CAGAYAN DE ORO CITY WATER DISTRICT

WATER SAFETY PLAN MANUAL

BOARD OF DIRECTORS
APPROVED
RES. NO. 110 s-14
DATED: 10/2/14
Cagayan de Oro City Water District

By:

EDWARD P. TESORO
Chairman

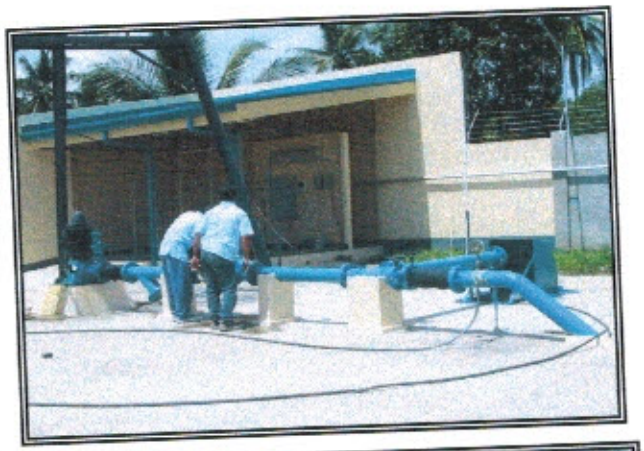
Members:

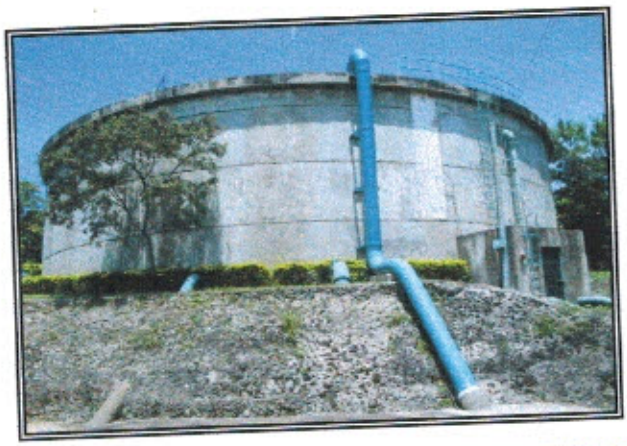
ALEX ABANGAN
DANILO O. DAROY
FARAH GAMBOA
EDNA S. NAJEAL
EDGARDO TUVILLA
ANTONIO B. YOUNG

BIENVENIDO V. BATAR, JR.
Advisor/Consultant

June 30, 2014

WATER SAFETY PLAN





MANAGING DRINKING WATER QUALITY FROM SOURCE TO CONSUMER

COWD WSP Flowchart:

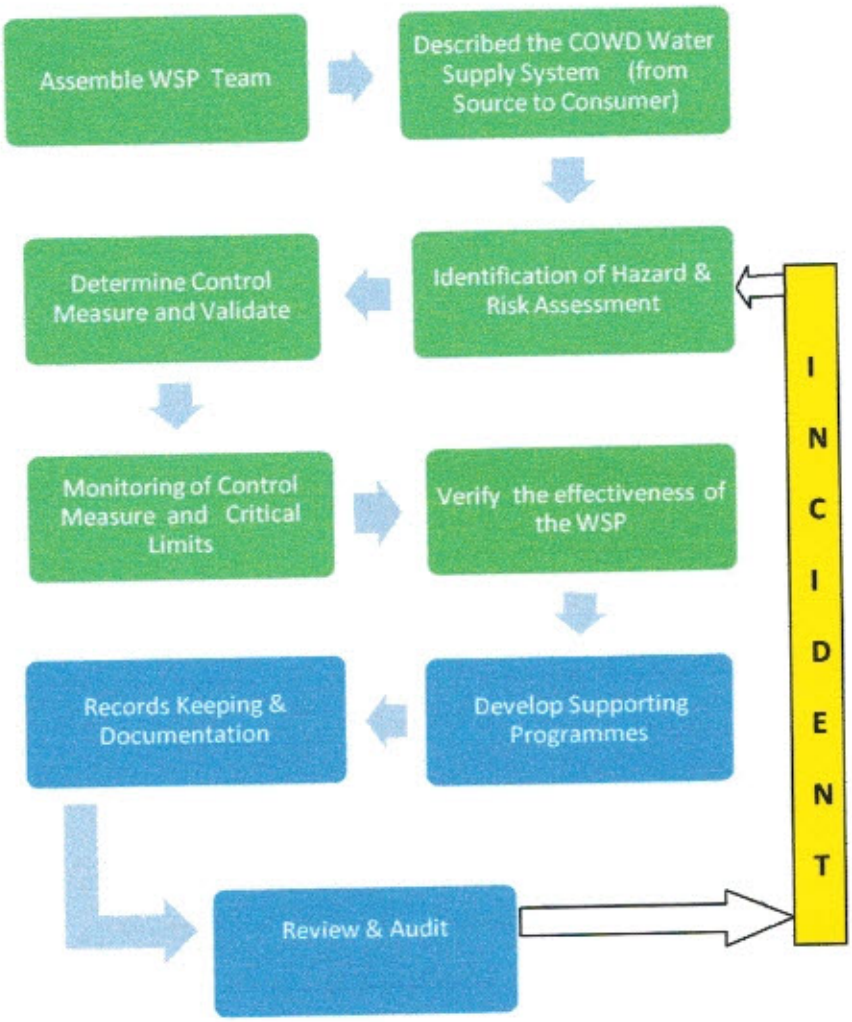


Table of Contents

Mission

To be an Outstanding Water District in the Country.

Vision

We Provide excellent water service to the community we serve.

Values

We demand Accountability in all our decision.

We are Result driven.

We work as a Team at all times.

We have faith in One Almighty.

I. INTRODUCTION

EXECUTIVE SUMMARY:

On August 1, 1973 Cagayan de Oro City Water District was created thru PD No. 198. The 1st Water District formed nationwide with CCC No. 001 dated Jan 4, 1974.

As of December 2013, it has a total of 83,016 service connections serving the *population of 581,112* (considering 7 person/household.) with service area of 48,885.83 person/ha.

Its source comes mainly from ground sources (deep wells) 70% including spring source and 30% from surface water. COWD has *28 Production Wells* (see attached table,) out of the 28 only 26 is presently operational, from the production wells it goes to the booster pumping station. Currently COWD has 4 booster pumping Stations . 2 in Macasandig, 1 in Bugo and the Balulang area.

Macasandig has 6 booster pumping facilities with a total production of *3,248 GPM*, Balulang has 6 with a discharge *of 4,926 GPM*; Bugo has 3 pumping facilities with *1,685* GPM and the Bulk Water Supplier. The average monthly production is *at 4,132,048 cu.m. and 1,231,708 cu.m.* from the Bulk Water with an average monthly Production efficiency of 88.80%

The District has *served* 562,056 linear meters of pipelines ranging from 50mmØ to 800 mmØ and *maintained* around 543,817 linear meters of pipelines with the balance still not turned-over by some subdivision developers/owners.

COWD has regularly monitored the *residual chlorine* in various strategic points of its water supply system. Maintained its established safety programs and standard operating procedure. And now on the process of developing the water safety plan for us to deliver quality drinking water to our consumer.

Being considered as the Godfather Water District, COWD has continued extending technical and financial assistance to its neighboring water districts. Also, it has continued extending free technical assistance and services to subdivisions and rural barangays.

COWD also appropriated enough funds to support its public relations program and has extensively used the print and broadcast media for disseminating information on drives, projects and emergencies. The District has also continued its information drive and seminars for its would-be concessionaires

SERVICE AREA

Cagayan de Oro City is located along the Central Coast of Northern Mindanao island facing the Macajalar Bay and is bordered by the municipalities of Opol to the west, Tagoloan to the east and provinces of Bukidnon and Lanao del Norte to the south of the city. It has an estimated population of *602,088* based on 2010 NSO Census. Land area *of 57,851 Ha.* representing *15.90%* of Misamis Oriental (3,570.10 Km2.)

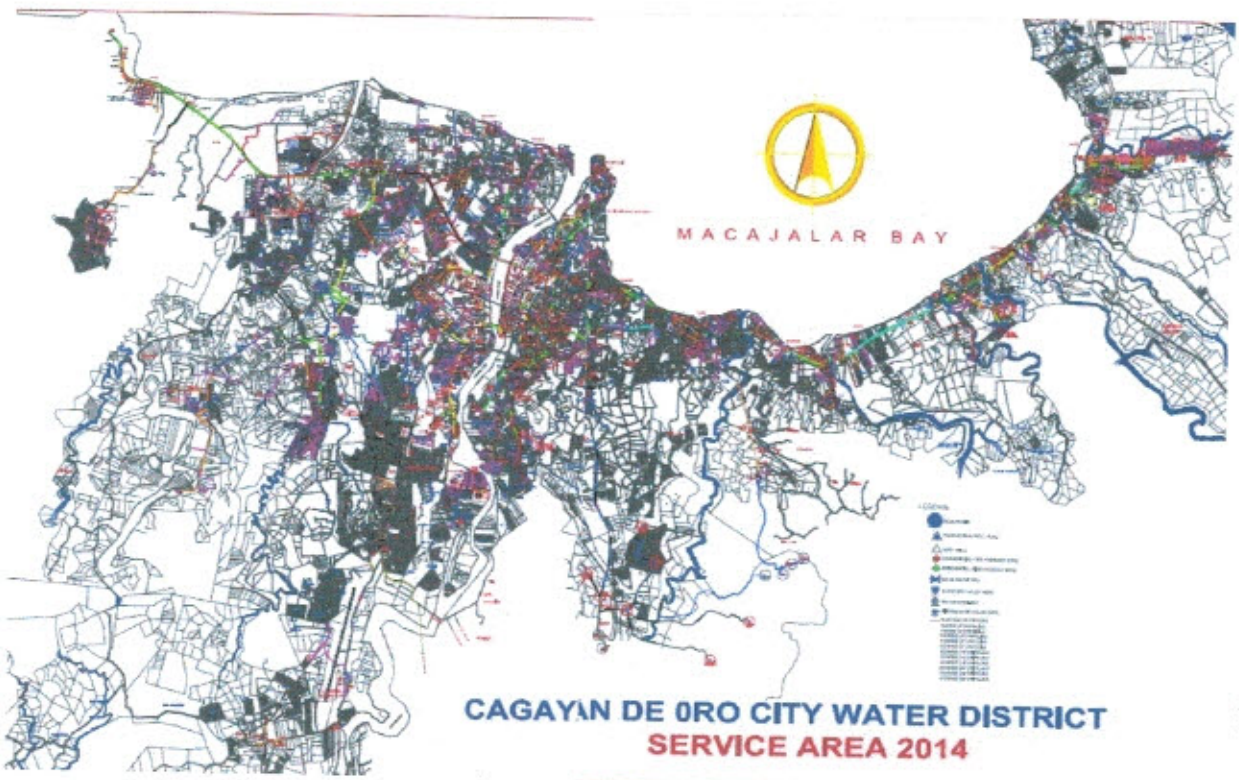
The city is divided into two congressional districts thru RA No. 9371:

1st district on the west side with 24 barangays and has an estimated population of *290,913* with land area *of 43,637.40 Ha.*

The 2nd District on the east side with 56 barangays, has a population of *311,175* with land area of *14,213 Ha*. Cagayan de Oro River is the natural boundary of the 2 districts.

Of the total 80 barangays 64 is being served by COWD with a population of 581,112 with the service area of 48, 885 ha.representing 84.5 % of the total population of Cagayan de Oro.

Aside from Cagayan de Oro City we also served the Municipality of Opol, presently we are serving 7 barangays of the said Municipality with a total of 5,929 connection representing 91.24 % of the total population (45,485) of the said 7 barangays.



CAGAYAN DE ORO CITY WATER DISTRICT
SERVICE AREA 2014

II. WATER SAFETY PLAN COMMITTEE

The committee was created thru GM's Memorandum No. 252, s2013 dated September 24, 2013. It's responsibilities are as follows:

1. **To Assess the existing COWD Water Supply System.**
2. **Develop Water Safety Plan for COWD.**
3. **Spearhead the implementation of the WSP**
4. **Monitor the Implementation of the WSP**
5. **Revise the WSP as may be necessary.**

The committee has 7 members chaired by Engr. Tesoro with Engr. Bienvenido V. Batar as the advisor.

As learned during the capacity building WSP Team member must be knowledgeable on either of the following:

1. **Technical expertise on the operation & maintenance of:**
   - ***a. Source***
   - ***b. Storage***
   - ***c. Treatment***
   - ***d. Distribution***

2. **Provide operational support for the WSP in terms of:**
   - ***a. Administrative***
   - ***b. Financing***
   - ***c. Technical***

3. **Capable of communicating the WSP objectives and outcomes:**
   - ***a. Inside the water district***
   - ***b. Outside the water district.***

4. **Understand water quality targets to be met (specific knowledge on product water)**
5. **Understand the impact of proposed water quality controls on the environment.**
6. **Knows the regulations**
7. **Familiar with training and awareness programmes.**
8. **With authority**
9. **Other members:**
   - ***a. consultants***
   - ***b. Coordinator***
   - ***c. Secretariat***
   - ***d. Documentation Committee.***

Name	Job Title	Role in the WSP Team	Contact Details	Expertise																	Remarks
				1				2			3		4	5	6	7	8	9				
				a	B	c	d	a	b	c	a	b						a	b	c	d	
EDWARD P. TESORO	OIC, ENG'G. Dept.	Chairman		X	X	x	x	x	x	x	x	x	x	x	x	x	x					
ANTONIO B. YOUNG	Div. Man., Prod'n.	member-motor,pumps & controler		X	X					x	x	x	x	x	x	x						
FARRAH B. GAMBOA	Quality Control Officer	member - water quality including bulk water				x					x		x	x	x	x						
EDGARDO D. TUVILLA	Div. Man., Pipelines	member-trans/dist. lines & serv. Conn.		X			x			x	x		x	x	x	x						
ALEX S. ABANGAN	OIC, Electro Mech'l. Div.	member - pump repairs & standby support fac.		X	X					x	x		x	x	x	x						
DANILO DAROY	OIC, Envi	member - wells, rivers & spring		X			x			x	x		x	x	x	x						
EDNA S. NAJEAL	Div. Man.-Const'n.	member - storage facilities & infra.			X		x			x	x	x	x	x	x	x						
BIENVENIDO V. BATAR	AGM - Technical	Consultant /advisor		X	X	x	x	x	x	x	x	x	x	x	x	x	x	x	x			

III. COWD WATER SUPPLY SYSTEM

The need to describe the whole system is for us to understand how the system works and to provide sufficient information to identify where the system is vulnerable to hazardous events and various types of hazards and how it can possibly contaminate water being supplied to the consumer.

GROUND WATER SUPPLY

Cagayan de Oro's abundant water supply comes from ground water. With an average production of 112,292 cubic meters a day, Cagayan de Oro Water District (COWD) is more than able to satisfy the existing average demand of 105,985 cubic meters daily. It maintains an average reserved capacity of 22,191 cubic meters a day.

On top of the generous supply of water is the COWD's Bulk Water Supply Project which is now operational and serving selected areas in the city. This project provides additional water supply of 50, 000 cubic meters per day. It improves the capability of COWD to serve elevations higher than 35 meters above mean sea level (msd).

Sources

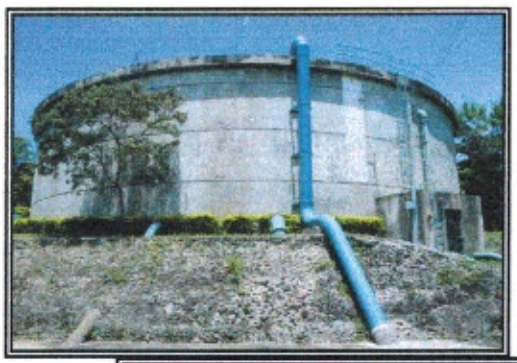
Reservoirs

Sump or Collector Well

Booster Stations

Pipelines

Others



SUMMARY OF PRODUCTION WELLS

Table 1.a

WATER SOURCES	DISCHARGE		Actual YTD
	lps	gpm	
a. Deep Well Source (26)	1475	23380	
b. Spring Source	2	30	
Total Wells & Spring	1477	23410	39,459,345
Booster Pumps (13)	622	9859	
BWSP (Bulk Water)			14,384,550

Table 1.b

WELLFIELD	NO. OF WELLS	CAPACITY, GPM
East Service Zone		
Agusan	1	1,544
Bugo	5	5,498
Macasandig	8	8,392
Tablon	2	2,076
Sub total	17	17,510
West Service Zone		
Balulang	7	4,997
Calaanan	4	873
Sub total	11	5,870
GRAND TOTAL	28	23,380

PRODUCTION WELL DESCRIPTIONS:

Well No.	Location	Depth (m)	Casing Dia (mm)	SWL (m)	PWL (m)	Year Const'd	Discharge, (lps) Tested	Recent
1	Pilot de Lara, Macasandig	248	400 - 200	10.26	32.93	1975	96	98.23
2	Bontula, Macasandig	219.4	400 - 250	17.7	30.34	1976	51	57.85
3A	Tomas Saco, Macasandig	204	450 - 300	23.32	46.04	1991	77.6	22.9
4	Macasandig	210	450 - 250	13.11	21.95	1975	52.2	31.1
5	Reyes Subd., Bugo	75.6	300 - 250	4.75	14.33	1975	28.9	34.7
7	Biasong Macasandig	200	450 - 200	9.57	19.05	1984	82.15	31.1
8	Ramonal Village, Nazareth	255	400 - 300	9.14	30.79	1986	74.76	63.09
9	Biasong Macasandig	236	400 - 300	9.21	25.91	1986	115.5	117.7
10	PN Roa Subd., Calaanan	123	400 - 250	6.74		1986	4.42	11.99
11	Bantiles, Bugo	151.9	400 - 250	3.81	14.63	1986	94.64	99.05
12	PN Roa Subd., Calaanan	139	400 - 250	4		1990	7.51	0
14	Balongis, Balulang	150	400 - 250	17.52	27.44	1994	48.26	53.31
15	CDO Resettlement, Calaanan	104.3	400 - 250	7.14	20.88	1994	25.74	28.14
16	Tomas Saco St., Macasandig	187	450 - 300	11.88	27.59	1995	96.5	74.45
17	Balongis, Balulang	187	300 - 250	16.16	20.58	1996	34.38	30.28
18	Pueblo de Oro, Calaanan	132	350 - 250	17	27.44	1997	19.94	14.99
19	Balulang	216	350 - 250	11.28	15.85	1997	21	65.93
20	Suntingon, Bugo	200	350 - 250	12.2	15.55	1997	50	44.1
21	Villa Trinitas Subd., Bugo	193.5	450 - 300	12.07	19.66	1998	56.09	82.59
22	Villa Trinitas Subd., Bugo	200	450 - 300	16.7	24.7	1998	100	86.44
23	Agusan	200	450 - 300	9.35	13.11	1998	100	96.28
24	Caballero Cpd., Balulang	57.2	250	4.51	5.79	1998	24	18.23
25	Villa Angela Subd., Balulang	226	450 - 300	11.32	15.7	1998	41.26	71.61
26	Balulang	216	450 - 300	15.24	40.55	1999	37.6	23.97
27	Macanhan, Carmen	207	450 - 300	16	33.54	1999	29	32.18
28	Phasco Village, Tablon	159	450 - 300	4.22	15.24	1999	80	67.44
29	Phasco Village, Tablon	201	450 - 300	0	14.02	1999	85	63.53

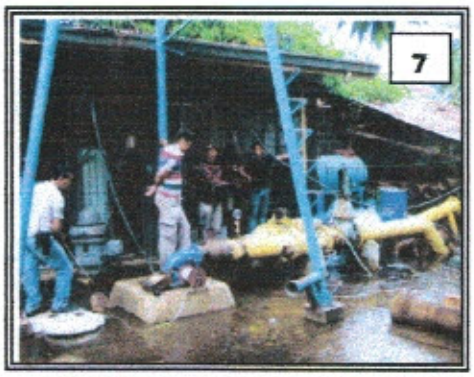
Table 2

SOURCE IDENTIFICATION:

SOURCE IDENTIIFICATION	LOCATION	DISCHARGE		MOTOR SIZE	STANDBY POWER
		LPS	GPM		
A. Deep Well Source:					
PW NO. 1	Macasandig	98	1557	125 hp	437.5 kva (part of mac. booster load)
PW NO. 2	Macasandig	61	969	75 hp	219 kva genset
PW NO. 3	Macasandig	23	363	100 hp	219 kva genset
PW NO. 4	Macasandig	64	1016	60 hp	219 kva genset
PW NO. 5	Bugo	35	550	40 hp	75v kva genset
PW NO. 6	Bugo				
PW NO. 7	Macasandig	31	493	60 hp	219 kva genset
PW NO. 8	Macasandig	51/66	949	60 hp	250kva genset
PW NO. 9	Macasandig	104/122	1865	125 hp	219 kva genset
PW NO. 10	Calaanan	12	190	40 hp	75 kva genset
PW NO. 11	Bugo	99	1570	125 hp	No genset to be installed w/ 219 kva)
PW NO. 12	Calaanan				
PW NO. 14	Balulang	73	1158	100 hp	219 kva genset
PW NO. 15	Calaanan	28	446	60 hp	132 kva genset
PW NO. 16	Tomas Saco (Macasandig)	74	1180	60 hp	175 kva genset
PW NO. 17	Balulang	30	480	60 hp	167 kva genset
PW NO. 18	Pueblo	15	237	60 hp	To be installed with 165 kvagenset
PW NO. 19	Balulang	66	1045	100 hp	219 kva genset
PW NO. 20	Bugo	44	699	20 hp	500 kvagenset(part of Bugo Booster load)
PW NO. 21	Bugo	83	1309	50 hp	156 kva genset
PW NO. 22	Bugo	86	1370	50 hp	156 kva genset
PW NO. 23	Agusan	97	1544	150 hp	313 kva genset
PW NO. 24	Balulang	18	289	30 hp	75 kva genset
PW NO. 25	Balulang	72	1135	75 hp	165 kva genset
PW NO. 26	Balulang	24	380	60 hp	165 kva genset
PW NO. 27	Balulang	32	510	60 hp	132 kva genset
PW NO. 28	Tablon	67	1069	125 hp	250 kva genset
PW NO. 29	Tablon	64	1007	125 hp	250 kva genset
SOURCE IDENTIIFICATION	LOCATION	DISCHARGE		MOTOR SIZE	STANDBY POWER
		LPS	GPM		
B. Spring source					
MALASAG SPRING	CUGMAN	2	30		

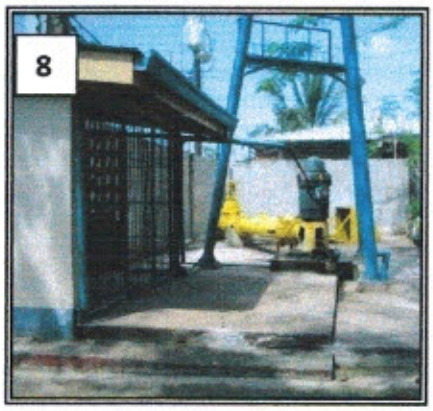
Table 3

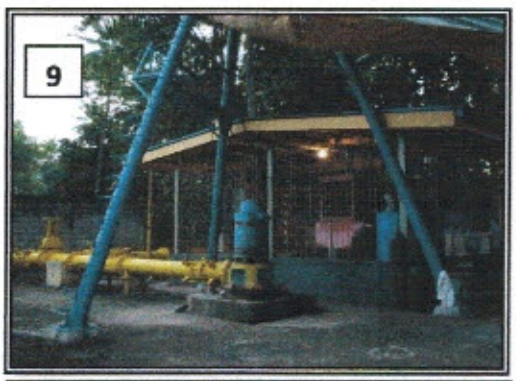
COWD WELL FIELDS:

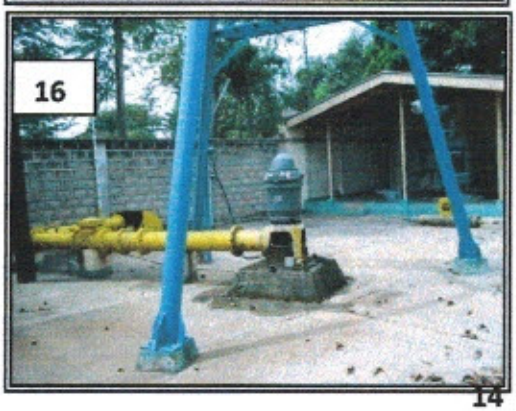


MACASANDIG
WELL FIELD

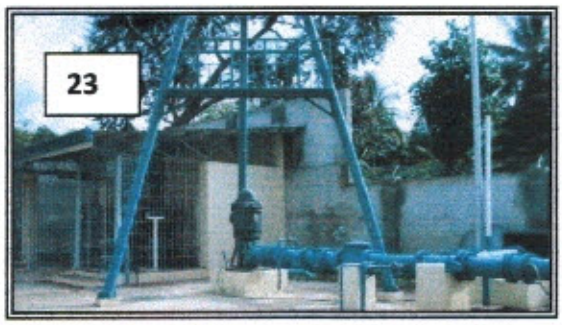
Production Wells



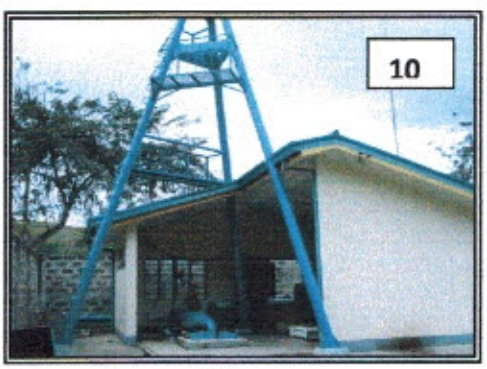


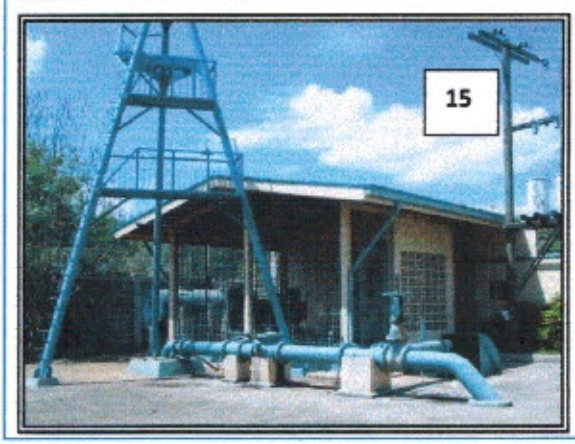


TABLON WELL FIELD
Production Well



AGUSAN WELL FIELD
Production Well





CALAANAN WELL FIELD

Production Well

14

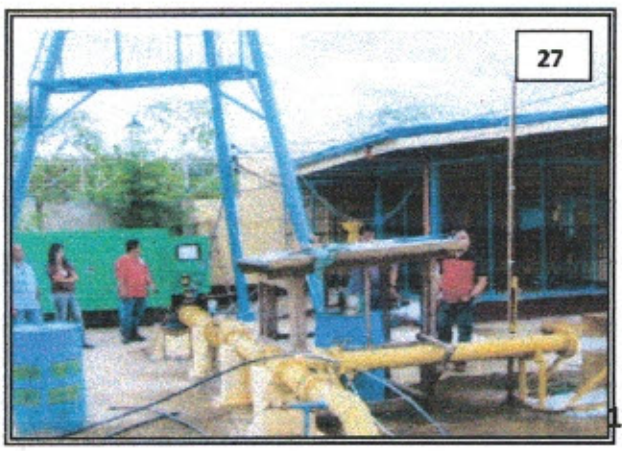
24

17

25

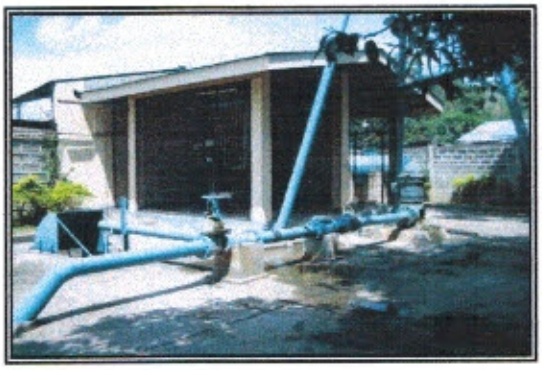
19

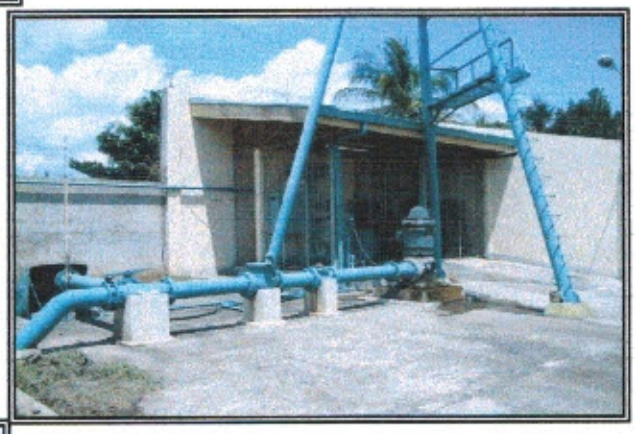
26

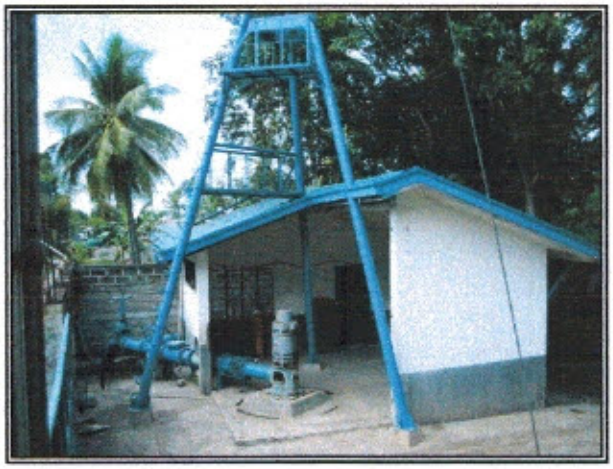


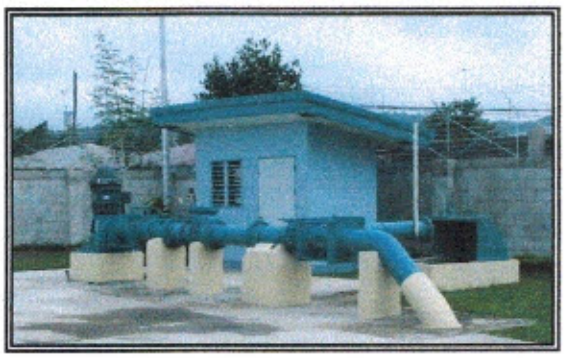
BALULANG WELLFIELD

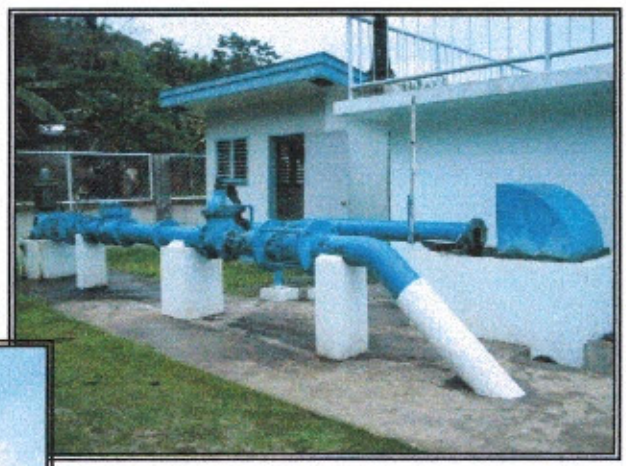
Production Wells

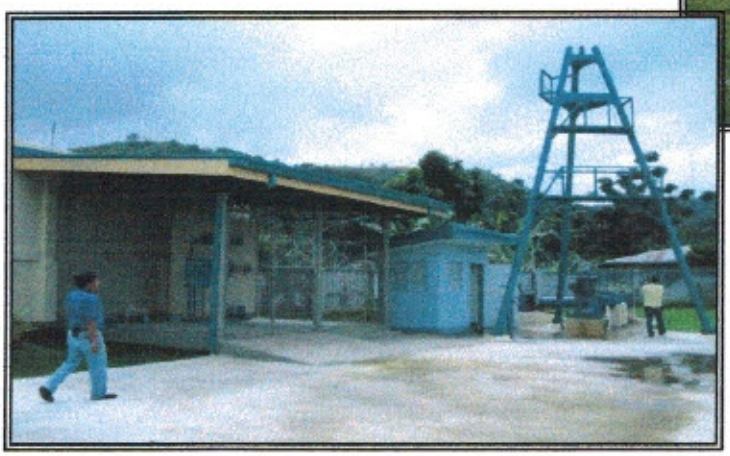












BUGO WELLFIELD

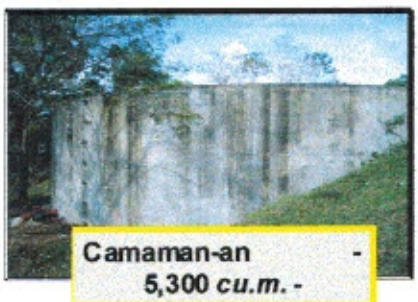
Production Wells

RESERVOIR

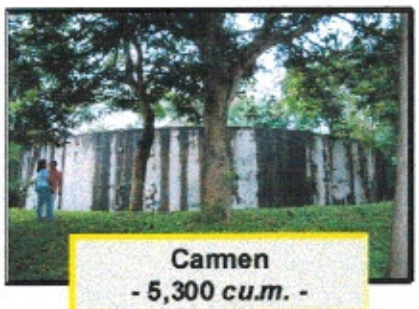
LOCATION	CAPACITY	DESCRIPTION
Carmen	5303 cu.m.	Concrete reservoir- balancing tank
Camaman-an	5303 cu.m.	Concrete reservoir
Aluba subdivision	95 cu.m.	steel tank
Bantiles, Bugo	443 cu.m.	Concrete reservoir
Bulua	2900 cu.m.	Concrete reservoir
Tablon	2100 cu.m.	Concrete reservoir
Puerto Heights	4000 cu.m.	Concrete reservoir

Table 4

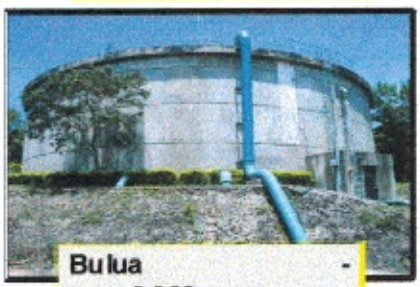
RESERVOIRS: Phase I & II



Camaman-an - 5,300 *cu.m.* -



Carmen - 5,300 *cu.m.* -



Bulua - 2,900 *cu.m.* -

Mandumol - 95 *cu.m.* -

SUMP & COLLECTOR WELLS

	LOCATION	DISCHARGE		Motor	Standby Power
		(lps)	(gpm)		
BP No. 1	Macasandig			100 hp	437.5 kva Genset
BP No. 2	Macasandig	100	1585	100 hp	
BP No. 3	Macasandig			200 hp	
BP No. 4	Macasandig			100 hp	
BP No. 5	Macasandig	105	1663	125 hp	
BP No. 6	Macasandig			200 hp	600 kva Genset
BP No. 5	Macasandig			150 hp	688 kva Genset
BP No. 1	Bugo			125 hp	
BP No. 2	Bugo	106	1685	125 hp	
BP No. 3	Bugo			125 hp	500 kva Genset
BP No. 1	Balulang			100 hp	
BP No. 2	Balulang	105	1658	100 hp	
BP No. 3	Balulang			100 hp	688 kva Genset
BP No. 4	Balulang			200 hp	313 kva Genset
BP No. 5	Balulang	105	1658	200 hp	
BP No. 6	Balulang	102	1610	200 hp	
Sub-Total	Macasandig	205	3248		
Sub-Total	Balulang	311	4926		
Sub-Total	Bugo	106	1685		
TOTAL		622	9859		
D. BWSP					
Dec 1-31, 2013			1,165,630 cu.m.		

Table 5

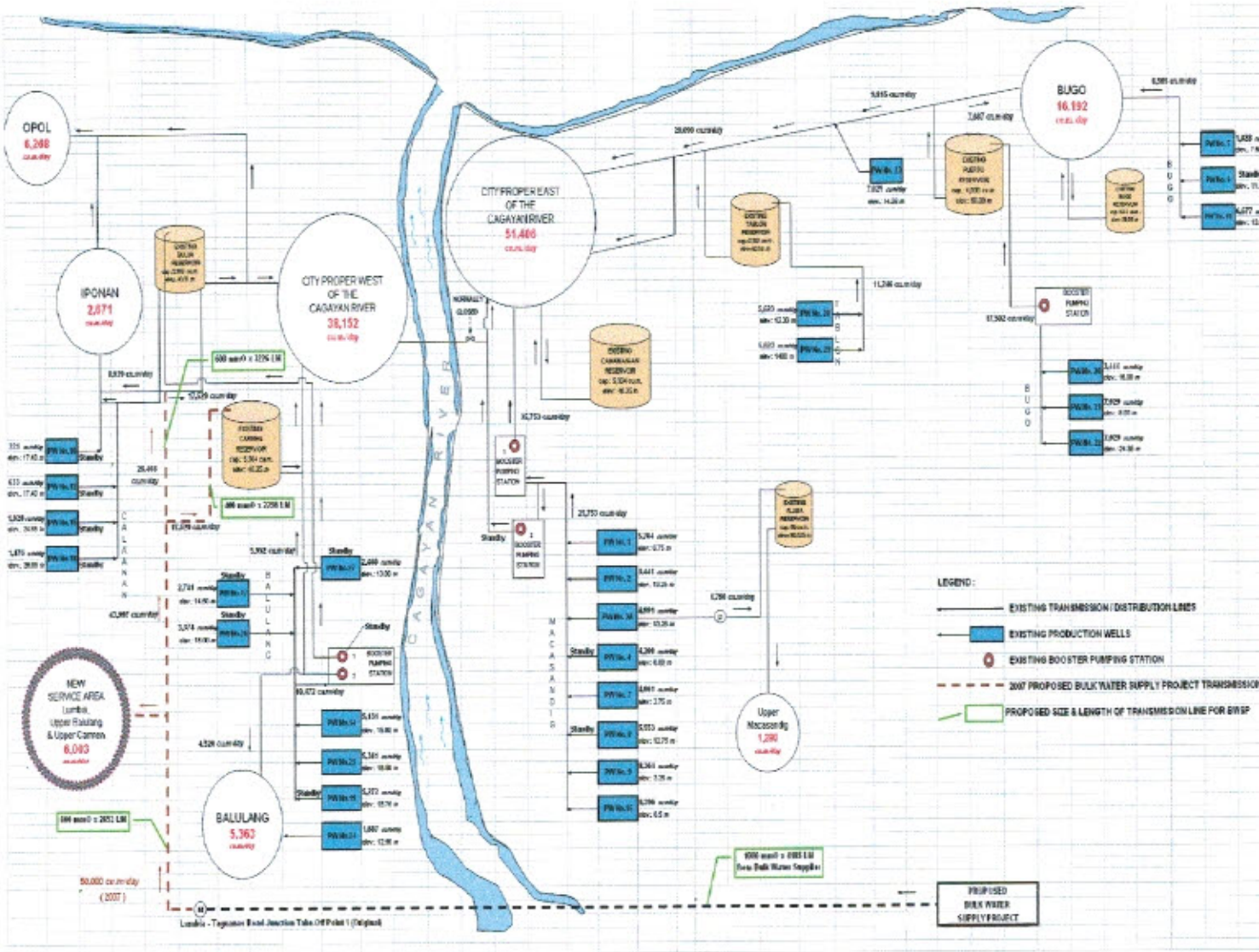
SUMMARY OF PIPELINES

As of December 2013

PIPELINE		OLD PIPELINES STILL IN SERVICE	PHASE I IMPROVEMENT	PHASE II IMPROVEMENT	PHASE III IMPROVEMENT	SUBDIVISION		COWD EXTENSION		TOTAL	
SIZE	MAKE					TURNED-OVER	NOT TURNED OVER	1979-2011	2012	MAINTAINED	SERVED
50mm (2") Ø	uPVC					8863		4296		13159	13159
50mm (2") Ø	G.I.					344		147	8	499	499
50mm (2") Ø	B.I.					179		226		405	405
50mm (2") Ø	P.E.					6786		41280	9098	57164	57164
63mm (2.5") Ø	G.I.							660		660	660
75mm (3") Ø	uPVC			2775		47278		6345		56398	56398
	ACP					5422				5422	5422
	G.I.					96				96	96
	CI							120		120	120
100mm (4") Ø	uPVC		15745	2433		32197	9553	54554	102	105031	114584
	STEEL	4877	14					181		5072	5072
	ACP	1460				4348	3160	240		6048	9208
	CCI	92						228		320	320
	G.I.					75				75	75
	CI/BI					48		307	6	361	361
150mm (6") Ø	uPVC		14	9494	3097	24471	3930	41882	240	79198	83128
	STEEL		27754			58	26	691		28503	28529
	ACP	146				1903	1120	231		2280	3400
	CCI	515						483		998	998
	CI/BI							117	57	174	174
200mm (8") Ø	uPVC			1586	8987	908	450	11743		23224	23674
	STEEL		4027					733		4760	4760
	CCI	2148						174		2322	2322
	BI					1		19		20	20
250mm (10") Ø	STEEL			4488	6354					10842	10842
	uPVC					547		3200		3747	3747
300mm (12") Ø	STEEL		16960	17996	20336			7596	18	62906	62906
350mm (14") Ø	STEEL							2531		2531	2531
400mm (16") Ø	STEEL		5660	569	17081			6270	6	29586	29586
500mm (20") Ø	STEEL		1176	445	3691			375		5687	5687
600mm (24") Ø	STEEL		186		14774					14960	14960
800mm (30") Ø	STEEL				2638					2638	2638
						133524	18239	184629	9535		
		9238	71536	39786	76958		151763		194164	525206	543445

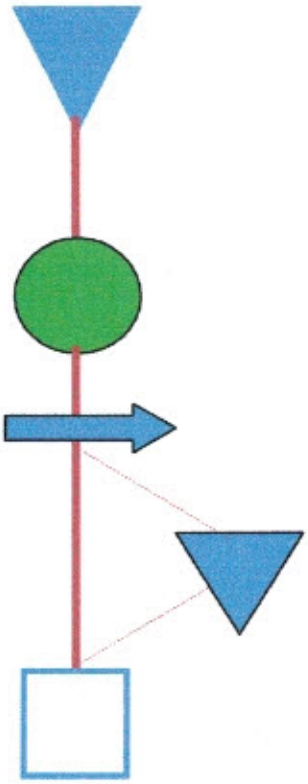
Table 6

IV. COWD WATER SUPPLY SYSTEM's SCHEMATIC DIAGRAM

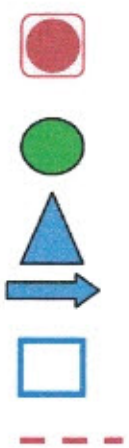


Typical flow diagram from PW – Direct feeding:

PROCESS STEP	RESPONSIBLE UNIT
Catchment (Well)	Prod. & Maint. Dept.
Chlorination	Quality Control Section
Distribution system	Prod, Maint. & Eng'g. Dept.
Reservoir	Prod., Maint. & Eng'g. Dept.
Consumer	Comm'l., Maint. Prod. Dept.



Legend:



Process Flow

Chemical Process

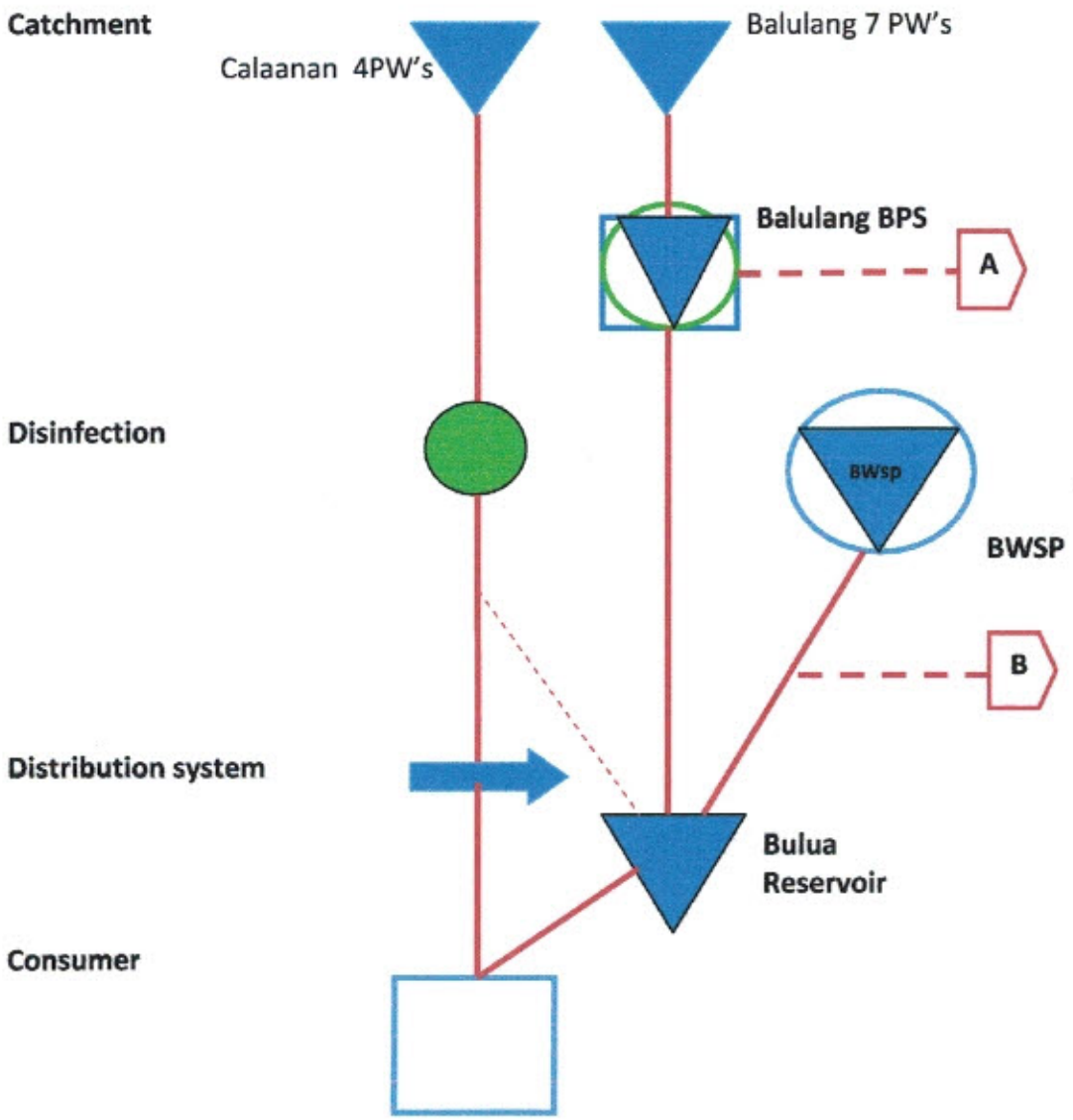
Catchment / Well /Reservoir

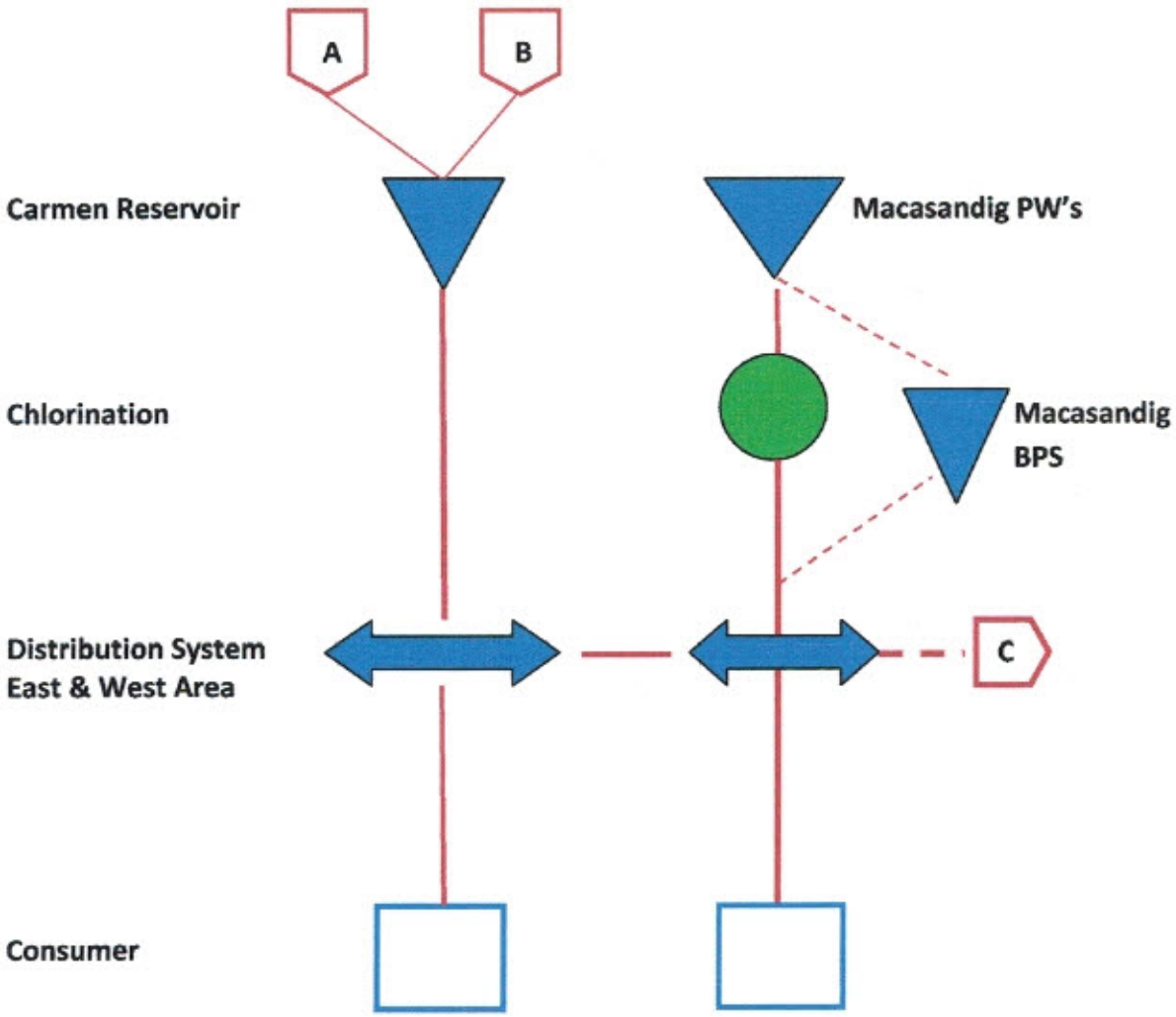
Transport Step

Consumer

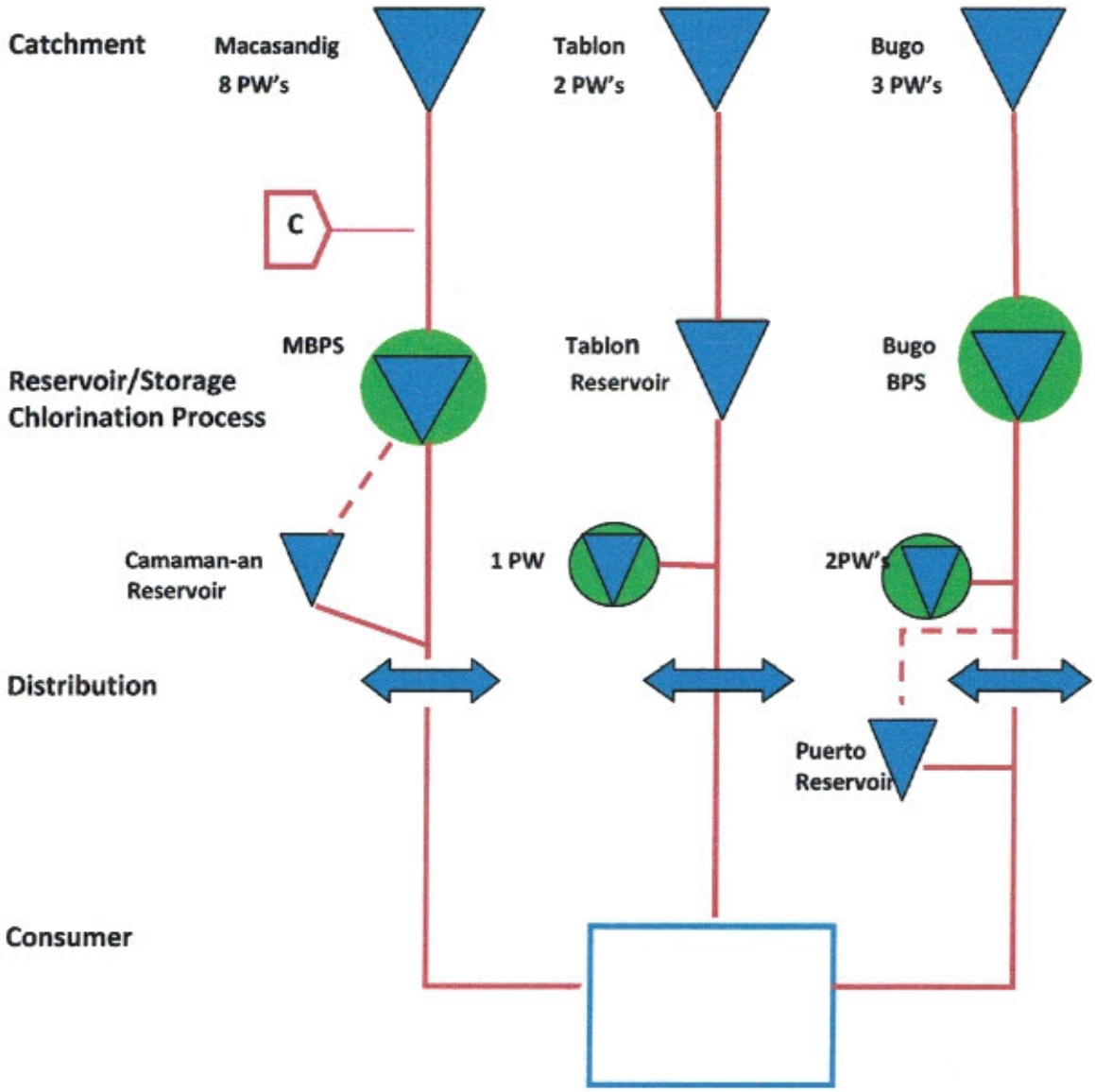
Connection

WEST AREA

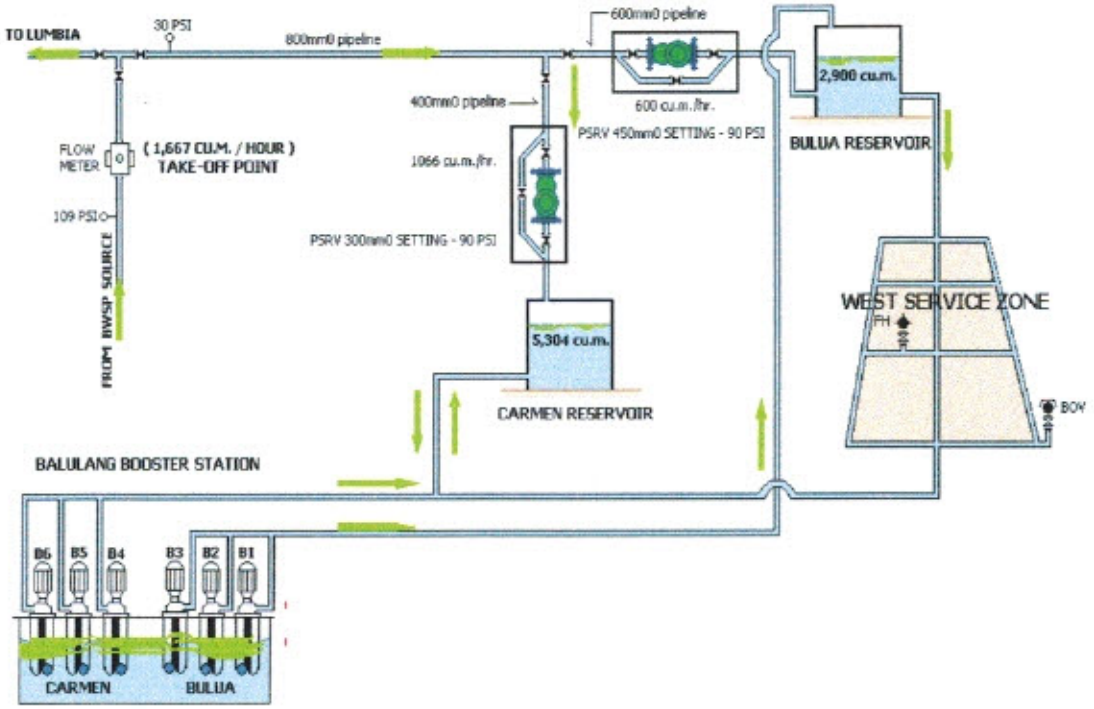

Catchment
Calaanan 4PW's
Balulang 7 PW's
Balulang BPS
A
Disinfection
BWsp
BWSP
B
Distribution system
Bulua
Reservoir
Consumer


A
B
Carmen Reservoir
Macasandig PW's
Chlorination
Macasandig
BPS
Distribution System
East & West Area
C
Consumer

EAST AREA


Catchment
Macasandig
8 PW's
Tablon
2 PW's
Bugo
3 PW's
C
MBPS
Reservoir/Storage
Chlorination Process
Tablon
Reservoir
Bugo
BPS
Camaman-an
Reservoir
1 PW
2PW's
Distribution
Puerto
Reservoir
Consumer

COWD WSS Schematic Diagram



V. IDENTIFICATION OF HAZARDOUS EVENTS & RISK ASSESSMENT

Identify the hazards and hazardous events:

For each step of the validated process flow diagram, the WSP team assess what could go wrong at what point in the water supply system in terms of hazards and hazardous events.

Hazard Assessment & Risk Prioritization Rating:

Ranking	Likelihood/frequency	Severity / Consequence
5	**Almost Certain**- *Once per day*	**Catastrophic** - potentially lethal to a large population, likely to have also very significant morbidity
4	**Most Likely**- *Once per week*	**Major** - Potentially lethal to a small population, likely to have also significant morbidity.
3	**Likely** - *Once per month*	**Moderate** - Potentially harmful to a large population but no mortality
2	**Unlikely** - *Once per year*	**Minor** - Potentially harmful to small population but no mortality.
1	**Rare** - *Once per year*	**Insignificant** - negligible impact in terms of severity of disease or numbers of people affected.

COWD HAZARDOUS EVENTS & RISK ASSESSMENT

MACASANDIG WELLFIELDS			PW #1			PW #2			PW #3A			PW #4		
Process Step	Hazardous Event	Hazard	Likelihood	Severity	Score	Likelihood	Severity	Score	Likelihood	Severity	Score	Likelihood	Severity	Score
Well / Catchment	Intrusion of contaminants due to Flooding	Microbial, Physical	2	5	10	1	5	5	1	5	5	2	5	10
	Intrusion of contaminants due to: Seepage from nearby septic tanks and indiscriminate disposal of waste from domestic and comm'l. establishment through ingress area.	Physical, Chemical, Microbial	1	5	5	2	5	10	1	5	5	1	5	5
	Intrusion of contaminants due to during repair of motors, pumps & other appurtenances.	Physical, Chemical, Microbial	3	2	6	3	2	6	3	2	6	3	2	6
	Vandalism	Microbial, Chemical	1	5	5	1	5	5	1	5	5	1	5	5
Chlorination	In adequate disinfection	Microbial, Chemical							1	2	2			
	Over-dosing of chlorine	Chemical							1	2	2			
	Under-dosing of chlorine	Chemical							3	2	6			
	Malfunction / Breakdown of Chlorinator	Microbial							1	2	2			

COWD HAZARDOUS EVENTS continued....

MACASANDIG WELLFIELDS (continued)			PW #7			PW #8			PW #9			PW #16			MBPS		
Process Step	Hazardous Event	Hazard	Likelihood	Severity	Score	Likelihood	Severity	Score	Likelihood	Severity	Score	Likelihood	Severity	Score	Likelihood	Severity	
Catchmnet/Well	Intrusion of contaminants due to Flooding	Microbial, Physical	2	5	10	1	5	5	2	5	10	1	5	5	2	5	
	Intrusion o contaminants due to Seepage from nearby septic tanks and indiscriminate disposal of waste from domestic and comm'l. establishment through ingress area.	Physical, Chemical, Microbial	1	5	5	2	5	10	1	5	5	2	5	10	1	5	
	Intrusion of contaminants during repair of motors, pumps & other appurtenances.	Physical, Chemical, Microbial	3	2	6	3	2	6	3	2	6	3	2	6	3	2	
	Vandalism	Microbial, Chemical	1	5	5	1	5	5	1	5	5	1	5	5	1	5	
Chlorination	In adequate disinfection	Microbial, Chemical							5	2	10						
	Over-dosing of chlorine	Chemical															
	Under-dosing of chlorine	Chemical															
	Malfunction / Breakdown of Chlorinator	Microbial															

COWD HAZARDOUS EVENTS continued....

CALAANAN WELLFIELDS			PW # 10			PW No. 15			PW No. 18		
Process Step	Hazardous Event	Hazard	Likelihood	Severity	Score	Likelihood	Severity	Score	Likelihood	Severity	Score
Well / Catchment	Intrusion of contaminants due to *Flooding*	Microbial, Physical	1	5	5	1	5	5	1	5	5
	Intrusion of contaminants due to *Seepage from nearby septic tanks and indiscriminate disposal of waste from domestic and comm'l. establishment through ingress area.*	Physical, Chemical, Microbial	1	5	5	3	5	15	1	5	5
	Intrusion of contaminants due to *Conduct of repair of motors, pumps & other appurtenances.*	Physical, Chemical, Microbial	3	2	6	3	2	6	3	2	6
	Intrusion of contaminants due to *Vandalism*	Microbial, Chemical	1	5	5	1	5	5	3	5	15
Chlorination	In adequate disinfection	Microbial, Chemical	1	2	2	1	2	2	5	2	10
	Over-dosing of chlorine	Chemical	1	2	2	1	2	2	no disinfection		
	Under-dosing of chlorine	Chemical	1	2	2	1	2	2			
	Malfunction / Breakdown of Chlorinator	Microbial	1	2	2	1	2	2			

HAZARDOUS EVENTS continued....

BALULANG WELLFIELDS			PW #14			PW #17			PW #19			PW #24		
Process Step	Hazardous Event	Hazard	Likelihood	Severity	Score	Likelihood	Severity	Score	Likelihood	Severity	Score	Likelihood	Severity	
Well / Catchment	Intrusion of Contaminants due to the following:													
	Flooding	Microbial, Physical	1	5	5	1	5	5	3	5	15	3	5	
	Seepage from nearby septic tanks and indiscriminate disposal of waste from domestic and comm'l. establishment through ingress area.	Physical, Chemical, Microbial	1	5	5	2	5	10	1	5	5	1	5	
	Conduct of repair of motors, pumps & other appurtenances.	Physical, Chemical, Microbial	3	2	6	3	2	6	3	2	6	3	2	
	Vandalism	Microbial, Chemical	1	5	5	1	5	5	1	5	5	1	5	
Chlorination	In adequate disinfection	Microbial, Chemical							5	2	10	1	2	
	Over-dosing of chlorine	Chemical										1	2	
	Under-dosing of chlorine	Chemical										1	2	
	Malfunction / Breakdown of Chlorinator	Microbial										1	2	

HAZARDOUS EVENTS continued....

BALULANG WELLFIELDS (continued)			PW #25			PW #26			PW #27			BBPS		
Process Step	Hazardous Event	Hazard	Likelihood	Severity	Score	Likelihood	Severity	Score	Likelihood	Severity	Score	Likelihood	Severity	Score
Well / Catchment	Intrusion of Contaminants due to the following:													
	Flooding	Microbial, Physical	1	5	5	1	5	5	1	5	5	1	5	5
	Seepage from nearby septic tanks and indiscriminate disposal of waste from domestic and comm'l. establishment through ingress area.	Physical, Chemical, Microbial	2	5	10	2	5	10	1	5	5	1	5	5
	Conduct of repair of motors, pumps & other appurtenances.	Physical, Chemical, Microbial	3	2	6	3	2	6	3	2	6	3	2	6
	Vandalism	Microbial, Chemical	1	5	5	1	5	5	1	5	5	1	5	5
Chlorination	In adequate disinfection	Microbial, Chemical										1	2	2
	Over-dosing of chlorine	Chemical										1	2	2
	Under-dosing of chlorine	Chemical										1	2	2
	Malfunction / Breakdown of Chlorinator	Microbial										1	2	2

HAZARDOUS EVENTS continued.....

BUGO WELLFIELDS			PW #5			PW #11			PW #20		
Process Step	Hazardous Event	Hazard	Likelihood	Severity	Score	Likelihood	Severity	Score	Likelihood	Severity	Score
Well / Catchment	Intrusion of Contaminants due to Flooding	Microbial, Physical	1	5	5	1	5	5	1	5	5
	Intrusion of Contaminants due to Seapage from nearby septic tanks and indiscriminate disposal of waste from domestic and comm'l. establishment through ingress area.	Physical, Chemical, Microbial	2	5	10	1	5	5	1	5	5
	Intrusion of contaminants due to Conduct of repair of motors, pumps & other appurtenances.	Physical, Chemical, Microbial	3	2	6	3	2	6	3	2	6
	Vandalism	Microbial, Chemical	1	5	5	1	5	5	1	5	5
Chlorination	In adequate disinfection	Microbial, Chemical	1	2	2	1	2	2			
	Over-dosing of chlorine	Chemical	1	2	2	1	2	2			
	Under-dosing of chlorine	Chemical	1	2	2	1	2	2			
	Malfunction / Breakdown of Chlorinator	Microbial	1	2	2	1	2	2			

HAZARDOUS EVENTS continued.....

BUGO WELLFIELDS (continued)			PW #21			PW #22			BBPS		
Process Step	Hazardous Event	Hazard	Likelihood	Severity	Score	Likelihood	Severity	Score	Likelihood	Severity	Score
Well / Catchment	Intrusion of Contaminants due to Flooding	Microbial, Physical	1	5	5	1	1	1	1	5	5
	Intrusion of Contaminants due toSeepage from nearby septic tanks and indiscriminate disposal of waste from domestic and comm'l. establishment through ingress area.	Physical, Chemical, Microbial	2	5	10	2	5	10	1	5	5
	Intrusion of Contaminants due to Conduct of repair of motors, pumps & other appurtenances.	Physical, Chemical, Microbial	3	2	6	3	2	6	3	2	6
	Vandalism	Microbial, Chemical	2	5	10	2	5	10	1	5	5
Chlorination	In adequate disinfection	Microbial, Chemical									
	Over-dosing of chlorine	Chemical									
	Under-dosing of chlorine	Chemical									
	Malfunction / Breakdown of Chlorinator	Microbial									

HAZARDOUS EVENTS continued.....

TABLON/AGUSAN WELLFIELDS			PW #23			PW #29			PW #28		
Process Step	Hazardous Event	Hazard	Likelihood	Severity	Score	Likelihood	Severity	Score	Likelihood	Severity	Score
Well / Catchment	Intrusion of Contaminants due to the following:										
	Flooding	Microbial, Physical	1	5	5	1	5	5	1	5	5
	Seapage from nearby septic tanks and indiscriminate disposal of waste from domestic and comm'l. establishment through ingress area.	Physical, Chemical, Microbial	1	5	5	1	5	5	1	5	5
	Conduct of repair of motors, pumps & other appurtenances.	Physical, Chemical, Microbial	3	2	6	3	2	6	3	2	6
	Vandalism	Microbial, Chemical	1	5	5	1	5	5	1	5	5
Chlorination	In adequate disinfection	Microbial, Chemical	1	2	2	1	2	2	1	2	2
	Over-dosing of chlorine	Chemical	1	2	2	1	2	2	1	2	2
	Under-dosing of chlorine	Chemical	1	2	2	1	2	2	1	2	2
	Malfunction / Breakdown of Chlorinator	Microbial	1	2	2	1	2	2	1	2	2

HAZARDOUS EVENTS continued.....

			Camaman-an			Mandumol			Carmen			Bulua			Tablon			Puerto Hts.		
Process Step	Hazardous Event	Hazard	Likelihood	Severity	Score	Likelihood	Severity	Score	Likelihood	Severity	Score	Likelihood	Severity	Score	Likelihood	Severity	Score	Likelihood	Severity	
Reservoir / Storage	open utility manhole and vents	Physical, Chemical, Microbial	5	1	5	5	1	5	5	1	5	5	1	5	5	1		5	1	
	Facility damage cause by natural calamity like typhoon	Physical, Chemical, Microbial	2	5	10	1	5	5	1	5	5	1	5	5	1	5	5	1	5	
	Contamination of water supply due to security/ vandalism/ sabotage.	Physical, Chemical, Microbial	2	5	10	1	5	5	1	5	5	1	5	5	1	5	5	1	5	

HAZARDOUS EVENTS continued.....

Process Step	Hazardous Event	Hazard	Likelihood	Severity	Score
Distribution	Intrusion of contaminants due to Mainline leakage (burst) for ACP Pipes	Physical, Chemical, Microbial	3	5	15
	intrusion of contaminants due at deteriorated pipes during low pressure.	Physical, Chemical, Microbial	3	5	15
Consumer	Intrusion of contaminants due to service line leakage	Physical, Chemical, Microbial	3	2	6
	Instrusion of contaminants due to cross connection w/ leaking sewerlines.	Physical, Chemical, Microbial	3	2	6

VI. DETERMINE AND VALIDATE CONTROL MEASURES for PW's with Risk Score 10 and above.

Macasandig Well fields

Process Step	Hazardous Event	Hazard	Control Measure	Validation of Control Measure
Well / Catchment	Intrusion of contaminants due to flooding for ***PW's nos. 1,2,4,7,9***	Microbial	sealing of all openings	make sure that all openning of PW's along theCDO river are sealed
			Allign COWD'S flood control plan w/ LGU.	coordinate w/ DPWH
	Intrusion due to Seepage from nearby septic tanks and indiscriminate disposal of waste from domestic and comm'l. establishment through ingress area. For ***PW # 2,8 within the residential area.***	Physical, Chemical, Microbial	1. secure wells by cement grouting; standard is 30 meters.	
			2. conduct bacteriological test.	
			3. Coordinate w/ LGU as to standard of septic tank const'n.	coordinated w/ CBO as to the standard of septic tank contruction.
Chlorination	In adequate disinfection for ***PW #9, raw water line but there are service connections which were tapped in this line.***	Microbial	transfer all the tapped service connections.	

Calaanan Well Fields…
PW #15 & 18 - both directly feed to distribution line.

Process Step	Hazardous Event	Hazard	Control Measure	Validation of Control Measure
Well / Catchment	Intrusion due to Seepage from nearby septic tanks and indiscriminate disposal of waste from domestic and comm'l. establishment through ingress area. For ***PW # 15, near relocation area***	Physical, Chemical, Microbial	1. secure wells by cement grouting; standard is 30 meters.	review as built plan
			2. conduct bacteriological test.	coordinate w/ CBO as to th standard of septic tank contruction.
			3. Coordinate w/ LGU as to standard of septic tank const'n.	
	Vandalism for ***PW # 18, no fence***	Microbial	secure P.W with perimeter fence	inventory of all PW's & reservoir as to safetiness.
Chlorination	In adequate disinfection for ***PW #18, no chlorinating unit***	Microbial	install chlorinating unit	monitor chlorine residual at end point.

BalulangWell field

Process Step	Hazardous Event	Hazard	Control Measure	Validation of Control Measure
Well / Catchment	Intrusion of contaminants due to flooding ***PW's nos. 19 & 24.***	Microbial	sealing of all openings	make sure that all openning of PW's along theCDO river are sealed
			Allign COWD'S flood control plan w/ LGU.	coordinate with LGU
	Intrusion due to Seepage from nearby septic tanks and indiscriminate disposal of waste from domestic and comm'l. establishment through ingress area. For ***PW # 17,25 & 26 near residential area.***	Physical, Chemical, Microbial	1. secure wells by cement grouting; standard is 30 meters.	review as built plan
			2. conduct bacteriological test.	coordinated w/ CBO as to the standard of septic tank contruction.
			3. Coordinate w/ LGU as to standard of septic tank const'n.	
Chlorination	In adequate disinfection for ***PW #19, no chlorinating unit***	Microbial	install chlorinating unit	monitor chlorine residual at end point.

Bugo Well field:

Process Step	Hazardous Event	Hazard	Control Measure	Validation of Control Measure
Well / Catchment	Intrusion due to Seepage from nearby septic tanks and indiscriminate disposal of waste from domestic and comm'l. establishment through ingress area. For ***PW # 5, 21 & 22 near residential area.***	Physical, Chemical, Microbial	1. secure wells by cement grouting; standard is 30 meters.	review as built plan
			2. conduct bacteriological test.	coordinated w/ CBO as to the standard of septic tank contruction.
			3. Coordinate w/ LGU as to standard of septic tank const'n.	
	Vandalism for ***PW # 21 & 22, no fence***	Microbial	secure P.W with perimeter fence	inventory of all PW's & reservoir as to safetiness.

DETERMINE VALIDATE CONTROL MEASURE (Continued)

Process Step	Hazardous Event	Hazard	Control Measure	Validation of Control Measure
Distribution	Intrusion of contaminants due to Mainline leakage (burst)	Physical, Chemical, Microbial	selective mainline repair	record of number of burst in the system per specific line.
	Intrusion of contaminants due to Leaking of deteriorated pipes during low pressure.	Physical, Chemical, Microbial	selective mainline rehabilitation/ replacement. Maintain pressure in the system	record of aged & ACP Pipe in the system.
Reservoir/Storage	Intrusion of contaminanats due to open utility manhole and vents	Physical, Chemical, Microbial	Proper & secured cover on all openings put locks if necessary.	manhole and vent covers are in place
	Facility damage cause by natural calamity like typhoon	Physical, Chemical, Microbial	reassess facilities and recommend for rectification.	check all existing facilities
	Contamination of water supply due to security/vandalism/ sabotage.	Physical, Chemical, Microbial	secure with fence and assign guard if necessary.	prepare POW for Camaman-an Reservoir
Consumer	Intrusion of contaminants due to service line leakage	Physical, Chemical, Microbial	regular information drive.	water quality monitoring report
	Intrusion of contaminants due to cross connection w/ leaking sewerlines.	Physical, Chemical, Microbial	regular information drive.	
	Contamination of water due to use of sub-standard materials.	Physical, Chemical, Microbial	regular information drive.	

VII. MONITORING CRITICAL LIMITS OF CONTROL MEASURE

Once the WSP has been prepared for the whole water system, it is necessary to prepare a routine validation monitoring programme including what is monitored and how frequently, this is to check if WSP is working, that system units are working as assumed in the system assessment and the water being supplied is safe and meets the health based standards, and other requirements.

Operational monitoring is essential for a safe water supply. What, When, Where and How it will be monitored.

Process Step	Control Measure	Validation of Control Measure	Critical Limits	Where	When	How	Who	Corrective Action
Catchment/Well	FLOODING: Sealing of all openings.	1. Allign COWD's flood control plan w/ LGU	signal #2 from PAG-ASA	PW's No. 1,4,7,9, 19,24	ASAP	install valve or cap	Prod., Maint. & Eng'g Dept.	shutdown operation, conduct bacteriological test, disinfection & flushing.
					w/in the year	coordinate w/ DPWH	Eng'g dept.	
	Conduct bacteriological test.		PNSDW (microbial)	PW's No. 2,8,15,25, 26	Hourly or as needed	MTFT, HPC	DOH, CEO, COWD	1. Educate land owners on contaminations. 2. Ensure future drilling conforms w/ PD 856
	Coordinate w/ LGU as to standard of septic tank const'n.	Coordinate w/ LGU as to standard of septic tank const'n.						
	secure all P.W #18 with fence.	Prepare POW		PW # 18	asap		Eng'g dept.	

MONITORING ... Continued

Process Step	Control Measure	Validation of Control Measure	Critical Limits	Where	When	How	Who	Corrective Action
Disinfection	1. regular monitoring of chlorine residual. 2 conduct flushing, 3.. intermediate chlorination	of burst in the system per specific line. record of aged & ACP Pipe in the system.	Cl conc leaving the plant must be >0.5 and <1.5 mg/L	Chlorine residual	At entry point to distribution system	On-line	Quality control	Operator-on-duty
	Periodic maintenance & inspection of chlorinator units. 2. assure availability of chemical,.	record of aged pipe in the system	not < 0.50 residual	PW's & Pumping Station	Quarterly	actual inspection	Quality control	Submit inventory of chemical requirement.
Distribution	Selective Replacement of mainline pipes:	not >1 burst/yr/specific line	not more than 1 burst/year/specific line	>1 burst	Annually	Using as-built plan & Field investigation	Eng'g./ Maint. Dept.	recommend pipe replacement
		reduce ACP by 10% annualy in the system	reduced ACP by 10% in the system	Entire Service area for identified ACP	Annually			revised rehabilitation program schedule
		reduce aged pipe (30 yrs. up) by 1%	reduced aged pipe by 1% in the system	Entire Service area-identified aged pipe	Annually			
Storage/Reservoir	Proper & secure cover on all openings put locks if necessary.	check all exisiting facilities	no more than 1 damaged of all facilities properly secured	all reservoir/ storage	semi-annual	field investigation	Eng'g./ Maint. Dept.	Submit field investigation report
	Reassess facilities and recommend for rectification.	conduct annual inspection on all reservoir/ storage	no damaged incident		annualy	as built plan & site investigation		Prepare POW if necessary
Consumer	regular information drive.	quality monitoring report	reduced incident report by 10%		monthly		PR, Customer care, Maint. Comm'l.	

VIII. VERIFICATION

Verification is the use of different methods, procedures or tests in addition to those used in regularly monitoring the specific process steps. Verifying the water quality from sources to distribution always includes bacteriological and biological testing done by the Quality Control Section or the surveillance agency like LWUA and DOH and oftentimes a combination of the two. The different procedures and types of verification are enumerated in the tables below.

Verification of Activity	Location of Activity	Type of Activity	Frequency of Activity	Which Dept.,Agency will conduct the Activity	Recipient of Analysis Result*	Action on unusual/ failing result	3rd-Party Recipient of Results
Water Quality							
measurement of Chlorine dosage	Booster Pumping station	automatic	daily	Quality Control officer	Prod. Manager	adjust dosage	LWUA
Bacteriological analysis	sampling points	sampling	weekly	Quality Control officer	Prod. Manager	protocol for positive result (flushing, re-sampling,)	LWUA
Chlorine residual	sampling points	sampling	monthly	Quality Control officer	Prod. Man	protocol for positive result	LWUA
Physical & Chemical Analysis	Water source	sampling	annually	DOH accredited laboratory	Gen. Man	protocol for positive result	LWUA
verification of laboratory eqpmnt.	laboratory	calibration	annually	DOH accredited calibrator	Prod. Man.	protocol for inefficient eqpmnt.	GM
verification of field activities, leak detection, pipeline repair,	along distribution line/ network		anytime there is field activity	Quality Control officer	Maint. Manager	protocol for inefficient repair	GM
Customer Satisfaction							
Customer Feedback	Admin ofc.	survey	annual	CCSD	MSD	Protocol for negative feedback	Concerned Dept.

IX. SUPPORTING PROGRAMMES:

Supporting programs are organization-wide activities that should be in place in support of the delivery of safe quality water. These activities do not directly affect water quality but are meant to ensure that no additional source of potential hazards will come from the operating / surrounding environment, the equipments used and the people themselves, employees and visitors alike. The types of supporting programs that this organization has in aid for the realization of our mission. Management commitment entails constant assessment that shall lead to updating of the existing programs and developing new ones.

X. RECORD KEEPING and DOCUMENTATION

A wide range of records should be generated daily as COWD continue to operate providing safe drinking water to its entire service area and upon the actual implementation of the water safety plan. Regular monitoring of every process step and any necessary corrective actions for every deviation from operational limits, incident response reports should consistently be recorded and keep for future reference. These records will serve as evidence in compliance or adherence of the organization to the WSP.

The documentation should be simple and short as much as possible and the level of detail in the procedures and work instructions is sufficient to provide assurance of operational control when performed by competent and well trained operators.This system of recording and documentation foster process and records ownership and eventual implementation of the procedures and more importantly it provides an auditable system wherein review can be done periodically.

XI. REVIEW & AUDIT

Following the implementation of the Water Safety Plan is the review of the procedures and examination of records to ensure that it is being carried out. This is where periodic auditing comes in. An audit-based approach places responsibility on every unit involved to provide information regarding system performance against agreed indicators. Auditing has both an assessment and a compliance checking role. It gathers information on the level of conformance to the quality system as indicated in the WSP and to ISO 9001:2000 standards. Aside from determining if the quality system is being effectively implemented, it obtains factual input for management decision, determines if company is at risk, identifies areas or opportunities for improvements, assesses individual performance, assists company staff training needs, improve communication and motivation of personnel.

For maximum effectiveness of the audit system for the ISO certified COWD facilities, ISO 9001:2000 requires an Internal Audit procedure that use trained internal auditors that have no direct involvement with the preparation of WSP but are qualified enough having a technical understanding of the audit area.