REPUBLIC OF THE PHILIPPINES

CAGAYAN DE ORO CITY WATER DISTRICT

Corrales Avenue, Cagayan de Oro City

WATER DEMAND PATTERN
And
WATER CONSERVATION PLAN:

An Approach to WATER DEMAND MANAGEMENT

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PART 1 – WATER DEMAND PATTERN

I. COWD BACKGROUND INFORMATION

On August 1, 1973, the Cagayan de Oro City Water District (COWD) was formed as the first water district in the country. It was issued the conditional certificate of conformance (CCC) No. 001 on January 4, 1974 by the Local Water Utilities Administration (LWUA). COWD was born as a self reliant quasi-public entity with the implementation of the Provincial Water Utilities Act of 1973 or PD 198, which created the water districts nationwide. However, through a Supreme Court decision, all Water Districts in the country have been categorized as government-owned and controlled corporation (GOCC) since March 1992.

COWD started with 3,500 service connections when it took over the management of then NAWASA or the City Waterworks System in 1973. This represented about 21% of the total City population of 117,895 during that year then. The average water production was 12,200 cubic meters per day distributed to consumers through transmission and distribution lines, 39 kilometers long. As of December 2015, the District currently serves 87,733 service connections with an average water production capacity of 160 million liters per day (MLD). This reflects that in 4 decades, COWD has grown around 24 times in service connections, and 13 times in water production capacity. The potable water that COWD serves to the public comes from twenty-seven (27) wells distributed in the six (6) well fields situated in Macasandig, Balulang, Calaanan, Bugo, Tablon and Agusan and one spring source located in Malasag. Since 2007, about 40 MLD of the District's total water production capacity has been supplied by a bulk water contractor. Production facilities include three (3) major booster pumping stations and eight (8) reservoirs while transmission and distribution lines extend up

to 565.50 kilometers ranging from 50mm – diameter to 800mm – diameter in size. Figure 1 shows that location of the water sources of the COWD.

At the moment, COWD has extended services to 6 barangays in Opol, a municipality of Misamis Oriental adjacent to Cagayan de Oro in the west side and to 1 barangay in Tagoloan, the municipality next to the City in the east side. In total, 63 of the 80 barangays of the City have been covered by COWD services. As of December 2015, the total city population served

by COWD has reached about 526,398 representing about 78% of the total city population of 675,950.

Figure 1 – Map of Location of COWD Water Sources

The Cagayan De Oro City Water District (COWD) foresees the continued growth and progress of a Metro Cagayan, which extends to Jasaan in the east and Laguindingan in the West. Part of the growth is due to expansion and economic development of the City and the neighboring municipalities. Expansion in water facilities and the need for more

water

will

take a big chunk of the requirements in the future. COWD recognizes the importance of water to the daily needs of a growing population and its role in the economic development of the Metro Cagayan. One of the immediate approach to address this need is to improve the utility's system efficiency and to promote advocacy and implement a realistic water conservation program.

STATEMENT of VISION-MISSION-CORE VALUES

Major decisions and day – to – day operations of the COWD are anchored on its Vision, Mission and the core values that the organization embraces. Specifically, the following are stated accordingly:

- **VISION :**

  We provide excellent water service to the community we serve.

- **MISSION :**

  To be an outstanding water district in the country.

- **CORE VALUES :**

  We demand accountability in all our decisions.

  We are result - driven.

  We work as a team at all times.

  We have faith in One Almighty.

II. UNDERSTANDING SUPPLY and CONSUMPTION PATTERNS

Supply from COWD Wells (Groundwater), Precipitation Rates and El Nino

More than 60% of COWD's water supply comes from its own 26 production wells distributed in 5 well areas. The other 40%, more or less, is supplied in bulk by a contractor whose source is a surface water, specifically, one of the tributaries of the Cagayan de Oro River. The total increase in supply of about 25% from COWD wells within the nine – (9) year period (2007 – 2016) has amounted to about 8,471,968 cubic meters. This is equivalent to a

little more than 2 month's supply. The increase in supply from wells did not necessarily come from new wells since the last 2 new wells were added into the system in 2006 yet. The largest increase in supply happened in 2009 and another, although a little less, was in 2013. On the other hand, the biggest reduction in supply occurred in 2008, albeit not as much as the increase. The supply from wells also slightly decreased in 2015 and 2016. The volume reduction in each of the 2 years was, more or less, enough for a 4 to 7 day's supply rate. It is worth to note that part of 2015 and 2016 were actually drought period due to the El Nino phenomenon which affected the entire country significantly.

Table 1a
WATER PRODUCTION FROM COWD WELLS (2011 – 2016)

MONTH	2016 (in cu. m.)	2015 (in cu. m.)	2014 (in cu. m.)	2013 (in cu. m.)	2012 (in cu. m.)	2011 (in cu. m.)
January	3,535,261	3,947,905	3,744,060	3,469,456	3,267,939	3,384,836
February	3,196,781	3,513,274	3,160,542	3,199,460	3,041,257	3,436,948
March	3,772,862	3,952,078	3,486,320	3,167,479	3,108,262	3,307,764
April	3,534,700	3,462,037	3,719,661	3,701,744	3,329,395	3,324,300
May	3,722,343	3,452,842	3,680,057	3,475,518	3,375,189	3,382,659
June	3,566,063	3,577,932	3,391,254	3,317,700	3,240,293	3,285,962
July	3,581,195	3,699,109	4,031,065	3,832,506	3,344,340	3,186,999
August	3,835,749	3,389,345	3,636,700	3,576,521	3,455,521	3,288,009
September	3,586,303	3,839,539	3,770,512	3,422,633	3,255,520	3,169,318
October	3,415,018	3,632,539	3,673,037	3,740,335	3,376,006	3,124,899
November		3,136,766	3,562,384	3,685,494	3,323,129	3,300,638
December		3,693,591	3,888,477	3,786,887	3,342,494	3,060,051
TOTAL	**35,746,276**	**43,296,957**	**43,744,069**	**42,375,733**	**39,459,345**	**39,252,383**
MEAN	**3,574,628**	**3,608,080**	**3,645,339**	**3,531,311**	**3,288,279**	**3,271,032**
STDEV	**182,860**	**239,107**	**228,163**	**225,926**	**116,550**	**113,534**
ANNUAL GROWTH		**-1%**	**3%**	**7%**	**1%**	**0.3%**

Table 1b
WATER PRODUCTION FROM COWD WELLS (2007 – 2010)

MONTH	2010 (in cu. m.)	2009 (in cu. m.)	2008 (in cu. m.)	2007 (in cu. m.)	AVERAGE (in cu. m.)	STD DEV (in cu. m.)
January	3,476,111	3,056,729	2,651,834	3,447,714	3,398,185	356,681
February	3,534,503	3,247,734	2,642,360	3,147,591	3,212,045	259,804
March	3,265,867	3,257,069	2,540,624	2,891,635	3,274,996	405,254
April	2,991,269	3,055,164	2,754,787	2,926,246	3,279,930	334,745
May	3,154,102	3,150,653	2,870,319	2,944,949	3,320,863	286,627
June	3,240,425	3,189,935	2,851,331	3,074,748	3,273,564	216,322
July	3,333,433	3,116,972	3,201,558	3,221,686	3,454,886	312,988
August	3,021,213	3,547,082	3,358,627	2,442,740	3,355,151	388,138
September	3,266,835	3,199,807	2,867,817	2,414,624	3,279,291	422,436
October	3,239,428	3,053,901	2,217,103	2,693,788	3,216,605	474,710
November	3,411,569	3,207,167	2,760,737	2,566,008	3,217,099	359,408
December	3,192,536	3,323,724	2,947,969	2,651,834	3,320,840	410,778
TOTAL	**39,127,291**	**38,405,937**	**33,665,066**	**34,423,563**	38,949,662	3,543,007
MEAN	**3,260,608**	**3,200,495**	**2,805,422**	**2,868,630**	**3,300,288**	
STDEV	**164,125**	**139,361**	**296,106**	**322,859**	**74,626**	
ANNUAL GROWTH	**2%**	**14%**	**-2%**			

Table 2
SUMMARY of OPERATIONAL DATES of COWD PRODUCTION WELLS

YEAR	# of NEW Wells	YEAR	# of NEW Wells
1976	2	1996	2
1977	2	1998	2
1985	1	2000	1
1987	1	2002	2
1989	1	2004	3
1992	2	2005	2
1993	2	2006	2
1995	2	**TOTAL**	**27**

Looking at the monthly precipitation rates of seven years (2007 to 2012), it would seem that the least rain volume fell in the months of March and April with March as the most consistently driest month. Similarly, April happens to be the month with the least supply volume coming from COWD wells. Furthermore, the driest years would seem to be 2007 and

2012 while the least supplied years were 2007 and 2008. On the other hand, the wettest years were 2009 and 2011 while the years with the largest supply from COWD wells were the years 2010, 2011 and 2012. It is important to note though that 2009 and 2011 were sort of unusual years. These were the only years when January and December received the highest precipitation rates during the year. These were the times when the City experienced extreme flooding but it looked like the well supply capacity of the District did not seem to be greatly affected in, general. However, the flood that swept six production wells in December 2011 significantly affected supply, said month having the least production rate during the year.

Table 3

PRECIPITATION (in mm) in Cagayan de Oro from 2007 to 2012

MONTH	2007	2008	2009	2010	2011	2012
JAN	85.60	183.80	457.00	153.20	181.30	24.20
FEB	47.40	90.10	207.10	0.40	166.30	122.90
MAR	2.80	83.40	1.00	23.30	130.80	67.40
APR	24.20	165.80	155.00	16.40	34.90	74.20
MAY	135.20	170.70	233.70	153.50	118.30	152.70
JUN	248.00	228.20	189.90	155.30	231.60	144.90
JUL	212.50	240.70	308.10	353.20	182.50	273.70
AUG	233.10	193.20	138.60	212.20	226.80	174.60
SEP	181.60	279.10	209.70	264.80	232.30	200.30
OCT	209.80	253.20	107.10	279.70	209.10	185.20
NOV	160.80	101.40	329.30	62.80	115.60	42.30
DEC	99.20	143.40	36.20	131.80	333.60	207.00
Total	**1,640.20**	**2,133.00**	**2,372.70**	**1,806.60**	**2,163.10**	**1,669.40**
average	**136.68**	**177.75**	**197.73**	**150.55**	**180.26**	**139.12**
stdev	**84.18**	**65.04**	**126.72**	**112.58**	**76.07**	**75.24**

Bulk Water Supply of COWD, Total Supply and Non – Revenue Water (NRW)

As mentioned, COWD also gets bulk water supply from a private contractor. The tables that follow show the supply pattern from this source. It is observed that the supply from this source is more consistent in rate. The only months that appeared much lower than the rest are January and December in 2007 and 2011, respectively. January 2011 was the start of the bulk supply agreement while December 2011 was the time when the facilities of the contractor were greatly damaged by the typhoon Sendong. It is also important to note that while 2015 and 2016 experienced drought, supply rate from surface water did not seem to be affected.

Table 4a
WATER SUPPLY FROM BULK SUPPLY (2011 – 2016)

MONTH	2016	2015	2014	2013	2012	2011
	(in cu. m.)	*(in cu. m.)*	*(in cu. m.)*	*(in cu. m.)*	*(in cu. m.)*	*(in cu. m.)*
January	1,288,960	1,280,280	1,212,750	1,247,400	1,035,190	1,189,260
February	1,136,730	1,120,780	1,194,800	1,119,490	1,181,210	1,242,490
March	1,320,870	1,236,920	1,168,080	1,072,390	1,241,980	1,212,320
April	1,200,310	1,200,840	1,289,330	1,255,640	1,202,560	1,231,580
May	1,237,310	1,190,770	1,247,640	1,249,770	1,213,700	1,235,520
June	1,196,000	1,243,980	1,201,870	1,335,380	1,204,140	1,193,930
July	1,195,630	1,240,810	1,323,360	1,303,960	1,241,970	1,222,520
August	1,280,810	1,160,700	1,196,890	1,262,190	1,241,668	1,296,300
September	1,159,210	1,295,590	1,193,530	1,178,440	1,201,142	1,267,390
October	1,216,870	1,240,770	1,193,770	1,285,090	1,242,440	1,163,920
November		1,240,770	1,183,610	1,215,340	1,212,920	1,284,150
December		1,200,870	1,241,410	1,255,410	1,165,630	697,183
TOTAL	**12,232,700**	**14,653,080**	**14,647,040**	**14,780,500**	**14,384,550**	**14,236,563**
ave	**1,223,270**	**1,221,090**	**1,220,587**	**1,231,708**	**1,198,713**	**1,230,853**
st dev	**58,706**	**49,026**	**46,385**	**75,399**	**57,301**	**40,747**

Table 4b
WATER SUPPLY FROM BULK SUPPLY (2007 – 2010)

MONTH	2010	2009	2008	2007	average	st dev
	(in cu. m.)	*(in cu. m.)*	*(in cu. m.)*	*(in cu. m.)*	*(in cu. m.)*	*(in cu. m.)*
January	1,245,160	1,241,530	1,241,750	447,532	1,142,981	75,714
February	1,121,440	1,125,410	1,161,610	1,144,801	1,154,876	40,607
March	1,231,780	1,242,060	1,240,180	1,270,224	1,223,680	65,750
April	1,208,360	1,200,470	1,184,800	1,205,690	1,217,958	31,953
May	1,151,600	1,240,910	1,243,110	1,258,580	1,226,891	32,911
June	1,163,160	1,203,890	1,201,900	1,174,010	1,211,826	48,291
July	1,251,600	1,243,870	1,243,498	1,282,910	1,255,013	38,105
August	1,246,550	1,245,070	1,240,752	1,387,400	1,255,833	60,338
September	1,204,080	1,201,450	1,240,752	1,334,710	1,227,629	55,820
October	1,207,990	1,240,950	1,205,670	1,258,620	1,225,609	34,928
November	1,268,150	1,201,620	1,236,350	1,216,460	1,228,819	31,974
December	1,189,350	1,305,790	1,241,530	1,280,850	1,175,336	184,690
TOTAL	**14,489,220**	**14,693,020**	**14,681,902**	**14,261,787**	14,306,036	752,632
ave	**1,207,435**	**1,224,418**	**1,223,492**	**1,255,841**	**1,212,204**	**58,424**
st dev	**44,716**	**43,086**	**27,951**	**69,427**	**35,990**	**42,365**

Evaluating the total supply pattern with the impact of the Non-Revenue Water (NRW) or water wastage of the system, it would appear that the COWD continued to suffer from dwindling water availability. More water has gone to the drain than what has been supplied to the consuming public at an NRW rate of more than 50% all throughout the year for the past nine years (2007 to 2016). It could be seen from the table below that the NRW level began to increase dramatically in 2005, which was the year when COWD started operating 2 additional booster stations, Balulang and Bugo. The operation of these booster pumping stations caused remarkable increase in system pressure, which practically stressed old and weak pipes causing more leakages.

Table 5
TOTAL WATER SUPPLY and NRW (1976 – 2016)

Year	WATER SUPPLY			NRW	
	COWD Wells	bulk water	total	cum	%age
1976	4,546,716	-	4,546,716	3,739,980	82.26%
1977	4,515,966	-	4,515,966	2,679,369	59.33%
1978	4,818,389	-	4,818,389	2,767,850	57.44%
1979	5,999,908	-	5,999,908	2,309,876	38.50%
1980	5,758,818	-	5,758,818	1,079,145	18.74%
1981	7,025,665	-	7,025,665	1,257,406	17.90%
1982	9,507,575	-	9,507,575	2,431,386	25.57%
1983	10,150,124	-	10,150,124	1,692,227	16.67%
1984	10,158,501	-	10,158,501	1,400,849	13.79%
1985	10,856,481	-	10,856,481	1,793,807	16.52%
1986	11,745,295	-	11,745,295	2,013,334	17.14%
1987	12,594,909	-	12,594,909	2,027,076	16.09%
1988	14,423,194	-	14,423,194	2,803,002	19.43%
1989	14,776,658	-	14,776,658	2,216,568	15.00%
1990	18,691,903	-	18,691,903	4,994,191	26.72%
1991	20,601,725	-	20,601,725	6,189,718	30.04%
1992	21,742,375	-	21,742,375	5,048,209	23.22%
1993	23,700,801	-	23,700,801	7,216,001	30.45%
1994	26,386,936	-	26,386,936	8,110,373	30.74%
1995	26,419,821	-	26,419,821	7,153,799	27.08%
1996	28,369,248	-	28,369,248	8,051,302	28.38%
1997	30,380,383	-	30,380,383	8,704,196	28.65%
1998	30,003,696	-	30,003,696	8,293,421	27.64%
1999	28,198,382	-	28,198,382	6,831,702	24.23%
2000	27,342,239	-	27,342,239	6,957,354	25.45%
2001	28,803,751	-	28,803,751	8,333,534	28.93%
2002	28,377,625	-	28,377,625	8,476,315	29.87%
2003	31,785,980	-	31,785,980	10,192,983	32.07%
2004	35,117,160	-	35,117,160	12,851,949	36.60%
2005	40,782,459	-	40,782,459	17,698,083	43.40%
2006	42,708,791	-	42,708,791	19,616,964	45.93%
2007[1]	34,423,563	14,261,787	48,685,350	25,551,576	52.48%
2008	33,665,066	14,681,902	48,346,968	25,773,913	53.31%
2009	38,405,937	14,693,020	53,098,957	29,781,092	56.09%
2010[2]	39,127,291	14,489,220	53,616,511	29,626,720	55.26%
2011	39,252,383	14,236,563	53,488,946	29,714,914	55.55%
2012	39,459,345	14,384,550	53,843,895	29,264,781	54.35%
2013	42,375,733	14,780,500	57,156,233	30,920,142	54.10%
2014	43,744,069	14,647,040	58,391,109	31,341,618	53.68%
2015	43,296,957	14,653,080	57,950,037	30,509,970	52.65%
2016	42,895,531	14,679,240	57,574,771	28,893,533	50.18%

Similarly, the year 2008 was immediately after the first delivery of the bulk supply at 40 MLD. It was observed that NRW level of COWD reached more than 50% starting 2007 when pressure at the distribution side increased upon injection of additional supply. Thus, in the following year, 2008, the District had to shut down and/or reduce discharge from 1 to 2 wells. In 2009, COWD had to put back in operation all wells to augment pressure since there had been no massive efforts to plug the leaking pipes at that time then. However, it was apparent that the additional supply actually just dissipated because of pipe leakages. On the other hand, the supply increase in 2013 was primarily due to the replacement of six (6) pump facilities, which were damaged by the typhoon in 2011. The efficiency of these wells improved and so were the respective discharge rates.

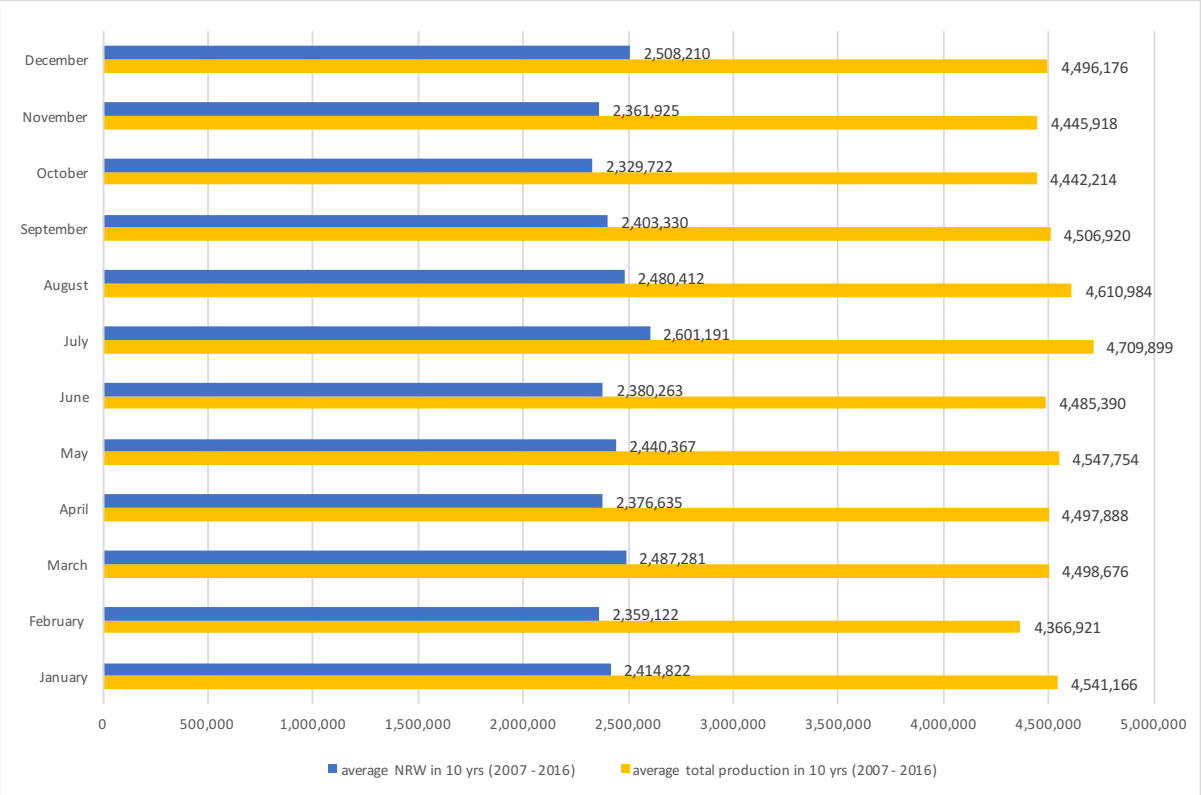

Figure 2
Monthly Average Total Supply and

Average NRW per Month (2007 – 2016)

Consumption Pattern by Customer Classification and Temperature

The table below illustrates that the average monthly consumption of the residential connections has declined in the past 7 years. From an average of about 30 cubic meters per month in 2009, a household in 2016 instead consumes only about an average of 24 cubic meters in a month. On the other hand, the monthly average consumption of a commercial connection over the same period has not changed as much as a residential connection. However, variations in the monthly consumption pattern of residential connections are rather far less sparse compared to monthly variations in commercial connections. Monthly consumption variations in residential connections vary only about 1 cubic meter per month on the average while those of commercial connections can differ by 9 to 14 cubic meters from each month, on the average. Irrespective of classification use, average total monthly consumption in the same past 7 years had dropped from about 33 cubic meters in 2009 to about 29 cubic meters in 2016.

Presumably, consumption may be higher during hotter seasons than the colder months. This seems to match with the consumption pattern of residential connections, which, from the tables that follow, suggest that a household would tend to consume more in the months of April and May. These are the same months when temperatures are also relative higher than the rest of the months. However, the dwindling monthly consumption of each connection over the years can also be logically associated with the continuing rise in the NRW level of the system considering that supply has continued to increase as well until 2014. In fact, assuming average consumption of 33 cubic meters per connection per month for a total of 90,000 connections (approximate existing number of connections of COWD), COWD would need about 36M cubic meters of water supply in a year. This is only about 63% of the existing supply capacity of COWD. Say, the most doable NRW level after 5 to 8 years would be 30% of the existing

supply capacity, the excess in supply of about 4M cubic meters in a year can still afford to serve about 10,000 more connections of about 33 cubic meters demand per month.

Table 6a
CONSUMPTION PER RESIDENTIAL CONNECTION
in CUBIC METERS (2014 – 2016)

MONTH	2016	2015	2014	AVERAGE	ST DEV
jan	24.50	27.88	27.46	28.02	3.87
feb	55.74	23.23	23.64	25.88	1.94
mar	22.83	21.79	24.18	25.14	2.24
apr	23.63	23.66	24.45	26.45	2.46
may	24.55	23.56	27.63	26.51	1.78
jun	23.51	24.26	25.60	26.11	1.73
jul	23.60	23.83	26.68	26.67	1.97
aug		24.29	25.76	27.32	1.90
sep		23.09	30.11	27.53	2.38
oct		23.10	26.17	25.94	2.13
nov		24.38	25.35	27.10	2.18
dec		37.29	24.58	27.79	4.96
TOTAL	**198.36**	**249.24**	**311.60**	**320.04**	36.27
AVERAGE	**23.77**	**25.03**	**25.97**		
ST DEV	**0.66**	**4.12**	**1.81**		

Table 6b
CONSUMPTION PER RESIDENTIAL CONNECTION
in CUBIC METERS (2009 – 2013)

MONTH	2013	2012	2011	2010	2009
jan	24.88	25.03	28.38	29.61	36.44
feb	26.92	25.31	26.01	27.98	28.05
mar	24.04	26.20	26.79	27.51	27.79
apr	28.10	26.17	26.42	29.73	29.44
may	27.52	26.33	26.74	26.52	29.21
jun		26.63	27.36	27.16	28.23
jul	26.73	27.93	27.38	28.38	28.86
aug	28.08	26.76	27.59	28.83	29.91
sep	27.27	26.62	27.16	28.56	29.89
oct	78.16	24.08	25.73	28.03	28.54
nov	42.00	27.11	30.32	26.65	28.76
dec	23.65	25.45	18.74	27.80	27.99
TOTAL	**357.35**	**313.61**	**318.63**	**336.75**	**353.11**
AVERAGE	**26.35**	**26.13**	**27.26**	**28.06**	**29.43**
ST DEV	**1.71**	**1.03**	**1.26**	**1.03**	**2.32**

Table 7a
CONSUMPTION PER COMMERCIAL CONNECTION
in CUBIC METERS (2014 – 2016)

MONTH	2016	2015	2014	AVERAGE	ST DEV
jan	49.02	49.79	57.64	53.64	9.22
feb	46.16	47.42	48.13	53.94	13.14
mar	47.68	44.34	50.39	52.64	10.11
apr	50.22	48.23	49.64	55.57	14.01
may	53.08	48.85	55.33	52.92	5.33
jun	50.05	52.13	51.08	53.89	6.35
jul	50.78	47.10	54.53	54.28	7.44
aug		47.33	50.80	54.34	5.12
sep		44.20	49.83	51.81	4.20
oct		45.76	47.39	47.86	11.42
nov		47.39	47.15	51.52	3.05
dec		77.46	45.16	55.04	11.13
TOTAL	297.97	550.21	607.06	626.91	54.86
AVERAGE	49.57	50.00	50.59		
ST DEV	2.23	8.92	3.66		

Table 7b
CONSUMPTION PER COMMERCIAL CONNECTION
in CUBIC METERS (2009 – 2013)

MONTH	2013	2012	2011	2010	2009
jan	74.74	46.60	52.10	52.16	47.08
feb	85.84	47.73	52.04	53.72	50.44
mar	76.77	49.78	53.76	50.13	48.29
apr	89.54	46.75	52.41	51.77	56.03
may	57.22	45.22	60.66	47.33	55.70
jun		48.40	57.11	66.93	51.50
jul	55.64	48.55	55.13	71.04	51.49
aug	55.98	52.73	52.73	57.69	63.10
sep	51.07	55.20	50.87	55.56	55.94
oct	56.68	24.08	49.12	55.26	56.73
nov	54.15	52.82	51.61	53.06	54.43
dec	50.75	55.46	44.25	54.46	57.75
TOTAL	708.40	573.32	631.78	669.10	648.47
AVERAGE	64.40	47.78	52.65	55.76	54.04
ST DEV	14.42	8.20	4.04	6.79	4.48

Table 8a
TOTAL CONSUMPTION PER CONNECTION
in CUBIC METERS (2009 – 2013)

MONTH	2009	2010	2011	2012	2013
jan	38.06	31.60	30.52	26.90	28.92
feb	29.93	30.04	28.28	27.34	29.36
mar	29.30	29.49	29.24	28.35	26.28
apr	31.47	31.45	28.66	28.15	30.61
may	31.36	28.37	28.76	28.15	29.95
jun	30.23	29.36	29.85	28.73	
jul	30.75	30.74	29.88	27.72	29.33
aug	32.25	31.26	29.88	28.85	30.67
sep	31.88	30.78	29.39	29.00	29.31
oct	30.83	30.35	27.96	28.11	30.10
nov	30.82	28.81	28.85	29.44	30.55
dec	42.54	30.15	27.87	27.89	28.13
TOTAL	389.42	362.41	349.13	338.64	**323.21**
AVERAGE	32.45	30.20	29.09	28.22	29.38
ST DEV	3.88	1.04	0.84	0.72	1.29

Table 8b
TOTAL CONSUMPTION PER CONNECTION
in CUBIC METERS (2014 – 2016)

MONTH	2014	2015	2016	AVERAGE	ST DEV
jan	32.38	32.34	29.46	31.27	3.32
feb	27.71	27.21	27.60	28.44	1.17
mar	28.25	27.07	27.78	28.22	1.14
apr	28.71	29.05	28.83	29.62	1.34
may	32.33	28.88	29.62	29.68	1.49
jun	30.17	29.61	28.54	29.50	0.66
jul	31.16	28.92	28.99	29.69	1.17
aug	30.34	29.67		30.42	1.11
sep	30.12	27.84		29.76	1.31
oct	30.48	28.10		29.42	1.29
nov	29.67	27.68		29.40	1.08
dec	28.73	27.43		30.39	5.43
TOTAL	**360.05**	**311.48**		347.76	26.16
AVERAGE	30.00	28.65	28.69	29.65	
ST DEV	1.49	1.47	0.78	0.82	

Table 9
TEMPERATURE PATTERN (2007 – 2012)

Month	2007	2008	2009	2010	2011	2012
JAN	25.90	25.60	25.85	25.90	26.15	26.65
FEB	25.75	25.60	26.30	26.50	25.90	26.90
MAR	26.80	26.20	27.00	27.80	26.55	27.70
APR	28.00	27.05	27.85	28.50	27.30	28.10
MAY	28.25	27.20	27.65	29.00	28.00	27.90
JUN	27.45	26.65	27.75	28.35	27.70	28.55
JUL	27.00	26.75	27.10	27.55	27.60	27.30
AUG	27.15	26.50	27.15	27.55	27.70	28.40
SEP	27.50	26.75	28.20	27.35	27.80	27.45
OCT	27.00	26.50	27.35	27.40	27.35	27.35
NOV	25.90	26.30	26.30	27.35	27.40	27.10
DEC	26.05	26.45	25.95	27.10	27.00	26.85
ave	26.90	26.46	27.04	27.53	27.20	27.52
stdev	0.84	0.49	0.78	0.84	0.67	0.62

Consumption Pattern Vis-à-vis Water Availability (in hours)

Considering the high NRW level of the COWD system, portions in the service area are not supplied with water 24 hours a day. In fact, as shown below, about 31% or some 27,965 connections have intermittent supply of less than 24 hours in a day while about 69% or some 61,804 connections get water supply 24/7. Furthermore, about 68% of the residential connections get 24/7 supply while 32% do not. On the other hand, a larger proportion of the commercial connections (81%) have 24/7 supply and only 19% have not. The government connections are, more less receiving water supply 24/7 for a little more than half of the population while the other less than half, get water less than 24 hours a day.

Table 10
Distribution of Service Connection by Classification and Water Availability as of July 2016

AVAILABILITY	RES	COMM	GOVT	TOTAL	%
24 HRS	56,724	4,881	199	**61,804**	***69%***
23 - 13 HRS	17,776	917	127	**18,820**	***21%***
12 HRS & BELOW	8,866	258	21	**9,145**	***10%***
TOTAL	**83,366**	**6,056**	**347**	**89,769**	***100%***
%	***93%***	***7%***	***0%***	***100%***	

When consumption patterns of service connections were further grouped according to water availability, consumption by water availability has not changed significantly in the last 7 years, especially for the residential connections. For instance, those getting water supply 24/7 consume an average of 26 cubic meters per month at a standard deviation of 1.26 cubic meters while those getting water less than 24 hours a day consume about 21 cubic meters per month at an even much closer standard deviation of only about 0.60 cubic meters monthly. The consumption pattern by water availability for commercial connections while not as dense as the residential connections, but variations over the past 7 years have not been that much at not more than 3 cubic meters per month. The variations in total consumption pattern irrespective of classification of use at all water availability levels across the years are even more homogeneous at less than 1 cubic meter per month.

Table 11
Average Annual Consumption by Classification and Water Availability (2009 – 2016)

OVERALL AVERAGE - RESIDENTIAL								
AVAILABILITY	**2016**	**2015**	**2014**	**2013**	**2012**	**2011**	**2010**	**2009**
24 HRS	24.48	24.23	24.89	25.82	25.61	26.28	26.95	27.91
23 - 13 HRS	22.23	22.28	22.66	23.16	22.35	22.89	23.51	23.52
12 HRS & BELOW	20.42	20.45	20.38	20.76	19.64	20.53	21.59	21.82

OVERALL AVERAGE - COMMERCIAL								
AVAILABILITY	**2016**	**2016**	**2015**	**2014**	**2013**	**2012**	**2011**	**2010**
24 HRS	48.02	44.72	49.94	50.44	46.77	49.61	50.32	49.13
23 - 13 HRS	46.27	42.25	43.96	45.78	37.61	40.74	40.28	40.34
12 HRS & BELOW	43.56	39.82	39.91	40.04	35.57	36.72	38.87	39.00
OVERALL AVERAGE - TOTAL								
AVAILABILITY	**2016**	**2016**	**2015**	**2014**	**2013**	**2012**	**2011**	**2010**
24 HRS	27.72	27.36	27.69	27.71	27.36	28.53	28.98	29.48
23 - 13 HRS	24.56	24.12	24.36	24.71	23.54	24.37	24.90	25.28
12 HRS & BELOW	21.47	21.50	21.21	21.39	20.30	21.20	22.01	22.19

However, it is notable to remark that consumption of connections with 24 – hour water supply is far higher than those with less than 24 – hour water availability. The former can consume, on the average by as much as 26 cubic meters per month while the latter can use water at 20 cubic meters per month only (residential connections). On the other hand, commercial connections with 24 – hour water supply can use as much as 49 cubic meters per month on average and only 39 cubic meters for those with fewer hours of supply availability. These figures suggest that consumption pattern of COWD customers at existing water supply system conditions seem to be largely dependent on the water availability in the lines and this circumstance is more triggered by the NRW situation of the system. Moreover, looking at the monthly variations in consumptions across all classification use and water availability, such are still more homogeneous than sparse but the month of August tend to register higher consumption while the month of March records the lowest consumption rate.

Table 12
Average Monthly Consumption by Classification and Water Availability (2009 – 2016)

Month	RESIDENTIAL			COMMERCIAL			TOTAL		
	24 HRS	23 - 13 HRS	12 HRS & BELOW	24 HRS	23 - 13 HRS	12 HRS & BELOW	24 HRS	23 - 13 HRS	12 HRS & BELOW
DEC	25.12	22.01	20.16	46.97	40.45	39.94	27.73	23.80	20.88
NOV	25.77	22.91	20.70	48.42	41.48	39.25	27.86	24.42	21.37
OCT	25.86	22.63	20.60	48.77	41.70	39.14	27.96	24.28	21.31
SEP	26.24	22.56	20.83	48.82	41.84	36.33	28.38	24.32	21.51
AUG	26.92	23.55	20.85	50.94	42.94	39.84	29.38	25.14	21.53
JUL	26.02	22.86	20.84	50.63	43.94	40.01	28.55	24.40	21.50
JUN	25.74	23.58	21.34	48.72	42.83	40.12	28.19	25.18	22.10
MAY	26.16	23.40	20.96	48.95	42.80	41.97	28.50	24.90	21.63
APRIL	25.90	23.23	21.35	47.48	41.88	38.04	28.21	24.99	22.03
MAR	24.80	21.87	19.89	46.86	42.57	38.94	27.04	23.83	20.54
FEB	24.94	22.29	19.74	47.30	38.94	37.17	26.99	23.27	20.46
JAN	26.75	23.31	21.26	50.03	41.60	36.58	28.78	25.15	21.95
AVERAGE	**25.85**	**22.85**	**20.71**	48.62	42.15	39.19	28.10	24.48	21.41
ST DEV	**0.65**	**0.59**	**0.54**	**1.36**	**1.30**	**1.65**	**0.68**	**0.62**	**0.54**

III. DEMAND and SUPPLY PROJECTIONS

The existing annual supply capacity of the District comprises sources from groundwater and surface water in the total volume of 57,952,053 cubic meters. Total demand from service connection consumption could be as much as 35,640,000 cubic meters, which is just about 62% of the total supply capacity. However, with an existing NRW of about 30,000,000 cubic meters in 2016, this adversely impacts on the total supply capacity of the District, which is short by more than 6,000,000 cubic meters. Thus, it is imperative and urgent for the District to prioritize NRW reduction efforts to save the wasted volume and instead use such to serve the needs of the public.

Table 13
Future Additional Additional Sources

SOURCE	Location	Target date	Capacity	
			cum/day	cum/yr
PW30	Macasandig	Q1 2017	2,500	912,500
PW31	Ayesa	Q3 2017	4,000	1,460,000
PW 33	Lumbia	Q2 2018		1,460,000
Bulk supply	west	Q3 2017	20,000	7,300,000
Bulk supply	east	Q1 2018	20,000	7,300,000
Bulk supply	east	Q1 2019	20,000	7,300,000

By early part of 2017, 2 more wells shall be added into the system. At the moment, the construction of the facilities in these well locations are being undertaken. Another well, which is on the drilling phase at the moment, is expected to be completed and in full operation by second half of 2018. This will bring in additional 3,832,500 cubic meters by 2018. Such volume can already serve about 10,000 new connections. Also, beginning 2017, another 7,300,000 cubic meters shall be introduced into the system. This shall come from a surface water source which the District has contracted through a Joint Venture Agreement with a private partner. The same volume shall be coming in in the succeeding years (2018 and 2019) bring the total supply capacity of the District more than 82,224,562.

Table 14
Projected Additional Supply

YEAR	EXISTING		ADDITIONAL		TOTAL
	PWs	Bulk	PWs	Bulk	
2016	43,296,957	14,653,080	0	0	57,952,053
2017	43,296,957	14,653,080	2,372,500	7,300,000	67,624,554
2018	45,669,457	21,953,080	0	7,300,000	74,924,555
2019	45,669,457	29,253,080	0	7,300,000	82,224,556
2020	45,669,457	36,553,080	0	0	82,224,557
2021	45,669,457	36,553,080	0	0	82,224,558
2022	45,669,457	36,553,080	0	0	82,224,559
2023	45,669,457	36,553,080	0	0	82,224,560
2024	45,669,457	36,553,080	0	0	82,224,561
2025	45,669,457	36,553,080	0	0	82,224,562

Table 14
Projected Supply, Demand (by classification) and NRW

PARTICULAR	2017	2018	2019	2020	2021
Residential	33,012,969	33,678,087	34,755,614	35,793,533	38,796,204
Commercial	317,982	324,425	330,996	337,700	361,812
Government	93,372	95,260	97,185	99,149	111,681
Total	33,424,322	34,097,771	35,183,795	36,230,382	39,269,698
TOTAL SUPPLY	67,624,554	74,924,555	82,224,556	82,224,557	82,224,558
NRW(cum)	33,812,277	35,963,786	37,823,296	36,178,805	34,534,314
NRW (%)	50%	48%	46%	44%	42%
Excess/Short of Supply	387,955	4,862,998	9,217,465	9,815,370	8,420,546
	1%	6%	11%	12%	10%
PARTICULAR	**2022**	**2023**	**2024**	**2025**	**2026**
Residential	39,499,113	40,357,300	41,232,793	42,510,006	43,511,685
Commercial	368,336	374,976	381,733	392,627	399,834
Government	113,698	115,751	117,839	121,264	124,173
Total	39,981,147	40,848,026	41,732,364	43,023,898	44,035,692
TOTAL SUPPLY	82,224,559	82,224,560	82,224,561	82,224,562	82,224,562
NRW(cum)	32,889,824	31,245,333	29,600,842	27,956,351	26,311,860
NRW (%)	40%	38%	36%	34%	32%
Excess/Short of Supply	9,353,588	10,131,201	10,891,355	11,244,313	11,877,010
	11%	12%	13%	14%	14%
PARTICULAR	**2027**	**2028**	**2029**	**2030**	
Residential	44,199,139	44,896,782	45,604,775	48,016,107	
Commercial	406,122	412,507	418,991	443,803	
Government	126,129	128,114	130,130	141,770	
Total	44,731,389	45,437,404	46,153,897	48,601,680	
TOTAL SUPPLY	82,224,562	82,224,562	82,224,562	82,224,562	
NRW(cum)	24,667,369	23,022,877	21,378,386	19,733,895	
NRW (%)	30%	28%	26%	24%	
Excess/Short of Supply	12,825,804	13,764,281	14,692,279	13,888,987	
	16%	17%	18%	17%	

Despite this additional volume into the system, with the high NRW level coupled with the increase in demand from service connection consumption, excess in supply still remains low at less than 20% in 2030. Therefore, it is as well urgent and important to consider water conservation efforts.

On the other hand, it may be an important point to note that the projected average water consumption of a residential connection has been assumed at 30 cubic meters, which is the historical consumption in areas with 24 – hour supply. The tables in the annexes show the details of the consumption patterns of areas in varying water supply conditions. In the case of COWD, about 98% of the total water demand comes from the residential connections.

PART 2 – WATER CONSERVATION PLAN

WATER CONSERVATION WORKPLAN
OF THE
CAGAYAN DE ORO CITY WATER DISTRICT

(Version 1.1 12/12/2016)

WATER DISTRICT INFORMATION

On August 1, 1973, the Cagayan de Oro City Water District (COWD) was formed as the first water district in the country. It was issued the conditional certificate of conformance (CCC) No. 001 on January 4, 1974 by the Local Water Utilities Administration (LWUA).COWD was born as a self reliant quasi-public entity with the implementation of the Provincial Water Utilities Act of 1973 or PD 198, which created the water districts nationwide. However, through a Supreme Court decision, all Water Districts in the country have been categorized as government-owned and controlled corporation (GOCC) since March 1992.

COWD started with 3,500 service connections when it took over the management of the then NAWASA or the City Waterworks System in 1973. This represented about 21% of the total City population of 117,895 during that year then. The average water production was 12,200 cubic meters per day distributed to consumers through transmission and distribution lines, 39 kilometers long. As of December 2015, the District currently serves 88,076 service connections with an average water production capacity of 170 million liters per day (MLD). This reflects that in 4 decades, COWD has grown around 24 times in service connections, and 13 times in water production capacity. The potable water COWD serves to the public comes from twenty-seven (27) wells distributed in the six (6) well fields situated at Macasandig, Balulang, Calaanan, Bugo, and Tablon/Agusan. There is one spring source located at Malasag. Since 2007, about 40 MLD of the District's total water production capacity has been supplied by a bulk water contractor.Production facilities include three (3) major booster pumping stations and eight (8) reservoirs while transmission and distribution lines extend up to 565.50 kilometers ranging from 50mm – diameter to 800mm – diameter in size.

At the moment, COWD has extended services to 6 barangays in Opol, a municipality of Misamis Oriental adjacent to Cagayan de Oro in the west side and to 1 barangay in Tagoloan, the municipality next to the City in the east side. In total, 63 of the 80 barangays of the City

have been covered by COWD services. As of December 2015, water service has reached 887,816 representing about 92% of the total estimated population of the District's service area.

OBJECTIVE.

The primary driver of the Cagayan de Oro City Water District in crafting this Water Conservation Workplan is to "Create Additional Supply" where traditional supply is available (in the template this is driver "5a"). COWD produces about 173 MLD of water, of which 40 MLD comes from a Bulk Water Supplier. The Bulk Water Supplier taps surface water from a tributary of Cagayan de Oro River and their current capacity is 100 MLD. Furthermore the Non-Revenue Water of COWD is at 58%, which translates to about 100 MLD.

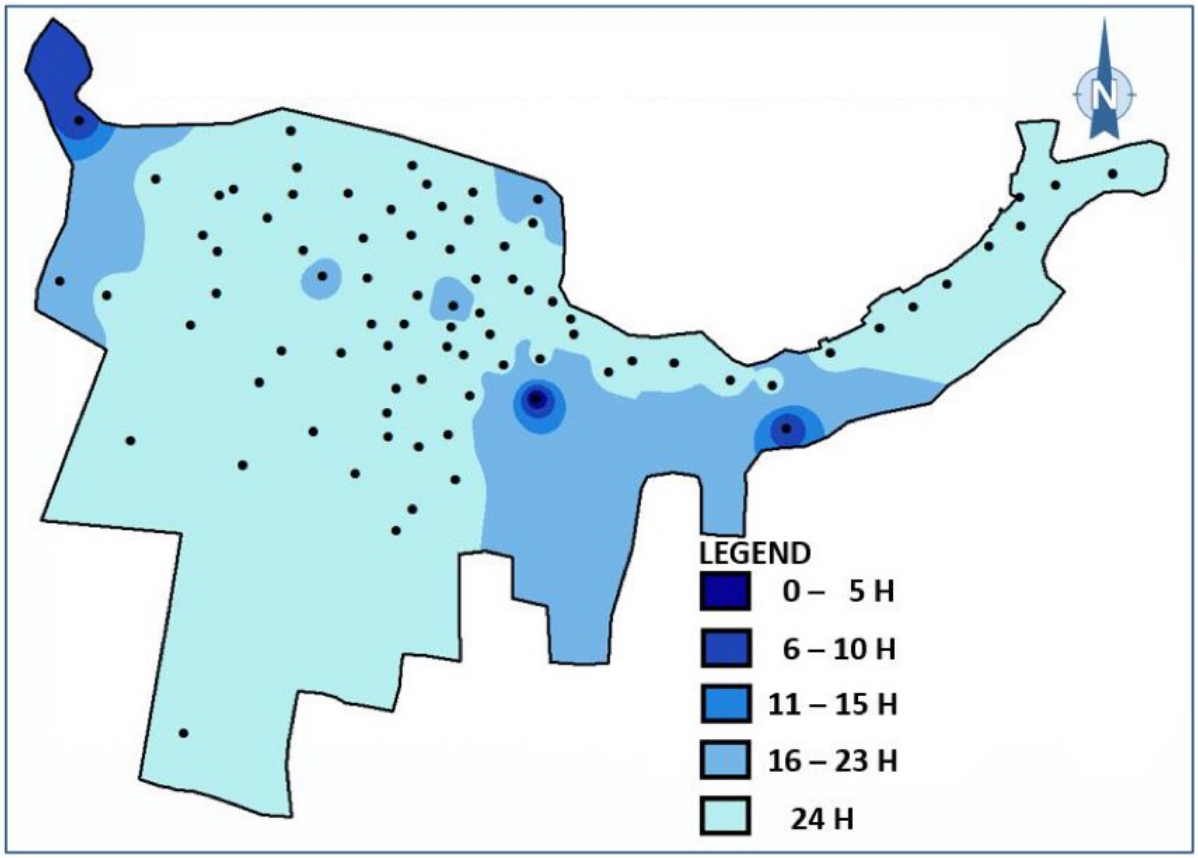

Figure 1. Average Supply Time Map of COWD

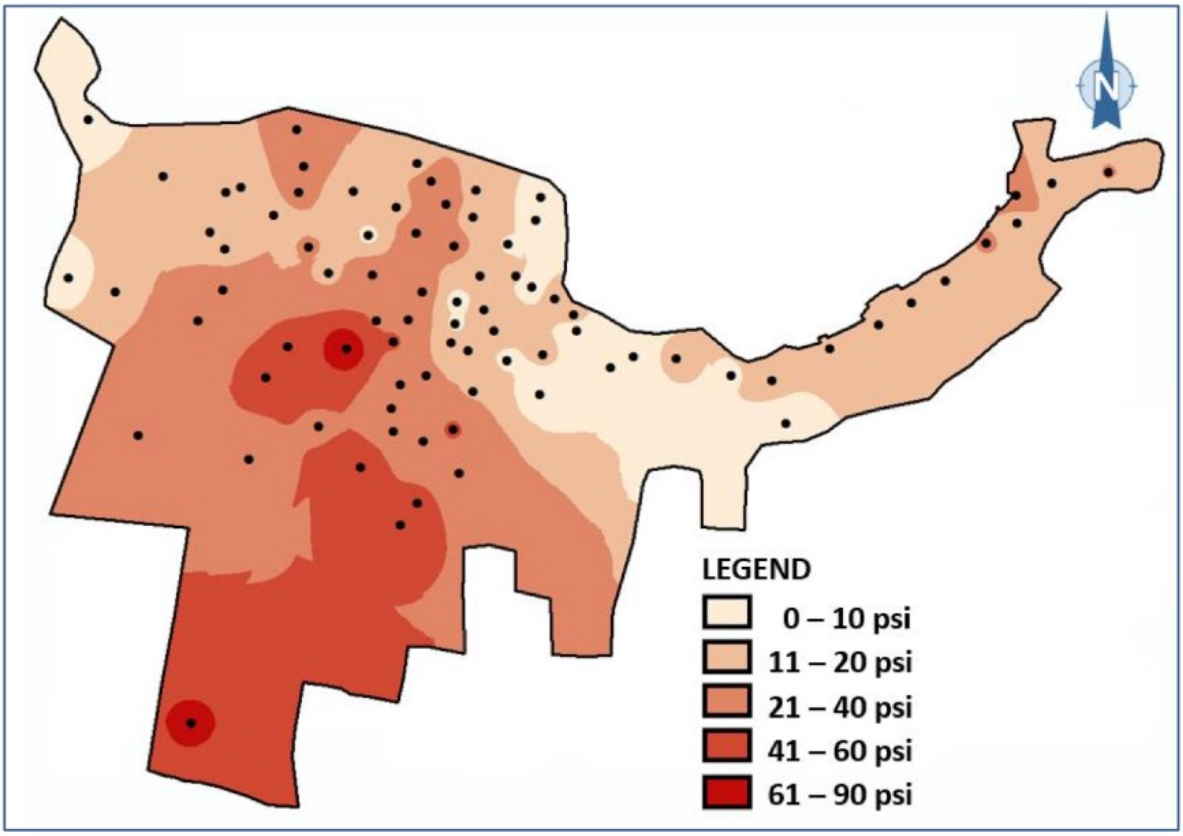

Figure 2. Average Operating Pressure Map

From Figure 1 above, based on the results of the monitoring done through the NRW Reduction Project funded by the USAID Be Secure Project, we see that there are portions of the service area which experiences water supply less than 24 hours. Furthermore in Figure 2, there are areas where water pressure is less than desirable (i.e. Less than 10 psi).

COWD clearly, would want to create additional supply where traditional supply is available. This can be done by addressing the supply side and the demand side of the water supply system.

INITIAL MEASURES/INCENTIVES.

Supply-side Measures/Incentives.

One of the primary concerns facing COWD today is its very high NRW. In the Water Balance recently completed through NRW Reduction Project, 58% of the total input volume or about 100 MLD is non-revenue water.

Figure 3 below shows the details of the COWD Water Balance for 2015.

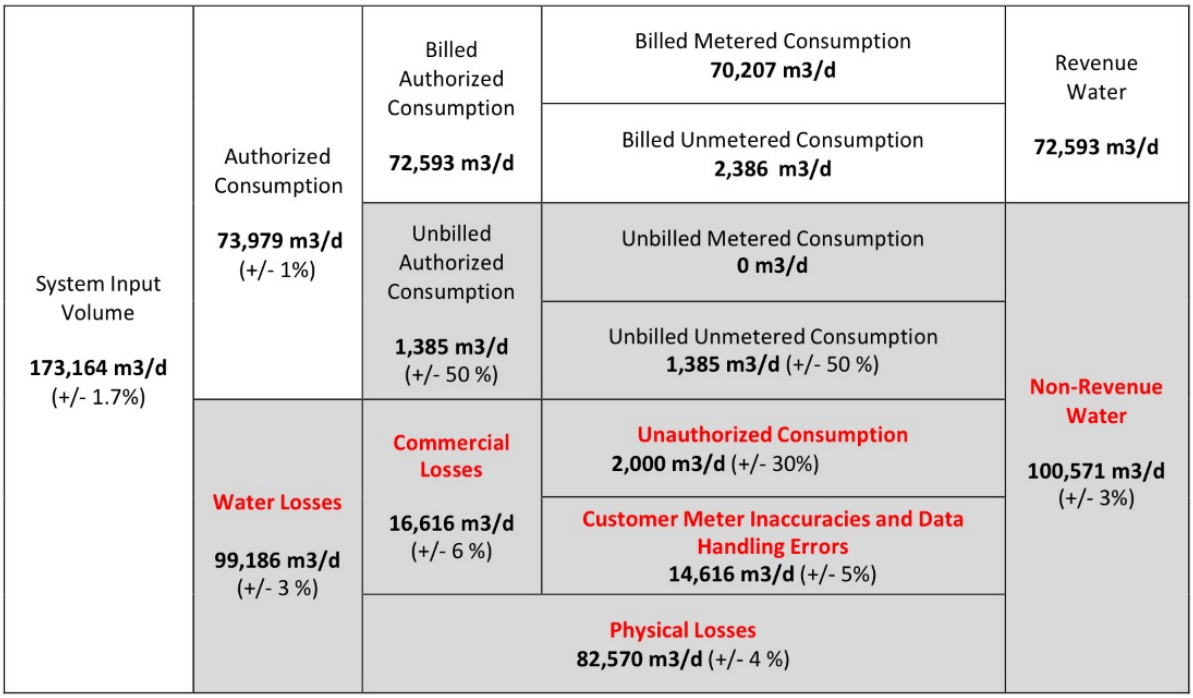

Figure 3. Water Balance for 2015

The system input volume of 173 MLD was determined using electromagnetic flowmeters. This figure is estimated to have an error of +/- 1.7%.

Improving System Uses. The measure that COWD can implement in this aspect is to improve the accuracy of its billings to its customers by implementing a Comprehensive Water Meter Replacement Program. This is very important because based on the NRW Reduction Project, the average water meter under-registration is 18%.

Attention to Leaks. One of the first measures COWD implemented was to improve response time to repairing leaks. It has set timelines for addressing service connection leaks and mainline leaks, such that these are repaired within 48 hours and 24 hours respectively. In order to facilitate this, leak detection teams go out three nights per week in order to accurately locate these leaks which are often located under concrete road pavements. However, COWD has not yet implemented a Programmatic Leak Detection Program but it intends to do so once resources become available.

The NRW Reduction Program. COWD, a few years back has started to work for the release of a loan, with a government bank, in the amount of Php 458M intended for its NRW Reduction Program. During this process, we realized that we needed expert assistance on how to implement the program. Fortunately, it is the recipient of a Technical Assistance from the USAID through its Be Secure Project and the Coca-cola Foundation for its Non-Revenue Reduction Program. This is being implemented by Miya Philippines. The technical assistance is intended to provide COWD with expertise and guidance in addressing NRW. While this assistance focuses on only three areas of Cagayan de Oro City, it is hoped that through this the water district can replicate the measures implemented such as Hydraulic Modeling and Analysis, DMA Construction and Management, and standard leak repair methods among others.

In summary, the important components of this program are the following:

1. Comprehensive Water Meter Replacement Program
2. Programmatic Leak Detection
3. Hydraulic Modeling (this would allow for more efficient analysis including pressure management)
4. DMA Construction (this would allow for a more effective NRW management)
5. Selective Pipe Replacement.

Demand-side Measures/Incentives

Current Measures. At present COWD is not implementing any measure that saves water, for example, through the use of more efficient toilets. While these plumbing fixtures are available in the market, however these are not labeled and marketed properly.

Current Incentives. The water rates structure of COWD is an Inclining Block, where, customers pay more per cubic meter as their consumption goes higher. However, the inclining block currently used by COWD can still be improved by making the difference in the price per block higher than the current Php2.35 difference.

APPROVED WATER RATES						
Approved by the Local Water Utilities Administration						
Classification	Meter size	Minimum Charge	Commodity Charge			
			11-20 cu.m	21-30 cu.m	31-40 cu.m	41-up cu.m
Residential/ Government	1/2"	218.40	30.55	31.85	33.65	36.00
	3/4"	349.40	30.55	31.85	33.65	36.00
	1"	698.90	30.55	31.85	33.65	36.00
	1 1/2"	1,747.20	30.55	31.85	33.65	36.00
	2"	4,368.00	30.55	31.85	33.65	36.00
	3"	7,862.40	30.55	31.85	33.65	36.00
	4"	15,724.80	30.55	31.85	33.65	36.00
Commercial/ Industrial	1/2"	436.80	61.10	63.70	67.30	72.00
	3/4"	698.80	61.10	63.70	67.30	72.00
	1"	1,397.80	61.10	63.70	67.30	72.00
	1 1/2"	3,494.40	61.10	63.70	67.30	72.00
	2"	8,736.00	61.10	63.70	67.30	72.00
	3"	15,724.80	61.10	63.70	67.30	72.00
	4"	31,449.60	61.10	63.70	67.30	72.00

Besides using an inclining block water rates structure, the water district focuses its efforts on water conservation through educational endeavors such as, radio skits, distribution of flyers and brochures. We also conduct water conservation campaigns during Barangay Consultations which we do on a regular basis. Furthermore, we conduct orientation for new customers where we also include water conservation tips.

New Measures/Incentives. Since we consider commercial customers and government offices as relatively more important considering the volume of water they consume, we would like to implement the following for these customers:

Measures:

1. Conduct Water Audits for these customers to make them see the benefits of using more efficient fixtures.
2. Orient them on what fixtures are available in the market.

Incentives:

1. Provide Water Conservation Stickers which they can place in conspicuous places inside their public toilets.

For our residential customers, we would like to implement following:

Measures:

1. Work with local distributors and the Department of Trade and Industry to properly market efficient plumbing fixtures.

Incentive:

1. Improve current media campaigns on water conservation by including social media initiatives.

Finally, for all our customers, we would like to implement the following:

Incentive:

1. Improved Inclining Block water rates structure.

Screening. The primary screens for COWD in selecting measures and incentives would be Longevity of Water Savings, Cost Effectiveness, and Customer Acceptance. We would want measures and incentives that will provide savings that will be sustained over the long-term. Since our resources are limited, Cost Effectiveness in important for us. Finally, we would like our customers to accept the measures and incentives we plan to implement, otherwise success would be difficult to achieve.

ANALYSIS OF MEASURES AND INCENTIVES

Supply-side Measures and Incentives

NRW Reduction Program. Quite clearly, aside from regulatory requirements, this program is very important for COWD. It will redound to the availability of more water for the growing needs of the city. A two percentage point reduction in NRW for example will result into an additional 3.4 MLD of water every day, enough for about 3,400 families. Eventually, any expenditure for reducing NRW will at least pay for itself.

Demand-side Measures and Incentives

Conduct of Water Audits. The resources of COWD will not be enough to implement this on a massive scale. What may be doable, at least in the initial stage, will be to implement this for the City Government, and for Centrio Mall, a major mall in the city. Hopefully through the influence of the City Government and the contacts of a major business like Centrio Mall, other establishments will conduct water audits on their own.

Orientation on Available Efficient Fixtures. Like Water Audits, this, at least in the initial stage, will be done for the City Government and Centrio Mall. While this is relatively easier to do, this will only be effective if done after a water audit.

Provide Water Conservation Stickers. This will be an effective partnership undertaking between COWD and commercial establishments. However, considering resources available, this incentive will initially be limited to restaurants in the city. Implementing this for hotels and offices would already be very expensive.

Work with Distributors and DTI to Properly Market Efficient Fixtures. Considering that there is no regulatory basis for this under existing laws, what can be done would be a joint effort for both COWD and the distributors. We can place informative posters within water district premises, on how much an efficient toilet consumes compared to an inefficient one. The distributors then can also place labels on their products showing how much water these consume.

Improve Media Campaigns. COWD has been doing this already but this can be further improved by including the social media. Specific things that can be done would be to open official Facebook, Twitter, and other social media accounts and use these as an avenue for discussing water conservation.

Improve Inclining Block Water Rates Structure. This will take some time to implement considering the regulatory requirements involved. However COWD can start designing an appropriate water rates structure and submit this to the Local Water Utilities Administration for approval.

Other Financial Incentives. The water district is not yet in a position to introduce other financial incentives such as rebates for using efficient toilets for example. The regulatory framework presently existing is not conducive for the introduction of rebates. This would require a legislative action from either the national government or the local government.

Regulatory Incentive. There are provisions in the National Building Code which requires certain plumbing standards however these are often not enough to really promote water conservation. A local ordinance which improves upon the national code would be needed at this stage.

FINALIZE MEASURES AND INCENTIVES

After going through the measures and incentives and analyzing each of these, the following would be a set of viable measures and incentives:

1. Conduct Water Audits and Orientation on Available Efficient Fixtures for the City Government and Centrio Mall;
2. Provide Water Conservation Stickers to Restaurants in the city;
3. Work with Distributors to Properly Market Efficient Fixtures
4. Improve Media Campaigns by Using Social Media
5. Design an Improved Inclining Block System.

IMPLEMENTATION ISSUES

Supply-side vs. Demand-side. The high NRW of COWD clearly calls for the implementation of the NRW Reduction Program ahead of the others. This is perhaps most desirable. However educational incentives and the design of an improved inclining block water rates structure can be done alongside this. Water audits, and the promotion of efficient plumbing fixtures which would require substantial cost to the property owners can be pursued when the NRW Reduction Program which start to be a visible program in Cagayan de Oro City, that is when at least some of the DMA construction will have been completed.

Partnerships. A partnership with the local government would go a long way towards the successful implementation of all the water conservation efforts of COWD. This goes for both demand-side and supply-side measures and incentives. The NRW Reduction Program for example can be done very efficiently with the support of the local government specially the project calls for extensive civil works constructions and excavations. The Water Dialogues initiated by the USAID through its Be Secure Project started a stronger collaboration among

COWD, the Local Government and the Department of Public Works and Highways. Building upon this initial collaboration is imperative for COWD.

COWD is a member of regional associations of water district like the Mindanao Association of Water Districts, NORMIN, and the national association of water districts, PAWD. In collaboration with these associations, water conservation efforts can be better coordinated and expenses as well as approaches and learnings are shared.

Marketing of Water Conservation Measures and Initiatives. In the local setting and from the experience of COWD, attaching flyers to water bills and paid advertisements are most feasible. We also see that putting up point of purchase displays, as well as displays in water district premises, would also be effective to encourage homeowners to use water efficient fixtures.

IMPLEMENTATION

An initial three-year water conservation program is envisioned and described below:

	YEAR 1	YEAR 2	YEAR 3
Supply-side			
Measures	NRW Reduction Program	NRW Reduction Program	NRW Reduction Program
Demand-side			
Measures		Promote Water Efficient Fixtures	Promote Water Efficient Fixtures
		Water Audits	Water Audits
		Orientation on Available Fixtures	Orientation on Available Fixtures
Incentives	Improve Existing Media Campaign	Design Improved Inclining Block Water Rates Structure	
	Include Social Media		

	Distribute Water Conservation Stickers		

TRACKING AND REFINING THE PROGRAM

On the demand-side, the NRW Reduction Program will most easily be tracked using the water balance of the COWD. On the other hand the supply-side measures and incentives will most likely be tracked through surveys among customers on both acceptability and actual reduction in water consumption experienced by them. The impacts may not be easily and immediately discernible if COWD will use billing and consumption patterns since these are normally done on a system-wide scale or a customer classification scale. The water audits and orientation on water efficient fixtures for the two identified customers (City Government and Centrio Mall), can be done using their actual consumption patterns.