

### 7.3.3 Groundwater Quality

There are water quality problems in deep wells in specified parts of alluvial plain and Samal Island. Major water quality problems are remnants of brackish water in southern part of alluvial plain, and high Fe and Mn contents in northeastern portion of that. In Samal Island, typical water qualities of deep well and spring sources have high Ca and Mg contents due to mineral rich recharge area formed by limestone. Also in west seashore belt of Samal Island, the saline water intrusion is now reported due to over exploitation. The results of water resources investigation for the province conducted by NWRB and general information from DPWH-DEO and PPDO revealed the problem areas as shown in the Groundwater Availability Map in Figure 7.3.1. The following are summary of the findings.

(1) Brackish Water Remained Area

Among the water quality problems of the province, brackish water is most serious one with about 70% percentage of affected existing deep wells. The problem is extended to most of alluvial plain area in many municipalities including Asuncion, Tagum, Braulio E. Dujali, Carmen and Panabo. Majority of potable groundwater source is shallow wells, which are utilizing Level-I or Level-II services.

(2) High Fe & Mn Contents Area

An area of groundwater with high Fe and Mn contents is experienced in northeastern part of the alluvial plain, which area is located in the municipalities of Asuncion and New Corella. Probably, the said groundwater is originated from west side of the cordillera formed by mineral rich volcanic rocks. To remove the Fe in the water, DPWH-DEO installed iron removal facilities at some sites as pilot test plants, some of which are being used at present.

(3) High Ca & Mg Contents Area

One of the major water sources in the Samal Island is developed by deep wells in the plateaus. The groundwater qualities have slightly high Ca and Mg contents, because the formation of groundwater recharge area is formed by limestone that covers most area of the Samal Island. The examination results indicate minimum Ca of 150 mg/l and Mg of 50 mg/l, respectively. Probably, the same groundwater quality could be observed in the Talikud Island.

#### (4) Saline Water Intrusion Area

There is small-scale alluvial plain in western coastal area of the Samal Island. Groundwater quality of this area is generally potable. However, the saline water intrusion is already occurred in seashore zones due to over exploitation of groundwater for urban water supply.

### 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 in provision of sanitary protection, 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 through the study, the province has 157 developed springs currently serving the province. These springs come out from high mountain areas in northwestern part and from low hilly areas in central part of the province, and from western abrasion cliff in the Samal Island. Of these springs, 151 have discharges of less than 2.8 lps, while 6 yield with 2.8 lps or more. Most of these springs are not dried up during a drought year with yields varying from 0.9 lps to 19.4 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 Hijo, Tagum and Lasang Rivers. There are only two (2) stream gauging stations at Hijo and Tagum Rivers in the province.

Surface water use in the province totaled 37.6 m<sup>3</sup>/sec according to the NWRB's water rights registration database, as of March 1997. Of this usage, 98% of the water rights were registered for irrigation. The large-scale flumes are operated by the NIA and some private companies. The diversions of major flume are located in Kapalong at the Tagum River and in

Panabo at the Lasang River. Other surface water rights are lodged to waterworks and private companies for domestic and fishery users. Several private companies have utilized river water for fisheries in the Tagum City at the Tagum River. For domestic water supply, the Maragusan Waterworks in the Tagum City had registered 0.02 m<sup>3</sup>/sec intake amount at the Magcagong creek (sub tributaries of the Hijo River) in the year 1993.

Data on river flow together with 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 streams were conducted through this study. The examined water quality at each stream meets the Class A limitation of "DENR Fresh Water Quality Criteria". However, higher Fe and Mn contents were observed at the Hijo River due to the existence of mineral rich rocks of the volcanoes. It is noted that mining activities on chromite are prevalent at the Tagum stream watershed in the province of Compostela Valley. This operation is small magnitude; however, it might have caused contamination of the surface water by heavy metals.

## **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 12.3 to 19.5 mbs. One disadvantage of shallow wells is the lowering of water level during dry season that reduces the discharge of the wells. 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 that the wells tap to comparatively deeper

Table 7.6.1 Groundwater Development Potential in the Province

Area	Groundwater Development Potential	Water Quality	Area Feature
Samal Island	<p>One of the major water sources in the Samal Island is developed by the scattered springs at abrasion cliff in western coast. The littoral deposits in western coast and the neritic sediments can also be considered as potential groundwater bearing aquifers. The wells in coastal area of Babak to Samal with depth of less than 30 m and shallow water level are producing groundwater for the Level-II/III services.</p> <p>In the plateaus areas with elevation of 50 m to 250 masl, the aquifers good for deep wells are seen mainly various sedimentary rock units, which indicate major reef limestone bodies. The deep wells with depths of 40 m to 120 m constructed in this plateau area have moderate production capacities, while the static water levels in this area are ranging from 30 m to 90 mbgs.</p>	<p>The groundwater contents high Ca and Mg, which are examined Ca of 150 mg/l to 200 mg/l and Mg of 50 mg/l to 80 mg/l, respectively. The groundwater quality in coastal area is potable. However, the saline water intrusion is already occurred in seashore belt due to over exploitation.</p>	<p>This area consists of two islands of the Samal and Talikad. Samal Island is strip island with length of N-S 33 km and width of E-W 15 km. Talikad Island with periphery of about 20 km is located southwest side of Samal.</p>
Northwestern Mountainous	<p>Most of this field is classified as a difficult area to develop groundwater in terms of quantity and quality. In areas where the formation made of tuff breccia or sandstone is distributed along the valley or in the hollow area, shallow wells might have possibility to product groundwater for Level-I service. Majority of the potential sources in this area is scattered springs.</p>	<p>Due to the presence of volcanic and tuffaceous rock formations in this area, the groundwater might have qualities of high Fe and Mn contents.</p>	<p>The northwest mountainous area is composed of entire Talangod and northwest part of Kapa-long.</p>
Central-Eastern Lowland Hills & Alluvial Plain	<p>Deep well development is possible in all of this area and they can be considered as sustainable sources for the future demands. In the lowland hills, which is located in the northern part of this area, the deep well depths ranging from 30 m to 80 m are restrained depend on the depth of static water level. Generally, the water level is lower than 5 mbgs and the production capacity is more or less of 100 m<sup>3</sup>/day. On the other hands in the alluvial plain area, the water level is observed shallow (1 mbgs to 6 mbgs) and the permeability of recent and diluvial deposits is quite high.</p>	<p>The groundwater quality problems are experienced in some part of alluvial plain area. About 70% of this area, groundwater from the confined aquifers is found brackish water. An area of groundwater with high Fe and Mn contents is distributed in northern part of the plain deposits.</p>	<p>This area consists of lowland hills and alluvial plain in the central to eastern portion of the province. Eight municipalities are covered by this area and are generally populated.</p>

aquifer. It reduces the hazards of groundwater pollution. In addition, lowering of groundwater level does not affect the discharge, since usual confinement of deep aquifer rises water level above the aquifers. In Recent deposits and Plio-Pleistocene series, good aquifers apparently occur from 21 m to 180 m in depth.

Additional wells can still be developed to meet the 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 data: 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 in the expected municipality area are assumed in the Supporting Report. The construction ratio of natural gravel packed well to the total requirements in the province is probably summed at more than 10%.

## (2) Spring

A total of 26 untapped spring sources for future development are listed in Table 7.6.4 Untapped Spring Source Identification, Supporting Report. The list includes detailed data on barangay name, owner, discharge rate in dry season, transmission line length and elevation difference between spring source and served area.

Such springs are mainly located in the mountainous municipalities of Kapitalong, New Corella and Talaingod, which are belonging to the Central Mindanao Cordillera. Other municipalities have a few untapped springs. Discharge rates of the springs are ranging from 0.1 lps to 66 lps. The spring development potential in the province is shown in Table 7.6.1.

## (3) Surface Water

The potential surface water volume exploitable at 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 draught 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 all of the major river basins are privileged to use larger amount of river water.

## 7.7 Water Source Development for Medium-Term Development Plan

For 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, which were established using well information from NWRB and the province (detailed data base is included in Table 7.1.1, Data Report), and hydrogeological assessment presented in Table 7.6.2, Supporting Report.

The water sources availability (ratio between wells to springs) by municipality is attached to the Table 7.7.1 that was assumed based on water sources study with consideration of limited information such as geology, topography, water sources inventory, etc. These ratios indicate general profile of different types of groundwater source available in the municipalities. Therefore, figures of ratio have no projected meaning of future development values of each groundwater source. With consideration of present water sources utilization, the percentages of spring development compared with well development for future demand in the entire province are studied in Chapter-8 as planning section.

**Table 7.7.1 Standard Specification of Wells by Municipality**

Municipalities with Classification		Type	Proportion (%)	Standard Specification			Ratio (%) well:spring
				Depth Range (m)		SWL (m)	
Asuncion	Rural	SW	-	-	<D<	-	90:10
		DW	100	20	<D<	50	
	Urban	SW	-	-	<D<	-	90:10
		DW	100	60	<D<	150	
Braulio E. Dujali	Rural	SW	-	-	<D<	-	100:0
		DW	100	20	<D<	50	
	Urban	SW	-	-	<D<	-	100:0
		DW	100	60	<D<	150	
Carmen	Rural	SW	-	-	<D<	-	90:10
		DW	100	20	<D<	50	
	Urban	SW	-	-	<D<	-	90:10
		DW	100	60	<D<	150	
Island Garden City of Samal	Rural	SW	-	-	<D<	-	90:10
		DW	100	60	<D<	100	
	Urban	SW	-	-	<D<	-	90:10
		DW	100	80	<D<	120	

**Table 7.7.1 Standard Specification of Wells by Municipality (continued)**

Municipalities With Classification		Type	Proportion (%)	Standard Specification			Ratio (%) well:spring	
				Depth Range (m)	SWL (m)	Sp. Cap. (lpsm)		
Kapalong	Rural	SW DW	- 30	- <D< 30 <D<	- 60	- 20	- 0.5	30:70
	Urban	SW DW	- 100	- <D< 60 <D<	- 80	- 10	- 1.0	
New Corella	Rural	SW DW	- 90	- <D< 30 <D<	- 60	- 20	- 0.5	70:30
	Urban	SW DW	- 100	- <D< 60 <D<	- 80	- 10	- 1.0	
Panabo	Rural	SW DW	- 100	- <D< 20 <D<	- 50	- 5	- 0.5	80:20
	Urban	SW DW	- 100	- <D< 60 <D<	- 150	- 5	- 2.0	
Santo Tomas	Rural	SW DW	- 100	- <D< 30 <D<	- 60	- 20	- 0.5	60:40
	Urban	SW DW	- 100	- <D< 60 <D<	- 80	- 10	- 1.0	
Tagum City	Rural	SW DW	- 100	- <D< 20 <D<	- 50	- 5	- 0.5	90:10
	Urban	SW DW	- 100	- <D< 60 <D<	- 150	- 5	- 2.0	
Talaingod	Rural	SW DW	- 20	- <D< 40 <D<	- 80	- 30	- 0.3	20:80
	Urban	SW DW	- 60	- <D< 70 <D<	- 100	- 20	- 1.0	

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

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

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 the geophysical prospecting and the construction of test wells shall be conducted. The areas that fall on this group are the cities of Tagum and Island Garden. Table 7.7.2 summarizes the requirements.

**Table 7.7.2 Detailed Groundwater Investigation Required**

Municipality	Area	Investigation Activities and Specification
Tagum City	Urban Area	Test Wells; Two deep wells depth of 120 m, diameter of 250 mm and well screen of 30 m  Installation of Test; Pumping Test & Water Quality Examination Time Draw-down with maximum discharge of 2,000 m <sup>3</sup> /day Recovery Test Water Quality Examination to include of Fe, Mn and Cl
Island Garden City of Samal	Plateaus made of limestone	Radioactive Prospecting; 20 km <sup>2</sup>  Test Wells; Two deep wells depth of 150m, diameter of 250 mm and well screen of about 40m  Installation of Test; Pumping Test & Water Quality Examination Time Draw-down with maximum discharge of 2,000 m <sup>3</sup> /day Recovery Test Water Quality Examination to include of Ca, Mg and Cl  Installation of Study on Groundwater Balancing River Flow; run-off measurement, Maintenance flow, etc. Meteorological Analysis; precipitation, etc.

The groundwater development for water supply in urban areas (Level II and III systems) may require the construction of deep wells with a 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 a remedy of the problem on 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<sup>2</sup> 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. Further investigation shall be conducted for these springs, prior to the implementation, on the following items: (1) locations and type of spring sources. (2) fluctuation of discharge rates through the year, (3) distance from spring sources and proposed served areas and (4) elevation differences between the two points.

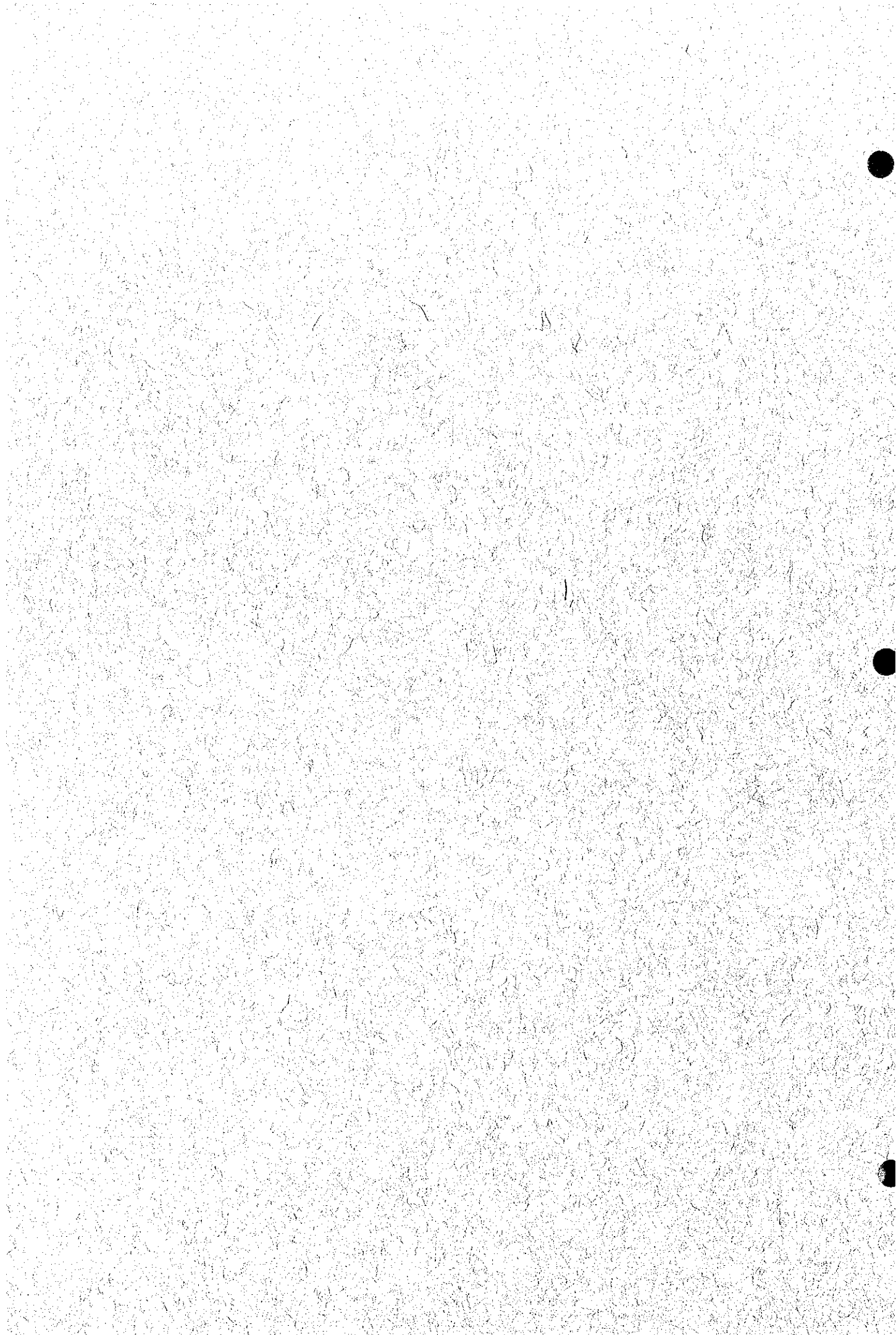


Chapter

8

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**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 are planned in almost the same manner as adopted in the 1998 Philippine National Development Plan (PNDP) and the National Sector Master Plan (NSMP), Medium-Term Investment covering the years 1999 to 2003 and Long-Term Development covering the period 2004 to 2010.

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 (1997) 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. Provincial population by target year and the base year (1997) is estimated with referring to NSO population census results (1980, 1990 and 1995), 1995 Census-based National and Regional Population projection prepared by NSO and Provincial Physical Framework Plan/Comprehensive Provincial Land Use Plan. While, the population distribution to urban and rural areas prepared by NSO in 1995 is modified to meet actual conditions in the classification of the areas.

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 2003 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 sub-section.

### **(1) Water supply**

The base year (1997) service coverage was calculated as a total of 1997 figures and expected by planned/on-going projects scheduled to be completed by 1998. Table 8.2.2 shows service coverage for the planning purpose (details are referred to Supporting Report).

Table 8.2.1 Provincial Sector Targets

Sub-sectors	Existing Service Coverage	Phase I (1999-2003)		Phase II (2004-2010)	
		Population Coverage (%)	Population Coverage (%)	Additional Population to be Served	Population Coverage (%)
Water Supply	Population Coverage (%)	Population Coverage (%)	Additional Population to be Served	Population Coverage (%)	Additional Population to be Served
<i>Urban Area</i>	59	60	29,501	95	227,922
<i>Rural Area</i>	44	45	65,149	93	264,407
Sanitation	Household Coverage (%)	Household Coverage (%)	Additional Households to be Served	Household Coverage (%)	Additional Households to be Served
<i>Household Toilet</i>					
<i>Urban Area</i>	83	90	9,604	95	39,911
Flush	19	35	8,550	50	26,434
Pour Flush	75	60	629	50	13,477
VIP	6	5	425	0	0
<i>Rural Area</i>	69	85	35,756	93	43,019
Flush	0	10	7,330	20	4,287
Pour Flush	63	70	26,448	80	38,732
VIP	37	20	1,978	0	0
<i>School Toilet</i>	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
	41	70	61,966	90	62,416
<i>Public Toilet</i>	Public Utilities Coverage (%)	Public Utilities Coverage (%)	Additional Public Utilities with Sanitary Toilets	Public Utilities Coverage (%)	Additional Public Utilities with Sanitary Toilets
	100	100	26	100	18
<i>Sewerage</i>	Urban Population Coverage (%)	Not Applicable		Urban Population Coverage (%)	Urban Population to be Served
	0			50	174,899
<i>Solid Waste</i>	Urban Household Coverage (%)	Urban Household Coverage (%)	Additional Urban Households to be Served	Not Applicable	
	66	90	10,617		

Table 8.2.2 Estimation of Base Year Service Coverage of Water Supply

Name of Municipality/City	Area	Population (1997)	Population Served by 1997 Facilities				Percentage Coverage
			Level III	Level II	Level I	Total	
Asuncion	Urban	7,325	1,200		834	2,034	28
	Rural	50,556	552	1,200	13,715	15,467	31
	Total	57,881	1,752	1,200	14,549	17,501	30
Braulio E. Dujali	Urban						
	Rural	15,577			691	691	4
	Total	15,577			691	691	4
Carmen	Urban	8,716	1,446			1,446	17
	Rural	45,937	1,560		592	2,152	5
	Total	54,653	3,006		592	3,598	7
Island Garden City of Samal	Urban	16,733	3,990	756	1,827	6,573	39
	Rural	65,126	420	14,027	1,724	16,171	25
	Total	81,859	4,410	14,783	3,551	22,744	28
Kapalong	Urban	10,224	2,778		4,780	7,558	74
	Rural	53,930	1,038	360	31,785	33,183	62
	Total	64,154	3,816	360	36,565	40,741	64
New Corella	Urban	8,389	2,256			2,256	27
	Rural	36,514	1,188	2,880	12,484	16,552	45
	Total	44,903	3,444	2,880	12,484	18,808	42
Panabo	Urban	47,762	4,590		14,166	18,756	39
	Rural	85,598	2,388	1,380	32,533	36,301	42
	Total	133,360	6,978	1,380	46,699	55,057	41
Santo Tomas	Urban	29,421	15,033		5,769	20,802	71
	Rural	53,201	780	3,000	31,677	35,457	67
	Total	82,622	15,813	3,000	37,446	56,259	68
Tagum City (Capital)	Urban	91,030	43,590		26,802	70,392	77
	Rural	78,334	47,844		5,473	53,317	68
	Total	169,364	91,434		32,275	123,709	73
Talaingod	Urban						
	Rural	17,141		660	13,053	13,713	80
	Total	17,141		660	13,053	13,713	80
<b>Provincial Total</b>	Urban	219,600	74,883	756	54,178	129,817	59
	Rural	501,914	55,770	23,507	143,727	223,004	44
	Total	721,514	130,653	24,263	197,905	352,821	49

The base year service coverage in urban area (59%) is behind the updated MTPDP sector target (68.8%) for the year 1998. Likewise, that in rural area (44%), is far behind the sector target of 79%. As identified in Chapter 4, the lower service coverage in rural area is caused by the presence of a large number of unsafe sources/facilities or no provision of water supply facilities.

For Phase I development, targets of service coverage for water supply are established to retain the current service coverage for both urban and rural areas. Sixty percent (60%) and 45% are adopted for urban and rural area, respectively. 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 1998 (details are referred to Supporting Report).

The province has base year service coverage of 73%, which is a way above the current national average coverage of 60%. Urban area registers a level of 83% that is also well above the national average coverage. Rural area however, has only 69% owing to the presence of numerous unsanitary facilities. By type of sanitary toilet facility, the existing percentage composition to total households is as follows:

Type	Urban (%)	Rural (%)
Flush	19	0
Pour-flush	76	63
VIP latrine	5	37

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, 85% is projected. Urban household toilet target is just 5% higher than rural household toilet target in order to lessen the gap of the coverage between these 2 areas and to achieve a balanced distribution of this basic facility as embodied in the PNDP. For Phase II, 95% as set by the NSMP is adopted for urban household toilets, while, 93% is arranged for rural household toilets.

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.

Table 8.2.3 Base Year Service Coverage of Household Toilets

Name of Municipality	Area	1998												
		Population		HHs		Number of Households			Households and Population Using Sanitary Toilets			Service Coverage (%)		
		Population	HHs	Flush	Pour	VIP/Dry	Total	Population	Flush	Pour	VIP/Dry	Total		
Asuncion	Urban	7,325	1,420	3	1,206	90	1,299	6,666		85		6	91	
	Rural	50,556	9,741		7,145	245	7,390	38,423		73		3	76	
	Total	57,881	11,161	3	8,351	335	8,689	45,089		75		3	78	
Braulio E. Dujali	Urban													
	Rural	15,577	3,300		2,039	112	2,151	10,126		62		3	65	
	Total	15,577	3,300		2,039	112	2,151	10,126		62		3	65	
Carmen	Urban	8,716	1,692		768	169	990	5,143	3	45	10	59		
	Rural	45,937	9,061	53	4,462	1,754	6,216	31,697		49	19	69		
	Total	54,653	10,753	53	5,230	1,923	7,206	36,840		49	18	67		
Island Garden City of Samal	Urban	16,733	3,300	7	2,076	173	2,256	11,379		63	5	68		
	Rural	65,126	12,695	40	4,727	3,339	8,106	41,681		37	26	64		
	Total	81,859	15,995	47	6,803	3,512	10,362	53,060		43	22	65		
Kapalong	Urban	10,224	1,978	128	1,601	73	1,802	9,304	6	81	4	91		
	Rural	53,930	10,939		1,989	5,453	7,442	36,673		18	50	68		
	Total	64,154	12,917	128	3,590	5,526	9,244	45,977	1	28	43	72		
New Corella	Urban	8,389	1,574		1,165	59	1,224	6,544		74	4	78		
	Rural	36,514	6,812		2,716	1,740	4,456	23,735		40	26	65		
	Total	44,903	8,386		3,881	1,799	5,680	30,279		46	21	68		
Panabo	Urban	47,762	9,439	956	5,678	377	7,011	35,344	10	60	4	74		
	Rural	85,598	16,557		7,864	3,956	11,820	60,775		47	24	71		
	Total	133,360	25,996	956	13,542	4,333	18,831	96,119	4	52	17	72		
Santo Tomas	Urban	29,421	5,615	175	3,768	397	4,340	22,655	3	67	7	77		
	Rural	53,201	10,411		3,824	3,128	6,952	35,645		37	30	67		
	Total	82,622	16,026	175	7,592	3,525	11,292	58,300	1	47	22	70		
Tagum City (Capital)	Urban	91,030	17,439	5,236	10,593	627	16,456	85,569	30	61	4	94		
	Rural	78,334	15,360		7,534	4,255	11,789	60,318		49	28	77		
	Total	169,364	32,799	5,236	18,127	4,882	28,245	145,887	16	55	15	86		
Talangod	Urban													
	Rural	17,141	3,578		468	986	1,454	7,028		13	28	41		
	Total	17,141	3,578		468	986	1,454	7,028		13	28	41		
Provincial Total	Urban	219,600	42,457	6,558	26,855	1,965	35,378	182,604	15	63	5	83		
	Rural	501,914	98,454	40	42,768	24,968	67,776	346,101		43	25	69		
	Total	721,514	140,911	6,598	69,623	26,933	103,154	528,705	5	49	19	73		



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 1998 (details are referred to Supporting Report).

**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 (1997)	Std. No. of Public School Student that can be Served by Base Year Sanitary Toilets (1997)	Service Coverage (%)	Number of Public Utilities with Toilets In 1997	Number of Public Utility with Sanitary Toilets in Base Year (1997)	Service Coverage (%)
Asuncion	14,682	9,320	63	4	4	100
Braulio E. Dujali	4,986	2,480	50			
Carmen	11,313	6,640	59	3	3	100
Island Garden City of Samal	18,841	7,360	39	11	11	100
Kapalong	15,447	6,720	44	2	2	100
New Corella	10,055	4,080	41	3	3	100
Panabo	29,510	9,200	31	4	4	100
Santo Tomas	18,835	4,920	26	2	2	100
Tagum City (Capital)	37,874	14,840	39	5	5	100
Talaingod	1,757	680	39	1	1	100
<b>Provincial Total</b>	<b>163,300</b>	<b>66,240</b>	<b>41</b>	<b>35</b>	<b>35</b>	<b>100</b>

Base year service coverage is 41% 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.

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 1998 is shown in Table 8.2.4 (details are referred to Supporting Report).

All existing public utilities are served with at least one sanitary toilet giving 100% coverage. This can be attributed by the fact that 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 1997 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.

**Table 8.2.5 Base Year Service Coverage of Municipal Solid Waste System in 1997**

Name of Municipality/City	Total No. of Households	No. of Urban Households	No. of Households Served	Coverage of Households (%)	Coverage of Urban Households (%)
Asuncion	11,161	1,420	220	2	15
Braulio E. Dujali	3,300				
Carmen	10,753	1,692	956	9	57
Island Garden City of Samal	15,995	3,300	1,132	7	34
Kapalong	12,917	1,978	500	4	25
New Corella	8,386	1,574	152	2	10
Panabo	25,996	9,439	7,356	28	78
Santo Tomas	16,026	5,615	1,586	10	28
Tagum City	32,799	17,439	16,113	49	92
Talaingod	3,578				
<b>Provincial Total</b>	<b>140,911</b>	<b>42,457</b>	<b>28,015</b>	<b>20</b>	<b>66</b>

About 20% of the total households in the province relied on municipal refuse collection using trucks or a 66% urban household coverage. These municipalities have a total of 18 units of collection truck.

No national targets have yet been set. However, considering the present level of coverage, 90% urban household coverage is applied for the medium-term period (1999-2003).

### **8.3 Projection of Frame Values**

#### **8.3.1 Population Projection**

Future population for all municipalities by urban and rural area was projected for the target years 2003 and 2010 together with the present population in 1997 as the planning base year.

The regional population in the future is published by the NSO, while the projection at the provincial and the municipal levels was not available during the time of 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 in 1980, 1990 and 1995
- 1995 Census-based National and Regional Population Projection prepared by the NSO
- Provincial Physical Framework Plan/Comprehensive Provincial Land Use Plan (1993-2002)

Before the study of the existing data and projections, the background of the province must be organized. The following are the major changes of the previous Davao Province and its component municipalities/cities.

The provinces of 'Davao del Norte' and 'Compostela Valley' were created having separated from previous 'Davao Province' in 1998.

Some municipalities of the Davao Province were merged and or separated to create new municipality/city.

##### **(1) 1995 Census-Based National and Regional Population Projections: NSO**

The NSO projected the regional population 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, Region X and XI are classified as medium-sized regions. The following are the result of projection for the two regions in 2000, 2005 and 2010.

**Table 8.3.1 Regional Population Projection**

Year		1980	1990	1995	2000	2005	2010
Region X	Population	2,758,985	3,509,753	3,938,252	4,441,739	4,955,545	5,465,272
	Growth Rate	-	2.44 %	2.33 %	2.44 %	2.21 %	1.98 %
Region XI	Population	3,346,803	4,458,829	5,052,730	5,749,821	6,456,464	7,146,889
	Growth Rate	-	2.91 %	2.53 %	2.62 %	2.35 %	2.05 %

Note: Growth rate of Region XI from 1990 to 2000 is projected at 2.58 %.

(2) Provincial Physical Framework Plan/Comprehensive Provincial Land Use Plan: Planning period 1993-2002

The provincial population (Davao province) for the year 2002 was projected with 1990 as the base year. The provincial growth rate of 3.8 % experienced between 1980 and 1990 was adopted for the projection. Meanwhile, the recorded/ projected growth rates of Region XI are 2.91 % between 1980 and 1990 and 2.58 % between 1990 and 2000.

The population projection on the provincial total and component municipalities was made with 1990 as base year. 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).

Comparing the census and the projected population in 1995, the provincial population of the census was lower to about 6% than the projected one. Regarding the municipal census population in 1995, about 70% of the 22 municipalities is lower than the projected ones (maximum 20% difference). While, the remaining municipalities are higher with a range of 0-60 %. Among the municipalities, Compostela, Laak and Talaingod have remarkable differences with about 30-60% between the census and the projected population. In this connection, it is necessary to reflect the 1995 census results in the projection as the base year population.

(3) Population Projection of the Province

The following conditions are considered/assumed in the population projection.

Provincial Population

- 1) The projection of the provincial population for the previous Davao Province was first made. Then, the population of Davao del Norte was projected proportionally, dividing the population of Davao Province referring to the share of the two re-arranged provinces in 1995. The following are the past population and the shares of the two provinces considering the composition of the municipalities by province. The shares

between the two provinces are almost constant in the last 15 years. Therefore, it may be assumed that the shares will be constant throughout the future.

Year	1980	1990	1995
Davao del Norte	405,663 (55.9%)	588,730 (55.8%)	671,333 (56.3%)
Compostela Valley	319,490 (44.1%)	466,286 (44.2%)	520,110 (43.7%)

- 2) The growth rates experienced by the province/municipalities from 1990 to 1995 are basically adopted for the projection of medium-term target years (1997-2003). However, the provincial population was first determined by applying the growth rate from 1990 to 1995 (2.46%), before finalization of the municipal population and their growth rates. The base year for the projection is 1995 using census results.
- 3) For the long-term projection from 2004 to 2010, the population ratio of the province to the regional total population was assumed considering past experience.

The range of population ratios of the provincial population (Davao Province) to the regional population (from 1980 to 1995 and projected year 2002 in the Land Use Plan) considered the correlation with other component provinces in the region and the projected regional population. The following are the population ratios of the province to the region both in the past and the projected.

Year	1980	1990	1995	2002	2003	2010
Province	725,153	1,055,016	1,191,443	1,647,359	1,447,132	1,672,372
Region	3,346,803	4,458,829	5,052,730	6,032,322	6,173,575	7,146,889
P/R (%)	21.7	23.7	23.6	27.3	23.4	23.4

The population ratios of the province from 1980 to 1990 were about 22-24 % and the 1995 census results maintained almost the same ratio as that in 1990. The ratio for the year 2002, which was projected in the Land Use Plan (27.3 %) seems to be over estimated referring to the past experience (1980-1995). The projected population for the year 2003 as mentioned above, is 23.4 % of the regional population. The population ratio of the province between 22-24 % may be taken into account throughout the future. The provincial ratio of 23.4 % (projected for the year 2003) is adopted for the year 2010 to determine the 2010 provincial population (estimated growth rate is 2.09%, while the regional rate from 2000-2005 is assumed at 2.05%). The projected population for the years 1997, 2003 and 2010 are as follows:

<u>Year</u>	<u>Population</u>	<u>Growth Rate</u>
1995	1,191,443	Census result
1997	1,250,783	2.46 % (growth rate from 1990 to 1995)
2003	1,447,132	2.46 % (growth rate from 1990 to 1995)
2010	1,672,372	2.09% (estimated from projected population)

The total population of Davao del Norte by target year was distributed to the two created provinces in proportion to the respective population sizes in 1995; Davao del Norte 56.3% and Compostela Valley 43.7%. The following are the population of Davao del Norte by target year.

<u>Year</u>	<u>Population</u>	<u>Growth rate</u>
1995	671,333	Census result (670,782 applying the share 56.3%)
1997	704,191	2.46 %
2003	814,735	2.46 %
2010	941,545	2.09 %

In comparison to the projected population of 959,400 in the year 2010 established by the Davao Integrated Development Program (DIDP-JICA assisted project) and the result of this study (941,545), the figures are almost the same with only a 2% differences. Therefore, the figures on the provincial population in this study may be employed.

#### Municipal/city population

- 1) The total population of the province by target year is fixed.
- 2) The projection of municipal/city population for the Davao del Norte is made.
- 3) The growth rates of respective municipalities for the years 1997 and 2003 are determined referring to the development experienced between 1990 and 1995. The municipal population for the respective target years was finally adjusted according to the initially calculated population sizes to meet fixed provincial population. Accordingly, the growth rates of the municipalities were modified. Table 8.3.2 presents the calculation results under the above conditions/assumptions.

Table 8.3.2 Municipal/City Population Projection

Municipality/ City	Annual Growth Rate (%)			Population/Growth Rate				
	'80-'90	Land Use Plan	'90-'95	1995	1997		2003	
				Census	Population	Estimated Growth- Rate	Population	Estimated Growth Rate
Asuncion	2.50	2.50	0.76	57,072	57,604	0.47	59,107	0.44
Babak	1.51	1.51	2.96	28,726	30,276	2.66	35,372	2.64
Carmen	4.89	4.50	2.59	56,260	58,867	2.29	67,297	2.26
Kapalong	5.01	4.60	1.34	62,183	63,484	1.04	67,413	1.01
Kaputian	0.75	0.75	2.35	26,874	27,990	2.05	31,557	2.03
New Corella	3.78	3.78	2.86	41,615	43,775	2.56	50,845	2.54
Panabo	4.48	4.10	3.46	130,585	138,958	3.16	167,090	3.13
Samal	0.50	0.50	1.53	21,395	21,928	1.24	23,560	1.21
Sto. Tomas	4.32	3.90	2.59	77,182	80,760	2.29	92,327	2.26
Tagum	4.62	4.20	2.94	156,588	164,977	2.64	192,539	2.62
Talaingod	0.88	0.88	10.39	12,853	15,571	10.07	27,629	10.04
Province	3.79	2.99	2.66	671,333	704,191	2.42	814,735	2.45

Note: 1995 population is census results.

For the year 2010 in the long-term, it is assumed that the trend of population growth of the respective municipality/city between 1990 and 2002, which is considered in the Land Use Plan, will be realized in line with the land use plan of the province. Thus, the projected growth rate for the year 2002 by municipality in the Land Use Plan is first applied to project 2010 population from the year 2003. Then, 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 year 2010 (941,545 persons). In this adjustment, the growth rates of Kaputian, Samal and Talaingod are fixed (rates used in the Land Use Plan) to avoid negative growth rates (less than -1.0%). Furthermore, the growth rate used in the Land Use Plan for Babak was fixed to avoid negative rate in the calculation process. Table 8.3.3 shows the study process result and the projected population by municipality for the year 2010 and the adjusted growth rates.

Table 8.3.4 presents a summary of past and projected population by target year that is rearranged to meet the current composition of municipalities/cities of the province.

Table 8.3.3 Municipal/City Population for the Year 2010 and Estimated Growth Rates

Municipality/ City	Population Projection using G.R in Land Use Plan					2010 Population Projection					
	2003 Pop.	G.R. (%)	2010 Pop.	1) Ad- justed	2) G.R. (%)	3) Share (%)	4) Ad- justed	5) G.R. (%)	6) Share (%)	7) Ad- justed	8) G.R. (%)
Asuncion	59,107	2.50	70,277	63,300	0.98	7.3	62,667	0.84	7.6	62,341	0.76
Babak	35,372	1.51	39,286	35,386	0.01	4.1	35,031	-0.14	N.A.	39,286	1.51
Carmen	67,297	4.50	91,582	82,489	2.95	9.6	81,664	2.80	10.0	81,240	2.73
Kapalong	67,413	4.60	92,356	83,187	3.05	9.6	82,354	2.90	10.0	81,926	2.82
Kaputian	31,557	0.75	33,261	29,959	-0.74	N.A.	33,261	0.75	N.A.	33,261	0.75
New Corella	50,845	3.78	65,943	59,396	2.25	6.9	58,801	2.10	7.2	58,496	2.02
Panabo	167,090	4.10	221,363	199,386	2.56	23.1	197,390	2.41	24.1	196,365	2.33
Samal	23,560	0.50	24,396	21,974	-0.99	N.A.	24,396	0.50	N.A.	24,396	0.50
Sto. Tomas	92,327	3.90	120,680	108,699	2.36	12.6	107,611	2.21	13.1	107,052	2.14
Tagum	192,539	4.20	256,798	231,304	2.66	26.8	228,988	2.51	27.9	227,799	2.43
Talaingod	27,629	0.88	29,383	26,465	-0.61	N.A.	29,383	0.88	N.A.	29,383	0.88
<b>Province</b>	<b>814,735</b>	<b>2.99</b>	<b>1,045,324</b>	<b>941,545</b>	<b>2.09</b>	<b>100</b>	<b>941,545</b>	<b>2.09</b>	<b>100</b>	<b>941,545</b>	<b>2.09</b>

Notes: G.R.: Annual Growth Rate N.A.: Not Applicable

- 1) Adjusted in proportion to municipal population (provincial total of 1,045,324) to meet the fixed figure (941,545)
- 2) Estimated growth rates of municipalities between 2003 and 2010 using adjusted population <sup>1)</sup>
- 3) Proportion of the municipal population (excluding three municipalities having negative growth rates) to total population of 863,147 <sup>1)</sup>
- 4) Population from adjusted population <sup>1)</sup> for Kaputian, Samal and Talaingod (figures in Land Use Plan are used) to avoid negative growth rates. The population of the remaining municipalities is modified proportionally (share of 3) ) to meet a total of 854,505.
- 5) Estimated growth rates of municipalities between 2003 and 2010 using modified population <sup>4)</sup>
- 6) Proportion of the municipal population (excluding Babak, Kaputian, Samal and Talaingod) to total population of 815,219 <sup>4)</sup>
- 7) Municipal population : modified for the 4 municipalities using G.R. in Land Use Plan and rearranged for the other municipalities to meet the population of 941,545 using the shares <sup>6)</sup>
- 8) Estimated growth rates of municipalities between 2003 and 2010 applying finally adjusted population <sup>7)</sup>

Table 8.3.4 Past and Projected Population by Current Municipality/City

Municipality	Past Pop. Development			Pop. Projection			
	1980	1990	1995	1997	1998	2003	2010
Asuncion	42,915	54,954	57,072	57,604	57,881	59,107	62,341
Braulio E. Dujali <sup>1)</sup>					15,577	17,887	21,220
Carmen	30,719	49,507	56,260	58,867	54,653	61,071	73,724
Island Garden City of Samal <sup>2)</sup>	62,423	68,573	76,995	80,194	81,859	90,490	96,943
Kapalong	42,869	66,030	62,183	63,484	64,154	67,413	81,926
New Corella	24,926	36,138	41,615	43,775	44,903	50,845	58,496
Panabo	71,098	110,172	130,585	138,958	133,360	155,429	182,662
Sto. Tomas	44,512	67,916	77,182	80,760	82,622	92,327	107,052
Tagum City	86,201	135,440	156,588	164,977	169,364	192,539	227,799
Talaingod			12,853	15,571	17,141	27,629	29,383
<b>Province</b>	<b>405,663</b>	<b>588,730</b>	<b>671,333</b>	<b>704,191</b>	<b>721,514</b>	<b>814,735</b>	<b>941,545</b>

Notes: 1) Population of Braulio E. Dujali is calculated using the population percentage of related barangays to mother municipalities in 1995 (9.3% of Carmen and 9.7% of Panabo in 1995).

2) 1980-1997 population of Island Garden City of Samal represents total population of previous three municipalities.

3) The population in 1998 (the year when re-arrangements of some municipalities were made) for the relevant municipalities was estimated using the growth rates adopted between 1995 and 2003.



### Population by urban and rural area

In the Land Use Plan, the urban/rural population by municipality for the year 2002 is projected with 1990 as base year. The annual growth rate of urban population for the year 2002 by municipality is estimated referring to the trend from 1980 to 1990 and the future land use plan. The provincial average growth rate is set at 5.1%. The rural population by municipality is estimated as the balance between the total population and the urban population. The average growth rate of the province (3.2%) is estimated to be almost half of the urban area. Urban and rural population by municipality/city was studied considering the 1995 census results and the estimated figures in the Land Use Plan.

#### 1) Past population development

With regard to urban population of the province to the total population, the provincial averages in 1980 and 1990 were 23.9 % and 28.3 %, and it increased to 30.4 % in 1995. The growth rates of Kapatian and Panabo from 1990 to 1995 showed considerable increase. Regarding the growth rate of the urban population, the provincial average (5.55% between 1980 and 1990) was reduced to 4.13 % in 1995. While, the rural population by municipality/city had decreased with a growth rate of 2.06% from 1990 to 1995 as a provincial average.

#### 2) Projection of urban and rural population for the years of 1997, 2003 and 2010

The urban population by municipality/city for the target years was first projected and the rural population was calculated to meet the aforementioned total population by smoothing the urban population.

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

- Short/Medium-term target: 1997 and 2003

Census results in 1995 are applied in terms of the share of urban population to the total population by municipality.

- Long-term target: 2010

It is anticipated that the share between urban and rural population will be regulated to meet the land use plan in the long-term period. The growth rate of the urban population by municipality, which is used for the projection in the year 2002 in the Land Use Plan, is employed with 2003 as base year.

Under the above assumptions, the provincial average share of the urban population for the year 2010 was arrived at 37.2%, higher than the figure in 1995 (30.4%). Table 8.3.5 shows the past and projected population by urban and rural area.

**Table 8.3.5 Past and Projected Population by Urban and Rural Area of Current Municipality/City**

Municipality/ City		Past Population Development			Population Projection		
		1980	1990	1995	1997	2003	2010
Urban Area	Asuncion	5,008	6,129	7,223	7,290	7,481	10,456
	Braulio E. Dujali					0	0
	Carmen	4,630	8,292	8,142	8,519	9,739	13,796
	Island Garden City of Samal	12,453	12,781	15,707	16,381	18,560	25,835
	Kapalong	5,195	11,950	9,910	10,117	10,743	15,218
	New Corella	4,915	6,746	7,775	8,179	9,499	12,927
	Panabo	14,067	25,964	43,504	46,293	55,665	80,440
	Sto. Tomas	14,941	22,230	27,484	28,758	32,877	43,556
	Tagum City	35,785	75,591	84,163	88,672	103,486	147,568
	Talaingod			0	0	0	0
	<b>Province</b>	<b>96,994</b>	<b>166,524</b>	<b>203,908</b>	<b>214,210</b>	<b>248,051</b>	<b>349,795</b>
Rural Area	Asuncion	37,907	48,825	49,849	50,314	51,627	51,885
	Braulio E. Dujali	0	0	0	0	17,887	21,220
	Carmen	26,089	41,215	48,118	50,348	51,331	59,928
	Island Garden City of Samal	49,970	55,792	61,288	63,808	71,930	71,108
	Kapalong	37,674	54,080	52,273	53,367	56,669	66,708
	New Corella	20,011	29,392	33,840	35,596	41,346	45,569
	Panabo	57,031	84,208	87,081	92,665	99,764	102,222
	Sto. Tomas	29,571	45,686	49,698	52,002	59,450	63,497
	Tagum City	50,416	59,849	72,425	76,305	89,053	80,232
	Talaingod			12,853	15,571	27,629	29,383
	<b>Province</b>	<b>308,669</b>	<b>422,206</b>	<b>467,425</b>	<b>489,980</b>	<b>566,685</b>	<b>591,750</b>

Note: Urban/rural population of Island Garden City of Samal from 1980 to 1997 represents summation of those of Babak, Kaputian and Samal

### 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, a decrease 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, a decrease of 1% from the 1997 rate is foreseen in 2003 and in 2010, the rate in 2003 is maintained. (details are referred to Table 8.3.6, Supporting Report).

Table 8.3.6 shows the projected number of public school students by municipality, by target year. About 183,150 and 211,800 public school students are estimated to enroll for years 2003 and 2010, respectively.

### 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.

**Table 8.3.6 Projected Public School Enrollment and Number of Public Utilities by Municipality**

Name of Municipality	Number of Public School Student			Number of Public Utilities		
	1997	2003	2010	1997	2003	2010
Asuncion	14,682	14,993	15,813	4	4	7
Braulio E. Dujali	4,986	5,726	6,792		6	6
Carmen	11,313	12,658	15,281	3	3	6
Island Garden City of Samal	18,841	20,827	22,312	11	25	25
Kapalong	15,447	16,232	19,727	2	3	6
New Corella	10,055	11,385	13,098	3	3	6
Panabo	29,510	34,395	40,422	4	5	7
Santo Tomas	18,835	21,047	24,404	2	3	5
Tagum City (Capital)	37,874	43,055	50,940	5	5	7
Talaingod	1,757	2,832	3,012	1	4	4
<b>Provincial Total</b>	<b>163,300</b>	<b>183,150</b>	<b>211,801</b>	<b>35</b>	<b>61</b>	<b>79</b>

A total of 26 public markets, bus/jEEPney terminals and parks/playgrounds are planned for construction by year 2003 and another 18 by the year 2010. Refer to Table 8.3.6 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.

Eight (8) municipalities with a total urban population of about 349,796 are considered (refer to Table 8.5.5).

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

The number of urban households in 2003 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 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 first reviewed mainly focusing on existing water sources and magnitude of service coverage. Planned/on-going projects for concerned municipalities were also studied and reflected on PW4SP 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 presents a summary of the study results by municipality.

1) Review of existing water supply systems and water sources

Majority of the existing Level III systems in urban areas is utilizing deep wells. The municipalities/cities of Carmen, Island Garden City of Samal, New Corella, Panabo and Tagum are served by WDs. While the municipalities of Asuncion, Kapalong and Santo Tomas are served by Level III systems operated either by the municipal government or local community.

Currently, 2 out of the total 10 municipalities, namely: Brulio E. Dujali and Talaingod have no Level III system in their urban areas and are presently served by Level II system and/or Level I facilities.

Population served by Level III systems range from about 1,200 persons in Asuncion to 44,000 persons in Tagum City. The average size of served population is about 5,800 persons.

Preference is made to utilize spring sources owing to less O&M activities and cost compared to deep well with electric motor pump.

2) Review of planned/on-going projects

At present, there is no particular planned/on-going project for municipalities in the province.

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, in general, as the most suitable measure. Therefore, for the investment needs of the sector development, it is assumed in this PW4SP that underserved or

Table 8.4.1 Summary of Urban Water Supply by Municipality

Municipality	Existing Condition	On-going/Planned Project	Water Source Availability	Future Requirements
Asuncion	There exists one Level III system managed by LGU, which was modified from Level II (under BWP). Previous deep wells had water quality problem (color and turbidity). Water source is deep well, however available quantity is limited (only 200 HHs are served: 15% service coverage). Expansion of the system with augmentation of the water source is urgent.	None	Groundwater is brackish and difficult to develop. The spring source located in Buan, near the boundary of New Corella, more than 20km away from urban area may be studied. DIDP suggested to develop Panes spring in New Corella for the three municipalities/city (Tagum, New Corella and Asuncion)-integrated water supply.	System expansion with water source augmentation is required. Integrated water supply shall be studied.
Braulio E. Dujali	There is no urban area at present. They rely on dug wells in the rural area and depend on water tender from Davao City.	None	Deep well source may have good potential, but possibility of brackish water exists.	Not Applicable (No urban area).
Carmen	There is a WD to serve for poblacion (17% of urban population are served). Water source is deep well, but water quality (saline) and quantity problems are prevalent.	None	Good spring sources are not available, but an untapped spring is listed with estimated discharge rate of 600 cu.m/day. For the medium term, study on the use of the untapped spring in Bygy. Tibulao shall be done (more than 10km from the poblacion, but quite different elevation between the spring and service area- gravity flow is ensured).	System expansion with water source augmentation is required.
Island Garden City of Samal	There are 3 administrative districts in the city. (1)Samal district has one WD having water quality problem in use of stream water without treatment. Thus, beneficiaries use shallow wells for drinking purpose. Study is under way by the WD to utilize a series of wells. (2)Babak district has no Level III system. Currently a deep well is under construction by the municipality. (3)Kaputian district has two Level III systems (modified from Level II) using respective spring sources. About 50% of urban population in these 3 districts is covered by these systems.	None	Watershed management and protection of spring sources are necessary to solve the inflow if high turbid water to the treatment plant, in rainy days. The study shall be conducted to use spring sources in view of economical and environmental aspects.	Physically, individual systems may be adopted. But integrated management in the City shall be sought.
Kapalong	There are two Level III systems; one is managed by the municipality and another by RWSA. Service coverage is about 30% of urban population. Water sources are deep wells. These systems were originally constructed as Level II systems. Under current deteriorated facilities upgrading must be studied by LGUs.	None	There is a high potential in deep well development, but brackish water may be encountered.	System expansion and improvement of deteriorated facilities are required.

Table 8.4.1 Summary of Urban Water Supply by Municipality (Cont'd.)

Municipality	Existing Condition	On-going/Planned Project	Water Source Availability	Future Requirements
New Corella	There is a WD serving for 2,300 persons (27% of urban population). Water source is spring. Due to water source problem, insufficient water supply is prevalent. The system was originally designed as a Level II system.	None	Availability of deep well source is poor (brackish, high iron/manganese content). Tapping of spring sources at Panas and Carcor shall be studied to prevent overuse of groundwater and salt water intrusion. DIDP suggested to develop the Panas spring in New Corella (Brgy. Carcor) for the three municipalities/city (Tagum, New Corella and Asuncion)-integrated water supply. The spring is 5km away from the poblacion.	Existing system shall be reviewed to provide countermeasures (pipe diameter and water source).
Panabo	There is a WD covering 4,600 persons (only 10% of urban population). Water source is a deep well. The remaining people use Level I facility and/or water peddlers selling water from Davao City.	None	There is a high potential in deep well development, but brackish water problem exists. Thus other water source development shall also be studied.	Expansion of the system is required. Merged system with neighboring municipalities may be studied.
Santo Tomas	There are two Level III systems managed by RWSA and privately owned with a deep well, Banana plantation to serve for poblacion. Service coverage by these systems is about 45% of urban population.	None	Groundwater is available (600cu.m/day/well).	Study on system expansion using deep wells shall be proceeded.
Tagum City	There are 2 Level III systems (a WD and waterworks managed by RWSA). Water sources are deep wells. The WD serving for 40,000 persons. The WD has practiced scheduled water supply according to zone area due to insufficient water source and capacity of the facilities. Request for new connections/installation is suspended due to the above reason. Another waterworks covers 3,500 persons. Service coverage by two systems is 48% of urban population.	None	Deep well source has water quality problems (brackish, high iron/manganese content). DIDP suggested to develop Panas spring in New Corella (Brgy. Carcor) for the three municipalities/city (Tagum, New Corella and Asuncion)-integrated water supply. The spring is 23km away from Tagum City. Tagum WD investigated the spring availability and confirmed the discharge rate of 350lps. However, it is necessary to ensure water right and watershed management.	Integrated water supply using spring water shall be considered as suggested by DIDP.
Talaingod	There is no urban area at present.	None	Deep well may be available.	Not applicable (No urban area). The service for indigenous people (70% is Ata tribes) shall be considered in the rural area.

unserved urban population at present and in the future will be provided with individual house connections. However, it does not intend to exclude from being implemented Level I and II facilities in urban area as individual cases in the future

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 assumed 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 second priority in principle. Surface water is, on the other hand, is not adopted at this moment, because of large capital investment requirements and complexity of surface water treatment.

Water source development study revealed that most of the municipalities in the planning area have high potential for spring development. Among various untapped spring sources identified during the course of PW4SP preparation, the untapped sources, located in the municipalities of Asuncion, Carmen and New Corella are considered to have favorable conditions for use in Level III service

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 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 view point 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 system for those with WD/Level III, while creation of new systems shall be considered for those without systems at present.

Due to water source problem, merged systems shall be studied; group A (long-term) – B.E. Dujali, Carmen and Panabo; group B (medium-term) – Tagum City, New Corella and Asuncion.

Merging of small Level III systems shall be sought, although these systems are currently managed individually. Island Garden City of Samal, in particular, shall be studied on integration of management for the 3 districts.

(2) Rural water supply

1) Service level

Level I systems (deep and shallow wells) are generally planned for rural areas where houses are scattered. In the PW4SP, public investment for Level I facilities covers 40% of the total number of required facilities, considering the existing share of population served between public (31%) and private facilities (69%).

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 presented in Figure 8.4.2, Supporting Report.

Spring development is also included in Level I planning adopting its share of 10%. This takes into account the existing percentage of developed springs (8%) among public Level I facilities as safe water sources.

**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 yielding 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 on the potential area 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 arial proportion between those in application of gravel-packed and natural gravel pack wells will be worked out 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, currently used in the Philippines, has operation experience of up to 40m in pumping water level, the diameter of riser pipe shall be adjusted between 1" to 2-1/2" to mitigate required power at the pump handle (calculating required power under the specific pumping water level).

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.

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.

5) Rehabilitation

Rehabilitation of existing Level I wells is not considered, since most of the existing 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 considered.

(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.

(3) Public toilets

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

The FW4SP 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 to be 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 2003. 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, 10 untapped springs in 3 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 94,700 persons in the province will be served by additional water supply services, of which 29,500 persons or 31% of the total will be urban population and 65,200 persons or 69% will be rural population.

For Phase II period, a total of 429,300 persons, of which 277,900 persons or 53% in urban area and 264,400 persons or 47% 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 54,900 persons served by Level I and II facilities in 1997.

## 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 2003 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 (2003)												Phase II Coverage (2010)											
		Total Population			Service Coverage			Additional Population to be Served			Total Population			Service Coverage			Additional Population to be Served								
		Level III	Level II	Level I	Total	Level III	Level II	Level I	Total	Level III	Level II	Level I	Total	Level III	Level II	Level I	Total	Level III	Level II	Level I	Total				
Asuncion	Urban	7,481	3,655	834	4,489	2,455	2,455	10,456	9,933	6,278	9,933	6,278	9,933	6,278	9,933	6,278	25,021	25,021	25,021	25,021	31,299	31,299			
	Rural	51,626	552	20,961	23,232	519	7,246	7,665	51,885	552	1,719	45,982	48,253	552	1,719	45,982	48,253	58,186	58,186	58,186	58,186	62,728	62,728		
	Total	59,107	4,207	21,795	27,721	2,455	519	7,246	10,220	62,341	10,485	1,719	45,982	58,186	10,485	1,719	45,982	58,186	62,341	62,341	62,728	62,728			
Braulio E. Dujali	Urban	17,887		8,049	8,049		7,358	7,358	21,220								19,735	19,735	19,735	19,735	11,686	11,686			
	Rural	17,887		8,049	8,049		7,358	7,358	21,220								19,735	19,735	19,735	19,735	11,686	11,686			
	Total	35,774		16,098	16,098		14,716	14,716	42,440								39,470	39,470	39,470	39,470	23,372	23,372			
Carmen	Urban	9,739	5,843	21,032	23,099	4,397	20,440	20,947	59,928	1,560	507	53,666	55,733	1,560	507	53,666	58,839	58,839	58,839	58,839	32,634	32,634			
	Rural	51,332	1,560	21,032	28,942	4,397	20,440	25,344	73,724	14,666	507	53,666	68,839	14,666	507	53,666	83,997	83,997	83,997	83,997	32,634	32,634			
	Total	61,071	7,403	42,064	52,041	8,794	40,880	46,291	133,672	26,226	1,014	107,332	124,573	26,226	1,014	107,332	162,836	162,836	162,836	162,836	65,268	65,268			
Island Garden City of Samar	Urban	18,560	8,553	1,827	11,136	4,563	16,198	16,198	71,108	420	14,027	51,683	66,130	420	14,027	51,683	70,673	70,673	70,673	70,673	33,761	33,761			
	Rural	71,930	420	14,027	32,369	4,563	16,198	20,761	96,943	24,963	14,027	51,683	90,673	24,963	14,027	51,683	115,653	115,653	115,653	115,653	49,751	49,751			
	Total	90,490	8,973	15,854	43,505	9,126	32,396	87,869	168,051	25,426	18,054	103,366	166,803	25,426	18,054	103,366	206,326	206,326	206,326	206,326	83,512	83,512			
Kapalong	Urban	10,743	2,778	4,780	7,558		66,708	66,708	15,218	14,457	60,640	62,038	15,218	14,457	60,640	66,495	66,495	66,495	66,495	28,855	28,855				
	Rural	56,670	1,038	31,785	33,183		81,926	81,926	15,495	360	60,640	62,038	15,495	360	60,640	66,495	66,495	66,495	66,495	28,855	28,855				
	Total	67,413	3,816	36,565	40,741		148,634	148,634	30,990	14,817	121,280	124,076	30,990	14,817	121,280	132,990	132,990	132,990	132,990	57,710	57,710				
New Corella	Urban	9,499	5,699	5,699	5,699	3,443	3,443	3,443	12,927	12,281	6,582	6,582	12,927	12,281	6,582	6,582	23,773	23,773	23,773	23,773	30,355	30,355			
	Rural	41,346	1,188	10,250	18,606	4,288	4,288	4,288	45,569	1,188	7,168	34,023	42,379	1,188	7,168	34,023	49,547	49,547	49,547	49,547	63,822	63,822			
	Total	50,845	6,887	20,500	24,305	7,731	7,731	7,731	58,496	2,376	11,356	41,411	46,621	2,376	11,356	41,411	59,094	59,094	59,094	59,094	83,177	83,177			
Panabo	Urban	55,665	19,233	14,166	33,399	14,643	80,440	80,440	76,418	76,418	57,185	57,185	80,440	76,418	57,185	57,185	137,628	137,628	137,628	137,628	50,172	50,172			
	Rural	99,764	2,388	41,126	44,894	4,288	4,288	4,288	102,222	2,388	1,380	91,298	95,066	2,388	1,380	91,298	107,684	107,684	107,684	107,684	50,172	50,172			
	Total	155,429	21,621	55,292	78,293	18,931	18,931	18,931	204,714	4,776	2,760	102,596	192,750	4,776	2,760	102,596	207,368	207,368	207,368	207,368	100,344	100,344			
Santo Tomas	Urban	32,877	15,033	5,769	20,802		63,496	63,496	43,556	41,378	22,178	22,178	63,496	41,378	22,178	22,178	85,674	85,674	85,674	85,674	23,594	23,594			
	Rural	59,450	780	31,677	35,457		107,052	107,052	42,158	3,000	55,271	100,429	42,158	3,000	55,271	100,429	142,577	142,577	142,577	142,577	23,594	23,594			
	Total	92,327	15,813	37,446	56,259		170,548	170,548	85,654	6,000	107,448	200,908	85,654	6,000	107,448	200,908	245,151	245,151	245,151	245,151	47,188	47,188			
Tagum City (Capital)	Urban	103,486	43,590	26,802	70,392		147,568	147,568	140,190	140,190	96,600	96,600	147,568	140,190	96,600	96,600	212,988	212,988	212,988	212,988	21,298	21,298			
	Rural	89,053	47,844	5,473	53,317		80,231	80,231	47,844	47,844	26,771	26,771	80,231	47,844	26,771	26,771	107,005	107,005	107,005	107,005	21,298	21,298			
	Total	192,539	91,434	32,275	123,709		227,799	227,799	188,034	188,034	123,371	123,371	227,799	188,034	123,371	123,371	219,013	219,013	219,013	219,013	42,596	42,596			
Talaingod	Urban						29,383	29,383	29,383								660	660	660	660	13,613	13,613			
	Rural	27,629		13,053	13,713		29,383	29,383	29,383								660	660	660	660	13,613	13,613			
	Total	27,629		13,053	13,713		58,766	58,766	58,766								1,320	1,320	1,320	1,320	27,226	27,226			
Provincial Total	Urban	248,050	104,384	54,178	159,318	29,501	59,835	65,149	59,835	5,314	59,835	65,149	59,835	5,314	59,835	65,149	28,821	28,821	28,821	28,821	264,407	264,407			
	Rural	566,687	55,770	201,328	285,919	29,501	59,835	65,149	59,835	5,314	59,835	65,149	59,835	5,314	59,835	65,149	28,821	28,821	28,821	28,821	264,407	264,407			
	Total	814,737	160,154	255,506	445,237	59,002	119,670	130,298	119,670	10,628	119,670	130,298	119,670	10,628	119,670	130,298	57,642	57,642	57,642	57,642	528,814	528,814			



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 137,700. Additional households to be served totaled to 45,400, of which 21% is urban households and 79% is rural households. While at the end of Phase II period, the number of served households are 220,700 with an additional households to be served at 82,900. 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 2003 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 135,900. The additional students to be served are 69,700. While at the end of Phase II period, the projected number of served students are 217,400 with an additional students to be served at 81,500. 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 (2003)										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	Flush	Pour Flush	VIP/Dry	Total	Flush	Pour Flush	VIP/Dry	Total	Flush	Pour Flush	VIP/Dry	Total					
Asuncion	Urban	1,450	457	783	65	1,305	454	532	1,071	5,305	454	532	1,071	5,305	1,242	1,176	65	2,483	785	393		1,178												
	Rural	9,947	552	6,212	1,691	8,455	552	1,446	1,998	12,971	552	1,446	1,998	12,971	552	9,820	1,691	12,063	785	3,608		3,608												
	Total	11,397	1,009	6,995	1,756	9,760	1,006	1,446	2,452	15,585	1,794	1,446	2,452	15,585	1,794	10,996	1,756	14,546	785	4,001		4,786												
Braulio E. Dujali	Urban	3,790	2,578	644	3,222	539	3,222	532	1,071	5,305	454	532	1,071	5,305	1,242	1,176	65	2,483	785	393		1,178												
	Rural	3,790	2,578	644	3,222	539	3,222	532	1,071	5,305	454	532	1,071	5,305	1,242	1,176	65	2,483	785	393		1,178												
	Total	7,580	5,156	1,288	6,444	1,078	6,444	1,064	2,142	10,610	908	1,064	2,142	10,610	2,484	2,352	130	4,966	1,570	786		2,356												
Carmen	Urban	1,891	596	1,021	85	1,702	543	796	3,449	1,639	543	796	3,449	1,639	1,639	1,553	85	3,277	1,043	532		1,572												
	Rural	10,125	861	6,024	1,721	8,606	861	1,562	2,423	14,982	1,560	1,562	2,423	14,982	1,560	10,652	1,721	13,933	699	4,628		5,327												
	Total	12,016	1,457	7,045	1,806	10,308	1,404	1,815	3,219	18,431	3,199	1,806	3,219	18,431	3,199	12,205	1,806	17,210	1,742	5,160		6,902												
Island Garden City of Samar	Urban	3,661	1,153	1,977	165	3,295	1,146	4,767	17,777	420	13,729	2,384	16,533	420	13,729	2,384	16,533	420	13,729	2,384	4,615		4,615											
	Rural	14,021	420	9,114	2,384	11,918	380	4,387	24,236	3,488	16,632	2,549	22,669	3,488	16,632	2,549	22,669	3,488	16,632	2,549	5,541		5,541											
	Total	17,682	1,573	11,091	2,549	15,213	1,526	4,387	5,913	24,236	3,868	17,113	19,942	24,236	3,868	19,153	4,933	25,162	6,932	11,085		11,085												
Kapalong	Urban	2,078	655	1,121	94	1,870	527	2,111	548	3,805	1,808	1,713	3,521	548	3,805	1,808	1,713	5,510	61	5,678		5,739												
	Rural	11,495	977	6,840	1,954	9,771	977	4,851	5,828	16,677	1,038	12,518	1,954	15,510	1,038	12,518	1,954	15,510	61	5,678		5,739												
	Total	13,573	1,632	7,961	2,048	11,641	1,504	7,968	8,339	24,503	2,035	14,435	3,905	21,420	2,035	14,435	3,905	21,420	122	11,356		11,488												
New Corella	Urban	1,782	561	963	80	1,604	561	2,165	582	3,222	1,535	1,455	3,070	582	3,222	1,535	1,455	4,757	974	492		1,466												
	Rural	7,714	656	4,590	1,311	6,557	656	1,874	2,530	11,392	1,188	8,096	1,311	10,595	1,188	8,096	1,311	10,595	532	3,506		4,038												
	Total	9,496	1,217	5,553	1,391	8,161	1,217	2,748	3,112	14,624	2,723	9,551	2,723	13,665	2,723	9,551	2,723	13,665	1,506	3,998		5,504												
Panabo	Urban	11,001	3,465	5,941	495	9,901	2,509	2,633	2,890	20,110	9,553	9,057	19,105	9,553	9,057	495	19,105	6,088	3,116		9,204													
	Rural	19,297	1,640	11,482	3,280	16,402	1,640	3,618	5,238	25,556	2,388	18,099	3,280	23,767	2,388	18,099	3,280	23,767	748	6,617		7,365												
	Total	30,298	5,105	17,423	3,775	26,303	4,149	6,251	8,128	51,666	11,941	27,156	3,775	42,872	11,941	27,156	3,775	42,872	1,496	13,732		15,230												
Santo Tomas	Urban	6,274	1,976	3,389	282	5,647	1,801	4,087	1,801	10,889	5,173	4,890	10,345	5,173	4,890	282	10,345	3,197	1,501		4,874													
	Rural	11,634	780	7,131	1,978	9,889	780	3,307	4,087	15,874	780	12,003	1,978	14,763	780	12,003	1,978	14,763	748	4,874		5,622												
	Total	17,908	2,756	10,520	2,260	15,536	2,581	7,394	8,174	26,758	15,683	13,983	12,323	29,526	15,683	13,983	12,323	29,526	1,496	9,748		11,020												
Tagum City (Capital)	Urban	19,825	6,245	10,706	892	17,843	1,009	113	265	1,387	36,892	17,524	16,631	53,047	11,279	5,925	2,968	63,972	2,247	1,565		3,812												
	Rural	17,461	1,484	10,390	2,968	14,842	1,484	2,856	4,340	20,058	3,731	11,955	2,968	18,654	3,731	11,955	2,968	18,654	2,247	1,565		3,812												
	Total	37,286	7,729	21,096	3,860	32,685	2,493	2,969	265	5,727	56,950	21,255	28,586	71,696	15,010	7,893	5,936	82,626	4,494	3,130		7,624												
Talaingod	Urban	5,768	3,922	981	4,903	3,454	3,454	3,454	3,454	7,346	3,454	981	6,832	3,454	5,851	981	6,832	3,454	1,929		1,929													
	Rural	5,768	3,922	981	4,903	3,454	3,454	3,454	3,454	7,346	3,454	981	6,832	3,454	5,851	981	6,832	3,454	1,929		1,929													
	Total	11,536	7,844	1,962	9,806	6,908	6,908	6,908	6,908	14,692	6,908	1,962	13,664	6,908	11,702	1,962	13,664	6,908	3,853		3,853													
Provincial Total	Urban	47,962	15,108	25,901	2,158	43,167	8,550	629	425	9,604	87,450	41,542	39,278	137,584	11,657	107,015	18,912	137,584	4,287	38,732		43,019												
	Rural	111,252	7,370	68,283	18,912	94,565	7,330	26,448	1,978	35,756	147,938	11,657	107,015	18,912	137,584	4,287	137,584	4,287	38,732		43,019													
	Total	159,214	22,478	94,184	21,070	137,732	15,880	27,077	2,403	45,360	235,388	53,199	146,393	21,070	220,662	30,721	220,662	30,721	82,509		86,038													

Table 8.5.3 Add'l. Number of Public School Student to be Served by Target Year (School Toilets)

Name of Municipality/City	Phase I Coverage (2003)			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
Asuncion	14,993	10,495	1,175	15,813	14,232	3,737
Braulio E. Dujali	5,726	4,008	1,528	6,792	6,113	2,105
Carmen	12,658	8,861	2,221	15,281	13,753	4,892
Island Garden City of Samal	20,827	14,579	7,219	22,312	20,081	5,502
Kapalong	16,232	11,362	4,642	19,727	17,754	6,392
New Corella	11,385	7,970	3,890	13,098	11,788	3,818
Panabo	34,395	24,077	14,877	40,422	36,380	12,303
Santo Tomas	21,047	14,733	9,813	24,404	21,964	7,231
Tagum City (Capital)	43,055	30,139	15,299	50,940	45,846	15,707
Talaingod	2,832	1,982	1,302	3,012	2,711	729
<b>Provincial Total</b>	<b>183,150</b>	<b>128,206</b>	<b>61,966</b>	<b>211,801</b>	<b>190,622</b>	<b>62,416</b>

(3) Public toilets

The service coverage of public utilities with sanitary toilet facility by municipality is estimated for the years 2003 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 61. The additional public utilities to be served are 26. While at the end of Phase II period, the number of served public utilities are 79 with an additional public utilities to be served at 18. 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

Municipality/City	Type	Phase I Coverage (2003)		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
Asuncion	Public Market		1	1	2
	Bus/Jeepney Terminal		1	1	2
	Parks/Playground		2	1	3
	Total		4	3	7
Braulio E. Dujali	Public Market	2	2		2
	Bus/Jeepney Terminal	2	2		2
	Parks/Playground	2	2		2
	Total	6	6		6
Carmen	Public Market		1	1	2
	Bus/Jeepney Terminal		1	1	2
	Parks/Playground		1	1	2
	Total		3	3	6
Island Garden City of Samal	Public Market	6	10		10
	Bus/Jeepney Terminal	6	8		8
	Parks/Playground	2	7		7
	Total	14	25		25
Kapalong	Public Market		1	1	2
	Bus/Jeepney Terminal	1	1	1	2
	Parks/Playground		1	1	2
	Total	1	3	3	6
New Corella	Public Market		1	1	2
	Bus/Jeepney Terminal		1	1	2
	Parks/Playground		1	1	2
	Total		3	3	6
Panabo	Public Market		2	1	3
	Bus/Jeepney Terminal	1	2		2
	Parks/Playground		1	1	2
	Total	1	5	2	7
Santo Tomas	Public Market		1	1	2
	Bus/Jeepney Terminal	1	1		1
	Parks/Playground		1	1	2
	Total	1	3	2	5
Tagum City (Capital)	Public Market		2		2
	Bus/Jeepney Terminal		2	1	3
	Parks/Playground		1	1	2
	Total		5	2	7
Talaingod	Public Market	1	2		2
	Bus/Jeepney Terminal	1	1		1
	Parks/Playground	1	1		1
	Total	3	4		4
<b>Provincial Total</b>	Public Market	9	23	6	29
	Bus/Jeepney Terminal	12	20	5	25
	Parks/Playground	5	18	7	25
	Total	26	61	18	79

### 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

Municipality/City	Urban Population in 2010	Level III Water Supply Coverage	Population to be Served
Asuncion	10,456	9,933	5,228
Braulio E. Dujali			
Carmen	13,796	13,106	6,898
Island Garden City of Samal	25,835	24,543	12,918
Kapalong	15,218	14,457	7,609
New Corella	12,927	12,281	6,464
Panabo	80,440	76,418	40,220
Santo Tomas	43,556	41,378	21,778
Tagum City (Capital)	147,568	140,190	73,784
Talaingod			
<b>Provincial Total</b>	<b>349,796</b>	<b>332,306</b>	<b>174,899</b>

#### 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 90% with reference to the present service coverage of 66% in urban area.. Additional service coverage in Phase I is calculated as a shortfall of target coverage in Phase I comparing with current service coverage. Table 8.5.6 presents additional service coverage for Phase I in the urban area.

Table 8.5.6 Add'l. No. of Urban HHs to be Served by Municipal Solid Waste System in Phase I

Municipality/City	No. of Urban Households Served in the Base Year	Phase I Coverage (2003)		
		No. of Urban Households	Urban Households Coverage	Add'l. No. of Urban Households to be Served
Asuncion	220	1,420	1,278	1,058
Carmen	956	1,692	1,523	567
Island Garden City of Samal	1,132	3,300	2,970	1,838
Kapalong	500	1,978	1,781	1,281
New Corella	152	1,574	1,417	1,265
Panabo	7,356	9,439	8,496	1,140
Santo Tomas	1,586	5,615	5,054	3,468
Tagum City (Capital)	16,113	17,439	16,113	
<b>Provincial Total</b>	<b>28,015</b>	<b>42,457</b>	<b>38,632</b>	<b>10,617</b>

## 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.

##### 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, 40% of the total required facilities will be implemented by public (LGUs) and 10% of these public Level I facilities will be allocated to spring development.

#### (2) Rehabilitation

Rehabilitation requirements were estimated as 10% of the total number of deep wells to be constructed under PW4SP. Rehabilitation work will mainly be 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 284 Level I deep wells shall be newly constructed by public (LGUs) and 10% of these deep wells shall be rehabilitated annually. Presently, the PEO has one unit of rotary type drilling rig and the DPWH-DEO have 4 units of percussion/rotary type drilling rigs applicable for more than 8" of bore hole.

Therefore, one unit of drilling rig (medium size percussion type) together with one set of well rehabilitation equipment, 1 unit of support vehicle for well rehabilitation and 1 unit 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

##### Required New Building:

To ensure potability of drinking water supplies, an existing laboratory facility located at the compound of the provincial hospital in Tagum City undertakes the water quality examination. Water samples from 8 municipalities and the 2 cities will be brought to this laboratory. At present, only bacteriological tests are being done. There is a need therefore, to upgrade the facilities to cover both physical and chemical examination of drinking water as indicated in the National standards for Drinking Water.

##### Instrument/Equipment and Other Laboratory Accessory:

A set of instrument/equipment for the upgrading will be necessary to undertake regular water quality monitoring and surveillance activities. The following are the requirements:

	Item	Unit	Upgrading of Existing Laboratory
1.	Instrument/Equipment		
	Turbidity meter	set	1
	Color meter	set	1
	PH/Residual chlorine	set	1
	Portable water quality testing kit	set	1
	Range hood	set	1
2.	Glassware/Chemicals	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.

Table 8.6.2 Sanitation Facilities Required by Target Year

Name of Municipality	Phase I (2003) Requirements												Phase II (2010) Requirements																		
	Urban Sanitation						Rural Sanitation						Urban Sanitation						Rural Sanitation												
	No. of Households			No. of Public Toilets			No. of Households			No. of Public Toilets			No. of Households			No. of Public Toilets			No. of Households			No. of Public Toilets									
	Flush	Pour Flush	VIP/ Dry	Total	No. of Public Sch. Toilets	Public Market	Jeepney Terminal	Parks/ Playground	Flush	Pour Flush	VIP/ Dry	Total	No. of Public Sch. Toilets	Public Market	Jeepney Terminal	Parks/ Playground	Flush	Pour Flush	VIP/ Dry	Total	No. of Public Sch. Toilets	Public Market	Jeepney Terminal	Parks/ Playground	Flush	Pour Flush	VIP/ Dry	Total			
Asuncion	454			454				552		1,446	1,998	5						785	393		1,178	3	1	1	1				3,608	59	
Braulio E. Dujali						2	2		539	532	1,071	8																	1,712	31	
Carmen	543	253		796	2			861	1,562		2,423	9						1,043	532		1,575	5	1	1	1	699	4,628		5,327	56	
Island Garden City of Suma	1,146			1,146	7	6	2	380	4,387		4,767	29						1,915	926		2,841	7							4,615	74	
Kapalong	527		21	548	4		1	977	4,851		5,828	20						1,153	592		1,745	6	1	1	1	61	5,678		5,739	72	
New Corella	561		21	582	4			656	1,874		2,530	16						974	492		1,466	4				1	532	3,506		4,038	46
Panabo	2,509	263	118	2,890	27			1,640	3,618		5,258	48		1				6,088	3,116		9,204	27	1		1	748	6,617		7,365	102	
Santo Tomas	1,801			1,801	17			780	3,307		4,087	32						3,197	1,501		4,698	15	1		1		4,874		4,874	65	
Taguean City (Capital)	1,009	113	265	1,387	41			1,484	2,856		4,340	35						11,279	5,925		17,204	51			1	2,247	1,565		3,812	81	
Talahaog							1		3,454		3,454	7															1,929		1,929	14	
<b>Provincial Total</b>	<b>8,550</b>	<b>629</b>	<b>425</b>	<b>9,604</b>	<b>102</b>	<b>9</b>	<b>12</b>	<b>7,330</b>	<b>26,448</b>	<b>1,978</b>	<b>35,756</b>	<b>209</b>	<b>26,434</b>	<b>13,477</b>	<b>39,911</b>	<b>118</b>	<b>6</b>	<b>4,287</b>	<b>38,732</b>	<b>43,019</b>	<b>600</b>	<b>5</b>	<b>7</b>	<b>5</b>	<b>4,287</b>	<b>38,732</b>	<b>43,019</b>	<b>600</b>			

(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).

(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 and the additional students to be served by target year (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.

(3) Public toilets

Future requirements in the number of toilet facilities were estimated based on the additional number of toilets for public markets and bus/jeepney terminals located in urban areas (details are referred to Supporting Report).

### 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. Seven (7) 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**

Municipality/City	Add'l. Urban Households to be Served	Estimated Daily Amount of Refuse to be Generated, (Kg)	Number of Collection Truck Required
Asuncion	1,058	443	1
Carmen	567	238	1
Island Garden City of Samal	1,838	769	1
Kapalong	1,281	536	1
New Corella	1,265	529	1
Panabo	1,140	477	1
Santo Tomas	3,468	1,450	1
<b>Provincial Total</b>	<b>10,617</b>	<b>4,442</b>	<b>7</b>