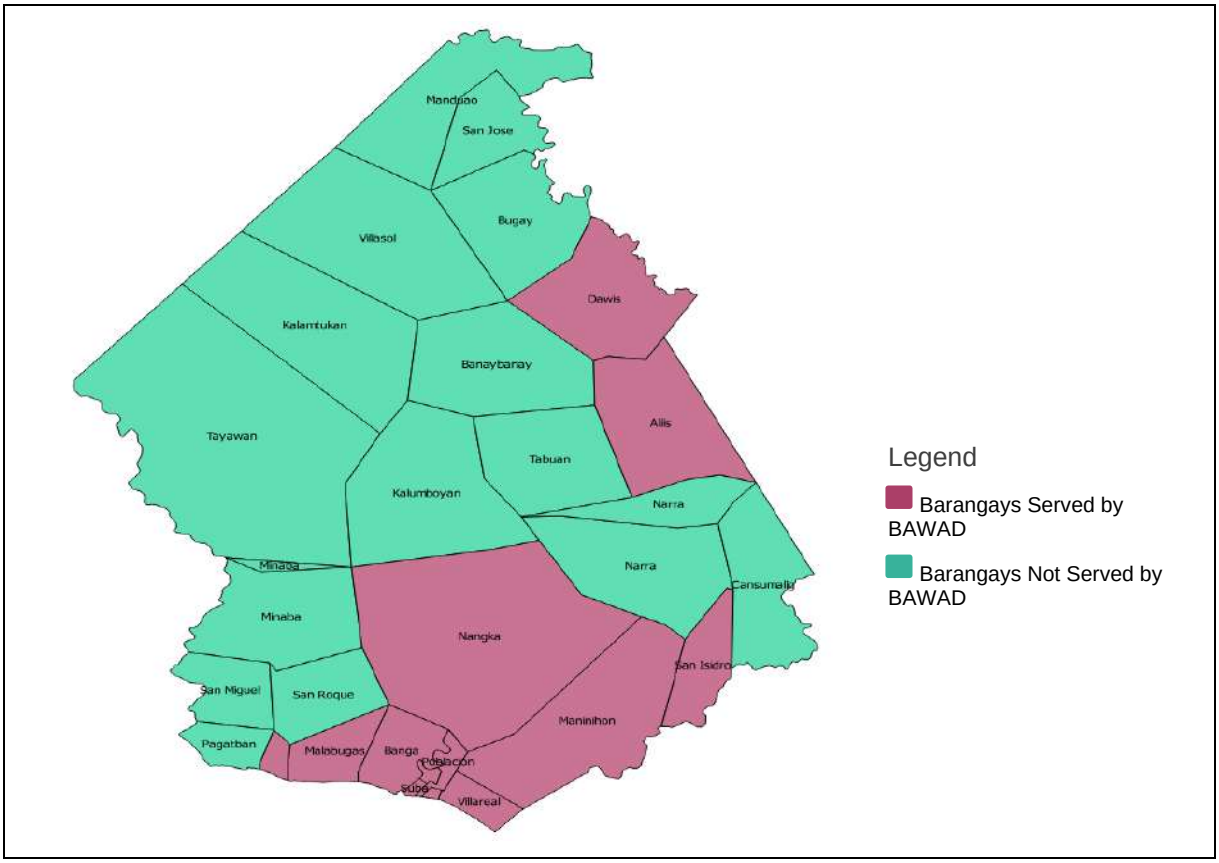


Figure 3
Bayawan Water District Served Barangays

2. Excerpts from Monthly Data Sheet

a. Number of Connections

As of September 2018, the district has 27 permanent personnel and 29 Job Orders serving 7,027 connections or a total of 32,255 served population. The service area includes the seven urban and four hinterland barangays of Bayawan City. BAWAD has extended its services to the neighbouring Municipality of Santa Catalina, Barangay Caranoche.

Table 5
2018 Service Connections

Month	No. of Service Connections
January	6,323
February	6,338
March	6,353
April	6,552
May	6,727
June	6,814
July	6,959
August	6,996
September	7,027

b. Collections

The district has a very high collection efficiency ratio of 96% with on-time payments of 70%.

Table 6
2018 Collection Data

Month	Billing	Collection	On-time Payment	Collection Efficiency (YTD)
January	3,220,426.77	3,265,305.09	71%	83%
February	3,123,906.46	2,981,551.07	61%	89%
March	2,880,854.28	2,979,865.58	71%	94%
April	3,332,694.45	3,222,283.37	71%	95%
May	3,464,966.79	3,463,754.75	74%	96%
June	3,369,852.98	3,239,871.90	70%	96%
July	3,303,379.79	3,315,954.68	72%	96%
August	3,421,525.73	3,309,150.75	69%	96%
September	3,420,417.75	3,295,624.67	66%	96%

c. Income vs. Expenditures

Table 7
Income vs. Expenditures

Month	Revenue Collection (in '000 pesos)	Expenditure
September 2018	44,869,978.72	28,089,442.56

d. Water Tariff

The LWUA Board of Trustees on February 11, 2016 per Board Resolution No. 21 has approved BAWAD tariff as follows:

Table 8
Water Tariff (PhP)

Classification	Size	Minimum Charge	11-20	21-30	31-40	41 and Up
Residential/Government	½"	230.00	28.20	33.90	39.80	45.80
	¾"	368.00	28.20	33.90	39.80	45.80
	1"	736.00	28.20	33.90	39.80	45.80
	1½"	1,840.00	28.20	33.90	39.80	45.80
	2"	4,600.00	28.20	33.90	39.80	45.80
	3"	8,280.00	28.20	33.90	39.80	45.80
	4"	16,560.00	28.20	33.90	39.80	45.80
Commercial/Industrial	½"	460.00	56.40	67.80	79.60	91.60
	¾"	736.00	56.40	67.80	79.60	91.60
	1"	1,472.00	56.40	67.80	79.60	91.60
	1½"	3,680.00	56.40	67.80	79.60	91.60
	2"	9,200.00	56.40	67.80	79.60	91.60
	3"	16,560.00	56.40	67.80	79.60	91.60
	4"	33,120.00	56.40	67.80	79.60	91.60
Semi-Commercial A	½"	402.50	49.35	59.30	69.95	80.15
Semi-Commercial B	½"	345.00	42.30	50.85	59.70	68.70
Semi-Commercial C	½"	287.50	35.25	42.35	49.75	57.25

3. Existing Facilities

Figure 4 presents the BAWAD existing facilities.

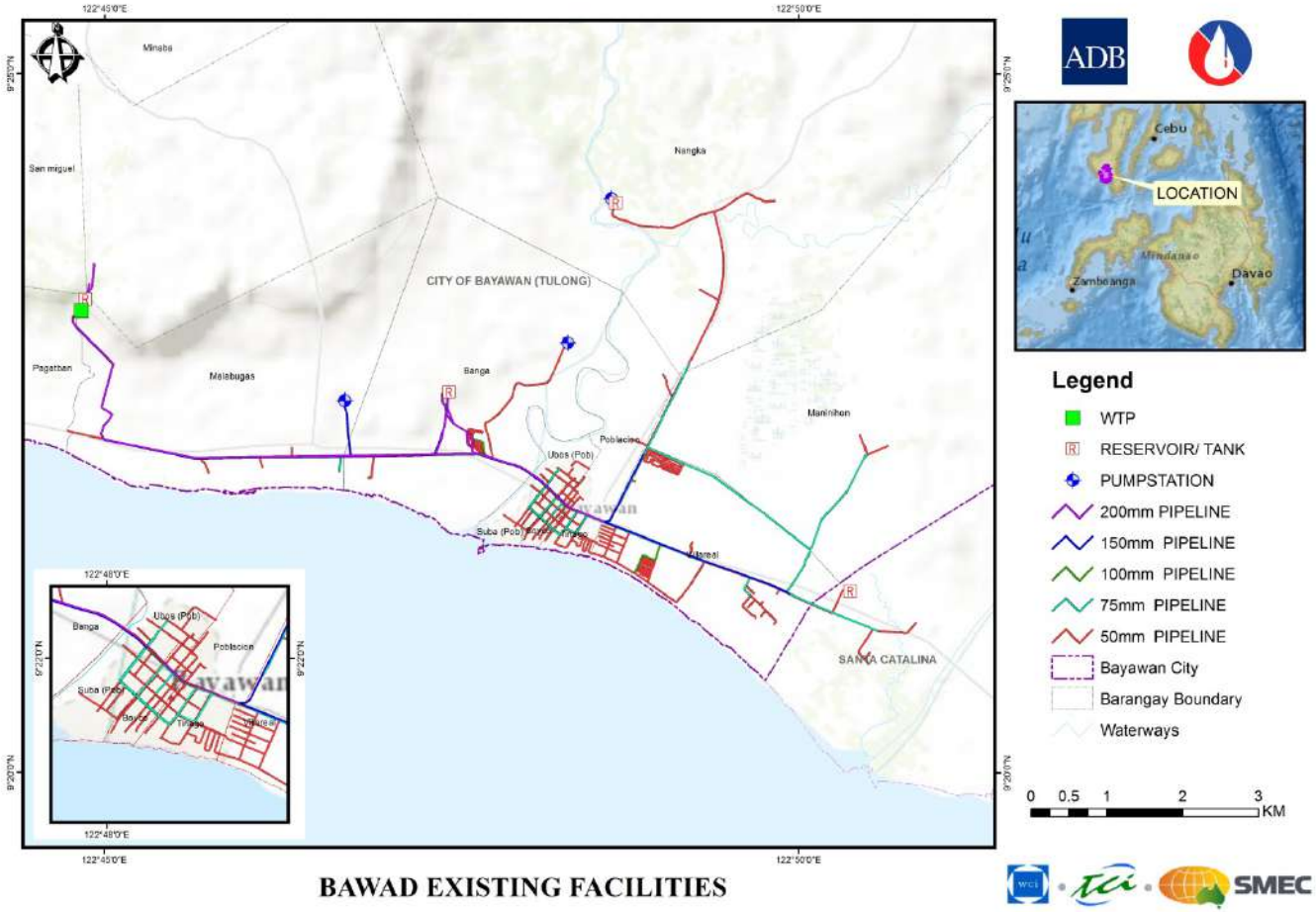


Figure 4
BAWAD Existing Facilities

a. Sources and Production

Figure 5 presents the existing sources of the district. About 70% of the supply in the main services area is from Manampa Water Treatment where Manampa spring 1 and spring 2 is located with a combined capacity of 174 lps. About 30 % of the supply in the main service area is from Cambulo Pumping Station with maximum capacity of 20 lps. All sources in the hinterland particularly San Isidro, Dawis, Aliis and Maninihon are from a dugwells boosted by the submersible pump. We also has deepwell located in Nangka, the Nangka Pumping Station with a capacity of 3 lps serving to this barangay.

Figure 5
Bayawan Water District Sources

b. Treatment Facilities

The District's main water treatment is located in Manampa, Pagatban, Bayawan City. Processes involved are coagulation, flocculation, sedimentation, slow sand Filtration, chlorination and softening. 100% of the water from this area passed the treatment plant. However, only 54 lps passed through the softening stage, hence there is a need to add more softener units to treat 100 percent of water from Manampa source 1 and 2. All other water source has chlorination treatment only. Shown in **Figure 6** are the photos of treatment facilities.

Manampa Sedimentation and Filtration

Manampa Softening Facility

Figure 6
Treatment Facilities

c. Number and Volume of Storage Reservoirs

The district has reinforced dome type ground concrete storage tank constructed during the Japanese colonization, a 400 cum capacity tank which was renovated in 2000 by the Danish International Development Assistance (DANIDA) project. It is located at Sitio Moyao, at elevation 50 meters above mean sea level. Another 30cum Steel ground Reservoir is located in Brgy Nangka from a 3 lps deepwell source, three units of 8 cum reinforced concrete tank in Sitio Kalamunggay, Brgy. Maninihon, Brgy Allis and Brgy Dawis.

400 cum Dome Type Moyao Tank

8 cum Kalamunggay Tank

8 cum Allis Tank

Dawis Tank

Figure 7
Storage Reservoirs

d. Pipe Lengths, Diameters and Materials

Currently, the district has 93.26 kilometers Transmission and Distribution Pipeline, made of Cast Iron (CI), Galvanized Iron (G.I.) , Unplasticized Polyvinyl Chloride (uPVC) and Polyethylene (PE) materials ranging from 50mm to 200mm diameter.

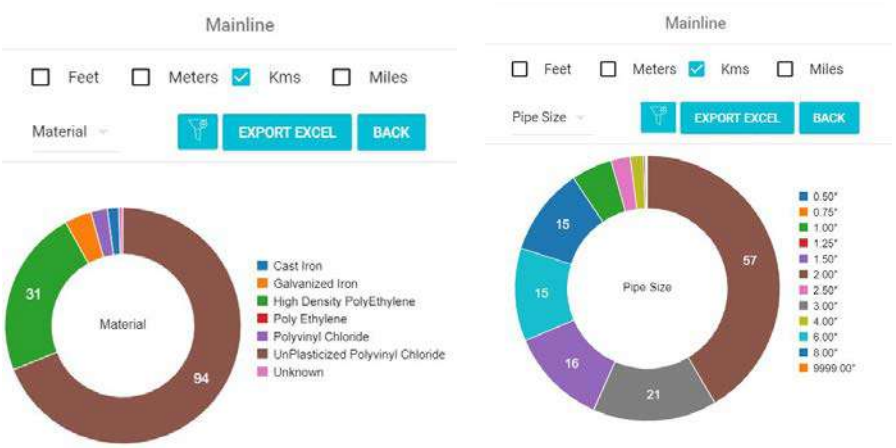


Figure 8
Details of Pipe Lengths, Diameters and Materials

e. Operational Details

The Main System

The catchment in Barangay Pagatban, Bayawan City is 330 hectares of virgin tropical forest, reforested and some agro-forestal land. The Department of Environment and Natural Resources (DENR) declared this as a watershed reserve and currently BAWAD is applying for a Forest land Use Agreement – Tourism (FlagT) on this areas with DENR.

Raw Water from the spring is collected by a spring box, then, monitoring is done for the turbidity and microbial content. It is then transported to the Water Treatment Facility just few hundred meters away, while coagulant and flocculants is injected, conveyed to the Sedimentation tanks where settling and pre-chlorination is done, then goes to the slow sand filtration bays operating in parallel. The filtered water goes to the Clearwater tank for post-chlorination, and inspection for water quality, after which it flows to the 3 units Softener Tanks operating in parallel for softening and transported via transmission pipelines to fill the reservoir 8 kilometers away. The fill and draw mode serve the distribution network in the service area and consumer tap where random Water Quality monitoring is done.

The BAWAD also has a spring source at ground level in the city, though 4 meters deep and is pumped out by centrifugal pumps to boost the supply and pressure especially during peak hours. It is located at Sitio Cambulo, Barangay Malabugas. It is called the Cambulo Pumping Station , 20 lps capacity , water of which is monitored for water quality, chlorinated and transported to the reservoir, inspected for residual chlorine then to the distribution area and for random microbiological testing at the consumer's tap.

Figure 9
BAWAD Main System

These pictures show the (1) Spring box (2) Flocculation, Sedimentation, Filtration (3) Softener tanks (4) Cambulo pumping station (5) 400 cum dome type Reservoir

Nangka Sub-System

Water is pumped from 70 meters below ground level, 3 liters per second capacity, checked for microbial properties, chlorinated and transported to the reservoir and to the distribution and monitored for water quality at the consumer's tap.

Figure 10
Nangka Pumping Station and 30 cum Reservoir

Omod Sub-System

From the spring box sample is taken to monitor its water quality, then pumped and injected with chlorine to the distribution and service tap for monitoring of residual chlorine.

Omod spring box and pumping station.

Figure 11
Omod Sub – System

Ali-is and Dawis Sub-System

From spring boxes, Water is monitored in term of quality, pumped and chlorinated, transported to the reservoir, to the distribution and monitoring is done randomly in consumer's tap for residual chlorine.

Ali-is Spring Box and Reservoir.

Dawis Pumping Station and Reservoir

Figure 12
Ali-is and Dawis – System

The BAWAD and the Rural Health Unit (RHU) of the City are in partnership to monitor water use and quality. The Barangay Health Workers (BHWs) are the frontliners of the water service to its consumers. They are called the Water Quality Service Surveillance Group (WQSSG), a unique community of health awareness practitioners in partnership with BAWAD. A monthly coordination meeting is done, every 16th of the month, to fully discuss observations, issues raised by clients and non-clients, and the daily walk-thru of the Barangay Health workers (BHW) within each service barangay. Sometimes, a client satisfaction survey is also conducted by these partners for strategic planning to address any water quality and quantity issues.

Parallel to the efforts of the Barangay Health Workers (BHW) , BAWAD also has an internal well-equipped laboratory where water testings are done for operational purposes to maintain water quality supplied to the concessionaires.

Likewise, it is also part of the water quality monitoring of BAWAD to regularly check residual chlorine so as to regulate dosage of same. A physico - chemical test for raw water sources and product water, as mandated under the 2016 Philippine Standards for Drinking Water (PNSDW), is also an ongoing activity. **Table 9** shows the average residual chlorine obtained from 2017-2018.

Table 9
Average Residual Chlorine for a 12 Month Period

Year	Monthly	Average Monthly (ppm)
2017	November	0.95
2017	December	0.60
2018	January	0.78
2018	February	0.88
2018	March	0.85
2018	April	1.52
2018	May	1.32
2018	June	1.22
2018	July	0.66
2018	August	1.62
2018	September	1.80
2018	October	1.29
Average		**1.12**

There is also a periodic sampling and testing for other physical and chemical properties of the source to check if water quality has changed or deteriorated with time.

The Non-Revenue Water

Leak survey is regularly conducted especially when water supply drops at peak hours. Production and billed water of BAWAD is constantly monitored and from thereon, leak survey must be conducted. The survey is done at night-time, when minimum activity occurs. Isolation valves are closed one by one while at the same time, discharge at the tank is measured.

Leak test is conducted from 10:00 PM until 4:00 AM. Results are encoded in the computer and outputs such as graphs and diagrams can be analyzed. Leaks are then verified in the field and proper repair is made.

The whole pipe network has 22 fire hydrants and blow-off locations. It is properly operated to wash out accumulated sediments or relieve pressure build-up when the pressure reducing valve malfunctions.

In 2016, BAWAD partnered with MAYNILAD to mitigate Non Revenue Water . A master plan is being made to establish District Monitoring Areas (DMAs). One ongoing activity is measuring flows at strategic locations in the service areas after procurement of flow measuring devices.

Meter Reading and Billing

At the first day of the month until the 11th, water meters are read from Zone 1 to Zone 11. Water consumption is measured against the production meter. Every concessionaire's bill will become due after 15 days from the reading date. A 10% penalty is imposed on unpaid bills after due date. Disconnection is effected at 2 months unpaid water bills.

f. Billing vs Production

Table 10
Billing vs Production (cum)

Billing	Production
2018	
911,704	1,121,660
2017	
1,095,996	1,404,882

g. Deficiencies of the Existing System

The current system cannot meet the increasing water demand in the coming years. The district has 55 lps maximum capacity as of the moment. With the vision of the management to attain 10,000 connections in 2022 and with the advent of the Metro Bayawan concept recently signed by the three local chief executive of the municipalities of Basay, Santa Catalina and Bayawan City without improvement in the current system, the district will be left behind in the development of Metro Bayawan City. Water treatment in Manampa is operating on overload status, the treatment design is 25lps, and it is now operating beyond its original design capacity.

In terms of water storage, the district has one 400 cubic meter capacity reservoir, with the target connection of 10,000 we will be needing a minimum of 1,500 cubic meter storage capacity as a rule of thumb. Current pipe diameter of transmission pipeline is not also capable of delivering required flow for the water demand of ten thousand connections.

4. Service Level Benchmark

Bayawan Water District is among the recipients of the "TOP PERFORMER IN THE PHILIPPINES 2008" under the average category.

The award is given to water districts in the country in the financial and operational parameters. The award was given during the National Annual Convention of PAWD on February 7, 2008.

Bayawan Water District is an awardee of Civil Service Commission "LINGKOD BAYANI AWARD - BRIGADA AHENSYA CATEGORY A (5S Principle)" in Years 2016, 2017 & 2018.

Recently, the district received the Big Brother Award from LWUA-WD Forum and Awards 2018, and a nominee in the Outstanding Water District.

III. DESIGN CRITERIA/BASIS

1. Design Horizon

Proposed Design must conform with LWUA, PNSDW standards and other governing Philippine Law but within the parameters stated by the end user in the Approved Program of Works/Concept Design.

2. Various Methods of Population Projection

Statistical methods of Population projection shall be used based on historical data from government agency involved in the locality.

3. Rate of Water Supply

To maximize the carrying capacity of the pipe size indicated in the approved Program of Works (POW), also for the water treatment design, 90 liters per second maximum flow rate must be considered. The pump functional specifications will be based on the well driller's recommendation.

For transmission and distribution pipeline, flow rate will be maximized based on pipe sizes indicated in the approved Program of Work/Concept Design.

4. Availability of Bid Docs

BAWAD shall prepare the bidding documents and will post same to PHILGEPS within a maximum of 3 months (90 calendar days) posting. After which at the commencement of the 3 months period, opening of bids will be done.

5. Life of Civil/Mechanical/Electrical Items

Ten years

6. Material of Construction for various Components

Should be of Good Quality and pass the LWUA Standards

7. Peak Factor

2.0

8. Selection of Pump Set

Pumps and appurtenances must be of good quality and passed prescribed standards and specifications, most favourable to the government and end user, with good after sales services and spare parts are readily available in the market.

9. Number of Pumps and Hours of Working

One pump running without spare and capable of running 24/7 for worst case scenario.

10. Capacity of Storage Reservoir

1 unit 500 cum capacity Reinforced Ground Concrete Tank

1 unit 1000 cum Capacity Ground Steel bolted tank with P.E. liner and discharge booster pump

1 unit 300 cum Capacity Elevated Steel tank

11. Selection of Pipe Materials

Should be of Good Quality and passed the LWUA Standards

12. Minimum Diameter

Pipe diameter as indicated in the approved Program of Work/ Concept Design

13. Reservoir Height

Maximum tank height is 4 meters.

14. Hydraulic Design Formula

Darcy–Weisbach and use Darcy friction factor for pipe flow

15. Velocity

The maximum velocity should not be more than 3.0 m/sec for distribution lines and transmission lines

16. Selection of Valves and Basis of Providing Isolation/Air/Scour Valves

All valves with 10 year warranty, AVK valves are highly recommended due to good performance.

IV. POPULATION AND WATER DEMAND PROJECTIONS

1. Assumptions Used (Design Year, Per Capita Consumption, Peaking Factors)

13 year design consideration, 0.120 cum per capita consumption, peak factor of 2.0

2. Service Area and Projected Served Population

Bayawan City existing service area, Barangays Caranoche and Poblacion Santa Catalina

3. Water Demand

Table 11
Water Demand

GENERAL DATA :	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Total Active Connections	5,794	6,494	9,194	10,694	11,694	11,994	12,294	12,594	12,894	13,194	13,494	13,794	14,094	14,394
Mid-Year Connections	5,429	6,144	7,844	9,944	11,194	11,844	12,144	12,444	12,744	13,044	13,344	13,644	13,944	14,244
Market Grow th/Year	700	2,700	1,500	1,000	300	300	300	300	300	300	300	300	300	300
Service Area Population	56,736	70,321	71,727	73,162	74,625	76,118	77,640	79,193	80,777	82,392	84,040	85,721	87,435	89,184
% Population Served	51%	46%	64%	73%	78%	79%	79%	80%	80%	80%	80%	80%	81%	81%
Cons./Conn./Mo. (Cu.M.)	18	18	18	20	20	20	20	20	20	20	20	20	20	20
Billed Water ('000 Cu.M.)	1031	1,327	1,694	2,387	2,687	2,843	2,915	2,987	3,059	3,131	3,203	3,275	3,347	3,419
Non-Revenue Water	24%	24%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Production ('000 Cu.M.)	1,404	1,746	2,118	2,983	3,358	3,554	3,643	3,733	3,823	3,913	4,003	4,093	4,183	4,273
Effective Rate/Cu.M.	28.48	28.48	28.48	28.48	28.48	28.48	28.48	28.48	28.48	28.48	28.48	28.48	28.48	28.48
% Rate Increase	16%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Collection Efficiency	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%

Water Demand Management Analysis and Sales Forecast

The consumption pattern per connection over the years shows a stationary trend or behavior. At the outset and from the point of view of climate change, this can be favorable. However, this stationary trend may not be advantageous to the district for it will limit its potential growth. The disturbing level of the NRW which was caused by the Calamity in the Year 2013, greatly affects the revenue generation of the district. With the continued efforts of the district to reduce the NRW to its minimum level and with the availment of Financial Assistance of PhP100M from LWUA, it is possible to increase the water consumption per connection, thus, resulting to an increase in Water sales and a reduced NRW to 20%.

Table 12
Sales Forecast in 10 Years

Year	Total Sales (PhP in Million)
2018	37,043
2019	47,292
2020	66,615
2021	74,989
2022	79,343
2023	81,353
2024	83,362
2025	85,372
2026	87,382
2027	89,391

Table 13
NRW Forecast

Year	NRW
2018	24%
2019	20%
2020	20%
2021	20%
2022	20%
2023	20%
2024	20%
2025	20%
2026	20%
2027	20%

V. FIELD STUDY / INVESTIGATION

1. Data collection

Field data will be collected by designer, (not available in the office).

2. Water Quality Analysis at Source and Distribution System

Table 14
2018 Water Quality of BAWAD Water Sources – Raw Water

2018 WATER QUALITY OF BAWAD WATER SOURCES - RAW WATER					
Parameters	BAWAD WATER SOURCE				
	Manampa	Cambulo	Ayum	Dawis	Ali-is
MICROBIOLOGICAL TEST					
1. Total Coliform				>8.0	
2. Fecal Coliform				<1.1	
3. HPC				73	
PHYSICAL-CHEMICAL ANALYSIS					
Color	1 CU	4 CU	1 CU	7 CU	3 CU
Arsenic	<0.001 ppm	<0.001 ppm	<0.001 ppm	<0.001 ppm	<0.001 ppm
Lead	<0.0027 ppm	<0.003 ppm	<0.003 ppm	<0.003 ppm	<0.003 ppm
Cadmium	<0.003 ppm	<0.001 ppm	<0.001 ppm	<0.001 ppm	<0.001 ppm
Chloride	14.71 ppm	<0.01 ppm	.94 ppm	<0.01 ppm	<0.01 ppm
Manganese	<0.002 ppm				
Sulfate	1.54 ppm				
Turbidity	0.1 NTU	.05 NTU	.05 NTU	.05 NTU	.05 NTU
pH	6.61	7.26	7.19	6.86	7.02
Nitrate	<0.01 ppm	<0.01 ppm	<0.01 ppm	<0.01 ppm	<0.01 ppm
Iron	0.04 ppm				
Total Dissolved Solids (TDS)	366 ppm	382 ppm	260 ppm	206 ppm	228 ppm

Table 15
2017 Water Quality Monitoring – Consumer's Tap

2017 WATER QUALITY MONITORING @ CONSUMER'S TAP			
Parameters	# of Sample taken	Passed	Failed
BACTERIOLOGICAL TEST			
January	6	6	0
February	6	6	0
March	6	6	0
April	10	10	0
May	6	6	0
June	8	8	0
July	8	8	0
August	8	8	0
September	8	8	0
October	8	8	0
November	8	8	0
December	8	8	0
Total	**90**	**90**	**0**
CHLORINE RESIDUAL			
January	89	89	0
February	83	83	0
March	76	76	0
April	56	56	0
May	74	74	0
June	80	80	0
July	56	56	0
August	50	50	0
September	27	27	0
October	30	30	0
November	26	26	0
December	77	77	0
Total	**724**	**724**	**0**

3. Structural Stability of Structures (Sump cum Pumphouse, OHT)

Structural details must be signed by a license Civil Engineer or Structural engineer.

4. Pipe Condition Assessment

The system has the old NAWASA Pipeline installed in 1940's to 70's which was not condemned during the year 2000 DANIDA Comprehensive Improvement Project (CIP). Below are just few examples;

Old Cast Iron NAWASA Pipeline location

Old Galvanized Iron NAWASA Pipeline location

Figure 13
Old Pipeline Locations

5. NRW Study

Based on the available Data below is this year's BAWAD Non Revenue Water (NRW).

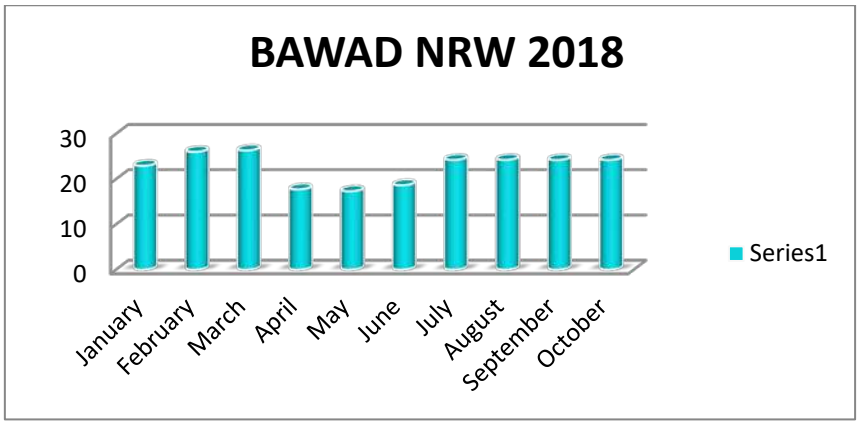


Figure 14
BAWAD NRW 2018

6. Topographical survey

Topographical survey on the existing Transmission and distribution pipeline is available in the office.

7. Trail Pits

No available data

8. Geotechnical Analysis

No available data

9. Resettlement Issues

a. There are no resettlement issues connected with project. Two of the lots for the smaller reservoirs will be acquired via donation from Cong. Arne Teves and a 800 sqm lot will be purchased from a private owner (Don Gaspar Vicente Inc, within the town proper for the 1,000 cum steel bolted reservoir.
b. As far as the transmission pipes are concerned, road widening is not an issue since the pipes are to be buried below ground level and shall be imbedded at the road pavement in case of road widening.
c. In the case of the new well to be drilled, it shall be done at the lot owned by the WD located at Upper Cambulo, Malabugas, Bayawan City just a few meters away from the existing Cambulo pumping station control house. Drilling has been completed and based on the electric logging results, there is a good potential of good water source.
d. For the replacement of the old NAWASA pipes, location is within the city proper. Only a portion of these pipelines will be replaced through this project, the Zamora-Gamboa-Valenzuela-Rizal Street to the location of the proposed 1,000 cum ground reservoir with a length of 1,800 lineal meters.
e. As far as the new submersible pump and appurtenances are concerned, this will be for the newly constructed well in Upper Cambulo, Malabugas and not for replacement of any pump.

VI. ALTERNATIVE ANALYSIS

In an alternative analysis, as we know it, usually several alternatives are given, and then analysed. For BAWAD, the project components are basically requested by the Water District which LWUA verifies in the field, and if found technically feasible, a Program of Work (POW) is immediately prepared. The POW is already the result of a final Concept (as envisioned/requested by the WD and verified/approved by LWUA), and eventually designed and to be implemented Thus, after verifying the existing system, taking note of its deficiencies, and assessing the project request of the WD, LWUA went directly to the Recommended Plan, and described and cost it.

1. Water Sources (Quality/Quantity) (Surface / Subsurface/Groundwater/Desalination – Nearby / Distance Source)

Table 16
Water Sources

SOURCE	SOURCE CAPACITY	UTILIZED	*YEAR*									
			2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
	(lps)	*(lps)*	*(lps)*	*(lps)*	*(lps)*	*(lps)*	*(lps)*	*(lps)*	*(lps)*	*(lps)*	*(lps)*	*(lps)*
Existing Source:												
Manampa Spring 1	54	54	54	54	54	54	54	54	54	54	54	54
Cambulo Pumping Station	15	15	15	15	*Reserved*	*Reserved*	*Reserved*	*Reserved*	*Reserved*	*Reserved*	*Reserved*	*Reserved*
Nangka Pumping Station	3	3	3	*Reserved*	*Reserved*	*Reserved*	*Reserved*	*Reserved*	*Reserved*	*Reserved*	*Reserved*	*Reserved*
Omod Pumping Station	3	3	3	3	3	3	3	3	3	3	3	3
Aliis Pumping Station	5	5	5	5	5	5	5	5	5	5	5	5
Dawis Pumping Station	3	3	3	3	3	3	3	3	3	3	3	3
New Source:												
Manampa Spring 2	80	50		50	50	50	50	50	50	50	50	50
Buli-buli Pumping Station	30	30		30	*Reserved*	*Reserved*	*Reserved*	*Reserved*	*Reserved*	*Reserved*	*Reserved*	*Reserved*
Camandagan Pumping Station	5	5		5	*Reserved*	*Reserved*	*Reserved*	*Reserved*	*Reserved*	*Reserved*	*Reserved*	*Reserved*
Tagubang Spring	100	100			100	100	100	100	100	100	100	100
Dawis Spring # 2	30	10			10	10	10	10	10	10	10	10
San Jose Pumping	80	10			10	10	10	10	10	10	10	10
Narra Proper Spring Source	50	-										
Ohot Narra Spring Source	80	-										
TOTAL SOURCE CAPACITY(lps)	538	288	83	165	235	235	235	235	235	235	235	235

2. Transmission Main / Feeder Main (Alternative Alignment and Optimization)

The District has an available As-built lay-out of the pipeline if needed.

3. Disinfection System at OHTs

Disinfection is done right after the discharge of the Water treatment facility at Manampa, Pagatban and Cambulo Pumping Station at Cambulo Malabugas. So far, there's no need for an additional chlorine dosing.

4. Water Treatment (Alternative Technologies)

The district has an existing slow sand filter, thus we proposed for new Fast Filtration Units without power supply for ease of operation and maintenance. Other technologies that can offer the same or better for the district are also acceptable.

5. Distribution System Facilities (With DMA Concept)

As objective of our existing BAWAD & MAYNILAD twinning partnership, District Monitoring Areas (DMAs) concept will be the direction of the program. A hydraulic model is already developed for BAWAD by MAYNILAD.

6. House Service Connection (With AMR Meters (Mechanical /Ultrasonic /Volumetric/Electromagnetic)

District's standard connection materials are as follows;

a.	Saddle clamp	1 pc
b.	Compression male adaptor, ISO	4 pc
c.	P.E. Tubing, ½" dia, ISO	6 m
d.	G.I. Elbow ½" x 90º	4 pc
e.	G.I. Nipple, sched 40, ½" x 10"	2 pc
f.	G.I. Nipple, sched 40, ½" x 20"	1 pc
g.	G.I. Reducer elbow, ¾" x ½", 90º	1 pc
h.	½" mechanical water meter, class B w/ tailpiece	1 pc
i.	Brass ball valve, bibb, w/ lockwing, ½"	1 pc
j.	Brass faucet, ½" hose bibb	1 pc
k.	Teflon tape, ½"	2 pc

7. SCADA System

The district has an updated digitized as built plan of the system, a working Geographic Information System or GIS link to our billing system, as preparation for SCADA system.

VII. RECOMMENDED IMPROVEMENTS (Refer to Annex 6 for the Recommended Plan)

1. Facilities and Costs

Program of Work

Replacement of old NAWASA Pipelines, Expanded Treatment Plant
Purchase of pumps and Pipelaying

I. ENGINEERING BASIC COST ITEMS

A. Source Development

Description	Unit	Quantity
Spring Box and Pipe Trust blocks Construction	LS	1
Supply, Installation and Commissioning of water softener	unit	10
Supply, Installation of Sand filters	unit	3

B. Transmission / Distribution Pipelines, fittings & Appurtenances

350 mm uPVC Transmission pipeline *(spring box 2 to water treatment)*	lm	600
200 mm uPVC Transmission pipeline *(Villareal to Santa Catalina)*	lm	4,200
200 mm G.I./Steel Bridge crossing *(Pagtigaon & Sicopong Santa Catalina)*	LS	1
200 mm uPVC Transmission pipeline *(Cansilong - La Vista)*	lm	3,400
200 mm uPVC Transmission pipeline *(BAWAD warehouse to Hiway Lamis)*	lm	400
150 mm uPVC Transmission pipeline *(Cambulo P.S. - Upper Malabugas)*	lm	1,400
150 mm uPVC Transmission pipeline *(Zamora St.-Gamboa-Rizal St to BAWAD)*	lm	1,800
150 mm uPVC Transmission pipeline *(Bollos St - Hiway San Ramon)*	lm	600
75 mm uPVC Distribution pipeline *(Back of DUEKSAM to San Ramon road, back in ACE med relocation site, URC Road and gemilina interior)*	lm	2,850
75 mm uPVC Distribution pipeline *(Hiway to breakwater interior)*	lm	1,000
50 mm uPVC Distribution pipeline *(Brgy Bugay and San Jose expansion)*	lm	5,500
50 mm uPVC Distribution pipeline *(Hiway to bless subdivision)*	lm	2,300
Pavement Demolition 200 mmm	sq. m.	1,020
Pavement restoration	cu m	255
Gatevalve 200 mm	pc	2

	Gatevalve 150 mm	pc	2
	Gatevalve 350 mm	pc	1
C. Malabugas)	**Pumping Station(sitio upper cambulo**		
	Malabugas		
	1. Pump house (5m x5m)	sq. m.	25
	2. Electro-mechanical		
	Submersible Pump/Motor, Control & Appurtenances	L. S.	1
	Fittings and other appurtenances	L. S.	1
	3. Site Development (Fencing and Gate)	L. S.	1
D. Storage Facility			
	1. Construction of 500 cum Ground concrete Reservoir for upper Malabugas	cu m	500
	2. Construction of a steel bolted w/ liner Reservoir 1000 cum at BAWAD Warehouse w/ boosters pumps	cu m	1,000
	3. Construction of an Elevated Steel Tank 300 cum at Brgy Caranoche	cu m	300
E. Generator Set			
	1. Standby Genset 100 kva 440-460 v 3 phase	unit	1
F. Powerline Extension			
	1. Powerline extension/Distribution single phase primary line	unit	1
G	**Service Connection**		
	Service Pipe 20mm (1/2")		
	150 mm	sc	100
	100 mm	sc	100
	75 mm	sc	150
	50 mm	sc	150
		w m	500

Recommended by:

Approved by:

Engr. Reno John S. Tuale
Division Manager - Eng'g, Prod., Maintenance

Alma L. Abrasaldo
General Manager

2. Operation /Maintenance Costs

The additional O & M costs of this project is very minimal which will only include other operation and maintenance expenses.

3. Implementation Schedule

Shown in **Figure 15** is the implementation schedule.

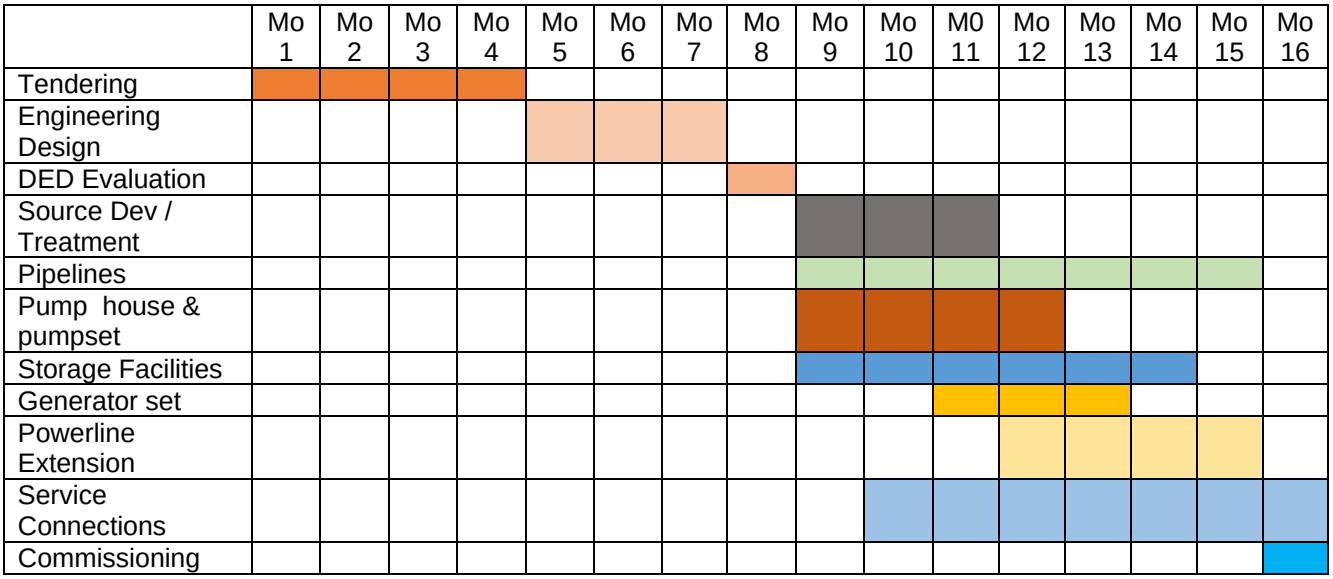


Figure 15
Implementation Schedule

4. Key Performance Indicator after Implementation

a. Improve Availability and Access to Clean Drinking Water

The provision of additional source, expand treatment capacity, improved transmission and distribution pipelines will assure the constituents of Bayawan City and neighboring municipalities within the service area a stable supply of potable water even during wet season and peak hours.

The pipelaying of additional 24.05 kilometers pipelines will bring water to unserved areas which in return will bring additional consumers of 5,000 in the next 5 years of after – project implementation. More people can have access to clean and drinkable water.

b. To Reduce the Waterborne Diseases Caused by Contaminated Water

The construction of additional Water Treatment Facility in Manampa, Pagatban will address the water quality problem of turbidity, calcium hardness and unsafe water in the service area thereby reducing the risk of diarrheal cases. The infusion of 5000 increased house connection will reduce the number of waterborne diseases cases in the community as many families can already have access to clean water. BAWAD in coordination with the City Health Office of Bayawan will provide training on hygiene and water management.

VIII. INSTITUTIONAL ASPECTS

1. Organogram structure (Existing/Proposed)

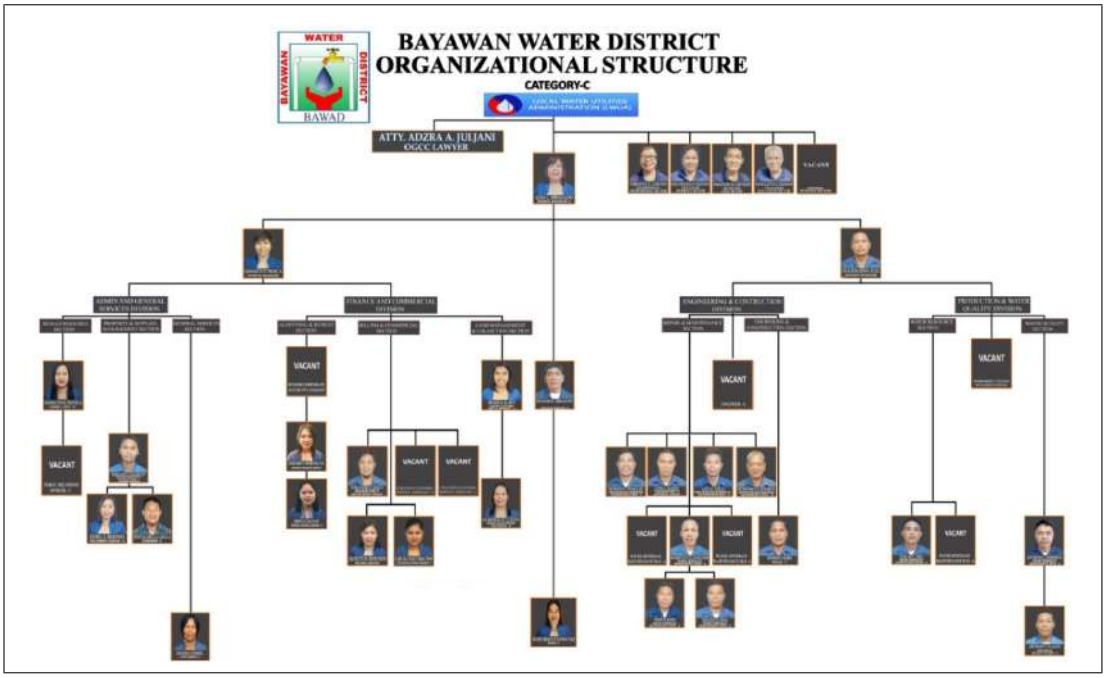


Figure 16
BAWAD Organizational Structure

2. Additional Skilled Staff Required

Due to the expansion of the Water treatment in Manampa, an additional staff will be needed in the area as well as security guards to secure the treatment. Increased in the coverage and number of connections will also mean additional workforce to meet additional work loads. This will involve plumbers, meter readers and other supporting staff.

3. Training Requirements

Bayawan Water District ensures that materials used in this project are all in compliance to material standards set by the Local Water Utilities Administration (LWUA). BAWAD is committed to preserve its assets by aligning itself to the evolving technological advancement. Part of the program is the periodic benchmarking to leading local water companies like for example Metro Cebu Water District and Maynilad. Currently, BAWAD and Maynilad have an on-going “twinning” program thru the Maynilad Water Academy. Maynilad as the trainor and BAWAD as the trainee which covers topics from Operation, Maintenance and planning best Practice. Also, BAWAD key personnel are sent to various National and International Expositions, advance courses on water management, training and require them to echo to the concerned staff. Continuing Professional Development is also provided to its professional staff.

Sustainability of the project is ensured through training of the operators and maintenance personnel prior to their assignment in the area. BAWAD section head in the Maintenance and Operation of the Water district takes all the responsibility over these hinterland areas, thus they are obliged to visit various installation regularly to ensure proper operation of the system.

IX. ENVIRONMENTAL AND SOCIAL ASSESSMENT AND SAFEGUARD MEASURES

1. Flora/Fauna

Based on the initial rapid assessment, the implementation of the project will somehow disturb the environment but not to the extent that will cause undue damage. During this phase, the district will ensure that the environment will be safe and well protected. There will be a regular monitoring of the activity.

2. Air/Noise

During the construction phase, a minimal noise will be generated particularly in the site preparation, but will not greatly affect the community and environment since we will be working only in the day time, civil works is minimal in the project, excavation and pipe laying are done manually thus do not emit so much noise and pollution to the environment.

3. Resettlement

No settler will be affected in the project implementation and operation since area involved are vacant and owned by the district upon purchase.

4. Gender

The Project will greatly help the women particularly the mother who are in charge of fetching water from source to the home. A supply of 24/7 safe and potable water for the family will give them the assurance that they are free from waterborne disease, thus giving them peace of mind. The role of women in the community is emphasized in the Bayawan WD as exemplified by the fact that the GM and one of the two divisions are women.

5. Safeguard Measures (i) Environmental; and (ii) Social

The initial assessment of the natural and social environment showed that there will be no noticeable interference of environment during implementation and operation of the project. Further environmental and social studies will be conducted for the proposed project. An Environmental Management Plan (EMP) will be prepared to manage further impacts to be identified and will be monitored. In general, the Bayawan Water District will make sure that impacts will be managed using mitigation hierarchy. It is planned that there will be regular tree planting and tree growing activities in the Water Production Areas. The water coming from various spring sources particularly comprises 80% of its water production

Curently, BAWAD is only serving 33% of the total population of Bayawan City. With the introduction of the Water project re: Replacement of old NAWASA Pipeline, Expanded Treatment Plant, Purchased of Pumps and Pipelaying, an additional 5000 households in the next 5 years will be connected. People will have easy access to clean, potable drinking water thereby improving their way of living. Over-all, health, hygiene and sanitation will be promoted.

X. OPERATION AND MAINTENANCE ISSUES

The district is equipped with personnel with enough knowledge and experience in the water industry, yet we still look forward for further training and exposure to improve our capacity to handle the operation and maintenance and be able to echo to our personnel and staff involved.

XI. CONCLUSIONS AND RECOMMENDATIONS

Meeting the challenge of the fast developing community like Bayawan City is not an easy task for the Bayawan Water District. Aligning our capacity to this will be attainable by implementing the Replacement of old NAWASA Pipeline, Expanded Treatment Plant, Purchased of Pumps and Pipelaying for the envisioned Metro Bayawan Water District towards Category B.

XII. TABLES, FIGURES/MAPS AND ANNEXURES

ANNEX 1. Program of Work

Program of Work

Replacement of old NAWASA Pipelines, Expanded Treatment Plant
Purchase of pumps and Pipelaying

I. ENGINEERING BASIC COST ITEMS

A. Source Development

Description	Unit	Quantity
Spring Box and Pipe Trust blocks Construction	LS	1
Supply, Installation and Commissioning of water softener	unit	10
Supply, Installation of Sand filters	unit	3

B. Transmission / Distribution Pipelines, Fittings & Appurtenances

350 mm uPVC Transmission pipeline *(spring box 2 to water treatment)*	lm	600
200 mm uPVC Transmission pipeline *(Villareal to Santa Catalina)*	lm	4,200
200 mm G.I./Steel Bridge crossing *(Pagtigaon & Sicopong Santa Catalina)*	LS	1
200 mm uPVC Transmission pipeline *(Cansilong - La Vista)*	lm	3,400
200 mm uPVC Transmission pipeline *(BAWAD warehouse to Hiway Lamis)*	lm	400
150 mm uPVC Transmission pipeline *(Cambulo P.S. - Upper Malabugas)*	lm	1,400
150 mm uPVC Transmission pipeline *(Zamora St.-Gamboa-Rizal St to BAWAD)*	lm	1,800
150 mm uPVC Transmission pipeline *(Bollos St - Hiway San Ramon)*	lm	600
75 mm uPVC Distribution pipeline *(Back of DUEKSAM to San Ramon road, back in ACE med relocation site, URC Road and gemilina interior)*	lm	2,850
75 mm uPVC Distribution pipeline *(Hiway to breakwater interior)*	lm	1,000
50 mm uPVC Distribution pipeline *(Brgy Bugay and San Jose expansion)*	lm	5,500
50 mm uPVC Distribution pipeline *(Hiway to bless subdivision)*	lm	2,300
Pavement Demolition 200 mmm	sq.m.	1,020

	Pavement restoration	cum	255
	Gatevalve 200 mm	pc	2
	Gatevalve 150 mm	pc	2
	Gatevalve 350 mm	pc	1
C.	**Pumping Station(sitio upper cambulo Malabugas)**		
	Malabugas		
	1. Pump house (5m x5m)	sq.m.	25
	2. Electro-mechanical		
	Submersible Pump/Motor, Control & Appurtenances	L.S.	1
	Fittings and other appurtenances	L.S.	1
	3. Site Development (Fencing and Gate)	L.S.	1
D.	**Storage Facility**		
	1. Construction of 500 cum Ground concrete	cum	500
	Reservoir for upper Malabugas		
	2. Construction of a steel bolted w/ liner Reservoir	cum	1,000
	1000 cum at BAWAD Warehouse w/ boosters pumps		
	3. Construction of an Elevated Steel Tank 300 cum	cum	300
	at Brgy Caranoche		
E.	**Generator Set**		
	1. Standby Genset 100 kva 440-460 v	unit	1
	3 phase		
F.	**Powerline Extension**		
	1. Powerline extension/Distribution	unit	1
	single phase primary line		
G	**Service Connection**		
	Service Pipe 20mm (1/2")		
	150 mm	sc	100
	100 mm	sc	100
	75 mm	sc	150
	50 mm	sc	150
		wm	500

Recommended by:

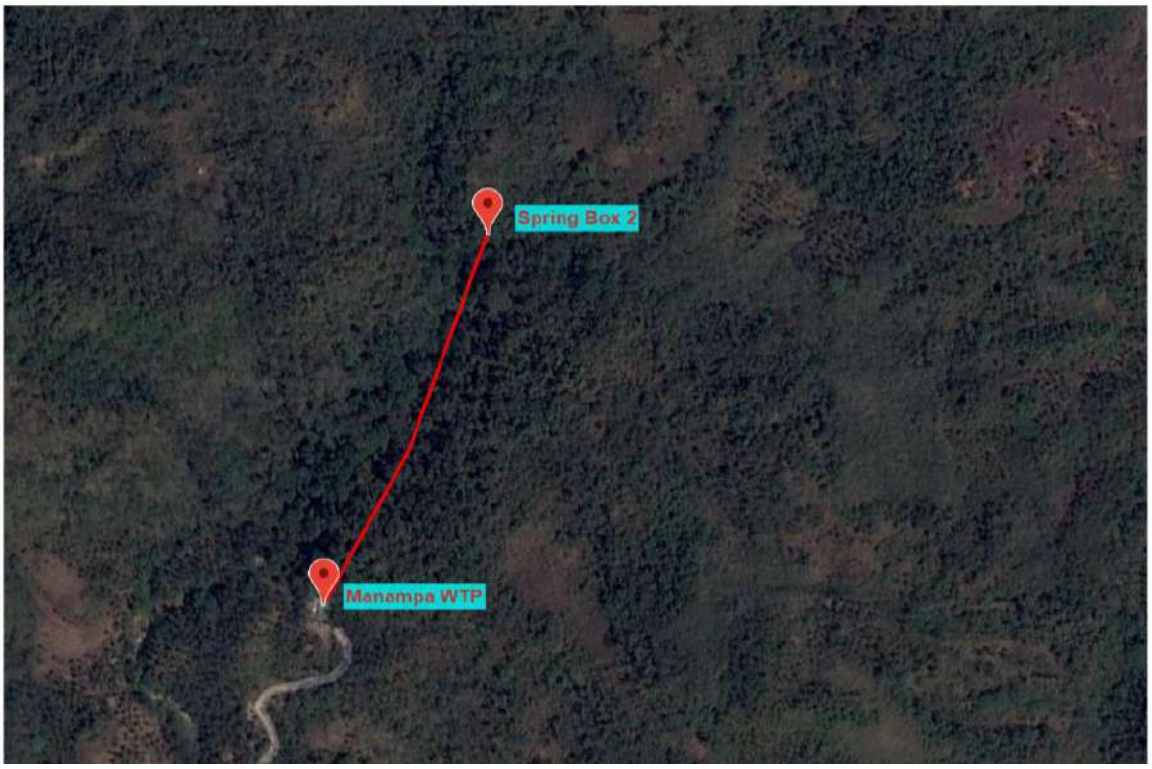
Engr. Reno John S. Tuale
Division Manager - Eng'g, Prod., Maintenance

Approved by:

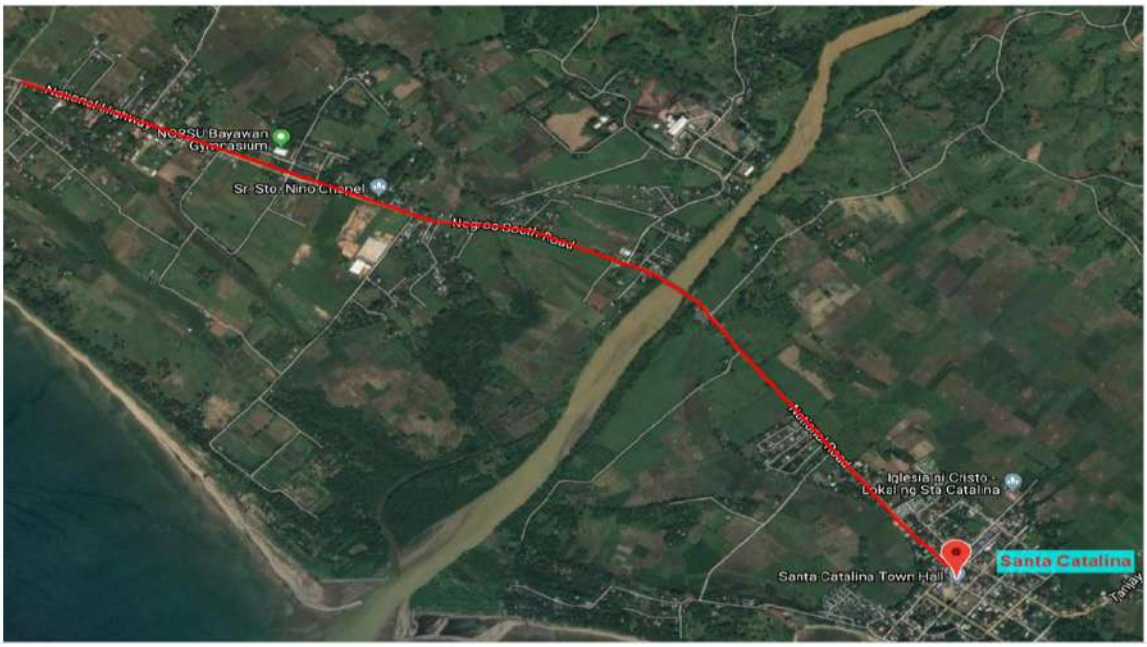
Alma L. Abrasaldo
General Manager

ANNEX 2. Maps

Pipelaying of 350mm Upvc Transmission Pipeline

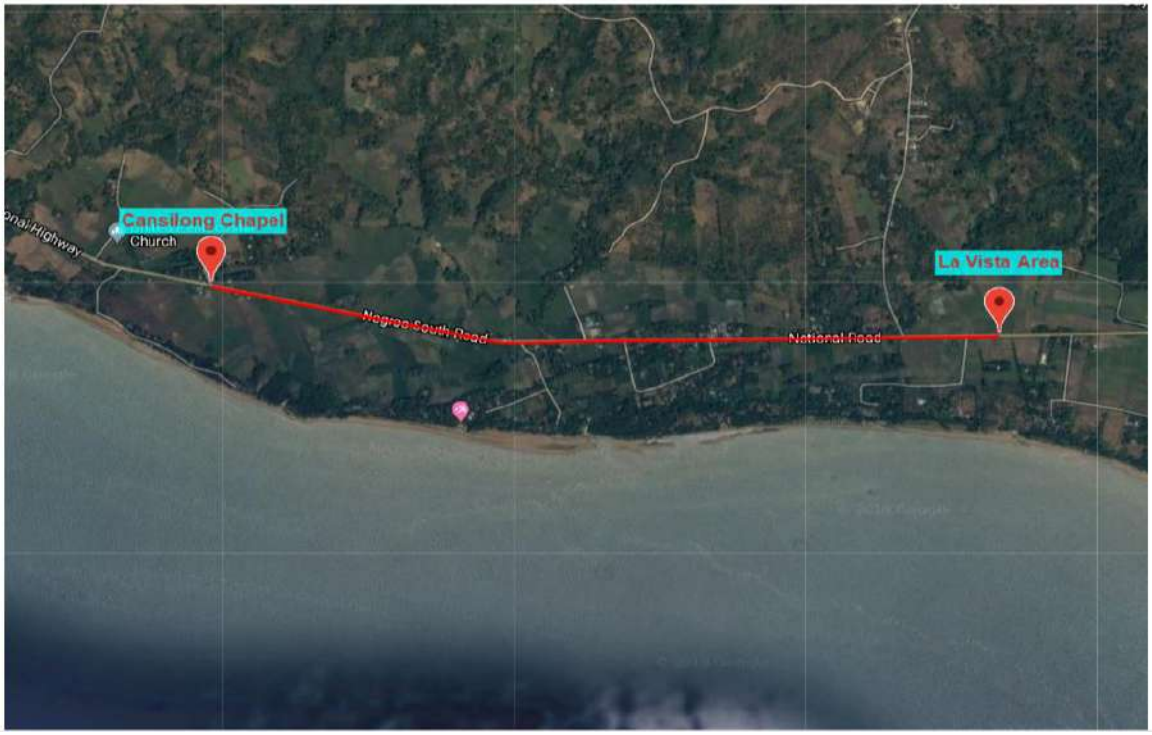


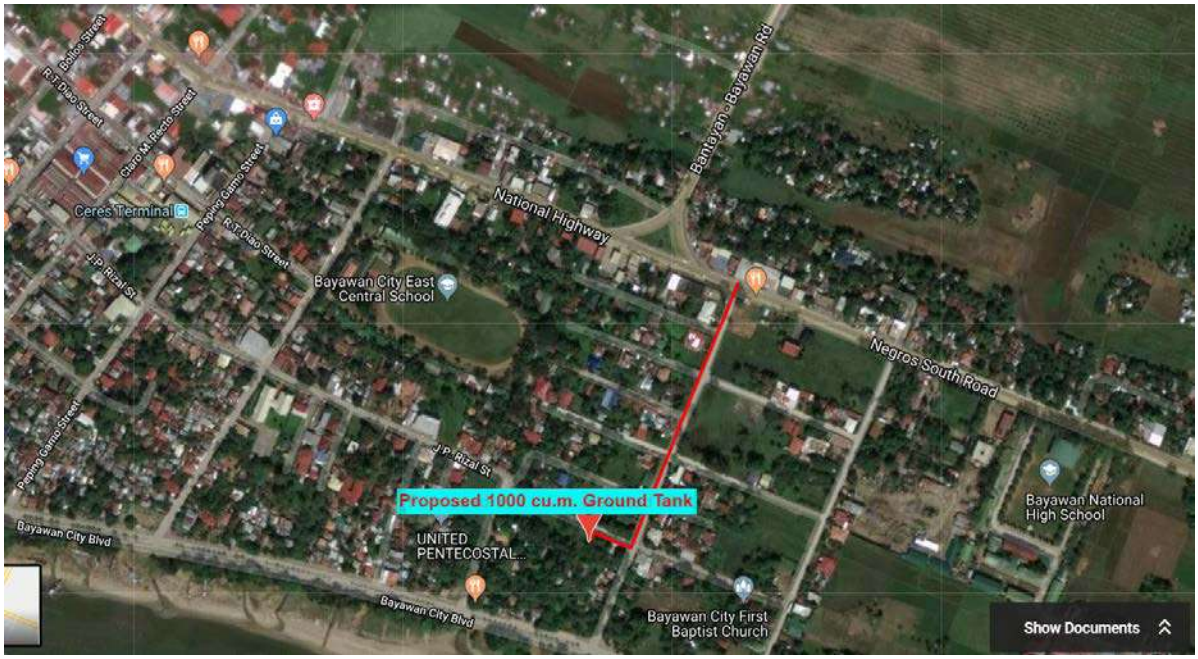
200mm Upvc Transmission Pipeline (Villareal to Sta Catalina)



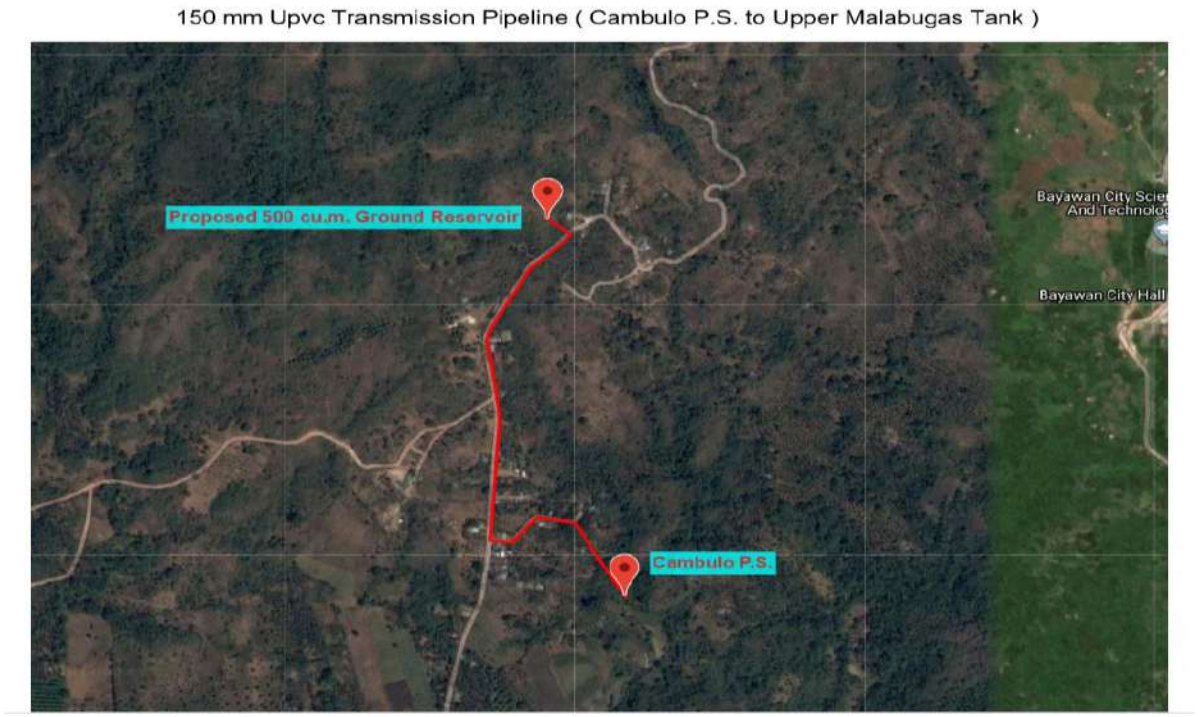
Bridge Crossings Locations

200 mm Upvc Transmission PIpeline (La Vista to Cansilong)

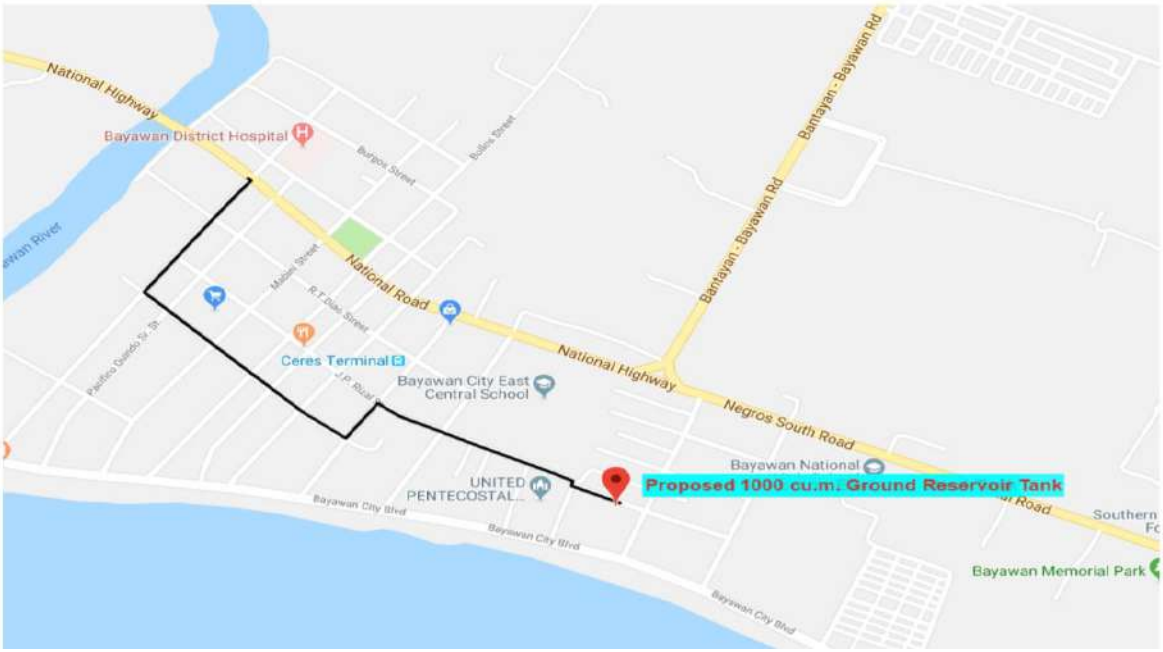




200 mm uPVC Pipeline BAWAD Warehouse to Nat'l Hiway Near Lamis

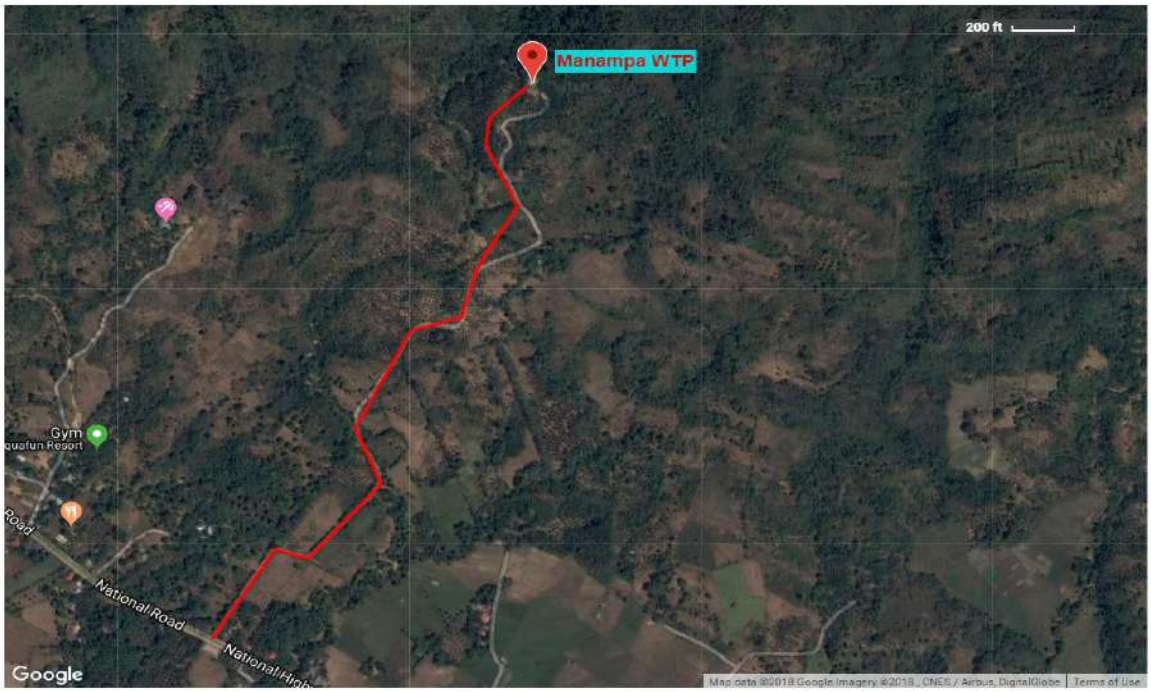


150mm Upvc Pipeline Along Zamora st., Gamboa nad Rizal st. Bawad Warehouse



150 mm Upvc Transmission PIpeline (Hiway cor Bollos st to San Ramon Hiway)

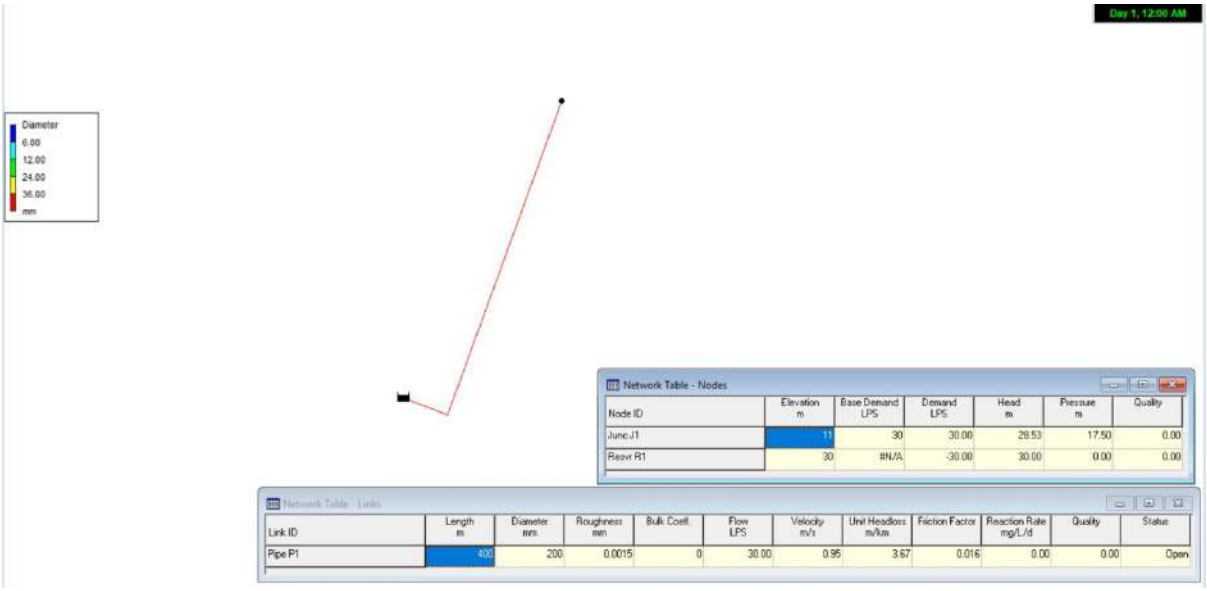
Mamampa Power Extension



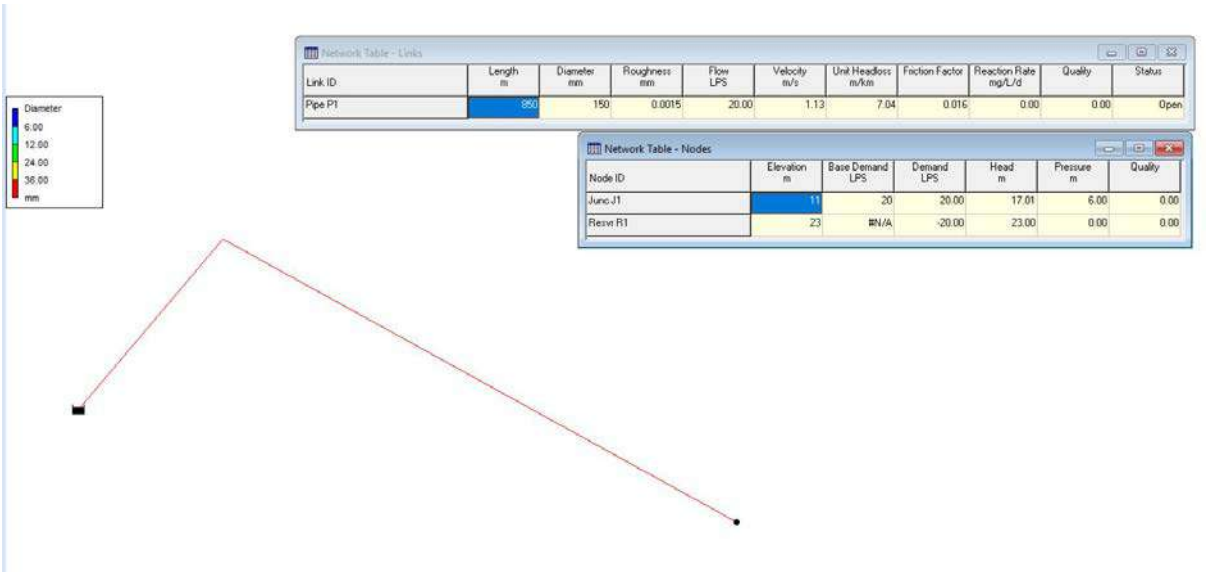
75 mm Upvc Distribution Pipeline (DUEKSAN to sn Ramon rd, Back of ACE med, Gemilina rd, & URC road

ANNEX 3. Hydraulic Design

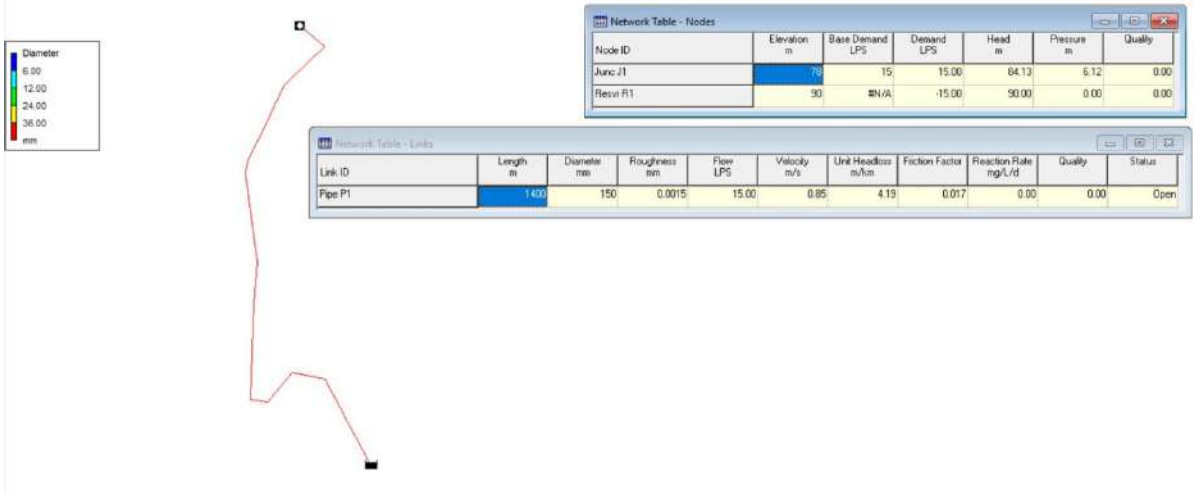
BAWAD Warehouse to Jamis Highway



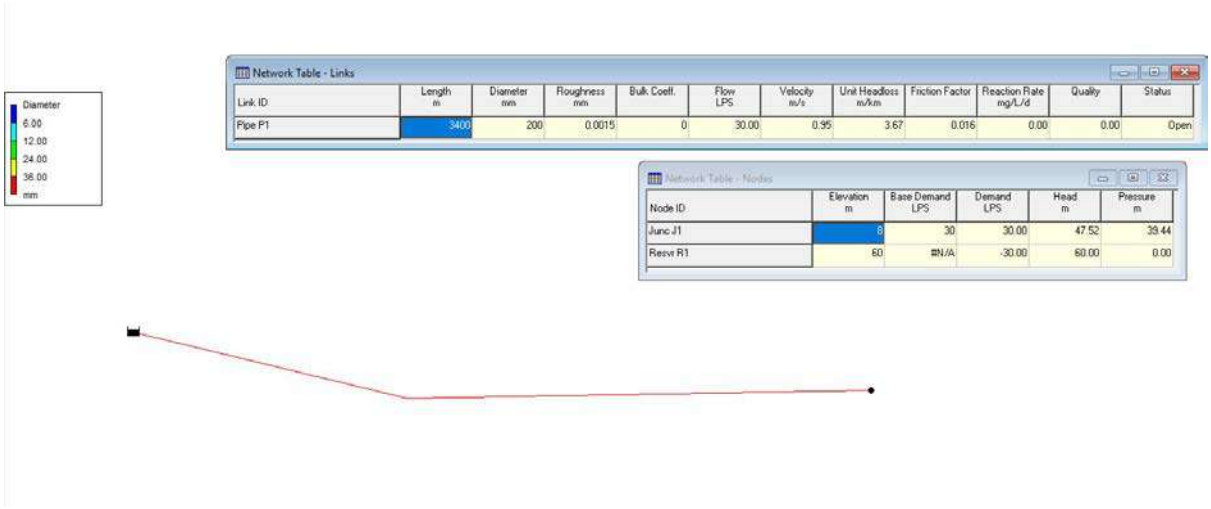
Bollos St. San Ramon Hydraulics



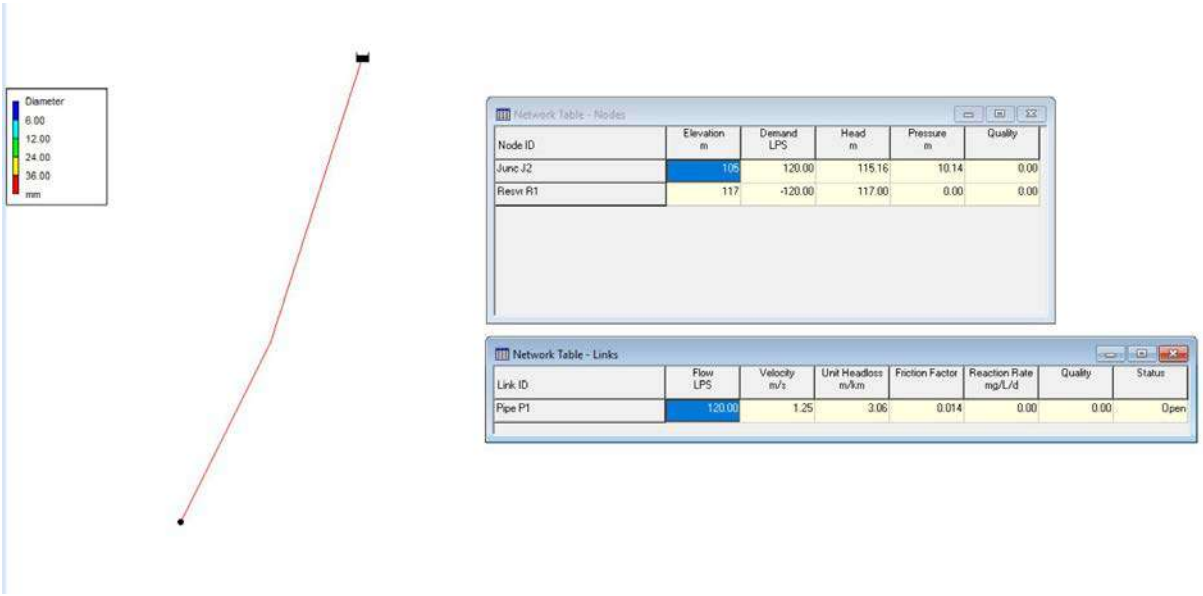
Cambulo P.S. Upper Malabugas



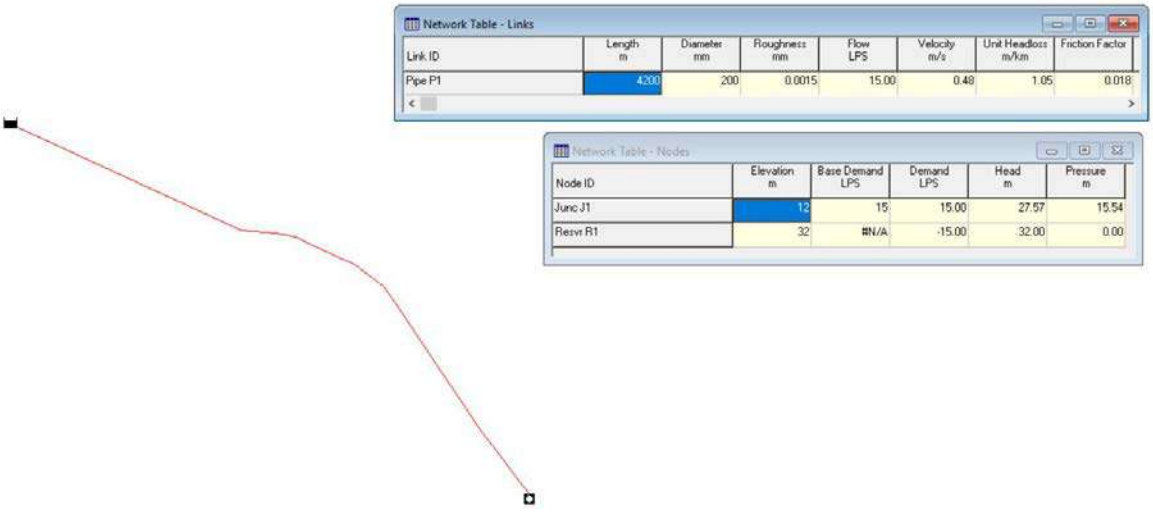
Cansilong Lavista



Spring Box 2 to Water Treatment

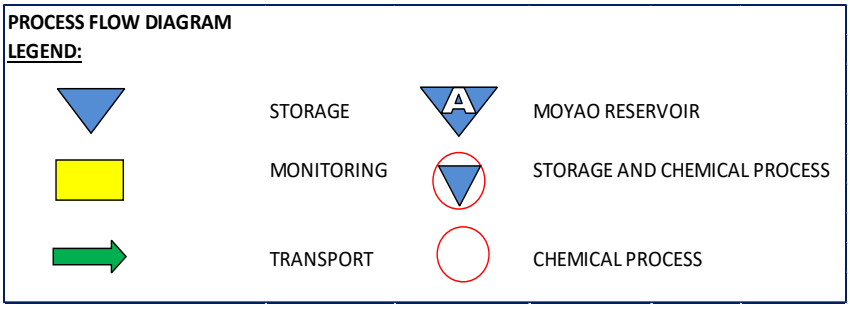


Villareal to Sta Catalina



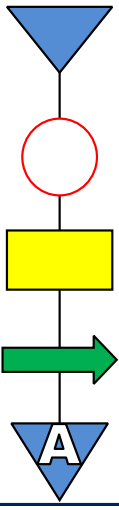
ANNEX 4. System Process Flow Diagrams

a. BAWAD Main System Process Flow Diagram



PROCESS FLOW DIAGRAM - MAIN SYSTEM		
DESCRIPTION	**STEP**	**RESPONSIBILITY**
Catchment / Manampa spring		Multiple stakeholders (DENR, NWRB, Community, Production Section)
Monitoring for Water Quality		Production Section
Transport for treatment		*
Injection of Flocculants, Coagulation, Chlorination		Production Section
Pre-Storage		Utility
Monitoring for Debris		Water Resource Operator
Flocculation, Sedimentation, Filtration		Water Resource Operator
Storage Clearwell Tanks and Post-Chlorination		Water Resource Operator
Transport to Softener Tanks		*
Softening		Softener Tender
Monitoring for Hardness and Residual		Softener Tender
Transport and Transmission		*
Storage at Moyao Tank		Storage Tender
Transport and Distribution		Maintenance Section
Concessionaires		*
Monitoring for Water Quality		Production Section (Water Quality Monitoring Team)

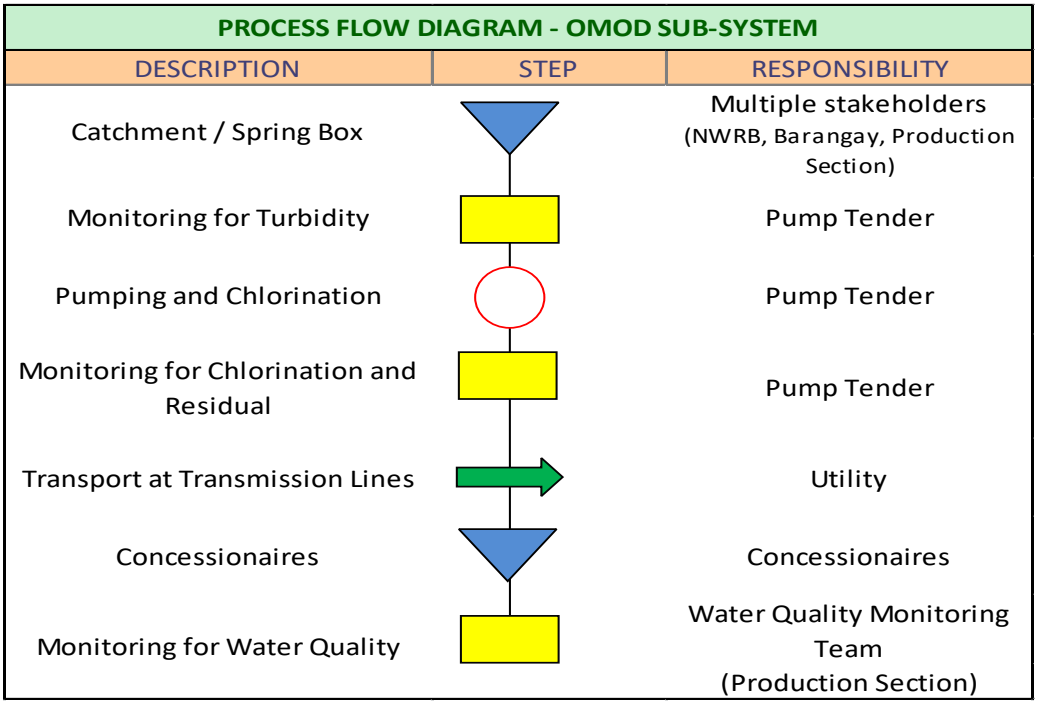
b. Cambulo Sub-System

PROCESS FLOW DIAGRAM - CAMBULO SUB-SYSTEM		
DESCRIPTION	STEP	RESPONSIBILITY
Cambulo Spring		Multiple stakeholders (DENR, NWRB, Production Section)
Pumping and Chlorination		Pump Operator
Monitoring for Residual Chlorine		Pump Operator
Transport to Moyao Reservoir		Utility
Moyao Reservoir		Utility

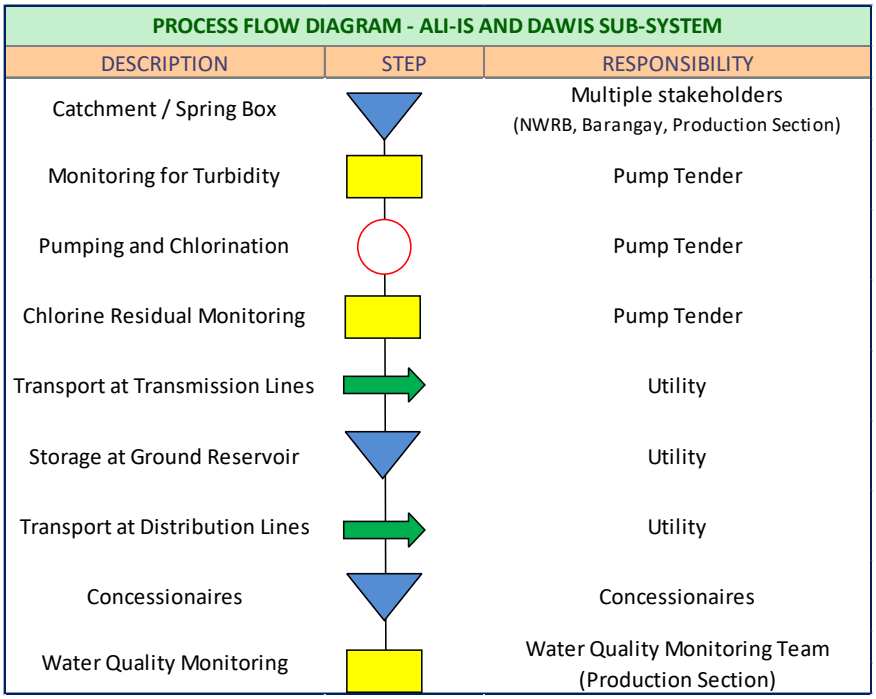
c. Nangka Sub-System

PROCESS FLOW DIAGRAM - NANGKA SUB-SYSTEM		
DESCRIPTION	STEP	RESPONSIBILITY
Pumping and Chlorination		Pump Tender
Monitoring Water Quality		Pump Tender
Transport at Transmission Lines		Utility
Storage at Elevated Tank		Utility
Transport		Utility
Concessionaires		Concessionaires
Monitoring for Water Quality		Production Section (Water Quality Monitoring Team)

d. OMOD Sub-System



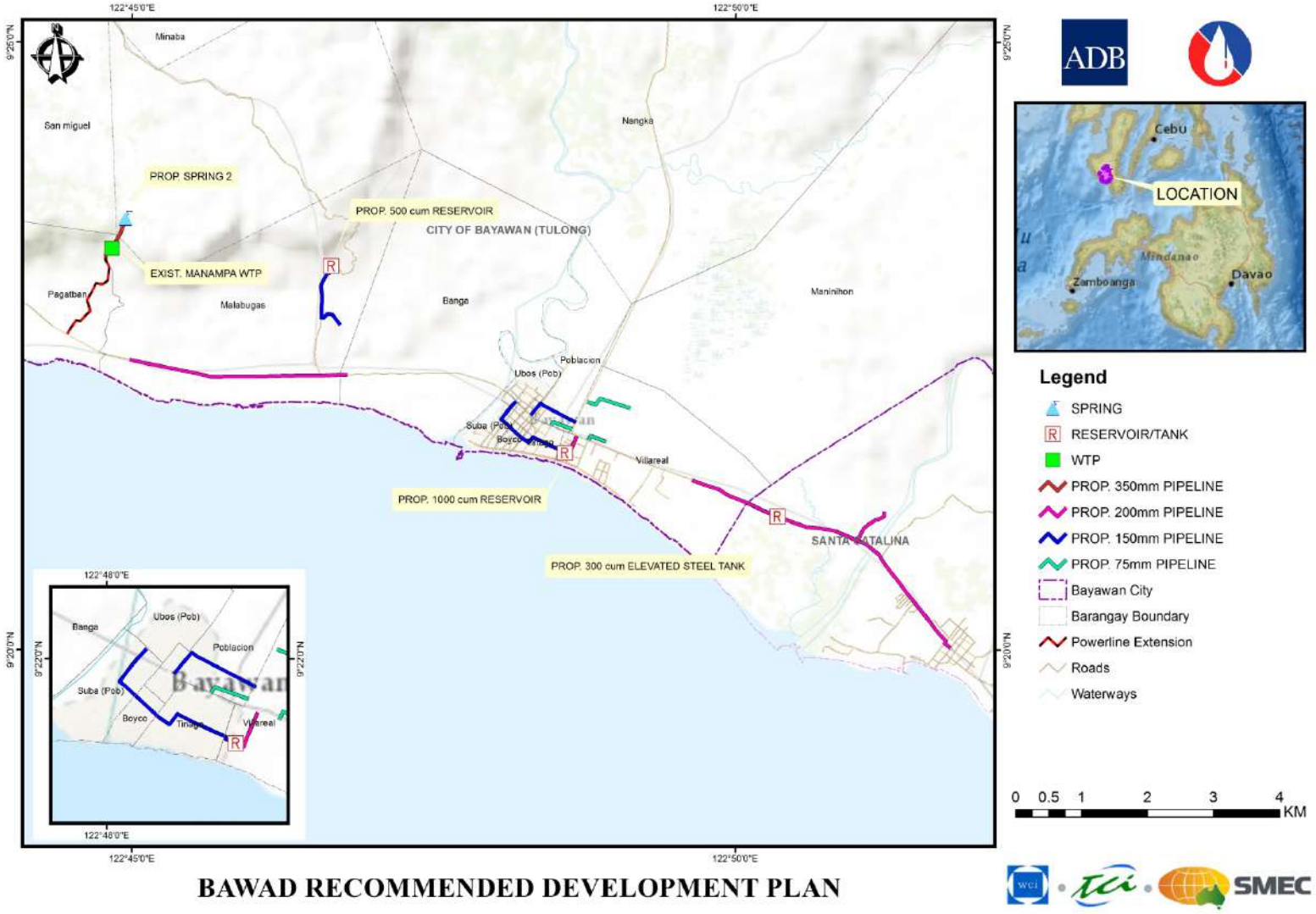
e. Ali-is and Dawis



ANNEX 5. Project Timeline

	Mo 1	Mo 2	Mo 3	Mo 4	Mo 5	Mo 6	Mo 7	Mo 8	Mo 9	Mo 10	M0 11	Mo 12	Mo 13	Mo 14	Mo 15	Mo 16
Tendering																
Engineering Design																
DED Evaluation																
Source Dev / Treatment																
Pipelines																
Pump house & pumpset																
Storage Facilities																
Generator set																
Powerline Extension																
Service Connections																
Commissioning																

ANNEX 6. Recommended Plan



BAWAD RECOMMENDED DEVELOPMENT PLAN