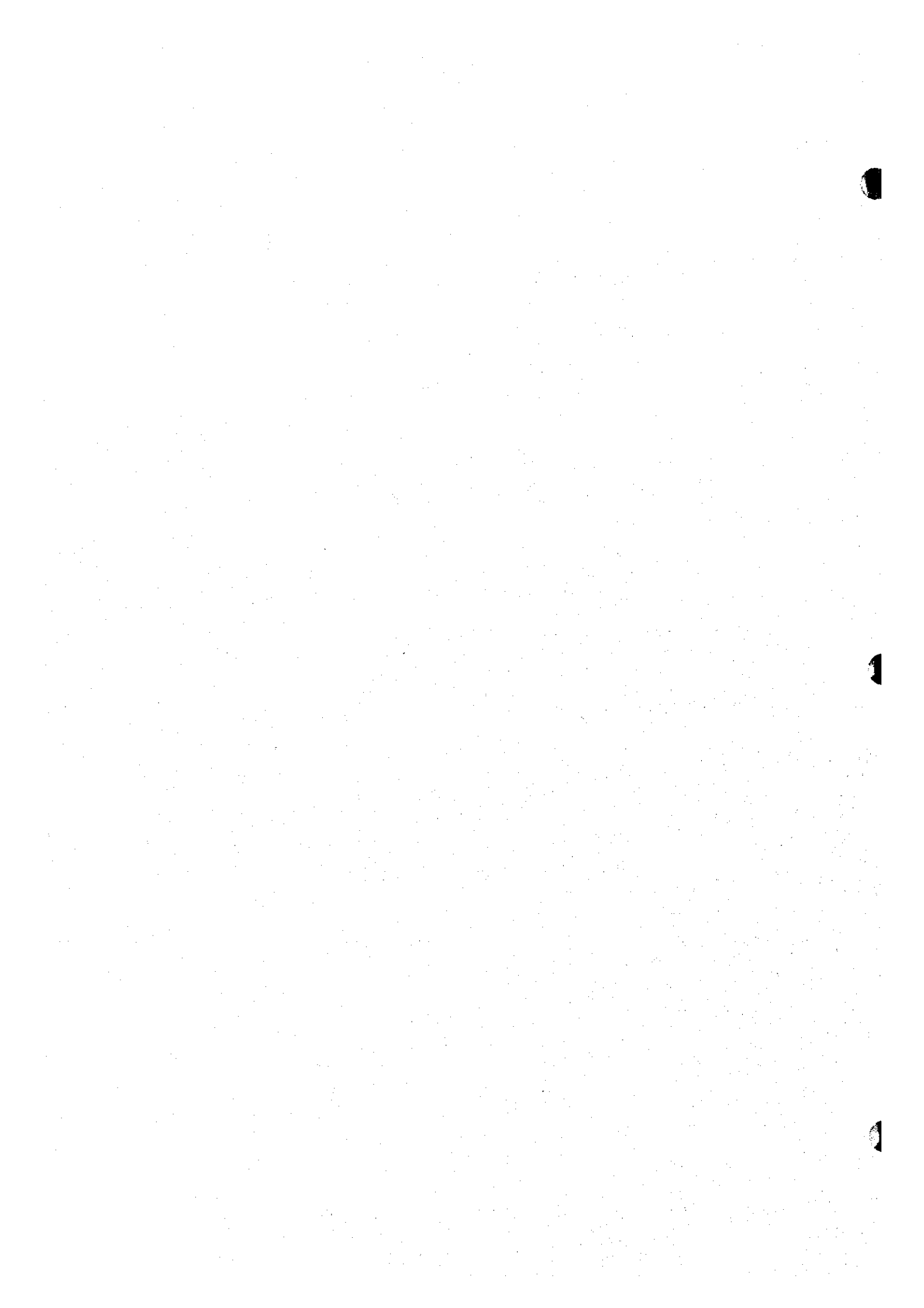


Chapter

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**WATER SOURCE DEVELOPMENT**

**7**



## 7. WATER SOURCE DEVELOPMENT

### 7.1 General

The study on water source development covers the entire province to come up with water source potential exploitable for mainly domestic water supply. An emphasis is placed on the groundwater availability due to its prevalent use and comparatively conservative development through the future in the jurisdiction of the provincial government. It is also advantageous to utilize groundwater for domestic water supply because of better quality and economical use. Nevertheless, surface water potential of major rivers was studied in terms of quantity (return period flow rate) and quality to provide information for LGU's future use, if necessary.

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

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

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

The overview on current groundwater use with the conditions is summarized in Table 7.1.1 (Well data collected from each municipality are presented in Table 7.1.1, Water Source Information, Data Report). There are 946 shallow wells, 197 deep wells and 233 developed springs in the province (functional services). Majorities of the wells are shallow wells. About 70% of these water sources are public facilities. Of the total existing wells, 86% remains functional at present. In addition to the above sources, 34 untapped springs are accounted.

**Table 7.1.1 Existing Groundwater Sources in the Province**

Category and Classification	Shallow Well	Deep Well	Spring	Total
1. Water source being availed				
a. Public sources	528	145	223	896
b. Privately owned sources	418	52	10	480
c. Number of water sources	946	197	233	1,376
d. Profile of different sources	68%	16%	16%	100%
2. Water sources with problems and non-functional wells				
a. Water quality problems*	190	0	0	190
b. Non-functional	92	95		187
3. Spring source information				
a. Undeveloped			N.A.	N.A.
b. Untapped			34	34

Note. 1: Number of water sources being availed at present including those with water quality problems.

2: Number of existing water sources with problems: being used, but with water quality problem and abandoned wells.

3: Number of springs availed, but not adequately protected; and those as candidate sources to be developed.

\*: Assumed number of sources (unsafe category) based on the study on existing water supply facilities in Chapter 4.

N.A.: Data not available.

## 7.2 Geology

The rock units in the province are classified into three (3) main groups based on the ages of the rock formations. These are, from the oldest to youngest, the Miocene and Older rocks, the Pliocene to Pleistocene Rocks and the Recent Deposits. The grouping of the rocks is related

to their potential as groundwater sources. The younger rocks are considered the most important to groundwater because of their porosity and permeability relative to the older rocks. The distribution of these rock groups is shown in Figure 7.2.1, Geological Map of the Province and their geological features are described below.

#### (1) Miocene and Older rocks

Dinagat Island is mostly covered by igneous rocks consisting of ultramafic and mafic rocks of Cretaceous age. The oldest basement complex rocks consist of schist and quartzite and are distributed in places on the rim of the western and southern part of the island.

Siargao Island has older sediments of Oligocene to Miocene age, in the western parts along the seashore and on the northeastern and southeastern sides of the island. These formations are made up of wackes, shales, and reef limestone.

The main Mindanao Island has older sediments of Miocene age in its northeastern, central, and eastern areas, consisting of marine clastics with silty limestone, consolidated wackes, and shales with reef limestone.

The non-active cones with very steep mountain slopes at an elevation of about 700 m are distributed and surrounded by low mountains. The cones are made up of pyroxene andesite.

The older sedimentary rocks are mostly in a consolidated condition; intrusive and extrusive rocks form steep mountains. Therefore, the area covered by the older rock formations has no groundwater development potential and is deemed the difficult area for groundwater development.

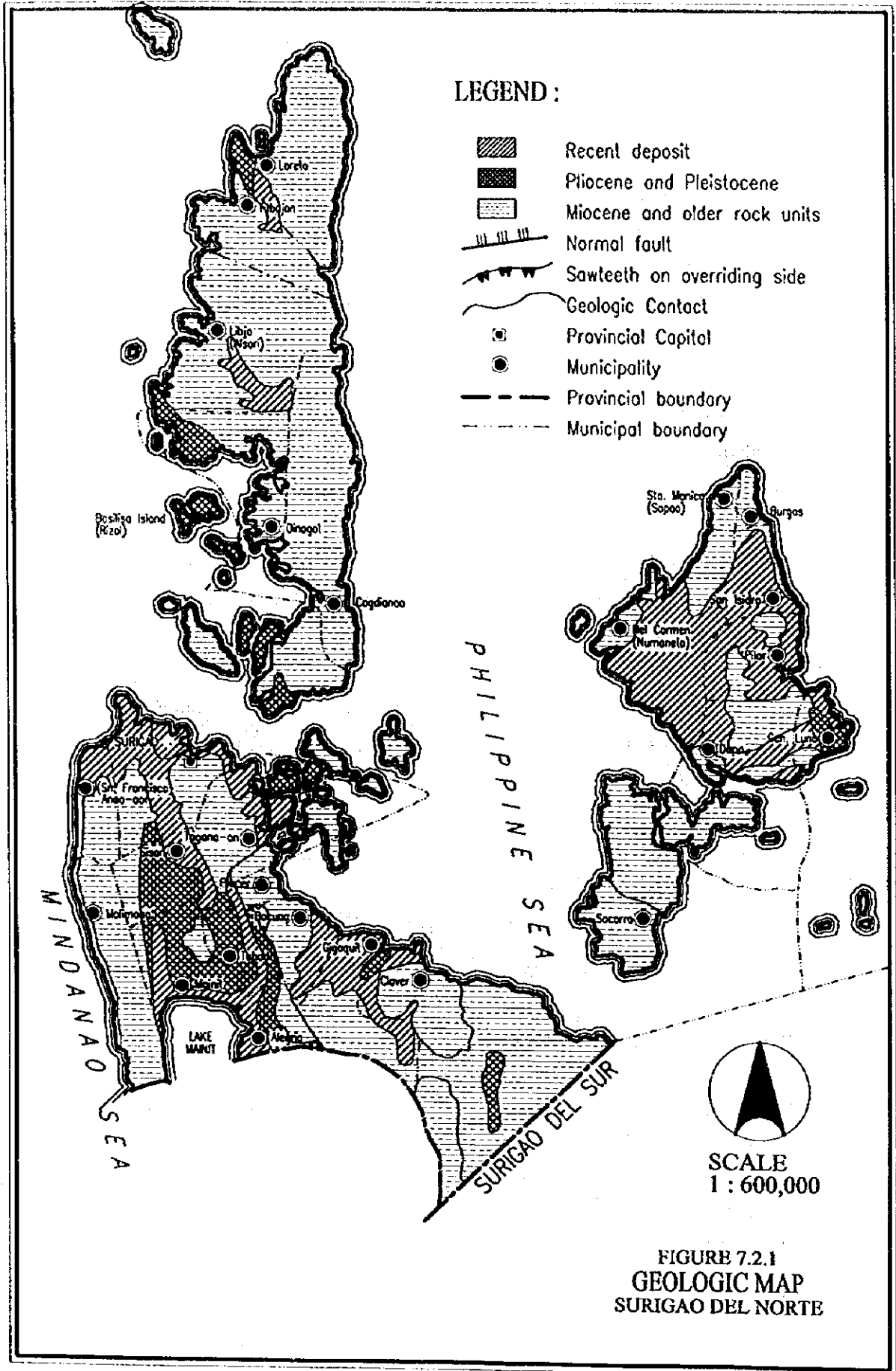
#### (2) Pliocene to Pleistocene rocks

Pliocene to Pleistocene sediments are distributed around the non-active cone that is located north of Mainit Lake. The sediments are composed of marine and terrestrial formations, associated with extensive reef limestone. The formation has low groundwater development potential and is appropriate for groundwater development by means of deep wells.

#### (3) Recent Deposits

Dinagat Island has almost no recent deposits except for the seashore line and in the

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inland central and northwestern areas.

Siargao Island has an alluvial plain in the central, northeastern and southeastern parts of the island. The main Mindanao Island has recent deposits (alluvial plain) in its north-eastern area. The alluvium was mainly formed by the fluvial action of the Surigao River. According to the results of an electric resistivity survey conducted by LWUA, the alluvium has a thickness of about 50 m along the river and thick sand and gravel formations that are considered to form a good aquifer at 30 m.

Alluvium is also distributed along the lake line north and east of Mainit Lake. The alluvial plain has a relatively smooth slope from the mountainous area to the lake. Moreover, the northeastern area of municipality of Claver is covered by the alluvial sediments.

These sediments consist of clay, silt, sand and gravel that are under unconsolidated condition. The alluvial plain generally has high groundwater development potential.

### **7.3 Groundwater Sources**

#### **7.3.1 Classification of Groundwater Availability**

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

##### **(1) Shallow well area**

These are areas having water-bearing rock formations extending not more than 20 m in depth from the ground surface. Shallow well areas are usually located in alluvial and coastal plains, where Recent unconsolidated materials overlie impervious rocks at shallow depth. The extent of completely shallow well area is limited, because most of the Recent formations are thick or deposited on the Late Pliocene to Pleistocene rocks, that usually have multiple aquifers located at greater depths.

##### **(2) Deep well area**

In deep well areas, the aquifers are located more than 20 m from the ground level. These areas could be found in portions underlain by the Pliocene to Pleistocene and Recent formations. Most of these areas have more than one aquifer occurring at various depths. Areas where shallow and deep wells could be developed are categorized as deep well areas.

(3) Difficult area

These are areas not suitable for well development. The areas under this category largely consist of rock formations older than Miocene in age. The groundwater availability in the aforesaid rocks is very low and usually released in the opened rock fractures. Springs are the common sources of water supply in these areas. However, difficult areas generally have alluvial sediments with small scale in the narrow areas along the streams issuing from mountains. In such areas, groundwater development by means of shallow and deep wells is often possible though the development potential is very limited.

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

### 7.3.2 Groundwater Availability in the Province

The Groundwater Availability Map is presented in Figure 7.3.1. The major databases used in the preparation of the map were obtained from BMGS and NWRB. The methodology and study procedure with respective output are discussed in 7.3, Supporting Report. Technical information on the wells by municipality is also shown in the same report. The groundwater development potential areas in the province through the future are summarized below.

(1) Shallow well area

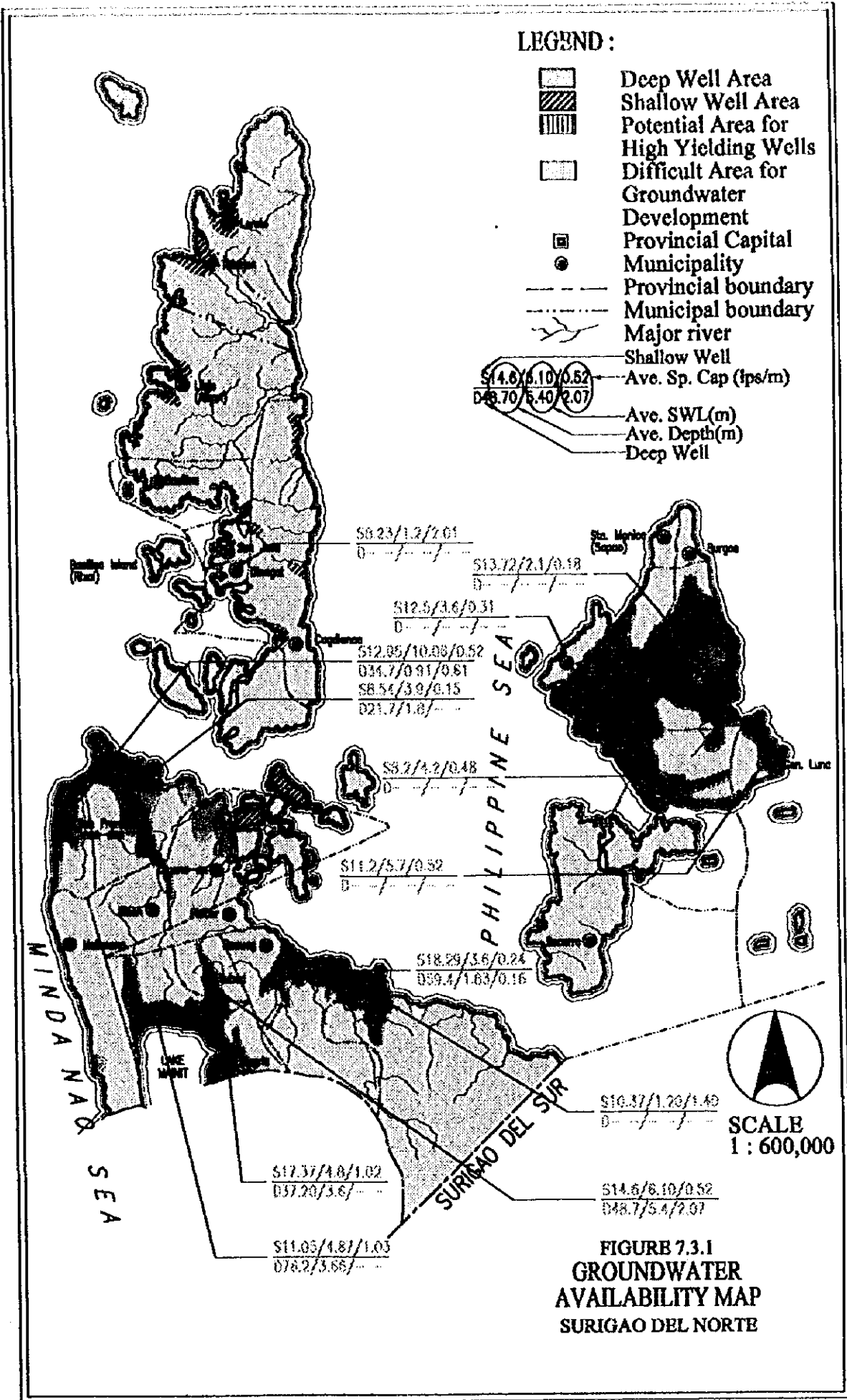
The shallow well area covers about 1% of the province. Groundwater development on Dinagat Island and the islets can mostly be undertaken by shallow wells. Shallow wells are generally driven/drilled to an average depth of 8.7 m to 11.2 mbgl, the water table is more than 1.4 mbgl.

(2) Deep well area

The deep well area covers approximately 20% of the province and is formed by the alluvial plain. The alluvial plain is distributed in Surigao City, and the municipalities of Anao-aon, Gigaquit, Claver, Mainit, and Alegria on main Mindanao Island; and the towns of Del Carmen, San Isidro, Pilar, Dapa, General Luna in Siargao Island. These areas have a high potential for deep well development. The average depth of the existing deep wells is 44.6 mbgl, with an average water level of 3.2 mbgl, and an average specific capacity of 2.9 cu. m/hr/m. However, the alluvial plain, formed by the Surigao River and located on the western side of Surigao City, cannot be recommended to be developed as a groundwater source for water supply because of mercury contamination caused by gold mining.

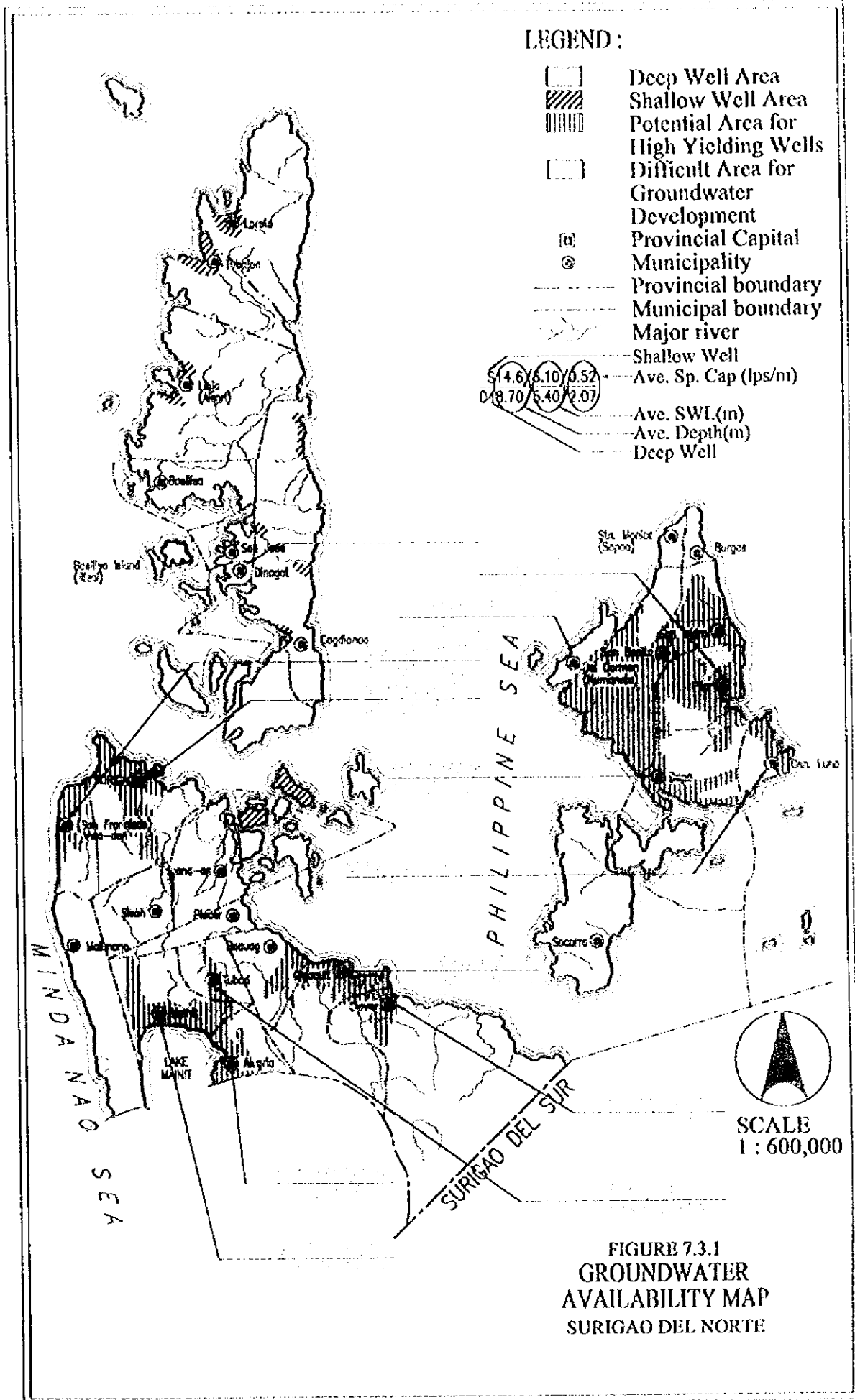


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**FIGURE 7.3.1**  
**GROUNDWATER**  
**AVAILABILITY MAP**  
**SURIGAO DEL NORTE**

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### (3) Difficult area

About 79% of the provincial area is classified as a difficult area to exploit groundwater. The areas are formed by the low mountains on Dinagat and Siargao Islands and by the high mountains on the main Mindanao Island. These formations are made up of 1) a basement complex consisting of undifferentiated schist and quartzite, 2) sedimentary formations of Eocene to Miocene age: conglomerate, marine deposits, largely wackes and shales, 3) igneous rocks of Cretaceous to Neogene age: ultramafic and mafic rocks, quartzdiorite and granodiorite. These rocks and formations are in dense, massive and consolidated conditions with impervious characteristics. Springs occur only in fissures or fault fracture zones.

### 7.3.3 Groundwater Quality

Groundwater is generally potable except in some areas with high iron content or salt water intrusion. A water resources investigation for the province conducted by NWRB, and general information from Mainit Municipality revealed the problem areas, as shown in the Groundwater Quality Map in Figure 7.3.2. The following are summary of the findings.

#### (1) High iron content

In the alluvial plain along the north line of Mainit Lake, the shallow wells about 18 m deep have high iron content. While, water from deep well at depths of 27 m in the same plain is potable. In Tagana-an area, water from wells at depths of 36 m has high iron content.

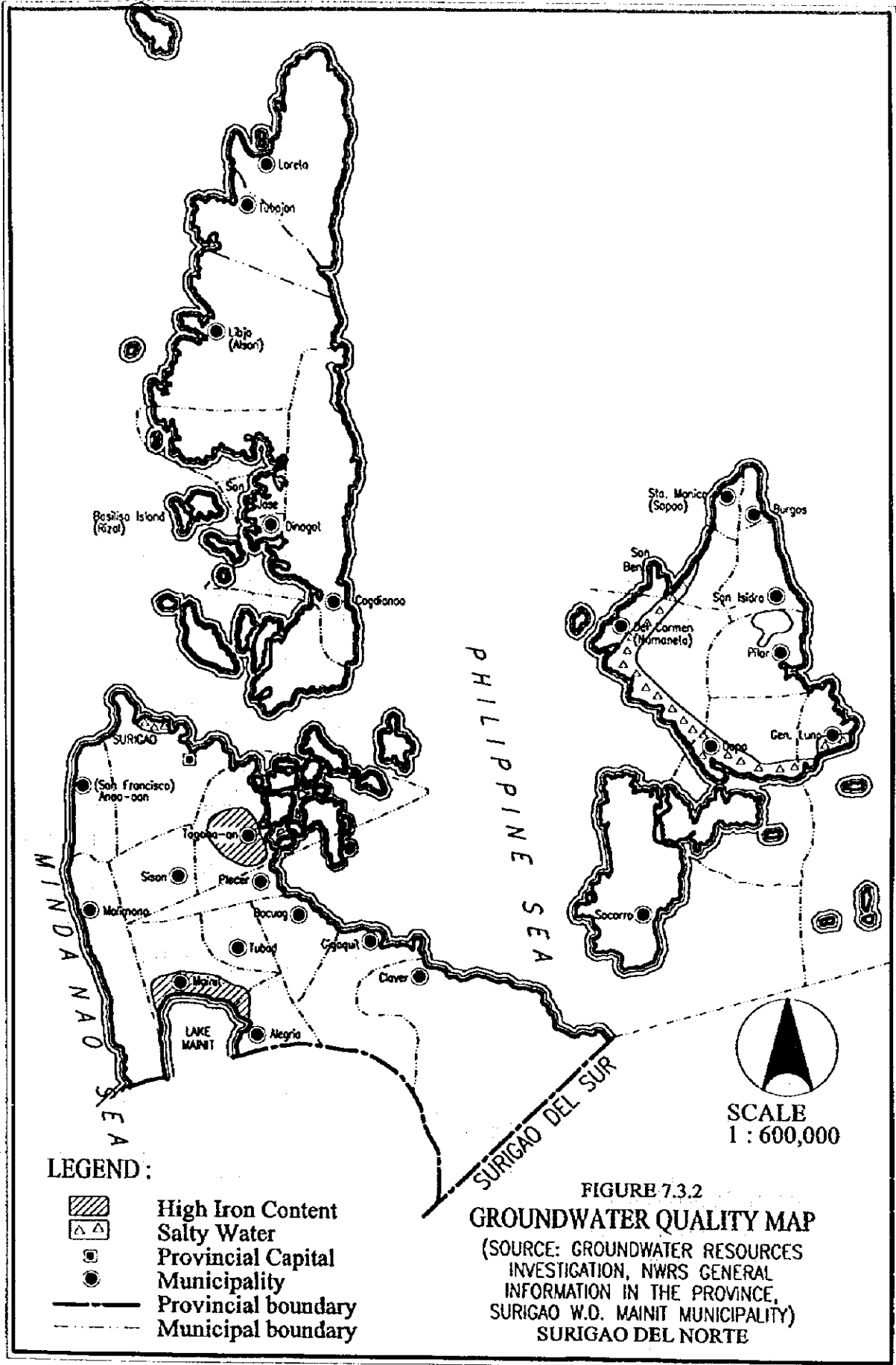
#### (2) Salt water intrusion

The alluvial plain formed by the Surigao River has salt water intrusion in its shallow aquifer. In addition, the results of the resistivity survey show that salt water intrusion in shallow groundwater may occur in Bacuag, Dapa, General Luna, San Benito, Sapao to Sta. Monica, Rizal to Basilisa, Cagdianao, and Dinagat Proper.

### 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.





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For the study, springs are categorized into developed, undeveloped and untapped springs. A developed spring is utilized and must have 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 277 developed springs currently serving the province.

Dinagat Island is mostly composed of old igneous hard rocks that cover the mountainous areas, and the alluvial area is distributed in a very limited area. The main water sources are springs (there are a total of 77 developed springs). Of these springs, 70 have discharges of less than 2.8 l/sec while the rest have discharges of more than 2.8 l/sec. A total of 9 untapped springs on Dinagat Island are reported in the municipality of Dinagat. These springs have yields varying from 0.03 to 0.67 l/sec.

About a half of Siargao Island is covered by mountainous areas composed of sedimentary rocks of the Tertiary age. The areas have 67 developed springs as their main water sources. Of these springs, 60 have discharges of less than 2.8 l/sec and 7 discharge more than 2.8 l/sec. A total of 8 untapped springs are reported in the municipalities of San Isidro, Del Carmen, and General Luna. These springs have yields varying from 1.11 to 27.6 l/sec.

The main Mindanao Island has a high mountain range consisting of intrusive rocks in the western portion of the province and non-active cones, with very steep mountain slopes at elevations of about 700 m, in the southwest and the southeast portions of the province. These mountains have many springs that supply water to the surrounding municipalities. The total number of developed springs are 89 on the main island. Of these springs, 53 have discharges of less than 2.8 l/sec, while 36 have discharges of more than 2.8 l/sec. A total of 17 untapped springs are reported in the municipalities of Anao-aon, Malimono, Bacuag, and Alegria. These springs have yields varying from 1.19 to 40.0 l/sec.

The technical information on the 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 the Surigao River, the Valencia River, the Mayag River, the Sonkoy River, the Bacuag River and the Gigaquit River. There are three

gauging stations in the province.

Surface water use in the province totaled 5.21 cu.m/sec according to the NWRB's water rights registration database as of March 1997. Of this usage, 93.7% of the water rights were registered for irrigation. Other surface water uses were for domestic, industrial and fisheries by water supply systems and a few private companies. For domestic water supply, the Metro Surigao WD has registered 8,400 cu.m/day water from the Parangparang creek (tributary of the Surigao River) since 1994. The private water supply service in the municipality of Mainit has used 160 cum/day water from the Binga creek (tributary of the Mayac River) since 1990. Actually, the Metro Surigao WD has been collecting surface water from protected spring fields.

Data on river flow, maintenance flow and water use of the major rivers and stream systems, based on available runoff records from the gauging stations are given in Table 7.5.2, Supporting Report. The inflows to and the outflows from the respective municipalities are estimated as the exploitable potential of the major rivers in the province.

Water quality analyses were conducted through this study. The results of water quality analysis at selected streams meet the Class A limitation of "DENR Fresh Water Quality Criteria" within the tested parameters. It is noted that gold mining operations are located in Surigao City. Several small-scale mining operations are found in the Mat-i area. Mercury has already polluted the watershed of the Surigao River, extending to the Surigao City bayside. Investigation of Surigao City (1996) shows that the pollution of the Surigao River is at a serious stage, enough to cause extensive harm to the people's health in the area.

## **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 5 and 20 mbgl. 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 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 Pliocene to Pleistocene sediments, good aquifers apparently occur from 20 to 80 mbgl.

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 depth, static water level, specific capacity, and aquifer formation as shown in Table 7.6.2, Supporting Report. The groundwater development potential in the province is shown in Table 7.6.1.

## (2) Spring

A total of 34 untapped spring sources for future development are listed in Table 7.6.3 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 differences between spring sources and served areas.

Dinagat Island has many small-discharge springs. The distances between the water sources and the served areas are fairly short, ranging from 0.3 km to 2.4 km.

Siargao Island has 8 springs with relatively large-discharge rates. The discharge rates of two springs are fairly large but the data of the others was not available. The distances between the water sources and the served areas are in the range of 2 km to 9 km.

On the main Mindanao Island, there are many springs and their discharge rates are fairly large. The distances between the spring sources and the served areas are generally less than 3 km. The elevation differences between the spring sources and the served areas range from 5 m to 300 m, but the majority are within 50 m.

The spring development potential in the province is shown in Table 7.6.2.

## (3) Surface Water

The potential surface water volume exploitable from major rivers for the use of domestic water supply was estimated by municipality. It was arranged in this calculation to ensure

Table 7.6.1 Groundwater Development Potential in the Province

Area	Groundwater Development Potential	Water Quality	Area Feature
1. Dinagat Island	Alluvial plains are distributed only in small/narrow areas. Suitable places for groundwater development are not distributed due to old igneous rocks covering most island. The plains are developed only by shallow wells. Well depth: 8.7 to 11.2 mbgl. Water table: more than 1.4 mbgl.	Groundwater has no salt water intrusion and no high iron content.	Mostly covered by mountainous areas with elevations of 200 m to 700 m. The mountain slopes suddenly rise up from the seashore. The mountainous areas are formed by older igneous rocks.
2. Siargao Island	Alluvial plains cover half of the island. Thus, wells occupy 62% of total water sources. It is a difficult area for groundwater development. Well depth of shallow wells: 4 to 13 mbgl.	Salt water intrusion: coastal areas in southern and western areas.	Mountainous areas with elevations from 80 m to 230 m in the northwest and southeast. Alluvial plains are widely distributed in the central, the northeast, and the southeast sides of Siargao Island.
3. West areas of Main Mindanao Island	Occupied by mountainous areas consisting of hard rocks. Deep well area in the areas of Surigao City and Ana-an. However, groundwater downstream of the Surigao River cannot be developed due to mercury contamination for gold mining. Well depth: 4 to 13 mbgl, and 21 to 76 mbgl. Water table: 0-91 To 10 mbgl. Specific capacity: 0.15 to 4.36 l/s/m.	Salt water intrusion: alluvial plain, formed by the Surigao River.	Formed by mountainous area with elevations of 300 m to 800 m consisting of Cretaceous to Paleogene age formations.
4. South areas of Main Mindanao Island	Groundwater development areas are limited along north line of Mainit Lake. Well depth: 7 to 12 mbgl, and 42 to 77 mbgl. Water table: 1.8 to 6 mbgl. Specific capacity: 0.12 to 1.0 l/s/m.	High iron content: shallow wells with depths of about 18 m in the alluvial plain along the north line of Mainit Lake. However, deep well water with depth of 27 m is potable. Deep wells with depth of 36 m, located in Tagana-an.	In the center of low mountains formed by sedimentary formations of Pliocene to Pleistocene, there are steep mountains consisting of volcanic rocks of Pliocene to Pleistocene.

Table 7.6.2 Spring Development Potential in the Province

Area	Spring Water Development Potential	Water Quality	Aerial Feature
1. Dinagat Island	Most water sources springs. No. of developed springs: 49; discharge range is usually < 2.8 l/s. No. of untapped springs: 9; discharges range from 0.03 to 40.0 l/sec.	Potable	Most island is covered by mountainous areas, consisting of older igneous rocks.
2 Siargao Island	Springs are important sources in the mountainous areas consisting of Tertiary formations. No. of developed springs: 71 and discharge range usually < 2.8 l/s. No. of untapped springs: 8; discharges range from 1.11 to 27.6 l/sec.	Potable	Half of island is occupied by mountainous areas.
3. West areas of Main Mindanao Island	Occupied by high mountainous area with steep slopes consisting of hard rocks. Difficult area for groundwater development. Main water sources are springs. No. of developed springs: 56; discharge range is usually > 2.8 l/s. No. of untapped springs: 3; discharges range from 1.19 to 40 l/sec.	Potable	Formed by steep and high mountain areas with elevation of 300 m to 800 m. The mountains are extended from north to south.
4. South areas of Main Mindanao Island	Many springs issue from steep mountains and supply water in the periphery areas. No. of developed springs: 101; range usually > 2.8 l/s. No. of untapped springs: 14; discharges range from 1.16 to 4.17 l/sec.	Potable	Non-active cones with steep slopes consisting of pyroclastic rocks are located around low mountains formed by sedimentary rocks of Pliocene to Pleistocene.

maintenance flow of the rivers under the draught flow in 10-year return period in consideration of the present water rights.

The calculation results are shown in Table 7.5.2, Supporting Report. In particular, municipalities situated in the Gigaquit River basin are privileged to use larger amount of river water. The remaining municipalities of the province have no major rivers, suitable or safe surface water source in the province. In addition, mining operations are located upstream of the Surigao and the Gigaquit Rivers. Therefore, the water source development in these rivers shall be planned considering the protection against the surface water pollution by heavy metals.

### **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 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 (detail data base is included in Table 7.1.1, Data Report) and hydrogeological assessment presented in Table 7.6.2, Supporting Report.

Shallow wells are currently used in some municipalities. The municipal areas are categorized into deep well and shallow well areas considering 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. Prior to the detailed design or pre-construction stages, additional groundwater investigations entailing electric resistivity survey and the construction of test wells in the municipalities of San Isidro, San Benito, Sison, Placer, Bacuag, Tubod shall be conducted. Table 7.7.2 summarizes the requirements.

The groundwater development for water supply in urban areas (Level II and III systems) will

Table 7.7.1 Standard Specification of Wells by Municipality

Municipality	Type	Type	Proportion (%)	Standard Specification			Remarks
				Depth Range (m)	SWL (m)	Specific Capacity (l/sec/m)	
Alegria	Rural	SW	0	10<D<20	4	1.0	
		DW	40	35<D<40	4	1.0	
	Urban	SW	0	10<D<20	4	1.0	
		DW	100	35<D<40	4	1.0	
San Francisco (Anao-aon)	Rural	SW	0	10<D<15	10	0.5	
		DW	50	30<D<35	1	0.5	
	Urban	SW	0	10<D<15	10	0.5	
		DW	100	30<D<35	1	0.5	
Bacuag	Rural	SW	0	5<D<15	3	1.5	
		DW	20	45<D<50	3	1.5	
	Urban	SW	0	5<D<15	3	1.5	
		DW	100	45<D<50	3	1.5	
Burgos	Rural	SW	-	-	-	-	
		DW	-	-	-	-	
	Urban	SW	-	-	-	-	
		DW	-	-	-	-	
Cagdianao	Rural	SW	-	-	-	-	
		DW	-	-	-	-	
	Urban	SW	-	-	-	-	
		DW	-	-	-	-	
Claver	Rural	SW	10	10<D<20	3	1.5	
		DW					
	Urban	SW	100	10<D<20	3	1.5	
		DW					
Dapa	Rural	SW	0	5<D<10	3	0.5	
		DW	15				
	Urban	SW	0	5<D<10	3	0.5	
		DW	100				
Del Carmen	Rural	SW	0	5<D<15	3	1.0	
		DW	70				
	Urban	SW	0	5<D<15	3	1.0	
		DW	100				
Dinagat	Rural	SW	0	5<D<10	2	0.5	
		DW	5				
	Urban	SW	0	5<D<10	2	1.0	
		DW	100				
Gen. Luna	Rural	SW	0	5<D<15	2	0.5	
		DW	40				
	Urban	SW	0	5<D<15	2	1.0	
		DW	100				
Gigaquit	Rural	SW	0	10<D<20	2	0.5	
		DW	20	55<D<60	2	0.5	
	Urban	SW	0	10<D<20	2	0.5	
		DW	100	55<D<60	2	0.5	
Libjo	Rural	SW	5	10<D<15	1	1.0	
		DW					
	Urban	SW	100	10<D<15	1	1.0	
		DW					

Table 7.7.1 Standard Specification of Water Sources by Municipality (Cont'd)

Municipality	Type	Type	Proportion (%)	Standard Specification			Remarks
				Depth Range (m)	SWL (m)	Specific Capacity (l/sec/m)	
Lorcto	Rural	SW	5	5<D<10	2	0.5	
		DW					
	Urban	SW	100	5<D<10	2	0.5	
		DW					
Mainit	Rural	SW	0	10<D<15	4	1.0	
		DW	50	45<D<80	3	1.0	
	Urban	SW	0	10<D<15	4	1.0	
		DW	100	45<D<80	3	1.0	
Malimono	Rural	SW	0	5<D<10	4	3.0	
		DW	5	75<D<80	4	3.0	
	Urban	SW	0	5<D<10	4	3.0	
		DW	100	75<D<80	4	3.0	
Pilar	Rural	SW	0	10<D<15	3	0.5	
		DW	70				
	Urban	SW	0	10<D<15	3	0.5	
		DW	100				
Placer	Rural	SW	5	5<D<15	1	0.5	
		DW					
	Urban	SW	100	5<D<15	1	0.5	
		DW					
San Isidoro	Rural	SW	-	-	-	-	
		DW	-	-	-	-	
	Urban	SW	-	-	-	-	
		DW	-	-	-	-	
Sta. Monica	Rural	SW	5	10<D<20	2	0.5	
		DW					
	Urban	SW	100	10<D<20	2	0.5	
		DW					
Sison	Rural	SW	0	10<D<20	4	1.5	
		DW	5	20<D<50	4	1.5	
	Urban	SW	0	10<D<20	4	1.5	
		DW	100	20<D<50	4	1.5	
Socorro	Rural	SW	-	-	-	-	
		DW	-	-	-	-	
	Urban	SW	-	-	-	-	
		DW	-	-	-	-	
Surigao City	Rural	SW	0	10<D<20	4	1.5	
		DW	40	20<D<25	2	1.5	
	Urban	SW	0	10<D<20	4	1.5	
		DW	100	20<D<25	2	1.5	
Tagana-an	Rural	SW	0	5<D<10		0.5	
		DW	15	20<D<25		0.5	
	Urban	SW	0	5<D<10		0.5	
		DW	100	20<D<25		0.5	
Tubagon	Rural	SW	-	-	-	-	
		DW	-	-	-	-	
	Urban	SW	-	-	-	-	
		DW	-	-	-	-	

Table 7.7.1 Standard Specification of Wells by Municipality (Cont'd)

Municipality	Type	Type	Proportion (%)	Standard Specification			Remarks
				Depth Range (m)	SWI. (m)	Specific Capacity (Use/m)	
Tubod	Rural	SW	0	15<D<20	6	0.5	
		DW	20	45<D<50	6	0.5	
	Urban	SW	0	15<D<20	6	0.5	
		DW	100	45<D<50	6	0.5	
Rizal	Rural	SW	5	5<D<10	2	1.0	
		DW					
	Urban	SW	5	5<D<10	2	1.0	
		DW					
	Rural	SW					
		DW					
	Urban	SW					
		DW					
	Rural	SW					
		DW					
	Urban	SW					
		DW					
	Rural	SW					
		DW					
	Urban	SW					
		DW					
	Rural	SW					
		DW					
	Urban	SW					
		DW					
	Rural	SW					
		DW					
	Urban	SW					
		DW					
	Rural	SW					
		DW					
	Urban	SW					
		DW					

require the construction of deep wells with larger casing diameters of 6" or more, which expect 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 simultaneously pump up during long period. This results in the intermittent pump operation with excess electric consumption. Thus, appropriate spacing interval and number of wells to be constructed per sq. Km were estimated as shown in Table 7.7.1 Spacing Arrangements for Planned Wells, Supporting Report.

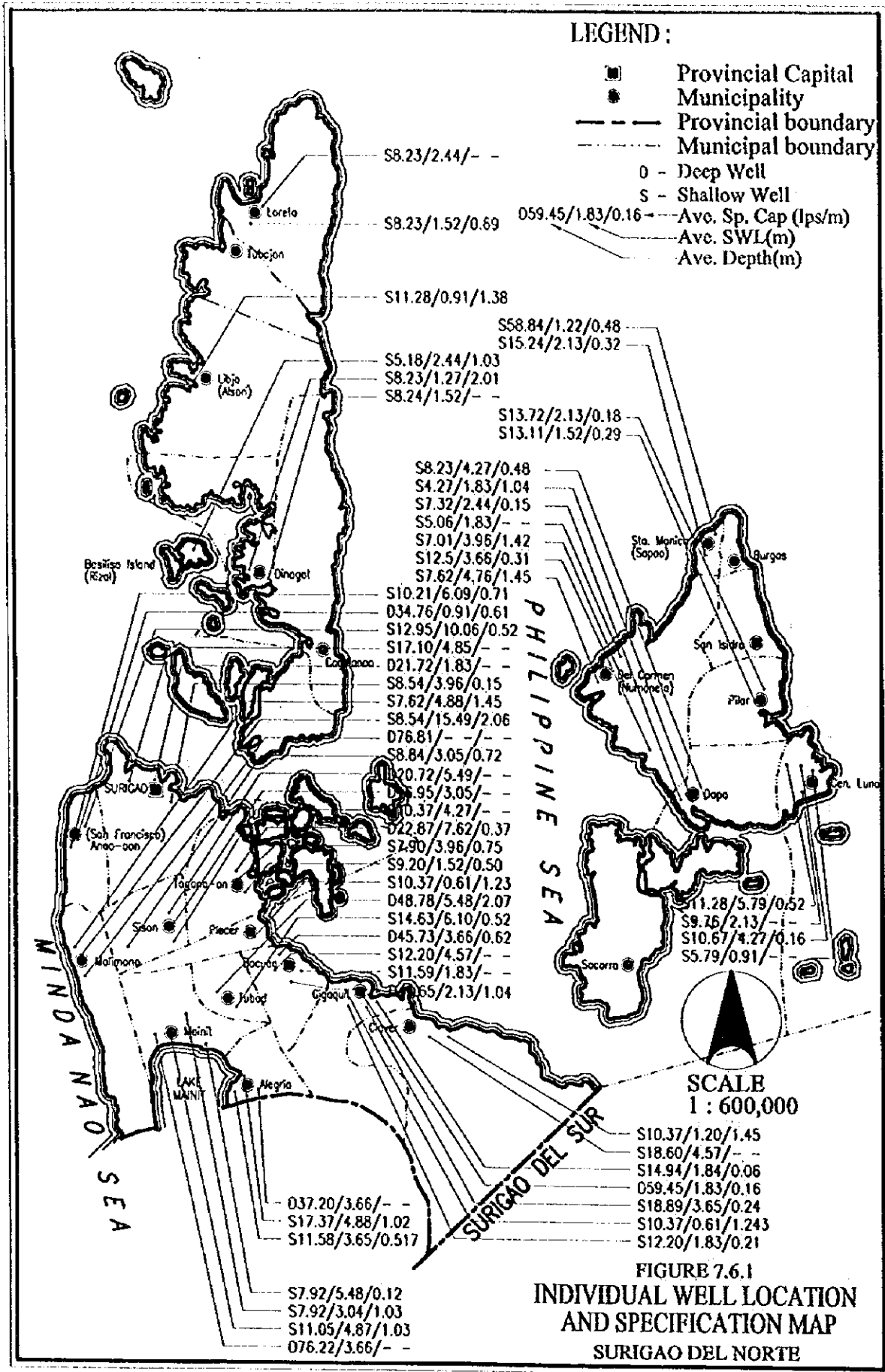
Spring sources, proposed by barangay level, for future development are shown in Table 7.6.3, Supporting Report. They shall also be investigated to confirm the development possibility in the following items: (1) locations and type of spring sources. (2) fluctuation of discharge rates through the year, (3) distances from spring sources and proposed served areas and (4) elevation differences between the two points.

**Table 7.7.2 Additional Detailed Groundwater Investigation**

Municipality	Survey Area	Survey Activities and Specification	
		Electric Resistivity Survey	Test Well Construction
San Isidro, San Benito, Sison, Placer, Bacuag, and Tubod	Urban area	Measuring lines: 4/each Municipality Measuring interval: 200 m Length of a measuring line: 1 km Prospecting depth: 100 m	Number of test well: one/each municipality Casing diameter: 200 mm Well depth: 60 m Including pumping test, electric logging, and water quality analysis



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 FILENAME : SURIGAO-DELNORTE(IWLSM)

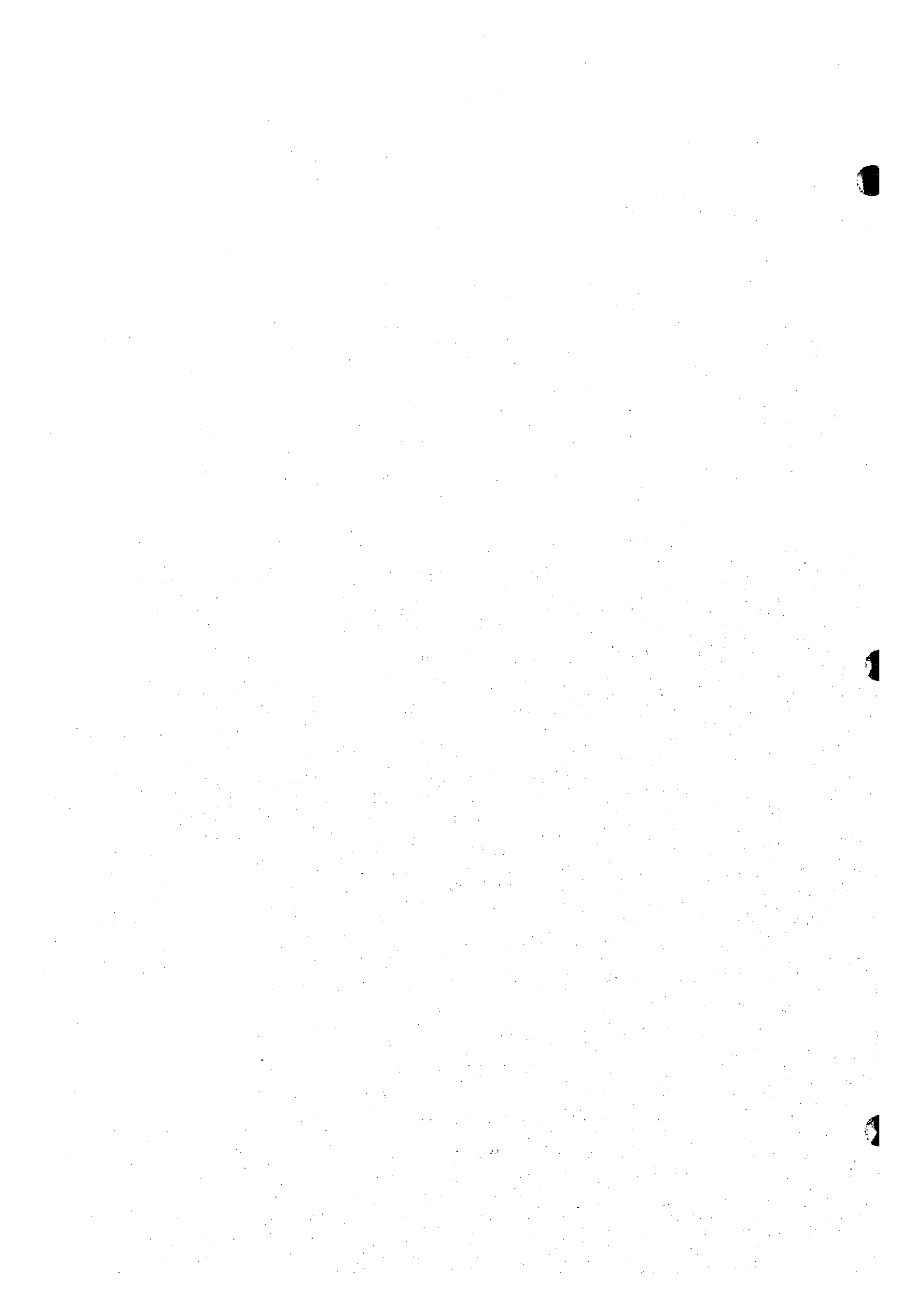


Chapter

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 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 information from relevant agencies. Provincial population by target year and the base year (1997) is estimated by adopting the projection method being used at NSO. 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 examination 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 those in 1997 and expected by planned/on-going projects scheduled to be completed by April 1998. Table 8.2.2 shows service coverage for the planning purpose (details are referred to Supporting Report).

The base year service coverage in urban area (74%) is exceeding the updated MTPDP sector target (68.8%) for the year 1998, while rural area (75%) is slightly 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.

Table 8.2.1 Provincial Sector Targets

Sub-sector	Existing Service Coverage	Phase I (1999-2003)		Phase II (2004-2010)	
		Population Coverage (%)	Additional Population to be Served	Population Coverage (%)	Additional Population to be Served
<b>Water Supply</b>	Population Coverage (%)	Population Coverage (%)	Additional Population to be Served	Population Coverage (%)	Additional Population to be Served
<i>Urban Water Supply</i>	74	80	36,310	95	150,480
<i>Rural Water Supply</i>	75	85	60,198	93	43,782
<b>Sanitation</b>	Households Coverage (%)	Households Coverage (%)	Additional Households to be Served	Households Coverage (%)	Additional Households to be Served
<i>Household Toilet</i>					
<i>Urban Household Toilet</i>	70	75	8,630	93	27,651
Flush	5	15	2,132	50	26,606
Pour Flush	66	75	2,993	50	1,045
VIP	0	10	3,505	0	0
<i>Rural Household Toilet</i>	69	75	8,152	90	28,385
Flush	0	0	0	20	4,019
Pour Flush	69	85	2,602	80	24,366
VIP	0	15	5,550	0	0
<b>School Toilet</b>	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
	60	85	28,997	90	13,422
<b>Public Toilet</b>	Public Utilities Coverage (%)	Public Utilities Coverage (%)	Additional Public Utilities with Sanitary Toilets	Public Utilities Coverage (%)	Additional Public Utilities with Sanitary Toilets
	100	100	21	100	9
<b>Sewerage</b>	Urban Population Coverage (%)	Not Applicable		Urban Population Coverage (%)	Urban Population to be Served
	0			50	121,760
<b>Solid Waste</b>	Urban Household Coverage (%)	Urban Household Coverage (%)	Additional Households to be Served	Not Applicable	
	81	90	14,690		

Table 8.2.2 Estimation of Base Year Service Coverage of Water Supply

Name of Municipality	Area	Population (1997)	Population Served by 1997 facilities				Percentage Coverage
			Level III	Level II	Level I	Total	
Alegria	Urban	5,264	1,040	1,500	2,258	4,798	91
	Rural	6,893		1,233	4,453	5,686	82
	Total	12,157	1,040	2,733	6,711	10,484	86
Bacuag	Urban	8,395	2,875			2,875	34
	Rural	4,440		1,140	1,377	2,517	57
	Total	12,835	2,875	1,140	1,377	5,392	42
Basilisa (Rizal)	Urban	3,209			1,699	1,699	53
	Rural	22,596			20,719	20,719	92
	Total	25,805			22,418	22,418	87
Burgos	Urban	2,213	321	1,188		1,509	68
	Rural	667		270	266	536	80
	Total	2,880	321	1,458	266	2,045	71
Cagdianao	Urban	5,172					
	Rural	6,186	544	1,945		2,489	40
	Total	11,358	544	1,945		2,489	22
Claver	Urban	7,668			5,161	5,161	67
	Rural	7,118		431	4,716	5,147	72
	Total	14,786		431	9,877	10,308	70
Dapa	Urban	11,760	1,389		6,962	8,351	71
	Rural	4,818		2,415		2,415	50
	Total	16,578	1,389	2,415	6,962	10,766	65
Del Carmen	Urban	3,437	65	3,255	9	3,329	97
	Rural	9,273	300	1,955	3,452	5,707	62
	Total	12,710	365	5,210	3,461	9,036	71
Dinagat	Urban	2,550		2,515	35	2,550	100
	Rural	6,175		1,351	4,575	5,926	96
	Total	8,725		3,866	4,610	8,476	97
General Luna	Urban	4,632			2,981	2,981	64
	Rural	8,404			6,519	6,519	78
	Total	13,036			9,500	9,500	73
Gigaquit	Urban	6,594	2,445		1,193	3,638	55
	Rural	9,317	3,100		3,744	6,844	73
	Total	15,911	5,545		4,937	10,482	66
Libjo (Albor)	Urban	3,094		835		835	27
	Rural	12,358		3,427	4,438	7,865	64
	Total	15,452		4,262	4,438	8,700	56
Loreto	Urban	5,662	499	3,773	780	5,052	89
	Rural	2,789		2,773		2,773	99
	Total	8,451	499	6,546	780	7,825	93
Mainit	Urban	10,125	1,698	3,373	3,274	8,345	82
	Rural	12,198	5,297	1,179	2,873	9,349	77
	Total	22,323	6,995	4,552	6,147	17,694	79
Malimono	Urban	6,777	735	120		855	13
	Rural	7,385		5,550	1,103	6,653	90
	Total	14,162	735	5,670	1,103	7,508	53

Table 8.2.2 Estimation of Base Year Service Coverage of Water Supply

Name of Municipality	Area	Population (1997)	Population Served by 1997 facilities				Percentage Coverage
			Level III	Level II	Level I	Total	
Pilar	Urban	2,289		1,886		1,886	82
	Rural	6,279		644	2,675	3,319	53
	Total	8,568		2,530	2,675	5,205	61
Placer	Urban	12,774		660	11,429	12,089	95
	Rural	8,906	735	1,286	5,098	7,119	80
	Total	21,680	735	1,946	16,527	19,208	89
San Benito	Urban	2,174	420	800		1,220	56
	Rural	2,460			570	570	23
	Total	4,634	420	800	570	1,790	39
San Francisco (Anao-Aon)	Urban	4,036	1,603	200	1,688	3,491	86
	Rural	6,303	3,138	1,364	1,251	5,753	91
	Total	10,339	4,741	1,564	2,939	9,244	89
San Isidro	Urban	1,800		1,720		1,720	96
	Rural	4,229			2,988	2,988	71
	Total	6,029		1,720	2,988	4,708	78
San Jose	Urban	16,011	386	802	3,553	4,741	30
	Rural	11,574		180	2,386	2,566	22
	Total	27,585	386	982	5,939	7,307	26
Santa Monica (Sapao)	Urban	1,815	1,459	356		1,815	100
	Rural	5,581	90	2,355	1,447	3,892	70
	Total	7,396	1,549	2,711	1,447	5,707	77
Sison	Urban	2,896	85		1,227	1,312	45
	Rural	6,270	3,515	2,489	33	6,037	96
	Total	9,166	3,600	2,489	1,260	7,349	80
Socorro	Urban	7,775			6,845	6,845	88
	Rural	8,069			5,325	5,325	66
	Total	15,844			12,170	12,170	77
Surigao City (Capital)	Urban	70,705	45,180	2,427	20,117	67,724	96
	Rural	37,570	500	25,227	6,432	32,159	86
	Total	108,275	45,680	27,654	26,549	99,883	92
Tagana-An	Urban	5,676			4,893	4,893	86
	Rural	6,867			5,718	5,718	83
	Total	12,543			10,611	10,611	85
Tubajon	Urban	1,910		708		708	37
	Rural	4,485		885	2,798	3,683	82
	Total	6,395		1,593	2,798	4,391	69
Tubod	Urban	1,526	1,526			1,526	100
	Rural	8,869	5,787	3,082		8,869	100
	Total	10,395	7,313	3,082		10,395	100
Provincial Total	Urban	217,939	61,726	26,118	74,104	161,948	74
	Rural	238,079	23,006	61,181	94,956	179,143	75
	Total	456,018	84,732	87,299	169,060	341,091	75



For Phase I development, the service coverage in rural area is increased up to 85%, while urban area is considered to moderately improve the present service level with 80%. 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 69%, which is a little above the current national average coverage of 60%. Urban area registers a level of 70% that is well above the national average coverage. Rural area has also 69% coverage, which is equivalent to the provincial average. By type of sanitary toilet facility, the existing percentage composition to total households is as follows:

Type	Urban (%)	Rural (%)
Flush	7	0
Pour-flush	93	100
VIP latrine	0	0

To attain sufficiency and equitable access to basic services, provincial targets of Phase I for both urban and rural household toilets are planned at 75%. This is to achieve a balanced distribution of this basic facility as embodied in the PNDP. For Phase II, 93% as set by the NSMP is adopted for urban household toilets, while, 90% is arranged for rural household toilets.

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

2) School toilets

The base year service coverage of public school students is shown in Table 8.2.4 counting expected coverage of any planned or on-going projects scheduled to be completed by 1998 (details are referred to Supporting Report).

Table 8.2.3 Base Year Service Coverage of Household Toilets

Name of Municipality	Area	1997											
		Population		HHs		Households and Population Using Sanitary Toilets			Service Coverage (%)				
		Population	HHs	Flush	Pour	VTP/Drv	Total	Population	Flush	Pour	VTP/Drv	Total	
Alegria	Urban	5,264	892		690		690	4,054			77		77
	Rural	6,893	1,267		775		775	4,205			61		61
	Total	12,157	2,159		1,465		1,465	8,259			68		68
Bacuag	Urban	8,395	1,502		1,200		1,200	6,716			80		80
	Rural	4,440	723		527		527	3,242			73		73
	Total	12,835	2,225		1,727		1,727	9,958			78		78
Basilisa (Rizal)	Urban	3,209	568		328		328	1,862			58		58
	Rural	22,596	4,079		2,811		2,811	15,592			69		69
	Total	25,805	4,647		3,139		3,139	17,454			68		68
Burgos	Urban	2,213	458		371		371	1,793			81		81
	Rural	667	124		85		85	461			69		69
	Total	2,880	582		456		456	2,254			78		78
Cagdianao	Urban	5,172	1,060		531		531	2,586			50		50
	Rural	6,186	1,215		905		905	4,578			74		74
	Total	11,358	2,275		1,436		1,436	7,164			63		63
Claver	Urban	7,668	1,524		1,371		1,371	6,902			90		90
	Rural	7,118	1,418		963		963	4,841			68		68
	Total	14,786	2,942		2,334		2,334	11,743			79		79
Dapa	Urban	11,760	2,400		1,829		1,829	8,938			76		76
	Rural	4,818	952		654		654	3,325			69		69
	Total	16,578	3,352		2,483		2,483	12,263			74		74
Del Carmen	Urban	3,437	671		646		646	3,300			96		96
	Rural	9,273	1,783		867		867	4,544			49		49
	Total	12,710	2,454		1,513		1,513	7,844			62		62
Dinagat	Urban	2,550	523		355		355	1,734			68		68
	Rural	6,175	1,206		779		779	4,014			65		65
	Total	8,725	1,729		1,134		1,134	5,748			66		66
General Luna	Urban	4,632	919		619		619	3,104			67		67
	Rural	8,404	1,556		1,062		1,062	5,715			68		68
	Total	13,036	2,475		1,681		1,681	8,819			68		68

Table 8.2.3 Base Year Service Coverage of Household Toilets

Name of Municipality	Area	1997										
		Population		HHs		Households and Population Using Sanitary Toilets			Service Coverage (%)			
		Population	HHs	Flush	Pour	VIP/Dry	Total	Population	Flush	Pour	VIP/Dry	Total
Gigaquit	Urban	6,594	1,217			865	4,682				71	71
	Rural	9,317	1,706			1,288	6,988				75	75
	Total	15,911	2,923			2,153	11,670				74	74
Libjo (Albor)	Urban	3,094	602			578	2,971				96	96
	Rural	12,358	2,319			1,259	6,674				54	54
	Total	15,452	2,921			1,837	9,645				63	63
Loreto	Urban	5,662	1,202			959	4,530				80	80
	Rural	2,789	568			222	1,088				39	39
	Total	8,451	1,770			1,181	5,618				67	67
Mainit	Urban	10,125	1,940			1,415	7,392				73	73
	Rural	12,198	2,255			1,854	10,003				82	82
	Total	22,323	4,195			3,269	17,395				78	78
Malimono	Urban	6,777	1,337			752	3,796				56	56
	Rural	7,385	1,409			1,137	5,982				81	81
	Total	14,162	2,746			1,889	9,778				69	69
Pilar	Urban	2,289	441			389	2,015				88	88
	Rural	6,279	1,113			705	3,956				63	63
	Total	8,568	1,554			1,094	5,971				70	70
Placer	Urban	12,774	2,366			2,072	11,242				88	88
	Rural	8,906	1,803			1,175	5,789				65	65
	Total	21,680	4,169			3,247	17,031				78	78
San Benito	Urban	2,174	388			373	2,088				96	96
	Rural	2,460	465			158	837				34	34
	Total	4,634	853			531	2,925				62	62
San Francisco (Anao-Aon)	Urban	4,036	827			552	2,705				67	67
	Rural	6,303	1,210			888	4,602				73	73
	Total	10,339	2,037			1,440	7,307				71	71
San Isidro	Urban	1,800	314			301	1,728				96	96
	Rural	4,229	735			373	2,157				51	51
	Total	6,029	1,049			674	3,885				64	64

Table 8.2.3 Base Year Service Coverage of Household Toilets

Name of Municipality	Area	1997														
		Population		HHs		Households and Population Using Sanitary Toilets			Population			Service Coverage (%)				
		Population	HHs	Flush	Pour	VIP/Dry	Total	Population	Flush	Pour	VIP/Dry	Total	Flush	Pour	VIP/Dry	Total
San Jose	Urban	16,011	2,895			1,966	10,888									68
	Rural	11,574	1,955			1,178	6,945									60
	Total	27,585	4,850			3,144	17,833									65
Santa Monica (Sapao)	Urban	1,815	341			175	926									51
	Rural	5,581	966			556	3,237									58
	Total	7,396	1,307			731	4,163									56
Sison	Urban	2,896	562			540	2,781									96
	Rural	6,270	1,146			946	5,205									83
	Total	9,166	1,708			1,486	7,986									87
Socorro	Urban	7,775	1,359			1,301	7,464									96
	Rural	8,069	1,368			862	5,084									63
	Total	15,844	2,727			2,163	12,548									79
Sungao City (Capital)	Urban	70,705	13,571	1,921		5,617	7,538	39,595	14	41						56
	Rural	57,570	7,309			5,845	30,056									80
	Total	108,275	20,880	1,921		11,462	13,383	69,651	9	55						64
Tagana-An	Urban	5,676	1,106			938	4,825									85
	Rural	6,867	1,313			942	4,945									72
	Total	12,543	2,419			1,880	9,770									78
Tubajon	Urban	1,910	398			398	1,910									100
	Rural	4,485	871			422	2,153									48
	Total	6,395	1,269			820	4,063									65
Tubod	Urban	1,526	295			287	1,481									97
	Rural	8,869	1,742			1,337	6,830									77
	Total	10,395	2,037			1,624	8,311									80
Provincial Total	Urban	217,939	41,678	1,921		27,418	29,339	154,008	5	66						70
	Rural	238,079	44,576			30,575	163,048									69
	Total	456,018	86,254	1,921		57,993	317,056	2	67							69

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

Name of Municipality	Public School Toilets			Public Toilets		
	Total Number of Public School Students (1997)	Std. No. of Public School Students that can be Served by Base Year (1997) Sanitary Toilets	Service Coverage (%)	Number of Public Utilities with Toilets in 1997	Number of Public Utility with Sanitary Toilets in Base Year (1997)	Service Coverage (%)
Alegria	3,189	1,040	33	1	1	100
Bacuag	2,138	2,138	100	2	2	100
Basilisa (Rizal)	4,460	3,000	67	1	1	100
Burgos	1,506	240	16	3	3	100
Cagdianao	2,928	2,840	97	1	1	100
Claver	3,760	3,600	96	3	3	100
Dapa	5,631	480	9	5	5	100
Del Carmen	2,156	2,156	100	1	1	100
Dinagat	3,152	880	28	5	5	100
General Luna	3,156	1,920	61			
Gigaquit	3,009	3,009	100	4	4	100
Libjo (Albor)	3,535	520	15	5	5	100
Loreto	1,458	1,458	100	3	3	100
Mainit	5,690	3,040	53	4	4	100
Malimono	3,932	1,680	43	8	8	100
Pilar	1,578	960	61	2	2	100
Placer	4,919	4,919	100	3	3	100
San Benito	2,301	1,600	70	3	3	100
San Francisco (Anao-Aon)	2,524	2,524	100	1	1	100
San Isidro	1,578	1,578	100	1	1	100
San Jose	0			4	4	100
Santa Monica (Sapao)	1,365	640	47	1	1	100
Sison	2,320	1,840	79	1	1	100
Socorro	3,886	2,640	68	3	3	100
Surigao City (Capital)	32,028	20,720	65	10	10	100
Tagana-An	2,775	1,040	37	1	1	100
Tubajon	1,869	1,320	71	1	1	100
Tubod	2,400	960	40	1	1	100
<b>Provincial Total</b>	<b>109,243</b>	<b>68,742</b>	<b>63</b>	<b>78</b>	<b>78</b>	<b>100</b>

Base year service coverage is 63% 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 toilets 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, 85% 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 a 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.

About 39% of the total households in the province relied on municipal refuse collection using trucks or an 81% urban household coverage. These municipalities have a total of 10 units of collection truck.

No national targets have yet been set. However, considering the present level of coverage, a 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 of 2003 and 2010 together with the present population in 1997 as a planning base year.

Regional population in the future is published by the NSO, while projection at provincial and municipal levels was not available during the time of study. The future population of LGUs was therefore projected in the following manner (details are included in the Supporting Report). Reference information/data used for the study are:

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

Name of Municipality	Total No. of Households	No. of Urban Households	No. of Households Served	Coverage of Households (%)	Coverage of Urban Households (%)
Alegria	2,159	892			
Bacuag	2,225	1,502	943	42	63
Basilisa (Rizal)	4,647	568	1,566	34	100
Burgos	582	458			
Cagdianao	2,275	1,060	1,137	50	100
Claver	2,942	1,524	1,382	47	91
Dapa	3,352	2,400	20	1	1
Del Carmen	2,454	671			
Dinagat	1,729	523			
General Luna	2,475	919	810	33	88
Gigaquit	2,923	1,217			
Libjo (Albor)	2,921	602	510	17	85
Loreto	1,770	1,202			
Mainit	4,195	1,940	611	15	31
Malimono	2,746	1,337	170	6	13
Pilar	1,554	441	120	8	27
Placer	4,169	2,366	883	21	37
San Benito	853	388			
San Francisco (Anao-Aon)	2,037	827	1,018	50	100
San Isidro	1,049	314			
San Jose	4,850	2,895	1,817	37	63
Santa Monica (Sapao)	1,307	341	1,307	100	100
Sison	1,708	562	560	33	100
Socorro	2,727	1,359			
Surigao City (Capital)	20,880	13,571	20,499	98	100
Tagana-An	2,419	1,106			
Tubajon	1,269	398	338	27	85
Tubod	2,037	295			
<b>Provincial Total</b>	<b>86,254</b>	<b>41,678</b>	<b>33,691</b>	<b>39</b>	<b>81</b>

- Population census data of 1980, 1990 and 1995 on different administrative levels,
- National and Regional population projection by the NSO based on 1995 census results
- "Ratio method" generally used by the NSO for population projection (details are shown in 8.3.1, Supporting Report)
- Revised classification of urban and rural barangays by the PPDO comparing with NSO statistic information, and
- The 1995 Philippine Yearbook.

The past population development at different administrative levels was first reviewed to come up with the demographic characteristics of the region and province. Then, through review of NSO regional population projection and the 1995 Philippine Yearbook, the behavior of population development through the future was analyzed. Referring to these demographic studies, population projection of the region by target year was confirmed to be reasonable.

Population projection of the province was carried out in application of "ratio method". The projected figures were studied by means of declining annual growth rates employing a simple compounded formula  $(1+r)^n$ . Present population of the province in 1997 was also estimated in the same manner. Likewise, municipal population was projected. Major study procedures and their results are presented below.

(1) Review of past population development in the province and population distribution in 1995 to urban and rural areas

The past population development during census periods from 1980 to 1990 and from 1990 to 1995 revealed that:

- The province recorded an average annual growth rates of 1.60% (1980-1990) and 0.75% (1990-1995), which were lower than the regional rates at 2.44% and 2.33%, respectively.
- Percentage of provincial population to the regional population increased from 13.2% in 1980 to 11.2% in 1995 caused by the higher growth rates than those of the region

The classification of urban and rural areas compiled in 1995 population census was reviewed and updated by the PPDO. As a result of some revision in the barangay classification, the population by municipality was adjusted as shown in table 8.3.2, Section 8.3.1, Supporting Report.

(2) Manner of population projection

The regional population projected by the NSO based on 1995 census results was employed. However, a review of the population has to be made in the near future upon endorsement of the Regional Development Plan (1998-2008) for the Caraga Region that is currently under preparation. The following are the projection procedures.

1) Adoption of regional population projected by the NSO for the years 1995 to 2020

Annual growth rates of regional population projected by NSO were analyzed using a simplified formula. The conservative growth rates were calculated reflecting demographic characteristics of moderate decline of fertility and mortality rate described in the 1995 Philippine Yearbook.



- 2) Application of ratio method for population projection of the province and municipalities

Adopted formula is: 
$$R(k) = R(0) \prod_{i=1}^k (1 + r - kr / 50)$$

where:  $R(k)$  = ratio in "k"th year from 1995 of the population to that of the region or of the population of the municipality to that of the province

$R(0)$  = ratio in 1995 of the population of the province to that of the region or of the population of the municipality to that of the province

$r$  = initial rate of change of the ratio

$k$  = "k"th year from 1995

The initial rate of change is derived based on the levels and trends of the ratio observed in the 1970, 1980, 1990 and 1995 censuses.

- 3) Categorization of the province and municipalities to set initial rate ( $r$ )

Four standard types are prepared based on the trends of the rate ( $r$ ) as observed in the censuses of 1970, 1980, 1990 and 1995. Initial rate to be used for each type of province or municipality is determined using a set-criteria (refer to Section 8.3.1, Supporting Report)

The province was classified as Type II and an initial rate of change ( $r$ ) was estimated at -0.008.

- (3) Present provincial population (1995) including its municipalities (further broken down to urban and rural areas) was estimated applying the initial rates of change as mentioned above, assuming that the behaviors of past population development prevailed up to the present.

- (4) Household size in 1997 was also assumed to be the same as that in 1995.

Population by target year and the year 1995 is presented in Table 8.3.1 covering all municipalities broken down to urban and rural areas. The number of households by target year was also studied and included in Table 8.3.5, Supporting Report.

Table 8.3.1 Future Population by Urban and Rural Area by Municipality

Municipality	1995			1997			2003			2010		
	Urban	Rural	Total	Urban	Rural	Total	Urban	Rural	Total	Urban	Rural	Total
Alegria	5,094	6,670	11,764	5,264	6,893	12,157	5,816	7,616	13,432	6,423	8,410	14,833
Bacuag	8,051	4,258	12,309	8,395	4,440	12,835	9,506	5,028	14,534	10,758	5,690	16,448
Basilisa (Rizal)	3,002	21,139	24,141	3,209	22,596	25,805	3,891	27,402	31,293	4,715	33,201	37,916
Burgos	2,140	645	2,785	2,213	667	2,880	2,450	739	3,189	2,712	817	3,529
Cagdianao	5,089	6,086	11,175	5,172	6,186	11,358	5,458	6,528	11,986	5,758	6,886	12,644
Claver	7,416	6,884	14,300	7,668	7,118	14,786	8,485	7,877	16,362	9,384	8,711	18,095
Dapa	11,659	4,776	16,435	11,760	4,818	16,578	12,157	4,980	17,137	12,563	5,147	17,710
Del Carmen	3,330	8,986	12,316	3,437	9,273	12,710	3,783	10,208	13,991	4,162	11,230	15,392
Dinagat	2,516	6,093	8,609	2,550	6,175	8,725	2,670	6,466	9,136	2,795	6,768	9,563
General Luna	4,461	8,093	12,554	4,632	8,404	13,036	5,187	9,409	14,596	5,803	10,529	16,332
Gigaquit	6,325	8,936	15,261	6,594	9,317	15,911	7,465	10,547	18,012	8,445	11,932	20,377
Libjo (Albor)	2,989	11,939	14,928	3,094	12,358	15,452	3,433	13,714	17,147	3,808	15,209	19,017
Loreto	5,392	2,656	8,048	5,662	2,789	8,451	6,538	3,221	9,759	7,545	3,716	11,261
Mainit	9,879	11,901	21,780	10,125	12,198	22,323	10,936	13,175	24,111	11,806	14,223	26,029
Malimono	6,791	7,400	14,191	6,777	7,355	14,162	6,802	7,411	14,213	6,825	7,437	14,262
Pilar	2,217	6,082	8,299	2,289	6,279	8,568	2,522	6,919	9,441	2,778	7,620	10,398
Placer	12,204	8,508	20,712	12,774	8,906	21,680	14,620	10,193	24,813	16,721	11,657	28,378
San Benito	2,110	2,388	4,498	2,174	2,460	4,634	2,382	2,696	5,078	2,609	2,953	5,562
San Francisco	3,906	6,099	10,005	4,036	6,303	10,339	4,458	6,962	11,420	4,922	7,686	12,608
San Isidro	1,729	4,062	5,791	1,800	4,229	6,029	2,030	4,769	6,799	2,288	5,374	7,662
San Jose	15,951	11,530	27,481	16,011	11,574	27,585	16,330	11,804	28,134	16,652	12,036	28,688
Santa Monica (Sapao)	1,772	5,447	7,219	1,815	5,581	7,396	1,958	6,020	7,978	2,111	6,491	8,602
Sison	2,797	6,056	8,853	2,896	6,270	9,166	3,216	6,963	10,179	3,569	7,728	11,297
Secorro	7,463	7,745	15,208	7,775	8,069	15,844	8,784	9,116	17,900	9,917	10,292	20,209
Surigao City (Capital)	68,507	36,402	104,909	70,765	37,570	108,275	77,841	41,362	119,203	85,649	45,510	131,159
Tagana-An	5,502	6,657	12,159	5,676	6,867	12,543	6,241	7,551	13,792	6,858	8,298	15,156
Tubajon	1,838	4,317	6,155	1,910	4,485	6,395	2,141	5,028	7,169	2,399	5,633	8,032
Tubod	1,515	8,803	10,318	1,526	8,869	10,395	1,572	9,135	10,707	1,619	9,407	11,026
<b>Province</b>	<b>211,645</b>	<b>230,558</b>	<b>442,203</b>	<b>217,939</b>	<b>238,079</b>	<b>456,018</b>	<b>238,672</b>	<b>262,839</b>	<b>501,511</b>	<b>261,594</b>	<b>290,591</b>	<b>552,185</b>

### **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. A decrease of 5% from the 1997 rate is foreseen in 2003 and another decrease of 2% from the 2003 rate in 2010 (details are referred to Table 8.3.6, Supporting Report). It should be noted that the participation rates of some municipalities in 1997 were over 100%, an indication that a number of school enrollees are over-aged.

Table 8.3.2 shows the projected number of public school students by municipality, by target year. About 113,000 and 122,000 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 8.3.2 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
Alegria	3,189	3,508	3,749	1	2	3
Bacuag	2,138	2,421	2,698	2	3	4
Basilisa (Rizal)	4,460	5,392	7,036	1	2	2
Burgos	1,506	935	983	3	3	3
Cagdianao	2,928	2,862	2,868	1	2	2
Claver	3,760	4,149	4,489	3	4	4
Dapa	5,631	4,858	4,769	5	5	5
Del Carmen	2,156	2,364	2,965	1	2	2
Dinagat	3,152	2,503	2,489	5	5	6
General Luna	3,156	3,528	4,143		2	2
Gigaquit	3,009	3,418	4,040	4	5	5
Libjo (Albor)	3,535	3,910	4,495	5	6	6
Loreto	1,458	1,673	1,839	3	4	4
Mainit	5,690	6,151	6,106	4	5	6
Malimono	3,932	3,949	4,048	8	9	9
Pilar	1,578	1,752	2,110	2	2	2
Placer	4,919	5,610	6,341	3	4	5
San Benito	2,301	1,499	1,560	3	3	3
San Francisco (Anao-Aon)	2,524	2,799	2,919	1	2	3
San Isidro	1,578	1,784	2,056	1	2	2
San Jose				4	4	4
Santa Monica (Sapao)	1,365	1,479	1,666	1	2	2
Sison	2,320	2,567	3,110	1	2	3
Socorro	3,886	4,382	5,066	3	3	3
Surigao City (Capital)	32,028	32,264	31,950	10	10	10
Tagana-An	2,775	3,038	3,548	1	2	3
Tubajon	1,869	1,920	2,043	1	2	2
Tubod	2,400	2,472	2,728	1	2	3
<b>Provincial Total</b>	<b>109,243</b>	<b>113,187</b>	<b>121,814</b>	<b>78</b>	<b>99</b>	<b>108</b>

A total of 21 public markets, bus/jeepney terminals and parks/playgrounds are planned for construction by year 2003 and another 9 by the year 2010. Refer to Table 8.3.2 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.

Six (6) municipalities with a combined urban population of about 77,000 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 for furtherance of water supply development.

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
- Recommendations for furtherance of water supply development.

1) Review of existing water supply systems and water sources

Majority of the existing Level III and II systems in urban areas is utilizing spring sources, owing to their locality as a province composed of islands.. WDs are operated in the municipality of Bacuag, Placer and Surigao City, while Level III systems are serving in 14 municipalities, namely; Alegria, Burgos, Dapa, Del Carmen, Gigaquit, Loreto, Mainit, Malimono, San Benito, San Francisco, San Jose, Santa Monica, Sison and Tubod.

The remaining 11 municipalities (Basilisa, Cagdianao, Claver, Dinagat, General Luna, Libjo, Pilar, San Isidro, Socorro, Tagana-An and Tubajon) have no Level III system and residents in these municipalities are depending on Level II system or Level I facilities.

Size of Level III system varies from less than 100 persons in Del Carmen and Sison to about 45,200 persons in Surigao City. Average size of served population is about 1,100 persons, excluding Surigao City.

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, aside from expansion plan of Metro Surigao WD., there are two proposed projects, namely; the Lake Mainit Integrated Area Development Project (LMIADP) and the Integrated Water System in Siargao Island (IWSSI).

The former project includes the municipalities of Alegria, Mainit, Sison and Tubod in its water supply component. These municipalities are proposed to avail spring sources, but no details are available at this moment.

The latter project involves a total of 7 municipalities (Dapa, Del Carmen, General Luna, Pilar, San Benito, San Isidro and Santa Monica). Although the detailed scope of water supply development is not available at present, most of these municipalities seem to utilize spring sources owing to hydrogeological conditions.

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

Water source development study revealed that most of the municipalities in the planning area have high potential of spring development. Among various identified untapped springs, the municipalities of General Luna and San Francisco have so far favorable spring sources suitable for Level III system and capable to expand its service to rural barangays and neighboring municipalities, if technical and financial feasibility is confirmed (details are referred to in Supporting Report).

Table 8.4.1 presents a summary of potential water source together with water supply conditions of the existing systems.

Table 8.4.1 Potential Water Source for Urban Water Supply

Name of Municipality	Served Population in Base Year			Existing Source in Municipality		Potential Water Source		Remarks
	Level III	Others	Total	Spring	Deep Well	Spring	Deep Well	
Alegria	1,040	3,758	4,798	*		*	*	Existing Level III, Proposed LMAIAD
Bacuag	2,875	0	2,875	*		*	*	Existing WD
Basilisa (Rizal)	0	0	0		No Data	*	x	
Burgos	321	1,188	1,509	*		*	*	Existing Level III
Cagdianao	0	0	0	*		*	x	
Claver	0	5,161	5,161	*		*	x	
Dapa	1,389	6,962	8,351	*		x	x	Existing Level III, Proposed IWSSI
Del Carmen	65	3,264	3,329	*		*	*	Existing Level III, Proposed IWSSI
Dinagat	0	2,550	2,550	*	*	*	*	
General Luna	0	2,981	2,981	*	*	*	*	Proposed IWSSI
Gigaquit	2,445	1,193	3,638	*		*	*	Existing Level III
Libjo (Albor)	0	1,301	1,301	*		*	x	
Lorcto	499	4,553	5,052	*		*	*	Existing Level III
Mainit	1,698	3,373	5,071	*		*	*	Existing Level III, Proposed LMAIAD
Malimono	735	120	855	*		*	*	Existing Level III
Pilar	0	1,886	1,886	*		*	*	Proposed IWSS
Placer	4,900	7,189	12,089	*		*	*	Existing WD
San Benito	420	800	1,220	*		*	*	Existing Level III, Proposed IWSSI
San Francisco	1,603	1,888	3,491	*		*	*	Existing Level III
San Isidro	0	1,720	1,720	*		*	*	Proposed IWSS
San Jose	386	6,682	7,068	*		*	x	Existing Level III
Santa Monica	1,459	356	1,815	*		*	*	Existing Level III, Proposed IWSSI
Sison	85	1,227	1,312	*		*	*	Existing Level III, Proposed LMAIAD
Socorro	0	6,845	6,845		No Data	*	x	
Surigao City	45,180	22,601	67,781	*		*	*	Existing WD
Tagana-An	0	4,893	4,893	*	*	*	*	
Tubajon	0	708	708	*		*	x	
Tubod	1,526	0	1,526	*		*	*	Existing Level III, Proposed LMAIAD

Note: LMAIAD - Lake Mainit Integrated Area Development  
 IWSSI - Integrated Water System in Siargao Island  
 \* - Available, x - Not available.

With regard to deep well development, the groundwater productivity was assumed based on the study results of water sources in Chapter 7 and presented in Table 8.4.2.

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.



Table 8.4.2 Groundwater Productivity

Name of Municipality	Specific Capacity (liter/sec/m)	Well Depth (meter)	Groundwater Productivity per Deep Well (cu.m/16 Hr)
Alegria	9.00	30	455
Bacuag	0.83	50	478
Basilisa (Rizal)	Not Applicable (Difficult Area for Deep Well)		
Burgos	0.67	30	386
Cagdianao	Not Applicable (Difficult Area for Deep Well)		
Claver	Not Applicable (Difficult Area for Deep Well)		
Dapa	Not Applicable (Difficult Area for Deep Well)		
Del Carmen	0.61	30	351
Dinagat	2.01	30	1,158
General Luna	0.72	30	415
Gigaquit	0.60	50	346
Libjo (Albor)	Not Applicable (Difficult Area for Deep Well)		
Loreto	0.69	30	397
Mainit	0.73	70	420
Malimono	2.62	70	1,509
Pilar	0.24	30	138
Placer	0.99	30	570
San Benito	0.55	30	317
San Francisco (Anao-Aon)	0.78	30	499
San Isidro	0.55	30	317
San Jose	Not Applicable (Difficult Area for Deep Well)		
Santa Monica (Sapao)	0.67	30	386
Sison	0.46	50	265
Socorro	Not Applicable (Difficult Area for Deep Well)		
Surigao City (Capital)	0.78	30	449
Tagana-An	0.35	30	202
Tubajon	Not Applicable (Difficult Area for Deep Well)		
Tubod	1.30	50	749

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

Municipalities taken up in this PW4SP are generally scattered throughout the province, and therefore have less possibility of merging with neighboring municipalities in urban water supply. However, the municipalities of General Luna

and San Francisco have quite large scale untapped spring sources which enable the municipalities to construct wide-area system. In this regard, further study shall be made for some coastal municipalities.

In addition to the above, any rural barangay/s being served by the existing urban Level III system are considered to continue throughout the future.

c. Rehabilitation

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

4) Recommendations for future water supply development

The province has high potential for spring development and various untapped spring sources suitable for urban water supply were identified during the course of PW4SP preparation. However, further survey to evaluate appropriate development of spring sources is prerequisite in the course of feasibility study and detailed design. Among others, confirmation of possible/dependable yield throughout the year, elevation and distance from the potential service area as well as topographic conditions to allow gravity flow of supply is indispensable.

Further study on system merging shall be made for some coastal municipalities with reference to water source arrangements.

(2) Rural water supply

1) Service level

Level I systems are generally planned for rural areas where houses are scattered. In the PW4SP, public investment for Level I facilities covers 80% of the total number of required facilities, considering the existing share of population served between public (85%) and private facilities (15%).

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 8.4.3 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.

Spring development is also included in Level I planning adopting its share of 10%. This takes into account the existing percentage of developed springs (12%) among public Level I facilities as safe water sources.

**Table 8.4.3 Standard Specifications of Level I Wells**

Specification	Shallow Well	Deep Well
Construction Method	Open-hole drilling and gravel pack	
Casing Diameter	50 mm	100 mm
Borehole Diameter	150mm	200 mm
Ranges of Well Depth	Standard Depth	
0 - 20 m	20 m	N.A.
21 - 40 m	N.A.	30 m
41 - 60 m	N.A.	50 m
61 - 80 m	N.A.	70 m

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

The open-hole drilling method is employed for well construction to ensure yield of ground water from adequate aquifer in provision of proper screen location and speci-

fications. 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 the 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 20 m and around 40 m, depending on the aquifer conditions.

Although, Malawi type deep well pump with a cylinder, currently used in the Philippines, has operation experience up to 40 m 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 works for handpump and concrete apron are 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 standard FW4SP 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 mu-

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, thirty-four (34) untapped springs in eight (8) 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 exhibits the population to be served by target (details are referred to Supporting Report).

Through the Phase I development, approximately 96,500 persons in the province will be served by additional water supply services, of which 36,300 persons or 38% of the total will be urban population and 60,200 persons or 62% will be rural population.

In the Phase II period, a total of 194,200 persons, of which 150,500 persons or 77% in urban area and 43,700 persons or 23% in rural area, will be further benefited by water supply services. This additional service coverage in urban area includes upgrade of service level for 10,200 persons served by Level I and II facilities in 1997.

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	Level III	Level II	Level I	Level III	Level II	Level I	Level III	Level II	Level I	Level III	Level II	Level I	Level III	Level II	Level I	Total					
Alegria	Urban	5,816	1,040	1,500	2,258	4,798						6,423	6,102				6,102	5,062		5,062					
	Rural	7,616		5,585	889	6,474		4,352		4,352		8,410			5,585	2,256	8,211	1,347		1,347					
	Total	13,432	1,040	7,085	3,147	11,272		4,352		4,352		14,833	6,102		5,585	2,256	13,923	5,062		6,409					
Bacuaug	Urban	9,506	7,605			7,605		4,730		4,730		10,758	10,220				10,220	2,615		2,615					
	Rural	5,028		4,824		4,824		3,684		3,684		5,690			4,824	468	5,292			468					
	Total	14,534	7,605	4,824		12,429		4,730		4,730		16,448	10,220		4,824	468	15,512	2,615		468					
Basilisa (Rizal)	Urban	3,391	1,414		1,699	3,113		1,414		1,414		4,715	4,479				4,479	3,065		3,065					
	Rural	27,402		23,292		23,292		2,573		2,573		33,201	4,479		30,877		35,356	3,065		7,585					
	Total	31,293	1,414	24,991		26,405		1,414		1,414		37,916	4,479		30,877		38,366	6,130		10,650					
Burgos	Urban	2,450	772	1,188		1,960		451		451		2,712	2,576				2,576	1,804		1,804					
	Rural	739		270		358		628		628		817			270	490	760			132					
	Total	3,189	772	1,458		2,588		1,088		1,088		3,529	2,576		270	490	3,336	1,804		1,936					
Caggiano	Urban	5,458	4,366			4,366		4,366		4,366		5,728	5,470				5,470	1,104		1,104					
	Rural	6,528	544	1,945		3,060		3,060		3,060		6,886	544		1,945	3,915	6,404	855		855					
	Total	11,986	4,910	1,945		9,915		4,366		4,366		12,644	6,014		1,945	3,915	11,874	1,104		1,959					
Claver	Urban	8,485	1,627			5,161		6,788		6,788		9,384	8,915				8,915	7,288		7,288					
	Rural	7,877		431		6,264		6,695		6,695		8,711			431	7,670	8,101	1,406		1,406					
	Total	16,362	1,627	431		11,425		13,483		13,483		18,095	8,915		431	7,670	17,016	7,288		8,694					
Dapa	Urban	12,157	2,764			6,962		9,726		9,726		13,755	11,935				11,935	9,171		9,171					
	Rural	4,980		2,415		1,818		1,818		1,818		5,147			2,415	2,372	4,787			554					
	Total	17,137	2,764	2,415		8,780		13,959		13,959		17,210	11,935		2,415	2,372	16,722	9,171		9,725					
Del Carmen	Urban	3,783	65	3,255		9		3,329		3,329		4,162	3,954				3,954	3,889		3,889					
	Rural	10,208	300	2,475		5,902		8,677		8,677		11,230	300		2,475	7,669	10,444			1,767					
	Total	13,991	365	5,730		5,911		12,006		12,006		15,392	4,254		2,475	7,669	14,398	3,889		5,656					
Dinagat	Urban	2,670		2,515		35		2,550		2,550		2,795	2,655				2,655	2,655		2,655					
	Rural	6,466		5,959		4,575		10,534		10,534		6,768			5,959	4,575	10,534			2,655					
	Total	9,136		8,474		4,610		13,084		13,084		9,563	2,655		5,959	4,575	13,189	2,655		5,310					
General Luna	Urban	5,187	1,169			2,981		4,150		4,150		5,803	5,513				5,513	4,344		4,344					
	Rural	9,409		540		7,458		7,998		7,998		10,529			540	9,252	9,792			1,794					
	Total	14,596	1,169	540		10,439		12,148		12,148		16,332	5,513		540	9,252	15,305	4,344		6,138					
Gizaquit	Urban	7,465	4,779			1,193		5,972		5,972		8,445	8,023				8,023	3,244		3,244					
	Rural	10,547	3,100			5,865		8,965		8,965		11,932	3,100				3,100			2,132					
	Total	18,012	7,879			7,058		14,937		14,937		20,377	11,123				11,123	3,244		5,376					
Libjo (Albor)	Urban	3,433	1,911			835		2,746		2,746		3,808	3,618				3,618	1,707		1,707					
	Rural	13,714		3,427		8,230		11,657		11,657		15,209			3,427	10,717	14,144			2,487					
	Total	17,147	1,911	4,262		13,460		14,403		14,403		19,017	3,618		3,427	10,717	17,762	1,707		4,194					
Loreto	Urban	6,538	677	3,773		780		5,230		5,230		7,545	7,168				7,168	6,491		6,491					
	Rural	3,221		2,773		2,773		2,773		2,773		3,716			2,773	683	3,456			683					
	Total	9,759	677	6,546		8,003		8,003		8,003		11,261	7,168		2,773	683	10,624	6,491		7,174					
Maitim	Urban	10,936	2,102	3,373		3,274		8,749		8,749		11,806	11,216				11,216	9,114		9,114					
	Rural	13,175	5,297	1,179		4,723		11,199		11,199		14,233	5,297		1,179	6,751	13,227			2,028					
	Total	24,111	7,399	4,552		7,997		19,948		19,948		26,029	16,513		1,179	6,751	24,443	9,114		2,028					





## 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.

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 72,000. Additional households to be served totaled to 17,000, of which 51% is urban households and 49% is rural households. While at the end of Phase II period, the number of served households is 126,000 with an additional households to be served at 56,000. Table 8.5.2 provides the number of households to be served by target year for urban and rural areas by municipality.

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)									
		No. of Served Households					Total Household \$					No. of Served Households					Total Household \$				
		Flush	Pour Flush	VIP/Dry	Total	Total	Flush	Pour Flush	VIP/Dry	Total	Total	Flush	Pour Flush	VIP/Dry	Total	Total	Flush	Pour Flush	VIP/Dry	Total	
Alegria	Urban	986	111	553	74	740	111	117	158	74	185	1,606	747	673	74	1,494	636	118	754		
	Rural	1,400	892	158	1,050	1,117	117	158	275	543	3,843	2,103	1,733	158	3,893	843	961	1,597			
	Total	2,386	1,003	716	1,790	2,234	234	275	433	1,086	7,686	4,206	3,466	331	7,737	1,480	1,962	2,594			
	Urban	1,701	191	957	128	1,276	191	128	319	128	319	2,690	1,251	1,123	128	3,941	1,060	166	1,226		
Bacuag	Rural	819	522	322	614	1,890	191	59	52	220	411	4,113	1,251	2,312	220	3,783	1,060	323	1,893		
	Total	2,520	1,911	1,479	229	1,890	191	78	59	52	389	1,179	548	496	52	1,096	470	109	579		
	Urban	690	78	387	52	517	78	59	52	342	899	8,300	6,913	557	7,470	3,760	3,760				
	Total	4,946	78	3,540	609	4,227	78	401	609	1,088	9,479	5,666	470	609	3,869	470	3,869				
Basilisa (Rizal)	Urban	507	57	265	38	380	57	38	38	277	38	678	316	277	38	631	259	81	259		
	Rural	137	88	88	15	103	57	53	53	113	18	204	316	446	53	815	259	81	340		
	Total	644	145	353	53	483	114	111	91	126	301	2,108	632	723	91	1,450	518	132	480		
	Urban	1,118	126	629	84	839	126	98	84	308	144	1,722	310	1,096	144	1,550	310	278	588		
Cagdianao	Rural	1,383	818	144	962	1,801	126	98	228	452	3,162	980	1,681	228	2,389	854	278	1,132			
	Total	2,401	126	1,447	228	1,801	126	98	228	452	3,162	980	1,681	228	2,389	854	278	1,132			
	Urban	1,687	1,234	177	1,177	2,079	279	279	297	576	4,428	1,461	2,321	297	4,079	1,182	420	1,091			
	Total	1,569	1,000	177	1,177	2,079	279	279	297	576	4,428	1,461	2,321	297	4,079	1,182	420	1,091			
Claver	Urban	3,256	279	1,396	186	1,861	279	111	111	111	111	1,287	1,047	111	1,158	1,182	420	1,091			
	Rural	2,481	627	1,111	738	1,861	279	111	111	111	1,287	1,047	111	1,158	1,182	420	1,091				
	Total	5,737	906	2,507	924	3,722	558	290	290	290	290	2,574	2,114	290	2,404	2,364	840	2,181			
	Urban	1,963	279	1,251	221	1,472	279	384	221	605	2,808	300	2,006	221	2,527	300	755	1,055			
Dapa	Rural	2,702	1,832	286	2,118	2,118	384	286	670	3,849	794	2,425	286	3,849	794	2,425	286	3,849			
	Total	3,465	279	2,023	297	2,599	279	41	55	699	325	284	41	699	325	284	41	699			
	Urban	739	581	65	646	646	65	65	65	65	1,041	484	419	65	968	484	484	484			
	Total	1,963	1,251	221	1,472	1,472	384	221	605	2,808	300	2,006	221	2,527	300	755	1,055	1,055			
Del Carmen	Urban	547	369	41	410	947	14	14	14	14	14	1,692	325	284	41	699	325	284			
	Rural	1,810	1,174	805	142	947	26	26	142	168	1,381	142	142	142	1,523	576	576	576			
	Total	1,029	116	579	77	772	116	77	77	193	1,451	675	597	77	1,349	559	18	577			
	Urban	1,742	1,111	196	1,307	2,079	116	49	196	245	2,632	1,692	2,173	196	2,369	1,062	1,062	1,062			
Dinagat	Rural	2,771	116	1,090	273	2,079	116	49	273	438	4,083	675	2,770	273	3,718	559	1,080	1,639			
	Total	1,377	155	775	103	1,033	155	103	258	2,111	982	878	103	1,963	827	103	910	910			
	Urban	1,932	155	207	217	1,449	217	217	217	217	2,993	537	1,931	217	2,683	537	699	1,226			
	Total	3,309	155	2,007	320	2,482	155	320	475	5,094	1,519	2,809	320	4,648	1,364	302	2,166	2,166			
General Luna	Urban	668	520	58	578	578	58	58	58	58	952	443	384	58	885	443	443	443			
	Rural	2,573	1,640	290	1,930	1,930	381	290	671	3,802	671	3,132	290	3,422	290	3,422	290	3,422			
	Total	3,241	2,160	348	2,508	2,508	381	348	348	729	4,754	443	3,516	348	4,307	443	1,492	1,935			
	Urban	1,388	156	781	104	1,041	156	104	260	260	1,886	877	73	104	1,784	721	721	721			
Gigaquit	Rural	656	418	74	492	492	74	74	74	74	929	74	74	74	836	344	344	344			
	Total	2,044	156	1,199	178	1,333	156	196	178	530	2,815	877	1,535	178	2,590	721	344	1,065			
	Urban	2,098	236	1,178	157	1,371	236	157	393	2,952	1,373	1,215	157	2,745	1,137	37	1,174	1,174			
	Total	2,435	236	1,576	278	1,854	236	278	278	640	3,556	640	2,282	278	3,200	640	706	1,346			
Maimit	Urban	4,530	236	2,754	435	3,425	236	435	671	6,508	2,013	3,497	435	5,945	3,777	743	2,510	2,510			
	Rural																				
	Total																				
	Urban																				

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)										
		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	
Malimono	Urban	1,342	151	755	101	1,007	151	3	101	255	1,706	794	692	101	1,587	643	643	643
	Rural	1,414	151	966	171	1,137	151	3	171	171	1,859	1,302	1,302	171	1,673	536	536	536
	Total	2,756	302	1,721	272	2,144	302	6	272	426	3,565	2,096	2,096	342	3,260	1,179	1,179	1,179
Pilar	Urban	486	350	359	39	389	39	77	39	695	695	323	284	39	646	323	323	323
	Rural	1,227	782	138	920	920	77	138	215	1,905	1,577	1,577	138	1,715	795	795	795	
	Total	1,713	1,132	1,777	1,309	2,072	207	207	207	4,180	4,180	1,944	1,944	207	3,887	1,944	1,944	1,944
Placer	Urban	2,063	1,315	232	1,547	1,547	140	232	372	2,914	2,914	525	1,866	232	2,623	525	525	525
	Rural	4,770	3,180	439	3,619	3,619	140	439	579	7,094	7,094	2,469	3,602	439	6,510	2,469	2,469	
	Total	6,833	4,495	671	5,166	5,166	280	671	951	10,008	10,008	2,994	5,266	878	9,133	4,994	4,994	
San Benito	Urban	510	326	57	383	383	168	57	225	738	607	607	57	664	281	281	281	
	Rural	935	662	94	756	756	188	94	262	1,390	1,390	303	873	94	1,270	303	303	
	Total	1,445	988	151	1,139	1,139	356	151	487	2,128	2,128	910	1,481	151	1,632	584	584	
San Francisco (Anao-Aon)	Urban	914	103	514	69	686	103	69	172	1,231	1,231	573	503	69	1,145	470	470	
	Rural	1,336	852	150	1,002	1,002	150	150	150	1,922	1,922	346	1,234	150	1,730	346	346	
	Total	2,250	1,033	2,064	219	1,688	1,688	303	322	3,153	3,153	919	1,737	219	2,875	816	816	
San Isidro	Urban	354	271	30	301	301	136	30	30	572	572	266	236	30	532	266	266	
	Rural	829	529	93	622	622	156	93	249	1,344	1,344	366	1,353	93	1,210	588	588	
	Total	1,183	800	123	923	923	292	123	279	1,916	1,916	632	1,747	123	1,742	266	266	
San Jose	Urban	1,994	1,272	224	1,496	1,496	94	224	318	3,099	3,099	2,484	2,484	324	2,708	1,212	1,212	
	Rural	4,947	332	2,933	446	3,711	332	446	872	7,172	7,172	1,936	4,198	446	6,580	1,604	1,604	
	Total	6,941	464	5,167	670	5,837	670	670	1,190	10,271	10,271	4,422	6,682	870	8,162	2,816	2,816	
Santa Monica (Sapao)	Urban	1,042	41	872	117	782	141	117	226	1,623	1,623	90	2,584	117	1,461	90	90	
	Rural	1,410	41	1,058	41	1,058	141	41	145	3,271	3,271	336	1,471	145	1,952	295	295	
	Total	2,452	82	1,930	158	1,870	282	158	371	4,894	4,894	426	3,055	262	3,317	585	585	
Sison	Urban	624	486	54	540	540	143	54	54	892	892	415	361	54	830	415	415	
	Rural	1,273	812	1,298	197	1,495	197	197	197	2,824	2,824	763	1,609	197	2,569	763	763	
	Total	1,897	1,294	1,842	394	1,842	394	394	394	3,716	3,716	1,178	2,170	394	3,364	1,178	1,178	
Socorro	Urban	1,536	1,171	130	1,301	1,301	123	130	304	2,460	2,460	1,153	1,153	304	4,621	1,153	1,153	
	Rural	1,545	985	174	1,159	1,159	123	174	297	2,573	2,573	2,142	174	2,316	1,157	1,157		
	Total	3,081	2,156	304	2,460	2,460	246	304	427	5,033	5,033	3,295	3,327	601	6,347	2,310	2,310	
Surigao City (Capital)	Urban	14,941	1,681	8,404	1,121	11,206	2,787	1,121	3,908	21,412	21,412	9,957	8,835	1,121	19,913	8,276	431	
	Rural	8,047	5,130	905	6,035	6,035	905	905	905	11,378	11,378	500	8,835	905	10,240	500	500	
	Total	22,988	6,811	9,309	2,026	17,241	17,241	2,787	2,026	4,813	32,790	10,457	17,670	2,026	30,153	8,276	4,265	
Tagana-An	Urban	1,217	944	94	938	938	94	94	29	1,715	1,715	798	703	94	1,595	798	798	
	Rural	1,444	921	162	1,083	1,083	162	162	162	2,075	2,075	1,706	1,706	162	1,868	785	785	
	Total	2,661	1,765	256	2,021	2,021	256	256	256	3,790	3,790	2,498	2,498	256	3,463	798	798	
Tubajon	Urban	446	358	40	398	398	40	40	40	600	600	279	239	40	558	279	279	
	Rural	976	622	110	732	732	200	110	310	1,408	1,408	279	1,157	110	1,267	535	535	
	Total	1,422	980	150	1,130	1,130	200	150	350	2,008	2,008	279	1,396	150	1,825	279	279	
Tubod	Urban	304	258	29	287	287	29	29	29	405	405	189	159	29	377	189	189	
	Rural	1,795	1,144	202	1,346	1,346	202	202	202	2,352	2,352	423	1,492	202	2,117	423	423	
	Total	2,099	1,402	231	1,633	1,633	231	231	231	2,757	2,757	612	1,651	231	2,494	612	612	
Provincial Total	Urban	45,629	3,813	27,706	3,505	35,024	2,132	2,993	3,505	8,630	8,630	30,419	26,899	3,505	60,823	26,606	1,945	
	Rural	49,197	31,454	5,550	37,004	37,004	2,602	5,550	8,152	72,651	72,651	4,019	55,820	5,550	65,389	4,019	24,366	
	Total	94,826	3,813	59,160	9,055	72,028	72,028	2,132	9,055	16,782	138,033	34,438	82,719	9,055	126,212	30,625	25,411	

(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 96,000. The additional students to be served are 29,000. While at the end of Phase II period, the projected number of served students is 110,000 with an additional students to be served at 13,400. Table 8.5.3 summarizes the number of public school students to be served by target year.

(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.

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

Name of Municipality	Phase I Coverage (2003)			Phase II Coverage (2010)		
	Total No. of Public School Students	Std. No. of Public School Students to be Served	Add'l. No. of Public School Students to be Served	Total No. of Public School Students	Std. No. of Public School Students to be Served	Add'l. No. of Public School Students to be Served
Alegria	3,508	2,982	1,942	3,749	3,374	392
Bacuag	2,421	2,058		2,695	2,428	370
Basilisa (Rizal)	5,392	4,583	1,583	7,036	6,332	1,749
Burgos	935	795	555	983	885	90
Cagdianao	2,862	2,433		2,868	2,581	148
Claver	4,149	3,527		4,489	4,040	513
Dapa	4,858	4,129	3,649	4,769	4,292	163
Del Carmen	2,364	2,009		2,965	2,669	660
Dinagat	2,503	2,128	1,248	2,489	2,240	112
General Luna	3,528	2,999	1,079	4,143	3,729	730
Gigaquit	3,418	2,905		4,040	3,636	731
Libjo (Albor)	3,910	3,324	2,804	4,495	4,046	722
Loreto	1,673	1,422		1,839	1,655	233
Mainit	6,151	5,228	2,188	6,106	5,495	267
Malimono	3,949	3,357	1,677	4,048	3,643	286
Pilar	1,752	1,489	529	2,110	1,899	410
Placer	5,610	4,769		6,341	5,707	938
San Benito	1,499	1,274		1,560	1,404	130
San Francisco (Arao-Aon)	2,799	2,379		2,919	2,627	248
San Isidro	1,784	1,516		2,056	1,850	334
San Jose						
Santa Monica (Sapao)	1,479	1,257	617	1,666	1,499	242
Sison	2,567	2,182	342	3,110	2,799	617
Secorro	4,382	3,725	1,085	5,066	4,559	834
Surigao City (Capital)	32,264	27,424	6,704	31,950	28,755	1,331
Tagana-An	3,038	2,582	1,542	3,548	3,193	611
Tubajon	1,920	1,632	312	2,043	1,839	207
Tubod	2,472	2,101	1,141	2,728	2,455	354
<b>Provincial Total</b>	<b>113,187</b>	<b>96,209</b>	<b>28,997</b>	<b>121,814</b>	<b>109,631</b>	<b>13,422</b>

The number of served public utilities at the end of Phase I period is 99. The additional public utilities to be served are 21. While at the end of Phase II period, the number of served public utilities is 108 with an additional public utilities to be served at 9. Table 8.5.4 summarizes the additional number of public utilities to be served by municipality by target year.

### 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

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

Name of Municipality	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
Alegria	Public Market		1		1
	Bus/Jeepney Terminal	1	1		1
	Parks/Playground			1	1
	<b>Total</b>	1	2	1	3
Bacuag	Public Market		2		2
	Bus/Jeepney Terminal	1	1		1
	Parks/Playground			1	1
	<b>Total</b>	1	3	1	4
Basilisa (Rizal)	Public Market		1		1
	Bus/Jeepney Terminal				
	Parks/Playground	1	1		1
	<b>Total</b>	1	2		2
Burgos	Public Market		1		1
	Bus/Jeepney Terminal				
	Parks/Playground		2		2
	<b>Total</b>		3		3
Cagdianao	Public Market		1		1
	Bus/Jeepney Terminal				
	Parks/Playground	1	1		1
	<b>Total</b>	1	2		2
Claver	Public Market		1		1
	Bus/Jeepney Terminal	1	2		2
	Parks/Playground		1		1
	<b>Total</b>	1	4		4
Dapa	Public Market		2		2
	Bus/Jeepney Terminal		2		2
	Parks/Playground		1		1
	<b>Total</b>		5		5
Del Carmen	Public Market		1		1
	Bus/Jeepney Terminal				
	Parks/Playground	1	1		1
	<b>Total</b>	1	2		2
Dinagat	Public Market		1	1	2
	Bus/Jeepney Terminal				
	Parks/Playground		4		4
	<b>Total</b>		5	1	6
General Luna	Public Market	1	1		1
	Bus/Jeepney Terminal				
	Parks/Playground	1	1		1
	<b>Total</b>	2	2		2
Gigaquit	Public Market		1		1
	Bus/Jeepney Terminal	1	1		1
	Parks/Playground		3		3
	<b>Total</b>	1	5		5
Libjo (Albor)	Public Market	1	1		1
	Bus/Jeepney Terminal				
	Parks/Playground		5		5
	<b>Total</b>	1	6		6
Loreto	Public Market		1		1
	Bus/Jeepney Terminal				
	Parks/Playground	1	3		3
	<b>Total</b>	1	4		4
Mainit	Public Market		1	1	2
	Bus/Jeepney Terminal		3		3
	Parks/Playground	1	1		1
	<b>Total</b>	1	5	1	6
Malimono	Public Market		1		1
	Bus/Jeepney Terminal		1		1
	Parks/Playground	1	7		7
	<b>Total</b>	1	9		9

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

Name of Municipality	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
Pilar	Public Market		1		1
	Bus/Jeepney Terminal				
	Parks/Playground		1		1
	Total		2		2
Placer	Public Market		1		1
	Bus/Jeepney Terminal		2		2
	Parks/Playground	1	1	1	2
	Total	1	4	1	5
San Benito	Public Market		1		1
	Bus/Jeepney Terminal		1		1
	Parks/Playground		1		1
	Total		3		3
San Francisco (Anao-Aon)	Public Market		1		1
	Bus/Jeepney Terminal	1	1		1
	Parks/Playground			1	1
	Total	1	2	1	3
San Isidro	Public Market		1		1
	Bus/Jeepney Terminal				
	Parks/Playground	1	1		1
	Total	1	2		2
San Jose	Public Market		2		2
	Bus/Jeepney Terminal				
	Parks/Playground		2		2
	Total		4		4
Santa Monica (Sapao)	Public Market		1		1
	Bus/Jeepney Terminal	1	1		1
	Parks/Playground				
	Total	1	2		2
Sison	Public Market		1		1
	Bus/Jeepney Terminal	1	1		1
	Parks/Playground			1	1
	Total	1	2	1	3
Socorro	Public Market		2		2
	Bus/Jeepney Terminal				
	Parks/Playground		1		1
	Total		3		3
Surigao City (Capital)	Public Market		6		6
	Bus/Jeepney Terminal		2		2
	Parks/Playground		2		2
	Total		10		10
Tagara-An	Public Market		1		1
	Bus/Jeepney Terminal	1	1		1
	Parks/Playground			1	1
	Total	1	2	1	3
Tubajon	Public Market		1		1
	Bus/Jeepney Terminal				
	Parks/Playground	1	1		1
	Total	1	2		2
Tubod	Public Market		1		1
	Bus/Jeepney Terminal	1	1		1
	Parks/Playground			1	1
	Total	1	2	1	3
Provincial Total	Public Market	2	37	2	39
	Bus/Jeepney Terminal	9	21		21
	Parks/Playground	10	41	7	48
	Total	21	99	9	108



the population in the area/s is to be served by the sewerage systems. Table 8.5.5 shows the population to be served in Phase II.

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

Name of Municipality	Urban Population in 2010	Level III Water Supply Coverage	Population to be Served
Bacuag	10,758	10,220	5,379
Dapa	12,563	11,935	6,282
Mainit	11,806	11,216	5,903
Placer	16,721	15,885	8,361
San Jose	16,652	15,819	8,326
Surigao City (Capital)	85,649	81,367	42,825
<b>Provincial Total</b>	<b>261,594</b>	<b>248,516</b>	<b>77,076</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 60% with reference to the present service coverage of 40% 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.

### 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 are 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. Number of water sources was also estimated based on the water source evaluation results in Chapter 7.

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

Name of Municipality	No. of Urban Households Served in the Base Year	Phase I Coverage (2003)		
		No. of Urban Households	Urban Households Coverage	Add'l. No. of Urban Households to be Served
Alegria		892	803	803
Bacuag	943	1,502	1,352	409
Basilisa (Rizal)	1,566	568	1,566	
Burgos		458	413	413
Cagdianao	1,137	1,060	1,137	
Claver	1,382	1,524	1,382	
Dapa	20	2,400	2,160	2,140
Del Carmen		671	604	604
Dinagat		523	471	471
General Luna	810	919	828	18
Gigaquit		1,217	1,096	1,096
Libjo (Albor)	510	602	542	32
Loreto		1,202	1,082	1,082
Mainit	611	1,940	1,746	1,135
Malimono	170	1,337	1,204	1,034
Pilar	120	441	397	277
Placer	883	2,366	2,130	1,247
San Benito		388	350	350
San Francisco (Anao-Aon)	1,018	827	1,018	
San Isidro		314	283	283
San Jose	1,817	2,895	2,606	789
Santa Monica (Sapao)	1,307	341	1,307	
Sison	560	562	560	
Socorro		1,359	1,224	1,224
Surigao City (Capital)	20,499	13,571	20,499	
Tagana-An		1,106	996	996
Tubajon	338	398	359	21
Tubod		295	266	266
<b>Provincial Total</b>	<b>33,691</b>	<b>41,678</b>	<b>48,381</b>	<b>14,690</b>

Table 8.6.1 Water Supply Facilities Required by Target Year

Name of Municipality	Phase I (2003) Requirements										Phase I (2010) Requirements										
	Urban Water Supply (Level III)					Rural Water Supply					Urban WS (Level III)					Rural Water Supply					
	Mode of Project	No. of Add'l. Deep Wells	No. of HHS Connection	No. of System	No. of Communal Faucets	Level I			Total No. of Wells	No. of Add'l. Deep Wells	No. of HHS Connection	Level I			Total No. of Wells	No. of Add'l. Deep Wells	No. of HHS Connection	Level I			
						30 m	50 m	70 m				30 m	50 m	70 m				30 m	50 m	70 m	
Alegria	N/A			8	160													10	10	13	23
Bacrag	Expansion	1	856	6	120													2	2	6	8
Basilisa (Rizal)	New	1	250					31	31											127	127
Burgos	Expansion	1	93					1	1											3	3
Cagdianao	Expansion	1	895					40	40											15	15
Claver	New	1	323					2	2											2	2
Dapa	Expansion	1	281					20	20											8	8
Del Carmen	N/A			1	20			9	31									21	21	9	30
Dinagat	N/A			9	180															664	
General Luna	New	1	232					5	7									12	12	18	30
Gigaquit	Expansion	1	431					6	20									8	8	28	36
Libjo (Alibor)	New	1	372					2	2											2	2
Lereto	Expansion	1	77															12	12	12	12
Maimit	Expansion	1	905					12	11									17	17	17	34
Malimono	Expansion	1	25																		
Pilar	New	1	25					21	9									15	15	6	21
Placer	N/A								21												
San Benito	Expansion	1	123					14	21									3	3	37	37
San Francisco (Anao)	Expansion	1	15					8	22									5	5	3	8
San Isidro	N/A			6	120													11	11	10	21
San Jose	Expansion	2	1,505															2	2	14	16
Santa Monica (Sapao)	N/A								84											20	20
Sison	Expansion	1	245					14	14									1	1	16	16
Socorro	New	1	32						27											19	20
Sungao City (Capital)	N/A							16	23									48	48	72	120
Tagana-An	New	1	19					2	7									4	4	4	22
Tubajon	New	1	209						8											3	17
Tubod	N/A																			3	
<b>Provincial Total</b>	<b>Exp.-12 New S</b>	<b>21</b>	<b>6,916</b>	<b>34</b>	<b>680</b>	<b>80</b>	<b>6</b>	<b>12</b>	<b>98</b>	<b>344</b>	<b>442</b>	<b>37</b>	<b>37,625</b>	<b>140</b>	<b>11</b>	<b>17</b>	<b>168</b>	<b>511</b>	<b>679</b>		

Rural water supply:

Physical requirements of Level II systems are estimated as the number of systems and number of communal faucets, while that of Level I wells are estimated as the number of wells with classification of deep and shallow wells. Deep wells are 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, 80% of the total required facilities will be implemented by public (I.GUs) and 10% of these public Level I facilities will be allocated to spring development.

(2) Rehabilitation

Rehabilitation requirements are estimated as 10% of the total number of deep wells to be constructed under PW4SP. Rehabilitation work is mainly redevelopment of wells by means of air surging, while minor repair of concrete apron and handpump was considered to 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- water testing kit, 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 the Phase I period, a total of 71 Level I deep wells shall be newly constructed and 10% of these deep wells shall be rehabilitated annually. Although there are huge requirements, only one manual type percussion drilling rig is available at DPWII-DEO in

the province, while 2 units of air compressor for well rehabilitation equipment is available at the provincial government.

Therefore, a total of 1 set of drilling rigs (medium size percussion type) together with 1 set of well rehabilitation equipment, 1 unit of support vehicles for well rehabilitation and 1 unit of service trucks for deep well construction shall be mobilized/procured either by 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 comparing with percussion type. The drilling speed of the percussion type is rather slow, but has advantages in drilling boulder and cobbles 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, a new laboratory facility in Dapa to cover the island municipalities of General Luna, Pilar, Burgos, Sta. Monica, San Isidro, San Benito, Del Carmen, Socorro and also Dapa will be provided because of the difficulty of transporting the water samples to Surigao City. Water samples have to be examined on time to avoid unpredictable changes of the quality due to long storage. The new building will have a floor area of 57m<sup>2</sup> to house an examining laboratory, an office space, a storage room and a toilet. Water and power supplies will be provided.

### Instrument/Equipment and Other Laboratory Accessory:

Two (2) sets of instrument/equipment will be necessary to undertake regular water quality monitoring and surveillance activities. The distribution would be: 1 set for the upgrading of the existing provincial laboratory, and the other set to the new laboratory. The new laboratory will also be provided with laboratory accessories such as sink, working table, etc. The following are the requirements:

<u>Item</u>	<u>Unit</u>	<u>Upgrading of</u>	
		<u>Existing Laboratory</u>	<u>New Laboratory</u>
1. Instrument/Equipment			
Turbidity meter	set	1	1
Color meter	set	1	1
pH/Residual chlorine checker	set	1	1
Incubator	set	x	1
Refrigerator	set	1	1
Sterilizer	set	x	1
Portable water quality testing kit	set	1	1
Electric stove	set	1	1
Range hood	set	1	1
2. Glassware/Chemical	set	1	1
3. Accessory			
Sink	set	x	1
Working table	set	x	1
Shelf	set	x	1
Office desk	set	x	1
Chair	set	x	1

### 8.6.2 Sanitation

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

#### (1) Household toilets

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

Table 8.6.2 Sanitation Facilities Required by Target Year

Name of Municipality	Phase I (2023) Requirements										Phase II (2019) Requirements														
	Urban Sanitation					Rural Sanitation					Urban Sanitation					Rural Sanitation									
	No. of Households		No. of Public Toilets		No. of Public Sch. Toilets	No. of Households		No. of Public Toilets		No. of Public Sch. Toilets	No. of Households		No. of Public Toilets		No. of Public Sch. Toilets	No. of Households		No. of Public Toilets		No. of Public Sch. Toilets					
	Pour Flush	VIP/ Dry	Total	Public Market	Bus/ Jeepney Terminal	Park/ Playground	Flush	Pour Flush	VIP/ Dry	Total	Public Market	Bus/ Jeepney Terminal	Park/ Playground	Flush	Pour Flush	VIP/ Dry	Total	Public Market	Bus/ Jeepney Terminal	Park/ Playground	Flush	Pour Flush	VIP/ Dry	Total	
Ateneña	111	74	185	4	1	1	117	158	275	6	636	118	754	1	843	843	843	1							
Ducog	191	128	319	1	1	1	1,060	166	1,226	1	667	667	667	1	667	667	667	1							
Rasilisa (Rizal)	78	59	137	1	1	1	342	537	899	7	470	109	579	1	3,760	3,760	3,760	1							
Burgos	57	34	91	2	1	1	3	15	18	1	259	259	259	1	81	81	81	1							
Cardianno	126	94	220	1	1	1	37	144	181	1	544	544	544	1	310	278	588	1							
Chavez	279	137	416	13	1	1	37	177	214	1	1,091	1,091	1,091	1	783	783	783	1							
Dapa	65	65	130	1	1	1	384	221	605	5	1,182	1,182	1,182	1	420	420	420	1							
Del Carmen	14	41	55	2	1	1	26	142	168	4	355	355	355	1	500	755	1,055	2							
Dingat	116	77	193	2	1	1	49	166	245	3	559	18	577	1	576	576	576	1							
General Luna	158	103	261	1	1	1	217	217	434	2	970	101	1,071	1	1,062	1,062	1,062	1							
Gugugui	58	58	116	3	1	1	381	290	671	11	443	443	443	1	1,692	1,692	1,692	1							
Libio (Albay)	104	260	364	1	1	1	196	74	270	1	721	721	721	1	344	344	344	1							
Lopez	236	157	393	5	1	1	278	278	556	6	1,137	371	1,508	1	640	706	1,346	1							
Maitim	151	101	252	4	1	1	171	171	342	4	643	643	643	1	536	536	536	1							
Pilar	39	39	78	1	1	1	77	138	215	2	323	323	323	1	795	795	795	1							
Malimono	207	207	414	1	1	1	140	232	372	2	1,944	1,944	1,944	3	525	551	1,076	2							
Placer	37	37	74	1	1	1	168	57	225	1	303	303	303	1	281	281	281	1							
San Benito	69	172	241	1	1	1	150	150	300	1	470	470	470	1	346	380	726	1							
San Francisco (Aklan-Avon)	30	30	60	1	1	1	156	91	247	1	266	266	266	1	568	568	568	1							
San Isidro	222	554	776	1	1	1	94	224	318	1	1,604	53	1,657	1	1,212	1,212	1,212	1							
San Jose	32	28	60	1	1	1	109	117	226	2	205	10	215	1	90	589	679	1							
Santa Monica (Sipoc)	54	54	108	1	1	1	123	174	297	2	415	415	415	1	348	436	784	1							
Sison	130	130	260	3	1	1	905	905	1,810	12	5,207	431	5,638	2	1,557	1,557	1,557	1							
Sucre	2,287	1,121	3,408	22	1	1	162	162	324	5	798	798	798	1	785	785	785	1							
Surigao City (Capital)	94	94	188	3	1	1	200	110	310	2	279	279	279	1	555	555	555	1							
Tigana-An	40	40	80	1	1	1	202	202	404	5	189	189	189	1	473	348	771	1							
Tubigon	20	20	40	1	1	1	2,602	5,550	8,152	78	26,006	1,045	27,051	25	4,019	24,366	28,385	44							
Provincial Total	2,132	2,993	5,125	68	22	22	2,602	5,550	8,152	78	26,006	1,045	27,051	25	4,019	24,366	28,385	44							

## (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/jeepony 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. Ten (10) additional units of truck are required to meet assumed service coverage as reflected in Table 8.6.3.

### **8.7 Identification of Priority Projects for Medium-Term Development Plan**

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

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

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



Table 8.6.3 Number of Refuse Collection Trucks Required in Phase I

Name of Municipality	Add'l. Urban Households to be Served	Estimated Daily Amount of Refuse to be Generated, (Kg)	Number of Collection Truck Required
Alegria	803	336	1
Bacuag	409	171	1
Basilisa (Rizal)			
Burgos	413	173	1
Cagdianao			
Claver			
Dapa	2,140	895	1
Del Camen	604	253	1
Dinagat	471	197	1
General Luna	18	8	1
Gigaquit	1,096	459	1
Libjo (Albor)	32	14	1
Loreto	1,082	453	1
Mainit	1,135	475	1
Malimono	1,034	433	1
Pilar	277	116	1
Placer	1,247	522	1
San Benito	350	147	1
San Francisco (Año-Año)			
San Isidro	283	119	1
San Jose	789	330	1
Santa Monica (Sapao)			
Sison			
Socorro	1,224	512	1
Surigao City (Capital)			
Tagana-An	996	417	1
Tubajon	21	9	1
Tubod	266	112	1
<b>Provincial Total</b>	<b>14,690</b>	<b>6,151</b>	<b>21</b>

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

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

