Chapter 7

WATER SOURCE DEVELOPMENT

7. WATER SOURCE DEVELOPMENT

7.1 General

The study on water source development covers the entire province in order to come up with water source potential exploitable mainly as domestic water supply. Emphasis is placed on groundwater availability due to its prevalent use and comparatively conservative development expected through the future in the jurisdiction of the provincial government. It is also advantageous to utilize groundwater for domestic water supply because of better quality and economical use. Nevertheless, with reference to river basin water resources management, surface water potential of major rivers was studied to provide information for the future use.

A "Groundwater Availability Map" was prepared, which identifies the areas with available potable water sources. The study has two major components: (1) interpretation of existing geologic and groundwater conditions and (2) preparation of Groundwater Availability Map to show groundwater potential areas under three categorized areas. Furthermore, standard well specifications by municipality were also established to reflect in the medium-term sector development plan.

The major data used in the study were obtained from concerned agencies (NAMRIA, BMGS, NWRB, LWUA, DPWH and PPDO) and supplemented by the information gathered through questionnaires from relevant local offices in the field (including spring inventories with verifications). The field information directly collected by the Study Team was also used to increase the accuracy of the Map. Among the information, the Geologic Map published by BMGS, the Water Resource Investigation Report and the Well Inventory Database of NWRB are essential for the analysis of geological characteristics, projection of high yielding area and possible area with saline water intrusion, and classification of groundwater potential areas, respectively (details are referred to Table 7.1.2, Data Report).

The Groundwater Availability Map may be used for provincial level master plan and feasibility study at present. However, recommendations on the required investigations were presented for specific areas with scope of survey, as reference for LGUs, to conduct these prior to D/D and construction work. Aside from the requirements, updating the map is a requisite to gain more information on prevailing groundwater conditions using the questionnaires prepared for the study. An annual review and updating of the database will enable the LGUs to implement water source development on a project site basis.

An overview on current groundwater use with the conditions is summarized in Table 7.1.1 (well data collected from each municipality are presented in Table 7.1.1, Water Source Information, Data Report). There are 12,761 shallow wells, 2,616 deep wells and 250 developed springs in the province (functional sources). Majority of the wells is shallow wells. Only about 16% of these water sources are public facilities. Of the total existing wells, 7,874 shallow/deep wells are not functional at present. In addition to the above sources, 42 untapped springs are accounted.

Table 7.1.1 Existing Groundwater Sources in the Province

Category and Classification	Shallow Well	Deep Well	Spring	Total
1. Water source being availed				
a. Public sources	1,711	587	250	2,548
b. Privately owned sources	11,050	2,029	0	13,079
c. Number of water sources	12,761	2,616	250	15,627
d. % share of different sources	82%	17%	1%	100%
2. Water sources with problems and non-functional facilities				
a. Water quality problems*	5,104	0	0	5,104
b. Non-functional	6,824	1,050	190	8,064
3. Spring source information				
a. Undeveloped	-	-	0	0
b. Untapped	-	-	42	42

Note. 1: Number of water sources being availed at present including those with water quality problems.
2: Number of existing water sources with problems: being used, but with water quality problem/abandoned wells.
3: Number of springs availed, but not adequately protected; and those as candidate sources to be developed.
*: Assumed number of sources (unsafe category) based on the study on existing water supply facilities in Chapter 4.

7.2 Geology

The geology of Aklan province located in the northwestern part of Panay Island is complex and attributed mainly to tectonic and magnetic actions generated from Cretaceous to Quaternary time. The high mountains of the province formed by the oldest rocks, largely volcanic origin, are the completely folded and faulted assemblages of igneous and metamorphic rocks. During late Miocene epoch, serpentinized igneous rocks of Cretaceous period to Oligocene epoch are assumed to have intruded through old fractures accompanied by faulting.

Overlying unconformably the basement complex is the Tertiary sequence of volcanic and sedimentary rocks, which forms the lower hills and the rolling areas in the middle portion of the province. The physical geography of the province is characterized by broad lowland

thickly covered by shale, sandstone and alluvium with maximum thickness of 150m at Kalibo. This plain is bounded on its western and southern side by continuous mountain ranges. This area extends far from inland until it encounters the foothills of the western highlands. There is one individual and small plain located in Malay. However, the thickness of this alluvium is only about 10m.

The Buruanga Peninsula, located at the northwestern margin of Aklan, is considered to be an uplifted block with a peninsular neck. This narrow N-S trending valley is now mostly covered with Pleistocene sediments, except where erosion has exposed the older rocks. In general, the fault-line structures are observed to be left lateral conforming to general movement of the Philippines. These geologic structures are believed to affect the movement of groundwater in the province.

For the purpose of preparing the Groundwater Availability Map of the province, only rock units significant to groundwater storage and permeability are briefly described. The rock units in the province are classified into 3 main groups based on the geologic ages. In geologic age these are; the Miocene and Older Systems, the Plio-Pleistocene Series and Recent Deposits. The grouping of rock units is related to their potential as groundwater sources. The younger rocks are essential in groundwater development because of their porosity and permeability relative to the older rocks. The distribution of these rock groups is shown in Figure 7.2.1, Geological Map. Its geological features are described below.

(1) Miocene and Older Systems

Rock units of Miocene and older systems are impermeable, which are classified as aquicludes. These rock systems are found in central highlands and two mountain systems at both eastern and western parts in the province. Basement complex of Mesozoic era is composed of serpentine, basalt flows and metamorphic rocks, commonly fractures. Groundwater is limited to fractured and weathered zones.

Basement complex in the western province represents the folded metamorphosed rocks possibly sedimentary origin, which forms the Buruanga Peninsula. Intrusive rock unit of Neogene period consists of nudge-like shaped quartz diorite. It is essentially quartz, biotite, hornblende and oligoclase with accessories of magnetite and disseminated pyrite.

The sedimentary rocks of Neogene period are composed of massive, amygdaloidal, agglomeritic and partly brecciated to basaltic lava flows intercalated with shale, conglomerate and limestone.. It is exposed on the eastern side of the neck of the Buruanga Penin-

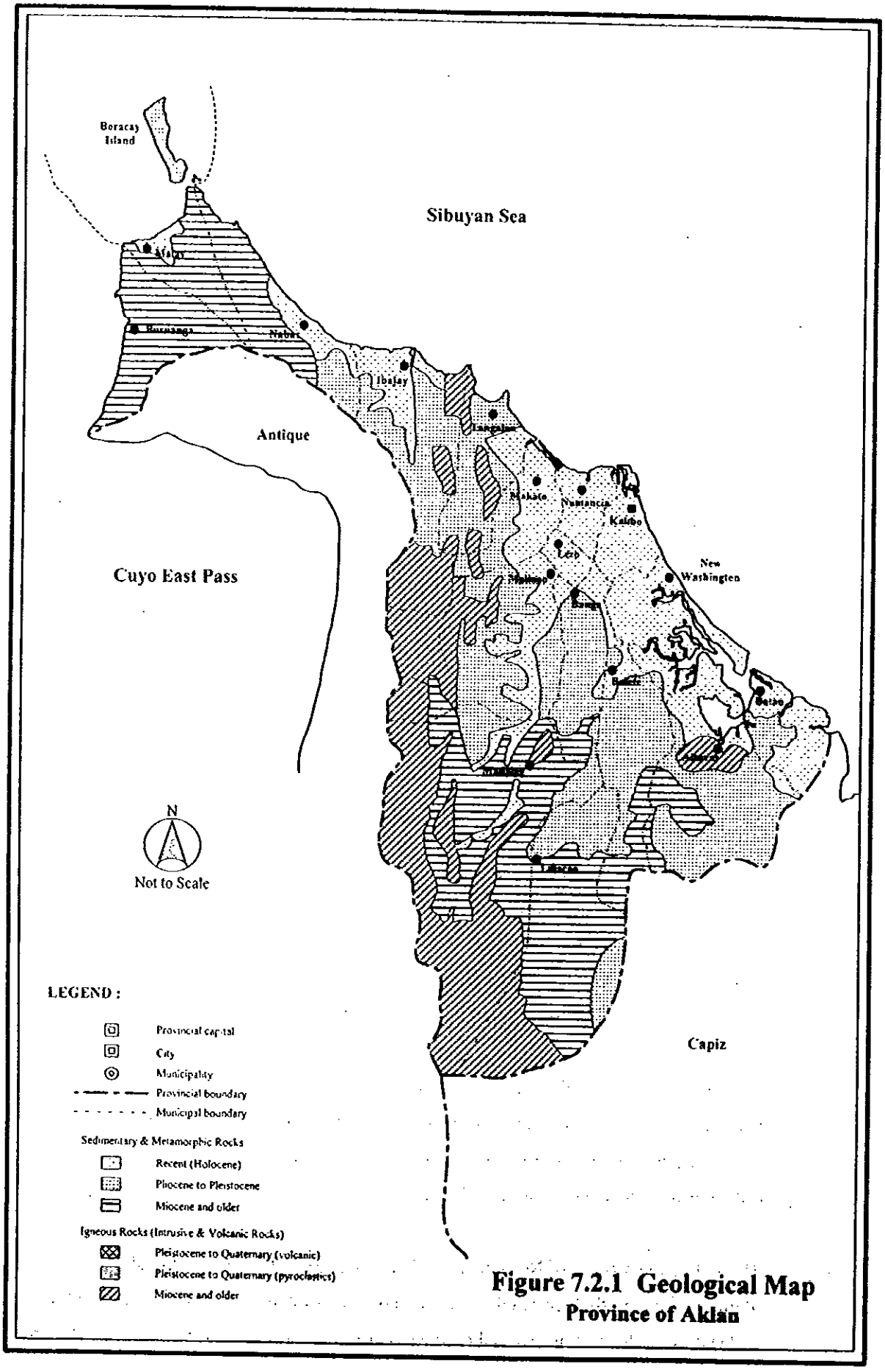

Figure 7.2.1 Geological Map
Province of Aklan

sula. The exposed thickness of this sedimentary rock formation is at least 1,000m.

(2) Plio-Pleistocene Series

The sedimentary rock units of Plio-Pleistocene epochs have various ranges of permeability and are extensively exposed in the middle portion of the province and in the western side of Buruanga Peninsula. In such areas, the sedimentary rock units overlie unconformably on the metamorphic rocks. It consists of gently to moderately dipping conglomerate calcareous mudstone to siltstone and shale limestone. The limestone comprises coralline, partly marly, sandy rubbly with gravel and clay, which are accumulated in depressions of the formation.

(3) Recent Deposits (Holocene Series)

The alluvium consists of lenticular, intertonguing loose coastal and river deposits of clay, silt, sand, gravel and shells. These are the detrital fragments weathered and eroded from the pre-existing rocks and transported mainly by water into the river valleys, coastal plains and beaches of the area. The most extensive plain in the province is located in the northeast of the basin formed by Aklan River. In the upstream portion of Aklan River, it also includes unconsolidated terrace gravel deposits locally found along the river, extending N-S from Lezo to Madalag. These formations have suitable grain sizes for the deep well construction using the natural gravel packed method.

The alluvium also includes the coral reefs fringing and is still growing on the coastal plains and on the partly submerged portion of Buruangan Peninsula. However, this formation is limited and the coastal aquifers are encroached by seawater.

7.3 Groundwater Sources

7.3.1 Classification of Groundwater Availability

For planning purpose, the provincial area is divided into the following sub-areas in terms of groundwater availability.

(1) Solo shallow well area

Solo shallow well area is defined in this study as the area where only shallow well is available. These areas have water bearing rock formations extending not more than 20m in depth below the ground surface. Solo shallow well areas are usually located in alluvial, coastal plains and inland small basins, where recent unconsolidated materials overlie on the impervious rocks at shallow depth. The extent of completely solo shallow well

area is limited, because most of the recent formations are thick or deposited on the Late Plio-Pleistocene series that usually have multiple aquifers located at greater depths.

(2) Deep well area

In deep well areas, the lower aquifers are located more than 20m below the ground surface. These areas could be found in portions underlain by the Plio-Pleistocene series and Recent formations. Most of these areas have several aquifers occurring at various depths. In this area, shallow wells can also be developed.

(3) Difficult area

This area is not suitable for well development. The areas under this category largely consist of rock formations older than Miocene epoch. The groundwater availability in the aforesaid rocks is very low and water is rarely released in the opened rock fractures. Springs are the common sources of water supply in these areas.

In addition to the above classification, potential areas to have high yielding deep aquifers are also presented based on NWRB's geo-resistivity survey.

7.3.2 Groundwater Availability in the Province

The Groundwater Availability Map is presented in Figure 7.3.1. The major databases used in the preparation of the map were obtained from BMGS and NWRB. The methodology and study procedures with respective outputs are discussed in 7.3.2, Supporting Report.

Technical information on the wells by municipality is also shown in the Data Report. The groundwater development potential areas in the province for the future are summarized.

(1) Solo shallow well area

Solo shallow well areas in the province are limited. The development of shallow wells is, however, possible in the "Deep Well Area" (recent alluvium and beach deposits), where shallow aquifers usually occur.

The essential definition of shallow well is to develop an unconfined aquifer. However, it is difficult to classify an aquifer into confined or unconfined. In this study, therefore, the well classification was made referring to the well depth of 20m as the boundary. The depths of shallow wells in the province were assumed ranging from 3.0 to 19.0m. The static water levels are from 1.0 to 16.5mbgs and specific capacities from 0.1 to 28.2lpsm.

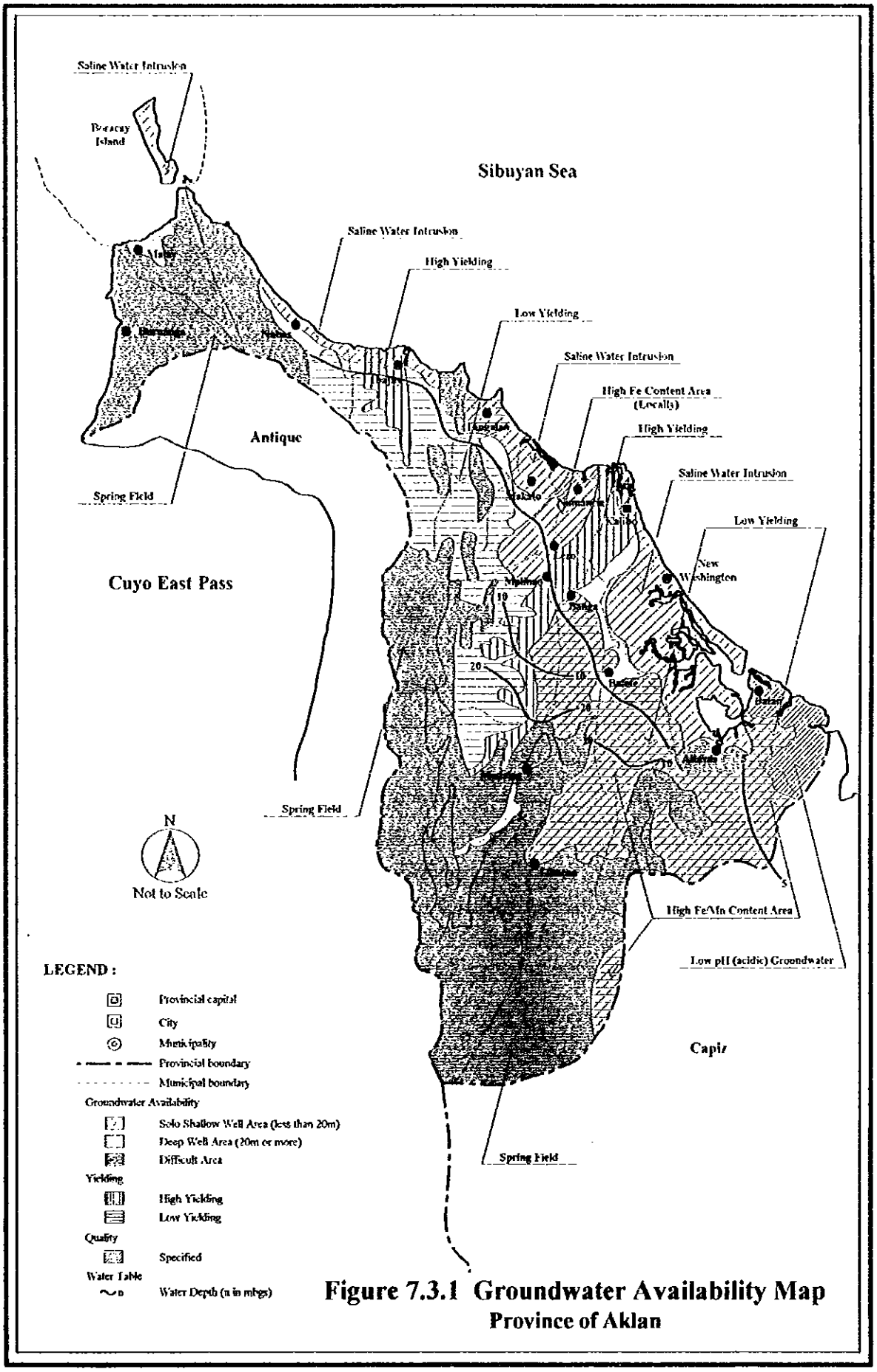

Figure 7.3.1 Groundwater Availability Map
Province of Aklan

(2) Deep well Area

The deep well area covers approximately 55% of the province, widely distributed in northeastern part of the province. The deep well area is composed of alluvial plain and low hills made of sedimentary rocks. The alluvial plain is composed of recent deposits of clay, silt, sand and gravel, which form a groundwater storage basin for some aquifers. While, the sedimentary formations of Plio-Pleistocene epoch consist of conglomerate calcareous mudstone to siltstone and shale limestone in northeastern slope of the western Cordillera of the province.

Considering the geological formation, the alluvial plain is categorized as a high potential area for deep well development, while the sedimentary rocks of Plio-Pleistocene epoch are classified as a low-yielding area for deep well development. In alluvial plain, the average depth of the existing deep wells is 24.7 m with an average water level of 11.3 mbgs. The average specific capacity is 0.2 lpsm.

(3) Difficult area

About 45% of the provincial area are classified as the difficult area to exploit groundwater, in which the western Cordillera and Buruanga Peninsula areas exist. These are located in the southwestern and western portions of the province.

The geology is made up of 1) serpentine, basalt flows and metamorphic rocks of Mesozoic era, 2) folded metamorphosed and intrusive rocks of Neogene period and 3) sedimentary rocks of Neogene period. These rocks and formations are in dense, massive and consolidated conditions and have impervious characteristics. Groundwater occurs only in fissures, fault fracture and weathered zones.

7.3.3 Groundwater Quality

The water quality problem in deep wells is found in the northwestern plains and hills (details are referred to Table 7.3.2, Data Report). Major water quality problem is ironic groundwater and saline water intrusion. The results of water resources investigation for the province conducted by NWRB and the general information from DPWH-DEO and PPDO revealed these problem areas and are shown in the Groundwater Availability Map in Figure 7.3.1.

Among the water quality problems of the province, ironic water is serious with a high percentage of affected existing wells (about half of the numbers of deep wells) in populated area. The problem is extended to most of the areas in the municipalities of Makato, Numancia,

Lezo, Banga, Balete and Altavas. Groundwater with saline water intrusion is developed in most of northwestern seashore and in the municipality of New Washington. Slight acidic groundwater was reported in the municipalities of Altavas and Batan, due to oxidization within the volcanics vicinity.

7.4 Spring Sources

Spring is a natural outlet of groundwater at the ground surface. It occurs when water table intersects the ground surface, usually along the contacts of pervious and impervious rock formation and through rock features. Because of the intense fracturing, particularly older formation, and the presence of large solution openings in limestone, secondary permeability is induced to the rocks that favors spring development.

For the study, springs are categorized into developed, undeveloped and untapped springs. A developed spring is utilized with sanitary protection provided, otherwise it is classified as undeveloped spring, which is considered as unsafe water source. An untapped spring, as the name implies, is unutilized and flowing in its natural state.

Based on the inventory of water sources prepared throughout the study, the province has 250 developed springs currently serving the province. Such spring sources come out from the Cordillera and from Buruanga Peninsula areas in the northwestern and western parts of the province. Of these springs, 32 have discharge rates of less than 2.0 lps (2.0 lps is enough for Level II water supply with service population of about 2,000 and can be applicable for small Level III water supply), while 27 springs exceed discharge rates of 2.0 lps. The other 191 developed springs have no data available on discharge rates at present. Most of these springs are not dried up during a drought year or dry season, though yields varying from 0.1 to 30 lps. The technical information of springs in each municipality is presented in Table 7.4.1 Existing Spring Sources, Supporting Report.

7.5 Surface Water Sources

The major surface water sources in the province are Malay, Ibajay, Tangalan, Aklan and Halo Rivers. The Malinao, Kinalanga, Timbaban, Dumalaylay and Dit-ana rivers are tributaries of Aklan River. There are 2 gauging stations at the major rivers in the province.

Surface water amount used in the province totaled to 17.6 m^3/sec according to the NWRB's water rights registration database as of March 1997. Of this usage, 98.2% of the water rights

were registered for irrigation. The diversions for major flume, which are operated by NIA, are located at Ibajay, the Ibajay River; and at Banga, the Aklan River. Other surface water rights are lodged to Philippine Tourism Authority (PTA) and private companies for domestic, fisheries and recreation uses. For domestic water supply, PTA and Boracay Utilities Inc. are entitled in 1997 intake 0.12 m^3/sec at Malay from the Nabay and Putol rivers. They will utilize the surface water fetching to improve the environmental sanitation in Boracay Island. Also, surface water with total amount of 0.17 m^3/sec is registered for fisheries in the municipalities of Altavas, Batan, Ibajay, New Washington, Numancia and Tangalan.

Data on river flow including maintenance flow and water use of the major rivers/streams were obtained from available runoff records at the gauging stations (refer to Table 7.5.1, Supporting Report). The inflow to and the outflow from the respective municipalities are estimated as the exploitable potential of the major rivers in the province as shown in Table 7.5.2, Supporting Report.

Water quality analyses at selected rivers were conducted during this study. The examined water quality at each river meets the Class A or B limitation of "DENR Fresh Water Quality Criteria". Mining activities on silica are prevalent in the western watersheds (municipalities of Navas and Tangalan). These operations cause no discharge of harmful mine waste to the rivers.

7.6 Future Development Potential of Water Sources

(1) Groundwater

Based on the study of existing water sources, groundwater is considered as a safe and more economical source for future water supply requirements of the province.

Shallow wells are the possible source for Level-I service. Considering the existing wells in the province, the potential aquifers for shallow wells occur between 3.0 to 19.0 mbgs. One disadvantage of shallow wells is the lowering of water level during dry season that reduces the discharge rate of the wells or disturbs the hand-pump operation. Another disadvantage is the usual high susceptibility of shallow aquifers to direct infiltration of surface pollutants.

In general, deep wells have better water quality and invariable yields when developed with appropriate technology. This depends if the wells tap to comparatively deeper aquifer. It reduces the hazards of groundwater pollution. In addition, lowering of static

groundwater level does not affect the discharge rate and the hand-pump operation. In Recent deposits and Plio-Pleistocene series, good aquifers apparently occur from 20 mbgs to 56 mbgs in depth.

Additional wells can still be developed to meet future water supply demand of the province. For future planning purpose, the Groundwater Availability Map includes basic information for municipal groundwater development with the following information: well type, well yield, water quality and static water level. Aquifer formations are shown in Table 7.6.2, Supporting Report. The groundwater development potential in the province is shown in Table 7.6.1.

The well design with gravel placement is required for additional well development. However, the natural gravel packed well for Level-I water supply is also adaptable within limited areas in the province. The percentages of the natural gravel packed wells to the total potential number of wells to be developed in the expected municipality areas are assumed in Table 7.6.3, Supporting Report. The construction ratio of natural gravel packed wells to the total requirements of the province is assumed at merely 5%.

Most of the Level-I deep well facilities had been designed with well materials made of either galvanized iron, mild steel or low carbon steel. However, in the area where groundwater with acidic pH is observed, anti-metallic (polyvinyl chloride; PVC) and anti-corrosive metals (stainless steel; SUS) for well casing pipes and screens, and hand-pump facility are required. The municipalities requiring such countermeasures are recommended in Table 7.6.4, Supporting Report. The ratio of deep wells using PVC materials to the total requirements of the province is assumed at about 5%.

(2) Spring

A total of 42 untapped spring sources identified by the PSPT is listed in Table 7.6.5 Untapped Spring Source Identification, Supporting Report. The list includes detailed data on barangay name, owner, discharge rate in dry season and transmission line length. However, the information on relative elevation between spring source and served area is not available at present. Such springs are mainly located at slopes on the southwestern Cordillera and Buruanga Peninsula. Other areas have few untapped springs. Of these springs, 20 untapped springs with discharge rates ranging from 0.5 to 5.0 lps (actual data base) are generally applicable for Level-II water supply. Spring development potential in the province is shown in Table 7.6.5, Supporting Report.

Table 7.6.1 Groundwater Development Potential in the Province

Area	Groundwater Development Potential	Water Quality	Area Feature
Southern Mountain Range & Buruangan Peninsula	Most of this district is classified as difficult area. There are some possible areas where groundwater can be developed at fractured or weathered metamorphic rock formation. The areas fall on the municipalities of Malay, Buruanga and Libacao locally. A few spring sources for Level-II water supply are found in this area. These spring eyes are located in mountain areas with a distance of 3km to 5km from populated barangays. There is deep well area in Altavas, but its productivity is low. Groundwater level is about 5 to 10 mbgs. There are also solo shallow well areas where the coastal plain and the river bottom plain are distributed in the municipalities of Malay and Madalag.	Existence of ironic groundwater is confirmed in deep well area of Altavas. In other areas, there is no groundwater quality problem both in wells and springs.	The physiographic feature is the northern portion of western Cordillera flanking Panay Island including Buruanga Peninsula. This area covers the western and southwestern parts of the province consisting of five (5) municipalities from Malay to Libacao. The Cordillera consists of continuous mountain ranges. The slopes are highest and steepest with a maximum elevation of 1,650 m at Mt. Nausang. These highlands make up areas of the headwaters for the Aklan River and its tributaries.
Aklan & Ibajay Valleys, & Boracay Island	Most of this area is classified as deep well area. Majority of the existing wells is deep wells with depths of 20 to 56m. The deep wells along Aklan and Ibajay Rivers have sufficient discharge for Level-III water supply. Groundwater levels are shallow along the coast, while deep in upland with maximum water depth of about 20 mbgs. In the upstream areas of Aklan and Ibajay Rivers, unconsolidated terrace gravel deposits are locally found, extending N-S from Lezo to Madalag and Ibajay. These formations have suitable grain sizes for the deep well construction using the natural gravel packed method. There are very few spring sources in this district.	Saline water intrusion is reported along the coast. High iron contents in groundwater are examined in the municipalities of Numancia and Makato.	The physiographic feature is represented by the valley of Aklan and Ibajay Rivers, and the coral island of Boracay. Th e subject areas are north to northeast coastal part and Boracay Island consisting of ten (10) municipalities from Nabas to Balete. The most extensive plain in the province is located in the northeast of the basin formed by Aklan River. The western Cordillera makes up areas of the water source for Aklan River and its tributaries.
Eastern Mangrove Coast	This district is classified as deep well area, while shallow well is also available. However, numerous rainwater collectors are found in the municipality of New Washington due to groundwater quality problem. Majority of the existing wells is shallow wells with depths of 6m to 18m. The well yielding capacity both shallow and deep is generally low.	Groundwater quality both shallow and deep wells has saline and ironic problems. Saline water intrusion also affects groundwater in Boracay Island.	The physiographic feature of this district is the existence of mangrove area bordering the coastline. This district covers the east coastal part of the province consisting of two (2) municipalities of New Washington and Batan.

(3) Surface Water

The potential surface water volume exploitable from major rivers for the use of domestic water supply was estimated by municipality. It was arranged in this calculation to ensure maintenance flow of the rivers under the drought flow in the 10-year return period with due consideration of the present water rights.

The calculation results are shown in Table 7.5.2, Supporting Report. In particular, municipalities situated in the Ibajay and Aklan River basins are privileged to use larger amount of river water.

7.7 Water Source Development for Medium-Term Development Plan

For the preparation of the medium-term development plan in terms of water source development, standard specifications of wells by municipality were prepared. The parameters, such as: proportion of well type, well depth, static water level and specific capacity are shown in Table 7.7.1. These were established using the well information from NWRB and the province (detailed database is included in Table 7.1.1, Data Report), and the hydrogeological assessment presented in Table 7.6.2, Supporting Report.

Groundwater source availability (well and spring) is reflected in Table 7.7.1 that was assumed based on water sources study considering the limited information on geology, topography, water sources inventory, etc. The groundwater source availability indicates the general profile of the different types of groundwater source available in the municipalities. Hence, the descriptions have no projected meaning on future development values of its groundwater source. Considering the present water sources utilization, the percentages of spring development compared with well development for the future demand of the entire province are studied in Chapter 8 of this report.

Shallow wells are currently used in some municipalities. The municipal areas are categorized into deep well and solo shallow well areas considering the on-going practices. The proportions (%) by deep well and shallow well area are determined with reference to groundwater development potential in the Groundwater Availability Map. Furthermore, well locations are assumed in terms of rural and urban areas by municipality using the classification of rural and urban barangays.

For municipalities without any well data, the well parameters are estimated using the data of adjoining towns, provided they have similar hydrogeologic features.

Table 7.7.1 Standard Specification of Wells by Municipality

Municipalities With Classification		Type	Proportion (%)	Standard Specification					Availability of Sources
				Depth Range (m)			SWL (m)	Sp. Cap. (lpsm)	
Altavas	Rural	SW	0	-	<D<	-	-	-	Fair DW and Few SP
		DW	80	20.0	<D<	50.0	15	0.2	
	Urban	SW	0	-	<D<	-	-	-	
		DW	50	20.0	<D<	50.0	5	0.2	
Balete	Rural	SW	0	-	<D<	-	-	-	Fair DW and Few SP
		DW	70	40.0	<D<	-	5	0.2	
	Urban	SW	0	-	<D<	-	-	-	
		DW	100	40.0	<D<	-	5	0.2	
Banga	Rural	SW	0	-	<D<	-	-	-	Fair DW and Poor SP
		DW	80	40.0	<D<	-	5	0.2	
	Urban	SW	0	-	<D<	-	-	-	
		DW	100	40.0	<D<	-	5	0.2	
Batan	Rural	SW	0	-	<D<	-	-	-	Fair DW and Poor SP
		DW	100	20.0	<D<	50.0	1	0.2	
	Urban	SW	0	-	<D<	-	-	-	
		DW	100	20.0	<D<	50.0	1	0.2	
Buruanga	Rural	SW	0	-	<D<	-	-	-	Risky DW and Few SP
		DW	0	-	<D<	-	-	-	
	Urban	SW	0	-	<D<	-	-	-	
		DW	0	-	<D<	-	-	-	
Ibajay	Rural	SW	0	-	<D<	-	-	-	Good DW and Few SP
		DW	90	40.0	<D<	-	5	0.6	
	Urban	SW	0	-	<D<	-	-	-	
		DW	100	40.0	<D<	-	5	1.0	
Kalibo	Rural	SW	0	-	<D<	-	-	-	Good DW and Poor SP
		DW	100	40.0	<D<	-	3	1.0	
	Urban	SW	0	-	<D<	-	-	-	
		DW	100	40.0	<D<	-	3	1.0	
Lezo	Rural	SW	0	-	<D<	-	-	-	Good DW and Poor SP
		DW	100	40.0	<D<	-	5	1.0	
	Urban	SW	0	-	<D<	-	-	-	
		DW	100	40.0	<D<	-	5	1.0	
Libacao	Rural	SW	0	-	<D<	-	-	-	Risky DW and Few SP
		DW	10	40.0	<D<	-	20	0.1	
	Urban	SW	0	-	<D<	-	-	-	
		DW	50	40.0	<D<	-	20	0.1	
Madalag	Rural	SW	0	-	<D<	-	-	-	Poor DW and Few SP
		DW	10	20.0	<D<	56.0	15	0.1	
	Urban	SW	20	6.0	<D<	18.0	9	0.1	
		DW	0	-	<D<	-	-	-	
Makato	Rural	SW	0	-	<D<	-	-	-	Good DW and Poor SP
		DW	90	40.0	<D<	-	3	0.6	
	Urban	SW	0	-	<D<	-	-	-	
		DW	100	40.0	<D<	-	3	0.8	
Malay	Rural	SW	10	6.0	<D<	18.0	3	0.2	Fair DW and Few SP
		DW	20	40.0	<D<	-	5	0.2	
	Urban	SW	100	6.0	<D<	18.0	3	0.2	
		DW	0	-	<D<	-	-	-	
Malinao	Rural	SW	0	-	<D<	-	-	-	Good DW and Poor SP
		DW	80	20.0	<D<	50.0	10	0.2	
	Urban	SW	0	-	<D<	-	-	-	
		DW	100	20.0	<D<	50.0	5	1.0	

Table 7.7.1 Standard Specification of Wells by Municipality

(cont'd)

Municipalities With Classification		Type	Proportion (%)	Standard Specification: Depth Range (m)			SWL (m)	Sp. Cap. (lpsm)	Availability of Sources
Nabas	Rural	SW	0	-	<D<	-	-	-	Fair DW and Few SP
		DW	50	40.0	<D<	-	5	0.2	
	Urban	SW	0	-	<D<	-	-	-	
		DW	100	40.0	<D<	-	3	0.4	
New Washington	Rural	SW	0	-	<D<	-	-	-	Fair DW and Poor SP
		DW	100	20.0	<D<	50.0	3	0.4	
	Urban	SW	0	-	<D<	-	-	-	
		DW	100	20.0	<D<	50.0	3	0.4	
Numancia	Rural	SW	0	-	<D<	-	-	-	Good DW and Poor SP
		DW	100	40.0	<D<	-	3	1.0	
	Urban	SW	0	-	<D<	-	-	-	
		DW	100	40.0	<D<	-	3	1.0	
Tangalan	Rural	SW	0	-	<D<	-	-	-	Fair DW and Poor SP
		DW	80	20.0	<D<	50.0	10	0.2	
	Urban	SW	0	-	<D<	-	-	-	
		DW	100	20.0	<D<	50.0	5	0.2	

For the furtherance in collecting accurate information to design the concrete specifications of the planned wells, the following recommendations are made (details are referred to Chapter 7.7.1, Supporting Report). Prior to the detailed design or pre-construction stages, additional detailed groundwater investigations entailing the construction of test wells shall be conducted. The municipalities that fall on this group are Malay, Makato, Numancia, New Washington, Banga, Balete, Altavas and Batan. Table 7.7.2 summarizes these requirements.

Table 7.7.2 Detailed Groundwater Investigation Required

Municipality	Area	Investigation Activities and Specification
Malay, Makato, Numancia, Banga, Balete, Altavas & Batan	Urban & Rural	Water Quality Examination Type of Sources; deep well Water Quality Examination to include Fe, Mn, Cl, pH, Color, Turbidity, etc. Type of Sources; shallow well & spring (both developed & untapped) Water Quality Examination to include Fe, Mn, Cl, pH, Color, Turbidity, Bacteria, Coliform, etc.
New Washington	Urban & Rural	Groundwater Database; Parameters include geologic log, well structures, SWL, discharge and water quality Electric Prospecting; Sounding Depth and Points; 70 m x 100 points Test Wells; four deep wells depths of 30m to 50m, diameter of 100 mm and well screen length of 10m Installation of Test; Pumping Test & Water Quality Examination to include Fe, Mn, Cl, pH, Color, Turbidity, Bacteria, Coliform, etc.

In addition to the above requirements, the distribution program of improved rainwater collector facility should be promoted for rural water supply with due consideration on roof materials, reservoir with sand filtration and chlorination system.

Groundwater development for water supply in urban areas (Level-II and -III systems) may require the construction of deep wells with larger casing diameter of 6 inches or more to ensure larger production rates. In these cases, short spacing intervals between the adjacent wells often cause the well interference due to the large lowering of pumping water level when the adjacent wells are operated simultaneously in a longer period. As the remedy of the problem pump-operation with excess electric consumption and deterioration of deep well life may be obliged. Thus, appropriate spacing interval and number of wells to be constructed per km^2 shall be considered. Table 7.7.1, Supporting Report presents reference information on spacing arrangements for planned wells.

Spring sources, proposed by barangay level, for future developments are shown in Table 7.6.4, Supporting Report. They shall also be investigated to confirm the development possibility in the following items: (1) location and type of spring sources, (2) fluctuation of discharge rates throughout the year, (3) distance from spring sources and proposed served areas, and (4) relative elevation between the two points.

Chapter 8

FUTURE REQUIREMENTS IN WATER SUPPLY AND SANITATION IMPROVEMENT

8. FUTURE REQUIREMENTS IN WATER SUPPLY AND SANITATION IMPROVEMENT

8.1 General

Phased investments for provincial sector development, Medium-Term Investment (2001-2005) and Long-Term Development (2006-2010), are planned in almost the same manner as adopted in the 1998 Philippine National Development Plan (PNDP), the National Sector Master Plan (NSMP) and Updated Medium-Term Philippine Development Plan.

Targets of provincial service coverage for the two phases are established as percentages of beneficiaries or utilities to be served by sub-sector. Service coverage in the base year (1998) and national sector targets indicated in the National Sector Master Plan (NSMP) and the updated Medium-Term Philippine Development Plan, 1996 - 1998 (MTPDP) are the bases of the study. Sector targets which are not prescribed in the national plan; school and public toilets as well as sewerage are assumed based on the current conditions. In addition, preliminary discussions on solid waste management are included as a vital component of sanitation sector.

Projection of frame values by municipality is undertaken for respective sub-sectors; future population by urban and rural area, the number of student enrollment to public schools and the number of public utilities. Reference base figures for the study of framework are the 1995 Census of Population and Housing, the statistical data of the province and the information from relevant agencies. Municipal population by target year and the base year (1998) is estimated referring to the NSO population census results (past 3 census periods: 1980 - 1995), the 1995 Census-based Regional and Provincial Population projection prepared by NSO and the Provincial Physical Framework Plan/Comprehensive Provincial Land Use Plan.

Types of required facilities and their implementation criteria according to service level standards are referred to the NSMP and the NEDA Board Resolution No. 12 (s. 1995). Some planning conditions and assumptions not prescribed in the national plan are conferred to the relevant standards of sector agencies and provincial government. For sewerage requirements, the deficit in sanitation must first be addressed. Partial upgrading of on-site disposal to a sewerage system (off-site disposal) is envisaged in the final target year.

In estimating future requirements by municipality, additional population (or number of students/public utilities) to be served by sub-sector is first calculated as a shortfall at target years in comparison between each target and its base year service coverage. In this regard,

planned/on-going projects to be completed by respective base years are considered as part of existing services for each target year. Required number of facilities by sector component is then estimated corresponding to the said additional population (or number of students/public utilities) to be served. Rehabilitation work for Level I facilities limited to new deep wells to be constructed under PW4SP is taken into account. Generally, rehabilitation of deep wells and shallow wells constructed by means of conventional method is difficult.

Logistic support is considered as a minimum requirement of LGUs for community development and training, and other relevant activities along with the implementation of PW4SP. The types and number of well drilling/rehabilitation equipment and supporting vehicle for Level I facilities are also suggested as reference information. Also, minimum requirements for setting up a provincial laboratory to support drinking water quality surveillance and monitoring are described. This will include building, instrument/equipment and reagent/chemical requirements. The 1993 Philippine National Standards for Drinking Water (PNSDW) requires that initial examinations of water from newly constructed sources should first be undertaken before operation for public use and henceforth periodic examinations of these water supply sources/facilities.

Project priority for medium-term development is discussed entailing general criteria to identify specific projects. However, at the provincial level master plan, it is suggested that municipal priority ranking be used for allocation of provincial fund.

8.2 Targets of Provincial Sector Plan

Provincial sector targets for the years 2005 and 2010 are determined as the provincial average of the desirable minimum level for each sub-sector. Table 8.2.1 summarizes the target percentages to be served by sub-sector. Details by sub-sector are discussed in this subsection.

(1) Water supply

The base year (1998) service coverage was calculated as a total of 1998 figures and expected by planned/on-going projects scheduled to be completed by 1999. Table 8.2.2 shows service coverage for the planning purpose (details are referred to Supporting Report).

The base year service coverage in urban area (75%) is higher than the updated MTPDP sector target (69%) for the year 1998, while rural area (59%) is far behind the sector

target of 79%. As identified in Chapter 4, lower service coverage in rural area is considered to arise from existence of high percentage of underserved population.

Table 8.2.1 Provincial Sector Targets

Sub-sector	Base Year Service Coverage	Phase I (2001-2005)		Phase II (2006-2010)	
Water Supply	Population Coverage (%)	Population Coverage (%)	Additional Population to be Served	Population Coverage (%)	Additional Population to be Served
Urban Water Supply	75	76	15,564	95	83,592
Rural Water Supply	59	60	25,397	93	146,063
Sanitation	Household Coverage (%)	Household Coverage (%)	Additional Households to be Served	Household Coverage (%)	Additional Households to be Served
Household Toilet					
Urban Area	87	90	4,079	93	11,637
Flush	52	60	1,868	50	3,844
Pour Flush	39	35	2,084	50	7,793
VIP/Dry	8	5	127	0	0
Rural Area	65	78	13,362	93	33,628
Flush	4	0	0	10	3,174
Pour Flush	76	85	10,839	90	30,454
VIP/Dry	21	15	2,523	0	0
School Toilet	Public School Student Coverage (%)	Public School Student Coverage (%)	Additional Public School Students to be Served	Public School Student Coverage (%)	Additional Public School Students to be Served
	57	70	19,990	90	34,066
Public Toilet	Public Utilities Coverage (%)	Public Utilities Coverage (%)	Additional Public Utilities with Sanitary Toilets	Public Utilities Coverage (%)	Additional Public Utilities with Sanitary Toilets
	98	100	37	100	36
Sewerage	Urban Population Coverage (%)	Not Applicable		Urban Population Coverage (%)	Urban Population to be Served
	0			50	48,835
Solid Waste	Urban Household Coverage (%)	Urban Household Coverage (%)	Additional Urban House-holds to be Served	Not Applicable	
	54	80	10,983		

Table 8.2.2 Estimation of Base Year Service Coverage of Water Supply

Name of Municipality	Area	Population (1998)	Population Served by 1998 Facilities				
			Level III	Level II	Level I	Total	Percentage Coverage
Altavas	Urban	2,829	200	25	1,480	1,705	60
	Rural	19,311		750	8,464	9,214	48
	Total	22,140	200	775	9,944	10,919	49
Balete	Urban	1,727		75	852	927	54
	Rural	18,392		375	1,066	1,441	8
	Total	20,119		450	1,918	2,368	12
Banga	Urban	2,155			2,044	2,044	95
	Rural	28,914		1,850	14,159	16,009	55
	Total	31,069		1,850	16,203	18,053	58
Batan	Urban	1,569	1,225		5	1,230	78
	Rural	25,377	510	225	8,059	8,794	35
	Total	26,946	1,735	225	8,064	10,024	37
Buruanga	Urban	1,181		250	536	786	67
	Rural	11,535		2,725	4,753	7,478	65
	Total	12,716		2,975	5,289	8,264	65
Ibajay	Urban	2,738			2,147	2,147	78
	Rural	33,926	8,108	1,200	15,956	25,264	74
	Total	36,664	8,108	1,200	18,103	27,411	75
Kalibo (Capital)	Urban	62,774	30,205		18,614	48,819	78
	Rural						
	Total	62,774	30,205		18,614	48,819	78
Lezo	Urban	1,969	1,295		351	1,646	84
	Rural	10,393	829		5,576	6,405	62
	Total	12,362	2,124		5,927	8,051	65
Libacao	Urban	2,808			2,231	2,231	79
	Rural	20,959	2,695	1,150	10,213	14,058	67
	Total	23,767	2,695	1,150	12,444	16,289	69
Madalag	Urban	1,657	696	100	227	1,023	62
	Rural	16,032		600	2,828	3,428	21
	Total	17,689	696	700	3,055	4,451	25
Makato	Urban	2,928	1,506		800	2,306	79
	Rural	20,926	612	2,475	10,139	13,226	63
	Total	23,854	2,118	2,475	10,939	15,532	65
Malay	Urban	6,484			2,933	2,933	45
	Rural	17,000		2,400	5,967	8,367	49
	Total	23,484		2,400	8,900	11,300	48
Malinao	Urban	1,544	1,500		44	1,544	100
	Rural	20,893	684	825	12,017	13,526	65
	Total	22,437	2,184	825	12,061	15,070	67
Nabas	Urban	3,899			2,331	2,331	60
	Rural	18,098		3,900	8,934	12,834	71
	Total	21,997		3,900	11,265	15,165	69
New Washington	Urban	5,139			4,759	4,759	93
	Rural	28,002			24,549	24,549	88
	Total	33,141			29,308	29,308	88
Numancia	Urban	3,154	780		1,829	2,609	83
	Rural	20,910	6,381		11,816	18,197	87
	Total	24,064	7,161		13,645	20,806	86
Tangalan	Urban	2,834			1,658	1,658	59
	Rural	14,301		1,225	7,299	8,524	60
	Total	17,135		1,225	8,957	10,182	59
Provincial Total	Urban	107,389	37,407	450	42,841	80,698	75
	Rural	324,969	19,819	19,700	151,795	191,314	59
	Total	432,358	57,226	20,150	194,636	272,012	63

For Phase I development, targets of service coverage for water supply by urban and rural were set up considering the following conditions:

i) at least the existing service coverage shall be secured to meet population increase: and

ii) viable investment using available IRA to be allocated to water supply sector shall be considered.

Thus, 76% for urban and 60% for rural area, which are each 1% increase of the existing service coverage, are established for the medium-term period.

Phase II targets are planned to increase urban and rural water supply coverage to 95% and 93%, respectively, as envisaged in the NSMP.

(2) Sanitation

1) Household toilets

As with water supply, the base year service coverage is calculated as shown in Table 8.2.3 reflecting any planned or on-going projects scheduled to be completed by 1999 (details are referred to Supporting Report).

The province has base year service coverage of 70%, which is above the current national average coverage of 60%. Urban and rural area registers a level of 87% and 65%, respectively. Both of them are above the national average coverage. By type of sanitary toilet facility, the existing percentage composition to total households is as follows:

Type	Urban (%)	Rural (%)
Flush	52	4
Pour-flush	39	76
VIP latrine	8	21

To attain sufficiency and equitable access to basic services, provincial target of Phase I for urban household toilets is planned at 90%, while, for rural household toilets, 78% is assumed. The target for the urban service coverage will be slightly increased compared with the existing high percentage (87%). While that for the rural service is pursued to lessen the gap of the coverage between the urban and rural areas and to achieve a balanced distribution of this basic facility as embodied in the PNDP. For Phase II, 93% as set by the NSMP is adopted for urban household toilets, while, 90% is arranged for rural household toilets.

Table 8.2.3 Base Year Service Coverage of Household Toilets

Name of Municipality/ City	Area	1998		Households and Population Using Sanitary Toilets								
				Number of Households					Service Coverage (%)			
		Popula-tion	HHs	Flush	Pour Flush	VIP/Dry	Total	Popula-tion	Flush	Pour Flush	VIP/Dry	Total
Altavas	Urban	2,829	521	41	255	100	396	2,151	8	49	19	76
	Rural	19,311	3,699	9	2,136		2,145	11,201		58		58
	Total	22,140	4,220	50	2,391	100	2,541	13,352	1	57	2	60
Balete	Urban	1,727	343		33	311	344	1,727		10	91	100
	Rural	18,392	3,642			1,433	1,433	7,173			39	39
	Total	20,119	3,985		33	1,744	1,777	8,900		1	44	45
Banga	Urban	2,155	422	295	94	11	400	2,048	70	22	3	95
	Rural	28,914	5,658	197	2,899	988	4,084	20,819	3	51	17	72
	Total	31,069	6,080	492	2,993	999	4,484	22,867	8	49	16	74
Batan	Urban	1,569	346	23	303	3	329	1,491	7	88	1	95
	Rural	25,377	5,106	10	2,886	14	2,910	14,465		57		57
	Total	26,946	5,452	33	3,189	17	3,239	15,956	1	58		59
Buruanga	Urban	1,181	224	125	62	17	204	1,075	56	28	8	91
	Rural	11,535	2,321	16	850		866	4,268	1	37		37
	Total	12,716	2,545	141	912	17	1,070	5,343	6	36	1	42
Ibajay	Urban	2,738	530	109	251		360	1,862	21	47		68
	Rural	33,926	6,952	89	4,311		4,400	21,374	1	62		63
	Total	36,664	7,482	198	4,562		4,760	23,236	3	61		64
Kalibo (Capi-	Urban	62,774	12,189	7,073	2,813	609	10,495	53,986	58	23	5	86
	Rural											
	Total	62,774	12,189	7,073	2,813	609	10,495	53,986	58	23	5	86
Lezo	Urban	1,969	416	43	241	107	391	1,851	10	58	26	94
	Rural	10,393	2,083	146	1,018	536	1,700	8,523	7	49	26	82
	Total	12,362	2,499	189	1,259	643	2,091	10,374	8	50	26	84
Libacao	Urban	2,808	529	205	153	65	423	2,247	39	29	12	80
	Rural	20,959	3,783	87	1,076	1,033	2,196	12,157	2	28	27	58
	Total	23,767	4,312	292	1,229	1,098	2,619	14,404	7	29	25	61
Madalag	Urban	1,657	286	9	153	56	218	1,260	3	53	20	76
	Rural	16,032	2,759	7	852	498	1,357	7,856		31	18	49
	Total	17,689	3,045	16	1,005	554	1,575	9,116	1	33	18	52
Makato	Urban	2,928	559	20	436	93	549	2,870	4	78	17	98
	Rural	20,926	3,840	26	2,300	905	3,231	17,578	1	60	24	84
	Total	23,854	4,399	46	2,736	998	3,780	20,448	1	62	23	86
Malay	Urban	6,484	1,188	824	264		1,088	5,966	69	22		92
	Rural	17,000	3,238	159	2,085		2,244	11,730	5	64		69
	Total	23,484	4,426	983	2,349		3,332	17,696	22	53		75
Malinao	Urban	1,544	316	25	235	18	278	1,359	8	74	6	88
	Rural	20,893	3,957	17	1,784	1,167	2,968	15,670		45	29	75
	Total	22,437	4,273	42	2,019	1,185	3,246	17,029	1	47	28	76
Nabas	Urban	3,899	778	340	356	42	738	3,705	44	46	5	95
	Rural	18,098	3,542	250	2,493	154	2,897	14,841	7	70	4	82
	Total	21,997	4,320	590	2,849	196	3,635	18,546	14	66	5	84
New Wash-	Urban	5,139	968	16	742	57	815	4,317	2	77	6	84
	Rural	28,002	5,364	34	3,292	603	3,929	20,442	1	61	11	73
	Total	33,141	6,332	50	4,034	660	4,744	24,759	1	64	10	75
Numancia	Urban	3,154	580	236	265		501	2,713	41	46		86
	Rural	20,910	4,006	354	1,990	382	2,726	14,219	9	50	10	68
	Total	24,064	4,586	590	2,255	382	3,227	16,932	13	49	8	70
Tangalan	Urban	2,834	522	23	347	26	396	2,154	4	66	5	76
	Rural	14,301	2,605	47	983	665	1,695	9,296	2	38	26	65
	Total	17,135	3,127	70	1,330	691	2,091	11,450	2	43	22	67
Provincial Total	Urban	107,389	20,717	9,407	7,003	1,515	17,925	92,782	45	34	7	87
	Rural	324,969	62,555	1,448	30,955	8,378	40,781	211,612	2	49	13	65
	Total	432,358	83,272	10,855	37,958	9,893	58,706	304,394	13	46	12	70

The existing composition of the 3 facility types serves as an indicator in the distribution for Phase I, while for Phase II, VIP and sanitary pit privy/latrine (dry-type) is phased-out.

2) School toilets

The base year service coverage of public school students is shown in Table 8.2.4 counting expected coverage of any planned or on-going projects scheduled to be completed by 1999 (details are referred to Supporting Report).

Base year service coverage is 57% applying the standard number of public school students to be served by one (1) unit of toilet facility. The low level is due to a large number of unsanitary or absence of facilities.

Table 8.2.4 Base Year Service Coverage of Public School Toilets and Public Toilets

Name of Municipality/City	Public School Toilets			Public Toilets		
	Total Number of Public School Students (1998)	Std. No. of Public School Student that can be Served by Base Year (1998) Sanitary Toilets	Service Coverage (%)	Number of Public Utilities with Toilets in 1998	Number of Public Utility with Sanitary Toilets in Base Year (1998)	Service Coverage (%)
Altavas	6,636	2,960	45	4	4	100
Balete	5,012	3,240	65	2	2	100
Banga	4,373	4,373	100	4	4	100
Batan	7,278	1,840	25	6	6	100
Buruanga	3,545	840	24	2	2	100
Ibajay	3,929	2,200	56	4	4	100
Kalibo (Capital)	13,792	11,480	83	20	20	100
Lezo	3,110	2,320	75	4	4	100
Libacao	5,705	3,320	58	2	2	100
Madalag	5,861	2,320	40	4	4	100
Makato	5,362	2,640	49	2	2	100
Malay	4,989	2,720	55	6	4	67
Malinao	5,700	3,840	67	2	2	100
Nabas	6,655	3,200	48	8	8	100
New Washington	6,444	2,800	43	6	6	100
Numancia	4,402	1,040	24	6	6	100
Tangalan	4,402	4,360	99	4	4	100
Provincial Total	97,195	55,493	57	86	84	98

In the absence of national targets for school toilets, the existing level of service coverage is the base in setting up the targets. It is expected that all new construction of school-buildings will entail sanitary toilets enabling the coverage to increase on a high level. For Phase I and II, 70% and 90% are set, respectively.

3) Public toilets

The base year service coverage considering expected additional coverage by 1999 is shown in Table 8.2.4 (details are referred to Supporting Report).

Almost all-existing public utilities are served with at least one sanitary toilet giving a 98% coverage. This can be attributed by the fact that almost all public utilities (mostly public markets) are provided with sanitary toilet facilities.

Without national targets as of now, the indicator in setting up provincial targets would be the existing level of coverage. Accordingly, 100% coverage for both Phase I and Phase II are assumed.

(3) Sewerage

Given the non-existence of sewerage systems in any municipality at the present time, this plan does not consider the service during Phase I. For Phase II, a target of 50% coverage was applied to urban population of municipalities with more than 10,000 urban population provided by Level III water supply systems.

(4) Solid waste

The municipal level data in 1998 on the number of households served by the municipal refuse collection revealed that the current practice is concentrated to urban areas. The base year service coverage for urban area by municipality is reflected in Table 8.2.5.

About 13% of the total households in the province relied on municipal refuse collection using trucks or 54% urban household coverage. These municipalities have a total of 12 units of collection truck.

No national targets have yet been set. However, considering the present level of coverage, a 80% urban household coverage is applied for the medium-term period (2001-2005).

Table 8.2.5 Base Year Service Coverage of Municipal Solid Waste System in 1998

Name of Municipality/City	Total No. of Households	No. of Urban Households	No. of Households Served	Coverage of Households (%)	Coverage of Urban Households (%)
Altavas	4,220	521	983	23	100
Balete	3,985	343	478	12	100
Banga	6,080	422	395	6	94
Batan	5,452	346	403	7	100
Buruanga	2,545	224	208	8	93
Ibajay	7,482	530	368	5	69
Kalibo (Capital)	12,189	12,189	2,415	20	20
Lezo	2,499	416	240	10	58
Libacao	4,312	529	617	14	100
Madalag	3,045	286	410	13	100
Makato	4,399	559	836	19	100
Malay	4,426	1,188	950	21	80
Malinao	4,273	316	70	2	22
Nabas	4,320	778	415	10	53
New Washington	6,332	968	475	8	49
Numancia	4,586	580	1,697	37	100
Tangalan	3,127	522	250	8	48
Provincial Total	83,272	20,717	11,210	13	54

8.3 Projection of Frame Values

8.3.1 Population Projection

Future population for all municipalities by urban and rural areas was projected for the target years of 2005 and 2010 together with the present population in 1998 as a planning base year.

The future regional and provincial population has been projected by the NSO, while the projections at municipal levels were not available during the study. The future population of LGUs was therefore projected (details are included in the Supporting Report). Available information for the study at present is as follows:

NSO population census results from 1980 to 1995

1995 Census-based Regional and Provincial Population Projection prepared by the NSO

Provincial Physical Framework Plan/Comprehensive Provincial Land Use Plan (1993-2002) prepared by the Provincial Office

(1) 1995 Census-Based Regional and Provincial Population Projections: NSO

The NSO conducted regional and provincial projections for the period 1995-2020. The assumptions take into account future trends in the demographic processes of fertility.

mortality and migration required by the cohort-component method for projecting population. The 1995 Population Census was used as the basis for the projection.

In the regional population projection, the subject region for this study; Region VI is classified as the medium-sized region (at least 5 million but less than 10 million by year 2000). The following are the result of projection for the region and the province of Aklan in 2000, 2005 and 2010.

Table 8.3.1 Regional and Provincial Population Projection by NSO

Year		1980	1990	1995	2000	2005	2010
Region VI	Population	4,525,615	5,393,333	5,756,623	6,328,671	6,890,447	7,428,329
	Growth Rate	-	1.77%	1.31%	1.91%	1.72%	1.51%
Aklan	Population	324,563	380,497	408,949	447,974	487,839	528,072
	Growth Rate	-	1.60%	1.45%	1.84%	1.72%	1.60%

Note: Average annual growth rates: geometric growth rate
Population of the province in 1995 as of September 1, 1995 was 410,539 (1995 Census)

In the past development, annual growth rates of the region between 1990 and 1995 decreased compared with those of previous census period. Likewise, the growth rates for the province slightly decreased within census period (1980-1995). For the projection, however, the NSO adopted the almost same growth rates for the region and province considering previous development (up to 1990) of the regional population. Thus, the growth rates of the region with 5-year interval between 1995 and 2010 are assumed at 1.91%, 1.72% and 1.51%, respectively. Likewise, those of the province are assumed at 1.84%, 1.71% and 1.60%.

(2) The Land Use Plan: Province of Aklan (Planning period 1993-2002)

The population projection on the provincial total and component municipalities was made with a base year 1990. The population for the year 2002 was projected using a uniform growth rate between 1990 and 2002 referring to the experience from 1980 to 1990 (census years).

In comparison between Land Use Plan and NSO's projection for year 2002, there is no significant difference in provincial population.

On the other hand, regarding 1995 municipal population, the projected population of ten (10) out of 17 municipalities is lower than the census results with a range of -1% to 14%, while that of remaining seven (7) municipalities is higher with a range of 3% to 8%.

Thus, future projection for the municipalities shall be made using 1995 census results as a base year. While, the regional and provincial population projected by the NSO may be adopted in this PW4SP, since the differences between population projected for the medium-term by Land Use Plan and by the NSO is less than 3%.

(3) Population Projection of the Province

The following conditions are considered in the population projection.

Regional and Provincial Population

For the regional and provincial population in the study, the projection conducted by NSO shall be adopted. Table 8.3.2 shows the projected population of the region VI and component provinces.

Table 8.3.2 Projected Population by the NSO

Province	Census Population	Projected Population/Growth Rate					
		Population			Average Annual Growth Rate		
	1995	1998	2005	2010	1995-2000	2000-2005	2005-2010
Aklan	408,949	432,359	487,839	528,072	1.84%	1.72%	1.60%
Antique	430,363	455,051	512,755	554,797	1.84%	1.69%	1.59%
Capiz	622,034	657,975	742,312	801,742	1.86%	1.71%	1.55%
Guimaras	126,034	133,422	150,680	162,774	1.88%	1.72%	1.56%
Iloilo	1,743,302	1,847,328	2,086,833	2,249,494	1.91%	1.72%	1.51%
Negros Occidental	2,425,941	2,573,658	2,910,028	3,131,450	1.95%	1.72%	1.48%
Region VI	5,756,623	6,099,793	6,890,447	7,428,329	1.91%	1.72%	1.51%

Source NSO
Note: Population of Aklan in 1995 as of Sep. 1, 1995 was 410,539 (1995 Census)

Municipal Population

1) The total population of the province in 1998, 2005 and 2010 was fixed.
2) Municipal population for short/medium-term target years (1998 and 2005) is estimated using the recorded growth rates between 1990 and 1995. The municipal population estimated initially is adjusted in proportion to the population size of each municipality to the total provincial population, to meet the above mentioned provincial population fixed for the years 1998 and 2005.

For the year 2010 in the long-term, it is assumed that the tendency of population growth of respective municipalities between 1980 and 1995 will not change drastically in the future. Thus, recorded growth rate between 1980 and 1995 by municipality is firstly applied to project 2010 population from the year 2005. Then, the municipal population estimated initially is adjusted in the same manner mentioned above.

Table 8.3.3 presents census results (1980, 1990 and 1995) and projected population of the municipalities.

Table 8.3.3 Census results and Projected Population of Municipalities

Municipality	Census Result					Projected Population/Growth Rate								
				GR		1998			2005			2010		
	1980	1990	1995	1990-1995	1980-1995	Population		GR	Population		GR	Population		GR
						Initial	Adjust.		Initial	Adjust.		Initial	Adjust.	
Altavas	17,443	20,526	21,475	0.91%	1.49%	22,065	22,140	1.02%	23,507	23,610	0.95%	25,304	25,036	1.18%
Balete	17,300	19,842	19,972	0.13%	0.96%	20,050	20,119	0.24%	20,235	20,323	0.17%	21,320	21,094	0.75%
Banga	25,031	28,640	30,071	0.98%	1.23%	30,964	31,069	1.09%	33,151	33,296	1.02%	35,394	35,020	1.01%
Batan	23,393	25,698	26,415	0.55%	0.81%	26,855	26,946	0.67%	27,910	28,032	0.66%	29,190	28,881	0.60%
Buruanga	10,764	12,652	12,665	0.02%	1.09%	12,673	12,716	0.13%	12,691	12,747	0.06%	13,457	13,314	0.88%
Ibajay	31,214	35,598	36,184	0.33%	0.99%	36,540	36,664	0.44%	37,395	37,549	0.37%	39,435	39,027	0.78%
Kalibo (capital)	39,894	51,277	58,065	2.52%	2.53%	62,562	62,774	2.63%	74,456	74,782	2.56%	84,749	83,851	2.32%
Lezo	9,625	10,338	11,535	2.22%	1.31%	12,320	12,362	2.33%	14,365	14,428	2.26%	15,325	15,163	1.00%
Libacao	21,683	21,425	22,812	1.26%	0.34%	23,687	23,767	1.38%	25,861	25,975	1.31%	26,418	26,138	0.13%
Madalag	14,128	15,160	16,659	1.90%	1.16%	17,629	17,689	2.02%	20,116	20,204	1.95%	21,345	21,119	0.89%
Makato	16,732	19,228	21,955	2.69%	1.83%	23,773	23,854	2.80%	28,624	28,750	2.73%	31,475	31,141	1.61%
Malay	9,120	14,201	19,406	6.44%	5.16%	23,405	23,484	6.56%	36,239	36,397	6.49%	46,815	46,319	4.94%
Malinao	18,117	20,161	21,509	1.30%	1.15%	22,361	22,437	1.42%	24,481	24,589	1.35%	26,036	25,761	0.94%
Nabas	16,607	20,533	21,391	0.82%	1.70%	21,923	21,997	0.94%	23,216	23,318	0.87%	25,371	25,102	1.49%
New Washington	26,119	30,093	31,896	1.17%	1.34%	33,029	33,141	1.28%	35,833	35,990	1.21%	38,468	38,061	1.13%
Numancia	16,216	19,887	22,356	2.37%	2.16%	23,982	24,064	2.48%	28,252	28,375	2.41%	31,581	31,247	1.95%
Tangalan	11,174	14,769	16,172	1.83%	2.50%	17,077	17,135	1.95%	19,391	19,475	1.88%	22,030	21,796	2.28%
Province	324,563	380,028	410,539	1.56%	1.58%	430,895	432,359	1.74%	485,711	487,839	1.74%	533,723	528,072	1.60%

Note: Growth rates in 1998, 2005 and 2010 were calculated using geometric formula.

Population by Urban and Rural Area

1) Past population development

With regards to the ratio of the urban population of the province to the total population, the provincial averages in 1980 and 1990 were 12.1% and 24.3%, respectively. While it maintained same ratio in 1995. The provincial growth rate of 8.88% between 1980 and 1990 decreased to 1.62% in 1995. With regard to the rural population, growth rates as the provincial average were 0.09% (1980 - 1990) and 1.54% (1990 - 1995), respectively.

2) Projection of urban and rural population for the years 1998, 2005 and 2010

Urban population by municipality for the target years was at first projected and rural population was calculated to meet aforementioned total population fixing the urban population.

In the projection of municipal urban population, the following are assumed by short/medium-term and long-term.

Short/Medium-term target: 1998 and 2005

The share of urban population in 1995 in terms of the profile of urban population to

total population by municipality were basically adopted, assuming that the latest profile will not change drastically in short/medium-term period.

Long-term target: 2010

For the long-term projection, the recorded growth rates of urban population between 1980 and 1995 may be applied for the municipal population in 2010, assuming that the tendency of urban population in the long-term period will be stable reflecting past longer term results.

However, for the municipality of Batan, the urban population in 2005 was fixed to avoid negative growth of the population in 2010.

In addition, some modifications were made as follows:

- Malay and Nabas; Shares of the urban population in 2005 were applied, since the growth rates of urban population between 1980 and 1995 were considerably high (more than 5%).
- Makato and Tangalan; Ratios of urban population in 2005 were applied, since the growth rates (1980-1995) were not available due to non existence of urban barangays in 1980 census time.

Under the above assumptions, provincial average share of urban population for the year 2010 arrived at 26.9%, slightly higher than the figure in 1995 (24.4%). Table 8.3.4 presents projected urban and rural population. The growth rates and shares on rural population are calculated using estimated rural population.

Table 8.3.4 Population Projection by Urban and Rural Area:1998, 2005 and 2010

	Municipality	1998		2005			2010			
		Total	Urban/ Rural	Total	Urban/ Rural	Share (%)	Total	Urban/ Rural	G.R. (%)	Share (%)
Urban Area	Altavas	22,140	2,829	23,610	3,017	12.8%	25,304	3,274	1.65%	12.9%
	Balete	20,119	1,727	20,323	1,744	8.6%	21,320	2,035	3.13%	9.5%
	Banga	31,069	2,155	33,296	2,310	6.9%	35,393	2,391	0.69%	6.8%
	Batan	26,946	1,569	28,032	1,632	5.8%	29,190	1,632	0.00%	5.6%
	Buruanga	12,716	1,181	12,747	1,184	9.3%	13,457	1,285	1.66%	9.6%
	Ibajay	36,664	2,738	37,549	2,804	7.5%	39,445	2,960	1.09%	7.5%
	Kalibo	62,774	62,774	74,782	74,782	100.0%	84,749	84,749	2.53%	100.0%
	Lezo	12,362	1,969	14,428	2,297	15.9%	15,325	2,384	0.74%	15.6%
	Libacao	23,767	2,808	25,975	3,069	11.8%	26,418	3,462	2.44%	13.1%
	Madalag	17,689	1,657	20,204	1,893	9.4%	21,345	2,170	2.77%	10.2%
	Makato	23,854	2,928	28,750	3,529	12.3%	31,475	3,864	1.83%	12.3%
	Malay	23,484	6,484	36,397	10,049	27.6%	46,815	12,926	5.16%	27.6%
	Malinao	22,437	1,544	24,589	1,692	6.9%	26,036	1,800	1.24%	6.9%
	Nabas	21,997	3,899	23,318	4,134	17.7%	25,371	4,493	1.70%	17.7%
	New	33,141	5,139	35,990	5,581	15.5%	38,468	5,967	1.35%	15.5%
	Numancia	24,064	3,154	28,375	3,719	13.1%	31,581	4,604	4.36%	14.6%
	Tangalan	17,135	2,834	19,475	3,221	16.5%	22,030	3,644	2.50%	16.5%
	Province	**432,359**	**107,389**	**487,839**	**126,656**	**26.0%**	**533,723**	**143,643**	**2.55%**	**26.9%**

Table 8.3.4 Population Projection by Urban and Rural Area:1998, 2005 and 2010 (Cont'd)

	Municipality	1998		2005			2010			
		Total	Urban/ Rural	Total	Urban/ Rural	Share (%)	Total	Urban/ Rural	G.R. (%)	Share (%)
Rural Area	Altavas	22,140	19,311	23,610	20,593	87.2%	25,304	22,030	1.36%	87.1%
	Balete	20,119	18,392	20,323	18,579	91.4%	21,320	19,285	0.75%	90.5%
	Banga	31,069	28,914	33,296	30,987	93.1%	35,394	33,004	1.27%	93.2%
	Batan	26,946	25,377	28,032	26,400	94.2%	29,190	27,558	0.86%	94.4%
	Buruanga	12,716	11,535	12,747	11,563	90.7%	13,457	12,171	1.03%	90.4%
	Ibajay	36,664	33,926	37,549	34,745	92.5%	39,445	36,485	0.98%	92.5%
	Kalibo	62,771	0	74,782	0	0.0%	84,749	0	-	0.0%
	Lezo	12,362	10,394	14,428	12,130	84.1%	15,325	12,942	1.30%	84.4%
	Libacao	23,767	20,960	25,975	22,906	88.2%	26,418	22,956	0.04%	86.9%
	Madalag	17,659	16,031	20,204	18,311	90.6%	21,345	19,175	0.93%	89.8%
	Makato	23,854	20,976	28,750	25,221	87.7%	31,475	27,611	1.83%	87.7%
	Malay	23,484	17,000	36,397	26,348	72.4%	46,815	33,889	5.16%	72.4%
	Malinao	22,437	20,893	24,589	22,897	93.1%	26,036	24,237	1.14%	93.1%
	Nabas	21,997	18,098	23,318	19,184	82.3%	25,371	20,873	1.70%	82.3%
	New Wash-	33,141	28,002	35,990	30,409	84.5%	38,468	32,502	1.34%	84.5%
	Numancia	24,064	20,910	28,375	24,657	86.9%	31,581	26,977	1.81%	85.4%
	Tangalan	17,135	14,301	19,475	16,254	83.5%	22,030	18,386	2.50%	83.5%
	Province	432,359	324,970	487,839	361,183	74.0%	533,723	390,080	1.55%	73.1%

8.3.2 School Enrollment Projection

From the 1995 total population of the province, the number of children who would be enrolling in elementary and high school levels for all municipalities is derived.

School age population is extrapolated from the NSO age group classification of 5-9, 10-14 and 15-19 years old bracket by municipality. The age group for the elementary level is from 6 to 13 years, while that for the high school level is from 14 to 17 years. The percentages of school age population for the target years are based on the existing composition or structure of the 1995 population.

From the school age population, the number of children who would attend either private or public school, by target year is computed using the projected participation rate. The participation rate by target year varies depending on the socio-economic condition of the province. Generally, an improved economy will result to a higher participation rate. For the province, an increase in the participation rate in both private and public schools is foreseen by year 2010.

The number of public school students by target year is then derived from the projected number of children who will attend school. A participation rate for public school enrollment is established based on the existing participation rate of public school students to the total school age population. Based on the projection, an increase of 3% from the 1998 rate is fore-

seen in 2005 and another increase of 3% from the 2005 rate in 2010 (details are referred to Table 8.3.6, Supporting Report).

Table 8.3.5 shows the projected number of public school students by municipality, by target year. About 107,800 and 121,700 public school students are estimated to enroll for years 2005 and 2010, respectively.

Table 8.3.5 Projected Public School Enrollment and Number of Public Utilities by Municipality

Name of Municipality/City	Number of Public School Student			Number of Public Utilities		
	1998	2005	2010	1998	2005	2010
Altavas	6,636	6,245	6,694	2	4	6
Balete	5,012	4,725	5,540	2	4	6
Banga	4,373	4,966	5,630	1	3	5
Batan	7,278	7,046	7,744	3	5	8
Buruanga	3,545	3,310	3,310	1	3	5
Ibajay	3,929	4,279	5,619	2	4	6
Kalibo (Capital)	13,792	17,969	19,292	8	11	14
Lezo	3,110	3,436	3,650	2	3	5
Libacao	5,705	6,310	6,796	1	3	5
Madalag	5,861	5,197	5,491	2	4	6
Makato	5,362	6,667	7,728	1	3	5
Malay	4,989	7,678	10,457	2	5	7
Malinao	5,700	6,053	6,410	1	3	5
Nabas	6,655	6,332	6,889	1	3	5
New Washington	6,444	7,084	8,654	2	4	6
Numancia	4,402	5,537	6,162	3	5	7
Tangalan	4,402	4,999	5,654	2	4	6
Provincial Total	97,195	107,833	121,720	36	71	107

8.3.3 Projection of the Number of Public Utilities

The number of public utilities (limited to public markets and bus/jeepney terminals) by target year is projected in urban areas for all municipalities. The provincial physical framework plan and the provincial comprehensive development plan serve as references in the projection. Bus or jeepney terminals are considered in major transport routes of the province.

A total of 37 public utilities are planned for construction by year 2005 and another 36 by year 2010. Refer to Table 8.3.5 for the number of public utilities by municipality by target year (details are referred to Supporting Report).

8.3.4 Planning Area and its Projected Population for Sewerage

Urban areas with more than 10,000 population provided by Level III water supply systems in 2010 serve as the planning area. Population in the area is considered as the potential population to be served.

Kalibo and Malay with urban population of about 48,800 are considered (refer to Table 8.5.4).

8.3.5 Number of Households to be Served by Municipal Solid Waste Collection System

The number of urban households in 2005 is the potential households for the planning (refer to Table 8.3.5, Supporting Report).

8.4 Types of Facilities and Implementation Criteria

In principle, types of facilities and their implementation criteria as prescribed in the NSMP and the NEDA Board Resolution No. 12 (s. 1995) are adopted to this PW4SP.

8.4.1 Water Supply

The following are the major conditions and assumptions applied to urban and rural water supply, which are intended as a guide for the implementation of sector projects.

(1) Urban water supply

Prevailing situation of urban water supply in each municipality was firstly reviewed mainly focusing on existing water sources and magnitude of service coverage. Planned/on-going projects for concerned municipalities were also studied and reflected in the planning, with due attention to merging of municipalities into an integrated water supply system. Potential water source for future development was then evaluated based on the study results in Chapter 7, taking into account the possibility to utilize untapped spring sources. Recommendations arising from these studies were also incorporated as overall development strategy.

Aforementioned studies were carried out by the following sequence:

Review of existing water supply systems and water sources;
Review of planned/on-going projects;
Establishment of planning conditions covering service level, utilization of existing facilities, water sources, and number of systems; and
Recommendations for overall development strategy.

Table 8.4.1 Summary of Urban Water Supply Development by Municipality (Aklan)

Municipality	Existing Condition	On-going/Planned Project	Water Source Availability	Future Requirements
Altavas	There exists a small Level III servicing only 35 households. Majority of the inhabitant is relying on deep/shallow wells (Level I facility).	none	DW; in the coastal area (salinity problem) SP; in the hilly area (scattered) Future development; grouped springs	Expansion of the system with spring development
Balete	Majority of the people is served by Level I facilities (deep/shallow wells). There is only one Level II system.	none	DW; in the populated area with medium yield (ironic problem) SP; far from the populated area (potable) Future development; select source through cost comparison between DW & SP	Spring source may be used for future system creation. Construction of trasmission and distribution facilities are required.
Banga	People in the Poblacion and its adjacent barangays is served by KWD.	Expansion plan by KWD Distribution pipeline is under construction	DW; in the town with high yield (locally ironic problem) SP; in the hilly area (potable) Future development; DW along Aklan River	Expansion of existing system according to the plan by the KWD.
Batan	There exists one Level III to serve for BRY Ambulong, not far from poblacion. The groundwater in pobulacion area is salinity. Majority of the inhabitant is relying on their own shallow wells (Level I facility).	none	DW; low yield and slinity/acidic problems SP; scattered & limited yield in the hilly area (potable) Future development; grouped springs	A new system may be constructed using a group of spring sources.
Buruanga	There is only one Level II system. Majority of the people in the urban area uses shallow wells.	none	DW; difficult (only radial well locally with ironic problem), SP; many eyes in the mountain (potable) Future development; grouped springs and construction of radial well are alternatives	Creation of Level III system using spring sources.
Ibajay	Ibajay WD provides services in the poblacion. It completed expansin project. There is a water quality problem in some areas. People in such areas use deep well (free flowing wells).	none	DW; in the coastal area (salinity problem) SP; in the hilly area (scattered) Future development; grouped springs	The need of rehabilitation /augmentation of existing facilities
Kalibo (capital)	Kalibo WD serves for 13 urban barangays (12,530 persons, 60 % of urban population).	Expansion of the system introducing a pumping system	DW; high yield along Aklan River (salinity in coastal area) SP; very few springs in the hilly/far area Future development; DW along Aklan River	Expansion of distribution system
Lezo	Numancia WD serves for one urban barangay. The service coverage is 60% of the urban population (1,476 persons).	Interconnection plan w/ KWD	DW; high yield along Aklan River (slightly & ironic problems) SP; very few springs in the hilly/far area Future development; DW along Aklan River	Expansion of existing system (Numancia WD) with an augmentation of water sources. Interconnection w/KWD

Table 8.4.1 Summary of Urban Water Supply Development by Municipality (Aklan)

Municipality	Existing Condition	On-going/Planned Project	Water Source Availability	Future Requirements
Libacao	There exists one WD servicing one urban barangay using deep well. Served population is 2,695. 55% of the urban population.	none	DW; low yield (ironic problem) SP; scattered &limited yield in the hilly area Future development; select through cost comparison between grouped springs and deep wells	Expansion of existing system/creation of a new system
Madalag	There is a waterworks cooperative servicing one urban barangay using the deep well. Served population is 1,020 (75% of the urban population).	none	DW; low yield (ironic problem) SP; scattered & limited yield in the hilly area Future development; select through cost comparison between grouped springs and radial wells (along Aklan River)	Expansion of the existing system in use of either radial well or springs
Makato	Numancia WD serves for one urban barangay. Served population is 1,506 (50% of the urban population). The deep well is used, but there is a salt water problem	Interconnection plan w/ KWD	DW; high yield (salinity in the coastal area) SP; field is far from populated area (potable) Future development; select through cost comparison between DW and SP uses	Expansion of existing system (Numancia WD) with an augmentation of water sources. Interconnection w/KWD
Malay	Deep and shallow wells (Level I service) are used by the people in urban barangays. Thr. the financial assistance by JBIC,transmission line across the sea between main island and Boracay was constructed. The water supply will be improved soon.	Boracay Water Supply Project is under way (JBIC)	DW; only shallow well is available (ironic problem). SP; many eyes in the hilly area Future development; SP otherwise radial well development	JBIC assisted project will provide Level III services including expansion of distribution facilities.
Malinao	The WD serve for one urban barangay using the deep well. The service covers 90% of the urban population (5,434 parsons).	none	DW; high yield (ironic problem locally) SP; field is far from populated area (potable) Future development; select through cost comparison between DW and SP uses	Expansion of service area
Nabas	There is no level III system in the urban area. They use shallow and deep wells (30-40 m deep).	none	DW; available in the eastern area of the town (salinity in the coastal area) SP; many eyes in the hilly area (potable) Future development; grouped springs	A new system may be constructed using a group of spring sources.
New Washington	Kalibo WD extended its services to New Washington and those barangays between Kalibo and New Washington.	Expansion Project by KWD	DW; low yield (ironic, salinity & brackish) SP; none Future development; covered by Kalibo WD	Expansion of the system under the plan of KWD
Numancia	Numancia WD covers whole of the municipal area. There exists Baragy Waterworks servicing 3 barangays. Water sources are deep wells, which have an ironic problem.	Interconnection plan w/ KWD	DW; high yield (salinity in the coastal area and slightly ironic) SP; field is far from populated area (potable) Future development; DW (new DW field shall be considered)	Expansion of existing system; interconnection with Kalibo WD
Tangalan	They use level I facilities (deep/shallow wells) in the urban area.	none	DW; low yield (salinity in the coastal area) SP; scattered & limited yield (potable) Future development; grouped springs	level II system sall be initiated using spring sources.

1) Review of existing water supply systems and water sources

The municipalities/city of Kalibo, Lezo, Madalag, Makato and Numancia are served by WDs. Among them, Lezo, Makato and Numancia are covered by the Numancia Water District. While the municipalities of Altavas, Batan and Madalag are served by Level III systems operated either by the municipal government or local community.

Population served by existing Level III systems range from about 200 persons at LGU-managed waterworks in Altavas to 30,200 persons at the Kalibo Water District. The average size of served population is about 5,300 persons. Majority of the existing Level III systems in urban areas is utilizing deep well sources.

The remaining 9 municipalities, out of the total 17 municipalities have no Level III system in their urban areas and are presently served by Level II systems and/or Level I facilities.

2) Review of planned/on-going projects

At present, there is on-going JBIC-assisted Boracay Water Supply Project in the municipality of Malay. In addition, Kalibo WD is undertaking expansion plan in assistance of LWUA using JBIC loan. The project aims at construction of inter-municipality water supply system. among the municipalities of Kalibo, Banga and New Washington.

Interconnection plan between Kalibo WD and Numancia WD is also sought.

3) Establishment of planning conditions

a. Service level

It shall be noted that a national policy for urban water supply is a Level III system, as the most suitable measure. Therefore, for the investment needs of the sector development, it is assumed in this PW4SP that underserved or unserved urban population at present and in the future will be provided with individual house connections. However, it does not intend in the future to exclude, as individual cases, Level I and II facilities from being implemented in urban area.

b. Utilization of existing facilities

The existing Level I and II facilities are considered to be utilized during the Phase I period. However, the population served by these facilities is to be absorbed by Level III service in Phase II.

c. Water sources

Possibility/availability to utilize surface water and groundwater (spring and deep well) is evaluated as potential water sources for water supply development.

From the viewpoints of cost effectiveness and easy O&M of water supply system, utilization of spring sources is given due priority in the course of urban water supply planning. Application of deep wells for water source is regarded as the second priority in principle. Surface water is, on the other hand, not adopted at this moment, because of large capital investment requirements and complexity of surface water treatment.

d. Number of systems

In principle, one (1) Level III system is considered for urban area of every municipality. In the municipalities with an existing Level III system/s, the expansion of the system was first considered. In case of no existence of Level III system/s, a new system was recommended. Existing plan/s on the development of Level III/WD are also taken into account to determine the respective systems of the municipalities.

Possibility and necessity to merge service area of some neighboring municipalities to an urban water supply system were also studied from the viewpoint of:

water source constraints, and

economical development/scale merit of water supply system by cost reduction of water source development and other common facilities as well as O&M cost/minimized number of technical staff.

Any rural barangay/s being served by an existing urban Level III system are considered to continue throughout the future.

e. Rehabilitation

Rehabilitation of existing and future facilities is assumed to be undertaken by the operating bodies.

4) Overall development strategy

Expansion of the existing system/s was planned for those with WD/Level III, while creation of the system is considered for those without systems at present.

Merging of municipal systems (physical arrangement) in the long-term is considered. Integrated management systems shall also be sought. Conditions to be studied in-

clude; water source availability, willingness by concerned municipalities and technical study on cost recovery/economic construction.

The following WD/municipalities were studied for the integration both in physical and management systems.

- Kalibo WD (Kalibo, Banga and New Washington)
- Interconnection between Kalibo WD and Numancia WD

Integration of small Level III systems for operation and management shall be sought. although these systems are currently managed individually.

In case of using spring sources for Level III systems, a detailed survey to ensure appropriate development shall be conducted in the implementation of the projects.

(2) Rural water supply

1) Service level

Level I systems (deep well/shallow well/developed spring) are generally planned for rural areas where houses are scattered. In the PW4SP, public investment for Level I facilities covers 50% of the total number of required facilities.

Level II systems are considered where houses are clustered and suitable untapped spring is available.

Service level standards are set forth as 15 households per source for Level I and 5 households per communal faucet for Level II, as defined in the national plan.

Application of Level III systems in rural areas may be considered in a case to case basis during actual implementation.

2) Utilization of existing facilities

The existing facilities/systems in all service levels are considered to be utilized throughout the future.

3) Water source

For Level I facilities, deep well construction is given priority wherever applicable considering safety against possible contamination and stable water supply. Standard specifications of shallow and deep wells are summarized in Table 8.4.2 based on the water source evaluation results presented in Chapter 7. Conventional construction method (driven well) may be employed under favorable substrata or hydrogeological

conditions. The standard structure of wells in application of "open-hole drilling and gravel pack" is presented in Figure 8.4.1, Supporting Report. In addition to this, for deep well with high iron content, application of iron removal facility is recommended. The standard structure of iron removal facility is presented in Figures 8.4.2 (a) and 8.4.2 (b), Supporting Report.

Spring development is not considered in Level I planning referring to the study results of water source development presented in Chapter 7.

For Level II systems, only untapped springs suitable for water supply purpose are considered. Identified untapped springs are presented in Table 7.4.1, Supporting Report.

Table 8.4.2 Standard Specifications of Level I Wells

Specification	Shallow Well	Deep Well
Construction Method	Open-hole drilling and gravel pack	
Casing Diameter	50mm	100mm
Borehole Diameter	150mm	200mm
Ranges of Well Depth	Standard Depth	
0 - 20m	20m	Not Applicable
21 - 50m	Not Applicable	40m
51 - 100m	Not Applicable	80m
101 - 150m	Not Applicable	120m

Profile between gravel packed well and natural gravel packed well for Level I water supply:

The open-hole drilling method is employed for the well construction to ensure yield of ground water from adequate aquifer in provision of proper screen location and specifications. The conventional "cased-hole driven well" shall be used only in cases where well specifications are established in the specified area with sufficient information on the hydrogeological condition including existence of natural gravel at the expected aquifer.

It is important to study the potential areas to adopt natural gravel method, which can perform the same level of function as gravel-packed wells. Such areas are usually limited to the upper stream of larger rivers in alluvial fans and alluvial plains. The proportion will be worked out between those areas where the application of gravel-packed and natural gravel pack wells referring to the condition of the province.

Modification needs of riser pipe diameter according to the water level of deep wells:

The standard specification of deep well hand pump is set with a diameter of 2-1/2 inch in the plan. However, water level of the deep wells may range between 20m and around 40m, depending on the aquifer conditions.

Although the Malawi type deep well pump with a cylinder that is currently used in the Philippines has operation experience up to 40 m in pumping water level, the diameter of riser pipe must be adjusted between 1" to 2-1/2" in order to lower required power at the pump handle (calculating required power under the specific pumping water level).

4) Number of systems/facilities

The number of Level I wells and spring development is estimated based on the service level standard; while the number of Level II systems coincides with the number of untapped springs having an estimated discharge of 2.0 lps. or more.

5) Rehabilitation

Rehabilitation of existing Level I wells is not considered, since most of the wells constructed by driving method is not suitable for rehabilitation to recover their functions. However, minor repair work for hand-pump and concrete apron is a requisite.

8.4.2 Sanitation

The conditions and assumptions are established for the different sanitation components to serve as guides in the implementation of projects.

(1) Household toilets

Three types of sanitary toilet facilities for individual houses are considered for Phase I; flush, pour-flush and VIP/sanitary pit privy (dry-type). While for Phase II, flush and pour-flush are planned considering the improvement of living standard.

The type of toilet facilities is dependent on the existing or planned service level of water supply in the community. In urban and rural areas with Level I or II water supply facilities, only pour-flush and/or VIP are considered, while in urban areas with Level III water supply systems, flush type toilets requiring a piped water connection are included. Isolated rural areas where there is dearth of water supply, sanitary pit privy (dry type) is taken into account.

(2) School toilets

Standard service level currently used by DECS (40 students per unit facility) is employed for both phases.

The standard toilet facility (1 building) with 5 units of toilet bowl to serve for 200 students is adopted for the planning purpose, which is modified from FW4SP design to provide a shallow well as a water source. Since DECS is currently promoting the "one classroom-one toilet" concept, the PW4SP also adopts this concept on a 50-50 basis, that is 50% of the school toilet requirements will be allocated using the JICA-RESP design and the other 50% will be adopting the new concept.

(3) Public toilets

As a minimum requirement, at least 1 sanitary toilet facility is assumed to be provided for respective utilities: public market bus/jeepney terminal and parks/playground.

The DOH standard design with 6-units of toilet bowl for the market is adopted. In this design, it is assumed that water supply will be tapped from the existing system, hence an elevated water tank is provided.

8.4.3 Urban Sewerage

The commencement of staged implementation of the sewerage program is planned in Phase II for the limited urban area (50% of urban population served by Level III system for the municipalities with urban population of more than 10,000). It is practical to start the program fully using the existing facilities to allow for lower initial investment cost than starting at once a conventional sewerage system (refer to Figure 8.4.2 Staged Improvement in Sewage Collection Method, Supporting Report).

Low cost off-site technologies such as small-bore sewer for collection of effluent from septic tank are to be adopted. Improvement of sewage collection method may be gradually achieved from combined sewer to separate sewerage system.

Sewage treatment facilities may range from community scale septic tank or Imhoff tank to aerated lagoon systems and to a more advanced treatment process such as oxidation ditch. For this PW4SP, aerated lagoons are assumed as a representative treatment facility for planning purpose. Daily average wastewater quantity is assumed at 100 liters per capita per day.

8.4.4 Solid Waste

In terms of facility requirements, this PW4SP only studied the number of refuse collection trucks required for the year 2005. A rated capacity of 5 cu.m truck/vehicle is considered for calculation of required units of truck. Disposal of solid waste shall be studied in detail through investigations, F/S and D/D. Unit solid waste generation for urban area is assumed to be 0.418 kg. per capita per day.

8.5 Service Coverage by Target Year

8.5.1 Water Supply

The service coverage in terms of population to be served by target year was estimated by urban and rural area by municipality. The service coverage in rural area was further subdivided by service level (Level I & Level II) to finally come up with physical requirements.

Base figures applied to estimate the future service coverage and the additional population to be served are:

provincial sector targets;
population projection by target year; and
base year service coverage (served population) by existing facilities.

Future requirements in terms of additional population to be served were then estimated by urban (Level III) and rural (Level I & II) area by municipality as a shortfall to meet the population to be served in each target year. The population served in base year is adopted as the population served in target year, when the former population exceeds the population to be served in the target year/s. Manner of calculation is specifically presented by phase.

(1) Phase I requirements

Additional service coverage was estimated as a shortfall of the population to be served in Phase I comparing with the population served in base year. In this connection, existing facilities both in urban and rural areas are assumed to be utilized during the Phase I period.

The utilization of untapped springs for Level II systems was given priority during Phase I period for rural water supply. At the time of this plan preparation, 20 untapped springs in 5 municipalities were identified.

(2) Phase II requirements

Additional service coverage was estimated as a shortfall of the population to be served in Phase II comparing with the population served in Phase I. In this regard, existing facilities in rural area were assumed to be utilized through the two Phases, while urban population served by Level I and II facilities in base year was assumed to be absorbed by Level III service during Phase II period.

Table 8.5.1 presents the service coverage by target year and by level of service as well as the additional population to be served (details are referred to Supporting Report).

Through Phase I development, approximately 41,000 persons in the province will be served by additional water supply services, of which 15,600 persons or 38% of the total will be urban population and 25,400 persons or 62% will be rural population.

For Phase II period, a total of 229,600 persons, of which 83,600 persons or 36% in urban area and 146,000 persons or 64% in rural area, will be further benefited by water supply services. This additional service coverage in urban area includes the upgrade of service level for 43,300 persons served by Level I and II facilities in 1998.

8.5.2 Sanitation

(1) Household toilets

The service coverage (number of households to be served) by different types of sanitary facility is estimated by urban and rural area by municipality for the years 2005 and 2010. The future service coverage and additional households to be served are estimated to meet the provincial targets using the number of household served in the base year and the number of households in target years.

Additional number of households to be served by different type of facility by urban and rural area by municipality is the shortfall of the number of households to be served in target years comparing with either that in base year or in Phase I (details are referred to Supporting Report). However, when the number of households to be served in target year/s is less than or equal to that in base year, no additional number of households to be served is counted.

In the determination of the number of households to be served by flush type toilet, when the number of households to be served in the target year is higher than in base year, the target coverage is applied with conditions. When the target coverage is higher than Level III water supply coverage, the latter coverage is adopted, while in the other case,

the target coverage is applied. In cases where the target coverage is less than that in base year, the base year coverage is adopted.

Table 8.5.1 Population to be Served by Target Year (Water Supply)

Name of Municipality	Area	Phase I Coverage (2005)									Phase II Coverage (2010)								
		Total	Service Coverage				Additional Population to be Served				Total	Service Coverage				Additional Population to be Served			
		Population	Level III	Level II	Level I	Total	Level III	Level II	Level I	Total	Population	Level III	Level II	Level I	Total	Level III	Level II	Level I	Total
Altavas	Urban	3,017	571	25	1,480	2,076	371			371	3,274	3,110			3,110	2,539			2,539
	Rural	20,593		2,198	8,464	10,662		1,448		1,448	22,030		2,198	18,290	20,488			9,826	9,826
	Total	23,610	571	2,223	9,944	12,738	371	1,448		1,819	25,304	3,110	2,198	18,290	23,598	2,539		9,826	12,365
Balete	Urban	1,744	214	75	852	1,141	214			214	2,035	1,933			1,933	1,719			1,719
	Rural	18,579		1,385	1,362	2,747		1,010	296	1,306	19,285		1,385	16,550	17,935			15,188	15,188
	Total	20,323	214	1,460	2,214	3,888	214	1,010	296	1,520	21,320	1,933	1,385	16,550	19,868	1,719		15,188	16,907
Banga	Urban	2,310	284		2,044	2,328	284			284	2,391	2,328			2,328	2,044			2,044
	Rural	30,986		1,850	16,338	18,188			2,179	2,179	33,003		1,850	28,843	30,693			12,505	12,505
	Total	33,296	284	1,850	18,382	20,516	284		2,179	2,463	35,394	2,328	1,850	28,843	33,021	2,044		12,505	14,549
Batan	Urban	1,632	1,426		5	1,431	201			201	1,632	1,550			1,550	124			124
	Rural	26,400	510	225	9,915	10,650			1,856	1,856	27,558	510	225	24,894	25,629			14,979	14,979
	Total	28,032	1,936	225	9,920	12,081	201		1,856	2,057	29,190	2,060	225	24,894	27,179	124		14,979	15,103
Buruanga	Urban	1,184	145	250	536	931	145			145	1,285	1,221			1,221	1,076			1,076
	Rural	11,563		2,725	5,566	8,291			813	813	12,172		2,725	8,595	11,320			3,029	3,029
	Total	12,747	145	2,975	6,102	9,222	145		813	958	13,457	1,221	2,725	8,595	12,541	1,076		3,029	4,105
Ibajay	Urban	2,804	345		2,147	2,492	345			345	2,960	2,812			2,812	2,467			2,467
	Rural	34,745	8,108	3,643	15,956	27,707		2,443		2,443	36,485	8,108	3,643	22,180	33,931			6,224	6,224
	Total	37,549	8,453	3,643	18,103	30,199	345	2,443		2,788	39,445	10,920	3,643	22,180	36,743	2,467		6,224	8,691
Kalibo (Capital)	Urban	74,782	39,393		18,614	58,007	9,188			9,188	84,749	80,512			80,512	41,119			41,119
	Rural																		
	Total	74,782	39,393		18,614	58,007	9,188			9,188	84,749	80,512			80,512	41,119			41,119
Lezo	Urban	2,297	1,577		351	1,928	282			282	2,384	2,265			2,265	688			688
	Rural	12,131	829		6,429	7,258			853	853	12,941	829		11,206	12,035			4,777	4,777
	Total	14,428	2,406		6,780	9,186	282		853	1,135	15,325	3,094		11,206	14,300	688		4,777	5,465
Libacao	Urban	3,069	377		2,231	2,608	377			377	3,462	3,289			3,289	2,912			2,912
	Rural	22,906	2,695	1,150	11,824	15,669			1,611	1,611	22,956	2,695	1,150	17,504	21,349			5,680	5,680
	Total	25,975	3,072	1,150	14,055	18,277	377		1,611	1,988	26,418	5,984	1,150	17,504	24,638	2,912		5,680	8,592
Madalag	Urban	1,893	929	100	227	1,256	233			233	2,170	2,062			2,062	1,133			1,133
	Rural	18,311		600	4,116	4,716			1,288	1,288	19,175		600	17,233	17,833			13,117	13,117
	Total	20,204	929	700	4,343	5,972	233		1,288	1,521	21,345	2,062	600	17,233	19,895	1,133		13,117	14,250
Makato	Urban	3,529	1,940		800	2,740	434			434	3,864	3,671			3,671	1,731			1,731
	Rural	25,221	612	2,475	11,912	14,999			1,773	1,773	27,611	612	2,475	22,591	25,678			10,679	10,679
	Total	28,750	2,552	2,475	12,712	17,739	434		1,773	2,207	31,475	4,283	2,475	22,591	29,349	1,731		10,679	12,410
Malay	Urban	10,049	1,235		2,933	4,168	1,235			1,235	12,926	12,280			12,280	11,045			11,045
	Rural	26,348		3,450	6,770	10,220		1,050	803	1,853	33,889		3,450	28,067	31,517			21,297	21,297
	Total	36,397	1,235	3,450	9,703	14,388	1,235	1,050	803	3,088	46,815	12,280	3,450	28,067	43,797	11,045		21,297	32,342
Malinao	Urban	1,692	1,708		44	1,752	208			208	1,800	1,752			1,752	44			44
	Rural	22,897	684	2,409	12,043	15,136		1,584	26	1,610	24,236	684	2,409	19,446	22,539			7,403	7,403
	Total	24,589	2,392	2,409	12,087	16,888	208	1,584	26	1,818	26,036	2,436	2,409	19,446	24,291	44		7,403	7,447
Nabas	Urban	4,134	508		2,331	2,839	508			508	4,498	4,273			4,273	3,765			3,765
	Rural	19,184		3,900	10,283	14,183			1,349	1,349	20,873		3,900	15,512	19,412			5,229	5,229
	Total	23,318	508	3,900	12,614	17,022	508		1,349	1,857	25,371	4,273	3,900	15,512	23,685	3,765		5,229	8,994
New Washington	Urban	5,581	686		4,759	5,445	686			686	5,967	5,669			5,669	4,983			4,983
	Rural	30,409			26,687	26,687			2,138	2,138	32,501			30,226	30,226			3,539	3,539
	Total	35,990	686		31,446	32,132	686		2,138	2,824	38,468	5,669		30,226	35,895	4,983		3,539	8,522
Numancia	Urban	3,720	1,237		1,829	3,066	457			457	4,604	4,374			4,374	3,137			3,137
	Rural	24,656	6,381		13,550	19,931			1,734	1,734	26,978	6,381		18,709	25,090			5,159	5,159
	Total	28,376	7,618		15,379	22,997	457		1,734	2,191	31,582	10,755		18,709	29,464	3,137		5,159	8,296
Tangalan	Urban	3,221	396		1,658	2,054	396			396	3,644	3,462			3,462	3,066			3,066
	Rural	16,254		1,225	8,442	9,667			1,143	1,143	18,386		1,225	15,874	17,099			7,432	7,432
	Total	19,475	396	1,225	10,100	11,721	396		1,143	1,539	22,030	3,462	1,225	15,874	20,561	3,066		7,432	10,498
Provincial Total	Urban	126,658	52,971	450	42,841	96,262	15,564			15,564	143,645	136,563			136,563	83,592			83,592
	Rural	361,183	19,819	27,235	169,657	216,711		7,535	17,862	25,397	390,079	19,819	27,235	315,720	362,774			146,063	146,063
	Total	487,841	72,790	27,685	212,498	312,973	15,564	7,535	17,862	40,961	533,724	156,382	27,235	315,720	499,337	83,592		146,063	229,655

For Phase I, any type of existing sanitary facilities both in urban and rural areas is to be utilized during Phase I period. For Phase II, water-sealed toilet facilities in Phase I both in urban and rural areas are to be utilized.

The projected number of served households at the end of the Phase I period is 76,147. Additional households to be served totaled to 17,441, of which 29% is urban households and 71% is rural households. While at the end of Phase II period, the number of served households are 121,170 with additional households to be served at 45,265. Table 8.5.2 provides the number of households to be served by target year for urban and rural areas by municipality.

(2) School toilets

The service coverage or the number of public school students to be served is estimated by municipality for the years 2005 and 2010.

The future service coverage and additional number of students to be served are estimated using the number of students served in the base year, the number of students in target years and the provincial sector targets.

Additional number of students to be served by municipality is the shortfall of the number of students to be served in targets comparing with either that in base year or in Phase I (details are referred to Supporting Report). However, when the number of students to be served in target/s is less than or equal to the base year, no additional number of households to be served is considered.

The existing facilities are to be utilized during Phase I period, while the facilities in Phase I are to be utilized during Phase II period.

The projected number of served students at the end of Phase I period is 75,483. The additional students to be served are 19,990. While at the end of Phase II period, the projected number of served students are 109,549 with additional students to be served at 34,066. Table 8.5.3 summarizes the number of public school students to be served by target year.

Table 8.5.2 Additional Number of Households to be Served by Target Year (Household Toilets)

Name of Municipality	Area	Phase I Coverage (2005)									Phase II Coverage (2010)								
		Total Households	No. of Served Households				Add'l. No. of Households to be Served				Total Households	No. of Served Households				Add'l. No. of Households to be Served			
			Flush	Pour Flush	VIP/Dry	Total	Flush	Pour Flush	VIP/Dry	Total		Flush	Pour Flush	VIP/Dry	Total	Flush	Pour Flush	VIP/Dry	Total
Altavas	Urban	596	300	200		500	104			104	819	381	381		762	81	181		262
	Rural	3,945	9	2,615	453	3,077		479	453	932	5,508	9	4,495	453	4,957		1,880		1,880
	Total	4,501	309	2,815	453	3,577	104	479	453	1,036	6,327	390	4,876	453	5,719	81	2,061		2,142
Balete	Urban	347		33	311	344					509	237	-75	311	473	237			237
	Rural	3,679		2,440	430	2,870		1,437		1,437	4,821		3,909	430	4,339		1,469		1,469
	Total	4,026		2,473	741	3,214		1,437		1,437	5,330	237	3,834	741	4,812	237	1,469		1,706
Banga	Urban	452	295	112		407		7		7	598	278	278		556		166		166
	Rural	6,064	197	4,021	512	4,730		646		646	8,251	197	6,717	512	7,426		2,696		2,696
	Total	6,516	492	4,133	512	5,137		653		653	8,849	475	6,995	512	7,982		2,862		2,862
Batan	Urban	359	23	303	3	329					408	190	186	3	379	167			167
	Rural	5,312	10	3,522	611	4,143		636	597	1,233	6,890	510	5,080	611	6,201	500	1,558		2,058
	Total	5,671	33	3,825	614	4,472		636	597	1,233	7,298	700	5,266	614	6,580	667	1,558		2,225
Buruanga	Urban	225	125	62	17	204					321	150	132	17	299	25	70		95
	Rural	2,427	16	1,543	256	1,815		693	256	949	3,043	16	2,467	256	2,739		924		924
	Total	2,652	141	1,605	273	2,019		693	256	949	3,364	166	2,599	273	3,038	25	994		1,019
Ibajay	Urban	342	293	195		488	128			128	740	344	344		688	51	149		200
	Rural	7,120	89	4,721	744	5,554		410	744	1,154	9,121	821	6,644	744	8,209	732	1,923		2,655
	Total	7,662	382	4,916	744	6,042	128	410	744	1,282	9,861	1,165	6,988	744	8,897	783	2,072		2,855
Kalibo (Capital)	Urban	14,521	7,841	4,574	654	13,069	768	1,761	45	2,574	21,187	9,852	9,198	654	19,704	2,011	4,624		6,635
	Rural																		
	Total	14,521	7,841	4,574	654	13,069	768	1,761	45	2,574	21,187	9,852	9,198	654	19,704	2,011	4,624		6,635
Lezo	Urban	486	262	175		437	46			46	596	277	277		554	15	102		117
	Rural	2,431	146	1,612	138	1,896		196		196	3,235	291	2,483	138	2,912	145	871		1,016
	Total	2,917	408	1,787	138	2,333	46	196		242	3,831	568	2,760	138	3,466	160	973		1,133
Libacao	Urban	578	312	182	26	520	97			97	866	403	376	26	805	91	194		285
	Rural	4,135	87	2,741	397	3,225		1,029		1,029	5,739	517	4,251	397	5,165	430	1,510		1,940
	Total	4,713	399	2,923	423	3,745	97	1,029		1,126	6,605	920	4,627	423	5,970	521	1,704		2,225
Madalag	Urban	326	176	117		293	75			75	543	253	252		505	77	135		212
	Rural	3,152	7	2,090	362	2,459		1,102		1,102	4,794	7	3,946	362	4,315		1,856		1,856
	Total	3,478	183	2,207	362	2,752	75	1,102		1,177	5,337	260	4,198	362	4,820	77	1,991		2,068
Makato	Urban	673	364	242		606	57			57	966	449	449		898	85	207		292
	Rural	4,628	26	3,069	515	3,610		379		379	6,903	612	5,086	515	6,213	586	2,017		2,603
	Total	5,301	390	3,311	515	4,216	57	379		436	7,869	1,061	5,535	515	7,111	671	2,224		2,895
Malay	Urban	1,840	994	580	82	1,656	170	316	82	568	3,232	1,503	1,421	82	3,006	509	841		1,350
	Rural	5,019	159	3,328	428	3,915		1,243	428	1,671	8,472	159	7,038	428	7,625		3,710		3,710
	Total	6,859	1,153	3,908	510	5,571	170	1,559	510	2,239	11,704	1,662	8,459	510	10,631	509	4,551		5,060
Malinao	Urban	347	187	125		312	34			34	450	210	209		419	23	84		107
	Rural	4,337	17	2,876	490	3,383		415		415	6,059	545	4,418	490	5,453	528	1,542		2,070
	Total	4,684	204	3,001	490	3,695	34	415		449	6,509	755	4,627	490	5,872	551	1,626		2,177
Nabas	Urban	825	446	297		743	5			5	1,125	523	523		1,046	77	226		303
	Rural	3,754	250	2,678		2,928		31		31	5,218	250	4,446		4,696		1,768		1,768
	Total	4,579	696	2,975		3,671	5	31		36	6,343	773	4,969		5,742	77	1,994		2,071
New Washington	Urban	1,051	568	378		946	131			131	1,492	694	694		1,388	126	316		442
	Rural	5,825	34	3,862	648	4,544		570	45	615	8,125	34	6,631	648	7,313		2,769		2,769
	Total	6,876	602	4,240	648	5,490	131	570	45	746	9,617	728	7,325	648	8,701	126	3,085		3,211
Numancia	Urban	684	370	246		616	115			115	1,151	535	535		1,070	165	289		454
	Rural	4,723	354	3,131	199	3,684		958		958	6,745	607	5,265	199	6,071	253	2,134		2,387
	Total	5,407	724	3,377	199	4,300	115	958		1,073	7,896	1,142	5,800	199	7,141	418	2,423		2,841
Tangalan	Urban	593	320	214		534	138			138	911	424	423		847	104	209		313
	Rural	2,961	47	1,964	299	2,310		615		615	4,597	47	3,791	299	4,137		1,827		1,827
	Total	3,554	367	2,178	299	2,844	138	615		753	5,508	471	4,214	299	4,984	104	2,036		2,140
Provincial Total	Urban	24,405	12,876	8,035	1,093	22,004	1,868	2,084	127	4,079	35,914	16,703	15,603	1,093	33,399	3,544	7,795		11,617
	Rural	69,412	1,468	46,213	6,482	54,143		10,839	2,523	13,362	97,521	4,622	76,667	6,482	87,771	3,174	10,454		13,628
	Total	93,817	14,324	54,248	7,575	76,147	1,868	12,923	2,650	17,441	133,435	21,325	92,270	7,575	121,170	7,018	18,247		25,265

Table 8.5.3 Additional Number of Public School Student to be Served by Target Year (School Toilets)

Name of Municipality/City	Phase I Coverage (2005)			Phase II Coverage (2010)		
	Total No. of Public School Student	Std. No. of Public School Students to be Served	Add'l. No. of Public School Student to be Served	Total No. of Public School Student	Std. No. of Public School Students to be Served	Add'l. No. of Public School Student to be Served
Altavas	6,245	4,236	1,276	6,694	6,025	1,789
Balete	4,725	4,205	965	5,540	4,986	781
Banga	4,966	4,373		5,630	5,067	694
Batan	7,046	3,279	1,439	7,744	6,970	3,691
Buruanga	3,310	1,516	676	3,310	2,979	1,463
Ibajay	4,279	3,074	874	5,619	5,057	1,983
Kalibo (Capital)	17,969	15,150	3,670	19,292	17,363	2,213
Lezo	3,436	3,022	702	3,650	3,285	263
Libacao	6,310	4,609	1,289	6,796	6,116	1,507
Madalag	5,197	3,382	1,062	5,491	4,942	1,560
Makato	6,667	4,002	1,362	7,728	6,955	2,953
Malay	7,678	4,288	1,568	10,457	9,411	5,123
Malinao	6,053	5,076	1,236	6,410	5,769	693
Nabas	6,332	4,493	1,293	6,889	6,200	1,707
New Washington	7,084	4,247	1,447	8,654	7,789	3,542
Numancia	5,537	2,171	1,131	6,162	5,546	3,375
Tangalan	4,999	4,360		5,654	5,089	729
Provincial Total	107,833	75,483	19,990	121,720	109,549	34,066

(3) Public toilets

The service coverage of public utilities with sanitary toilet facility by municipality is estimated for the years 2005 and 2010.

The future service coverage and additional coverage are estimated using the existing number of public utilities with sanitary toilets in the base year, the number of public utilities in target years, and provincial sector targets.

The additional number of public utilities with sanitary toilets needed by municipality is the shortfall of the number of public utilities in target year comparing with either the existing coverage or Phase I coverage (details are referred to Supporting Report).

The existing sanitary facilities are to be utilized during Phase I period. The facilities in Phase I are to be utilized during Phase II period.

The number of served public utilities at the end of Phase I period is 84. The additional public utilities to be served are 37. While at the end of Phase II period, the number of served public utilities are 157 with additional public utilities to be served at 36. Table 8.5.4 summarizes the additional number of public utilities to be served by municipality by target year.

Table 8.5.4 Additional Number of Public Utilities with Sanitary Toilets by Target Year

Name of Municipality/City	Type	Phase I Coverage (2005)		Phase II Coverage (2010)	
		Add'l. No. of Public Utility with Sanitary Toilets	No. of Public Utility with Sanitary Toilets	Add'l. No. of Public Utility with Sanitary Toilets	No. of Public Utilities with Sanitary Toilets
Altavas	Public Market	1	5	1	6
	Bus/Jeepney Terminal				
	Parks/Playground	1	1	1	2
	Total	2	6	2	8
Balete	Public Market	1	3	1	4
	Bus/Jeepney Terminal				
	Parks/Playground	1	1	1	2
	Total	2	4	2	6
Banga	Public Market	1	5	1	6
	Bus/Jeepney Terminal				
	Parks/Playground	1	1	1	2
	Total	2	6	2	8
Batan	Public Market	1	3	1	4
	Bus/Jeepney Terminal	1	3	1	4
	Parks/Playground		2	1	3
	Total	2	8	3	11
Buruanga	Public Market	1	3	1	4
	Bus/Jeepney Terminal	1	1	1	2
	Parks/Playground				
	Total	2	4	2	6
Ibajay	Public Market	1	3	1	4
	Bus/Jeepney Terminal		2		2
	Parks/Playground	1	1	1	2
	Total	2	6	2	8
Kalibo (Capital)	Public Market	1	10	1	11
	Bus/Jeepney Terminal	1	7	1	8
	Parks/Playground	1	6	1	7
	Total	3	23	3	26
Lezo	Public Market	1	3	1	4
	Bus/Jeepney Terminal		2		2
	Parks/Playground			1	1
	Total	1	5	2	7
Libacao	Public Market	1	3	1	4
	Bus/Jeepney Terminal	1	1	1	2
	Parks/Playground				
	Total	2	4	2	6
Madalag	Public Market	1	3	1	4
	Bus/Jeepney Terminal	1	3	1	4
	Parks/Playground				
	Total	2	6	2	8
Makato	Public Market	1	3	1	4
	Bus/Jeepney Terminal				
	Parks/Playground	1	1	1	2
	Total	2	4	2	6
Malay	Public Market	3	5	1	6
	Bus/Jeepney Terminal	1	1		1
	Parks/Playground	1	3	1	4
	Total	5	9	2	11
Malinao	Public Market	1	3	1	4
	Bus/Jeepney Terminal				
	Parks/Playground	1	1	1	2
	Total	2	4	2	6

Table 8.5.4 Additional Number of Public Utilities with Sanitary Toilets by Target Year

(Cont'd)

Name of Municipality/City	Type	Phase I Coverage (2005)		Phase II Coverage (2010)	
		Add'l. No. of Public Utility with Sanitary Toilets	No. of Public Utility with Sanitary Toilets	Add'l. No. of Public Utility with Sanitary Toilets	No. of Public Utilities with Sanitary Toilets
Nabas	Public Market	1	9	1	10
	Bus/Jeepney Terminal				
	Parks/Playground	1	1	1	2
	Total	2	10	2	12
New Washington	Public Market		4		4
	Bus/Jeepney Terminal	1	3	1	4
	Parks/Playground	1	1	1	2
	Total	2	8	2	10
Numancia	Public Market	1	3		3
	Bus/Jeepney Terminal		4	1	5
	Parks/Playground	1	1	1	2
	Total	2	8	2	10
Tangalan	Public Market	1	5		5
	Bus/Jeepney Terminal			1	1
	Parks/Playground	1	1	1	2
	Total	2	6	2	8
Provincial Total	Public Market	18	73	14	87
	Bus/Jeepney Terminal	7	27	8	35
	Parks/Playground	12	21	14	35
	Total	37	121	36	157

8.5.3 Urban Sewerage

The service coverage in 2010 (Phase II) is estimated for the municipalities with population of more than 10,000 in urban area provided by Level III water supply. It is assumed that half of the population in the area/s is to be served by the sewerage systems. Table 8.5.5 shows the population to be served in Phase II.

Table 8.5.5 Population to be Served by Urban Sewerage in Phase II

Name of Municipality	Urban Population in 2010	Level III Water Supply Coverage	Population to be Served
Kalibo (Capital)	84,749	80,512	42,375
Malay	12,926	12,280	6,463
Provincial Total	143,645	136,563	48,838

8.5.4 Solid Waste

Future requirements in the sub-sector are studied giving priority to urban area for the Phase I. Staged improvement for the rural area shall be studied in the future.

Service coverage in Phase I was assumed at 80% in consideration of the improvement of the present service coverage of 54% in urban area. Additional service coverage in Phase I is cal-

culated as a shortfall of target coverage in Phase I to meet urban population growth. Table 8.5.5 presents additional service coverage for Phase I in the urban area.

Table 8.5.5 Additional Number of Urban Households to be Served by Municipal Solid Waste System in Phase I

Name of Municipality	No. of Urban Households Served in the Base Year	Phase I Coverage (2005)		
		No. of Urban Households	Urban Households Coverage	Add'l. No. of Urban Households to be Served
Altavas	983	556	983	
Balete	478	347	478	
Banga	395	452	395	
Batan	403	359	403	
Buruanga	208	225	208	
Ibajay	368	542	434	66
Kalibo (Capital)	2,415	14,521	11,617	9,202
Lezo	240	486	389	149
Libacao	617	578	617	
Madalag	410	326	410	
Makato	836	673	836	
Malay	950	1,840	1,472	522
Malinao	70	347	278	208
Nabas	415	825	660	245
New Washington	475	1,051	841	366
Numancia	1,697	684	1,697	
Tangalan	250	593	475	225
Provincial Total	11,210	24,405	22,193	10,983

8.6 Facilities, Equipment and Rehabilitation to Meet the Target Services

8.6.1 Water Supply

(1) Required facilities

Water supply facilities required by service level were estimated by urban and rural area by municipality based on the additional service coverage by target year and summarized in Table 8.6.1 (details are referred to Supporting Report).

Urban water supply:

Physical requirements of Level III systems were estimated as the number of required house connections. Mode of project indicates whether future urban water supply will be implemented as expansion of existing system or construction of a new system. The number of water sources was also estimated based on the water source evaluation results in Chapter 7.

Table 8.6.1 Water Supply Facilities Required by Target Year

Name of Municipality	Phase I (2005) Requirements											Phase I (2010) Requirements							
	Urban Water Supply (Level III)			Rural Water Supply								Urban WS (Level III)		Rural Water Supply					
				Level II		Level I								Level I					
	Mode of Project	No. of Add'l. Water Source	No. of HHs Connection	No. of System	No. of Communal Faucets	Number of Deep Wells				No. of Shallow Wells	Total No. of Wells	No. of Add'l. Water Source	No. of HHs Connection	Number of Deep Wells				No. of Shallow Wells	Total No. of Wells
						40 m	80 m	120 m	Sub-total					40 m	80 m	120 m	Sub-total		
Altavas	Expansion	1	68	4	56							1	635	132			132	32	164
Balete	New	1	43	2	40	3			3	1	4	1	430	178			178	76	254
Banga	New	1	56			23			23	5	28	1	511	168			168	41	209
Batan	Expansion	1	44			25			25		25	1	31	250			250		250
Buruanga	New	1	28							11	11	1	269					51	51
Ibajay	Expansion	1	67	9	101							1	617	94			94	10	104
Kalibo (Capital)	Expansion	2	1,784									6	10,280						
Lezo	Expansion	1	60			11			11		11	1	172	80			80		80
Libacao	Expansion	1	71			2			2	17	19	1	728	10			10	85	95
Madalag	Expansion	1	40			2			2	13	15	1	283	22			22	197	219
Makato	Expansion	1	83			20			20	2	22	1	433	161			161	17	178
Malay	New	1	226	2	40	2			2	8	10	2	2,761	71			71	284	355
Malinao	Expansion	1	43	3	60							1	11	100			100	24	124
Nabas	New	1	101			9			9	9	18	1	941	44			44	44	88
New Washington	New	1	129			27			27		27	1	1,246	59			59		59
Numancia	Expansion	1	84			22			22		22	1	784	86			86		86
Tangalan	New	1	73			12			12	2	14	1	767	100			100	24	124
Provincial Total	Exp.- 10 New- 7	18	3,000	20	297	158			158	68	226	23	20,899	1,555			1,555	885	2,440

Rural water supply:

Physical requirements of Level II systems were estimated as the number of systems and number of communal faucets, while that of Level I facilities were first estimated as the number of wells with classification of deep and shallow wells. Deep wells were further subdivided in terms of three different standard depths based on the water source evaluation results.

Furthermore, as for Level I facilities, in this PW4SP, 30% of the total required facilities will be implemented by public (LGUs).

(2) Rehabilitation

Rehabilitation requirements were estimated as 10% of the total number of deep wells to be constructed under PW4SP. Rehabilitation work will be mainly redevelopment of wells by means of air surging, while minor repair of concrete apron and hand-pump will be undertaken by respective beneficiary organizations.

(3) Equipment

Logistic support:

For rural water supply development, 1 unit each or set of the following equipment was considered necessary for the provincial government to conduct various activities of PW4SP implementation;

Transportation-	service vehicle
Office equipment-	computer with printer, typewriter, mimeo machine, scanning machine and copier
Field equipment-	sound system, tape recorder and tools for maintenance

For urban water supply, no hardware was considered.

Well drilling and rehabilitation equipment:

As a reference information, necessary types and number of well drilling and rehabilitation equipment were studied considering the existing equipment of sector agencies in the province.

During Phase I, a total of 82 Level I deep wells shall be newly constructed by public (LGUs) and 10% of these deep wells shall be rehabilitated annually (details are referred to Supporting Report). The DEO-DPWH (in Kalibo) has two (2) unit of rotary drilling rig applicable for deep well (8" of bit diameter and 60 m of depth). They were procured in 1988 and not operational at present.

Therefore, at least 2 sets of drilling rig (medium size percussion type) together with 1 set of well rehabilitation equipment, 1 unit of support vehicle for well rehabilitation and 2 units of service truck for deep well construction shall be mobilized/procured either by the private sector or LGUs (details are referred to Supporting Report).

Selection of well drilling machine

An appropriate type of well drilling machine with its specifications shall be selected after comprehensive study on the technical requirements, local capability in O&M of the machine and cost effectiveness.

From the technical viewpoint, geological conditions in the province allow for the use of either rotary or percussion type drilling machine (no rock drilling is expected). While, in view of economical and O&M experience on the machine in the local area, a percussion type is recommendable. Although, the rotary type machine is quite effective to reduce construction period under soft soil condition, special training on mud-circulation, handling manner, etc. are required together with additional equipment and materials as compared with percussion type. The drilling speed of the percussion type is rather slow, but has advantages in drilling boulder and cobble formations.

One unit of truck mounted percussion drilling machine was considered to be procured in the long-term development period.

(4) Laboratory

Instrument/Equipment and Other Laboratory Accessory:

The provincial government will need at least one set of instruments/equipment in order to ensure regular water quality monitoring and surveillance activities for the entire province. Water samples have to be examined on time to avoid unpredictable changes of the quality due to long storage.

The laboratory equipment requirement for the provincial laboratory in Kalibo is designed to upgrade the existing facility. The following are the requirements:

	Item	Unit	Upgrading of Provincial Laboratory
I.	Instrument/Equipment		
	Turbidity meter	set	1
	Color meter	set	1
	pH/Residual chlorine checker	set	1
	Incubator	set	1
	Refrigerator	set	1
	Sterilizer	set	1

	Item	Unit	Upgrading of Provincial Laboratory
	Portable water quality testing kit	set	1
	Electric stove	set	1
	Range hood	set	1
2.	Glassware/Chemical	set	1
3.	Accessory		
	Sink	set	1
	Working table	set	1
	Shelf	set	1
	Office desk	set	1
	Chair	set	1

8.6.2 Sanitation

This sub-section refers to physical requirements by target year covering household, school and public toilet facilities. Table 8.6.2 presents the required sanitation facilities by target year. Rehabilitation for the sanitation facilities is considered as part of recurrent cost.

(1) Household toilets

Future requirements in the number of household toilets by different type for urban and rural areas were estimated based on the additional households to be served by type of facility both for urban and rural areas by target year (details are referred to Supporting Report).

Table 8.6.2 Sanitation Facilities Required by Target Year

Name of Municipality	Phase I (2005) Requirements													Phase II (2010) Requirements											
	Urban Sanitation								Rural Sanitation					Urban Sanitation								Rural Sanitation				
	No. of Households				No. of Public Sch. Toilets	No. of Public Toilets			No. of Households				No. of Public Sch. Toilets	No. of Households				No. of Public Sch. Toilets	No. of Public Toilets			No. of Households				No. of Public Sch. Toilets
	Flush	Pour Flush	VIP/ Dry	Total		Public Market	Bus/ Jeepney Terminal	Parks/ Playground	Flush	Pour Flush	VIP/ Dry	Total		Flush	Pour Flush	VIP/ Dry	Total		Public Market	Bus/ Jeepney Terminal	Parks/ Playground	Flush	Pour Flush	VIP/ Dry	Total	
Altavas	104			104		1		1		479	453	932	6	81	181		262		1		1		1,880		1,880	26
Balete						1		1		1,437		1,437	4	237			237		1		1		1,469		1,469	23
Banga		7		7		1		1		646		646			166		166		1		1		2,696		2,696	24
Batan						1	1			636	597	1,233	7	167			167		1	1	1	500	1,558		2,058	33
Buruanga						1	1			693	256	949	3	25	70		95		1	1			924		924	13
Ibajay	128			128		1		1		410	744	1,154	4	51	149		200		1		1	732	1,923		2,655	23
Kalibo (Capital)	768	1,761	45	2,574	18	1	1	1						2,011	4,624		6,635	11	1	1	1					
Lezo	46			46		1				196		196	3	15	102		117		1		1	145	871		1,016	14
Libacao	97			97		1	1			1,029		1,029	6	91	194		285		1	1		430	1,510		1,940	27
Madalag	75			75		1	1			1,102		1,102	5	77	135		212		1	1			1,856		1,856	22
Makato	57			57		1		1		379		379	6	85	207		292	2	1		1	586	2,017		2,603	31
Malay	170	316	82	568	2	3	1	1		1,243	428	1,671	6	509	841		1,350	7	1		1		3,710		3,710	34
Malinao	34			34		1		1		415		415	6	23	84		107		1		1	528	1,542		2,070	27
Nabas	5			5		1		1		31		31	5	77	226		303	2	1		1		1,768		1,768	26
New Washington	131			131			1	1		570	45	615	6	126	316		442	3		1	1		2,769		2,769	33
Numancia	115			115		1		1		958		958	5	165	289		454	2		1	1	253	2,134		2,387	24
Tangalan	138			138		1		1		615		615		104	209		313			1	1		1,827		1,827	21
Provincial Total	1,868	2,084	127	4,079	20	18	7	12		10,839	2,523	13,362	72	3,844	7,793		11,637	27	14	8	14	3,174	30,454		33,628	401

(2) School toilets

The future requirements in the number of toilet facilities were estimated based on the standard number of students to be served by a 5-unit standard facility or a toilet in every classroom (50-50 sharing) and the additional students to be served by target (details are referred to Supporting Report).

Total required facilities were further broken down into urban and rural areas by applying the percentage share of urban and rural population.

8.6.3 Urban Sewerage and Solid Waste

Physical requirements for the sewerage facilities are not discussed in this sub-section. Further study shall be conducted in the future.

As reference information, the number of refuse collection trucks is estimated for the urban area in Phase I. Ten (10) additional units of truck are required to meet assumed service coverage as reflected in Table 8.6.3.

Table 8.6.3 Number of Refuse Collection Trucks Required in Phase I

Name of Municipality/ City	Additional Urban Households to be Served	Estimated Daily Amount of Refuse to beGenerated, (Kg)	Number of Collection Truck Required
Cuartero	623	261	1
Dao	1,004	420	1
Dumalag			
Dumarao	580	243	1
Ivisan	109	46	1
Jamindan	683	286	1
Ma-ayon	347	146	1
Mambusao	150	63	1
Panay	650	272	1
Panitan	99	42	1
Pilar			
Pontevedra	97	41	1
President Roxas			
Roxas City (Capital)			
Sapi-an			
Sigma			
Tapaz			
Provincial Total	4,342	1,820	10

8.7 Identification of Priority Projects for Medium-Term Development Plan

In general, the present service coverage by municipality with reference to the target coverage indicates the direction of development effort for implementing PW4SP with municipal priorities.

Specific projects shall be selected subject to detailed studies and will not be discussed in the provincial master plan. In addition, pertinent information to identify priority projects is not available both at provincial and municipal level during this PW4SP preparation, except some future expansion work for WDs.

The general criteria for identifying priority projects as guide for implementing the PW4SP are summarized below.

The first level of priority should be given to projects with positive feasibility studies and identified funding. Next level of priority should be given to projects with positive feasibility studies, although no funding source has been identified. The third level should be for which feasibility study has been conducted. Within each level, if funds were insufficient, a ranking could be carried out applying some factors, such as willingness to pay, water-related diseases status and per capita cost. Under the above-mentioned conditions, the implementers should prepare a list of projects.

Due attention shall be paid on the importance of integrated development of relevant sub-sectors to maximize the effects and benefits through simultaneous implementation of water supply and sanitation projects. On a municipal level priority, synthetic evaluation of sector components for concerned municipalities (which is studied in the financial arrangements, Chapter 11) may be used for implementation arrangements.