



Australian Government
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Republic of the Philippines
PROVINCE OF BOHOL



BOHOL INTEGRATED WATER SUPPLY SYSTEM MASTER PLAN (BHL - 01)



EXECUTIVE SUMMARY

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1.0 BACKGROUND

The project was conceived by Bohol Local Area Development Partnership (LADP), through the Philippine–Australia Local Governance Development Program (LGDP), with the end in view of contributing to local economic development and poverty alleviation, while improving Local Government Units (LGUs) capabilities for service delivery and achieving greater local economic development through partnership approaches. The study area is the island province of Bohol as shown in **Figure 1**.

2.0 GOAL AND PURPOSE

The ultimate goal of the project is to protect Bohol's water resources, while providing for the needs of economy, community and environment, as reflected in **Figure 2**. Hence, the purpose is to develop an Integrated Water Supply System Master Plan that guides development of water resources for safe domestic, commercial and industrial use in order to improve the health of the community, while increasing opportunities for local economic development and protecting the depleting groundwater systems.

3.0 METHODOLOGY

In pursuing this, the Integrated Water Resources Management (IWRM) methodology was used as an approach, based on the Medium Term Philippine Development (MTPDP) strategies to promote the devolution of the decision making process at the lowest appropriate levels, such as local government and community-based institutions. IWRM is a process that promotes the coordinated development and management of water, land and related resources within hydrological boundaries, to optimize the economic development and social welfare without compromising the sustainability of vital ecosystems.

4.0 OBJECTIVES/OUTPUTS

In addressing the project objectives, the results/outputs adapting the approaches and methodologies for various activities are the following:

1. On gaining a common understanding amongst key stakeholders of the current situation with regard to water supply, the documentary information about Bohol's water resources were assembled in common format and used as basis for developing the tabular guide in the organization of data and information. A conceptual design for a water management information system (MIS) was developed for the establishment of a data center for water resources, wherein the said data center will be a repository of water related information, which can be shared and accessed by stakeholders. The schematic diagram of MIS area is shown in **Figure 3**.
2. On the development of an integrated plan, which includes the descriptions of the required technical infrastructure for the supply of purified water for domestic, commercial and industrial use, based on an analysis of existing water resource, projected demand and community needs, the results are as follows:
 - a) Water resources inventory was conducted through hydrologic study of the seven (7) identified priority river basins in terms of quantity and quality, including a study on water balance to determine the available water against competing users. The identified river system is shown in **Figure 4**.

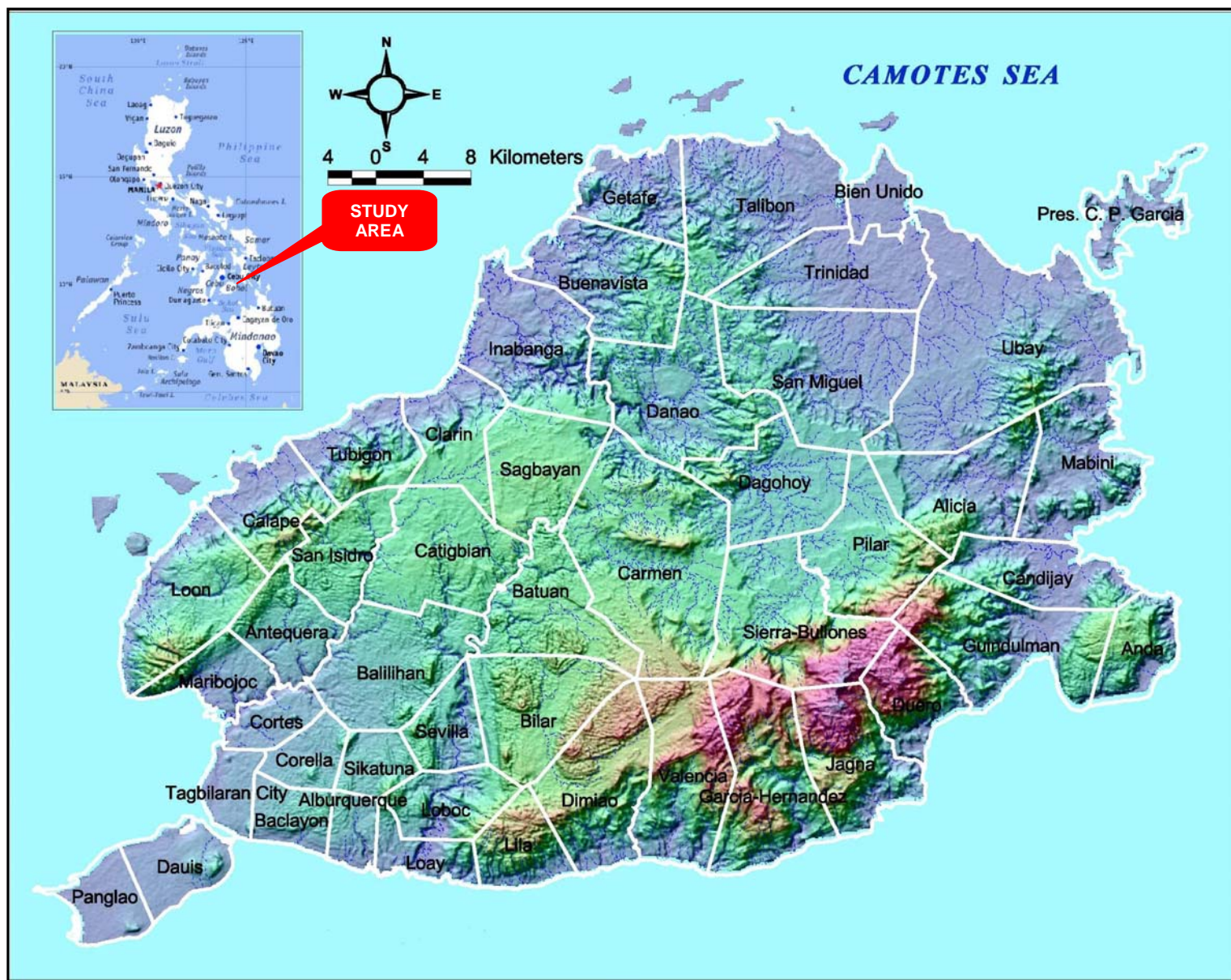


Figure 1 The Study Area

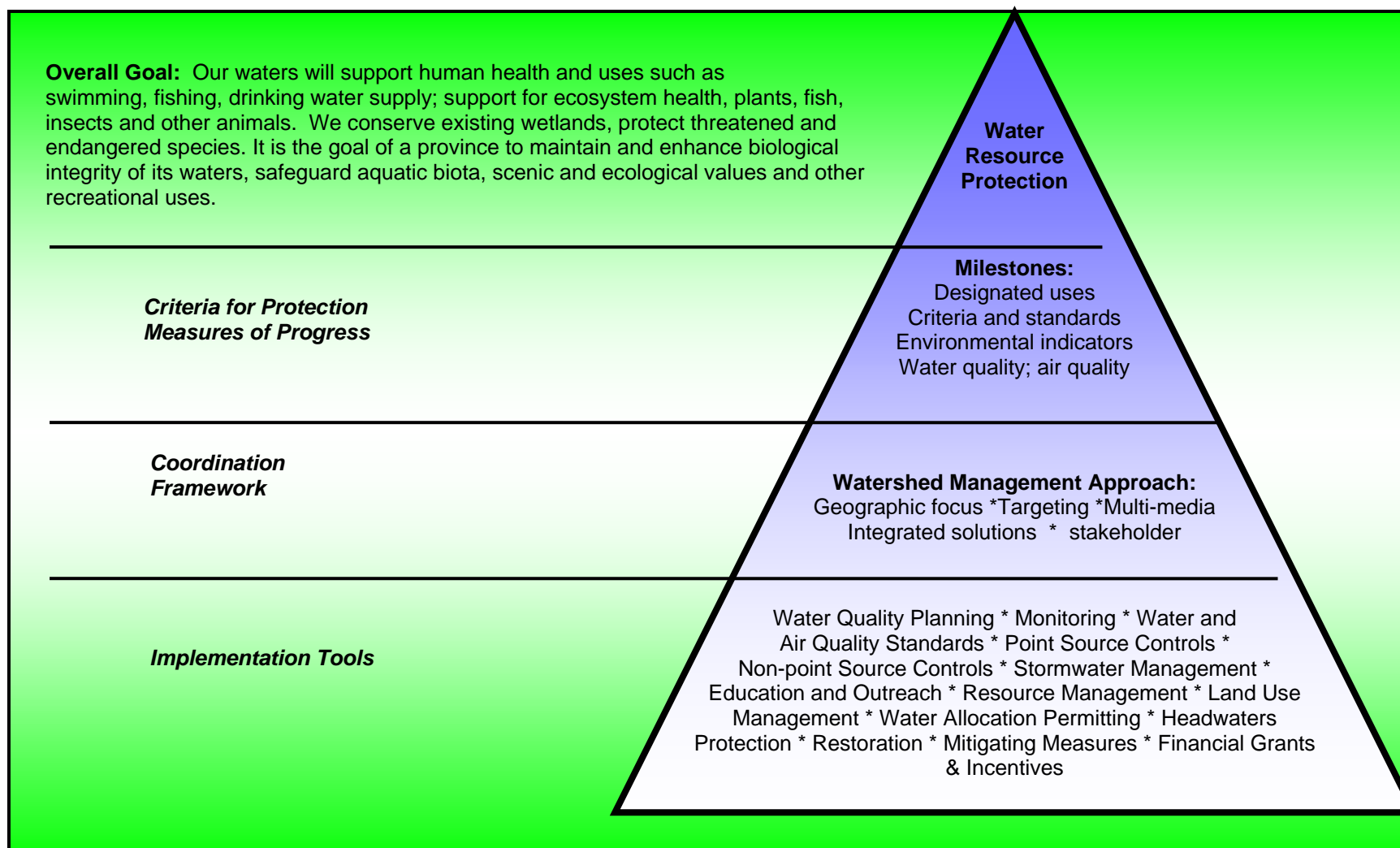


Figure 2 Conceptual Management Framework

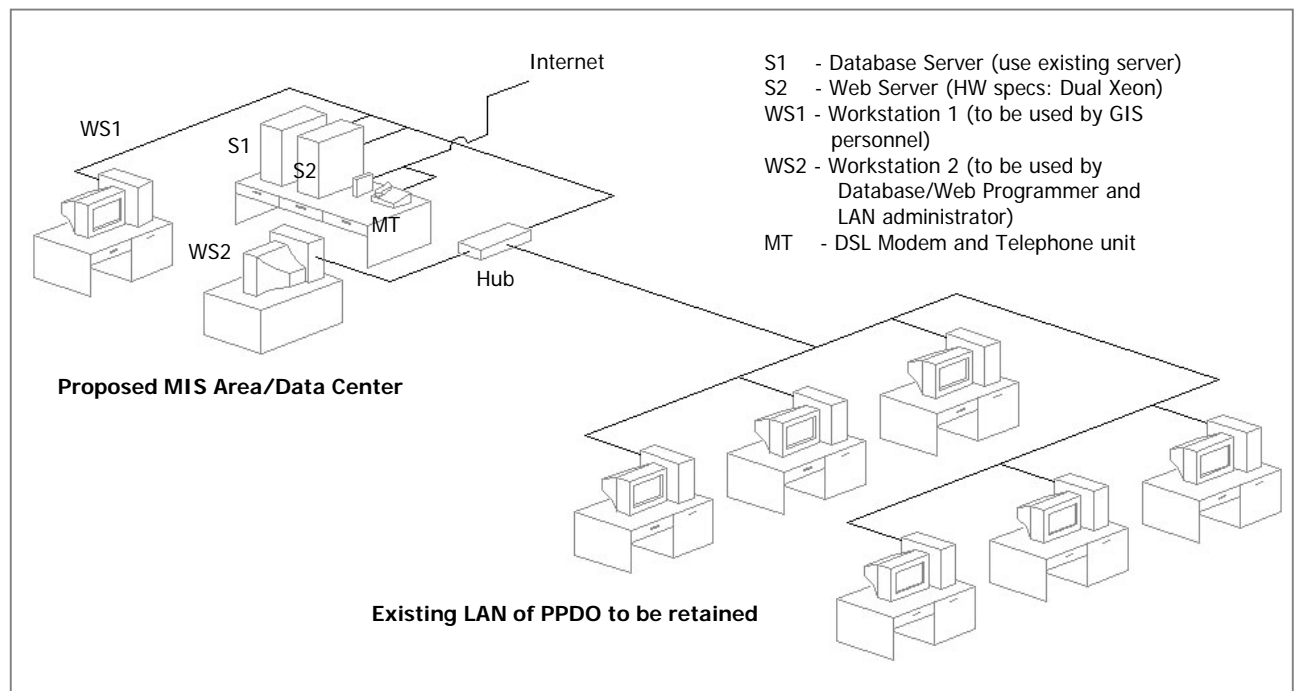


Figure 3 Schematic Diagram of MIS Area

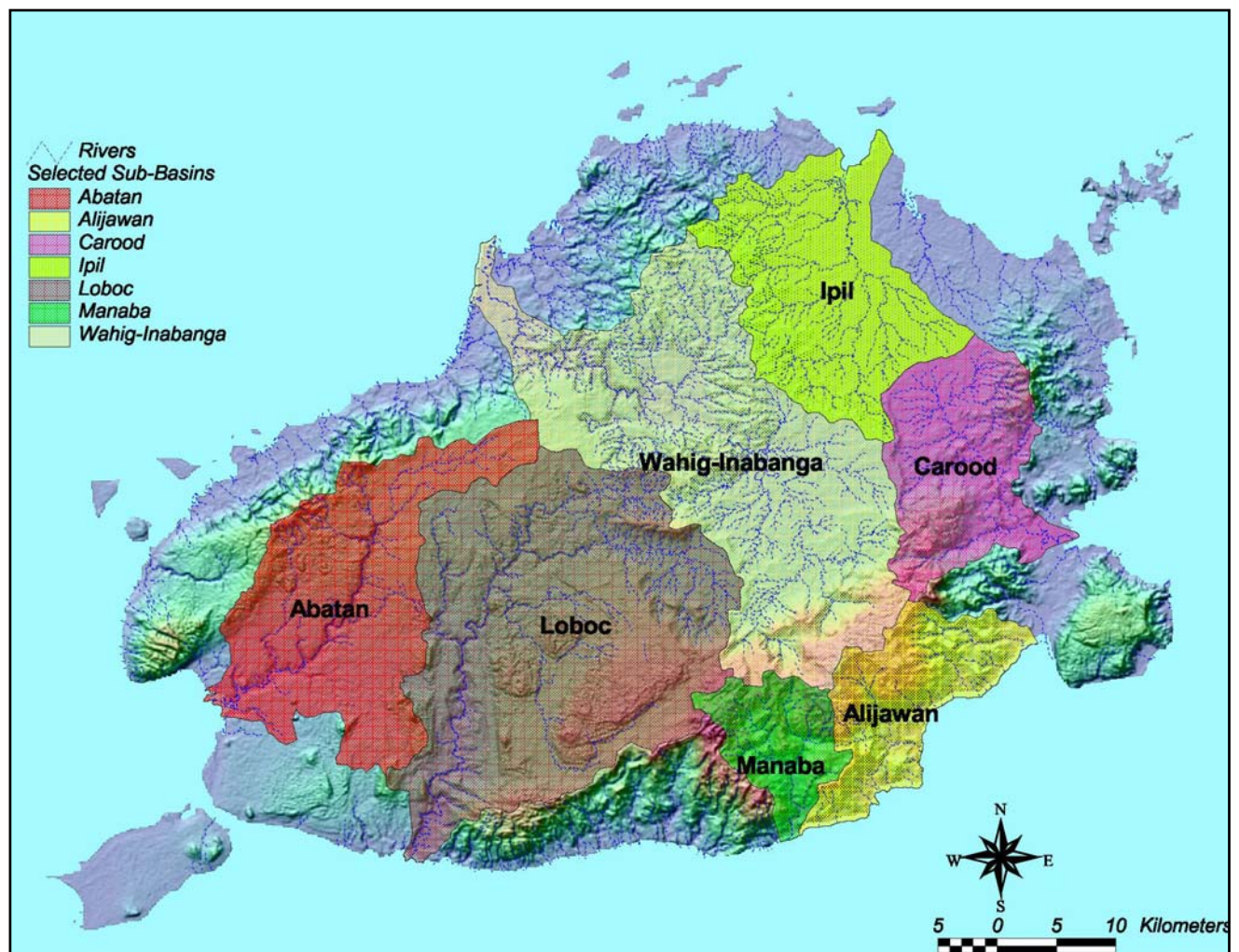


Figure 4 Identified River Basins

- b) Water demand analysis through survey of beneficiary municipalities was undertaken to determine water demand characteristics. Local waterworks were also surveyed to determine the adequacy of water service. **Table 1** and **Figure 5** present the projected population of Bohol and the projected population to be served under the Master Plan up to 2035. **Table 2** and **Figure 6** indicate the water demand requirement up to 2035.

Table 1 Projected Service Coverage for Urban and Rural Population at Five Year Interval Projection Period

Year	Projected Population	Target Service Coverage		Source of Supply			
				Bulk Supply and Current Level III Sources		Other Sources	
		(%)	Population	(%)	Projected Population to be Served	(%)	Projected Population to be Served
2010	1,362,900	62	840,590	38	519,490	24	321,100
2015	1,480,700	90	1,327,568	58	864,638	31	462,930
2020	1,597,100	94	1,496,431	64	1,017,012	30	479,419
2025	1,707,600	94	1,600,192	66	1,126,300	28	473,892
2030	1,811,100	94	1,697,423	68	1,227,369	26	470,054
2035	1,908,200	94	1,788,683	68	1,298,559	26	490,124

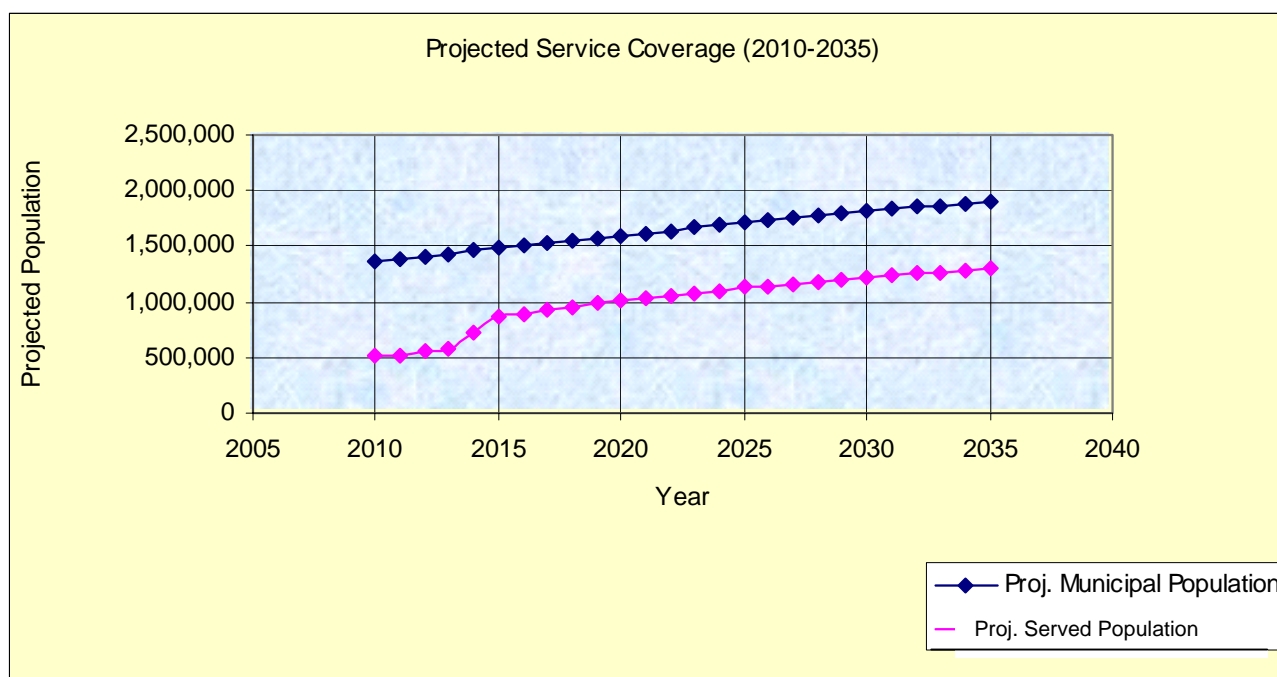


Figure 5 Projected Population Figures (2005-2035)

Table 2 Summary of Water Demand Projections for the Whole Province of Bohol

Demand Category	Demand (cumd)					
	2010	2015	2020	2025	2030	2035
Domestic	59,985	94,789	112,526	131,073	143,411	152,195
Commercial/Industrial	4,007	6,000	13,158	15,480	16,543	17,273
Institutional	2,996	3,272	3,965	5,490	5,790	6,024
Tourism	1,954	3,387	3,675	5,249	5,249	5,249
Industrial Estate	-	11,985	21,420	21,420	21,420	22,270
Total Water Demand	68,942	119,433	154,744	178,712	192,413	203,011
Non-Revenue Water	37,122	29,858	38,686	44,678	48,103	50,753
Average Daily Demand	106,064	149,291	193,430	223,390	240,516	253,764
Maximum Day Demand	134,499	188,924	244,840	281,637	303,223	319,906
Yearly Demand (mcm/yr)	38.71	54.49	70.60	81.54	87.79	92.62

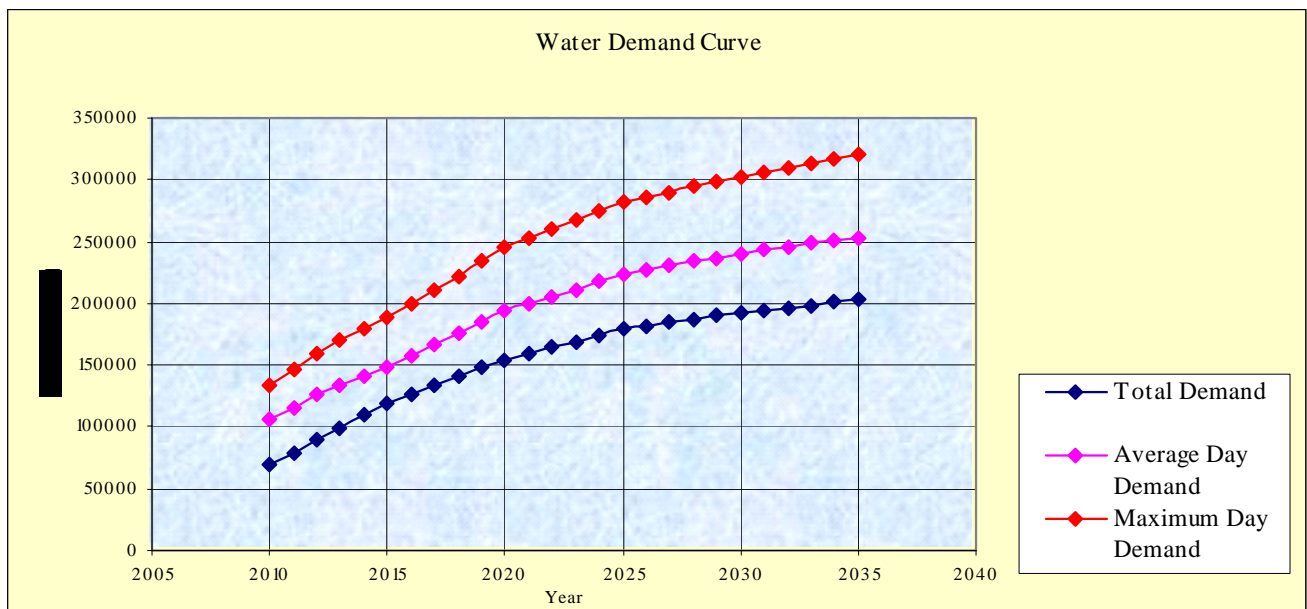
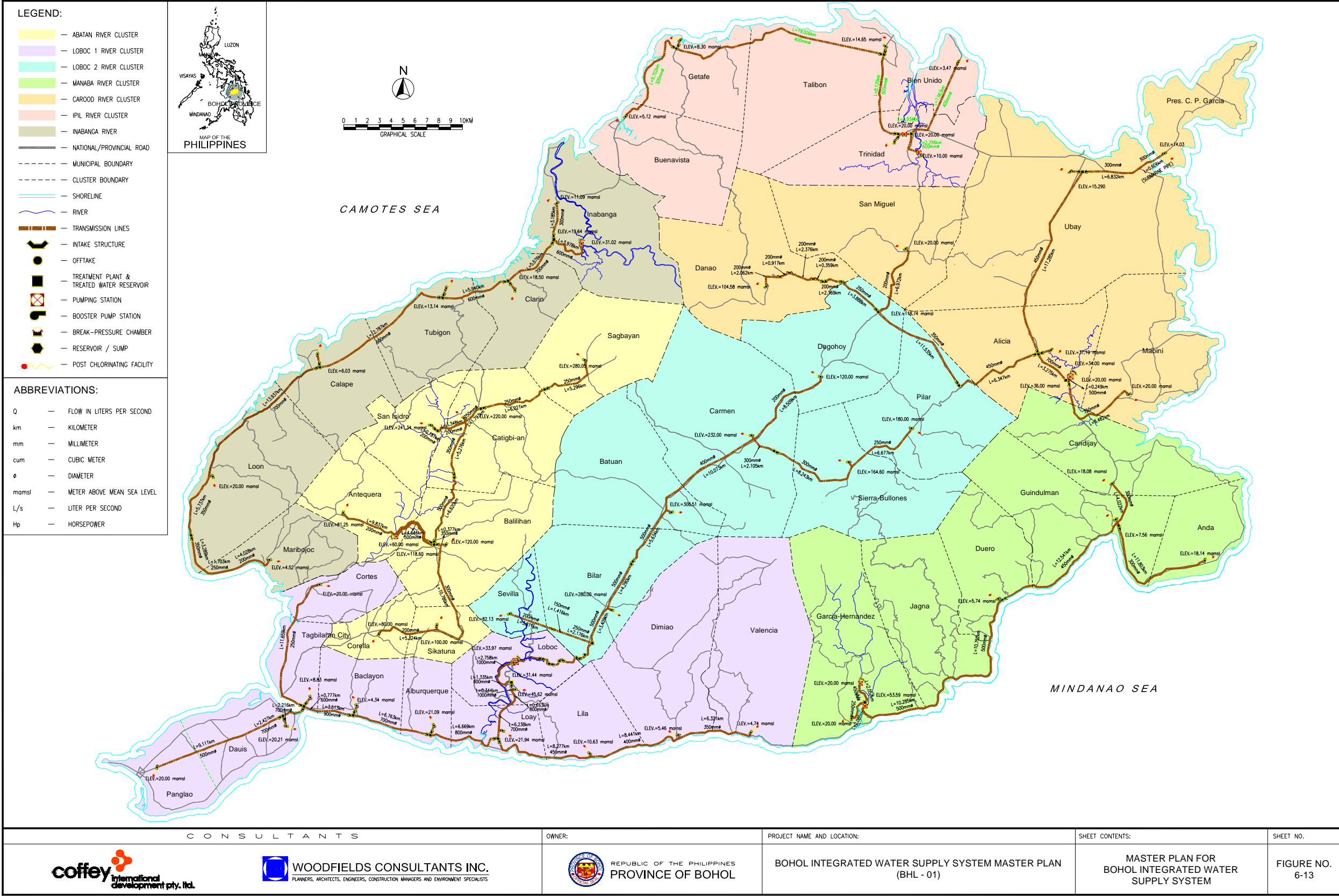


Figure 6 Water Demand Curve

- c) Alternative analyses for water supply infrastructure requirements on each identified sites were conducted. The recommended water supply infrastructure includes river intake, pumping stations, treatment plants, distribution systems and storage requirements. Schematic drawings showing the development scheme and relative location of the major facilities were prepared. From the alternatives presented the recommended water supply master plan was selected (**Figure 7**) on the bases of comparison of the net present worth costs of facilities including operation and maintenance costs and other non-quantifiable parameters.
- d) Social and environmental impacts that may result from the implementation of the project which will negatively affect the local people were studied. Mitigating measures to address these issues were recommended.

3. On the review of policy and legislative framework to protect and sustain water supplies, a number of associated policies, laws and regulations that are relevant in the development and management of water resources were explored. These were used as reference in the formulation of policy based on discussions with the provincial government and key stakeholders, wherein series of meetings, consultations, and workshops were conducted. This has culminated to the signing of an Executive Order by the Provincial Governor creating the Bohol Integrated Water Resources Management Board (BIWRMB) during the first Bohol Water Summit. The organizational structure of BIWRMB is shown in **Figure 8**.
4. On the development of framework for watershed management, a province-wide approach was developed, as shown in **Figure 9**. This will provide a coordinating mechanism for environmental management that focuses public and private sector efforts and resources to address priority concerns within hydrologically defined geographic areas. The watershed management framework assumes that a systematic sequence of watershed management activities will occur within each watershed management areas over a given period of time, and then repeat itself in an iterative process as shown in **Figure 10**. The cycle of watershed management activities includes the fundamental planning steps of data collection and assessment, problem identification, strategy development, implementation and evaluation.
5. On creating a capacity development framework, it was crafted with the primal objective of initiating a continuing process of learning that can be used to perform activities towards attracting, developing, and sustaining local water industry skills and expertise. The framework is shown in **Figure 11**. An initial step towards this is the learning by doing approach, through briefings conducted by the consultants with their counterparts during the course of the study.
6. On the development of viable investment and management strategies, plans were developed to fund, build and operate the required infrastructure, including levels of service delivery, pricing regimes and financial viability.
7. Marketing plan was formulated, including the development of an effective marketing group within the Provincial Government that will work to establish communication and liaisons with the business community on the benefits of efficient water supply system. Promotion of water conservation campaign measures to protect viable water resources were also considered.



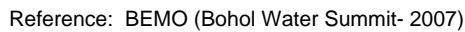


Figure 8 BIWRMB Structure

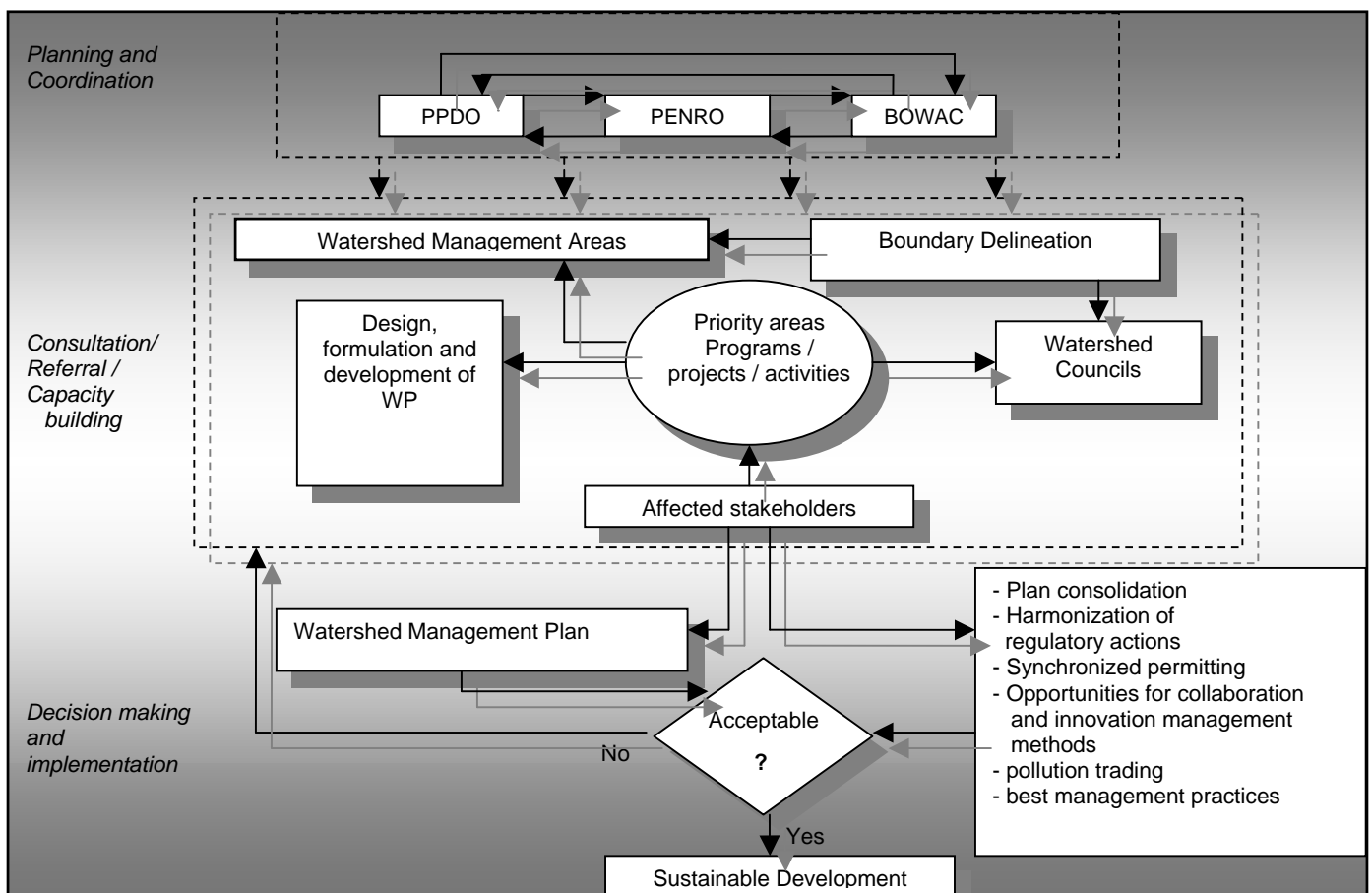


Figure 9 The Province-Wide Watershed Management Framework for the Province of Bohol

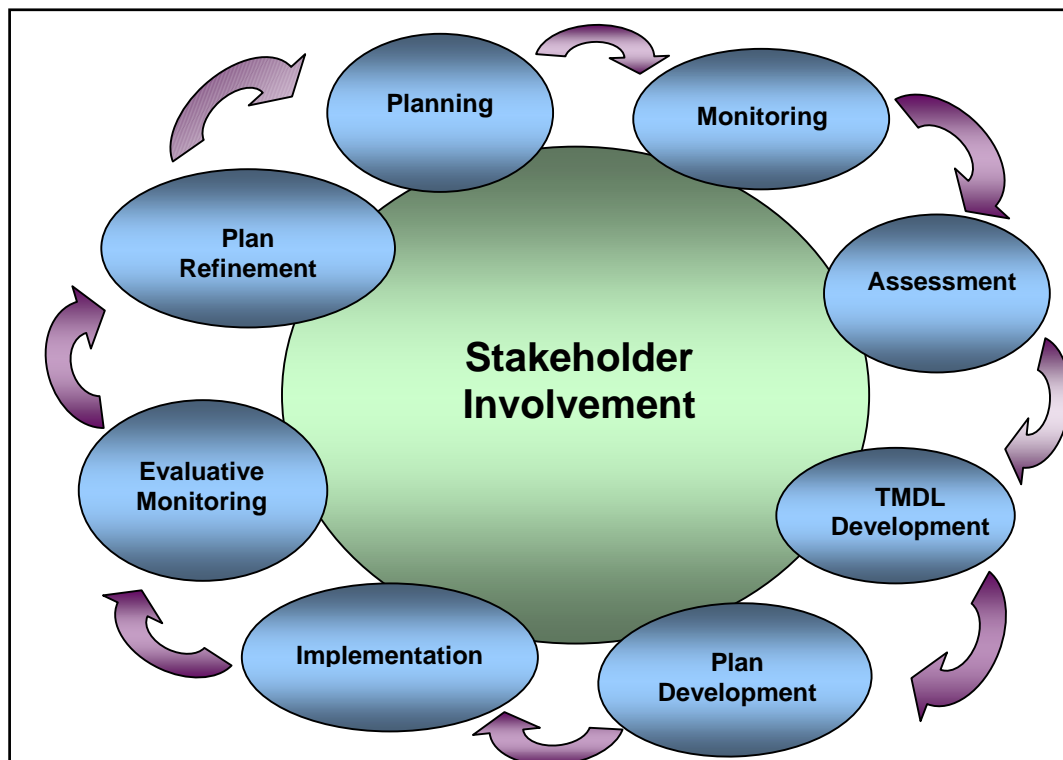


Figure 10 The Watershed Management Cycle

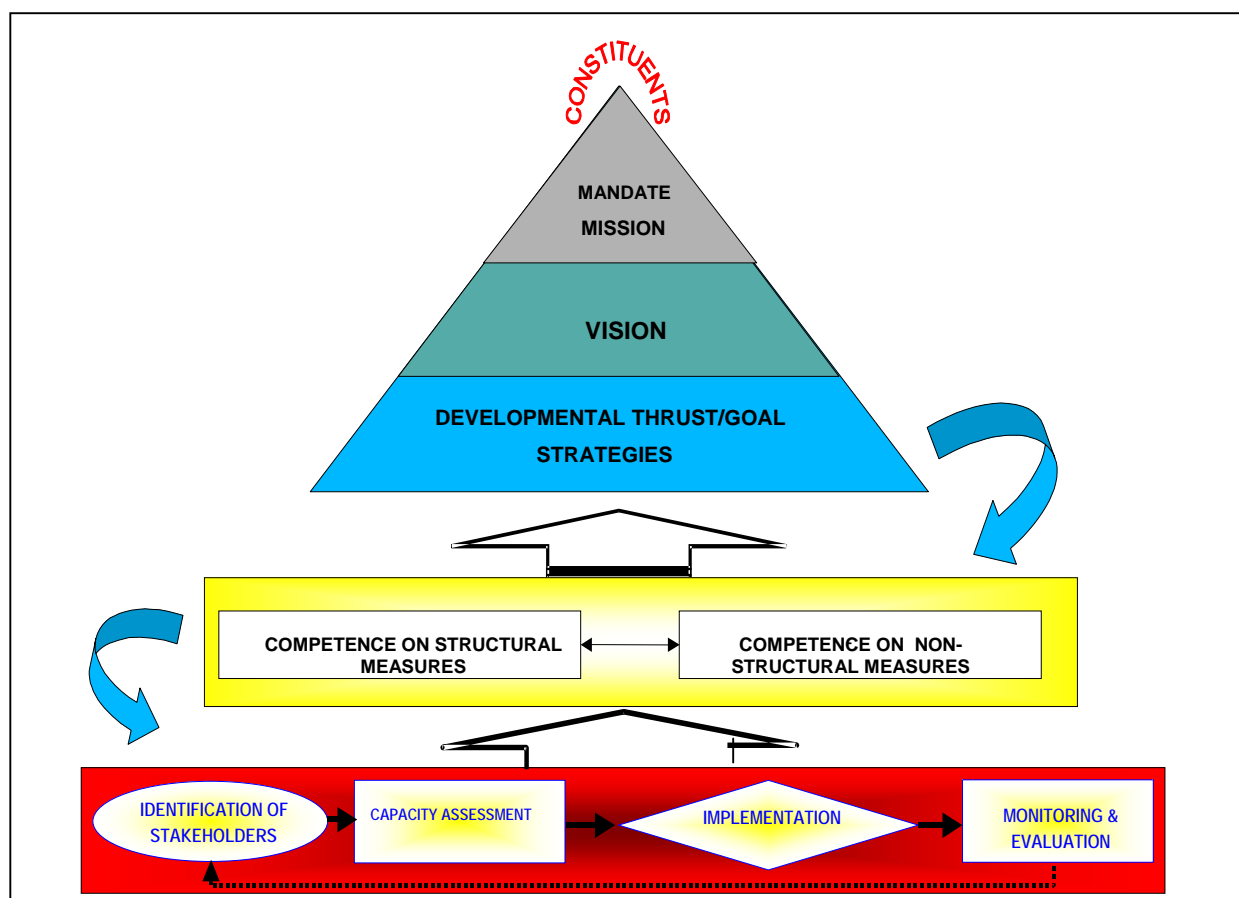


Figure 11 Capacity Building Framework

5.0 THE WATER SUPPLY MASTER PLAN

5.1 RECOMMENDED PLAN

The recommended water supply master plan is envisioned to serve all the 47 municipalities and one city in Bohol. The identified potential sources are the six (6) river basins namely, Abatan, Loboc, Manaba, Carood, Ipil and Wahig-Inabanga. The municipalities and city are clustered under each river basin depending on the available flow that may be diverted from the river against the demand requirement, proximity of municipalities with respect to the river basin, hydraulic consideration, and geomorphology of the area. When completed, it will provide a total average daily production 208,353 cumd benefiting a population of about 1,078,000 in the Province of Bohol.

The recommended plan was selected after conducting technical evaluation such as system operation (pumping or gravity), and comparison of the net present worth costs of construction of facilities and operation and maintenance costs. The major water facilities and components of each cluster include (a) source facilities, (b) water treatment plants, (c) storage facilities, (d) transmission lines, (e) pumps stations, and (f) power source development. Other components include land acquisition and rights-of-way, and stored materials and equipment.

The construction of Phase I facilities is assumed to commence in 2010 and completed in 2012. Phase 2 of the project will involve replacement of pumps/upgrading of pumping units for all the 7 bulk systems. The initial operation of the bulk water supply system will start in 2013.

The total cost of the development program includes costs for the construction of facilities (base cost), feasibility study, detailed engineering design, and construction supervision.

The summary of the important information regarding the recommended water supply master plan is presented in **Table 3** while the development program for the selected 7 bulk water supply system clusters up to year 2035 is shown in **Figure 7**.

The results of the financial evaluation and feasibility analysis showed very high costs at 15% and 12% FIRR. The recommended plan could provide reliability in terms of water quantity and quality, and availability. However, the development cost may not be acceptable, hence, it may encourage very little or no participation at all from interested proponents. The results further showed that the project would only be affordable to the Boholano people at 0% FIRR which is only possible for projects implemented by the government.

Although the project aims to help in the alleviation of poverty in the province. this financial option at 0% FIRR may be burdensome to the provincial government's finances. The tariffs may suffice loan repayment and daily operation and maintenance costs, however, there will be no funds for future improvements and developments and other water related expenses such as promotions for water conservation measures, water quality and quantity monitoring and NRW monitoring and control.

The results of the financial analysis and the derived water tariffs for each cluster were presented to and discussed with the Provincial Governor in a meeting held at the Bohol Provincial Capitol on 26 November 2007 wherein Governor requested the Consultant to prepare other viable options that are affordable to the Boholanos. Options were discussed to give priority to some areas that have immediate water supply requirements

Table 3 Summary of Information for the Integrated Water Supply System

River Cluster		LGUs Served	Projected Population to be Served	Projected Average Daily Production (cumd)	Estimated Project Cost in Million Pesos at 2007 Prices (Phase 1)	Pesos at 2007 Prices per Cubic Meter					
						FIRR=15%	FIRR=12%				FIRR=0%
							Base Case	+30% Sales	-20% Cost	+30% Sales & -20% Cost	
1	Abatan	Antequera, Balilihan, Catigbian, Corella, Sagbayan, San Isidro and Sikatuna	70,200	10,179	772.74	90.39	71.46	54.97	59.23	45.56	19.48
2	Loboc1	Alburquerque, Baclayon, Cortes, Dauis, Dimiao, Lila, Loay, Loboc, Panglao, Tagbilaran City and Valencia	237,400	61,309	2,724.10	50.48	40.33	31.03	33.65	25.90	12.31
3	Loboc2	Batuan, Bilar, Carmen, Dagohoy, Pilar, Sevilla and Sierra Bullones.	124,000	19,612	1,238.58	74.62	60.10	46.19	50.36	38.74	19.63
4	Manaba	Anda, Candijay, Duero, Garcia Hernandez/ Manaba, Guindulman and Jagna.	114,000	18,418	1,068.24	69.22	54.40	41.85	44.92	34.56	14.14
5	Carood	Alicia, Danao, Mabini, San Miguel, Pres. Carlos P. Garcia and Ubay	147,500	24,534	1,404.52	62.84	49.42	38.02	40.65	31.27	12.36
6	Ipil	Bien Unido, Buenavista, Getafe, Talibon and Trinidad	177,700	29,968	1,240.55	48.90	38.19	29.38	31.35	24.11	9.22
7	Wahig-Inabanga	Calape, Clarin, Inabanga, Loon, Maribojoc and Tubigon	207,400	44,435	2,063.27	58.23	44.99	34.61	36.99	28.45	10.87
Total All Clusters		All Bohol municipalities and city	1,078,200	208,455	10,512.00	59.19	46.70	35.92	38.68	29.76	12.79

5.2 PRIORITY DEVELOPMENT AREAS

Based on the thrusts of the Provincial Government to accelerate the economic development of Bohol, and upon the request of the Provincial Governor to identify priority development areas and evaluate options that will be affordable to consumers, two priority areas or zones were considered for water supply development that would lower the bulk tariff, namely:

- 1) Panglao Island Tourism Estate, Metro Tagbilaran City, and adjacent areas, and
- 2) Northeastern Industrial Zone, namely, Wahig-Inabanga Option (composed of Clarin, Inabanga, Buenavista and Getafe) and Ipil Option (composed of Talibon, Bien Unido, Trinidad and Ubay).

5.2.1 Abatan-Loboc River Option

Metro Tagbilaran City including adjacent areas and the Panglao Island Tourism Estate (PITE) are identified as the top priority areas that need water supply improvement. Tagbilaran City is the center of education, tourism, commerce and industry in the province. While PITE is the center of tourism and the site of the proposed international airport in the province.

The proposed Abatan-Loboc River Option (**Figure 12**) could provide average daily production of 56,325 cumd benefiting about 203,800 population. Initially in 2010, the bulk supply will cover Cortes, Tagbilaran City, Daus and Panglao and by 2018, the service will be expanded to cover Loboc, Loay, Albuquerque, and Baclayon. To minimize the development cost, the offtake interconnected with the transmission line of Bohol Water Utilities, Inc. (BWUI) will convey water to Daus and Panglao through bulk supply.

The Abatan-Loboc River Option will initially utilize Abatan River in 2010 up to 2017. By 2018, Loboc River will be tapped to supplement the supply to satisfy the increasing projected water demand.

5.2.2 Loboc River Option

The proposed Loboc River Option (**Figure 13**) is a variant of Abatan-Loboc River Option. However, Loboc Option turned out to be expensive alternative than Abatan-Loboc Option. It will also provide average daily production of 56,325 cumd benefiting about 203,800 population and covering the same city/municipalities. Unlike the previous option, it will cover all city/municipalities on the first year of operation - 2010. Daus and Panglao will be served by bulk supply through the offtake interconnected with the transmission line of BWUI.

5.2.3 Ipil River Option

The proposed Ipil River Option will provide an average daily production of 32,409 cumd benefiting about 180,000 population. The proposed Ipil River Option will cover 4 municipalities, namely: Bien Unido, Ubay, Talibon, and Trinidad. **Figure 14** shows the development plan of Ipil River Cluster detailing the major facilities and the covered municipalities.

5.2.4 Wahig-Inabanga River Option

The proposed Wahig-Inabanga River Option (**Figure 15**) will provide an average daily production of 15,262 cumd benefiting about 97,300 population. It will cover 4 municipalities, namely, Inabanga, Clarin, Buenavista and Getafe.

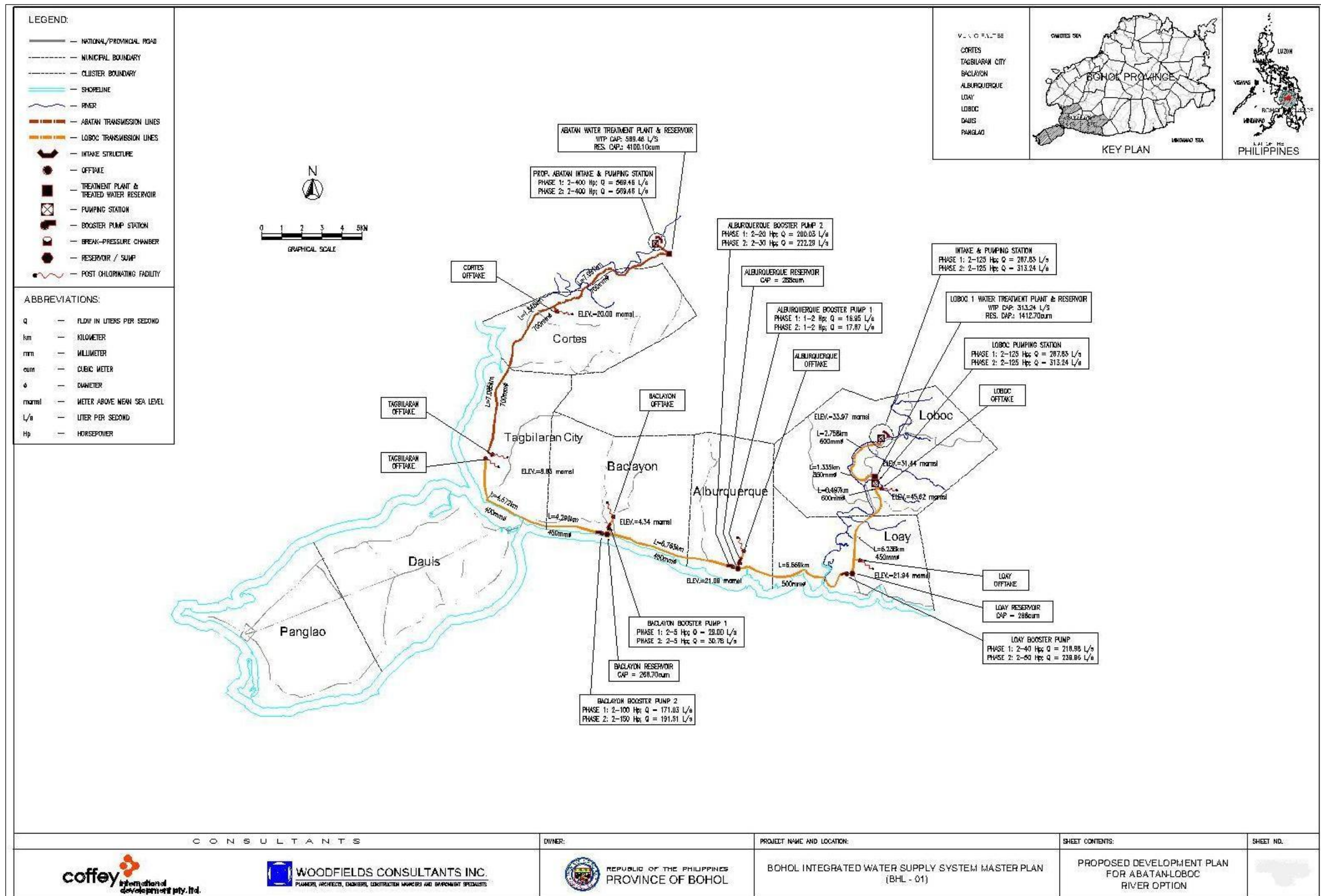


Figure 12 Abatan-Loboc River Option

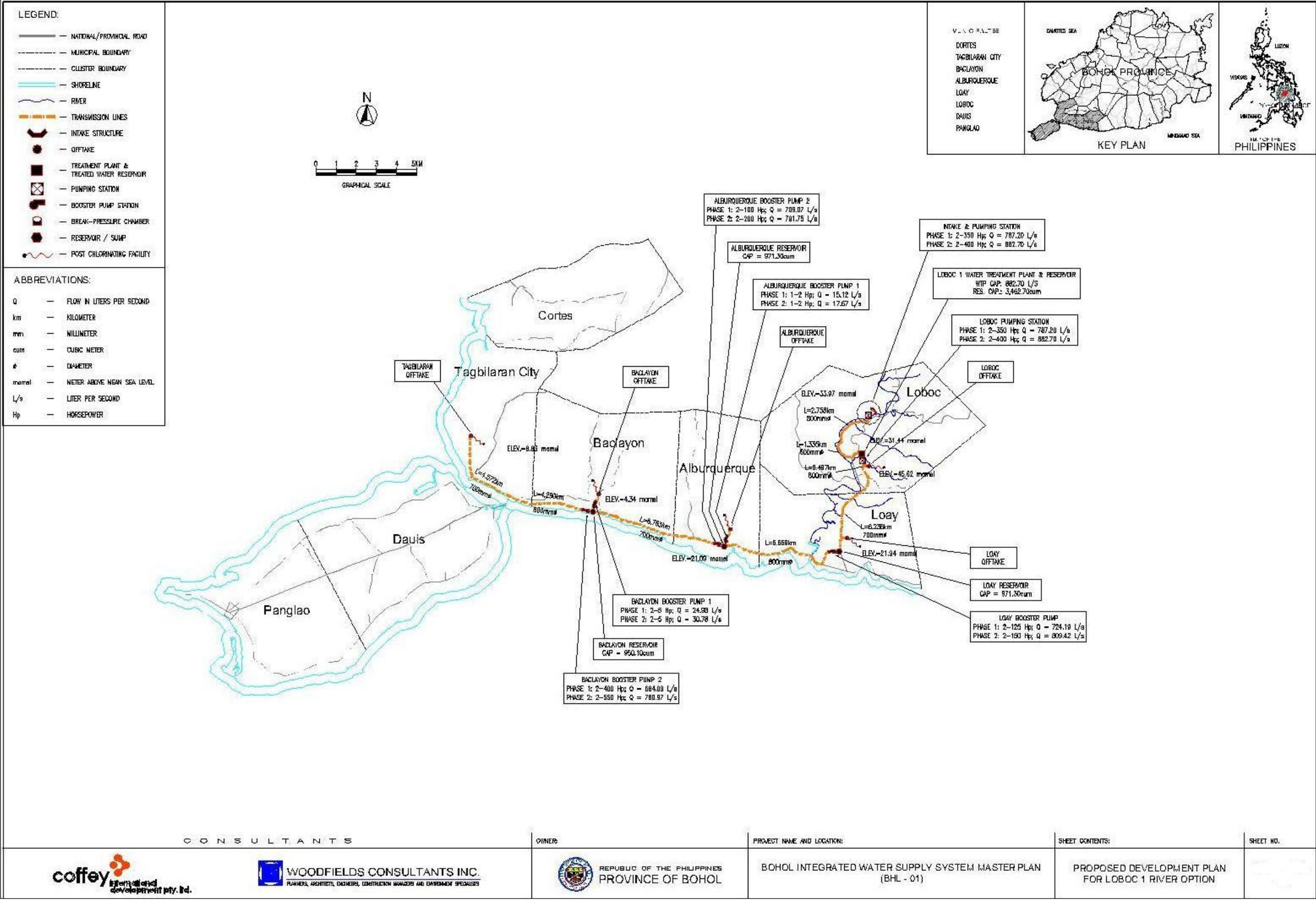


Figure 13 Loboc River Option

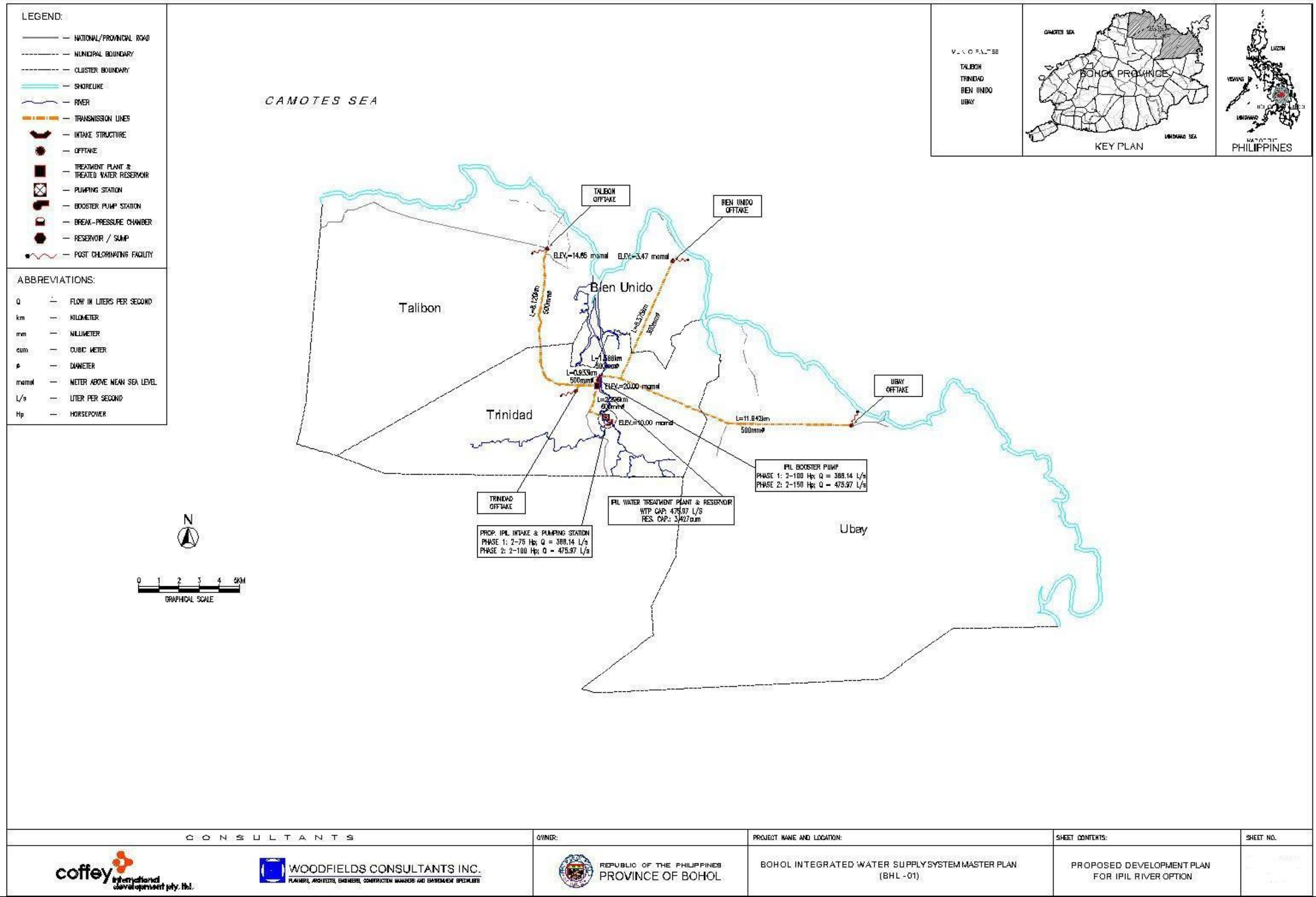


Figure 14 Ipil River Option

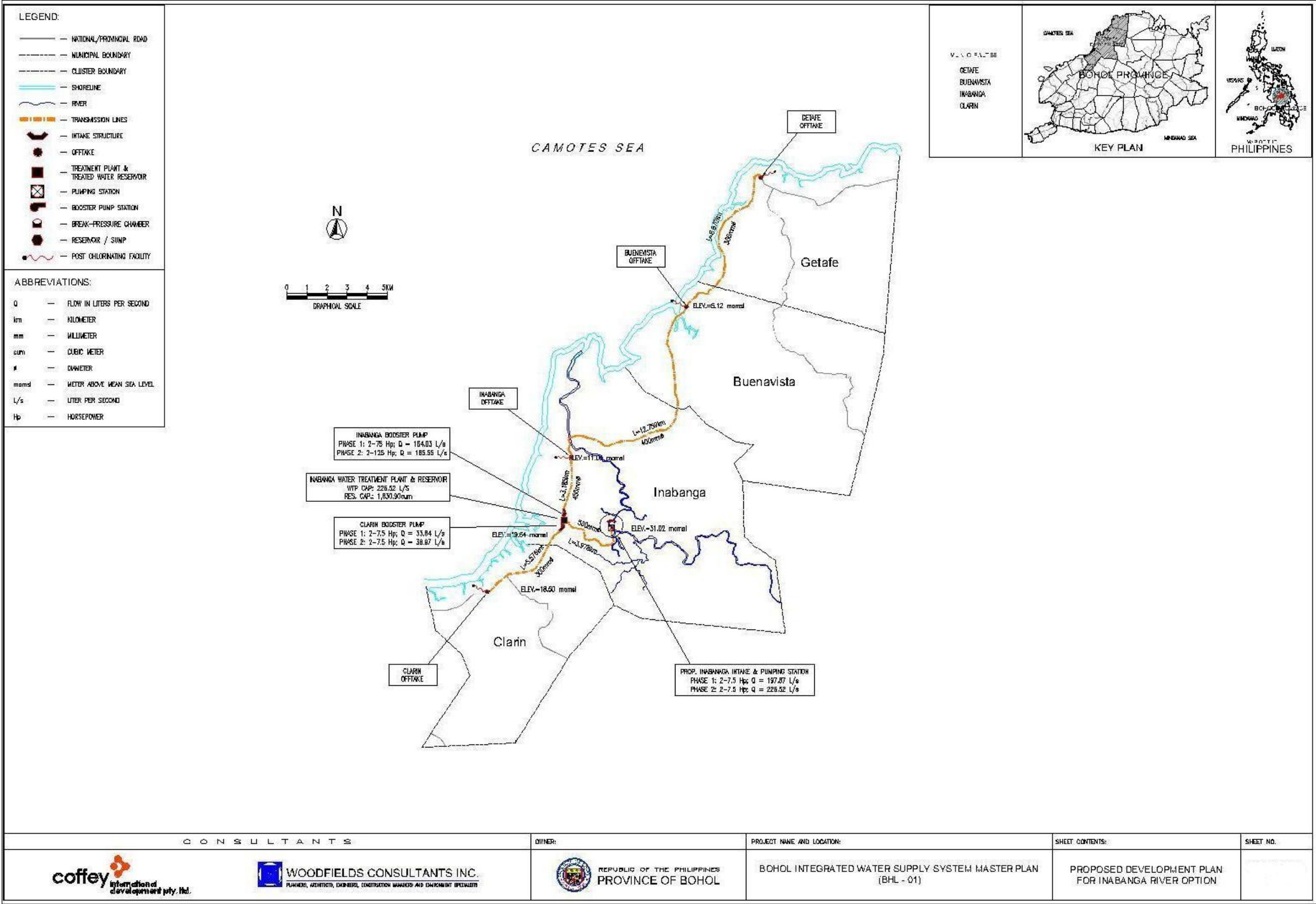


Figure 15 Wahig-Inabanga River Option

5.3 FINANCIAL ANALYSIS

The summary of project cost estimates of different options is presented in **Table 4**. Abatan-Loboc River Option has the lowest development cost among all options evaluated. However, further in-depth study has to be pursued in order to optimize the proposed bulk water supply system.

5.3.1 Bulk Water Supply to Metro Tagbilaran and Panglao Island Tourism Estate

The results of the financial feasibility analysis (**Table 5**) indicate that the Abatan-Loboc River Option could be viable. For an FIRR of 12%, the derived bulk water price is PhP25.73 per CuM. For a scenario of 30% increased sales and 20% decreased project cost, the derived bulk water price is PhP16.42 per CuM. For an FIRR of 15%, the derived bulk water price is PhP31.31 per CuM.

The Abatan-Loboc Option Phase 1 analysis resulted in a bulk water price of PhP21.14 per CuM at 12% FIRR, well within the BWUI commercial bulk water price of PhP25 per CuM. If sales increase by 30% and project cost decreases by 20%, the derived bulk water price is PhP13.47 per CuM. If the investment proponent would borrow about 60% to 70% of project cost from a local or international financial institution or consortium, return on equity would increase and bulk water price would decrease.

The other alternative of supplying water to Metro Tagbilaran is the Loboc River Option. However, this alternative is costlier and less viable than the Abatan-Loboc River Option.

The Loboc River Option has an estimated project cost of PhP2.2 billion at 2007 prices, which is nearly PhP100 million more expensive than the Abatan-Loboc River Option.

At 12% FIRR, the derived bulk water price of the Loboc River Option is PhP35.07 per CuM. If sales increase by 30% and project cost decreases by 20%, the bulk water price would be PhP22.59 per CuM, which is below the commercial bulk water rate of PhP25 per CuM. At 15% FIRR, the derived bulk water price is PhP43.72 per CuM.

5.3.2 Bulk Water Supply to the Northeastern Industrial Zone

For the Wahig-Inabanga River Option, at FIRR of 12%, the derived bulk water price is PhP39.91 per CuM. For a scenario of 30% increased sales and 20% decreased project cost, the derived bulk water price is PhP25.18 per CuM. For an FIRR of 15%, the derived bulk water price is PhP51.02 per CuM.

At 12% FIRR, the derived bulk water price of the Ipil River Option is PhP31.22 per CuM. If sales increase by 30% and project cost decreases by 20%, the bulk water price would be PhP19.65 per CuM, which is below the commercial bulk water rate of PhP25 per CuM. At 15% FIRR, the derived bulk water price is PhP40.11 per CuM.

Table 4 Summary of Project Cost Components

		Options In Million Pesos at 2007 Prices				
Item No.	Description	Abatan-Loboc River		Loboc River	Ipil River	Wahig-Inabanga River
		2010	2018	2010	2010	2010
A	FACILITIES/ STRUCTURES					
1	Source Facility	7.79	3.98	3.98	7.15	10.73
2	Pipelines	473.45	462.99	1,001.43	427.09	396.44
3	Pumping Stations	6.28	11.61	24.10	3.93	3.32
4	Storage Facilities	32.80	24.25	63.55	34.27	16.31
5	Water Treatment Plant	492.00	270.60	762.60	493.44	195.70
6	Power Source Development	0.45	13.99	40.93	7.27	4.28
7	Land/ROW Acquisition	0.39	0.53	0.81	0.40	0.44
8	Stored Materials, Equipment and Vehicles	7.19	7.05	15.32	6.45	5.97
B	TOTAL BASE COST (TBC)	1,030.28	794.99	1,912.73	980.00	633.19
C	Feasibility Study, and Detailed Engineering Design (3.0% of TBC)	30.91	23.85	57.38	29.40	19.00
D	Contingency (8.0% of TBC)	82.42	63.60	153.02	78.40	50.66
E	Construction Management Supervision (2.0% of TBC)	20.61	15.90	38.25	19.60	12.66
		1,164.22	898.34			
F	PROJECT COST ESTIMATE	2,062.56		2,161.38	1,107.40	715.50

Table 5 Highlights of Results of Financial Analysis

River Cluster Area	LGUs Served	Projected Population to be Served	Estimated Project Cost in Million Pesos at 2007 Prices	Pesos at 2007 Prices per Cubic Meter					
				FIRR=15%	FIRR=12%				FIRR=0%
					Base Case	+30% Sales	-20% Cost	+30% Sales & -20% Cost	
Wahig-Inabanga	Clarin, Inabanga, Buenavista & Getafe	97,351	715.51	51.02	39.91	30.70	32.73	25.18	9.55
Ipil	Talibon, Bien Unido, Trinidad & Ubay	179,790	1,107.40	40.11	31.22	24.02	25.55	19.65	7.23
Abatan-Loboc									
Phase 1 (2013 - 2017)	Cortes, Tagbilaran City, Dauis & Panglao	203,825	1,164.22	26.08	21.14	16.26	17.51	13.47	6.24
Phase 2 (2018 - 2035)	Loboc, Loay, Alburquerque, Baclayon, Tagbilaran City, Dauis & Panglao		898.34	5.23	4.59	3.54	3.84	2.95	2.40
Total Abatan-Loboc			2,062.56	31.31	25.73	19.80	21.35	16.42	8.64
Loboc	Loboc, Loay, Alburquerque, Baclayon, Tagbilaran City, Dauis & Panglao	203,825	2,161.38	43.72	35.07	26.98	29.37	22.59	11.17

7.0 CONCLUSIONS AND RECOMMENDATIONS TOWARDS REALIZATION OF THE MASTER PLAN

- 1) In the preparation of master plan, sufficient time and funding are needed to come up with a more comprehensive study in one cycle. However, even with some limitations, this study was able to address the initial requirements towards the three pillars of IWRM, such as, a) a step on the process of enabling environment of policy was formulated, b) an organizational structure which will implement the policy was developed, and c) the management instruments to be used by the organization has just started. Therefore, all of these actions should be pursued to attain the ultimate goal of protecting and conserving the water resources of Bohol.
- 2) Effective watershed management and planning that will ensure protection of the watershed should be part of the strategy for continuous availability and sustainability of water for groundwater and surface water sources.
- 3) The welfare of women and children should always be given attention in development projects, like in this master plan. As an IWRM principle, “Woman play a central part in the provision, management and safeguarding of water”, hence the need to involve them in decision making in matters pertaining to water issues.
- 4) The proposed GAD interventions prior to implementation that will ensure participation of women in the realization of the master plan should include: a) institutionalization of gender-responsive water policies; b) creation of a coordinating center for GAD mainstreaming in Bohol; c) nurturing GAD advocates in water activities, and development of a creative but efficient information dissemination plan on GAD. Men and women from the clusters should take active participation in formulating water policies for Bohol.
- 5) The master plan should also involve putting in place a GIS-based management information system accessible to all stakeholders, particularly the LGU. Since the plan would cover the whole province, an information system would be very useful in gathering information, updating situation and keeping track records. This will facilitate coordination and communications between water managers and the LGU officials, as well.
- 6) The recommended monitoring and evaluation system for this Master Plan should adopt a strategy map and balance scorecard, which will be used as tool for translating the vision into action and will be measured based on (a) customers', (b) process, (c) financial, and (d) learning and growth perspectives.
- 7) A marketing strategy should be pursued to promote private sector investment and local commercial and industrial development based on having improved access to safe and reliable water supplies, which is also part of plan to attain water sustainability for Bohol, including the promotion of water conservation measures.
- 8) The Master Plan must be periodically updated at least once every 5 years, or sooner if significant changes occur. Updating is necessary to assess the effectiveness of the current plan, benefits gained, the actual costs, the problems and constraints encountered; and to provide overall review, refinement and direction for the future.
- 9) Proper disposal and treatment of sewage and other liquid wastes should be implemented. Since improved water supply system would result in increase in wastewater, proper disposal system, particularly, in the urban areas should be considered in planning for future water supply projects.

- 10) Affordable bulk water systems should be considered in priority development areas. Based on the financial feasibility analysis, the Abatan-Loboc River Option that would supply water to Panglao Island Tourism Estate, and Metro Tagbilaran City and adjacent areas appears to be commercially viable, particularly the Phase 1 that would tap water from the Abatan River.
- 11) In order to further reduce investment costs of different options or clusters presented in the Master Plan and to make it affordable to consumers/residents and attractive for private sector participation, it is recommended that a feasibility study focusing on different viable water resources alternatives must be pursued. A need to evaluate groundwater availability with due consideration to safe yield, particularly in areas where population is small and/or sparse, far away from potential surface water sources, and affordability of tariff.
- 12) The groundwater resources as an option may be considered for immediate potential sources. Gradual phasing out of groundwater will be done when water demand increases which will require the development and use of surface waters as the ultimate sources.