USAID
FROM THE AMERICAN PEOPLE

WATER SECURITY MASTER PLAN FOR ZAMBOANGA CITY

USAID Strengthening Urban Resilience for Growth with Equity (SURGE) Project

SEPTEMBER 30, 2021

This report is made possible by the support of the American people through the United States Agency for International Development (USAID). The contents of this report are the sole responsibility of the International City/County Management Association and do not necessarily reflect the views of USAID or the United States Government.

WATER SECURITY MASTER PLAN FOR ZAMBOANGA CITY

USAID Strengthening Urban Resilience for Growth with Equity (SURGE) Project

Date of Publication: September 30, 2021

Table of Contents

Tables & Figures

Annexes

Acronyms

AFF	Agriculture, Forestry and Fishing
Be Secure	Water Security for Resilient Economic Growth and Stability
BOD	Biochemical Oxygen Demand
CDI	Cities Development Initiative
CDRRMO	City Disaster Risk Reduction and Management Office
CEO	City Engineering Office
CHED	Commission on Higher Education
CHIRPS	Climate Hazards Group Infra-Red Precipitation Station
CHO	City Health Office
CIS	Communal Irrigation System
CLUP	Comprehensive Land Use Plan
COVID-19	Coronavirus Disease-2019
CPDO	City Planning and Development Office
CRU	Climate Research Unit
CWA	Clean Water Act
DENR	Department of Environment and Natural Resources
DILG	Department of Interior and Local Government
DMA	District Metering Area
DO	Dissolved Oxygen
DOF	Department of Finance
DOH	Department of Health
DPWH	Department of Public Works and Highways
EMB	Environmental Management Bureau
ENSO	El Niño El Niño Southern Oscillation
EO	Executive Order
ERPs	Emergency Response Plans
FIES	Family Income and Expenditure Survey
GCMs	Global Climate Models
GDP	Gross Domestic Product
GFI	Government Financing Institutions
GIS	Geographic Information System
GOCC	Government Owned and Controlled Corporation
GVA	Gross Value Added
ha	Hectares

IAs	Irrigator's Association
ICMA	International City/Country Management Association
IP	Indigenous People
IPCC	Intergovernmental Panel on Climate Change
IRR	Implementing Rules and Regulations
IWRM	Integrated Water Resource Management
LGU	Local Government Unit
lpcd	Liters per capita per day
lps	Liters per seconds
LWUA	Local Water Utilities Administration
masl	Meters above sea level
MDS	Monthly Data Sheet
MGB	Mines and Geosciences Bureau
MLD	Million Liters per Day
MM3	Million cubic meters
MWCI	Manila Water Company Inc.
MWSS	Metropolitan Waterworks and Sewerage System
NEDA	National Economic and Development Authority
NGAs	National Government Agencies
NIA	National Irrigation Administration
NIPAS	National Integrated Protected Areas System
NIS	National Irrigation System
NRW	Non-Revenue Water
NWRB	National Water Resources Board
NWRC	National Water Resources Council
OCENR	Office of the City Environment and Natural Resources
ODA	Official Development Assistance
O&M	Operations and Maintenance
PaNP	Pasonanca Natural Park
PAGASA	Philippine Atmospheric, Geophysical and Astronomical Service Administration
PD	Presidential Decree
PDP	Philippine Development Plan
PHILVOLCS	Philippine Institute of Volcanology and Seismology
PIS	Private Irrigation System
PPA	Programs, Projects, and Activities
PSA	Philippine Statistics Authority

PWSSMP	Philippine Water Supply and Sanitation Master Plan
RA	Republic Act
RBCO	River Basin Control Office
RDP	Regional Development Plan
SC	Sub-catchment
SDG	Sustainable Development Goal
SWIP	Small Water Impounding Project
SWISA	Small Water Irrigation System Association
SURGE	Strengthening Urban Resilience for Growth with Equity
TE	Tobon Engineering
TR-WQMA	Tumaga River-Water Quality Management Area
TSS	Total Suspended Solids
TWG	Technical Working Group
UFF	Unified Financing Framework
UN	United Nations
USAID	United States Agency for International Development
WCI	Woodfields Consultants, Inc.
WDs	Water Districts
WDM	Water Demand Management
WEAP	Water Evaluation and Planning
WS	Water Security
WSPs	Water Service Providers
WSMP	Water Security Master Plan
WSS	Water Supply and Sanitation
WTP	Water Treatment Plant
WWF	World Wide Fund for Nature
ZCLGU	Zamboanga City Local Government Unit
ZCWD	Zamboanga City Water District
ZCWSC	Zamboanga City Water Security Council
ZWAT	Zamboanga City Water District Water Audit Team

I. Introduction

The Strengthening Urban Resilience for Growth with Equity (SURGE) Project is an award of the U.S. Agency for International Development (USAID) to the International City/County Management Association (ICMA). The SURGE Project supports the USAID/Philippines' Cities Development Initiative (CDI) by supporting the Philippines to shift to a sustained and more inclusive growth trajectory at par with other high-performing emerging economies. The SURGE Project has three objectives: (1) improve local capacity in inclusive and resilient urban development; (2) improve environment for local economic development; and (3) expand economic connectivity and access between urban and rural areas.

USAID supports eight partner cities included in the CDI, which are being provided with support following a "whole-of-mission" approach in which all other USAID projects are encouraged to converge for an integrated delivery of assistance. These cities are Batangas, Legazpi and Puerto Princesa in Luzon, Iloilo and Tagbilaran in the Visayas, and Cagayan de Oro, General Santos and Zamboanga in Mindanao.

The SURGE Project provides technical assistance to CDI cities aimed at improving access to sustainable and resilient water and sanitation services. Technical assistance includes capacity development, policy support, pre-feasibility studies, water safety planning, non-revenue water (NRW) assessments, hydraulic modeling, and water supply system concept designing, Geographic Information System (GIS) mapping, and database establishment, review of funding options, geo-resistivity surveys[1], sanitation services, water demand management (WDM) and now the preparation of a comprehensive Water Security Master for Zamboanga City. This intervention of the SURGE Project is aligned and consistent with the Water Demand Management (WDM) program of the city and with the national government's key reform agenda provided in the Philippine Water Supply and Sanitation Master Plan (PWSSMP) to help achieve universal access to water and sanitation by 2030.

The reliance on surface water as the primary water supply means that changes in weather patterns and hydrological systems due to climate change could lead to severe disruptions in water resource availability. Extended warm weather, brought about by the El Niño phenomenon, triggers more water use and heightens the extraction of water, which changes the operational patterns of water delivery resulting in water scarcity and insecurity. The occurrence of prolonged drought upsets the balance between water supply and demand, significantly increasing the vulnerability of local governments and water districts resulting in damaging impacts, especially for customers and end-users.

Zamboanga City, a major urban center in the western part of Mindanao, has been experiencing climate-related disasters in recent years, including tropical cyclones, extreme rainfall, and drought. For instance, drought in Zamboanga City, triggered by a strong El Niño in 2015 to 2016, caused reservoirs to empty, exacerbating the loss of livelihood for local and regional farmers[2]. In 2017, the City also experienced heavy rains, strong winds and storm surge that resulted in more than 12,000 people (2,448 families) from 12 barangays being displaced due to flooding[3]. This incident also caused the Pasonanca Dam to reach a "critical" level, threatening downstream

[1] Use as basis in the identification of location of new water source development projects for the expansion of existing water services

[2]Falcatan, R. (2015, April 2). Zamboanga City under state of calamity due to drought.

[3]Davies, R. (2017, October 18). Philippines – 12,000 Displaced by Floods in Zamboanga. http://floodlist.com/asia/philippines-zamboanga-floods-october-2017.

communities with a severe flooding threat. Future impacts such as these will increase as climate change impacts become more profound, impacting the growing population of Zamboanga City. Climate change will increase the exposure and water resource vulnerability of both the city and its constituents. This becomes a challenge not only for the local government unit (LGU) of Zamboanga City but particularly for the Zamboanga City Water District (ZCWD), which is the main water service provider.

Water security is more than just providing access to water supply and sanitation. It is also about having sufficient water and sanitation systems that are resilient and well-built, that reliably and efficiently provide those services to the public in a cost-effective manner, and that which promote the efficient use of water by the consuming public[4]. The preparation of the water Security Master Plan to improve drought resiliency in Zamboanga City leads to measurable results such as the number of people with improved access to reliable water as well as reduction in water rationing. These results provide immediate and long-range benefits of not only current users but future generations as well. This study yielded related benefits such as improved planning process, strategic program and policy formulation, well-calibrated development and implementation of recommended activities toward a more secure water future.

Objectives of the Water Security Master Plan

The main objective of this study is to provide technical assistance to the Zamboanga City LGU (ZCLGU), ZCWD and other stakeholders in developing a comprehensive Water Security Master Plan that will serve as basis and guidance for subsequent water and sanitation programs, projects, and activities, including watershed management given the impacts of climate change.

The Water Security Master Plan focused on the key and essential aspects of economic growth and development which includes public health, economic growth, environmental sustainability, political stability, and disaster and risk reduction, as presented in Figure 1.

The outcome of this study is a comprehensive water planning support document, which will benefit the current and future water users of Zamboanga City. This study will form part of the strategic plan that will serve as a blueprint for future development of the city.

[4] Remarks by Clay Epperson, USAID Deputy Mission Director, Media Forum on Water Security and Climate Change, 08 February 2017. https://www.usaid.gov/philippines/speeches/feb-28-2017-remarks-clay-epperson-deputy-mission-director-media-forum-water-security.

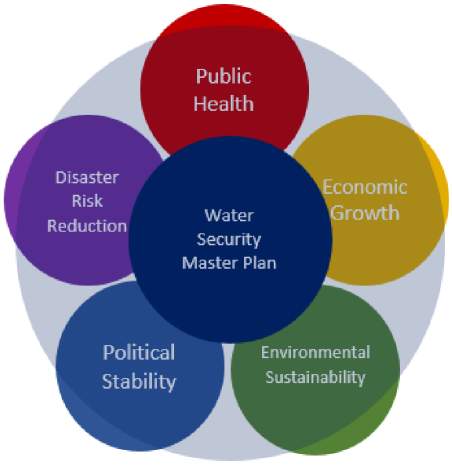


Figure 1: Essential Aspects of Economic Growth and Development

Overall Assessment and Planning Approach

The overall assessment and planning approach for this master plan is presented in Figure 2. The assessment is anchored on an integrated water resources management model built on the Water Evaluation and Planning (WEAP) system platform, which incorporates all aspects of the water resource system[5]. This integrating platform readily accommodates WDM alternatives and the integration of climate change scenarios.

[5] Including source water supply derived from the natural watershed; river networks that bring water to the municipal infrastructure such as reservoirs and pipes; distribution network including customer water use; and the return of waste effluent.

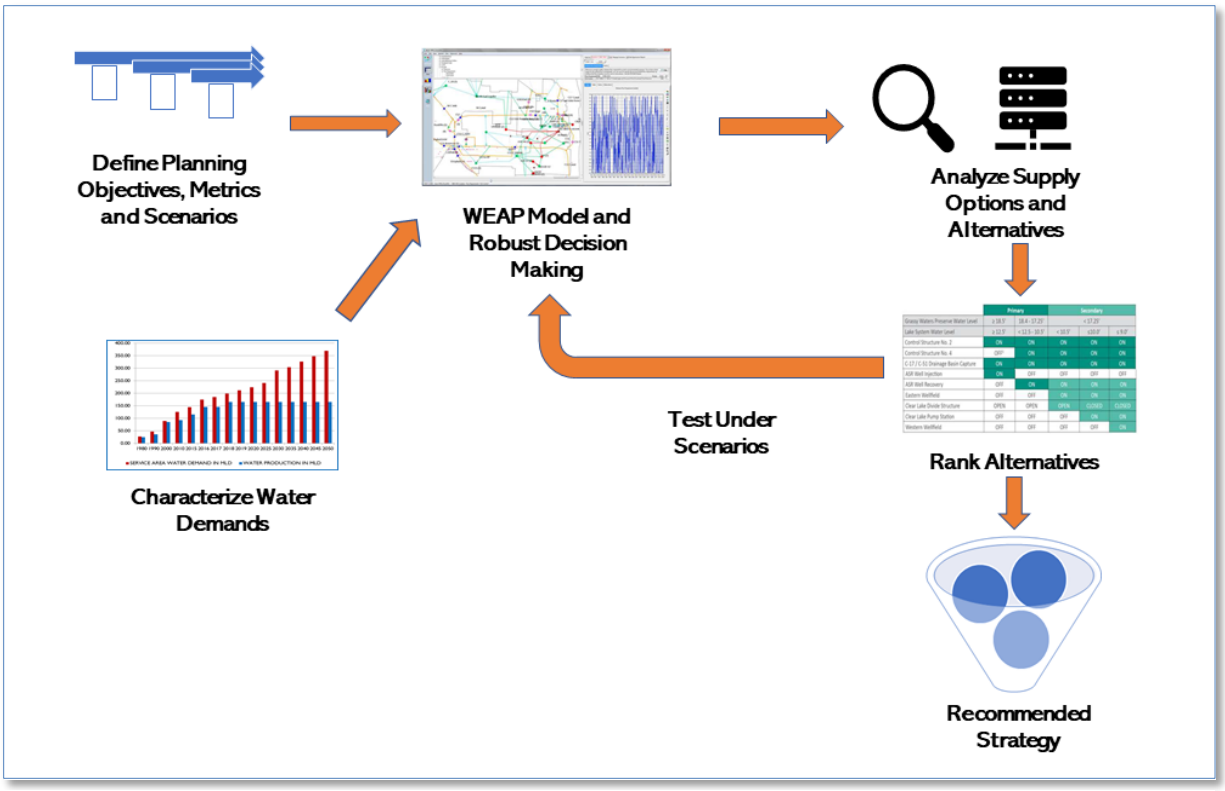


Figure 2: Overall Planning and Assessment Approach

The integration process analyzed the City's water supply and demand situation under the existing and planned water supply infrastructure assets, potential gaps between future water demands and existing water supply under various hydrological risks, particularly drought, and the options and alternatives needed to meet these gaps. Moreover, the preparation of the Water Security Master Plan takes stakeholder participation and engagement as part of the whole master planning process by embedding in at the core of the various activities.

II. The Study Area

This section describes the study area in terms of geographical location, physical features, economy, and socio-economic conditions. It also presents the existing and future growth potentials of the area.

Physical Features

Location and Administrative Boundaries

Zamboanga City, with coordinates of 6º54'16.433" North and 122º4'35.110" East, is located in the southwestern-most section of the Zamboanga Peninsula on the western part of Mindanao Island. The city is bounded by the provinces of Zamboanga del Norte and Zamboanga Sibugay to the north, and by the Basilan Island to the south. In terms of bodies of water, it is bounded on the west by the Sulu Sea, on the east by the Moro Gulf, and on the south by the Basilan Strait and Celebes Sea. The location map is presented in Figure 3.

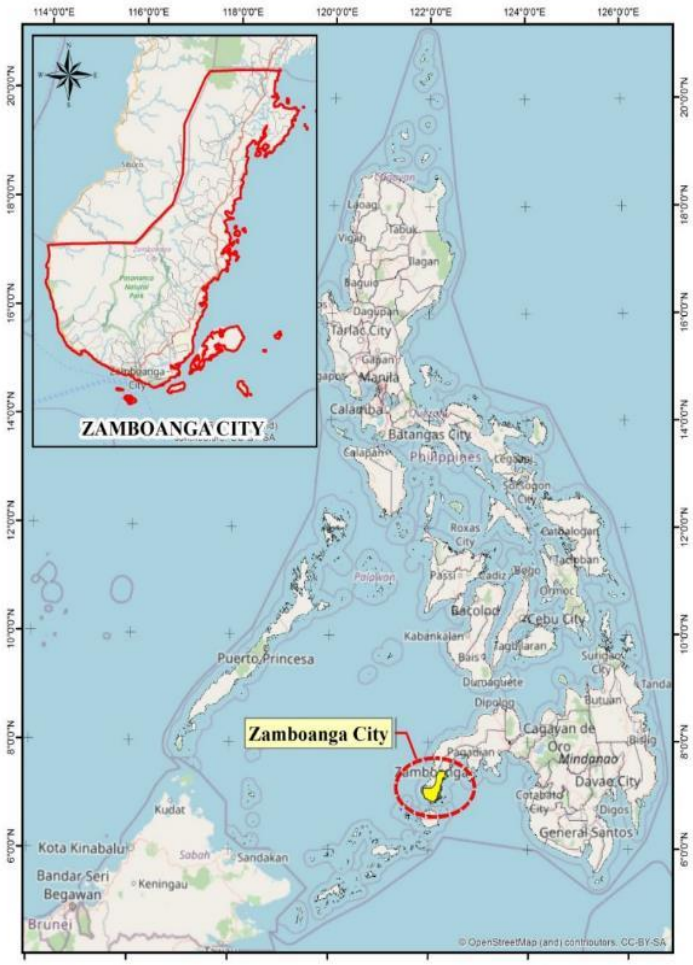


Figure 3: Location of Zamboanga City

The City is a first class urban municipality in the province of Zamboanga del Sur. It is politically subdivided into 98 barangays.

Zamboanga City is sheltered and shielded geographically from typhoons by the mountainous Basilan Island, Sulu Archipelago, Palawan Island, and the main island of Mindanao.

The City has seven watershed forest reserves with a total area of 56,094 hectares (ha). One of which is the Pasonanca Natural Park which was officially proclaimed as protected area of the National Integrated Protected Areas System (NIPAS) pursuant to RA 7586. The Sangguniang Panlunsod Resolution No. 566 also identified other six watersheds namely Ayala, Culianan, Manicahan, Bolong, Curuan, Vitali. The protected areas under NIPAS are presented in Table 1.

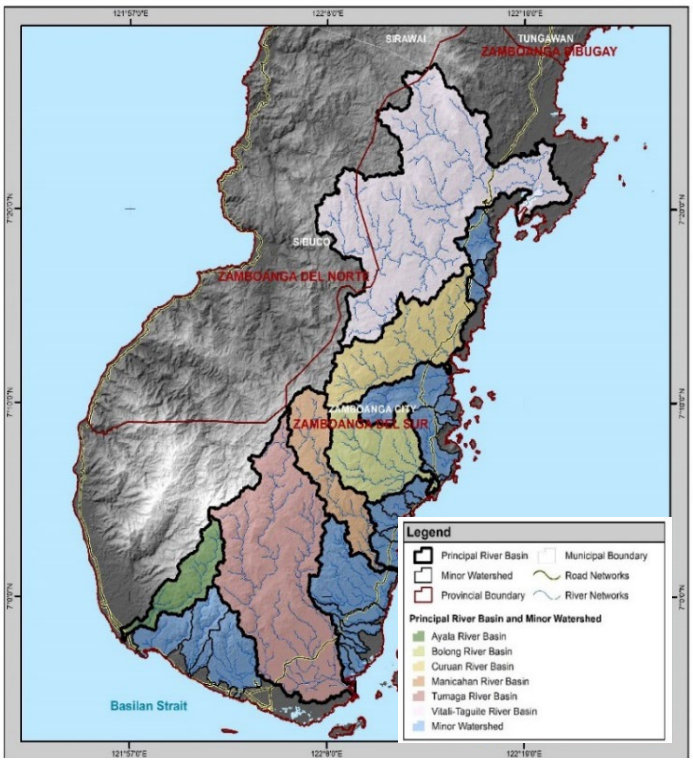
Table 1: Protected Areas in Zamboanga City under NIPAS

Proclamation No.	Protected area	NIPAS category	Core area & buffer zone	Management Authority
132	Pasonanca watershed forest reserve	Natural Park	17,414	PAMB
271	Great & Little Sta. Cruz Islands	Protected Landscape and Seascape	1,877	PAEMB
2152	Mangrove swamps forest reserve	Protected Landscape and Seascape	-	Interim PAMB

Source: Zamboanga City CLUP 2016-2025

The six watersheds in the administrative boundaries of Zamboanga City are presented in Figure 4. The largest in terms of area is the Vitali-Taguite River Basin covering 28,687 ha of which, 87.76 percent is within Zamboanga City. The second largest is the Tumaga River Basin with 21,047 ha wherein the Pasonanca Natural Park is situated. Ayala watershed is a key source of water for domestic, agricultural and industrial uses for Tulungatung and Ayala districts. Bolong watershed supplies the irrigation needs and fresh water supply for domestic and livestock use. In addition, Curuan watershed serves as a source of water for agriculture, industries, fishpond and domestic use. Barangays covered and the corresponding areas and percentage distribution are presented in Table 2.

Apart from these major river basins, there are 26 minor watersheds with total area of 98,445 ha. The areas for these small watersheds vary from 133 to 4,497 ha.



Source: Climate Change-Responsive IRBMD Master Plan for the Cluster 7 River Basin

Figure 4: Major River basins within the Administrative Boundaries of Zamboanga City

Table 2: Area Coverage of Zamboanga City Major Watersheds

Province/City/Barangay	Area (ha)	Percent within River Basin (%)
Vitali-Taguite River Basin	**28,687**	**100.00**
Zamboanga Del Norte		
Sibuco		
Lunday	2,813	9.81
Dinulan	471	1.64
Cawit-cawit	113	0.39

Province/City/Barangay	Area (ha)	Percent within River Basin (%)
Anongan	76	0.26
Basak	33	0.12
Litawan	2	0.01
Sirawai		
Sipawa	3	0.01
Zamboanga City		
Calabasa	1,663	5.80
Curuan	1,399	4.88
Latuan (Curuan)	378	1.32
Limaong	1,648	5.74
Mangusu	1,164	4.06
Muti	483	1.68
Sibulao (Caruan)	4,132	14.40
Tagasilay	1,347	4.70
Tictapul	331	1.15
Tigbalabag	552	1.92
Unclaimed Area under Jurisdiction of Zamboanga City	3,334	11.62
Vitali	8,745	30.48
Tumaga River Basin	**21,047**	**100.00**
Zamboanga City		
Arena Blanco	35	0.17
Baluno	54	0.26
Boalan	806	3.83
Bunguiao	2	0.01
Cabatangan	4	0.02
Culianan	55	0.26
Divisoria	393	1.87
Dulian (Upper Pasonanca)	234	1.11
Guiwan	141	0.67
Lanzones	111	0.53
Lumayang	741	3.52
Lumbangan	490	2.33
Lunzuran	384	1.82
Mampang	510	2.42
Mercedes	468	2.22
Pasobolong	303	1.44
Pasonanca	1,132	5.38
Pasonanca Natural Park	9,657	45.88
Putik	325	1.54
Salaan	1,941	9.22
Santa Maria	78	0.37
Talon-talon	135	0.64
Tetuan	51	0.24

Province/City/Barangay	Area (ha)	Percent within River Basin (%)
Tolosa	1,963	9.33
Tugbungan	282	1.34
Tumaga	294	1.40
Zambowood	458	2.18
Curuan River Basin	**8,785**	**100.00**
Zamboanga City		
Buenavista	1,095	12.46
Calabasa	1,420	16.16
Curuan	3,463	39.42
Dulian (Upper Bunguiao)	658	7.49
Latuan (Curuan)	993	11.30
Muti	460	5.24
Quiniput	77	0.88
Tagasilay	1	0.01
Unclaimed Area under Jurisdiction of Zamboanga City	618	7.03
Bolong River Basin	**6,767**	**100.00**
Zamboanga City		
Bolong	650	9.61
Bunguiao	4,098	60.56
Dulian (Upper Bunguiao)	1,765	26.08
Lamisahan	11	0.16
Lubigan	166	2.45
Sangali	77	1.14
Manicahan River Basin	**5,698**	**100.00**
Zamboanga City		
Bunguiao	2,189	38.42
Dulian (Upper Bunguiao)	108	1.90
Lamisahan	857	15.04
Lapakan	513	9.00
Manicahan	166	2.91
Pasonanca Natural Park	800	14.04
Tolosa	830	14.57
Unclaimed Area under Jurisdiction of Zamboanga City	129	2.26
Victoria	106	1.86
Ayala River Basin	**3,559**	**100.00**
Zamboanga City		
Ayala	112	3.15
Baluno	1,762	49.51
Cawit	1	0.03
La Paz	1,065	29.92
Pasonanca Natural Park	411	11.55
Tulungatung	208	5.84

Source: Climate Change-Responsive IRBMD Master Plan for the Cluster 7 River Basin

Land Use and Land Cover

Zamboanga City is considered as the third largest city in the Philippines in terms of land area. It has a total declared land area of 145,327 ha, with its growth and development being heavily concentrated along the major urban areas in the southern part of the city. Presented in Figure 5 is the summary of land use per category while detailed in Table 3 is the existing land cover of each watershed.

Forest and agriculture areas are the dominant land covers and uses in the City Specifically, the Tumaga watershed covers 45 percent of the total area since the majority of the Pasonanca Natural Park is located in this area.

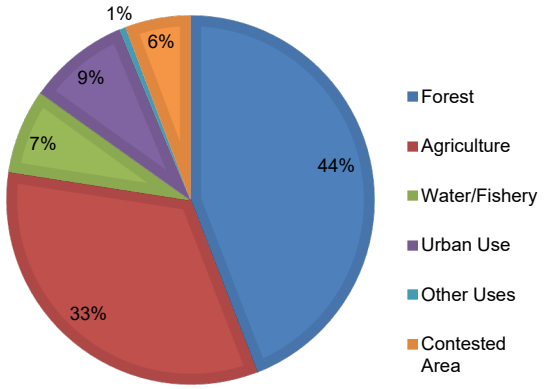


Figure 5: Zamboanga City Land Use Plan

Table 3: Land Cover of Zamboanga City (in hectares)

Land Cover	Ayala	Bolong	Curuan	Manicahan	Tumaga	Vitali-Taguite	Total
Annual Crop	1.00	306.00	166.00	36.00	425.00	487.00	1,421.00
Brush/ Shrubs	310.00	1,467.00	3,308.00	3,478.00	4,004.00	15,072.00	27,639.00
Built-up	38.00	7.00	45.00	14.00	1,506.00	2.00	1,612.00
Closed Forest	538.00	-	-	146.00	9,377.00	-	10,061.00
Fishpond	-	0.40	234.00		664.00	978.00	1,876.00
Grassland	12.00	262.00	2,083.00	268.00	628.00	3,355.00	6,608.00
Inland Water	0.40	3.00	0.50	-	35.00	168.00	207.00
Mangrove Forest	-	-	382.00	2.00	133.00	247.00	764.00
Open Forest	141.00	-	9.00	699.00	25.00	2,356.00	3,230.00
Open/ Barren	0.20	4.00	-	-	-	-	4.00
Perennial Crop	2,519.00	4,717.00	2,817.00	1,055.00	4,253.00	6,021.00	21,382

Source: Approved Land Use Plan 1997-2012, Google Earth, National Mapping and Resource Information Authority (NAMRIA) Land Classification Maps, NAMRIA Topographic Maps, DENR Cadastral Survey and GIS generated data

Topography

The southwestern most tip of the Zamboanga Peninsula, which stands at approximately 1,360 meters above sea level (masl), exhibits a characteristic domal physiographic expression on rugged to mountainous terrain toward the highest peak (Mount Nancy). Topography along coastal plain, alluvial plain, marshland, and floodplains are relatively flat to undulating. Generally, most of the barangays in Zamboanga City are situated within flat lying coastal zone, alluvial plain, and marshland. There are also narrow strips of flat lands along the east coast.

A major portion of the city have slopes ranging from 0-8 percent as shown in Table 4. Meanwhile, undulating to rolling at 8-18 percent slope level has the least area with about 24 percent share. The highest elevation in the city is the Batorampon Point with an elevation of 1,335 masl. Presented in Table 4 is the slope level per watershed.

Table 4: Slope Level per watershed in Zamboanga City

Principal River Basin	Slope Class (%)					
	0-3	3-8	8-18	18-30	30-50	>50
Ayala	325	589	801	793	661	389
Bolonq	1,078	1,578	1,556	1,200	868	485
Curuan	1,586	2,316	2,359	1,650	709	163
Manicahan	465	1,265	1,615	1,283	769	300
Tumaga	4,523	3,930	4,492	3,933	2,840	1,328
Vitali-Taquite	4,399	5,740	6,983	6,372	4,071	1,115
Total (hectares)	12,376	15,418	17,806	15,231	9,918	3,780

Source: Climate Change-Responsive IRBMD Master Plan for the Cluster 7 River Basin

Based on the 2016-2025 Comprehensive Land Use Plan (CLUP), the soils in Zamboanga City are categorized in three groups: (i) residual soil, embracing the undulating and mountainous portion; (ii) alluvial soil, located in level to nearly level areas which are devoted mainly to agricultural crop cultivation; and (iii) swamps land, mainly used for fishpond development. Further, there are seven identified landforms in the City namely:

- **Coastal Landscape.** The soil texture is clay to silty clay and very deep; the area is flat to nearly flat with a slope range of 0-3 percent with an elevation of 05 meters (m). It is located along the northeastern coast of Zamboanga City wherein the area is mostly of lower alluvial lowlands and small low-lying areas.
- **Broad Alluvial Plain**. The areas have deep to very deep soil to clayish texture, elevation is between 510 m and a slope range of 0-3 percent. These are the areas comprising the valley floors and flood plains of the City.
- **Minor Alluvial Plain.** The soil in the area is silty loam to clay loam and are moderately deep, elevation is between 80160 m and slope ranges from 03 percent.
- **Plain.** The soils are silty clay loam and are moderately deep, highest elevation is 10 m and a slope range of between 0-3 percent. This is within the low-lying areas with fine sediments mixed with classic materials.
- **Hills.** These types of area are formed from sedimentary rock formations with soil that are clay to loam and are moderately deep-to-deep. A large portion of the city occupies this type of soil and includes areas with a crest below 500 masl. The areas are formed from sedimentary rock formations.
- **Mountain.** The area has a land profile of clay soil texture and a moderate depth, elevation not lower than 500 masl and slope ranges between 18-50 percent.
- **Miscellaneous.** This landform includes the urban areas and the salt beds.

Water Resources

The Zamboanga Peninsula has a land area of 1,413,754 ha, 54 percent of which is classified forest land. This portion is retained as part of public domain mainly for ecological reasons.

There are several river systems emanating from the watershed forest reserves as their head source consisting of a group of rivers discharging water by way of a common flow or system of channels into a sea or bay. It usually consists of the main river, primary, secondary and their tributaries. Table 5 and Figure 6 shows the major river systems emanating from watershed forest reserves, their respective service areas and outfall.

Table 5: Major River Systems in Zamboanga City

Major River System	Watershed Forest Reserve	Service area (Barangay)	Outfall
Dumalon River	Ayala	Talisayan, Tulungatung Ayala, Recodo, Cawit	Sulu Sea
Patalon River	Ayala		Sulu Sea
Saaz River	Ayala		Sulu Sea
Tumaga River	Pasonanca	Pasonanca, Tumaga, Guiwan, Tugbungan, Talon-talon, Mampang	Basilan Strait
Culianan River	Culianan	Tolosa, Culianan, Zambowood	Moro Gulf
Mercedes River	Culianan		Moro Gulf
Bolong River	Bolong	Bunguiao, Bolong	Moro Gulf
Manicahan River	Manicahan	Victoria, Manicahan, Lamisahan	Moro Gulf
Curuan River	Curuan	Curuan	Moro Gulf
Vitali River	Vitali	Vitali	Moro Gulf
Tumaga River	Pasonanca	Pasonanca, Sta. Maria Tumaga, Tetuan, Guiwan Tugbungan, Zambowood, Mampang	

Source: CENRO

Figure 6: Map of River Systems in Zamboanga City

Tumaga River. Tumaga River is the main source of water of Zamboanga City. The river is situated on the northwest section of Zamboanga City. It is bounded by barangays Lunzuran and Putik to the North/East, Sta. Maria to the west side, Luyahan to the North, Guiwan and Tetuan to the South/East. Tumaga River traverses nine barangays in Zamboanga City. The headwater starts at Luyahan which outflows in the southern side of the peninsula in Tugbungan.

As shown in Figure 7, the Tumaga River has a dendritic drainage pattern in the upstream and converges into one reach downstream right before the ZCWD diversion weir. The watershed of Tumaga River is mostly covered by trees.

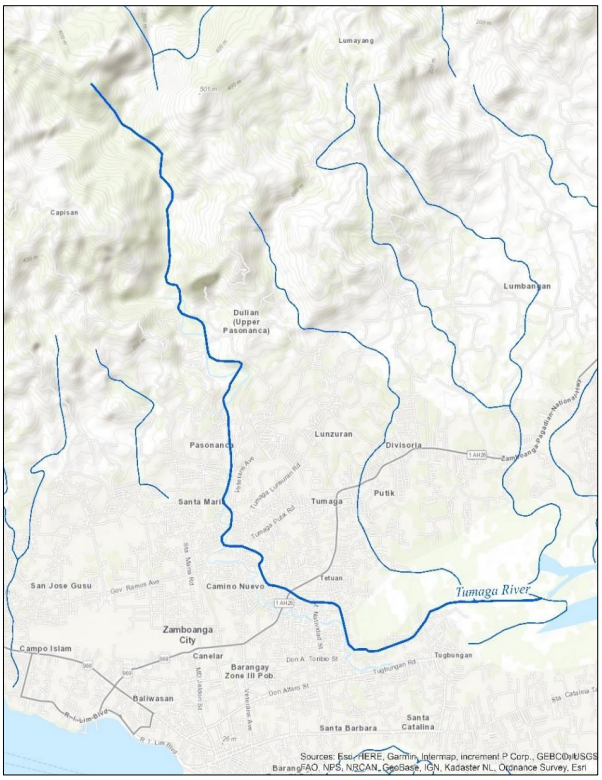


Figure 7: Map of Tumaga River

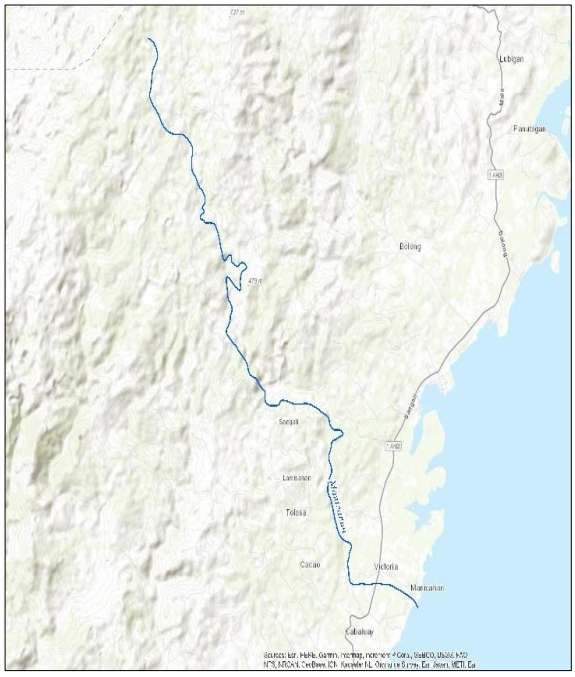


Figure 8: Map of Manicahan River

Manicahan River. The Manicahan River runs through 26 kilometers (km) stretch from Bunguiao in the north down to Lapakan, Lamisan and Manicahan in the southern part of the city. It covers a portion of the heavily forested Pasonanca Watershed. Normally, it has a daily discharge of about 145,000 cubic meters (m^3). It has a total catchment area of 70.83 square kilometers (km^2). (University, 2017)

The Manicahan River (Figure 8) is the prime source of irrigation for the farmers in the barangays of Bunguiao, Lapakan, Lamisan, and Manicahan, as well as the neighboring barangays of Victoria, Bolong, and Sangali. It is one of several rivers in Zamboanga City which have been investigated for potential hydroelectric power source. Manicahan River is also one of the highlights of the Victoria Adventure Park in Victoria, Zamboanga City.

Ayala River. Ayala River is located in Ayala, Zamboanga City approximately 17 km west of the city proper. The river is about 8 km in length and approximately 10 m wide. It originates from Zambales and empties to Sulu Sea. The river traverses the barangays of Tulungatong and Ayala.

The river is used for domestic purposes such as bathing and washing. There are some residential houses built near the riverbanks. In the upper portion of the river, some residents have dug shallow wells within the riverbed and used the water for drinking. The river is also used for irrigating rice fields. It has been noted that there are quarrying activities of sand and gravel in the river. Any alteration in the quality of the water could possibly be attributed to domestic wastes, quarrying activities and agricultural run-off.

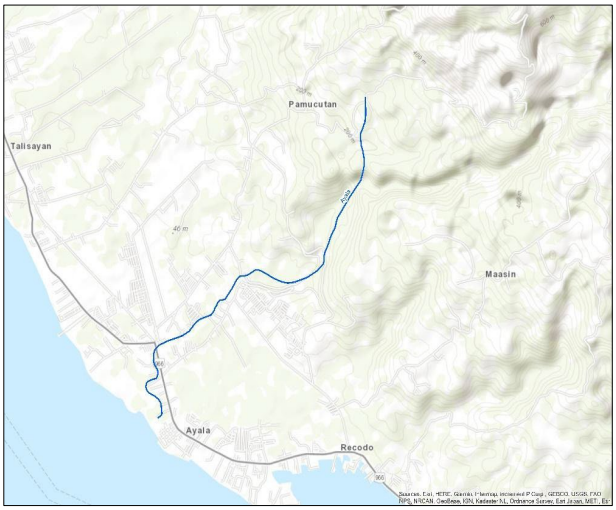


Figure 9: Map of Ayala River

Figure 10: Map of Saaz River

Saaz River. Saaz River is located at Sitio San Ramon, Brgy. Talisayan, about 22.3 km west of Zamboanga City. The river traverses the barangays of Pamucutan, Anoling, Talisayan and San Ramon. The head source of the river watershed is at Camp Susana. Its length is approximately 12 km with an average width of 20 m and widens up to 75 m during rainfall and has average depth of 2 feet (ft). The river has an average flow rate of 2,408.5 liters per second (Lps) and empties to Sulu Sea.

Saaz River is used for domestic purposes such as bathing and laundry. The upstream portion is used for drinking and according to the National Irrigation Administration (NIA), a dam was constructed in Brgy. Anoling which taps water from the river for irrigation purposes. The river has also been used for sand and gravel quarrying activities.

Figure 11: Location of San Roque Bog Lake

Bog Lake. Bog Lake otherwise known as San Roque has a surface area of 82.3 ha located in the middle of a populated area in the western part of Zamboanga City. The San Roque Bog Lake Recreation Park is a destination for nature lovers, thrill seekers, adventurers, and others as the park offers many activities and amenities.

According to the City of Government of Zamboanga CLUP (2016-2025), Bog Lake and surrounding areas could be developed into tourism, residential, institutional, parks and recreation zones with appropriate capital investments. Using the lake as a potential water source is consistent with potential land use with careful and inclusive planning. In order to investigate future water supplies, Zamboanga City in 2020 considered tapping the lake as water source[6] with water from the area sent to a laboratory in Manila to determine its potability (Santiago, 2020).

Groundwater. About 43 percent of the total area are covered by local and less productive aquifers, 36 percent are comprised of rocks without any known significant groundwater and 21 percent is constituted by ground aquifers described as rocks with limited potential. The area breakdown per watershed as presented in Table 6.

Table 6: Groundwater Resources

Principal River Basin/ Watershed	Local and less productive aquifers	Rocks with limited potential (low to moderate permeability)	Rocks without any known significant groundwater (largely untested)
Ayala	1,485	357	1,717
Bolong	3,405	2,014	1,347
Curuan	2,881	1,743	4,161
Manicahan	1,572	936	3,190
Tumaga	6,903	4,735	9,409
Vitali-Taguite	5,504	8,411	14,772

[6] During the recent consultation, Bog Lake has been considered only as an emergency source of water, particularly during periods of drought, because of the high cost of treating it.

Principal River Basin/ Watershed	Local and less productive aquifers	Rocks with limited potential (low to moderate permeability)	Rocks without any known significant groundwater (largely untested)
Minor Watersheds	20,980	2,352	571
Total	42,730	20,548	35,167

Climate

Zamboanga City is under Type III based on the Modified Coronas Classification[7] of Climate System as shown in Figure 12. The Type III Climate is characterized by an intermediate type with no pronounced maximum rain period and short dry season, lasting from one to three months only. Areas under this type are only partly sheltered from the northeast monsoon and trade winds and are open to the southwest monsoon or at least to frequent cyclonic storms.

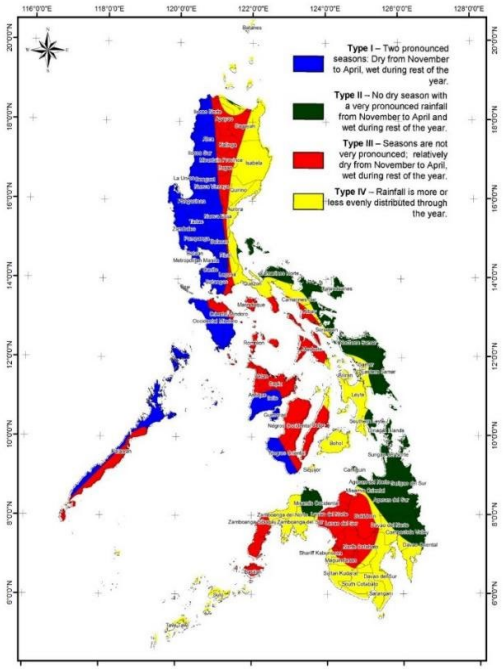


Figure 12: Climate Classification in the Philippines

Rainfall

Rainfall data was taken from the Philippine Atmospheric Geophysical and Astronomical Services Administration (PAGASA) Synoptic Station located near Zamboanga Airport[8]. The rainfall data collected was from year 1980-2015. Figure 13 shows the annual rainfall from 1951-2015. The highest recorded annual rainfall from the 64-year record is 2,150 millimeters (mm) in 1999, the lowest recorded was 677 mm in 1997.

The rainfall variation which is the difference in rainfall from the average for the period is also presented. As shown in the figure, rainfall variation (blue line) is increasing which indicates more high rainfall events and prolonged drought periods.

[7] The Philippine climate zones traditionally were classified from a rain-gauge network, using the Modified Coronas Classification which uses average monthly rainfall totals to define four climate zones: Types I-IV. (Irenea L. Corporal-Lodangco, 2017)

[8] This is the only rainfall gauging station of PAGASA in Zamboanga City.

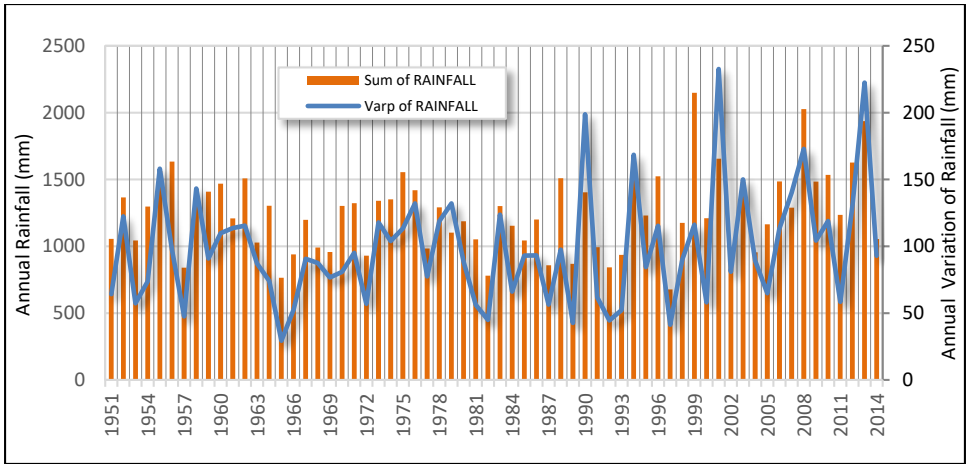


Figure 13: Zamboanga City Annual Rainfall, 1951-2015

Temperature

Figure 14 illustrates the historical temperature in degree Celsius (°C) from 1951-2015 in Zamboanga City. As presented in the figure the minimum, mean and maximum annual average temperature have been increasing, also shown is the rate of increase which varies for the three temperature parameters. The annual average maximum temperature has increased the least at a rate of 0.016 °C per year, while the annual average minimum temperature has increased at twice the rate of the average maximum temperature at 0.032 °C per year. As earth's climate gets warmer, most of the increased heat energy is absorbed by the oceans, therefore due to the location of the temperature gauge near the ocean, this data is consistent in showing the highest rate of increase in temperature occurs during the evening when the main temperature influence is the ocean.

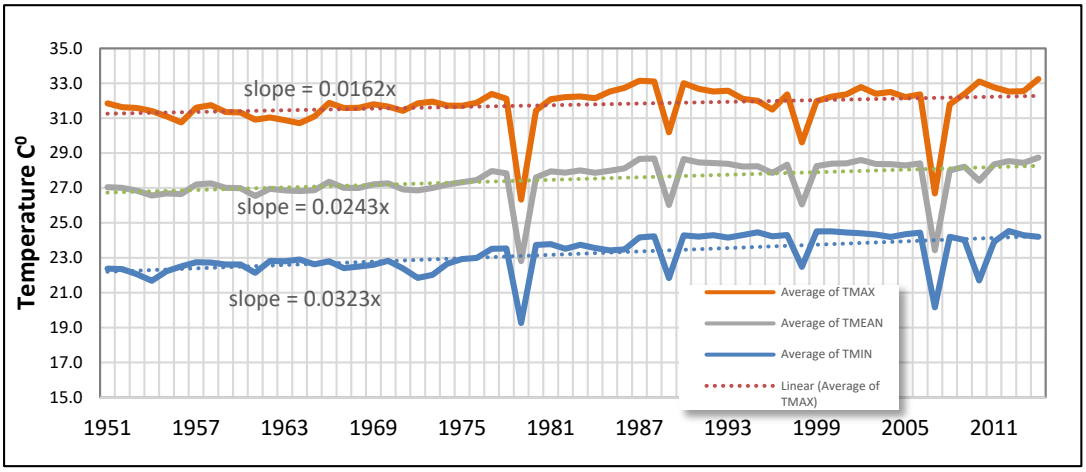


Figure 14: Zamboanga City Historical Temperature, 1951-2015

Climate Change and Disaster Risks

Increase in Temperature. The Manila Observatory projected that the climate scenario for years 2011 to 2065 for temperature and precipitation for the City will increase. Prolonged dry season

weather is said to affect almost the entire city with 12 barangays being identified as drought prone. Other impacts include drying of communal irrigation, decreased in water production capacity, increase public health and sanitation issues, as well as bushfire, erosion, and saline intrusion.

Flooding and Landslide. The city center is prone to flooding since it is situated on a low-lying deltaic and floodplain environment in which elevation is typically below 5 masl. According to the 2010 Mines and Geosciences Bureau (MGB) Landslide and Flood Susceptible Map, at least 77 barangays mostly in coastal and island barangays are highly susceptible to flooding while there were at least 44 barangays that are highly prone to landslides. Among the barangays largely affected by flooding are Tumaga, Tolosa, Sibulao (Caruan), Bunguiao and Curuan. The susceptibility per watershed is presented in Table 7. Economic, agricultural, infrastructure and social damages as well as displacement of settlements have been caused by flooding and landslide events.

Table 7: Zamboanga City Flood Susceptibility per River Basin

Principal River Basin / Watershed	Susceptibility		
	Moderate	High	Very High
Ayala	-	-	402
Bolong	-	-	649
Curuan	-	-	1,505
Manicahan	65	-	508
Tumaga	201	-	3,489
Vitali-Taguite	-	28	3,842
Minor Watersheds	362	-	7,272
Total (ha)	629	28	17,667

Source: MGB

Sea Level Rise and Storm Surge. With the annual sea level rise in the Philippines at 12 millimeter per year (mm/yr), Zamboanga City is one of the areas experiencing the residual effects of the global sea level rise. This mainly affects the 45 coastal and island barangays of the City. Impacts reported are the massive settlement, livelihood displacement and destruction, water scarcity, extensive saline intrusion, increased deforestation, and land conversion. On the other hand, storm surge events are usually worsened by tides and depth of water body relative to the storm path. It is typically considered a secondary hazard to tropical cyclones. For Zamboanga City, about 216 ha are highly susceptible while 1,413 ha are moderately susceptible to 2-meter inundation or Alert Level 1 as presented in Table 8.

Table 8: Zamboanga City Storm Surge Susceptibility to Alert Level 1

Principal River Basin / Watershed	Susceptibility			
	None	Low	Moderate	High
Ayala	3,554	1	3	1
Bolong	6,753	4	9	1
Curuan	8,413	37	278	57
Manicahan	5,696	1	1	-
Tumaga	20,830	58	144	16
Vitali-Taguite	28,687	-	-	-
Minor Watersheds	22,497	286	978	141

Principal River Basin / Watershed	Susceptibility			
	None	Low	Moderate	High
Total (ha)	96,430	387	1,413	216

Source: UP-NOAH

Earthquake and Tsunami. The city has experienced moderate to high frequency of earthquake because of the presence of two major underwater tectonic faults, namely: the Sulu and Cotabato Trench. Alongside with earthquake due to the movements of tectonic plate, other geologic-related incidents that could be triggered by earthquakes are liquefaction, landslide, and tsunami. According to Philippine Institute of Volcanology and Seismology (PHIVOLCS), Zamboanga City has been identified as one of the tsunami prone areas in the country. The city's coastal barangays can be overcome by tsunami from 2-5 km landward. The waves could penetrate up to 5 km inside the city center inundating almost the entire city's central business district area. In terms of area, 10,126 ha or 10 percent is susceptible to tsunami. This event can destroy almost all the coastal settlements along the city's coastal and riverine areas and most of the business, commercial, institutional, buildings, and educational establishments around the central business district.

Socio-Economic Characteristics

Demographics

In terms of population, Zamboanga City ranked as the sixth largest city in the Philippines. It has a total population of 977,234 based on the 2020 Philippine Statistics Authority (PSA) census from 861,234 in 2015. Talon-talon located in an urban area is the most populated barangay with 34,916 residents in 2015. Meanwhile, Pangapuyan, a small island barangay, is the least populated with only 590 residents.

Its annual population growth rate based on 2010 and 2015 census is 1.26 percent and increased faster between 2015 to 2020, with 2.50 percent growth; its population density when forest lands are excluded is 14 persons per hectare. The total number of households in 2015 is 193,970 with a household size of 4.4.

In terms of watersheds, Tumaga watershed has the most populous area with a total population of 346,729. This is followed by (i) Ayala watershed with 51,660, (ii) Vitali-Taguite watershed with 37,496, (iii) Bolong watershed with 36,741, (iv) Curuan watershed with 21,468, and (v) Manicahan watershed with 19,991. The rest of the barangays are clumped into minor watershed with a total population of 347,714. The breakdown of population per barangay is presented in Annex 1.

The estimate of the Regional Development Plan (RDP) is the sustained or increasing population increased reaching to 3.9 million by 2022 and the population density to 246 per km² from a 226 per km² in 2015. The increase in population, should be complimented with economic growth to address the constraints of the economy of Zamboanga. If sustained, the direction will most likely point to decrease of unemployment, underemployment, as well as informal settlement, and urban sprawl.

Poverty

In reference to the latest CLUP for Zamboanga City, poverty in the city and in the whole of the Zamboanga Peninsula has four source areas: (i) slow improvement of economic growth, (ii) wide

income inequality, (iii) weakness of employment generation and, (iv) vulnerability to externalities i.e., natural or manmade calamities and disasters. These are generally attributed to the predominance of agriculture and marine fishing economic activities that majority of its population especially the marginalized and indigent people are involved.

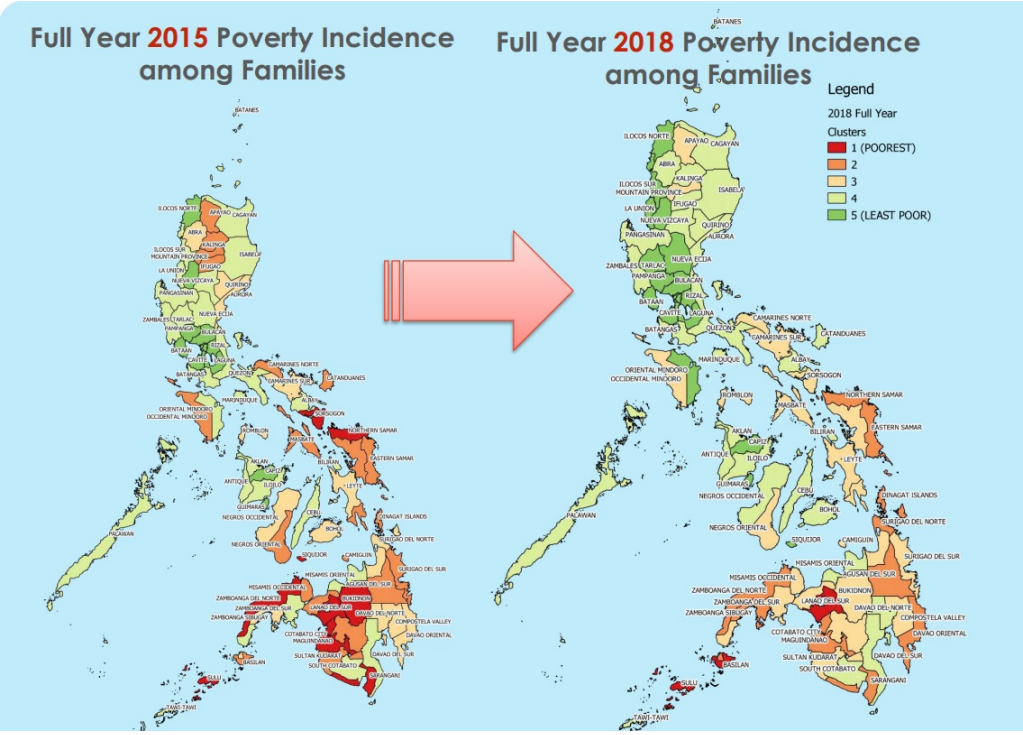
The PSA measures poverty through the Family Income and Expenditure Survey (FIES) every three years. The report generates a wide array of information including the following:

- **Poverty Threshold** – minimum income required for a family/individual to meet for basic food needs
- **Poverty Incidence** – proportion of families/individuals with per capita income less than the per capita poverty threshold to the total number of families
- **Food Threshold** - minimum income for a family/individual to meet the basic food needs which satisfied the nutritional requirements for economically necessary and socially desirable physical activities
- **Subsistence Incidence** – Proportion of families/individuals with per capita income/expenditure less than the per capita food threshold to the total number of families/individuals

The Poverty Threshold and Poverty Incidence among Families in Region IX is PhP12,388 for year 2018 which is higher compared to the 2015 data which is PhP11,038. While for Zamboanga del Sur, the per capita poverty threshold for 2018 is PhP11,829, a little lower compared to the regional data. The poverty incidence in 2018 is 25.2 percent showing an increase from the 23.2 percent of 2015. Further, the food threshold in 2018 is PhP8,222 compared to the PhP7,035 of 2015. The subsistence incidence is 9.8 percent in 2018 against 8.4 percent in 2015.[9]

When clustered and compared among other provinces, the poverty incidence of Zamboanga del Sur in 2018 is at “2” (poor) whereas in 2015 the province was clustered under “3” on a scale of “5”. Figure 15 presents the poverty incidence clusters nationwide comparing 2015 and 2018 results from the FIES.

[9] Philippine Statistics Authority. Official Poverty Statistics of the Philippines. First Semester 2018. Available at: https://psa.gov.ph/sites/default/files/First%20Semester%202018%20Official%20Poverty%20Statistics_1_0.pdf



Source: PSA

Figure 15: Poverty Incidence Cluster Nationwide (2015 and 2018)

The poverty and subsistence incidence presents a picture that a great number of families/individuals are unable to have access, due to financial constraints, to necessities including water resources. For instance, poverty and subsistence constraints may deprive access to clean drinking water and water for hygienic activities that increases susceptibility to water related/borne diseases.

PSA also claims that poverty is not exclusively defined by income and expenditure but also by other indices that captures deprivation or disadvantage on various dimensions. The following indices are captured as the Multidimensional Poverty Index (MPI).

- **Education** – captured by information on school attendance and educational attainment
- **Health and Nutrition** – captured by information on hunger, food consumption and health insurance
- **Housing, Water and Sanitation** – captured by information on assets, toiled, water, tenure, housing materials and electricity
- **Employment** – captured by information on underemployment and working children not in school

Indigenous Peoples

Within the study area are five indigenous peoples (IPs) communities namely: Badjaos, Subanun, Banguingui, Kolibugan and Yakan. These communities are mostly located in islands and rural

areas of Zamboanga City, specifically 16 barangays from District 1 and 33 barangays in District 2.[10]

The Badjaos are a sea-based tribe living on boats and coasts in stilt houses. They are usually referred to as the "Sea Gypsies" found in the provinces of Tawi-Tawi, Sulu, Basilan and Zamboanga City. The Badjao's livelihood are tied to the sea wherein most of them are expert fishermen, divers and navigators. In Zamboanga City, they are mostly located in Brgy. Sinunuc.

On the other hand, the Subanun (also as Subanon or Subanen) tribe are land-based living in solitude in deep forest lands. Their seclusion and distance enabled preservation of deep seeded traditions and culture that for other remain lost and forgotten. The Subanun, much like the Badjaos are river-dependent however due to tribe settlement issues and competitions were forced to relocate in internal regions towards the mountainous areas. Adapting, the Subanun tribe converted to farming in field, cultivating rice crops and nurturing livestock as their livelihood.

The other three indigenous tribes of Banguingui, Kolibugan and Yakan are a mix of both sea, mangrove and land-based settlement and livelihood.

Health

The City Health Office (CHO) serves the whole 98 barangays in the City. It has 27 medical officers or doctors, four dentists, 41 nurses, 117 midwives, 35 sanitation inspectors, four nutritionists, seven laboratory/medical technologists, 70 administrative personnel and the others serve as assistants.

As per 2015 record of the CHO, there are 13 medical hospitals, of which six are owned by the government and seven are private. As of year 2015, these hospitals comprise of 210 doctors, 1,007 nurses and 158 midwives. The hospital under the CHO (Cristino Paragas Memorial Hospital) is in Brgy. Quiniput. It is classified as an infirmary. However, this hospital is intended to be converted into a primary hospital which provides clinical care and management on the prevalent disease in the locality.

There are also 16 main health centers within the city, of which 13 functions as lying-in clinics. Main Health Centers cover mostly preventive, promotive, and curative aspects of health care services including referrals from Barangay Health Stations.

In 2015, the crude birth rate in the city is 23.11 per 1,000 population, while the crude death rate is 4.87 per 1,000 population. The top leading causes of morbidity are: (i) acute respiratory infection; (ii) wounds; (iii) fever; (iv) animal bite; (v) acute gastroenteritis; (vi) skin disease; (vii) hypertension; (viii) fibromyalgia; (ix) urinary tract infection; and (x) asthma. Among this sickness: acute gastroenteritis and skin diseases are waterborne diseases. Meanwhile, the top leading causes of mortality are: (i) myocardial infarction; (ii) pneumonia; (iii) cerebrovascular disease; (iv) cancer (all types); (v) undetermined cause; (vi) tuberculosis (pulmonary); (vii) diabetes mellitus Type II; (viii) sepsis; (ix) congestive heart failure; and (x) chronic obstructive pulmonary disease.

[10] The 1st District encompasses the geographic districts of Ayala, Baliwasan, Labuan, Santa Maria, Zamboanga Central and the southern part of Santa Barbara; the 2nd District covers the rest of the geographic district of Santa Barbara, along with Curuan, Manicahan, Mercedes, Putik, Tetuan, Vitali and the Island Barangays.

Education

For school year (SY) 2015–2016, the city has the following number of schools per curricular activity: 21 purely kindergarten (private), 209 elementary, and 71 secondary schools. The kindergarten and elementary levels are male dominated while the secondary level is female dominated for both public and private schools.

As per records of the Commission on Higher Education (CHED) for SY 2015–2016, there are 18 tertiary schools and 34 vocational schools. Female population is more dominant than that of the males for the enrollees of these schools.

The Senior High School (SHS) Program has been implemented since the SY 2016–2017. There are 25 DepEd Schools and 37 Non-DepEd schools offering SHS. The programs that are being offered include Accountancy, Business and Management (ABM), General Academic Strand, Humanities and Social Sciences, Pre-Baccalaureate Maritime, Science, Technology, Engineering and Mathematics (STEM), Arts and Design, Sports and Technical-Vocational Livelihood.

Economy

In 2020, Zamboanga Peninsula registered a gross regional domestic product (GRDP) of Php376 million, contributing to 2 percent of the nation's gross domestic product (GDP). The 2020 value presented a decelerated growth of -5.2 percent (at constant prices) from a growth of 4.6 percent in 2019. The contraction is mostly attributed to the decline of most, if not all, industries with other services (-66.2 percent), accommodation and food service activities (-47.2 percent) and transportation and storage (-39.5 percent). The drastic decline is related to either permanent or closure of business due to the Coronavirus 2019 (COVID-19) pandemic. In spite of this, the services sector continues to drive the economy accounting for 51.5 percent share to the regional economy with industry (29.2 percent) and the agriculture, forestry and fishing (19.3 percent) as contributors.

Zamboanga Peninsula's share to the 9.6 percent economic contraction of the nation's economy is -0.1 percent.

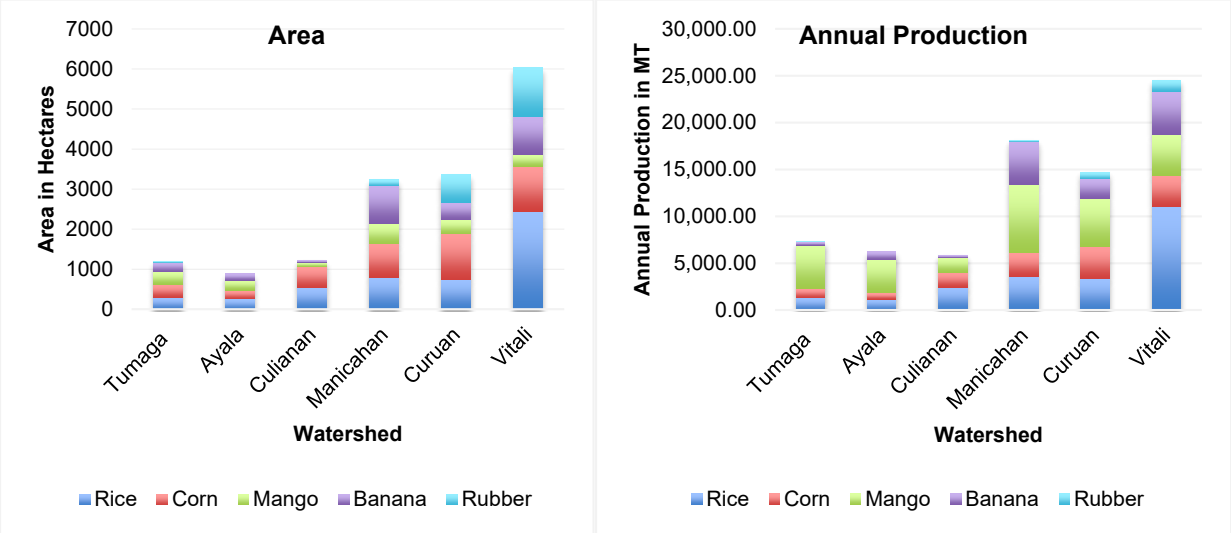
Agriculture

The agricultural sector plays a vital role in the development of Zamboanga City economic position. It accounts for 30 percent of employment for the Philippines and is a major contributor to the revenues of the local government. Crops, which have been the highest production in terms of volume and value, are mango, rice, banana, corn and rubber. In terms of area, rice take up the highest land covering 5,098.4 ha of land while mangoes produce the largest yield per hectare of land reaching 14.5 metric tons per ha. Agriculture is a source of livelihood for almost 18,000 farmers. Most of the agricultural products are sold locally. The type of farming technology being utilized is both traditional and modern.

The strong presence of the agriculture sector in Zamboanga City is contingent to its natural environment and physical landscape. Considering the vast agriculture land and the settlements being situated in coastal areas, residents heavily relied on agriculture and fishing as their main sources of livelihood.

Record shows that the crops with the highest production in terms of volume and value are mango, rice, banana, corn and rubber. In terms of area, rice covers 5,098.4 ha while in terms of production, mango has the largest yield per ha of land reaching 14.5 metric tons per hectare. Most of the produce are sold locally and a total of 17,834 farmers are involved in agricultural production. Apart from the major crops, the City also contributes to the region's production of vegetables such as cabbage, tomato, eggplant and cassava.

The agricultural crops by area and production for year 2015 is presented in Figure 16.

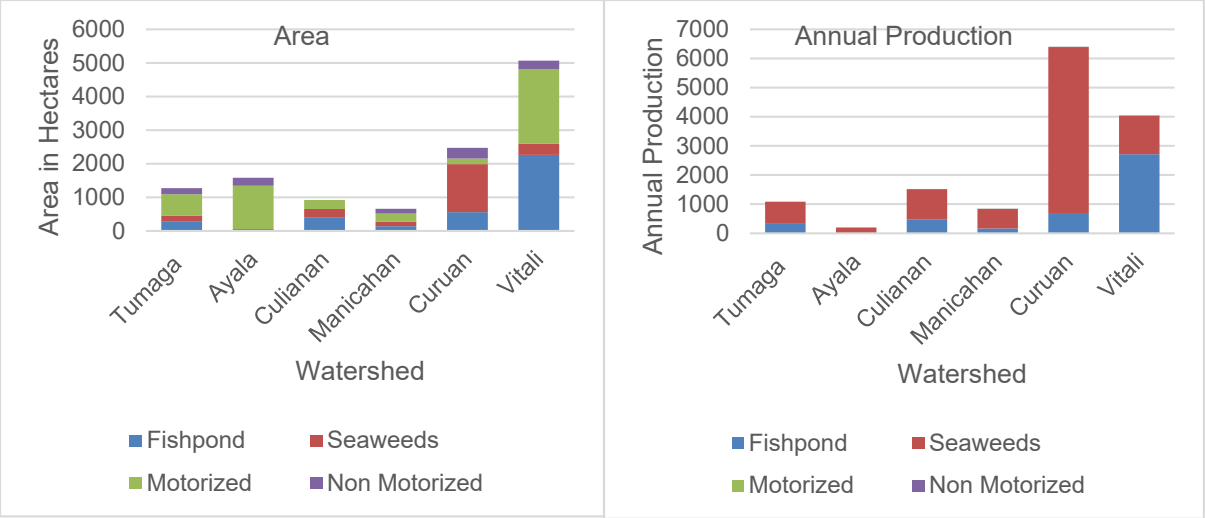


Source: Office of the City Agriculturist (through Zamboanga City CLUP 2016-2025)

Figure 16: Agricultural Crops and Production for Year 2015

Among the major industries of the city are canning and fish processing. Zamboanga City is considered as the "Sardines Capital of the Philippines" as it supports 75 percent of the country's domestic requirements for canned sardines. Another major manufacturing venture in the City is shipbuilding and repair since Zamboanga City is declared destination by the Maritime Industry Authority as a ship building and repair hotspot in the Philippines.

In 2015, Zamboanga City achieved the highest commercial fishery percentage share with approximately 76.15 percent of the region's production and the major fish species are indian sardines (*tamban*), big-eyed scad (*matangbaka*) and the roundscad (*galunggong*). Figure 17 presents the fishery by area and production.

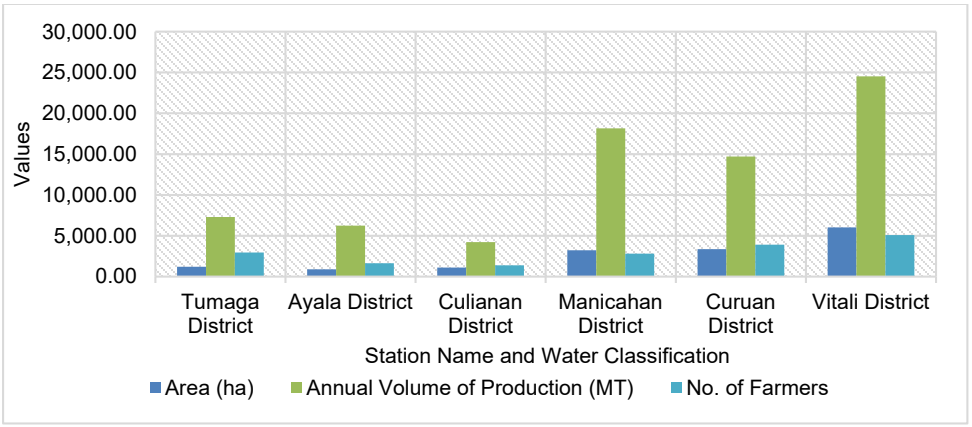


Source: Office of the City Agriculturist (through Zamboanga City CLUP 2016-2025)

Figure 17: Fisheries Area and Annual Production for Year 2015

Zamboanga is dominantly engaged in tertiary economic activities primarily in the wholesale and retail businesses. Also, the city boasts of numerous natural features which are tapped as tourism destinations. Examples of which are the pristine beaches in the Sta. Cruz Islands and Bolong, the Merloquet Falls and the Latuan Caves. Owing to its rich history, the city is also characterized with culture and heritage sites which celebrate the vibrant and diverse mix of religion, traditions and ways of life.

Zamboanga City is geographically divided into six agricultural districts. As shown in Figure 18, the Vitali District is the most productive and dominant with largest coverage for agriculture of 6,208.50 ha and the leading producer of major agricultural crops.



Source: Office of the City Agriculturist

Figure 18: Agricultural Crops by Area, Production and No. of Farmers, 2016

Among the issues and challenges in agriculture in the City were (i) decrease in agricultural area; (ii) decrease in crop production; (iii) low value added leading to low income of farmers; (iv) rice smuggling; (v) rehabilitation of irrigation systems in irrigable lands; (vi) lack of credit support and financing for agriculture production; (vii) inadequate market linkages; (viii) lack of technical

knowledge and low skill level of farmers; (ix) climate related and natural phenomena challenges (long dry spell and flooding) and (x) difficulty in implementing the organic agriculture act.

The City's Irrigation System

The construction of irrigation systems across the City has significantly declined in comparison to the 1980s. More than construction, there is a need to modernize and rehabilitate these irrigation systems to support agriculture activities. The City government has been introducing efforts such as 'cash-for-work program' introduced by the City Agriculturist Office which aims to give employment to affected farmers. Among the major activities they were engaged in is the desiltation of irrigation dams and rivers.

Overview of the existing irrigation system with a total irrigable area of 3,437 ha is presented in Table 9.

Table 9: Existing Irrigation Systems

Name of Irrigation System	Area (ha)					Irrigated Area (ha)	
	Service Area	New Generated Area	FUSA	Operational	Non Operational	Wet	Dry
NIA-Assisted/Constructed							
Gravity							
District 1							
Ayala CIS	187		152	152		152	152
La Paz CIS	60		60	60		60	60
Baluno sip	40		40	40		40	5
Patalon SIP	39		39	24	15	24	24
Malagutay SIP	50		50	50		50	50
Preza Mayor CIS	100		80	65	15	65	65
Talisayan CIS	100		86	86		86	86
Sta. Rita CIS	50		50	50		50	50
Labuan SIP	50	20	30	20	10	20	20
Lumayang SIP (CARP)	35	11	24	24		24	24
Sta. Rita CIS (CARP)	45	30	15	15		15	15
Sub-Total District 1	756	61	626	586	40	586	551
District 2							
Boalan CIS	35		30	30		30	30
Bolong CIS	100		100	100		100	100
Bunguiao CIS	95		72	72		72	72
Curuan CIS	115		115	115		115	115
Dabuy CIS	77		77	70	7.00	70	70
Buenavista PIS	50		-			-	-
Mangga CIS	103		103	103		103	103
Manicahan CIS	254		254	254		254	254
Mercedes CIS	701		665	516	149	516	516
Quiniput CIS	75		75	75		75	75
San Isidro Bunguiao CIS	35		35	35		35	35
Sinuropan CIS	36		36	36		36	36
Sinuropan CIS Extension	25	25	-			-	-
Tictapul CIS	5		5	5		5	5
Tictapul CIS Extension	25		25	25		25	25
Vitali CIS	225		225	60	165.00	60	60

Name of Irrigation System	Area (ha)					Irrigated Area (ha)	
	Service Area	New Generated Area	FUSA	Operational	Non Operational	Wet	Dry
Lower Tigbao Licomo SIP	65	65	-			-	-
Guisao CIS	80		80	80		80	80
Licomo SIP	40	40	-			-	-
Taloptap CIS	75		75	25	50	25	25
Sub-Total District 2	2,216	130	1,972	1,601	371	1,601	1,601
Sub-Total (Gravity)	**2,972**	**191**	**2,598**	**2,187**	**411**	**2,187**	**2,152**
Pumps							
District 1							
Ayala PIP	22		22		22		
Zamboanga City CIS I	3		3		3		
Vitali PIP	8		8		8		
Sub-Total District 1	33	-	33	-	33	-	-
District 2							
Lumayang PIS	24		24		24		
Vitali PIP	22		22		22		
Buenavista PIS/Upper Buenavista CIS	30		24	24		24	24
Sub-Total District 2	76	-	70	24	46	24	24
Sub-Total (Pump)	109	-	103	24	79	24	24
Sub-Total (NIA-Assisted)	**3,081**	**191**	**2,701**	**2,211**	**490**	**2,211**	**2,176**
OGA-Other Gov't Agency Assisted							
Buenagatas CIS	-		-				
Cabaluay CIS	25		25	25		25	25
Guiwan CIS	110		110	110		110	110
Lunzuran CIS	5		5	5		5	5
Manga-Bunguiao CIS	38		38	38		38	38
Muti CIS	20		20	20		20	20
Pamiguitan CIS	18		18	18		18	18
Sapa Tomas CIS	20		20	20		20	20
Seguinan CIS	75		75	75		75	75
Licopon CIS	45		45	45		45	45
Sub-Total OGA	**356**	**-**	**356**	**356**	**-**	**356**	**356**
Grand Total	**3,437**	**191**	**3,057**	**2,567**	**490.00**	**2,567**	**2,532**

Source: Office of the City Agriculture

Transportation

Land travel within the city is serviced mostly by tricycles, public utility vehicles (PUVs), private cars and buses. There are two main entry and exit points in Zamboanga City which are both national highways: (i) Zamboanga West Coastal Road[11] located in the western portion of the city; and (ii) Pagadian City-Zamboanga City Road which is located in the eastern part. Additionally, Curuan Lunday Road and Licomo Sinoropan Road are considered as entry and exit points of Zamboanga City. The total road kilometrage in the city is 1,214 km wherein about 76 percent of the City's roads are gravel surfaced or unpaved. There are also 49 bridges present in the city as of year 2015.

[11] Also known as Zamboanga City-Labuan-Limpapa Road

Another major gateway is the Zamboanga International Airport. The airport covers a land area of 137 ha and the length of its runway is 2,611 meters. Having 144 flights per week, it plays a vital role both in the national air transport system and in the local transport system covering not only Zamboanga City but also the Western Mindanao region.

In terms of seaports, the most prominent port is the Port of Zamboanga. The three different types of services that the port of Zamboanga caters are cargo handling, pilotage, and bunkering and water supply.

Power

The main electricity provider of Zamboanga City is the National Grid Corporation of the Philippines (NGCP) and several Independent Power Producers (IPPs), while the Zamboanga City Electric Cooperative (ZAMCELCO) is the one of the three power providers that distribute power throughout the city. As of 2014, ZAMCELCO serves 90 barangays. The other power distributor is Zamboanga del Sur Electric Cooperative (ZAMSURECO) 2 covering Vitali district.

Communication Network

There are a number of communication network and information facilities operated in Zamboanga City. In year 2013, the communication facilities and providers in the city includes seven AM radio stations, one FM radio station, several TV stations, 15 post office and telegraph stations and eight local publications. There are three major cellular providers operating in the city: (i) SMART (including DIGITEL and SUN), (ii) GLOBE; and (iii) PLDT. Two telephone landlines are operating in the city. As of 2013, the total telephone lines installed is 17,227 km.

Among the issues and challenges faced by the city in the communication sector are: (i) only one line supports the communication facilities in the city; (ii) poor signals of cellular phones are experienced by the subscribers; (iii) intermittent internet connection; (iv) no private-public partnership exists; and (v) no local ordinance protect the rights of the consumers.

Access to Water

According to DOH-FHSIS (2016), about 96 percent of households in the six major watersheds have access to improved safe water supply. Majority or about 74 percent have access to Level III water supply system, 14 percent to Level II and 12 percent to Level I. ZCWD is the City's water service provider of Level III water supply system. The source primarily comes from Tumaga River and Mercedes River. Further information about water district is discussed in ZCWD's Section.

Waste Management

Solid Waste. The City has undertaken several measures to facilitate the implementation of a functional solid waste management system. The City is currently operating a Sanitary Landfill Facility (SLF) on a 10.6 ha property located at Brgy. Salaan which started operation on 31 March 2015. The SLF is design to receive the City's solid waste for 15 years at a rate of 200 tons per day and it is operating the first cell that receives heterogenous wastes at an average rate of 160 tons per day. Waste reduction and recycling activities namely composting, recycling of polystyrene using styro/plastic densifier machine and waste recovery at junk shops are among the activities which contribute to the lower actual disposal volume.

Wastewater. The Environmental Management Bureau under the Department of Environment and Natural Resources (EMB-DENR) in Zamboanga City revealed that domestic wastes are the major source of pollution with 33 percent, followed by livestock with 29 percent and industrial sources at 27 percent. On the other hand, non-point sources of pollution account for 11 percent of the organic load contribution to bodies of water. Republic Act (RA) No. 9275 or Clean Water Act of 2004 states that industrial and manufacturing establishments that discharge wastewater must install and operate efficient wastewater pollution control facilities before starting its operation.

ZCWD has handled sewerage system for a total of 887 service connections which cater an average flow rate of 4,000 cubic meters per day (m³/day) as of May 2017. It is among the few water service providers in the country which operates and maintains a sanitary sewer system. It was turned over to the water district in 1976 along with the transfer of the water supply system. The existing system has limited coverage, but it provides a sanitary means of sewage collection from the high-density commercial areas of the city. Outside the existing sewerage service areas, residents and other establishments rely on the on-site systems specifically septic tanks for wastewater treatment and disposal.

Figure 19: Sewage Pumping Station

Sewerage includes, but is not limited to, any system or network of pipelines, ditches, channels, or conduits. This includes pumping stations, lift stations and force mains, service connections and other constructions, and devices and appliances appurtenant thereto, which involves the collection, transportation, pumping, and treatment of sewage to a point of disposal.

ZCWD's sewerage system was constructed in 1933 by the United States. It currently covers about 80 ha in four urban barangays, with a combined population of 9,083, according to the August 2015 census.

The collection system consists of approximately 11,400 linear meters (lm) of vitrified clay pipes of with sizes ranging from 100 to 300 mm diameters. The facility includes two pumping stations, the East Pumping Station has three vertically mounted sewage pumps that have a combined capacity of 9,230 m³/day. The West Pumping Station has two vertically mounted sewage pumps with a combined capacity of 11,535 m³/day. The sewage collected at the West Pumping Station is discharged through a 300 mm cast iron pipe. The two pumping stations are connected by two 200 mm cast iron pressure pipes. (USAID, 2017).

Spatial Development

The Zamboanga Peninsula Regional Spatial Development Framework (ZRSDF) for 2016 to 2045, consistent with the National Spatial Strategy (NSS) and the Mindanao Spatial Strategy Development Framework (MSSDF) provides information on the network of settlements and the growth direction and channels for the Zamboanga Peninsula. The document charters the direction

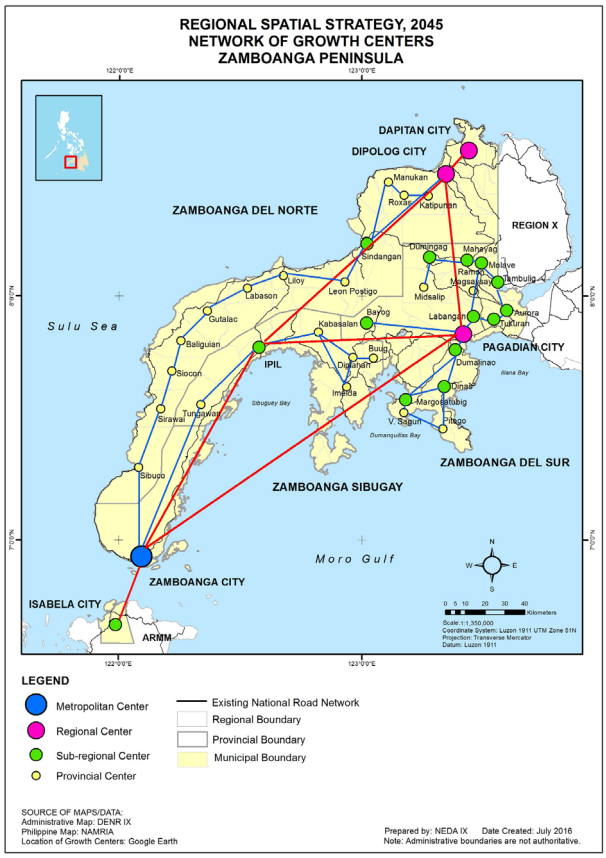
through the triangulation of their area's natural resource endowments, facilities, comparative advantages, population projections and other information related to overall development.

The increasing population coupled by variable inflation rates and the slow, or at times, deceasing regional economic growth requires Zamboanga Peninsula to adapt the Concentric Y-strategy. This focuses and distributes intervention into areas of economic concentration which are Dipolog City, Dapitan City, Pagadian City, Ipil, Zamboanga Sibugay and Zamboanga City.

With the increasing population at Zamboanga City, it is envisaged to be classified as Metropolitan Center by 2045 as presented in Figure 20, with its population projected to 1,254,711. Its economic reach and influence shall extend to the Southwestern Mindanao and beyond to the Basilan, Sulu, Tawi-Tawi (BaSulTa) provinces. Two economic zones are being proposed to harness the industry and the agriculture, fishery and forestry sector. With this, the preparation and upgrading of Zamboanga City in all development centers shall play a significant role in transforming it to an international gateway to Southeast Asia.

Apart from an economic center, Zamboanga City is also set to become an Education Center where in universities, research and training facilities shall be housed. As a financial center it shall have state of the art communications and banking facilities and shall also become a center for health care services.

The plan also emphasized on reviving the agriculture and fisheries sector in Zamboanga City. This shall be done through enabling Zamboanga City as the principal actor to the whole Peninsula in transforming as a Center of Sustainable Agri-Fishery Industries of the Philippines.



Source: ZamPenRDP 2017-2022, Midterm Update

Figure 20: Proposed Hierarchy of Settlements

Zamboanga City Water District Profile

The original water system in Zamboanga City was built between 1911 and 1913 by the United States colonial government for the purpose of serving the needs of US forces in the city at that time. In 1948, the City of Zamboanga took over the management of the water system. Presidential Decree 198, otherwise known as the Provincial Water Utilities Act of 1973, authorized the formation of water districts to operate local waterworks system. Consequently, ZCWD was created pursuant to Resolution No. 446 (amended by Resolution No. 77, dated 6 March 1974) that was passed by the Zamboanga City Council on 8 November 1973. Since then, ZCWD operates and manages the water supply for Zamboanga City.

Figure 21: Official Logo of ZCWD

Organization and Management. The ZCWD is governed by a five-member Board of Directors, headed by the General Manager who oversees the day-to-day operation of the Water District. Based on its 2020 Monthly Data Sheet (MDS), ZCWD employs a total of 345 regular employees and serves 65,261 resulting in an employee to connections ratio of 1:189.

Year End Monthly Data Sheet. Highlights of the ZCWD's performance in terms of service and financial condition for the year 2020 based on its MDS for December 2020 are shown in Table 10.

Table 10: ZCWD Profile

Description	Value
Service Connection Data	
Total Active	65,261
Estimated Population Served	326,305
Billing and Collection Data	
Billing (PhP)	55,897,391.91
Collection (PhP)	58,172,407.00
Collection Efficiency (%)	92.33%
YTD Collection Ratio (%)	79.77%
Financial Data (YTD)	
Revenue	754,914,121.15
Expenses	705,181,687.98
Income (loss)	49,732,433.02
Source of Supply	
Operational Wells	21
Spring	7
Surface	1
Bulk	1
Total production (m^3/year)	51,395,097.9
Total consumption (m^3/year)	20,667,522.0
Accounted water (%)	40.21%
Miscellaneous Data	
Total no. of employees	672
Regular	345

Description	Value
Job order contracts	327
No. of connections per employee	189

Source: ZCWD MDS 2020

Tariff Structure and Approved Rates for Implementation. Effective April 2021, ZCWD adopted the recently approved water rates as presented in Table 11.

Table 11: Tariff Structure, April 2021[12]

Classification	Minimum Charges	Commodity Charges (per m³)				
		11-20	21-30	31-40	41-50	51-60
Domestic/Government	210	29.50	30.65	35.20	39.75	44.25
Commercial/Industrial	420	59	61.30	70.40	79.50	88.50
Commercial A	367.50	51.60	53.60	61.60	69.55	77.40
Commercial B	315	44.25	45.95	52.80	59.60	66.35
Commercial C	262.50	36.85	38.30	44.00	49.65	55.30
Bulk Sales	630	88.50	91.95	105.60	119.25	132.75

Source: ZCWD

Existing Water Supply System

Service Area Coverage and Served Population. The mandate of the ZCWD covers the entire area of the city, which consists of 98 barangays. In year 2020, service area covers the 61 barangays (62.24 percent) classified into three districts: West Coast, East Coast and Central Area as indicated in the Figure 22. As of December 2020, total number of active service connections is 65,261 of which 58,623 are residential/domestic serving about 293,000[13] people. Based on the USAID's Hydrological Vulnerability Assessment for Zamboanga City (2016) inventory, most of the service areas experience low water pressure and water shortage during the dry season.

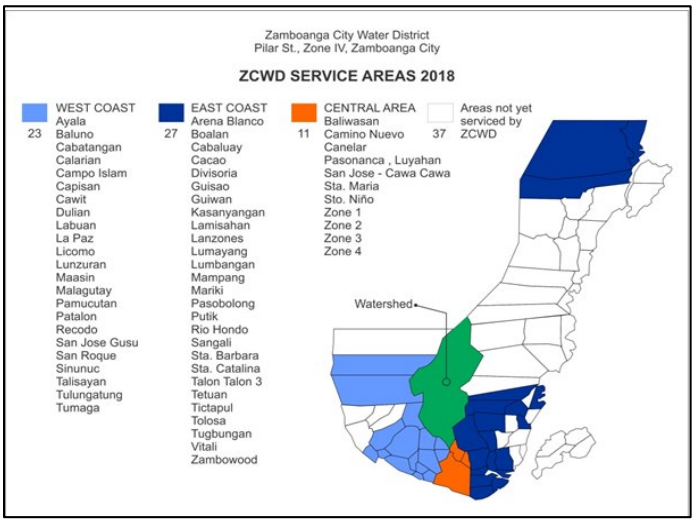


Figure 22: ZCWD Service Area Map

Existing Water District Facilities and Water Sources. The original water system in Zamboanga City was built by the United States colonial government in 1911 for the purpose of serving the needs of US forces in the city at the time. It consisted of an intake box, a grit removal basis, a three- kilometer reinforced concrete aqueduct, a reservoir and a distribution system which was expanded in 1930.

The Local Government of Zamboanga City took over the management of the water system in 1948. The water system was subsequently named as Zamboanga City Waterworks and

[12] Approved by LWUA Board of Trustees per Resolution No. 53, series of 2020 and ZCWD Board of Directors per Resolution No. 20, series of 2021

[13] Based on December 2020 ZCWD MDS, the average number of persons per connection is five members per household.

Sewerage System (ZCWSS). The city government, through a PhP 2 million financing loan from the Development Bank of the Philippines, funded the repair and improvement of the water system.

In September 1973, former President Ferdinand E. Marcos issued Presidential Decree 198 otherwise known as the Provincial Water Utilities Act of 1973. This Act authorized the formation of water districts to operate local waterworks system. This law aimed to improve the water systems in the country, to match the rapid growth of the population. Consequently, the ZCWD was created pursuant to Resolution No. 446 (amended by Resolution No. 77, dated 6 March 1974) that was passed by the Zamboanga City Council on 8 November 1973.

Figure 23: Aerial View of ZCWD Phases 1 and 2 Water Treatment Facilities

The ZCWD took over the operation of the ZCWSS on 1 April 1974. Two years after, the Local Water Utilities Administration (LWUA) granted ZCWD a PhP 1.2 million loan package for the construction of three deep wells, a laboratory, and the purchase and installation of 5,000 water meters. In 1978, the following projects were implemented under the Comprehensive Water Supply Improvement Program (CWSIP) that was funded by a loan from the Asian Development Bank (ADB) through LWUA:

- Construction of a 35,000 m^3 water treatment plant (WTP);
- Construction of diversion dam and intake facilities on the Tumaga River;
- Laying of a 4.1 km raw water transmission pipeline and 33 km of main distribution and pipeline network; and
- Installation of fire hydrants and transfer of service connections.

ZCWD also operates and maintains a complex water system which utilizes both surface and groundwater sources. Majority of these water sources are found within the Pasonanca Natural Park. It contains most of the water sources and catchment areas utilized by ZCWD. Presented in Figure 24 is the main water system schematic diagram.

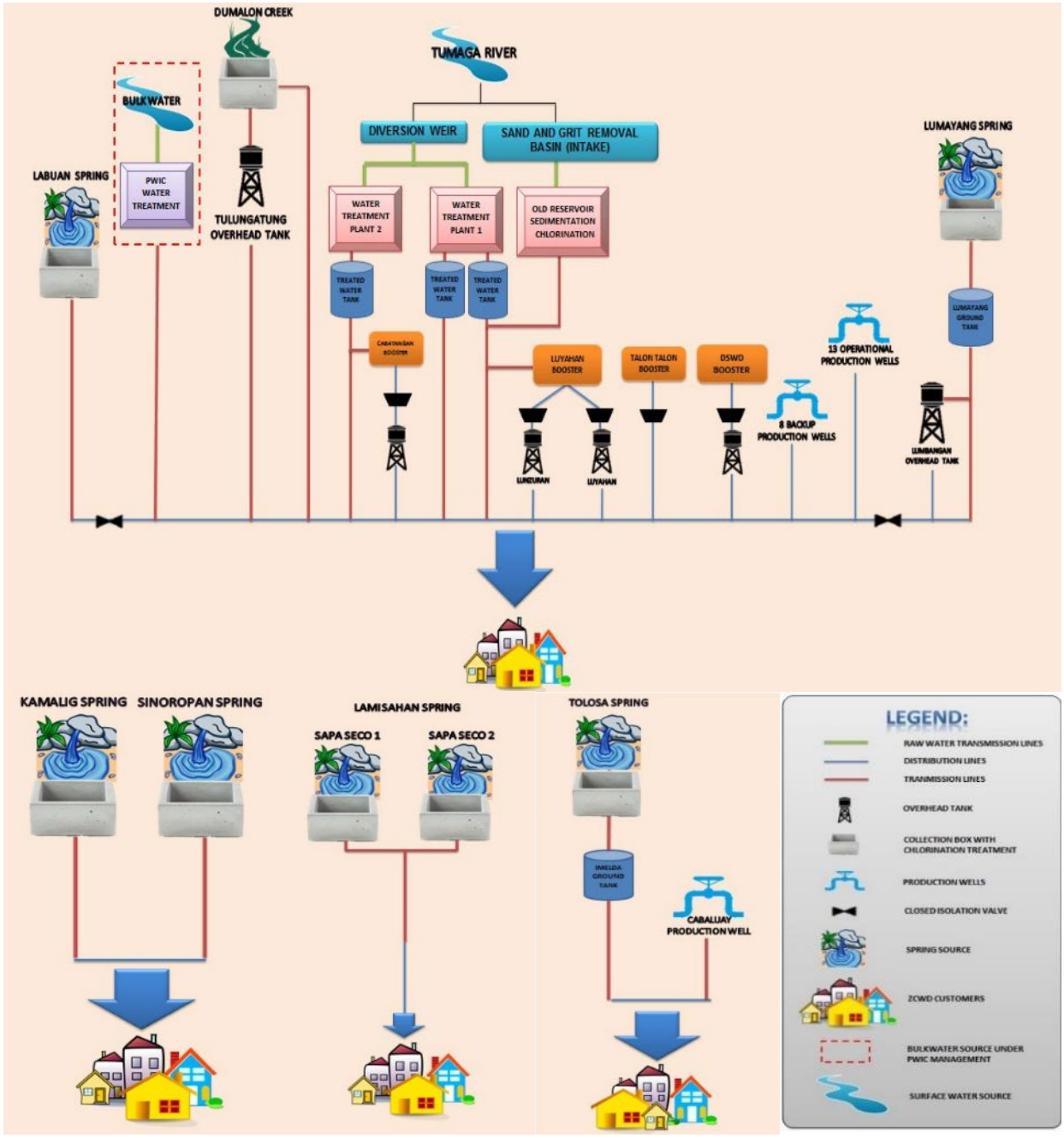


Figure 24: ZCWD Main Water System Schematic Diagram

a. Surface Water

Figure 25: Tumaga River Diversion Weir

One of the biggest catchment basins found within Pasonanca Natural Park is the Tumaga River which supplies the existing WTP and serves 60 percent of the city's water demand. It is classified as Class A Freshwater thus the raw water is regularly monitored not only by ZCWD but also by the Tumaga River Water Quality Management Area (WQMA) Governing Board with EMB Region IX as its secretariat. A diversion weir situated at the Tumaga River is about 4.1 km upstream of the WTP. The dam is made of reinforced concrete construction. It has 18 m long crest, 3.50 m toe to crest height. It has an elevation of 74.20 masl. This supplies water to the WTP and its main purpose is to divert water coming from the source (watershed) to the treatment plants through the two transmission lines. The profile of the Tumaga River is presented in Table 12.

Table 12: Profile of Tumaga River

Name of the Surface Water Source	Tumaga River
Number of Intake Structure	2
Type of Intake Structure	Diversion Dam/Ogee Weir
Quality of Raw Water	
Average:	Class A Public Water Supply Class II – Intended as source of water supply requiring conventional treatment (coagulation, sedimentation, filtration and disinfection) to meet the latest Philippine National Standards for Drinking Water 2017 (DENR Administrative Order No. 2016-08, May 4, 2016)
Extreme Conditions	NTU levels reaching above 10,000 NTU during heavy precipitation
Persistent Water Quality Issue	High turbidity levels after heavy precipitation

Water Treatment Plant. The existing WTP was constructed in two phases. Phase I was commissioned in 1981 with production capacity of 35 million liters per day (MLD), and an identical plant (Phase II) was commissioned in 1991, resulting in a total installed capacity of 70 MLD. The WTP has a ground concrete reservoir with a combined storage capacity of 15,000 m^3. The WTPs are located at the Pasonanca Park in Brgy. Pasonanca.

Old Reservoir. Another water supply facility is The Zamboanga City Old Reservoir, located several meters below the existing Phase I and Phase II WTPs, is also used to augment water to the system. The old reservoir can produce 24 m^3/day and up to a maximum of 29 m^3 of potable water. Excess water from the watershed is being diverted to the old reservoir for distribution. However, operation of the old reservoir is dependent only on the excess water. During drought, the old reservoir is rendered in operational. As with the Dumalon water source, the old reservoir is also vulnerable to high turbidity. In the absence of a treatment facility, high turbidity drastically diminishes the old reservoir from supplying its rated capacity.

Dumalon. The Dumalon water source is located at upper Baluno, at the western portion of Zamboanga City. It is approximately located 835 masl. Dumalon is a spring source with a capacity of 550 gallons per minute (gpm). Areas supplied by the Dumalon Water system are: Baluno – Zambame, portion of Cawit, portion of Brgy. Maasin, portion of barangays Tulungatung, Malagutay, Flamingo, Upper Calarian, Pasay- San Roque, Bandera, Capisan, Dulian, Km. 7 Pasonanca and Busay Lantawan. The DPWH Project: Dulian – Cabatangan Water System which is for commissioning will also be supplied by the Dumalon source. However, the source is still susceptible to high turbidity. Whenever heavy precipitation occurs in the area, water becomes turbid. In the absence of a water treatment facility, operation has to be stopped until the turbidity level goes down to acceptable limits. Due to its high elevation, pressure surges are also experienced. However, interruptions are mainly caused by high turbidity. Although the source traverses several barangays, water supply in these areas are erratic as a result of adverse climatic conditions.

Table 13 presents the historical annual production of the surface water source from years 2016 to 2020.

Table 13: Surface Water Source Historical Annual Production

Type of Water Source	Rated Capacity (m^3/year)	Actual Annual Production (m^3/year)				
		2016 (w/ El Niño)	2017	2018	2019 (w/ El Niño)	2020 (w/ drought)
Surface Water Sources	33,215,000	29,773,612	34,008,210	34,000,685	29,330,579	31,276,580

b. Groundwater

Production Wells. Production wells provide the domestic water supply needs of residents, which are not or inadequately served by the ZCWD. Many of the wells are shallow to moderate depths and of low designed capacity. Except for a few commercial and industrial wells, they usually provide for household requirements. Well casing diameters range from 64 mm for household boreholes to 300 mm for industrial wells. Depths range from 9 to 183 m although more than 75 percent are not more than 25 m deep. ZCWD is presently utilizing 13 production wells with an average production capacity of about 11,700 m^3/day. Each of these production wells is equipped with submersible/turbine pump and a generator set that runs it for 24 hours a day. Presented in Table 14 is the profile of the production wells.

Table 14: Profile of Production Wells of ZCWD

Number of Wells	24
Number of Operational Wells	13
Number of Decommissioned Wells	3
Wells placed on Stand-by	8
Range of Years of Service	11–28 years
Range of Years Constructed	1975–2006
Range of Well Depths	22–90 m (Shallowest: 22 m; Deepest: 90 m; Average: 70 m)
Materials used for	
Casing	B.I./Spirally welded steel pipe
Screen	Stainless wire wound
Depth of Cement Grout	15 m

Clay Seal	2 m
Protection Structures/mechanisms against natural threats	Encased with spiral steel casing Elevated structures; Sealed casing 15 m from NGL With perimeter fence with Security Guards Equipped with loggers Equipped with Standby Generator Set (Standby Power)
Raw Water Quality	
Average General Quality	Passed the Philippine National Standards for Drinking Water mandatory parameters
Persistent Water Quality Issue	High levels of Manganese (Mn), Iron (Fe) and Chloride (Cl)

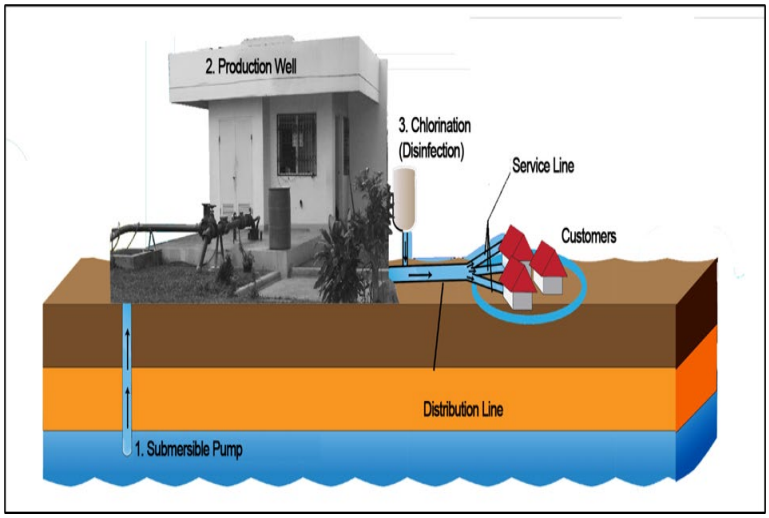


Figure 26: ZCWD Production Wells Concept

The 24 production wells are installed with back-up power generators. The total contribution of these wells is about 18 percent of the total production capacity. Also, some other smaller water springs are tapped, like the Dumalon Water System Intake Structure with a capacity of 48 lps in the upstream part of the Ayala River catchment area located at +869 masl, contributing together about 2 percent of the total water supply (USAID, 2016).

A total of 24 production wells are owned by ZCWD of which, 13 are operational, eight are on standby and three are decommissioned. The historical annual production of wells from years 2016 to 2020 is presented in Table 15. Detailed production of each well is presented in Annex 2.

Table 15: Production Wells Historical Annual Production

Type of Water Source	Rated Capacity (m^3/year)	Actual Annual Production (m^3/year)				
		2016 (w/ El Niño)	2017	2018	2019 (w/ El Niño)	2020 (w/ drought)
Production Wells	6,733,140	6,925,396	5,596,665	4,721,277	5,000,380	5,214,920

Spring Sources. ZCWD is also operating seven spring water sources which include: (i) Tolosa; (ii) Tictapul; (ii) Lumayang; (iv) Labuan; (v) Vitali; (vi) Dumalon; and (vii) Lamisan.

Tolosa Water System tapped a total of 12 spring sources located at varying elevations ranging from 500-510 masl. These spring sources include: (i) Florida Spring, (ii) Lupirao – Erwino 1, (iii) Lupirao – Erwino 2, (iv) Lupirao – Erwino 3, (v) Lupirao – Erwino Pandan, (vi) Kanya 1, (vii) Kanya 2 – Box 1, (viii) Kanya 2 – Box 2, (ix) Virgilio 1, (x) Virgilio 2, (xi) Sta. Clara 1 and (xii) Sta. Clara 2. The system is expected to supply a population of 2,775 persons or 555 households.

The Lumayang Spring Source has a discharge of 2.52 lps and is projected to serve a population of 1,982 persons or 396 households. Labuan Water System is being supplied by three springs located in Labuan with elevations ranging from 352 to 479 masl. It has a total flow of 8.20 lps and is capable of serving 6,411 persons or 1,288 households. Vitali Water System is being supplied the Kamalik surface water source located at an elevation of 161 masl. It has an average flow of 4.08 lps and is capable of serving 3,205 persons or 641 households. The Dumalon Water System, which will utilize Dumalon River as the water source, has a total discharge of 47.25 lps. An intake facility will be constructed at an elevation of 850 masl in Sitio Zambales, Brgy. Baluno. This water system is expected to serve a population of 37,113 persons or 7,423 households. The spring water source in Lamisahan has an average discharge of 5.34 lps and is located at an elevation of 370 masl. This water source is seen to be capable of serving a population of 7,878 persons or 1,576 households.

Table 16: Spring Sources Profile of ZCWD

Number	Seven spring sources, namely: 1. Tolosa 2. Tictapul 3. Lumayang 4. Labuan 5. Vitali 6. Dumalon 7. Lamisahan
Intake Structure (Spring box)	23
Range of Years in Service	5–15 years
Materials used	Concrete
Protection structures/mechanism against natural threat	Constructed encasement surrounding the spring box and began adding screen walls to protect the wells from unauthorized access;
Raw Water Quality	
Average General Quality	Passed the Philippine National Standards for Drinking Water
Persistent Water Quality Issue	Intrusion of run-off water during high precipitation

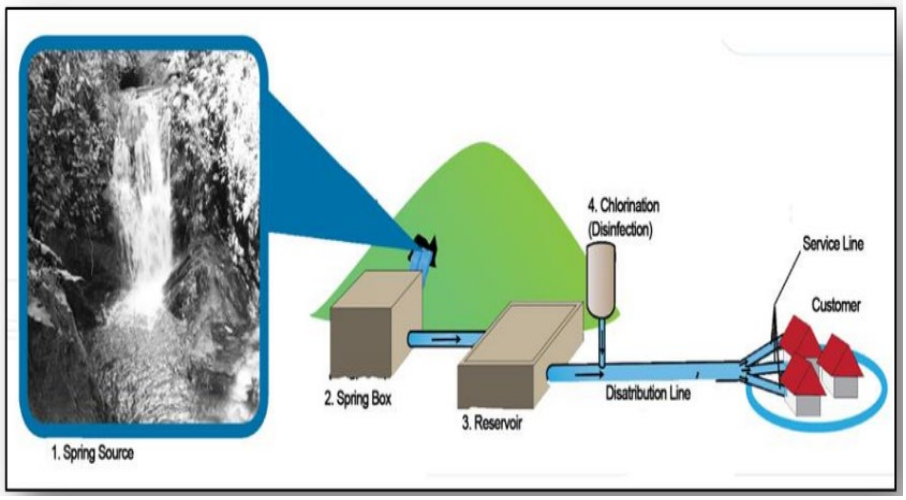


Figure 27: ZCWD Spring Sources Concept

ZCWD is operating seven spring water sources with total rated capacity of 662,856 m^3/year. Historical actual production is presented in Table 17. Detailed historical production of each spring source is presented in Annex 2.

Table 17: Spring Sources Historical Actual Production

Type of Water Source	Rated Capacity (m^3/year)	Actual Annual Production (m^3/year)				
		2016 (w/ El Niño)	2017	2018	2019 (w/ El Niño)	2020 (w/ drought)
Spring Sources	662,856	650,884	867,403	804,950	669,726	717,938

Source: ZCWD, 2020

c. Bulk Water Supplier

The water district engaged with a bulk water supplier in 2016, Prime Water Infrastructure Corporation (Prime Water), to provide the 50 MLD WTP. As part of the bulk agreement Prime Water, constructed a 50 MLD Pamucutan WTP in the west coast area. Due to water supply issues during drought conditions, the facility can only produce less than half the contracted amount of water. In 2019 during El Niño drought conditions; the facility was only able to produce 21 MLD down from the 50 MLD rated capacity. (Teofilo Garcia, 2019). After the El Niño event in 2019, the average bulk water production increased to 39 MLD in 2020. Historical actual production is presented in Table 18.

Figure 28: Prime Water 50 MLD Pamucutan Bulk Water Facility

Table 18: Bulk Water Historical Actual Production

Type of Water Source	Rated Capacity (m^3/year)	Actual Annual Production (m^3/year)				
		2016 (w/ El Niño)	2017	2018	2019 (w/ El Niño)	2020 (w/ drought)
Bulk Water Supplier	18,250,000	83,563	7,794,118	15,704,410	12,851,416	14,185,663

Source: ZCWD, 2020

Distribution Network. The profile of ZCWD distribution system is presented in Table 19.

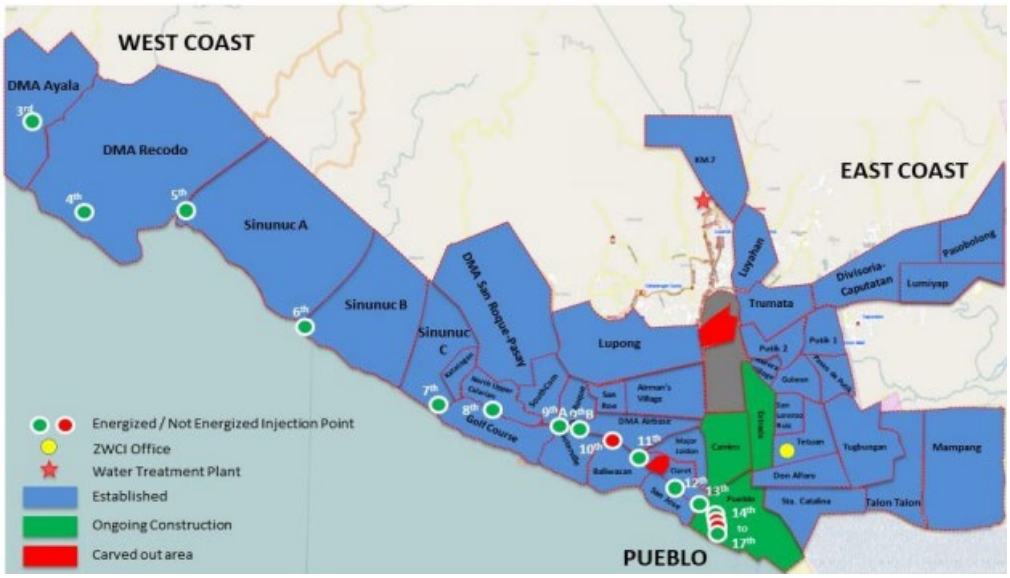
Table 19: Profile of ZCWD Distribution System

Distribution Components	General Descriptions	
1. Reservoir	• Talon-Talon Booster Station • DSWD Booster Station • Luyahan Booster Station • Cabatangan Booster Station • Lunzuran Booster Station • Lumbangan Overhead Tanks • DSWD Overhead Tank • Talon-Talon Ground Tank • Lumayang Ground Tank • Tolosa-Imelda Ground Tank	
2. Valves	538 units	
3. Valve Boxes	538 units	
4. Telescopic	138 units	
5. Hydrants	395 units	
6. Blow Offs	36 units	
7. Distribution Network	Transmission Pipeline (Materials: DI/CI/CLCS)	
	700 mm	19,454 lm
	600 mm	6,172 lm
	500 mm	6,446 lm
	450 mm	3,987 lm
	Distribution Pipeline (Materials: PVC/CI/CLCS)	
	400 mm	9,950 lm
	350 mm	5,499 lm
	300 mm	4,649 lm
	250 mm	20,396 lm
	200 mm	56,934 lm
	150 mm	86,748 lm
	Lateral Pipeline (Materials: PVC/CI/PE/PB)	
	100 mm	216,335 lm
	75 mm	53,902 lm
	50 mm	45,684 lm

Source: ZCWD Water Safety Plan

District Metering Areas. A district metering area (DMA) is defined as a discrete area of a water distribution network. It is usually created by closing boundary valves so that it remains flexible to changing demands. The DMA facilitates the measurement of supply and billed volume. The difference of these represents the NRW level in a particular DMA. It serves as an input in prioritizing reduction.

Under the NRW Reduction Project of ZCWD, which is carried out through Joint Venture Agreement (JVA) with Manila Water Company, Inc. (MWCI), there will be a total of 39 DMA from Ayala in the west coast to Pasobolong in the east coast. Five of these DMAs in the east coast and the DMA Ayala in the west coast are deep-well fed. The rest are supplied by surface water source through the two water treatment plants and the old reservoir in Pasonanca. In addition to these DMAs, the ZCWD also established and manages its own nine DMAs which are mostly separate and stand-alone water systems that are not yet completely interconnected to the main network. Map of the DMA formation is presented in Figure 28. The NRW as of December 2020 for each DMA is presented in Table 22.



Source: ZCWD Water Safety Plan

Figure 29: Map of DMA Formations

Table 20: DMA NRW as of December 2020

DMZ No. and Name	NRW (%)	DMZ No. and Name	NRW (%)
1A - Sinunuc A	24.73	20B1 - Pasobolong	19.62
1B - Sinunuc B	45.08	20B2 - Lumiyap	22.49
1C - Sinunuc C	29.75	26 - Sta. Catalina	72.00
02 - Katatagan	44.82	27 - Talon-Talon	42.62
03 & 04 - Golf Course & North Upper	24.94	28 - Mampang	74.25
08 - Southcom	30.96	29A - Estrada	83.30
09 - Suterville	73.90	29B - San Lorenzo Ruiz	59.13
11 - San Roque	70.17	29C - Tetuan	-
12 - San Jose	73.32	29D - Don Alfaro	61.25
14 & 15 - Mayor Jaldon & Claret	71.26	29E - Tugbungan	48.12
18 - Airman's Village	42.73	30 - Pueblo	84.82
19A - Putik 1	16.93	31 - Pasay	30.69
19B - Aurora	47.02	32 - Lupong	21.59
19C - Guiwan	65.95	33 - Camins	85.55
19D - Putik 2	-	35 - Luyahan	25.33
19E - Paseo de Putik	68.75	36 - Km 7	41.60
1A - Sinunuc A	24.73	37 - Ayala	41.50
1B - Sinunuc B	45.08	38 - Recodo	47.58
1C - Sinunuc C	29.75	39 -San Roe	32.97
20A - Trumata-Divisoria-Caputatan (TDC)	16.83		

System Operation and Maintenance

The service quality and water quality of the ZCWD observes the following standards:

- Hours of Service: 24/7
- Pressure: 10 psi
- Residual: 0.3 ppm at the farthest most point of the system
- Water quality: In compliance with the PNSDW.

Water Use Profile

Based on December 2020 MDS, the average water consumption per connection of ZCWD for residential customers is about 23.2 m^3. Assuming an average of five persons per household connection, the unit per capita for same period can be calculated to be 155 liters per capita per day (lpcd). This will be used as baseline data for the water demand projection.

Population Served. The served population of ZCWD as of December 2020 is estimated to be 326,205. It was derived by multiplying the assumed average number persons per household connections with the total number of connections. ZCWD has 65,261 active connections as of December 2020 and the assumed number of persons per household in this study is five.

Water Accountability. The total annual production of ZCWD based on its December 2020 MDS was 4,696,176 m^3 and the total accounted for water was 1,688,255 m^3 resulting to an estimated NRW of 64.1 percent.

Consumption Data. Presented in Table 21 is the monthly average consumption per connection data for the different classifications.

Table 21: Average Consumption Data

Classification	Monthly Average Consumption per connection (m^3)
Bulk/Wholesale	Unmetered
Commercial/Industrial	37.3
Government	166.9
Residential	23.2
Overall Average per Connection	29.0

Source: December 2020 MDS

Deficiencies of the Existing System

Resource Constraints. Presented in Table 22 is the resources constraint of the existing system.

Table 22: Resource Constraints of the Water System

Source	Quality of Raw Water	Quantity of Raw Water	Other Issues Identified
Surface Water	• Physical – High turbidity during heavy rainfall • Bacteriological Contaminants (E. coli)	• Low flow during dry season (dry spell/drought, El Nino) • Limited data/study/profile of the sources	• Absence of an impounding facility • High Non- revenue water

Source	Quality of Raw Water	Quantity of Raw Water	Other Issues Identified
Groundwater	• Physical (presence of sand/debris due to over extraction or deterioration of the well casing) • Chemical (high concentration of metallic elements, such as iron and manganese) • Bacteriological contaminants due to seepage of waste from septic tanks or other sources	• Limited water production due to over extraction • Improper planning and lack of well permitting • Lack of hydrogeologic and water pumping data of existing wells	• Absence of a treatment facility to address high concentration of metallic elements

Source: ZCWD Water Safety Plan

Non-Revenue Water. Almost all water districts in the Philippines suffer to some extent from losses in their distribution network. Referred to as NRW, the resulting losses hamper efforts to expand the distribution network to underserved or non-served populations. In 2020, the NRW is 64 percent and varies between 50 and 64 percent on an annual basis since the year 2015 as presented in Table 23. The trend is a steady increase in NRW over the past six years.

Table 23: NRW Performance of ZCWD

Year	2015	2016	2017	2018	2019	2020
NRW	50%	55%	59%	63%	64%	64%

Source: ZCWD 2015-2020 Monthly Data Sheet

Prior efforts with outside contractors to control NRW have not been successful. A twinning collaboration between Davao City Water District (DCWD) and ZCWD was first introduced in 2010 as part of the Local Water Operators Partnership Program of Philippine Association of Water Districts (PAWD). The partnership sought to address the challenge of reducing NRW through the sharing of expertise and experiences between DCWD (the expert twin) and ZCWD (the recipient twin). As of this writing, another effort for this twinning agreement is being considered by the ZCWD.

In 2015, ZCWD and the Manila Water Company Inc. signed an agreement on a performance-based NRW-reduction and network restructuring project. The project is a PhP300 million agreement that was reportedly a pioneering public partnership program on system loss reduction. It is a 10-year joint agreement with the first five years set to a network reconstructing program that will involve the formation of 33 DMAs and will involve an active leakage reduction program. Moreover, the first five years of the contract aimed for decrease of ~25% NRW or equivalent to 28 MLD recovered water. After two years from the beginning of the joint venture, the NRW program had established and commissioned 26 DMAs. This figure was 18 percent more that the contractual target of 22 as of March 2017 resulting in the recovery of about 410 million liters or 410,000 m^3 in May of the same year (ZCWD, 2017). With respect to the data presented in the Table 23, the NRW program with Manila Water Company does not appear to result in any reduction in NRW.

Bulk Water Supply. There are several operational issues identified with regards to the bulk water supply of ZCWD which are hindering the ability of the water district to achieve water security:

- During heavy precipitation, high turbidity causes reduction in production, thus it cannot meet its 50 MLD contractual obligation;
- Drought reduces production due to insufficient water at its source, thus it cannot meet its 50 MLD contractual obligation;
- Deep wells were developed by Prime Water to augment production during low water levels at its source[14];
- During the last El Niño climatic events, Prime Water tried to continuously operate the wells, however, the pumping water level dropped causing the flow to drop; and
- Out of the four deep wells, two are not yet operational. There are permitting issues pending with the City Planning Division Office (CPDO).

Presented in Figure 30 is the Prime Water production summary for year 2020. The delivery of bulk water improved starting June of 2020. However, if another El Niño phenomenon will hit the city, it is expected that bulk water supply will again be unable to meet its contractual obligation. Even with the operation of the deep wells to augment its water production, the problem that Prime Water experienced in the pumping water level drop after continuous pumping and insufficient water from its surface source will still cause a shortfall in its supply. The issues faced by Prime Water related to the wells are directly linked to the lack of proper planning and will likely continue in the future. As shown during the recent El Niño events, any shortfall in Prime Water's supply will impact water security especially at the west coast. The construction and utilization of the new wells may increase the ability of Prime Water to supply water, but any additional water supplied during dry periods or El Niño events will have minimal impact on the water needs of ZCWD.

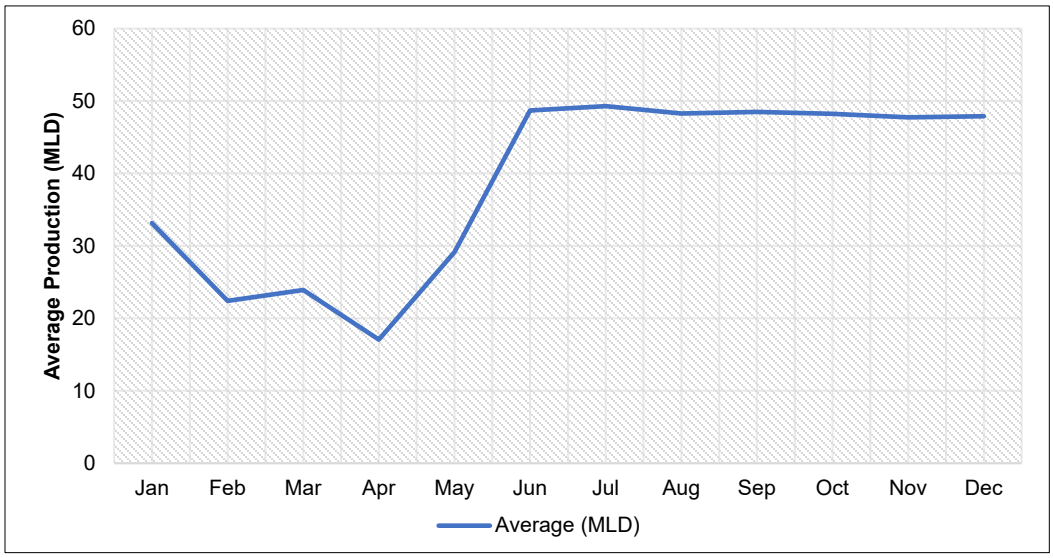


Figure 30: Prime Water Production Summary, 2020

[14] The ZCWD maintains that under the contract, Primewater should supply bulk water from its surface source. Using deep wells to augment its production is not within the contract. Primewater developed and uses the wells anyway.

Assessment on the Condition of the Study Area

On the Physical Features

Zamboanga City's dominant land uses are the forest and agriculture areas. Its growth and development are highly concentrated in the major urban areas of the City, specifically in the Tumaga watershed.

The city being a Type III climate is least frequent to be visited by typhoon, however, based on historical records, it has experienced high rainfall event causing flood and prolonged drought seasons. These conditions pose effects such as displacement of settlements in affected areas, drying of communal irrigation, less water production, and increase health and sanitation issues.

To address persistent effects of drought and other climate-change related hazards, certain measures must be taken into consideration by the city government of Zamboanga. One of which is the preservation and protection of forest and watershed resources coupled with implementation of stricter policy for the preservation of these areas. Another is the distribution and concentration of the developments away from the coastal and other vulnerable areas which may reduce the social damages brought by natural hazards calamities and disasters. In addition, the city government could educate and train the IPs in helping to preserve the natural environment. These IPs could greatly aid in the protection and preservation of Zamboanga City's forests and watershed areas. Another is the exploration of surface water from various river systems of the city as additional sources for domestic and irrigation consumption. Opting for groundwater sources for domestic water supply is not recommended since they are found to be either less productive or limited or insignificant and prone to contamination/pollution.

On the Socio-Economic Profile

In 2020, the city has higher population growth rate at 2.50 percent from 2015 to 2020 compared to the national and regional growth rates at 1.30 percent and 1.21 percent, respectively. Likewise, the population density is also higher at 610 per km² compared to the national and regional of 358 per km² and 215 per km², respectively. Among the major watersheds, Tumaga is the most populous and considered entirely as urban area and has become highly attractive for locals and migrants to reside in. This leads to high density developments and increasing land values.

Table 24: Population 1990 To 2045, Zamboanga City, Zamboanga Peninsula and The Philippines, 1990 To 2045

Year	Zamboanga City	Zamboanga Peninsula	Philippines
1990	442,345	2,280,460	61,895,168
1995	511,139	2,567,651	69,784,088
2000	601,794	2,831,412	77,991,755
2010			92,337,852
2015			102,113,212
2020			109,035,343
2025			116,833,053
2030			123,697,926
2035			130,039,796
2040			135,618,864
2045			142,000,000

Year	Zamboanga City	Zamboanga Peninsula	Philippines
2050	1,500,000		

Population projections based on 1980 to 2010 population growth rates, with a rate of change of 1.72 percent between 2010 to 2015, decreasing to 0.65 percent per year from 2040 to 2050. The medium variant projected population of the city in 2050 using the above growth rate is around 1.5 million from 2020 population of 977,234. (See Table 25)

Table 25: Population Rate of Change, 1990-2020

Year	Zamboanga City	Zamboanga Peninsula	Philippines
1990	2.56	2.27	2.58
1995	2.75	2.25	2.35
2000	3.54	1.83	2.02
2010	1.52	1.96	2.18
2015	1.26	1.21	1.59
2020	2.50	1.30	1.75

Table 26: Population Density, Persons Per Sq.Km., 2020

Year	Zamboanga City	Zamboanga Peninsula	Philippines
2020	610	215	358

Assuming the same increasing incidence of poverty as in the province, the number of poor households who will need to have access to cheaper but clean water for drinking and for personal hygiene will be increasing correspondingly with threats to health, particularly incidence of gastroenteritis and skin diseases.

The presence of IPs communities, particularly the Subanuns in the forest areas which are critical watersheds as well as the Badjaos living on boats and along and off the coasts and those based in mangrove areas require protected mountain springs development and unique water supply and sanitation systems in low-lying and above-the seawater, respectively.

Zamboanga City is poised and positioned as the commercial, industrial, financial, and educational center of the region. And by 2045, the City is envisioned to be the Metropolitan Center of the region which can be achieved through the following strategies: (i) build efficient, productive, and green urban areas for inclusive development, (ii) improve connectivity within and beyond the borders of Zamboanga Peninsula, (iii) reduce vulnerability of communities from risks due to natural and human-induced hazards, (iv) reduce poverty and, (v) ensure peace, security and safety.

The city government must take advantage of strategic development planning strategies to fully maximize its potential especially that the Zamboanga Ecozone and Freeport is in the City. Furthermore, the city government must be able to capitalize on the existing assets and resources to generate more income and provide employment opportunities for the people mainly because of the strong presence of agricultural industry.

The development pattern of Zamboanga City as presented in the recent CLUP should be directed inland due to the high susceptibility of coastal areas to ecological hazards. Decentralization of the

existing urban concentration is possible with much space for development and expansion for all land use types. Through this, the City will be able to accommodate the current and projected population of Zamboanga. Vis-à-vis to this various proposed growth centers, provision of social services, increasing employment opportunities and improving quality of life and enhancing various infrastructures including the provisions for safe and reliable water supply and sanitation, must be taken into consideration.

On the Situation of the Agricultural Water Industry

Over years, the agricultural area has found to decrease primarily due to the conversion of some into residential uses. Thus, the demand for both food and housing will increase the conflict in land use, where the demand for increasing residential lands will result to a corresponding decrease in agricultural lands and agricultural production, unless a corresponding increase in productivity can be attained. Increased coverage of irrigation and drainage systems can provide the needed agricultural productivity improvements.

Based on Zamboanga City Land Use Plan, agriculture areas cover 33% of the City's total land area. The City is heavily reliant on its agriculture industry. Hence, issues and concerns pertaining to agricultural sector shall be addressed to achieve resiliency. One issue is the need to address the negative impacts of climate change and the onset of long dry spells and flooding in the City that can affect crop and livestock production. Another is the need for improvement or development of communal irrigation system across the City. The construction of irrigation systems has significantly declined in comparison to the 1980s. Lastly, the possible conflicting issues or competition dynamics in water resources particularly between agricultural and domestic water demand must be taken into account. For instance, Manicahan River which is currently being used as irrigation water supply is also proposed as an additional source for domestic consumption. The average dependable flow within the existing NIA dam in Manicahan River with geographical coordinates of 7°2'10.76"N, 122°10'30.89"E can supply approximately 0.903 cms (78 MLD) under base case scenario and 0.855 cms (74 MLD) considering climate change scenario. On the other hand, the average dependable flow in the proposed intake point[15] for the domestic water supply can supply approximately 0.642 cms (56 MLD) under base case scenario and 0.606 cms (52 MLD) considering climate change scenario.

On Catering Water Supply and Sanitation Services

Infrastructure and utilities are considered to be vital factors in order to attain community's sustainability. For domestic water supply, ZCWD being the primary water service provider has to increase its area coverage and has to plan for additional water requirements with the City's continuous development and growth. Concurrently, there is a need to address the existing water supply deficit in its service area. As reported, barangays Malagutay, Sinunuc, Maasin, Tulungatung, Sangali, Lamzones, Tolosa, Vitali, Lamisahan, Lumayang, and Cacao are experiencing low water supply even during rainy season. There is also a need to reduce the non-revenue water of its system. Considering 50 percent water loss, a water supply shortage of 4,032,891 m^3 per annum was experienced during 2015.

[15] The geographical coordinates of the proposed intake point for the domestic water supply is 7°4'18.44"N, 122°9'8.11"E. It is located approximately 8 kilometers upstream of the existing NIA Dam in Manicahan River.

Consequently, with the increase in water consumptions, used water collection and treatment must be implemented to protect the water quality grade of the rivers. In particular, the rivers of Manicahan, Cabaluay, and Mercedes are below the quality standard set by DENR. Currently, the City's sewer system is only limited within the central business district. Other sources of pollution from industries, public markets, and flea markets, and non-point pollution sources such as agricultural run-off, must be provided with wastewater treatment measures.

In terms of solid waste management, it is expected that along with the increase in urban population, the total volume of solid waste generation in the city will also escalate. If no effective management measures are implemented, the health of residents of Zamboanga City will be affected and greatly damage the natural environment, affecting the tourism and housing industries.

On Challenges Brought by COVID-19 Pandemic

The COVID-19 pandemic has strained the City's health system to its limits to fight the spread of the virus and protecting the lives of Zamboangueños. Not only does it pose threats to the health and medical sector but it has also drastically developed into an economic crisis. Relevant to the community quarantine imposed by the LGUs, the COVID-19 pandemic has disturbed the City's economic and consumption activities. The total estimated losses due to the imposition of Enhanced Community Quarantine (ECQ) in the Zamboanga region alone was estimated at PhP4.91 billion or 1.26 percent of the projected 2020 GRDP.[16]

In the water supply sector, the ideal 24/7 supply of water has not been attained in some areas. About 14 percent of total households have Level II water supply access. The most common complaint is the difficulty in fetching water from communal faucets due to ECQ.

There are numerous strategies and suggested policy formations under social sector, economic sector, infrastructure, governance, and environment of the Zamboanga Region to move toward the new normal. Highlighted herein are the strategies related to the preparation of the Water Security Master Plan:

- Fast track the requirements for proposed water development projects;
- Persuade the national government to give financial aid to all local water districts nationwide;
- Forge sustained partnerships with capable and reputable private entities in the implementation of water supply, development, and distribution and sanitation projects;
- Institutionalize a National Emergency Management Program for Water Districts for emergency response network and resource procurement and pooling;
- Institutionalize water harvesting facilities in all residential, business, commercial and government offices; and
- Prioritize the protection and conservation of natural resources, especially in environmental hotspots and critical ecosystems.

[16] Regional Disaster Risk Reduction and Management Council for Region IX. Zamboanga Peninsula COVID-19 Regional Recovery Program 2020-2022 (Abridged Version). June 2020

III. Current Water Security Situation in Zamboanga City

Institutional and Organization Outlook

Legal Framework of the Water Sector

Constitution and Water Code of the Philippines. The 1987 Constitution of the Philippines stipulates that water resource is "owned by the State" and its development and utilization "shall be under the full control and supervision of the State"[17]. The basic water law is the Presidential Decree (PD) No. 1067 series (s) of 1976 otherwise known as the Water Code of the Philippines, which is enacted under the same principles as those of the Constitution. It has the following underlying principles:

- All waters belong to the State;
- All waters that belong to the State cannot be the subject to acquisitive prescription;
- The State may allow the use or development of waters by administrative concession;
- The utilization, exploitation, development, conservation and protection of water resources shall be subject to the control and regulation of the government through the National Water Resources Board[18] (NWRB); and
- Preference in the use and development of waters shall consider current usages and be responsive to the changing needs of the country.

The Water Code governs the appropriation of water. Such appropriation of water is legally allowed for the following purposes: domestic, municipal, irrigation, power generation, fisheries, livestock raising, industrial, and recreational. The measure and limit of water appropriation is its beneficial use[19]. Standards of beneficial use are prescribed by NWRB to the appropriators of water for different purposes and conditions. No person shall appropriate water without a water right that is acquired through issuance of a water permit[20]. The most noticeable point in the water appropriation is that the Water Code adopts the policy of "first-in time, first-in right" for the water allocation among users. In its Article 22, the code provides "between two or more appropriators of water from the same sources of supply, priority in time of appropriation shall give the better right, except that in times of emergency the use of water for domestic and municipal purposes shall have a better right over all other uses; provided, that where water shortage is recurrent and the appropriator for municipal use has a lower priority in time of appropriation, then it shall be his duty to find an alternative source of supply".

Water Supply. In the 1970s, the Philippines made three legislations which formed the basis of today's water supply sector:

- *RA No. 6234* an act creating the Metropolitan Waterworks and Sewerage System (MWSS) and dissolving the National Waterworks and Sewerage Authority

[17] Section 2, Article XII
[18] Formerly known as National Water Resources Council
[19] Defined in the code as the utilization of water in the right amount during the period that water is needed for producing the benefits for which the water is appropriated.
[20] A water permit may be granted to: (i) a Philippine citizen, (ii) a legal entity. i.e., cooperative, corporation, etc., with at least 60% of its capital owned by Philippine citizens, or (iii) a government entity or a government-owned corporation.

(NAWASA)[21]. This act authorized MWSS to serve water supply and sanitation needs of Metro Manila.

- *Presidential Decree No. 198,* as amended, otherwise known as the Provincial Water Utilities Act of 1973 was enacted to form local water districts[22] for provincial cities and municipalities outside of Metro Manila. The act also created the LWUA to provide institutional, technical and financial assistance to water districts nationwide.
- *Presidential Decree No.1206, s. 1977*, known as the Public Service Law, authorizes NWRB to supervise water supply services and regulate water tariffs, except those under the control of MWSS and LWUA.

Sanitation. The Sanitation Code promulgated as Presidential Decree No. 856, s. 1975 is a comprehensive legal basis which broadly covers various activities related to health and sanitation. The health of the people, being of paramount importance, all efforts of public services should be directed towards the protection and promotion of health. With the advance in the field of sanitation in recent years, there arises the need for updating and codifying the scattered sanitary laws to ensure that they are in keeping with modern standards of sanitation and provide a handy reference and guide for their enforcement. Hence, the Department of Health (DOH) issued the Revised IRR for Chapter XVII "Sewage Collection and Disposal, Excreta Disposal and Drainage" which was signed on 27 May 2021 establishing/updating the requirements on collection, treatment, and disposal of sewage and domestic sludge. Furthermore, provisions on sanitation services are also emphasize in the Local Government Code and Presidential Decree 198[23].

Water Related Organizations

There are more than 30 national agencies involved in the water sector but ten of which are key agencies involved in the planning, financing, implementation, operation, and regulation of the water sector outside Metro Manila. Presented in Table 27 are the major institutions and their key functions.

Table 27: Key National Agencies in the Water Sector

Agency	Main Function
NWRB	Water resource allocation and economic regulation of private waterworks including cooperatives, real estate developments and private operator
Department of Public Works and Highways (DPWH)	Technical Assistance to LGUs; and Level I and II water system Implementer; grant program on septage and sewerage (NSSMP)
National Economic and Development Authority (NEDA)	Sector macro-planning; approval of major sector projects; development of guidelines on economic policies, including public-private partnerships
NIA	It has mandate of overseeing the sustainable development and management of irrigation systems nationwide that is supportive of the agricultural development program of the government.

[21] NAWASA was a national agency in charge of waterworks development and operation in the Philippines. The NAWASA systems suffered from inadequate capital and an inordinately centralized decision-making. Most decisions and purchases had to be approved by the Manila central office.
[22] A water district is a local corporate entity responsible for water supply and wastewater management systems in one or more provincial cities or municipalities. It is established on a local option basis by the local chief executive and, like LWUA, is classified as a Government Owned and Controlled Corporation (GOCC).
[23] Otherwise known as Provincial Water Utilities Act of 1973

Agency	Main Function
DENR	Watershed management programs and oversight body for wastewater effluent
LWUA	Provides financing, technical assistance and institutional development services to water districts
LGUs	Delivery of basic services and facilities such as safe potable water to their constituents. Responsibility includes policy formulation, planning, and regulatory functions and program implementation on water, sewerage and sanitation.
Department of the Interior and Local Government (DILG)	Extends general administration and capacity-building support in all aspects of local governance to the LGUs, including water and sanitation concerns.
DOH	Develops water quality guideline for water service providers; formulates water supply and sanitation programs to prevent environmental-related diseases; development of policies related to health
Department of Budget and Management (DBM) and Department of Finance (DOF)	DBM is an executive body under the Office of the President which is mandated to promote the sound and efficient use of government resources. DOF is responsible for national fiscal policy and management. It provides sector funding through government financing institutions (GFIs)

National Plan and Policies

Updated Philippine Development Plan. The Philippine Development Plan (PDP) 2017-2022 has been formulated to lay down the foundation for inclusive growth, a high-trust and resilient society, and a globally competitive knowledge economy. This foundation is intended to be strong enough for the next three development plans to build on. The strategic framework of the PDP 2017-2022 is guided by AmBisyon Natin 2040[24]. The Philippines was on its way to becoming an upper-middle-income country, until the once-in-a-century global pandemic caused by COVID-19, hit. Given this, the PDP was enhanced to respond to the challenges brought about by the pandemic. The Updated PDP 2017-2022 will lead the Philippines back to the vision of a strongly rooted, comfortable and secure life. Under the Updated PDP 2017-2022, the following strategies related to water resources were identified:

- *Pursue water supply and sanitation (WSS) policies, plans and programs in accordance with the key reform agenda identified in the PWSSMP.* With the amplified importance of WSS during the COVID-19 pandemic and moving forward, the reform agenda will focus on the following areas, which are ultimately aimed at making water services adequately accessible for all: (i) establishing effective WSS sector institutions; (ii) strengthening regulatory environment; (iii) creating and ensuring effective WSS services; (iv) balancing water supply and demand; (v) building climate resiliency; (vi) enabling access to funding and financing; (vii) managing data and information; and (viii) driving R&D.

- *Pursue initiative on attaining water security.* Increase in water demand arising from an expected rise in individual hygiene practices and disinfection of public spaces due to COVID-19, as well as rising support to urban/community farming practices, would call for

[24] "By 2040, the Philippines shall have been a prosperous, predominantly middle-class society where no one is poor; our peoples live long and healthy lives, are smart and innovative, and live in a high-trust society" (Executive Order No. 5 s. 2016)

new water sources to ensure that demand is met, especially in areas suffering from water scarcity. Thus, the government will continue to support the development of new water sources and prioritization of surface water development. Groundwater recharge system in the development of the surface water source for critical areas will be incorporated. Measures on efficient water utilization and conservation, as well as the use of eco-efficient water infrastructure such as, but not limited to, rainwater harvesting, water reuse, proper agricultural and agronomic planning for irrigation, and other emerging technologies on WSS will continue to be promoted to avert water shortage.

- *Adopt a common/unified framework for resource allocation for WSS and review the National Sewerage and Septage Management Program (NSSMP) to accelerate the provision of WSS services.* Under the common/unified framework for resource allocation, the national government will ensure the availability of the required budget allocation for WSS projects. Likewise, in accordance with the Clean Water Act (RA 9275), sewerage and septage management projects will be implemented. Given this, the government will explore the expansion or restructuring of the NSSMP to accommodate more beneficiaries other than sewerage or septage management systems in highly-urbanized cities and first-class cities or municipalities.

- *Optimize funds for irrigation development and strengthen technical capacities for the development and maintenance of irrigation facilities guided by the National Irrigation Master Plan.* Water allocation for irrigation will have to be managed efficiently to offset the imminent increase in domestic or municipal water consumption to combat COVID-19. Specifically, the government will shift its focus in the short term towards funding the operation and maintenance, rehabilitation, and/or restoration of existing irrigation systems across the regions, instead of funding for the construction of multi-year large irrigation systems.

- *Improve coordination between flood management efforts and undertakings in other sectors.* Pending the creation of an apex body for the water sector, DPWH, as the de facto lead agency for flood control and management, and other relevant agencies will intensify coordination between flood management efforts and undertakings in other sectors. Likewise, a paradigm shift from looking at floodwaters as “disaster to be prevented” into a “resource to be managed” is a necessary step in attaining the objectives of the Integrated Water Resources Management (IWRM) framework.

Philippine Water Supply and Sanitation Master Plan. PWSSMP is an action plan being led by NEDA to achieve universal access to water supply and sanitation services from 2019 to 2030. It was aligned in government’s goal of attaining water supply and sanitation targets under the PDP 2017-2022, Clean Water Act of 2004 and United Nations (UN) Sustainable Development Goals (SDG). Highlights concerning Zamboanga City as presented in the PWSSMP are as follows:

- *Water Availability, Water Stress, and Water Scarcity.* NWRB has identified Zamboanga City as one of the nine water-critical urban areas where water is consumed intensively.

- *List of Programs and Projects.* An estimated amount of PhP20.46 billion for water supply projects[25] and PhP339 million for sanitation projects[26] are identified for Zamboanga City.

Local Plans and Policies

Zamboanga Peninsula Regional Development Plan (2017-2022 Midterm Update). This development plan captures policy directions, strategies and programs addressing current regional development issues and concerns in Zamboanga Peninsula. The following strategies related to the water resources were identified:

- Sustain the implementation and rehabilitation of irrigation systems in the region. The funding and implementation of rehabilitation of Communal Irrigation System (CIS) and Small Water Impounding System (SWIP) shall be accelerated to sustain the provision of water for rice lands across the region;
- Prioritize the funding of major irrigation projects;
- Conduct preliminary investigation on supplemental water sources for CIS and allocate funds to augment and sustain the supply of irrigation water;
- Provide adequate, safe and sustainable water supply and explore and develop new water sources to meet existing and growing demand;
- Public and private facilities shall be required to establish sewage and septage treatment plants for treating wastewater;
- Incorporate water collection system in school building design of DPWH/DepEd;
- Zamboanga Peninsula water districts to conduct Isotope studies for watershed within their areas of responsibility;
- Improve disaster flood mitigation and response and reduce adverse effects; and
- Mitigate flood damage in principal river basin.

Zamboanga Peninsula COVID-19 Regional Recovery Program (2020-2022). The overall objective of the Regional Recovery Program (RRP) is to address the adverse effects brought about by COVID-19 pandemic and facilitate the transition and adaptation of Zamboanga Peninsula to the “new-normal”. The following strategies related to the water supply were identified:

- Fast track the requirements for the proposed water development projects;
- Persuade the national government to give financial aid to all local water districts nationwide;
- Forge sustained partnerships with capable and reputable private entities in the implementation of water supply, development, and distribution projects;
- Institutionalize a National Emergency Management Program for water districts for emergency response network and resource procurement and pooling; and
- Institutionalize water harvesting facilities in all residential, business, commercial and government offices.

[25] Proposed water supply projects include: (i) Short Term (Cahumban Water System, Feederline/Water Services Expansion, Zamboanga City WD Impounding Dam); (ii) Medium Term (NRW Reduction Program, Rancho Frio and Bunguiao Water System); and (iii) Long Term (Bulk Water Distribution Line, Impounding Facilities, Mainline Replacement Project and Water Demand Management)

[26] Proposed sanitation projects include: (i) Short Term (Computer software system for data analysis, Material Recovery Facility for every barangay, Sanitary Landfill Facility); (ii) Medium Term (Sewerage Treatment Plant); and (iii) Long Term (WaSH in Schools and Zero Open Defecation)

Zamboanga City Policies. With the trajectory in the Philippine water supply and sanitation sector to achieve universal access to water supply and sanitation services from 2019 to 2030, the following efforts of the local government of Zamboanga City through executive ordinances are:

- Executive Order (EO) BC-540, s. 2000 is an executive order creating the technical working group (TWG) on Water Security of Zamboanga City.
- Ordinance No. 529, s. 2020. The "Environment Code of the City of Zamboanga" provides for inland water management in ensuring clean water supply, protection of underground water, water quality standards, monitoring and maintenance.
- Ordinance No. 542 s. 2020. An ordinance requiring the proper harvesting, storage and utilization of rainwater in the City of Zamboanga, appropriating funds therefor, providing penalties for violations thereof and for other related purposes.
- EO BC-661 s. 2021 is an executive order creating the Zamboanga City Water Security Council (ZCWSC). This supersedes the EO BC-540 (2000). Details regarding the Council is presented in Annex 3. The main functions of the Council are as follows:
    a. Collaborates with concerned government and non-government agencies, water service providers and stakeholders in crafting the ZC Water Security Master Plan and the ZC Septage Management Plan.
    b. Reviews and recommends to the Local Chief Executive and the City Legislative Council relevant and responsive policies, strategies, guidelines and innovations on water supply and sanitation development and management that serve as bases in establishing the targets and directions for water and sanitation expansion and improvement programs.
    c. Reinforces public information, education and communication campaigns, advocacies and promotions on water conservation and proper and efficient water use including the installation/ use of rainwater harvesting systems.
    d. Promotes use of water efficient fixtures and products in public and private structures in coordination with the business sector that shall make available fixtures, products, and appliances that are water efficient.
    e. Reviews plan and programs on the construction of small impounding dams and other water supply system projects in strategic areas across the City and provide recommendations to the LGU and the water service providers.

Water Resource Management Practice

Water Resource Allocation. The NWRB is the government agency which manages and regulates all water resources and services in the Philippines. It integrates and coordinates all water related activities that have social, environmental and economic impacts in the country. It is mandated to issue water rights on both surface water and groundwater upon the requests from water users in accordance with the Water Code

River Basin Management. The River Basin Control Office (RBCO) was created in pursuant to EO Nos. 510, 816 and 50. It is the lead government agency to implement the integrated river basin management and development framework across all river basins. It was created to develop a national master plan to address flooding and to provide sustainable supply of water for the entire country. In attaining these, an integrated river basin management and development master plan was crafted in 2007 identifying 18 major river basins[27] in the Philippines. The Program Budget

[27] On 2 May 2012, the Cabinet Cluster on Climate Change Adaptation and Mitigation (CCAM) passed Resolution No. 2012-001 adopting the 18 major river basins of the country as priority areas of the government. These 18 Major River

Approach (PBA) allowed the expansion of the program into other river basins aside from the eighteen 18 major river basins.

The Cluster 7 River Basin being managed by RBCO is present in the study area. It is composed of six principal river basins namely: (i) Ayala; (ii) Bolong; (iii) Curuan; (iv) Manicahan; (v) Tumaga; and (vi) Vitali-Taguite. All are exclusively located in Zamboanga City, Zamboanga del Sur except for Vitali-Taguite with administrative boundaries shared by Sibuco and Sirawai in Zamboanga del Norte and Zamboanga City in Zamboanga del Sur.

Water Quality and Watershed Management. Under Section V of the Philippine Clean Water Act of 2004[28], the DENR in coordination with NWRB was tasked to designate certain areas as water quality management areas (WQMA) using appropriate physiographic units such as watershed, river basins or water resources regions. The objective of the WQMA is to protect, through stakeholders' collaboration, the water body and its tributaries by keeping their water quality within the Water Quality Guidelines or Criteria conforming to the water body's classification or even improve the quality to higher classification. The Tumaga River[29] and Ayala River[30] in the study area are under WQMA. The Tumaga River is classified as Class A in upstream, Class B in midstream and Class C in the downstream. Ayala River is classified as Class A in Upstream and Class B in the downstream.

A watershed is simply the area of land that catches rain that drains or seeps into a marsh, stream, river, lake or groundwater. The City has one proclaimed watershed and six identified watersheds as shown in Table 28.

Table 28: Watersheds in Zamboanga City

Watershed	Area (ha)
Ayala watershed forest	1,469
Culianan watershed forest reserve	3,394
Manicahan watershed forest reserve	4,035
Bolong watershed forest reserve	5,961
Curuan watershed forest reserve	5,499
Vitali watershed forest reserve	21,002
Pasonanca Natural Park/ Watershed	12,000

The Pasonanca Natural Park is a proclaimed natural park under Presidential Proclamation 132 on 22 July 1999 and confirmed such status under Republic Act 110381 or the Expanded National Integrated Protected Areas System Act of 2018 which was approved on 22 June 2018. It is the main source of potable water in the City which supplies approximately 60 percent of its water demands. A co-management agreement was signed by the DENR, ZCWD and the City Government of Zamboanga. It was agreed therein that the DENR shall provide the necessary technical assistance, whereas the City Government and ZCWD shall provide the necessary logistics for the protection of the watershed. As a result of said agreement, ZCWD has continuously endeavored to provide the necessary security forces to protect not only its' facilities

Basins have been identified as priority areas of spatial focus of convergence under the CCAM Cluster's PBA in CY 2013 and CY 2015.

[28] Otherwise known as RA 9275

[29] DENR Administrative Order No. 2013-01 "Designation of the Tumaga River Water Quality Management Area and Creation of Its Governing Board" dated 24 January 2013

[30] DENR Administrative Order No. 2016-15 "Designation of the Ayala River Water Quality Management Area and Creation of Its Governing Board" dated 21 June 2016

within, but also physical environment of the watershed. The watershed covers an area of 12,000 ha and is surrounded by a five-hectare buffer zone. The buffer zone is an inhabited area. The ZCWD is regularly conducting information, education and communication (IEC) activities to involve buffer zone residents in livelihood programs. The management of the Pasonanca Natural Park is vested with the Protected Areas Management Board.

As a result of earlier threats of illegal logging activities, wildlife poaching, and gold panning activities, and considering that anthropogenic activities within the watershed could cause significant decrease in the water quality of its water sources, it has installed 29 Biodiversity Monitoring Stations, which at the same time serve as security outposts, strategically located around the outskirts of the strict protection zone.

Because of the sustained efforts of ZCWD, and its partner agencies, in the protection of the Pasonanca Natural Park, it has received several recognitions. It is now in the process of being recognized as an ASEAN Heritage Park. And more recently, the discovery of the Philippine Eagle and their nesting sites within the strict protection zone, which is a strong indication of the excellent health of the watershed.

Water Resource Assessment. Several government agencies are involved in the assessment of water resources. Primarily responsible agencies for collecting the stream flow data are the Bureau of Research and Standards (BRS) of DPWH, NIA, and NPC.

Water Supply and Sanitation Services Regulation. LWUA with its specialized lending function mandated by law to promote and oversee the development of water supply systems as well as sanitation services in water districts, includes the determination and implementation of socially responsive and financially viable water rates, and tariff review to determine its adequacy to meet water districts improvement and/or expansion needs. In this regard, the water rates are implemented only after it has been presented in a public hearing through the City Council and after the review and approval by LWUA.

Issues and Recent Developments

Non-Revenue Water. The NRW of ZCWD as of 30 June 2021 is 62.3 percent which is very high compared to 30 percent standard prescribed by LWUA. There have been efforts made for NRW reduction of the water district: (i) Twinning collaboration between DCWD and ZCWD in 2010, and (ii) Performance-based NRW Reduction Network Reconstruction Project between Manila Water and ZCWD in 2015. Despite these efforts, there was no significant reduction in NRW percentage. The failure to reduce NRW through the Manila Water agreement is the result of contractual issues which cancelled the project before results could be obtained, future efforts to reduce NRW through similar contracts will require outside assistant to ensure all term and conditions are clear and understood by all parties.

The NRW Management Division, under the Operations Group of ZCWD, is the unit tasked to address NRW reduction. However, presently, this unit is doing monitoring activities such as data gathering/reading and analysis of flow meters and data loggers installed at the ZCWD network system. This information is shared to other units for the design of projects and interventions for the purpose of reducing NRW[31]. There is no global target or percent reduction given to the NRW Management Division. Without a global target, there is no specific timeline as well.

[31] e.g., replacement of old tuberculated and leaking pipes, defective appurtenances, upgrading of distribution pipes, design and construction of facilities among others.

Instead of a global (system-wide) approach, management opted to identify a DMA with high NRW and address the issue as its Pilot Area. DMA 30 with 2,444 connections and with baseline NRW of 83 percent[32] was identified as the pilot area. It covers barangays Zone 1, Zone 2, Zone 3, Zone 4, Sta. Barbara and Rio Hondo. The target percent reduction specified is 30 percent by the end of February 2022[33]. Activities conducted by the NRW Committee[34] are: (i) repair/replace leaking service line; (ii) repositioning of tilted water meters as water meters not installed horizontally tend to under register; (iii) replace non-functioning and defective water meters; (iv) regular visits and reading of water meters in the pilot area to ensure that it is registering accurately; (v) undergo leak detection and prompt repair of leaks; and (v) apprehend water pilferers. In the meantime, reduction of ZCWD's NRW hinges on the outcome of the DMA 30 experiment. If successful, ZCWD intends to replicate its best practices gained from the DMA 30 experience to the other DMAs.

Additionally, it is noteworthy that ZCWD does not have specifics on the composition of the NRW. They use production and billing data to come up with the NRW figure. However, attempts to measure lost water due to leakages is being made and records kept. The volume on record is not representative of the entire amount lost through leakages because there are so many unattended or unnoticed before-the-meter leakages that have been wasting water for extended periods of time before they are repaired. The Legal department who is in charge of apprehending water pilferers computes the estimated volume of water lost to pilfering for the purpose of establishing the amount of penalties to be imposed on those apprehended. This, again is not representative of the entire volume of pilfered water as there may be many more existing that escaped the eyes of the ZCWD. Usually, pilferers opt to settle the penalty out of court to avoid being charged in court.

The early implementation of the proposed projects and programs intended for the NRW reduction should be given priority. As of this time, the NRW reduction program of the ZCWD is not yet well defined as to what the global reduction target is and its timeline. ZCWD will still have to operate under the present NRW situation.

Zamboanga City Water Audit Team. The Zamboanga City Water Audit Team (ZWAT) was created in 2016 as part of the USAID Be Secure project. Be Secure introduced WDM to ZCWD as a climate change adaptation measure to address some of the water-related vulnerabilities facing Zamboanga City. In response to the threat of worsening droughts, floods, storms and sea level rise, ZCWD created a WDM Program and a water audit team. Further details are presented in Section VI.

Impounding Dam Project. Since the 1970's and more recently USAID and others have investigated the proposed construction of a large dam on the Tumaga River as a way to increase water supply and for generation of power for Zamboanga City. Due the large cost of this project (PhP6,585-12,855 million) and risk, it was not included in the ZCWD improvement project list. A project of this magnitude would require substantial government funding or a public private partnership (PPP).

[32] Average NRW in DMA 30 based on January to June 2021 data.
[33] The original deadline was in December 2021. However, very recently, the NRW committee was given six months extension to complete the project and the new deadline is set in February 2022.
[34] A committee was formed on June 2021 to identify a pilot area to reduce its NRW with the purpose of replicating to other DMAs the techniques and knowledge gained in reducing NRW.

The impounding dam project would include a 105 m high earth filled dam capable of providing 216 MLD of water, which would be used for domestic supply and hydropower. A new 146 MLD WTP and 900 mm transmission main would be constructed as part of the project. (EDCOP, 2021). As a long-term water security supply solution, the impounding dam has merits but the size, risk, environmental and social impacts require careful consideration. As a general approach to achieving water security, diversification of water resources and phasing of options generally tends to be a more effective approach in particular due to the future climate change impacts.

Improvement Programs. There are several ongoing and proposed improvement projects identified by ZCWD and ZCLGU. Details are presented in Section VI.

Water Resources (Supply Side Study)

Water Permits

Extraction of surface water and groundwater through wells and springs within the recommended locations on physiographic units must secure all necessary permits, particularly from the NWRB for proper allocation of water use. Water rights data for Zamboanga Peninsula including Zamboanga City was obtained from NWRB.

As of 2020, there are 44 permits issued within Zamboanga City. About 70 percent of the grantees use water extracted from the ground while about 30 percent source their water from surface as shown in Figure 31[35].

Table 29 presents the inventory of water rights issued within the Zamboanga City. Highest percentage of flow granted is for irrigation purposes with 46 percent. On the other hand, municipal and domestic purpose accounts for 31 percent and 12 percent, respectively.

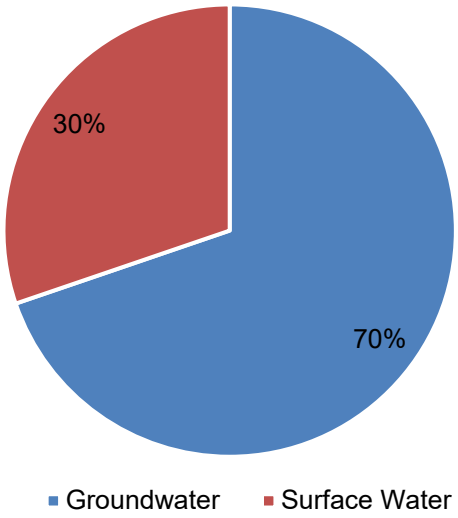


Figure 31: Water Permits in Zamboanga City

Table 29: Water Rights Issued in Zamboanga City

Purpose	Number of Permittees	Total Flow Granted (lps)	Percent Share (%)
Domestic	2	364.00	12
Fisheries	1	120.00	4
Industrial[a]	17	174.76	6
Irrigation	8	1,365.20	46
Municipal	14	918.67	31
Others (Firefighting)	1	0.03	0
Others (Office Use)	1	0.03	0
Total	44	2,942.68	100

Note: [a] Excluded 6,388.89 lps water rights for seawater granted to San Ramon Power Inc. (SRPI)
Source: NWRB 2020

Water Permits – Domestic and Municipal. Based on NWRB records, there are 13 water permits issued to ZCWD with a total of 519.78 lps. The 12 water permits are for groundwater sources with 165.78 lps and one for surface water (Tumaga River) for 354 lps. There are also 14 conditional water permits[36] issued to ZCWD with a total of 350.33 lps. Details are further presented in Annex 4.

[35] Excluding one water permit issued for the purpose of fisheries utilizing sea water as source
[36] The Conditional Water Permit (CWP) is valid for a period of two years upon approval of the Board and may be extended for one year upon request of the permit stating the reasons for extension. The CWP shall be revoked automatically upon the expiration of the Renewable Energy (RE) Contract with DOE, water permit shall be issued after

Water Permits – Irrigation. There are eight water permits issued in Zamboanga City for irrigation with a total of 1,365.20 lps as presented in Table 7. Details are further presented in Annex 4.

Surface Water Resources

As discussed in Section II, there are several river systems in Zamboanga City emanating from the watershed forest reserves as their head sources consisting of a group of rivers discharging water by way of a common flow or system of channels into the sea or bay. It usually consists of the main river, primary, secondary and their tributaries.

The only available stream flow record is from Tumaga River covering the periods 1987 to 2003. From 1983 to 2003, the highest annual average streamflow was recorded in 1988 with about 867,874 m^3/day, while the lowest was recorded in 1992 with only about 139,586 m^3/day as shown in Figure 32[37].

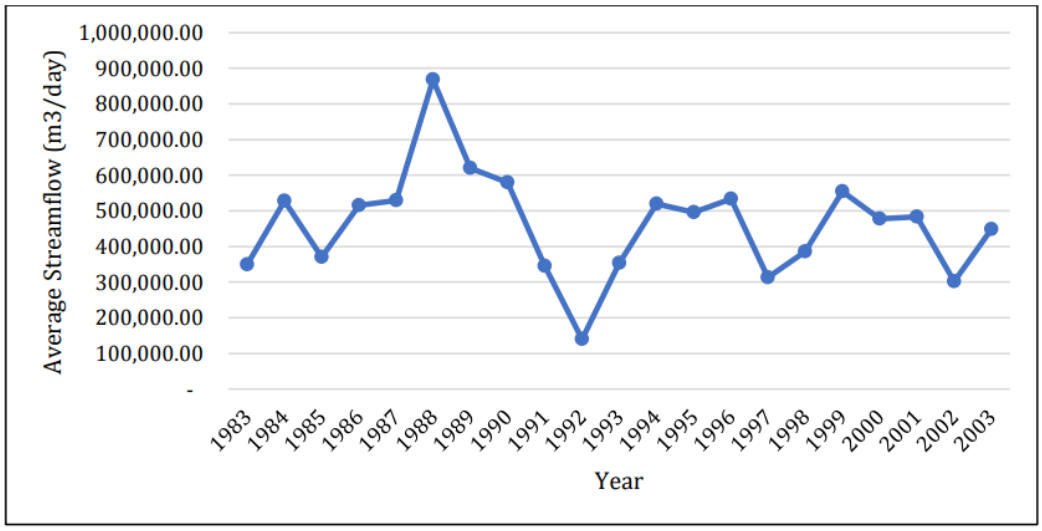


Figure 32: Annual average streamflow (m3/day) in Tumaga River, 1983-2003

With regards to the monthly streamflow, the 2020 records for Tumaga River shows that peak discharge was in November, followed by the month of October as shown in Figure 32. The lowest streamflow discharge was recorded in the months of February and April. The January to July 2021 streamflow record was also obtained from ZCWD. Monthly streamflow pattern is quite similar to 2020 record except for the month of April and July as shown in Figure 32. High streamflow discharge was recorded in 2021 compared to the 2020 records.

compliance on the conditions stipulated in the permit. The grantee shall pay the appropriate Annual Water Charges during the validity of the CWP.

[37] Originally reported in the Climate Change-Responsive Integrated River Basin Management and Development Plans for the 8 Clustered River Basin. River Basin Control Office (DENR, 2016)

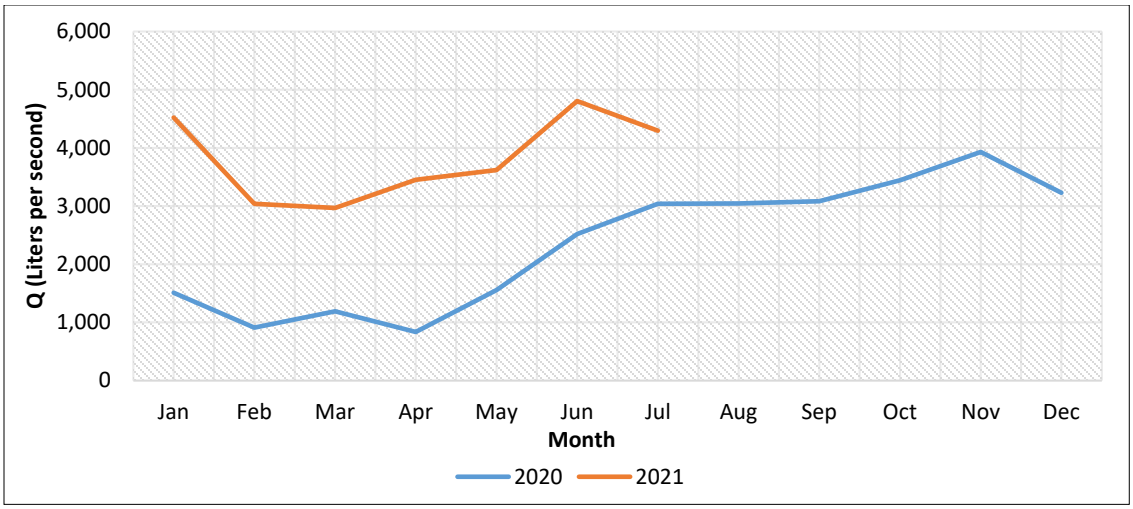


Figure 33: Monthly streamflow of Tumaga River, 2020 and 2021[38]

The net available water for Tumaga at 80 percent dependable flow is 1.568 cubic meter per second (m^3/s). Available surface water for extraction is computed considering the allocation for riparian flow in streams, as required by the DENR. This is equal to 10 percent of the computed flow in consideration. Further, the amount of granted water permits along the river of concern should also be deducted.

Considering the climate change scenario, net available water for Tumaga at 80 percent dependable flow is 1.489 m^3/s. PAGASA has climate change scenarios for years 2036-2065 including projections on the percent change in rainfall and temperature[39]. The model used assumptions underlying RCP 8.5 scenario. In the Zamboanga Peninsula, the driest possible rainfall change is at about -18.7 percent and the wettest possible change can reach about 16.7 percent. For conservative results, the lower bound values were used in estimating the most drastic effect of climate change to the surface water resources of the project area. Detailed calculation is presented in Annex 5.

Surface Water Quality

Water Quality. Tumaga River is regarded as the most important inland river in Zamboanga City. The river traverses several heavily populated areas including Pasonanca, Tumaga, Tetuan, Tugbungan and Mampang. The Tumaga River-Water Quality Management Area (TR-WQMA) was officially designated through the signing of DENR Administrative Order No. 2013-01 on 24 January 2013. As part of the requirement under the WQMA program, water quality monitoring is regularly conducted to assess the present condition of the Tumaga River. Presented in Table 30 and Figure 34 are the monitoring stations in Tumaga River.

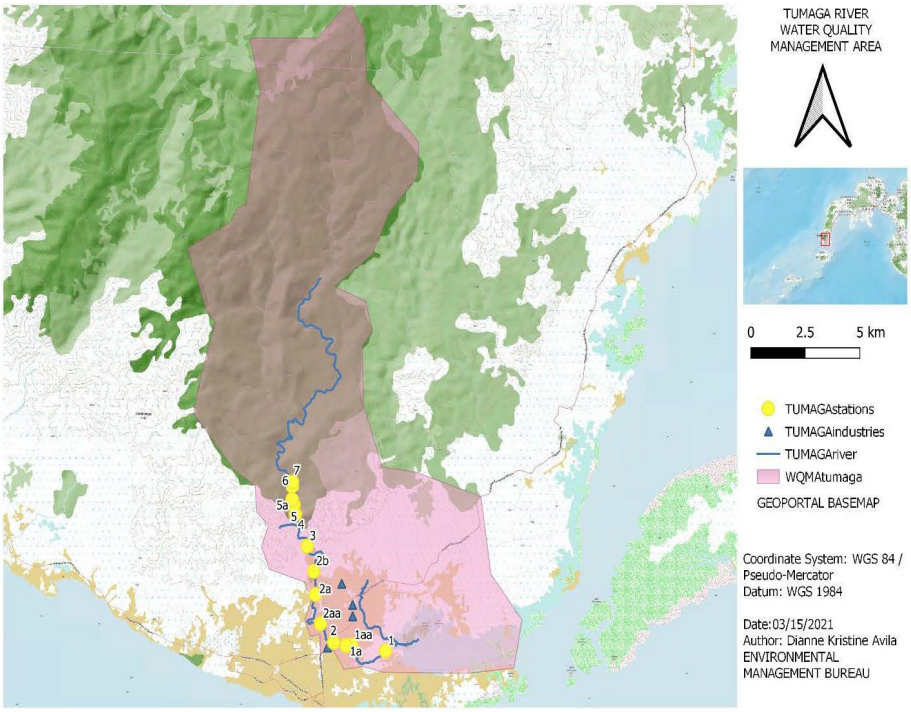
Table 30: Location of Sampling Stations (Tumaga River)

Station No.	Location	Coordinates		Water Body Classifications
		North	East	
1	Tugbungan Bridge, Tugbungan	6º55'22.40''	122º6'22.30''	Class C

[38] The geographical coordinates of the location where streamflow is measured is 6º'59'61" N and 122º'3'57.21" E, first 500 meters upstream of the dam in Tumaga River.
[39] Observed Climate Trends and Projected Climate Change in the Philippines, 2018

Station No.	Location	Coordinates		Water Body Classifications
		North	East	
1aa	Presa Dam, Mormon's Drive Guiwan	6º55'33.00''	122º5'31.60''	
1a	Jumbo Bridge, Guiwan	6º55'33.60''	122º5'27.20''	
2	San Fernando Bridge, Guiwan	6º55'33.60''	122º5'4.20''	
2aa	Near Manaog Church, Tumaga	6º55'58.50''	122º4'44.30''	
2a	Between Pasonanca and Tumaga Boundary	6º56'37.50''	122º4'36.90''	Class B
2b	Near Philippine Public Safety College (formerly NAPOLCOM), Pasonanca	6º57'14.90''	122º4'33.70''	
3	Spillway, Kilometer 7, Upper Pasonanca, Pasonanca	6º57'41.90''	122º4'24.40''	
4	Intake, Upper Pasonanca, Pasonanca	6º58'24.50''	122º4'6.70''	Class A
5	Intake, Upper Pasonanca, Pasonanca	6º58'37.10''	122º4'4.60''	
5a	Upstream of old intake inlet, Intake, Upper Pasonanca, Pasonanca,	6º58'37.10''	122º4'4.60''	
6	Downstream of catchment basin, Intake, Upper Pasonanca, Pasonanca	6º59'1.80''	122º4'2.20''	
7	Upstream of catchment basin, Intake, Upper Pasonanca, Pasonanca	6º59'1.80''	122º4'2.20''	

Source: DENR-EMB Reqion IX



Source: EMB, Region IX

Figure 34: Tumaga River Monitoring Stations

The water quality guidelines for specific parameters being sampled in Tumaga River is presented in Table 31. The parameters are based on guidelines for water body classification included in DENR Administrative Order No. 2016-08 dated 24 May 2016.

Table 31: Water Quality Guidelines (Fresh Water: Primary Parameters)

Parameters	Unit	Class				
		AA	A	B	C	D
Temperature	ºC	26-30	26-30	26-30	25-31	25-32
pH (range)		6.5-8.5	6.5-8.5	6.5-8.5	6.5-9.0	6.0-9.0
Dissolved Oxygen (minimum)	mg/L	5.0	5.0	5.0	5.0	2.0
Biochemical Oxygen Demand (BOD)	mg/L	1	3	5	7	15
Total Suspended Solids	mg/L	25	50	65	80	110
Phosphate	mg/L	<0.003	0.5	0.5	0.5	5
Nitrate	mg/L	7	7	7	7	15
Color	TCU	5	50	50	75	150
Chloride	mg/L	250	250	250	350	400
Fecal Coliform	MPN/100mL	<1.1	<1.1	100	200	400

Source: DENR DAO 2016-08

Highlights of the result of water quality monitoring in Tumaga River for year 2020 are as follows, details are further presented in Annex F.

- *Phosphate.* The phosphate levels in Tumaga River are within the guideline values ranging from 0.05 to 0.46 milligrams per liter (mg/L). Highest value was recorded in Station 1.
- *Chloride.* The chloride levels are within the guideline values ranging from 2.61 to 23.53 mg/L except in Station 1 with chloride level of 615.72 mg/L.
- *Total Suspended Solids.* For TSS, the values are within the guideline values ranging from 5.17 to 47.80 mg/L.
- *Fecal Coliform.* The level of fecal coliform in all the sampling stations are beyond the guideline values ranging from 1,413.01 to 231,533.20 MPN/100mL. The fecal coliform values are extremely high, especially in Class C part of the river.
- *pH.* The pH levels are within the guideline values ranging from 2.13 to 8.27 mg/L.
- *Dissolverd Oxygen.* The DO levels for all the sampling stations are all higher than the minimum guideline values of 5 mg/L.
- *BOD.* BOD levels are within the guideline values ranging from 1.94 to 6.48 mg/L.
- *Color.* The color levels in all the sampling locations are within the guideline values ranging from 5.00 to 7.82 mg/L.
- *Temperature.* The temperatures are within the guideline values for most of the sampling stations except for Stations 5, 5a and 6 as shown in Figure 17.

Groundwater

Zamboanga City is identified by the NWRB as a water-critical urbanized area. Thus, there is an intensive consumption of water in the city. The estimated groundwater development potential[40] in the area is 19.49 MCM/year and projected to increase to 28.50 MCM/year in 2050[41].

[40] The groundwater development potential was estimated as the amount of groundwater recharge, taking into consideration the land cover in various areas.
[41] Climate Change-Responsive Integrated River Basin Management and Development Master Plan for the Cluster 7 River Basin

Existing Water Sources – Domestic

Figure 35 presents the water supply sources for ZCWD from years 2015 to 2020. Majority of the supply comes from Tumaga River. The reliance of water from the bulk water facility has grown to approximately 25 percent of the supply. However, due to limitations of the bulk water facility to supply water during droughts; there is no possibility to increase the contribution to the entire water needs of the ZCWD customers. Groundwater reliance, on the other hand, varies depending on climate factors such as droughts.

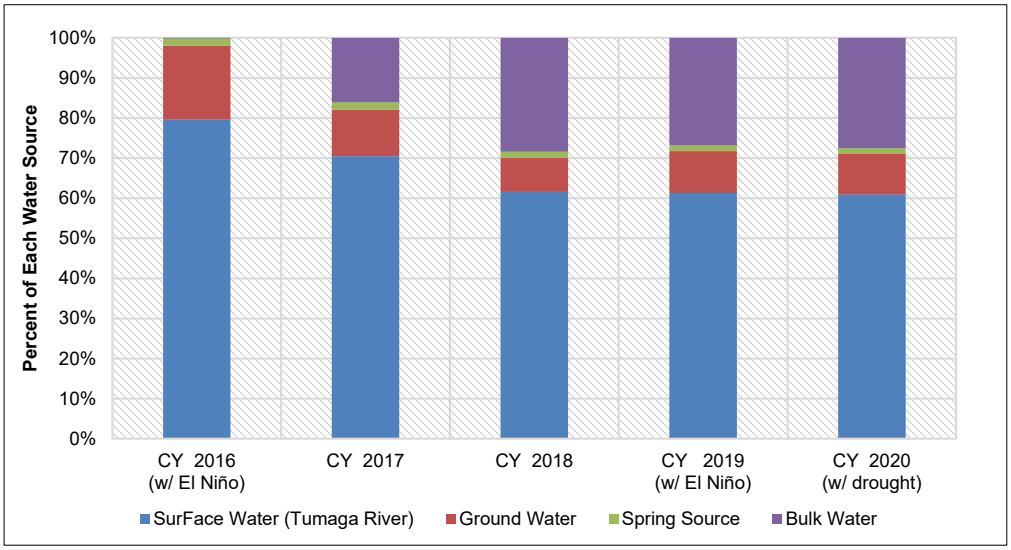


Figure 35: ZCWD Water Sources (2015-2020)

Table 32 presents the raw water quality of existing sources.

Table 32: Water Quality of Existing Sources[42]

Source	Raw Water Quality	
	Average Water Quality	Persistent Water Quality Issue
Tumaga River	Class A Public Water Supply Class II – Intended as sources of water supply requiring conventional treatment (coagulation, sedimentation, filtration and disinfection) to meet the latest Philippine National Standards for Drinking Water 2017 (DENR Administrative Order No. 2016-08, May 4, 2016). Extreme Conditions: NTU levels reaching above 10,000 NTU during heavy precipitation	High Turbidity levels after heavy precipitation
Production Wells	Passed the PNSDW mandatory parameters	High levels of Manganese (Mn), Iron (Fe) and Chloride (Cl
Spring Sources	Passed the PNSDW standards	Intrusion of run-off water during high precipitation

[42] ZCWD Water Safety Plan

Existing Water Sources – Irrigation

The identified surface water being used for irrigation and the brief description of each are as follows:

(i) *Manicahan River.* The river is a 26-kilometer stretch from Bunguiao in the north down to Lapakan, Lamisan and Manicahan in the southern part of the City. It covers a portion of the heavily forested Pasonanca Watershed. Normally, it has a daily discharge of about 145,000 m^3/day. It has a total catchment area of 70.83 km^2. It is the prime source of irrigation for the farmers in the barangays of Bunguiao, Lapakan, Lamisan, and Manicahan, as well as the neighboring barangays of Victoria, Bolong, and Sangali.

(ii) *Saaz River.* It is located at Sitio San Ramon, Barangay Talisayan, about 22.3 kilometers west of Zamboanga City. The head source of the river is from the watershed of Camp Susana. Its length is approximately 12 km with an average width of 20 m and widens up to 75 m during rainfall and has average depth of 0.6 m. The river has an average flow rate of 2,408.5 lps and empties to Sulu Sea. The upstream portion is used for drinking purposes. According to NIA, a dam was constructed at Brgy. Anoling which taps water from the river for irrigation purposes.

(iii) Other tributary rivers with no found records of average flows are: Talisayan River, Sibulao River, Cabaluay River, Vitali River, Masaba River, Singup River, Lumpanac Creek.

Water Usage (Demand Side Study)

Domestic

Present Water Use in ZCWD Service Area. The ZCWD has five classifications and eight different sizes of water meters, which follow different minimum charges and commodity charges pursuant to the approved water rates by the LWUA. General definitions of the classifications listed below may differ among utilities, but in very broad terms these definitions are common. The classifications and their definitions are:

- *Residential.* Water used is domestic in nature and for day-to-day living (cooking, washing, bathing, drinking, lawn watering, and any other uses to maintain everyday life).
- *Semi-Commercial*. Residential users that have an attached business establishment whose business activities have a start-up capitalization of more than PhP20,000; also includes multi-family apartments whose owner assumes payment of the monthly water bill.
- *Commercial/Industrial.* Business establishments whose start-up capitalization is more than PhP20,000; residential users with two or more families dwelling under separate roofs but using one central meter; residential users who supply/sell to or share water with others; establishments drawing water from the system for the purpose of using this water directly or indirectly to promote trade or to produce a commercial or saleable product; government institutions doing business directly with the public (such as the Philippine National Bank, Philippine Ports Authority); and government-owned establishments that are being rented, leased, utilized, and/or contracted by the private sector for the purpose of doing business with the public.
- *Government.* All government institutions, offices, hospitals, public schools, and similar entities that are presumed to be performing public service and that consume water, in connection with the performance of these public duties.
- *Bulk/Wholesale.* Establishments drawing water from the system, with the purpose of reselling without transforming into a new product.

Table 33: Water District Consumption Classification

Class	Total Active Service Connections	Percent Total (%)
Bulk/Wholesale	1	0.001
Commercial	6,082	9.323
Government	555	0.846
Residential	58,623	89.830
Total	65,261	100.000

Source: December 2020 MDS

Below is the monthly average consumption per connection data for the different classifications.

Table 34: Average Consumption Data

Classification	Monthly Average Consumption per connection (m^3)
Bulk/Wholesale	Unmetered
Commercial/Industrial	37.3
Government	166.9
Residential	23.2

Source: December 2020 MDS

Water Demand Projection in ZCWD Service Area. As the local economy and population of Zamboanga City continue to grow, there is an increasing need to develop more effective planning strategies to respond to pressing problems associated with expanding water demands.

A major consideration in designing a secure water supply system is the present and future size of the customer base. Water is an essential human need; every sector of society becomes its market. The customer base of a water supply system, therefore, is the entire population or portions of it depending on the size of the service area and other relevant factors being considered in the study.

Population Projections. Fertility, mortality, and migration mainly determine the increase or decrease in population. To determine the size of a population at some future time, demographers make assumptions about levels of fertility and mortality and the number of people will move into or out of the area. The increase or decrease in the net population over a certain period is added to the beginning population to make future projections.

The computation of population projections until 2045 based on the Water Impounding Dam Study was considered in the Zamboanga City projections. The projected population in the City relative to the projected population of the whole Zamboanga Peninsula is shown in Table 35.

Table 35: Existing and Projected Population of Zamboanga City

City	2020	2025	2030	2035	2040	2045
Zamboanga City	976,827	1,055,299	1,130,641	1,199,172	1,259,004	1,309,539
Zamboanga Peninsula[43]	5,906,500	6,431,800	6,933,700	7,400,500	7,804,000	8,130,500
Ratio (City/ Region IX)	16.54%	16.41%	16.31%	16.20%	16.13%	16.11%

Source: FS for the Zamboanga City Impounding Dam Project

Water Service Area Population Projections. Water demand projections depend on the size of the service area of the water supply provider and the population it intends to serve. Based on the latest available data and study, future water demands were derived from a previous analysis in the FS for the Impounding Dam Study (EDCOP, 2021). The data presented in this section serves as a baseline and to allow the reader to understand the current state of population projections, water supply and demands. The ultimate goal of this study is to develop a water security plan what will move beyond the current planning methodology into one that takes into account future climatic conditions, WDM and other more sophisticated techniques.

The CLUP of Zamboanga City was also referenced to quantify the future population growth within the barangays. Only those barangays that are within the existing service area of ZCWD are used on this analysis. The served population projection is, therefore, only based on the projected population within the service areas.

For the analysis carried out in this section of the Water Security Master Plan, the goal is to investigate the existing water supply and demand situation of ZCWD to determine what is the future prognoses if the water supply and planning assumptions remained constant. Therefore, the future water supply and demand profile can be described as “status quo”, this allows an

[43] Sourced from the PSA, 2010 Census based projection

understanding of the current and future water situation if the current water planning framework were to continue through 2045.

The status quo condition that will be presented assumes that the existing percentage of the served population within the 58 barangays contained within the existing service area of the ZCWD will remain constant throughout the planning period. Therefore, only the existing ZCWD service area will be considered in the total service area population. In 2020 according to ZCWD, 34% of the population within the service area of the ZCWD is currently being served. The projections regarding the service areas and served population for the years 2020, 2025, 2030, 2035, 2040, and 2045 are summarized in Table 36.

Table 36: Service Area and Served Population Projections for Zamboanga City (Constrained Condition)

Population	2020	2025	2030
Total Service Area Population	775,086	837,351	897,133
Served Population	260,927	281,888	302,013
% Service Area Population	34%	34%	34%
Population	**2035**	**2040**	**2045**
Total Service Area Population	951,510	998,985	1,039,083
Served Population	320,319	336,301	349,799
% Service Area Population	34%	34%	34%

Source: FS for the Zamboanga City Impounding Dam Project

Under a status quo condition, by 2030, the total service area population is projected at 897,133 of which 34 percent will be served. By 2045, it is expected that out of the total service area population of 1,039,083 only 349,799 will be served.

Service Connection Projections

In order to project the future water demands of the customers within the ZCWD service area, projecting the service connections is required. For the ZCWD service area, connections are categorized as residential, commercial, semi commercial, industrial, institutional, and ZCWD-Facility connections. Data on the annual projected service connections and served population are presented in Tables 37 and 38. The projection of connections is based on the ratio of population to the number of connections and increases at the same rate as population growth. The breakdown per category is discussed in the following paragraphs.

Table 37: Service Connection Projections for Zamboanga City

Category	2020	2025	2030	2035	2040	2045
Domestic	56,799	61,361	65,742	69,727	73,206	76,144
Commercial	4,388	4,742	5,078	5,388	5,654	5,882
Semicommercial	1,576	1,705	1,824	1,937	2,032	2,114

Category	2020	2025	2030	2035	2040	2045
Industrial	27	30	32	34	36	37
Institutional	497	540	579	614	644	670
ZCWD-Facility	40	44	47	50	53	55
Total No. of Connections	**63,327**	**68,423**	**73,302**	**77,750**	**81,625**	**84,903**

Source: ZCWD

- *Domestic Connections.* Domestic water demand is the water required by residential households. Based on the December 2019 MDS of the ZCWD, the city's average daily per capita water consumption is 151.04 lpcd. As part of the analysis referenced in this study, the assumption is that the per capita consumption will increase by 2.5 lpcd every five years. By 2045, the average daily per capita water consumption will reach 163.5 lpcd. Under this planning methodology, the number of domestic connections by 2030 is projected to be 65,742 and is expected to increase to 76,144 by 2045.
- *Commercial Connections.* For this study it is assumed a water demand of 1.2 m^3/day/connection, which is consistent with the data provided by the ZCWD. It is projected to increase to 1.5 m^3/day/connection by 2045. Therefore, it is projected that the total number of commercial connections by 2045 will have reached 5,882.
- *Semi-commercial Connections.* Semi-commercial water demand is assumed for small-scale commercial establishments such as food stalls or carinderias. The average water consumption per m^3/day/connection is approximately 1.0 based on the data provided by ZCWD. This is projected to increase to 1.3 m^3/day/connection by 2045. For this study, the existing ratio of the total population to the number of semi-commercial connections at the barangay level based on ZCWD connection data. It is projected that by 2045, there will be 2,114 semi-commercial connections.
- *Industrial Connections.* Industrial water demand is assumed for factories in the area (e.g. those engaged in canning and tin manufacturing). Based on the consumption data provided by the ZCWD, the average consumption is 12.1 m^3/day/connection. This figure is projected to increase to 12.5 m^3/day/connection by 2045.
- *Institutional Connections.* Institutional water demand includes water consumed by schools, hospitals, government offices/ institutions, churches, and non-profit institutions. LWUA design standards assume a consumption of 3.9 m^3 per institutional connection. For this project, the consumption data were based on the water consumption data from government water supply installations, both local and national, supplied by ZCWD.

The average consumption based on ZCWD data is 4.9 m^3/day/connection. It is assumed that by 2045 the average consumption will increase to 5.4 m^3/day/connection. For this study, the analysis referenced uses the existing ratio of the total population to the number of institutional connections at the barangay level based on ZCWD data. Based on this planning methodology the number of institutional connections is projected to reach 2,846 by 2045.

ZCWD-Facility Connections. For ZCWD-facility water connections, the current consumption is 3.9 m^3/day/connection and is projected to increase to 4.4 m^3/day/connection by 2045. Based on the same ratio from ZCWD data, it is projected that by 2045, there will be 37 connections. Also, as part of the projections for these connections, only the barangays with existing ZCWD-facility connections will be maintained.

Water Demand Projections. The calculation of total water demands through 2045 are based on future connections. As previously described, under this status quo planning methodology barangays currently being served by ZCWD will be only ones with water service in the future.

As part of the referenced study and used in this report, water demand is categorized as domestic, commercial, semi commercial, industrial, institutional, ZCWD-Facility and NRW.

The development of a water supply source requires the analysis of all future water demands. Included in this analysis of water demands is the future levels of NRW, which acts as a water demand in the system. The levels of NRW as expressed as a percentage of the water supply considers leaks, pilferages, technical or system losses, unmetered services, flushing and disinfection of pipelines and reservoirs. For this study, it is assumed that the level of NRW will be 60 percent in the future, which has historically been slight above and below this value. In 2020, the NRW as reported by ZCWD is 64 percent and varied between 50 percent and 64 percent on an annual basis since the year 2015.The status quo of NRW is an important and meaningful impact on the future water demand for the service area. As the goal of this report task is to show the existing water situation of ZCWD, it is assumed that NRW will remain in the future at 60 percent. A summary of water demand projections is shown in Table 38.

Table 38: Water Demand Projections Summary ZCWD Service Area (in MLD)

Category	2020	2025	2030	2035	2040	2045
Domestic	39.41	43.28	47.13	50.78	54.16	57.21
Commercial	5.27	7.11	7.62	8.08	8.48	8.82
Semicommercial	1.60	1.70	1.82	1.94	2.03	2.75
Industrial	0.33	0.37	0.40	0.43	0.45	0.46
Institutional	2.46	2.92	3.13	3.32	3.48	3.62
ZCWD-Facility	0.16	0.19	0.21	0.22	0.23	0.24
Non-revenue water	73.82	84.14	91.27	98.02	104.16	109.65
Total Water Demand	123.05	139.71	151.58	162.80	172.99	182.75

Source: FS for the Zamboanga City Impounding Dam Project

The water demand for ZCWD is expected to grow from 123 to 183 MLD within the planning period of 2020 to 2045. The water demand calculated is the average demand for the planning year shown in the table. In order to properly plan the development of water sources and to account for variations in water usage caused by weather and other factors, a peaking factor is utilized and incorporated into future water demand projections.

Water System Peaking Factors. Variations in water demands in this study are classified into average day and maximum day Average day demand is the average water consumption per day for the entire year (total yearly demand divided by 365 days). The maximum day demand is the highest water consumption in a day and accounts for high usage as the result of weather and other factors. Maximum day demand is the most important parameter used when developing water supply sources.

The calculation of maximum day water demand factor is often time based on daily water production records, absent of this data a standard value can be used. For 2020-2045 water demand projections used in this study the maximum day water demand factor of 1.2 is used which

is based on LWUA design standards manual. The annual average and maximum day water demand through 2045 are presented in Table 39.

Table 39: Future Average and Maximum Day Water Demands (MLD)

Category	2020	2025	2030	2035	2040	2045
Ave. Day Demand	123.0	140.2	152.1	163.4	173.6	182.8
Max. Day Demand	147.6	168.3	182.5	196.0	208.3	219.3

Source: FS for the Zamboanga City Impounding Dam Project

The resulting losses hamper efforts to expand the distribution network to underserved or non-served populations and is a key factor hindering the establishment of water security. ZCWD is committed to reducing NRW and recognizes its value but has struggled with reducing the percentage of water loss. In 2020, the NRW was 64 percent and varied between 50 percent and 64 percent on an annual basis since the year 2015. The trend is a steady increase in NRW over the past six years as shown in Table 40.

Table 40: NRW Performance of ZCWD

Year	2015	2016	2017	2018	2019	2020
NRW	50%	55%	59%	63%	64%	64%

Source: ZCWD 2015-2020 Monthly Data Sheet

The process of identifying the range and scale of the NRW problem as well as its solution is variable and may take several years, depending on available investment resources and the magnitude or rate of NRW reduction required. ZCWD has a dedicated team that is responsible for reducing NRW, utilizing a varying approach such as identification of high-water losses areas, water main replacement, and utilizing the private sector through PPP. The current focus of ZCWD NRW reduction program is to replace large water mains that were installed in 1930's. The focus of replacing large water mains in order to reduce NRW is a strategy that should be of value, but it is unknown by how much since there is no data to quantify the water loss that is occurring in the large old water mains. It is critical that ZCWD keep focusing on reducing NRW to get closer to the goal of water security. It is more cost-effective and less risky to increase or recover water resources by reducing NRW than it is to identify new sources, develop them, and build the infrastructure to access, treat, and distribute the additional water.

Irrigation

Based on the data gathered, eight water permits with total flow granted of 1,365.20 lps (118 MLD) was issued by NWRB within Zamboanga City. The irrigation water demand for the total service area, using maximum water duty of 1.5 lps/ha per NIA standard is estimated to be 5,155 lps (445 MLD) wherein 3,851 lps (333 MLD) are for the operational irrigation systems (See Annex 5). This implies shortage of 215MLD available supply to meet the water duty criteria of NIA. Meanwhile, the Manicahan River which is proposed to be an additional source for domestic consumption is also a source of irrigation water supply. The average dependable flow within the existing NIA dam with geographical coordinates of 7°2'10.76"N, 122°10'30.89"E can supply approximately 0.855 cms (74 MLD)[44]. Based on the data gathered, only 381lps (33 MLD) is being utilized for Manicahan CIS to serve 254 hectares of irrigable area. These estimations however, is suggested to be validated through a conduct of a comprehensive study on water demand and supply gap for agricultural uses for full inclusion of data from NWRB and NIA including Irrigator's Association within Zamboanga City which was requested but not secured in this Water Security Master Plan study.

Water and Climate Risks

Hydrological Risk Assessment

Zamboanga City is geographically located within an area rarely visited or traversed by a typhoon. Its hydrological hazards are often attributed to the weather disturbance in nearby provinces and cities. Extreme drought conditions on the other hand, is historically known to affect the city with the most recent one recorded in 2014 to 2016. Through the USAID Be Secure Project Hydrological Risk Assessment Study (2017) for Zamboanga City, baseline risk was established and measures in risk reduction from 2013 to 2016 were identified.

Hydrological hazards considered in the risk assessment are flooding, storm surge, storm-associated strong winds, rain-induced landslides, and severe drought conditions. The vulnerable elements at risk considered in the study are lives, health, livelihood, assets and services. The following are the key approaches in the conducted risk assessment:

- Secondary data particularly the hazard maps from various agencies were the basis for risk assessment.
- The likelihood (rare, unlikely, possible, likely, probable) of the hazard affecting a given area representing 10 percent to 90 percent chance of occurrence was based on historical data.
- The probable extent of impact (insignificant, minor, moderate, major, and catastrophic) of that hazard on vulnerable elements present in that area was determined according to inconsequential to critical effect on the area.
- Series of workshops were conducted and participated by different local government units of Zamboanga City which includes Disaster Risk Reduction and Management Office (DRRMO), City Planning and Management Office (CPMO), City Health Office (CHO),

[44] The calculation of dependable flow takes into consideration the PAGASA climate change scenarios for years 2036-2065 including projections on the percent change in rainfall and temperature

stakeholders from the Zamboanga City Water District (ZCWD), local Academe and representatives of various barangays located in hazard prone areas.

- The assessment involved the development and utilization of a Risk Register System[45] to obtain inputs from the participants. The objective was to qualitatively determine a reduction of risk levels across the defined geographic regions due to adaptation and mitigation measures undertaken.

Among the hydrological hazards cited, severe drought conditions are mostly related to this Water Security Master Plan and related findings and conclusions from the previous study is highlighted herein. Risk Reduction is defined as the reduction of the risk level from the Baseline Risk (year 2013) to the Updated Risk (years 2013 to 2016). Given that the risk level ranges from Low, Medium, High and Extreme represents a four-level metric, a single level risk reduction assigned on an area constitutes a 25-percent reduction. The median risk reduction of two levels is equivalent to 50%, and the maximum risk reduction of three levels is equivalent to a 75% risk reduction. The Risk Register was similarly updated to capture the mitigations implemented from 2013 to 2016 which resulted in a change in both the Impact Level and Risk Level. The observed risk reduction level using spatial assessment of updated risk maps is up to 25% (within the High-Medium and Medium-Low range) across all hazards and vulnerable elements. The baseline risk and updated risk level for drought is presented in Table 41.

Table 41: Drought Hazard Baseline and Updated Risk Summary

Updated Risk Level		Vulnerable Elements				
		Lives	Health	Livelihood	Services	Assets
Baseline (2013)	Extreme	0.00	0.00	32.06	62.56	30.86
	High	0.00	71.36	63.10	0.00	57.75
	Medium	0.00	21.71	4.04	37.36	1.15
	Low	100.00	6.93	0.80	0.09	10.25
	Total Baseline Risk Area	0.00	93.07	99.20	99.91	89.75
Updated (2016) (25% risk reduction)	Extreme to High	0.00	0.00	32.06	39.21	30.86
	High to Medium	0.00	71.36	63.10	0.00	57.75
	Medium to Low	0.00	21.71	1.28	14.08	1.15
	Total Area	0.00	93.07	96.44	53.29	89.75

Note: Total baseline risk area excludes low risk area
Source: USAID Be Secure (2017)

Some of the intervention measures were already in place prior to 2013 through the initiatives of national and local government agencies to reduce disaster risk to affected populations. During the severe drought in 2014 to 2016 brought about by the El Nino conditions in Mindanao, the ZCWD undertook contingency measures to address the impact of drought on water supply, such as planning for the development of alternative water sources, as well as increased IEC program on water conservation and the adoption of WDM.

[45] The Risk Register Tool (RRT), an interactive electronic spreadsheet, was particularly developed for this Study which incorporates the Risk Analysis Matrix (RAM) in an automated process. It contains the Impact Risk Criteria as a reference, the content of which can be modified by the user according to the nominated criteria applied for the Tool.

However, most interventions and mitigation for risk reduction were attributed to the USAID Be Secure partnership with ZCWD in which capacity building in the development of the water district's Vulnerability Assessment, Business Plan (BP) and Emergency Response Plans (ERP) to manage future disaster events were undertaken. In addition, key staff of ZCWD had been trained to develop and undertake Water Audit and the promotion of water efficiency and conservation as part of the water district's WDM Program. Pre-Feasibility Study for an Impounding Dam and preparation of Design and Build Tender Documents for a 20 MLD Water Treatment Plant to augment the existing water resources that supply the City in the future were also funded under USAID Be Secure Project during this period.

Similarly, there were 'soft' and 'hard' measures that agencies of the local and national government substantially contributed and complemented the contributions of the USAID Be Secure Project in addressing climate change resiliency of Zamboanga City from hydrological risks. These were applied to the baseline levels to reflect the reduction of the impact level in hydrological risk. Among the 'soft' measures are: (i) the conduct of IEC Programs implemented by various agencies; (ii) crop rotation and management by the Department of Agriculture (DA) and ZCLGU; (iii) water efficiency and conservation programs by ZCLGU and ZCWD; and (iv) planning for alternative water resources by the by ZCLGU and ZCWD. 'Hard' measures on the other hand, were noted to be limited. This includes pipeline rehabilitation and deployment of generator sets in all facilities. The implementation of forest protection measures in hotspot areas were included in the ZCWD and ZCLGU program as part of improvement of watershed areas to enhance the resilience of both surface and groundwater resources to future occurrence of severe drought.

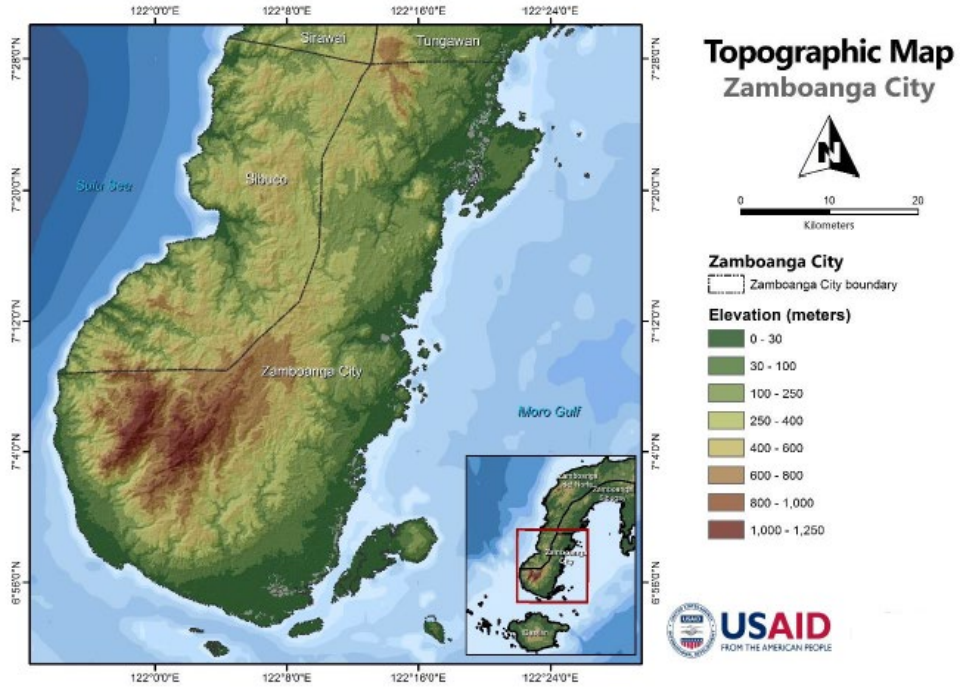
The Updated Risk Assessment attempts to reflect the current temporal baseline risk conditions at the time of this Study. The USAID Be Secure study indicated areas that may require additional mitigation and management to further reduce the risk levels. Nevertheless, some areas remain within a high baseline risk where vulnerable elements continue to be in hazard prone areas, requiring future climate change interventions in terms of continuous social re-engineering and infrastructural development. For instance, there are areas that remain exposed to health risks during drought conditions and some of the downtown areas that remain prone to flooding. The USAID Be Secure study led to notable enhancement of local resilience to hazard through IEC campaigns, raising awareness among the stakeholders, and served as a tool in decision-making and planning for future occurrences of hydrological risks in the City.

In relevance to this Water Security Master Plan, the previous drought season was noted to have been effectively managed with the emergency response plans programs of the ZCWD. Recommended action plans cited from the Be Secure study to enhance the level of hydrological risk awareness and reduce risk levels were: (i) establish buffer zones such as parks and green zones in hazard-prone areas to reduce unnecessary vulnerability, and (ii) diversification of water sources in the advent of future drought conditions to improve water security in the City. The protection and management of existing groundwater and surface water resources and the adaptation of modern and dual use technologies to complement the existing water sources will lower the risk of vulnerable areas from reduced water supply.

Historical Climate Analysis

The Philippines is generally a humid equatorial climate, characterized by high temperatures and heavy rainfall. The Zamboanga City region is considered as Type III of the revised Coronas Climate Type Classification standard, with a less pronounced maximum rain period and a relatively short dry season. The months of May to November generally mark the rainy season,

which peaks in July, while the dry period is generally from December to April. The hottest months in Zamboanga City are April and May with cooler months in December, January, and February. The topography of the Zamboanga City region, an important determinant of the spatial pattern of rainfall, is shown in Figure 36 and is characterized by narrow coastal plains, mostly along the east coast, that abruptly rise to interior hills and mountains with the highest elevation at 1200 masl. Slopes of not less than 30 percent make up 37 percent of the total area. Due to its topography, the City is susceptible to landslides; while the risk of flooding is high along the coast, most notably, the City center and the east coast. This topographic gradient generally supports enhanced rainfall in the higher elevations, with the primary rivers, such as the Tumaga originating in these mountain regions.



Source: USAID Be Secure

Figure 36: Topographic Map of Zamboanga City

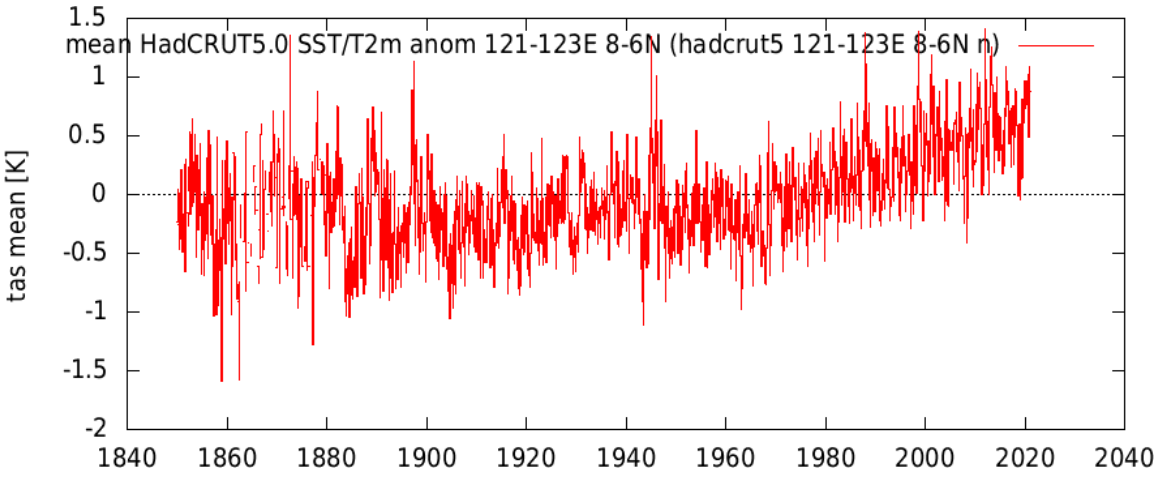
This study examines current trends and future projections of the regional climate to gain an understanding of the type of climate scenarios that are to be explored in this master plan. Both the recent climatological trends that have been observed across the Philippines and those in the Zamboanga City region are summarized. In addition, some of the future climate projections made available through the Intergovernmental Panel on Climate Change (IPCC) 5th assessment report are included to gain an understanding of future climate risk that can be incorporated into the study. Generally, the following observational trends have been observed:

- Mean temperatures across the South Pacific have increased by approximately 1ºC since 1970, at an average rate of 0.3ºC per decade.
- Temperatures appear to be increasing more rapidly in the southern reach of the archipelago. In the Philippines specifically, mean annual temperatures increased by 0.14°C between 1971 and 2000.
- Evidence suggests a tendency for wetter conditions during the dry season, as the frequency of heavy storms seems to have increased in this period. This dynamic is most

notable during La Niña periods. The number of rainy days in the Philippines has increased since the 1990s, as has the inter-annual variability of the onset of rainfall.

- Sea surface temperatures in the Pacific have increased between 0.6ºC to 1.0ºC since 1910, with the most significant warming occurring after the 1970s.
- The number of category 4 and 5 storms in the Pacific region has more than doubled between 1975-1989 and 1990-2004.
- The number of hot days and hot nights has increased significantly across the Pacific[46].
- The frequency of cyclones entering the Philippines Area of Responsibility from 1990 to 2003 has increased[47].

Figure 37 shows the observed temperature anomaly for the region that includes Zamboanga City, derived from the Climate Research Unit (CRU) TS 4.04 archived dataset (http://climexp.knmi.nl/), suggesting a significant warming trend starting around 1980 through the current period within the observational record. This is quite a strong, pronounced warming signal over this region, in excess of 0.5ºC over an approximately 40-year period. Note that the bounding region for which this trend is estimated is quite large (6º to 8º N by 121º to 123 ºE).



Source: http://climexp.knmi.nl/

Figure 37: Regional 2-meter air temperature anomaly based on the Hadley CRU.5.0.1.0 blended land air temperature and sea-surface temperature anomaly data set averaging anomalies over region lon= 120.000 -125.000, lat= 5.000 -10.000

Meteorological data from the Zamboanga City (Zamboanga Del Sur at Latitude: 06°55'10.78"N, Longitude: 122°03'47.78"E, Elevation: 6.857 m), located near the Zamboanga Airport is used to explored some of the statistical attributes of the data to draw some broad conclusions regarding historic trends in the study region. The meteorological data includes the year 1951 to 2015, with Figure 38 showing the annual average temperature for the Zamboanga Station, suggesting a similar but even more pronounced warming trend of more than 1ºC since 1970.

[46] Hot days and nights are defined as the temperature above which 10% of days or nights are recorded in current climate of that region and season.
[47] IPCC Fourth Assessment Report, WGII (2007)

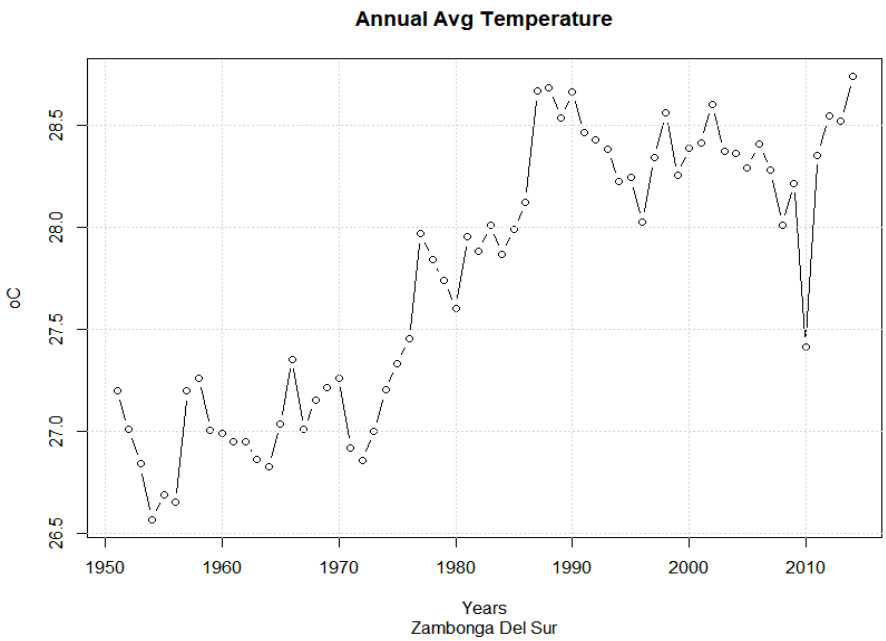
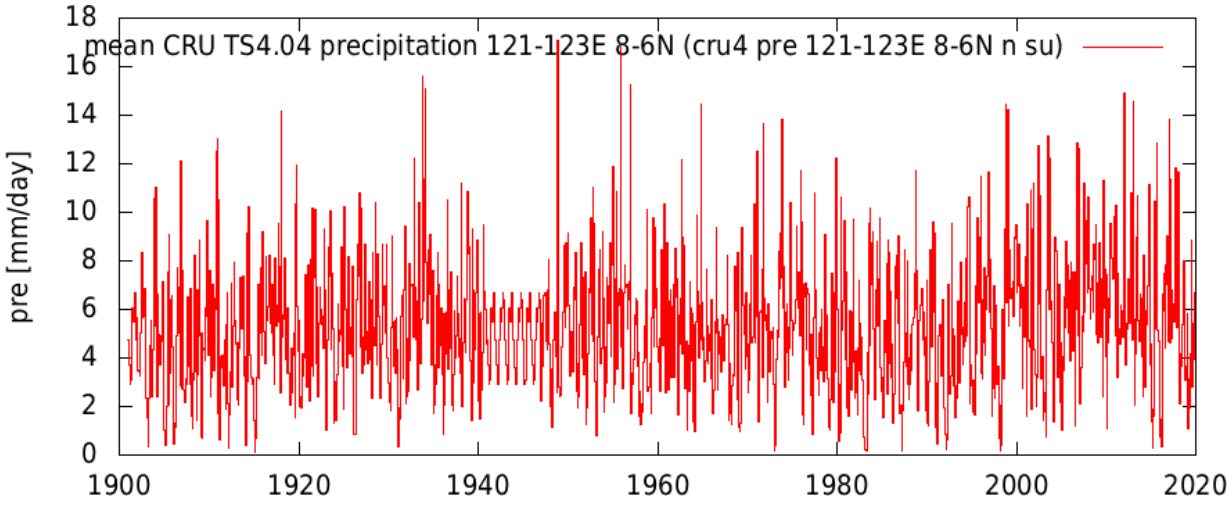


Figure 38: Annual average temperature from the Zamboanga station data for the period of 1951 to 2015, suggesting a strong warming trend starting around 1980

Figure 39 shows the long-term monthly precipitation for the region that includes Zamboanga City from the CRU TS 4.04 dataset and the monthly anomaly of precipitation for this same period, where the anomaly is based on a 1970 to 1990 averaging period. Generally, around the beginning of the 21st century, the precipitation anomaly turns strongly positive. Note the observational data in the early 1940's corresponding to World War II.



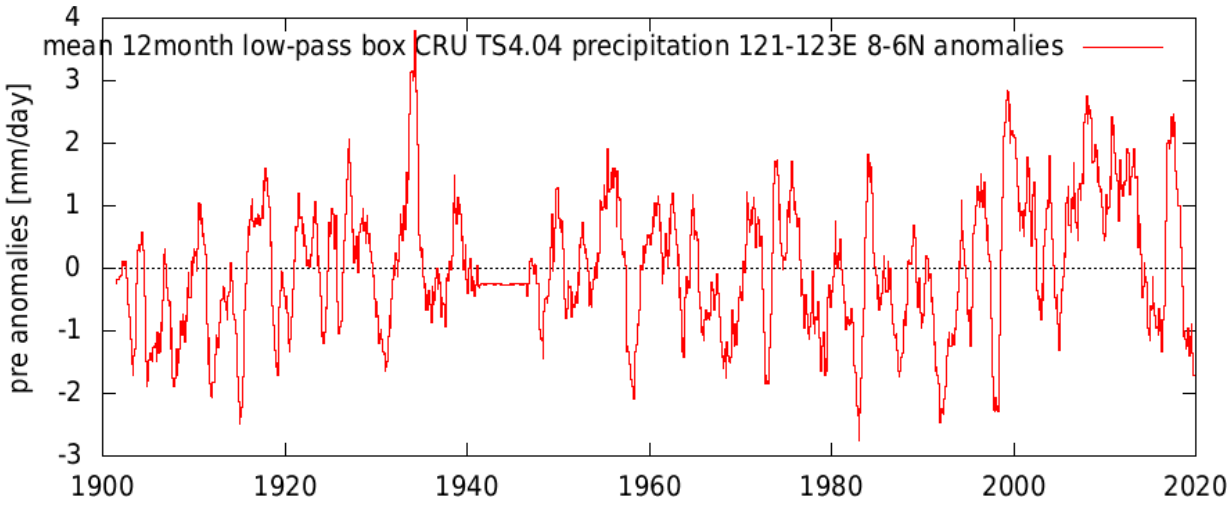


Figure 39: Regional average monthly precipitation (top, in mm/day) for the 6oN to 8oN and 121oE to 123oE region from the CRU TS4.04 dataset (note missing values during the WWII era), and the monthly anomaly for this same period (bottom, in mm/day)

Figure 40 shows the total monthly rainfall and the 12-month moving average of monthly rainfall from the Zamboanga Station for the period 1951 to 2015. For this period, the highest annual rainfall was 2,150 mm in 1999 while the lowest observed annual rainfall was 677 mm in 1997. The figure includes the historic time series of the monthly Niño 3.4 El Niño Southern Oscillation (ENSO) index and suggests the negative correlation between this index and the annual rainfall. When the ENSO anomaly is positive (i.e., a warmer Pacific Ocean corresponding to the El Niño phase, which includes the years 1972, 1982, 1998), precipitation in the region tends to be at its lowest, while during the La Niña phase (cold Pacific Ocean, such as around 1955, 1983, and 1999), regional precipitation is greatest (e.g., 1999). Figure 41 shows some derived rainfall indices from the Zamboanga Station record, including the count of heavy precipitation days (those greater than 50 mm) and the days that precipitation exceeds the 95th percentile. Both of these indicators suggest greater extreme rainfall in the recent record. Figure 42 shows the total amount of precipitation during wet days and the number of days in a year with no rainfall.

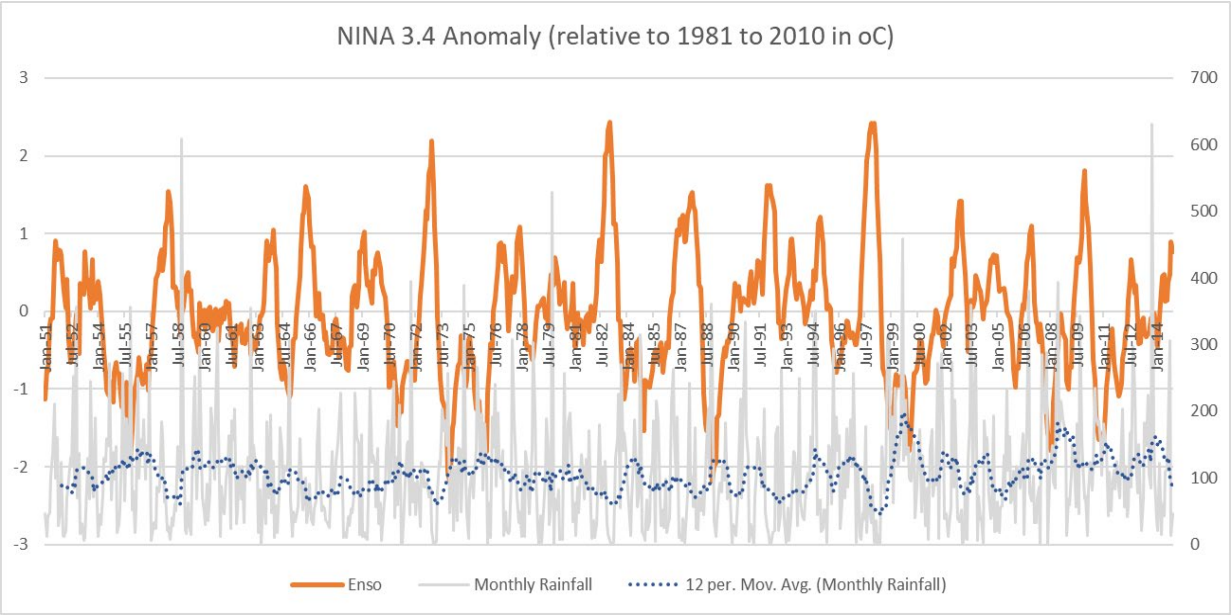


Figure 40: Zamboanga City monthly average rainfall (light gray), 12-month moving average of monthly rainfall (blue line) and the ENSO Nina 3.4 temperature anomaly (oC) for the period 1951-2015

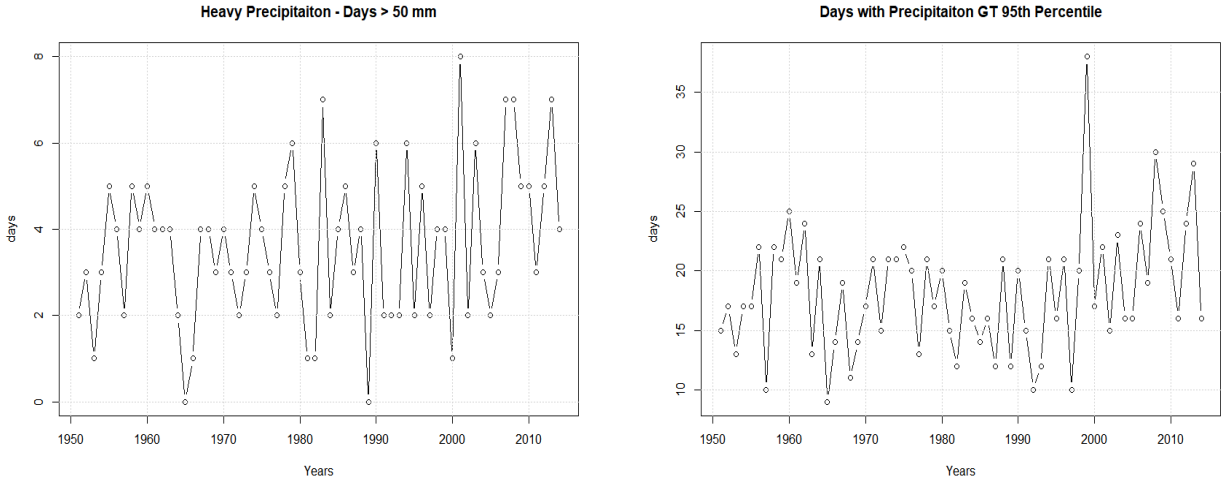


Figure 41: Zamboanga City heavy precipitation days as, days with rainfall greater than 50 mm (left) and days with precipitation greater than the 95th percentile of wet days (right)

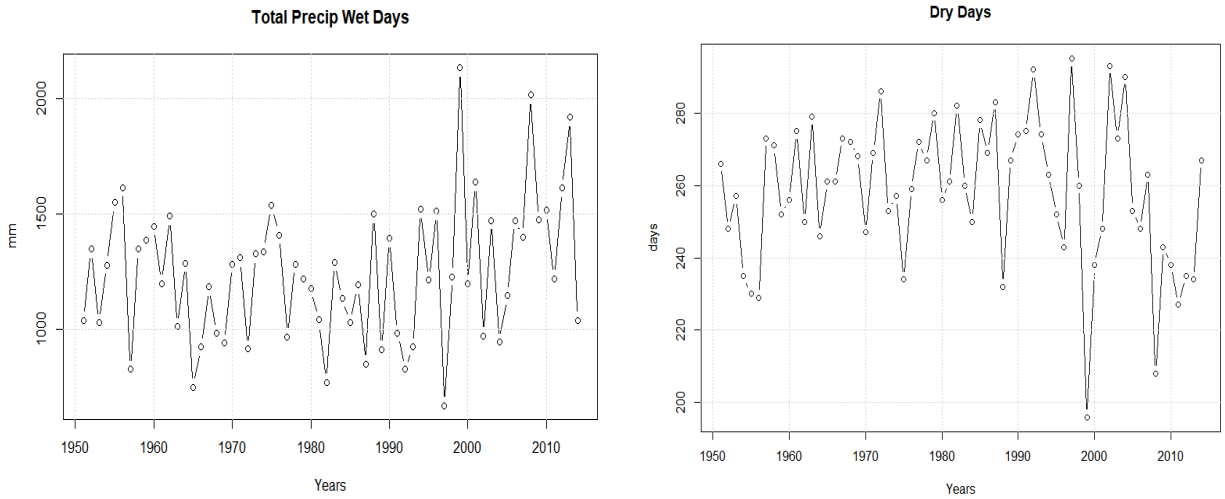


Figure 42: Zamboanga City total precipitation for wet days in mm (left) and total number of dry days (right)

Climate Projections

Global Climate Models (GCMs) are a primary source of information used in the projection of future climate conditions. GCMs comprise mathematical descriptions of important physical and chemical processes governing climate, including the role of the atmosphere, land, oceans, and biological processes. Unfortunately, as with all small island nations, there are specific challenges when viewing the projected changes for the Philippines. This "island dilemma" is attributable to the fact that the surrounding oceans are a dominating factor of the regional island climate, which single-grid cell values from GCMs are considered the least accurate measure of projected changes, and the relative spatial resolution of GCMs renders interpretation of climate change in island nations difficult. The following insights into a changing climate are thus based on information from this part of the Pacific region as a whole from a suite of GCMs used by the IPCC. A few outcomes of the IPCC's 5th Assessment Report summary of climate change results taken from analysis of GCM outputs includes for the region of the Philippines:

- Average annual and monthly rainfall changes are inconsistent across this region of the Pacific, with models projecting +/-25 percent changes in rainfall. As yet, it is not possible to get a clear picture for precipitation change, due to large model uncertainties.
- While the future patterns of rainfall remain unclear, studies suggest precipitation increases, particularly in the wetter seasons (June to November).
- Recent evidence and model simulations also point to a more frequent occurrence of El Niño weather patterns that could contrast the previous conclusion, and could bring an increase in drought conditions in the region. These more frequent El Niño events are believed to be associated with climate change, though some disagreement exists within the science community on this point.
- More frequent El Niño events could also increase the intensity of tropical cyclones along the Pacific, with important implications for disaster management and response.
- Temperatures in the Pacific are projected to increase between 1.4 and 3.1ºC.
- Sea levels are projected to rise by the end of the century (2090-2099) by 0.35 m, although the spatial manifestation of this rise will not be uniform due to circulation changes and ocean density.

Figure 43 and Figure 44 show the results of the ensemble mean of multiple GCM simulations over the 6°N to 8°N and 121°E to 123°E domain that includes the Southern Philippines[48] for the RCP4.5[49] assumptions of future greenhouse gases, for surface temperature and precipitation anomaly, respectively. The results suggest regional warming of about 1.5°C and generally increased precipitation, with the RCP8.5 suggesting a more than 3.0°C warming by the end of the 21st century (not shown). Figure 45 shows the ensemble mean of the future precipitation for the higher RCP8.5 emission pathway, suggesting an even stronger increase in regional precipitation.

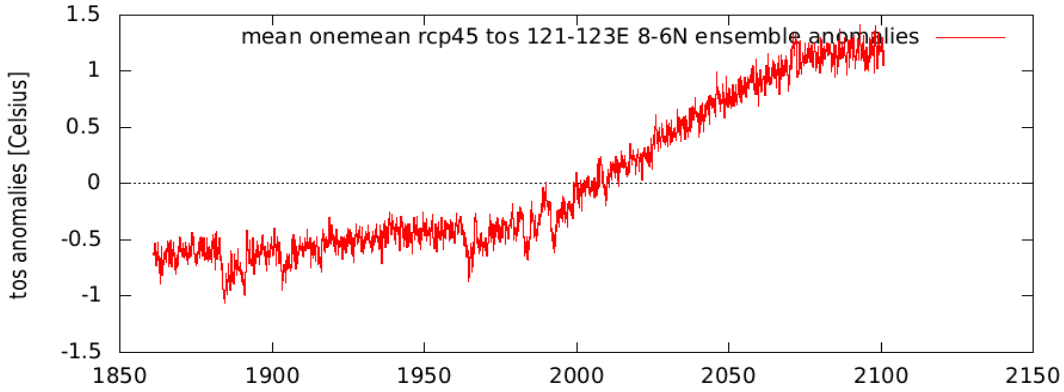


Figure 43: The ensemble mean of the surface temperature of the multi-model ensemble over the Zamboanga City region out to 2100 for the RCP4.5 assumptions of future greenhouse gas concentrations

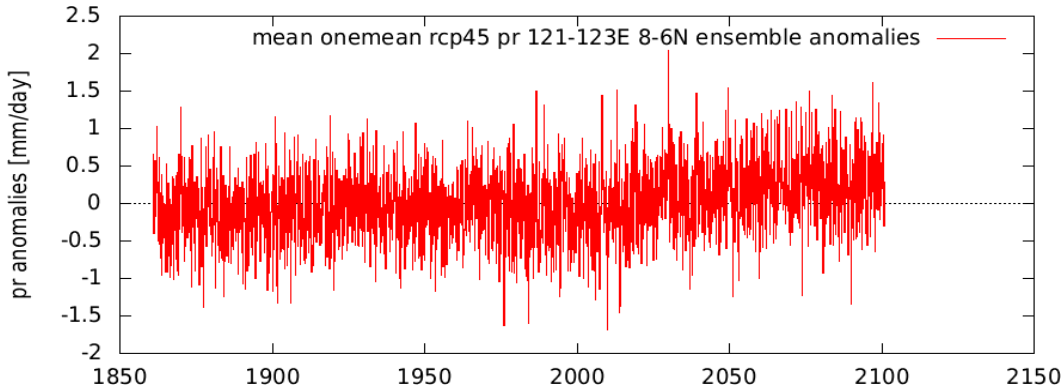


Figure 44: The ensemble mean precipitation anomaly of the multi-model ensemble over the Zamboanga City region out to 2100 for the RCP4.5 assumptions of future greenhouse gas concentrations

[48] Multi-model mean (one member/model) are derived from these model experiments: ACCESS1-0 ACCESS1-3 bcc-csm1-1 bcc-csm1-1-m CanESM2 CCSM4 CESM1-BGC CESM1-CAM5 CMCC-CM CMCC-CMS CNRM-CM5 CSIRO-Mk3-6-0 EC-EARTH FIO-ESM GFDL-CM3 GFDL-ESM2G GFDL-ESM2M GISS-E2-H GISS-E2-H GISS-E2-H GISS-E2-H-CC GISS-E2-R GISS-E2-R GISS-E2-R GISS-E2-R-CC HadGEM2-CC HadGEM2-ES inmcm4 IPSL-CM5A-LR IPSL-CM5A-MR IPSL-CM5B-LR MIROC5 MPI-ESM-LR MPI-ESM-MR MRI-CGCM3 NorESM1-M NorESM1-ME

[49] A Representative Concentration Pathway (RCP) is a greenhouse gas concentration (not emissions) trajectory adopted by IPCC fifth Assessment Report (AR5), which describe different climate futures. The RCPs –RCP4.5 and RCP8.5 used here – describe a possible range of radiative forcing values in the year 2100 (2.6, 4.5, 6, and 8.5 W/m2, respectively).

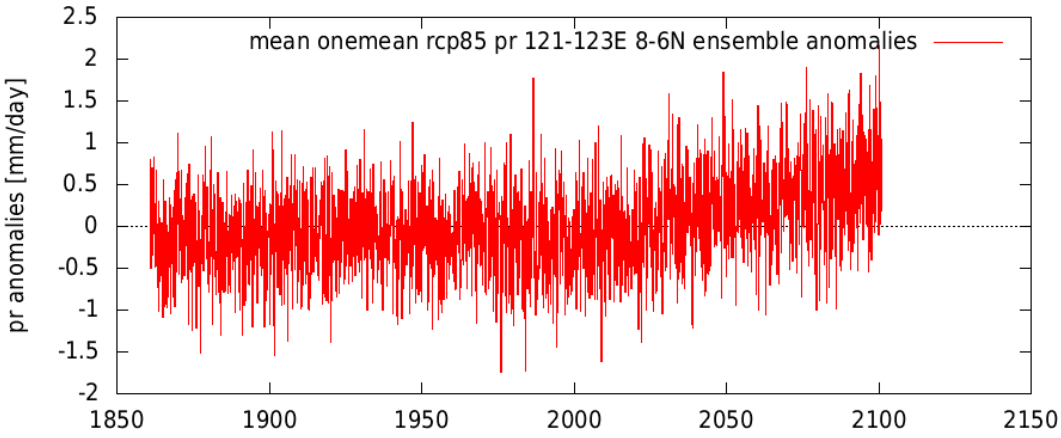


Figure 45: Same as Figure 26, but for the RCP8.5 assumptions of future greenhouse gas concentrations

This observation of the negative correlation between ENSO and rainfall in the Zamboanga Region is somewhat confounding in terms of the development of future precipitation projections for this study. On the one hand, Global Climate Models generally show greater annual rainfall in the future. This outcome is a relatively simple and straightforward dynamic, as warmer sea surface temperatures combined with a warmer regional atmosphere leads to a generally enhanced precipitating environment. A warmer atmosphere can hold more water and the warmer ocean provides that additional water source, and together, these two processes result in higher precipitation amounts and rates. Yet the negative correlation between ENSO and precipitation in this region of the Philippines suggests that if El Niño conditions are more prevalent, then there is a higher likelihood that precipitation amounts in Zamboanga City could be reduced. A probable future scenario is little to no change in total precipitation, but higher precipitation rates when it rains, especially if the warm ENSO phase (El Niño) is more prevalent.

Future Water Demand and Supply Gap Analysis

This section presents a gap analysis, which is determined by calculating the difference between future water demands and supply. The gap analysis is based on water demands as described in Section V and status quo of water supply sources. The status quo of water supply assumes that the existing water sources of ZCWD will remain the same, historical and future availability of water will remain constant (i.e., the available water supply from the Tumaga River is the same, well pumping is also the same). This status quo gap analysis is an important first step in the water security process in order to understand future needs and potential scenarios to ensure adequate supply to meet demands.

Future Water Demands

The gap analysis presented will determine the surplus and shortfall of supply to the ZCWD service area. Detailed water demand projections are included in Section V of this study that includes all users of surface water and groundwater sources for domestic, industrial, and institutional demands and NRW.

Non-Revenue Water

Almost all water districts in the Philippines suffer to some extent from losses in their distribution network. Referred to as NRW, the resulting losses hamper efforts to expand the distribution network to underserved or non-served populations. In 2020, the NRW as reported by ZCWD was 64 percent and varied between 50 percent and 64 percent on an annual basis since the year 2015. The trend is a steady increase in NRW over the past 6 years of about 410 million liters or 410 thousand cubic meters in May of the same year. (ZCWD, 2017). As described previously, the gap analysis in this section will assume NRW will remain at 60 percent throughout the planning period. Future tasks as part of this study will include an NRW analysis and the importance of reducing this metric.

Future Water Availability based on Existing Sources

The initial step in the water security analysis is to determine what would happen if water demands grow and the existing water sources and capacities remained constant (i.e. status quo). Based on data obtained from ZCWD, Table 42 presents the existing water sources and future availability.

Table 42: Existing ZCWD Water Sources under Status Quo Analysis (MLD)

Water Source	2020	2025	2030	2035	2040	2045
Surface Water Tumaga River	87	87	87	87	87	87
ZCWD Production Well (Ground Water Source)	15	15	15	15	15	15
ZCWD Spring Source	2	2	2	2	2	2
Primewater Bulk	35	35	35	35	35	35
Total	138	138	138	138	138	138

As shown in the table, the Tumaga River is main source of water for ZCWD at 87 MLD, the Prime Water Bulk source has a capacity of 50 MLD but due to water planning issues has only been able to produce on average of 35 MLD which is projected to be the average through 2045. The other groundwater and spring sources are also constant as shown. Therefore, under this status quo

analysis the total available water supply for ZCWD is 138 MLD. It is important to note that the status quo analysis does not factor in limitations in water supply caused by other users or climate change. The status quo serves as a base line for additional analysis carried out in this master plan.

Gap Analysis

The difference between future water supply and demand is known as the gap and is an important metric in order to determine the needed water supply in the future. The gap or supply deficit under the status quo condition is presented in Figure 46. As shown in the figure, by 2045 the water supply gap is 81 MLD under maximum day conditions and 44 MLD under average day. As noted previously this gap analysis does not account for changes in climate such as extended droughts, more frequent El Niño events that will exacerbate the inability to meet water demands in the future.

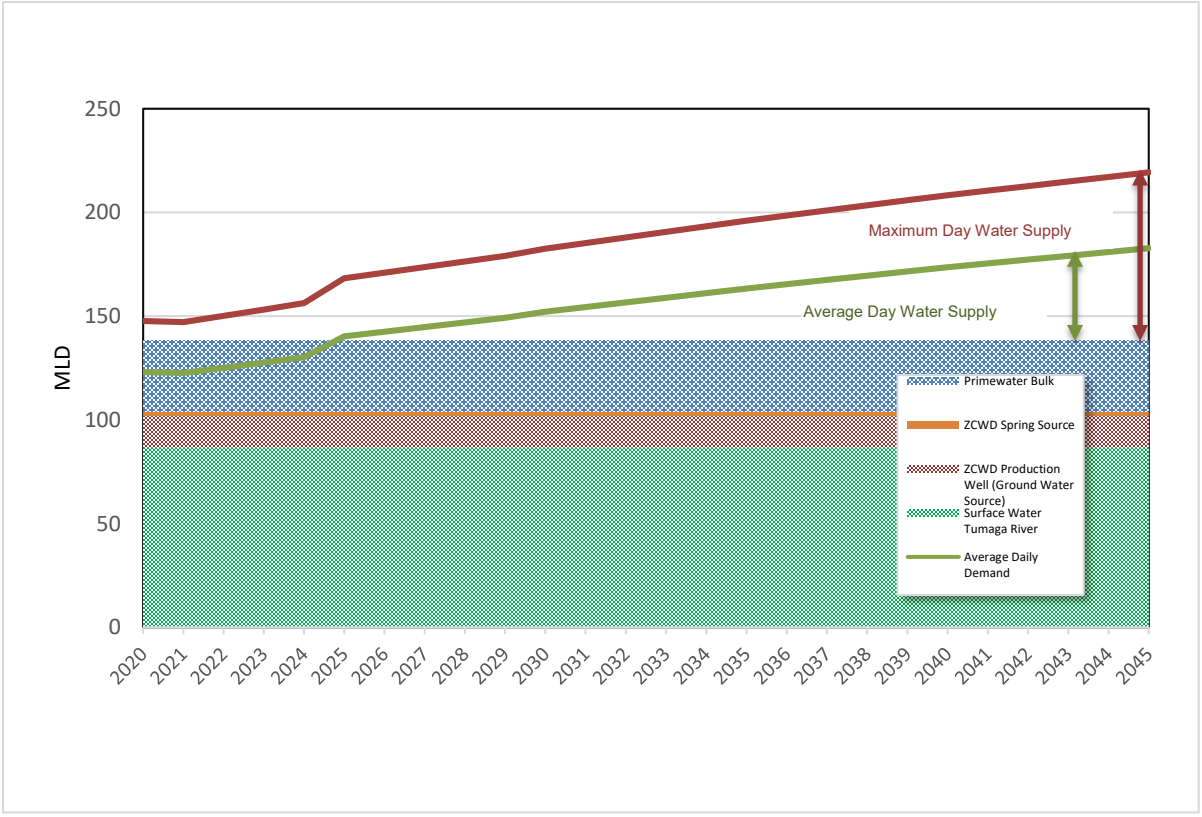


Figure 46: ZCWD Water Supply and Demand Gap

The data in Figure 46 indicates that even under average day water demands the water district will have a water supply shortfall by 2025. Under dry periods or El Niño events the water district has already experienced shortfalls in water supply, in 2016-2017 water supply to water districts customers was curtailed due the lack of supply. The shortfall will be exacerbated by trying to meet maximum water day demands under drought conditions which already occurred over the past several years. As noted previously this gap analysis does not account for changes in climate such as extended droughts, more frequent El Niño events which will exacerbate the inability to meet water demands in the future and expand the gap.

IV. Goals, Strategies and Objectives Based on Water Risks

The preparation of this Water Security Master Plan takes into account stakeholder participation and engagement as part of the whole planning process by embedding their inputs at the core of the various activities. The participation of stakeholders is essential in understanding their needs and desires to craft the master plan. Stakeholder involvement is also crucial in the formulation of goals, objectives, and strategies to achieve water security based on water-related risks encountered in the city. Annex 7 presents the activities conducted with the stakeholders.

Prevailing Issues and Concerns on Water Security

A gap analysis matrix as presented and described in Table 24 are based on the consultation with the Zamboanga City WSC. The following are the detailed discussion of each gap:

- *Lack of and/or insufficient potential surface water sources[50], including other surrounding areas.* The main source of ZCWD is the Tumaga River wherein the water treatment facility is located in Brgy. Pasonanca, Zamboanga City. However, supply from Tumaga River barely meets the requirements of the WTPs as the river's current source is barely enough to supply the town proper and some of its adjacent barangays. As such, several studies have been conducted to identify other potential sources of surface water other than the existing and depleting water resources. One of the studies is the USAID Water Security for Resilient Economic Growth and Stability (Be Secure) Project which identified six major river systems[51] in Zamboanga City as potential alternative surface water sources. The identified rivers include the Vitali River, Curuan River, Balong River, Manicahan River, Culiahan River and Ayala River. In this regard, the Manicahan River which has headwaters also coming from the Pasonanca National Park may be developed as an additional domestic water source to feed into ZCWD's system. As their development is contingent on population density projections, an alternative would be to optimize first existing spring sources in these barangays while the other one is to identify potential water sources in adjoining and/or surrounding localities. To address this insufficiency, there is an urgent need to expedite the approval, funding and implementation of the feasibility study and conceptual/basic design for the Tumaga River Impounding Dam and Multi-Purpose Dam Project to abate this impending problem.

- *Lack of and/or insufficient information on the use of isotopic and nuclear techniques to ensure clean ground water sources.* During rainy season, quick infiltration of silt and debris in the Tumaga River is a perennial problem as it becomes heavily silted during the rainy season. In the same manner, groundwater contamination is also one of the issues in zoning, monitoring and development of water resources management policies. In this regard, the use of isotopic and nuclear techniques could be a solution to address these constraints, but this method has not been introduced yet. Therefore, the lack of and/or insufficient information on the use of isotopic and nuclear techniques to ensure clean ground water sources should be appropriately addressed. Scientists[52] from the

[50] Determining the available water sources in an area depends on the hydrologic cycle and its various compartments: rainfall, surface water, groundwater and any man-made impoundment.

[51] These rivers were identified based on their large catchment basins and high discharge. Several ground water sources were also identified.

[52] The study was led by Dr. Sunshine P. Tan of UP Diliman's Environmental Engineering Program, under the mentorship of Dr. Angel Bautista VII of the DOST-PNRI's Nuclear Analytical Techniques Applications Section. The study also received assistance from the

University of the Philippines-Diliman (UP Diliman) and the Department of Science and Technology-Philippine Nuclear Research Institute (DOST-PNRI) used nuclear techniques to analyze the salinity of the groundwater sources in Pampanga. In this regard, a capacity building and/or technology transfer activity on the use of the isotopic and nuclear techniques for the ZCWD to ensure clean freshwater and groundwater supply to ZCWD concessionaires is needed.

- *Insufficient monitoring and enforcement of EO 524-harvesting, storage utilization of rainwater.* Based on the processing capacity of WTPs from Tumaga River, water shortages are presently affecting the City[53] Similarly, the insufficient water supply is directly affecting the operations of the ZCWD particularly during the dry season/El Niño period.[54] However, despite these conditions, there is still insufficient monitoring and enforcement of EO 524: An Ordinance Requiring the Proper Harvesting, Storage and Utilization of Rainwater in the City of Zamboanga, Appropriating Funds and Providing Penalties for Violations and for Other Purposes. There were observations that there is insufficient enforcement of EO 524 as several new commercial buildings and/or establishments as well as those being designed or constructed do not have rainwater harvesting system (RWH) or other means, designs, fixture, materials, and methods to collect rainwater in commercial buildings. Article XII, Section 4 on Water Efficiency, specifically states that "it requires the adoption of efficient practices, designs, materials, fixtures, equipment, and methods that reduce water consumption resulting in cost savings. Its scope includes water fixtures and water management (e.g., rainwater harvesting and water recycling)." As such, the adoption of EO 524 or the Rainwater Harvesting, Storage and Utilization Ordinance of the City of Zamboanga is recommended.

- *Lack of or insufficient information on the results of the water impounding dam feasibility study.* Since there is no reservoir in the water intake facility of ZCWD, there is a no way to capitalize on the excess runoff of the Tumaga River during the rainy season (months of June to October). As such, there is insufficient water to match the water demand from concessionaires as there is a decrease in flow of the Tumaga River[55] during summer. To help mitigate this problem, ZCWD is planning to construct a reservoir to store water during rainy season and use the stored water during dry season. In this regard, there are two studies conducted with regard to water impounding dam in Zamboanga City: (i) Technical Services for Pre-Feasibility Study for an Impounding Dam with Conjunctive Hydroelectric Power Plant for a Sustainable Water Supply for Zamboanga City[56] ; and (ii) Feasibility Study for the Zamboanga City Impounding Dam Project [57]. The latter study has an approved contract of PhP74.9 million from NEDA's Project Development and Other Related Studies (PDRS) Fund which is envisaged as a long-term solution and legacy project to address water security for Zamboanga City. In the project update

Mines and Geosciences Bureau of the Department of Environment and Natural Resources and the Micro Analysis Laboratory, Tandem Accelerator of Tokyo University.

[53] USAID Water Security for Resilient Economic Growth and Stability (Be Secure) Project. Technical Services for Preparing Vulnerability Assessments of Water Resources in Zamboanga City: Final Report. Geoscience Foundation, Inc. February 2016.

[54] It is predicted that effects of climate change will result in more extreme conditions in the coming decades with the periods of drought presently experienced by Zamboanga City getting worse.

[55] The Tumaga River source can also be augmented by tapping additional surface water sources draining the intact forest of Pasonanca Park.

[56] USAID Be Secure Project commissioned Royal Haskoning DHV (RHDHV) to identify five candidate rivers as potential sites for an impounding dam and these include: Tumaga River, Manicahan River, San Ramon/Saaz River, Limpapa River, and Ayala River.

[57] Awarded by the National Economic and Development Authority (NEDA) to the joint venture (JV) of Engineering and Development Corporation of the Philippines (EDCOP), Pacific Rim Innovation and Management Exponents, Inc. (PRIMEX) and Key Engineers, Co. (KEC) on December 2018.

provided by ZCWD, the study report is being finalized pending completion of bore tests analysis.

- *Varying levels of awareness and knowledge about water security.* Considering the progress made by EO 536-2000: An Executive Order Creating the TWG on Water Security and EO-BC-661-2021: An Executive Order Creating the Zamboanga City Water Security Council, members of the WSC has varied level of awareness and knowledge about water security as generated from consultations. While EO 536-2000 requires the TWG[58] to (i) support the information and education campaign on water saving, plumbing fixtures and water efficient facilities; (ii) review plans and programs on the construction of small impounding dams and other water supply system projects in strategic areas across the city; and (iii) assess policies on rain water harvesting and the establishment of wastewater treatment facilities; there is a need to level-off and embark on an institutional development and capacity building program to enable participating city government institutions and/or organizations to increase and strengthen the level of awareness and degree of knowledge about water security particularly (i) strengthening the enabling environment for sustainable service delivery; (ii) strengthening the capacity of water supply and wastewater treatment service provision services activities; (iii) strengthening the collection, analysis and sharing of water and climate data; (iv) reducing risks from climate-related disasters; and (v) improving capacity for ensuring long-term water security.

- *Insufficient implementation period of the Water Audit Program.* The Water Audit Program (WAP) is part of the WDM initiative of ZCWD with the support of the USAID Be Secure Project. The WDM complements traditional WSM for meeting existing and future water demands by minimizing or avoiding development of new water resources as well as getting the most use from the available water supplies through water conservation and increased water efficiency.[59] As the water audit provides a better understanding of customer water use patterns, characteristics, and consumption, particularly in providing customers with a specific water conservation reminders (e.g. understanding of where water is used, water efficiency opportunities, achieving water savings from leak detection), its implementation period may not be sufficient given the existing need for more data and information on WDM and water security of both residents and concessionaires of Zamboanga City. As such, the Zamboanga City Water Audit Program: Phase 2 (Expansion Phase) is recommended for a second implementation and expansion.

- *Lack and/or insufficient sources of potential financing facilities and modalities for water sector infrastructure development projects.* Despite the formulation of numerous policies, orders and regulations on the preparation of PPAs on climate change, WDM and water security; the lack and/or insufficient sources of potential financing facilities and modalities for water sector infrastructure development projects still remain. USAID's technical assistance through the Be Secure and SURGE Projects are not only strategic source of financing for water sector's IWRM, WDM and water security studies, but also an initiative that expedites policy directives, roadmaps, actions plans and PPAs supporting water

[58] The TWG is composed of the following offices, namely: Office of the Vice Mayor, City Environment and Natural Resources Office, Office of the City Administrator, City Agriculture Office, City Budget Office, City Planning and Development Coordination Office, City Disaster Risk Reduction and Management Office, City Legal Office, City Chamber of Commerce, Employee Confederation of the Philippines, Rotary Club of Zamboanga City West and Ateneo de Zamboanga University.

[59] USAID Water Security for Resilient Economic Growth and Stability (Be Secure) Project. A Toolkit for Water Editors (Residential Sector),

sector programs of the City. Aside from the financial assistance of international aid agencies, it is also important to initiate access to financing facilities and/or modalities being offered by multilateral international financial institutions such as the Asian Development Bank (ADB), Asian Infrastructure Investment Bank (AIIB), International Finance Corporation (IFC) and the World Bank. Aside from these, partnerships from international programs and initiatives such as the Global Water Partnership-Southeast Asia (GWP-SEA), United Nations Water (UNW), Waterlinks, etc. are also potential sources of information and partnerships in the water sector.

Table 43: Gap Analysis Matrix on Addressing Prevailing Issues, Concerns and Challenges on Water Security[60]

Issue/Concern	Description of the Gap	Relevant Applicable Policy	Suggested Actions to Bridge the Gap	Projects/ Programs	Responsible Party
1. "Lack of and/or insufficient potential surface water sources, including in other surrounding areas"	Although there have been several studies conducted on identifying potential freshwater sources, there is still no definitive results on the potential freshwater sources	a) PD 1067-Water Code and its Amended IRR[61] (b) PD 198-Provincial Water Utilities Act 1973[62] (c) PD 856 Code of Sanitation (d) RA 9275 Clean Water Act (e) RA 8041 Water Crisis Act (f) PD 424 and its Amendments[63] (g) Zamboanga Peninsula Regional Development Plan 2017-2022[64] (h) Zamboanga City Comprehensive Development Plan & Comprehensive Land Use Plan[65] (i) EO BC-661-2021-Zamboanga City Water Security Council[66] (j) Executive Order No.524-Rainwater Harvesting[67]	Expedite the completion as well as commission additional studies/projects on identifying potential freshwater sources within and surrounding areas	Feasibility Study and Conceptual/Basic Design for the Tumaga River Impounding Dam and Multi- Purpose Dam Project	City Government of Zamboanga (CGZ) and City Engineering Office (CEO) & Zamboanga City Water District (ZCWD)
2. "Lack of and/or insufficient information on the use of isotopic techniques to ensure clean freshwater"	Groundwater contamination is one of the issues in zoning, monitoring and crafting of water resources management policies, but the use of isotope and nuclear techniques have not been introduced yet		Introduce the use of isotopic and nuclear techniques used by DOST's Philippine Nuclear Research Institute (PNRI) to ensure the utilization of clean freshwater sources	Capacity Building on the Use of Isotopic & Nuclear Techniques in Ensuring Freshwater Supply to Zamboanga City Water District Concessionaires	City Government of Zamboanga (CGZ) and City Engineering Office (CEO) and Zamboanga City Water District (ZCWD), Zamboanga City Water Security Council (WSC)
3. "Insufficient monitoring and enforcement of EO 524-harvesting storage utilization of rainwater"	There is insufficient adoption of efficient practices, designs, fixture, materials and methods to collect rainwater in commercial buildings		Intensity the adoption of EO 524 particularly in designing rainwater collection fixtures in commercial establishments	Adoption of EO 524 on Rainwater Harvesting Fixtures in Commercial Building Designs/Plans	City Government of Zamboanga (CGZ) and City Engineering Office (CEO)
4. "Lack of or insufficient information on the results of the water impounding dam FS"	Insufficient/lack of information on the results of pre-feasibility study for Zamboanga City Impounding Dam Project financed by NEDA		Facilitate regular issuance of information on the updates of various ongoing infrastructure projects in the water sector	Feasibility Study & Basic Conceptual Design of Zamboanga City Water Impounding Dam Project	City Government of Zamboanga (CGZ) and Zamboanga City Water District (ZCWD)
5. "Varying levels of awareness and knowledge about water security"	Personnel of the Zamboanga City Water Security Council members have varying degree of awareness and knowledge on water security		Recommend an institutional capacity building program to increase the awareness and knowledge on water security	Institutional Capacity Strengthening on Water Security Awareness and Knowledge Training	City Government of Zamboanga (CGZ) and Zamboanga City Water Security Council (WSC)
6. "Insufficient period and/ or implementation of Water Audit Program"	The ongoing implementation of the Water Audit Program needs to be expanded to cover other areas		Recommend and support the extension and expansion of the Water Audit Program	Zamboanga City Water Audit Program: Phase 2 (Expansion Phase)	City Government of Zamboanga (CGZ) and Zamboanga City (ZCWD)
7. "Lack of potential financing facilities and modalities for water sector infrastructure development projects"	There is a significant and urgent need to identify potential financing facilities and modalities to finance several infrastructure developments projects in the water sector		Initiate a request to national and international financing institutions to introduce and offer available facilities and modalities to finance projects	Conduct of Market Sounding Exercise and Financing Assistance from International Financing Institutions	City Government of Zamboanga (CGZ) Zamboanga City Water District (ZCWD) and Water Security Council

[60] The issues and concerns described in the Gap Analysis Matrix were obtained from respondents and/or representatives of the Zamboanga City Water Security Council participated in the Online Consultation Meeting on the Preparation of the Zamboanga City WSMP held on 28 July 2021.
[61] Under PD 1067 of 1976, the Water Code governs the appropriation of water, i.e., the acquisition of rights over the use, taking, or diverting of water from natural resources. Such appropriation of water is legally allowed by the code for the following purposes: domestic, municipal, irrigation, power generation, fisheries, livestock raising, industrial and recreational.
[62] PD 198 of 1973 refers to the declaration of national policy favoring local operation and control of water systems; authorizing the formation of local water districts and providing for the government and administration of such districts; chartering a national administration to facilitate improvement of local water utilities to optimize public service from water utility operations.
[63] PD 424 of 1074 refers to the creation of a National Water Resources Council to coordinate and integrate water resources development in the country.
[64] The Zamboanga Peninsula Regional Development Plan (2017-2022) supports the attainment of accelerating growth and regional contribution to the Philippine Development Plan (2017-2022).
[65] The six-year Zamboanga City Comprehensive Development Plan (2017-2022) "seeks to establish Zamboanga as a Metropolitan City with robust biodiversity and sustainable development that is globally competitive, where investments thrive through good governance and industry".
[66] EO BC-661-2021 is an Executive Order creating the Zamboanga City Water Security Council to strengthen the enabling environment for sustainable management of water supply and water demand.
[67] EO 524 requires the adoption of efficient practices, designs, materials, fixtures, equipment, and methods that reduce water consumption (e.g. rainwater harvesting and recycling.

Goals, Objectives, and Strategies to Address Water Risks

With the foregoing analysis of the challenges and issues on water security, the following goals, objectives, and strategies were formulated in consultation with the ZCLGU, ZCWD and other stakeholders.

Goals are identified in this section to accomplish water security and pertain to the water district, rather than to a specific department. Goals identify what an organization wants to achieve, preserve, reduce, or eliminate. Goals provide an organization, specifically its management, with a sense of direction by stating quantified performance targets. The WSC can have many important goals, but having too many can defeat the purpose of planning. The goals should address the major issues being faced by various members and stakeholders of the WSC, over the next five years. Based on the various consultations, SWOT analysis by ZWAT, virtual meetings with stakeholders, and adherence to the goal of the city government which is to *"Ensure availability, dependable, proper management of water and sanitation services towards sustainable development of the City of Zamboanga"*, the following goals to achieve water security include:

- Long-term water sustainability
- 24/7 consistent safe water supply including adequate system pressure
- Conservation and protection of watershed
- Use of innovative technology and data
- Improve operational and fiscal efficiency
- Maintain and improve relationships, partnerships, and collaboration with stakeholders and LGU
- Promote the value of water to the customers and instill confidence of the water district
- Maintain attractive investment profile

The identified goals are aligned to the PWSSMP direction for attaining the water supply and sanitation subsector's targets and with the following key reform agenda (KRA): (i) KRA2: Strengthening the Regulatory Environment; (ii) KRA3: Creating and Ensuring Effective WSS Services; (iii) KRA4: Balancing Water Supply and Demand; (iv) KRA5: Building Climate Resiliency; (v) KRA6: Enabling Access to Funding and Financing; (vi) KRA7: Managing Data and Information and (vii) KRA8: Driving Research and Development.

Objectives are specific actions and steps you need to take to achieve a goal. Objectives must be specific, measurable, and accomplished within a set time frame and are accomplished through performance measures. The objectives listed in Table 45 were based on existing conditions and organizational capabilities. The performance measures provide a method to measure whether the objectives are met.

Table 44: Objectives and Performance Measures

Objectives	Performance Measures
Supply Reliability	Number of weeks of unmet demand
	Flexibility and adaptability to meet future climatic conditions
	Ability to maintain system pressure
Cost Effectiveness	Capital and operating cost
	Impacts of water tariff
Implementation Ease	Degree of public and stakeholder support

Objectives	Performance Measures
	Degree of operational complexity
	Ability to implement based on acceptance by the government
Competing Impacts	Degree of Impacts to the Environment
	Degree of Impacts to commercial or agricultural users
Training of Employees	Number of hours of training per employee on new or innovative technologies

Strategies enumerated below are the specific actions that need to be taken to accomplish the goals. These strategies require the collaboration of concerned government and non-government agencies, ZCWD and other stakeholders through the Zamboanga City WSC.

- Development of new groundwater or surface water supplies
- Climate resilient water supply
- Diversified water supply
- WDM and conservation
    - Reduce NRW
    - Rainwater harvesting
    - ZWAT
- Training on innovative technologies, processes, and systems
- Maintain adequate water rates by the ZCWD
- Invest and maintain employee
- Government transparency

The strategies to achieve water security are further refined and redefined in Section VII and are included as alternatives in the WEAP model.

V. Priority Programs, Projects and Activities

The Projects, Programs, and Activities (PPAs) listed in Table 46 were generated from the stakeholders' consultations and interviews. These PPAs are recommended to address issues on water security such as the NRW reduction, water scarcity, improvement of water support facilities, service area expansion, sanitation, and climate change adaptation. These PPAs are classified according to the following timeline: (i) short-term: 2022-2026 and (ii) long-term: 2027-2045. Furthermore, prioritization of short-term project is based on the readiness of the project, funding source availability, or the need for immediate development plans.

The proponent of majority of the projects listed herein is the ZCWD, which is expected to specifically address the issues on water security. For these PPAs to be effectively implemented, however, finding available funding source is not only important but also the capability and competence of personnel who will have oversight functions over its implementation. To this end, short course programs on management conducted by reputable learning institutions is recommended to be included in the programs for top level officials of the ZCWD. Training on project planning and design, water source development, isotope technology, leak detection management, pressure management, water meter management, and DMA management for technical personnel is highly recommended. Maynilad Water Academy may be able to offer these technical trainings. These proposals can be classified as short term.

What has become a recurring problem for the city of Zamboanga is the inadequate supply of drinking water during droughts and during the onset of the El Niño phenomenon. On the other hand, during wet seasons and during La Niña, excess water is being drained from the watershed, causing flash floods and inundating low lying areas in the city. Excessive precipitation also causes high turbidity, affecting the production capacity of the WTPs and causing a shutdown to the old reservoir. It is ironic that inadequate supply of water not only happen during dry season but also during heavy precipitation.

Table 45: List of PPAs for Zamboanga City

	List of Programs/Projects/Activities	Total Investment Requirement (PhP)	Guaranteed Funding Source	Proponent
Physical Investment				
Short Term				
1	Implementation of NRW Reduction Program (Pipe replacement Phase 1)	102,000,000		
2	Implementation of NRW Reduction Program (Pipe replacement Phase 2)	590,000,000	ADB WDDSP	ZCWD
3	Rehabilitation and Expansion of Sewer line	28,500,000	ADB WDDSP	ZCWD
4	Water Distribution Network Expansion and Improvement Program	150,000,000	ADB WDDSP	ZCWD
5	Treated Water Production Augmentation Program	123,000,000	ADB WDDSP	ZCWD
6	Water Supply Systems (Artesian Wells, Reservoirs, Pumping Stations and Conduits)	34,000,000	ZCLGU	ZCLGU
7	Construction of Rainwater System	20,000,000	ZCLGU	ZCLGU
8	Expand Groundwater sources	17,000,000	ZCWD	ZCWD

	List of Programs/Projects/Activities	Total Investment Requirement (PhP)	Guaranteed Funding Source	Proponent
9	Implementation of the National Sewerage and Septage Management Program (NSSMP)	177,000,000	DPWH	LGU, ZCWD
10	Cahumban Water System	76,100,000	ZCLGU	LGU, ZCWD
11	Infiltration Gallery for Dumalon Water Source	4,800,000		ZCWD
12	Septage Treatment Plant/ Septage Management Plan	TBD		ZCWD
13	Pamucutan-Ayala Pipelaying	12,000,000		ZCWD
14	Bunguiao Water System	59,000,000		ZCWD
15	Construction/Rehabilitation/ Improvement of Mangusu Water System	8,700,000		ZCWD
16	Water system at Dulian-Cabatangan	7,800,000		ZCWD
17	Feederline/Water Services Expansion	10,000,000		ZCWD
18	Installation of Air Release, Blow-off in ZCWD Pipeline Network	12,600,000		ZCWD
19	Watershed Protection/ Rehabilitation Program: Perimeter Fencing	197,000,000		ZCWD
20	Network expansion: Pipelaying of 40 kms pipe	TDB		ZCWD
Long Term				
21	Rehabilitation of Raw Water Transmission Line of ZCWD WTP	106,200,000		ZCWD
22	Proposed Water Source Development at Sitio Latap Barangay Limpapa	120,400,000		ZCWD
23	Construction of Impounding Dam (216 MLD): Bulk water supply and hydroelectric power	6,600,000,000		ZCLGU, ZCWD
24	Water source development: Manicahan River (50MLD)	2,700,000,000		ZCWD
25	Water source development: Bog Lake (20 MLD)	790,000,000		ZCWD
26	Transboundary water supply: Malayal River in the municipality of Sibuco, Zamboanga del Norte	TDB		ZCWD
27	Transboundary water supply: Lakewood in Zamboanga del Sur	TDB		ZCWD
28	Construction of Bulk water supply receiving line (50 MLD from PrimeWater)	580,000,000		ZCWD
	Sub-Total	**13,111,100,000**		
Institutional Development and Capacity Strengthening				
Short Term				
1	Robust Decision Making - XLRM	TDB		ZCWSC
2	Sanitation and Septage Management	TDB		ZCWD
3	Ecosystems Based Analysis and Assessment	TDB		ZCWSC
4	Results-Based Monitoring	TDB		ZCWSC
5	Emergency Response Planning	TDB		ZCWSC
6	Vulnerability Assessment in relation to Climate Change Adaptation	TDB		ZCWSC
7	Conflict Resolution and Management	TDB		ZCWSC
8	Basic Negotiation Skills	TDB		ZCWSC
9	Implementation of Water Safety Plan			ZCWD

	List of Programs/Projects/Activities	Total Investment Requirement (PhP)	Guaranteed Funding Source	Proponent
10	Water demand management program including Water Audit	TDB		ZCWSC
11	ZC WSC Policy Research on Institutional Capacity Strengthening (ICS)	20,000,000	PWSSMP	ZC LGU-ZCWSC
12	City-Level Strategic Institutional Development and Capacity Building Program of the ZC Water Security Master Plan	10,000,000	ZC LGU	ZCWSC
13	ICS of ZC WSC: Training on Water Planning Approach and Decision Support System using WEAP	5,000,000	ZC LGU	ZCWSC
14	Policy Research on the Assessment of Benefits for the Establishment of a National Knowledge, Learning and Research Center for Water Security	25,000,000	ZC LGU	ZCWSC
15	WAP Impact Evaluation: Best Practices and Lessons Learned in Program Implementation	5,000,000	ZC LGU	ZCWD
16	City-level Strategic Communication Campaign Plan for ZC Water Security Master Plan	10,000,000	PWSSMP	ZC LGU-ZCWSC
Long Term				
17	Development of Watershed Security Plan	20,000,000	PWSSMP	ZC LGU-ZCWSC
18	Integrated Water Resource Management	25,000,000	PWSSMP	ZCLGU-ZCWSC
19	ICS of ZC WSC Personnel involved in Development and Implementation of Water Sector Development Projects	15,000,000	PWSSMP	ZC LGU-ZCWSC
20	Long-Term, Comprehensive and Sustainable ICS for ZC WSC	250,000,000	PWSSMP	ZC LGU-ZCWSC
21	WATSEC Watch: Supporting the Zamboanga City and Regional Water Sector Partnership	25,000,000	PWSSMP	ZCWD
22	Establishment of a Knowledge, Learning and Research Center for Water Security	5,000,000	ZC LGU	ZCWD
23	WAP-Pro: ZC WAP Implementation for Sustainable Institutional Partnership	5,000,000	ZC LGU	ZCWD
24	City-level Strategic Communication Campaign Plan for ZC WDM Plan	20,000,000	PWSSMP	ZC LGU-ZCWSC
25	Water–Isotope Capacity Building and Demonstration	25,000,000	PWSSMP	ZCLGU-ZCWSC
26	Wins (WASH in Schools)	TDB	TDB	ZCLGU
27	Zero Open Defecation	TDB	TDB	ZCLGU
	Sub-Total	**465,000,000**		

Priority and Other Long-term PPAs

From the array of all the PPAs identified during the stakeholders' consultations, the following priority PPAs that have significant impact to achieve water security were identified:

Programs, Projects, Policies and Activities Identified by ZWAT Planning Session

During its Strategic Planning Session held on 30 June 2021, the ZWAT identified the following activities that could support water security:

- Implement NRW reduction plan
- Wastewater management (construction, commissioning and reuse)
- Additional water supply
- Advocate a development of city-wide WDM through the WSC
- Expand the roster of trained water auditors by capacitating current external and internal teams through re-training and/or immersion activities
- Monitoring of projects
- Revise/improve current WSM materials and develop new ones to adapt to emerging and present global, national and local industry standards and best practices
- Strengthen existing stakeholders' relationship through engagement, consultative and two-way partnership building activities
- Completion or updating of the business plan
- Implement internal audit of the WSP
- Continue the preparation for ISO certification
- Development of new office complex
- Development of database asset management
- Prime HR-accreditation for Level 2
- Enhance customer care program

Some of the activities identified above have already been shown to be important within the context of this study. Other activities such as monitoring of projects, HR accreditation, among others are more aligned with improvements to the operation of ZCWD but do contribute in a smaller portion to the achievement of water security. Annex 8 shows the SWOT Analysis of ZWAT as the basis of the list of activities supporting water security.

NRW Reduction Program

The early implementation of the proposed projects and programs intended for the NRW reduction should be given priority. Furthermore, a comprehensive, time bound and specific targets should be considered by the ZCWD in implementing its NRW Reduction Program. Some of the strategies that ZCWD may apply for the reduction of NRW are as follows:

- *"Walk the Line" program.* This includes the identification of the pipe locations, pipe conditions, potable water pilferages, and leakages as well as location of valves that are existing but considered lost. This also includes the investigation of service connections and recommended corrections that will ensure the application of accepted standards for materials used and installation methods are followed.

- *Replacement of water meters.*[68] Appropriate type or class of water meters used in the system must be carefully studied and selected to ensure a more accurate registration of consumption. For example, displacement type water meters are ideal for areas with very low water pressure but are not a good choice where water contains abrasive/sandy materials. These types of meters tend to stop functioning when abrasive materials get in contact with its pistons. Current type water meters on the other hand are ideal for areas having good water pressure even if sand is present but may not be able to measure very low flows.
- *Recalibration of production meters and replacement of all mechanical production meters to electromagnetic flow meters*. Calibration of production meters must be done regularly to have accurate readings.
- *Metering of fire hydrants to record water withdrawn for firefighting.* ZCWD can also identify specific fire hydrants in the city where the Bureau of Fire Protection (BFP) can withdraw water for firefighting activities and meter these specific fire hydrants only. Presently, the BFP submits reports to ZCWD indicating the volume of water withdrawn by the unit for a specific time period.
- *Proper installation of water meters.* Meter reading errors may also be caused by the improper installation of such. Some meter clusters are enclosed in cages with vegetation growing all around, rendering the meter dials difficult to read. Also, water meters not installed horizontally tend to under register. Correct positions of installed water meters are important to conform to the standards. Incorrectly installed water meters will cause meter under registration.
- *Replacement of all ACP pipes.* ZCWD is already replacing the pipes yet some are still existing.
- *Replacement of distribution lines including defective valves and flow meters.* Most of these items are already in the program under the ADB WDDSP loan.
- *Regular flushing of distribution lines through fire hydrants to remove debris inside the lines.* Flushing prevents solids e.g., sand to get into water meters, thus prolonging its useful life and ensuring clean water for the customers. However, with the insufficient supply of water, line flushing may not be advisable at this time.
- *Continuous training of personnel to effectively use the full potential of the leak detection equipment.* Currently, leak detection accuracy is very low which sometimes results in several excavations being done before the leak can actually be located. Leak detection is a skill that can be honed through proper training of personnel handling the equipment.
- *Continuous training of meter readers must be implemented to reduce water meter reading errors*[69]. Different water meter brands may have different presentations of their reading dials. These subtle differences can confuse meter readers and may cause some to incorrectly read the meter. Meter readers must be regularly oriented on the different presentations for a more accurate reading. It is more advisable to have only one or two brands of water meters to minimize diversity in the reading dial presentation which can easily cause misreading and also to make maintenance and repair of water meters easier.

The strategy of replacing lines and appurtenances is expected to address the following: (i) *Eradication of illegal connections.* This can be achieved by decommissioning the old pipes and transferring only the registered connections to the new pipelines. This will render illegal

[68] Approximately 25,000 water meters are programmed to be replaced under the ADB WDDSP loan. Replacement and repair of water meters are regular programs of the unit tasked to maintain water meters. Water meters that are three to five years in the field are being replaced. Non- functioning water meters are reported by meter readers for replacement. ZCWD owns Water meter test benches used to ensure that new and repaired water meters are functioning within the allowable percentage error.

[69] The meter reading unit may not admit to meter reading errors, but it certainly does happen.

connections attached to the old lines waterless; (ii) *Getting rid of "lost" or defective appurtenances*. There are many appurtenances such as valves within the system that are missing and its conditions are unknown that will be eradicated by installing new appurtenances along the new lines; (iii) *Increasing the water carrying capacity.* Old lines that are tuberculated will be replaced by new lines which will deliver water with less "solids", thus reducing chances of water meters being damaged; (iv) *Eradicate abandoned connections*. These lines are either being used by unscrupulous individuals or were left leaking.

Additional Source Development

In the near-term, additional water sources are needed to meet the demands of the ZCWD customers. In the past five years, there have been challenges for the existing sources to meet water demands due to increased demands brought by rapid urbanization, high NRW and climatic impacts. The development of the WEAP model in this study will focus on the ability of the identified near-term sources to mitigate the impacts of increased water demands and climatic condition in order to achieve water security. The near-term sources to be investigated include Manicahan River and Bog Lake.

Development and Implementation of Watershed Security Plan

The Pasonanca watershed covers the main source of potable water in Zamboanga City. It supplies approximately 60 percent of the city's water needs. However, the watershed is vulnerable in so many ways, from human encroachment to climatic change impacts. As such, it is imperative that its protection be placed in the highest priority.

A watershed security plan must be developed and implemented which will include provisions for security workforce, maintenance personnel, reforestations and other activities that will ensure the protection and conservation of the watershed. As such, the security workforce, maintenance personnel, foresters and other support staff in the watershed should be brought back to its normal strength. Security guards can keep illegal intruders from illegal logging, gold panning, poaching, discharge of harmful wastes and other activities that can impact on the quality of raw water to the ZCWD. With regular maintenance workers, tributaries may be cleared from debris ensuring the unhampered flow of clean water to the intake. Most important, security guards can keep illegal intruders from illegal logging, gold panning, poaching, discharge of harmful wastes and other activities that can impact on the quality of raw water to the ZCWD.

Moreover, nurseries should be maintained to ensure ample supply of seedlings for reforestation. Resource biodiversity inventory should be made operational again to monitor and ensure that the watershed's most precious assets, its flora and fauna are healthy. Likewise, tree surgery activity is important so that damaged trees that would normally die and rot are being salvaged so they can continue to provide canopy cover to the forest for a much longer time.

To facilitate both short- and long-term water supply planning, additional streamflow measurement should be implemented at various locations along the Tumaga River. Continuous flow data should be recorded at least hourly and made available for analysis.

Management of the existing surface and groundwater water sources as well as bulk water supply

Water resource management of various sources of the ZCWD is important to obtain its optimum uses. For instance, Dumalon spring source, is susceptible to high turbidity whenever heavy precipitation occurs in the area, water becomes turbid. In the absence of a water treatment facility, operation has to be stopped until the turbidity level goes down to acceptable limits. Due to its high elevation, pressure surges are also experienced.
In the case of the bulk water supply, ZCWD should ensure that the contractual obligation of the bulk water supplier shall be met. If the bulk water provider cannot meet their contractual obligation, then all legal and financing options should be used in order to allow ZCWD to explore other supply options. Any shortfall in the bulk water supplier's sources will impact water security especially in the west coast area which is under DMZ-West.

Water Demand Management

Water demand management involves the adoption of policies or investment to achieve efficient water use by all residents of the city. WDM refers to getting the most use from the available water supplies through water conservation and increased water efficiency. It consists of reducing the quantity of water required to accomplish a task as it flows from the source through use and disposal. WDM includes the use of public policies, laws, water rates, and measures and practices to reduce water use, with the goal of securing long-term, reliable, affordable, and safe supply of water for the benefit of society and the environment. More importantly, managing water demand ensures the ability of the water system to serve society even during times when water is in short supply. The WDM was first introduced by the USAID Be Secure project in 2015, ZCWD has implemented WDM various components since then. One of the prominent results of this program in the city was the formal launching of ZCWD's WDM Program on February 2016 and the creation of the Zamboanga City ZWAT. The ZWAT prepared water audit toolkits for residential and commercial water users and trained water auditors, as part of the major undertaking in mainstreaming WDM in Zamboanga City.

As part of integrating WDM a key component is understanding the water use patterns of customers utilizing a water audit. A water audit provides a better understanding of customer water use patterns, characteristics, and consumption. The data gathered during a water audit will also assist in establishing a baseline for various customer segments and for future strategic and policy planning. The results of the water audits will provide ZCWD with a specific understanding of where water is used, as well as water-efficiency opportunities. In conjunction with a water audit, other WDM tools that should be investigated and implemented include community awareness, local capacity building, plumbing codes, regulation and policy revisions and as previously identified protection of catchment areas.

Implementation of Water Safety Plan

The ZCWD has formulated a Water Safety Plan (WSP) to ensure water quality from its source in the watershed, treatment, storage and up to the consumer's faucet. ZCWD should follow the actions, investments, and recommendation stated in the plan.

Development and Finalization of Water District Business Plan harmonized with City Development Plans

The programs and projects in water supply and sanitation as identified by the ZCWD has to be congruent with that of the City Planning. Among the programs and projects mentioned by City Planning its CLUP are:

- Additional construction of artesian wells or other sources of potable water,
- Use multi-media water filtration and sanitizer that will remove the existing turbidity of water,
- Apply other options and institutionalize strategy like staggered payment or subsidy from the LGU to the poorest of the poor families,
- Construct water treatment facility to all point of disposal and reuse it to other purposes,
- Construct private or public sewer system that will cater all sanitary sewer even piloting first in the city proper, and
- Construct a private or public sewer system that will cater all sanitary sewer even piloting first in the city proper.

Planning for Long Term Transboundary Water Supply

The identification of long-term water supply options could assist in achieving water security. But due to the relatively high cost, long distance and risks these water sources and subsequent projects should only be investigated as long-term water sources. The two long-term water supply projects identified by the stakeholders include: Malayal River in the municipality of Sibuco, Zamboanga del Norte, and Lakewood in Zamboanga del Sur. The size, cost and risk of these potential long-term project would warrant additional investigation outside the scope of this study.

Stakeholder Development and Institutional Capacity Strengthening

The long-term success of achieving water security is based on the premise that the ZCLGU, ZCWD and other stakeholders will have adequate knowledge and understanding in order to implement the recommendations of this study. Institutional development through capacity building will be critical in achieving this outcome. Engineers, operations and maintenance, planning, and administration personnel will all have a role in the successful implementation of the Water Security Master Plan.

Listed below are the recommended PPAs in order to allow staff to achieve the goals and objectives of this study. The short- and long-term interventions are based on the following: (i) Summary of Results of Survey Questionnaire, (ii) Online Stakeholder Consultation on the Preparation of the Zamboanga City Water Security Master Plan , (iii) Online Consultation Meeting with the ZCWSC on the Preparation of the Water Security Master Plan (Consultation on the Pressing Issues on Water Security), (iv) Gap Analysis on Addressing Prevailing Issues, Concerns and Challenges on Water Security, and (v) SWOT for ZWAT during the Strategic Planning.

Short-Term Institutional Development and Capacity Strengthening Interventions

- **Project No. 1: Policy Research on Institutional Capacity Strengthening of the Zamboanga City Water Security Council.** The proposed policy research aims to assess the capacity of personnel/staff, effectiveness of existing capacity building programs, and assess the performance of roles and/or functions of member-organizations of the ZCWSC. The policy research study is subdivided into three stages, namely: (i) Stage 1-Institutional Performance Review; (ii) Stage 2-Strategic Institutional Assessment and (iii) Stage 3-Institutional Strengthening Framework Design. The study is designed to be implemented for a period of nine months. This strategic intervention will be spearheaded by the ZCLGU and to commission a reputable management consulting firm with extensive experience in undertaking various capacity building and

institutional strengthening programs in both public and private sectors or commission a number of individual consultants with extensive experience in conducting policy research, capacity building, institutional development and institutional capacity strengthening.

- **Project No. 2: City-Level Strategic Institutional Development and Capacity Building Program for the Zamboanga City Water Security Master Plan.** The completion of the Zamboanga City Water Security Master Plan coincides with the commencement of the implementation of the PWSSMP (2019-2030), which is designed to attain the water supply and sanitation subsector's targets through the development of strategies, formulation of policy reforms, and identification of priority programs and projects for implementation. As such, the city-level strategic institutional development and capacity building program for the ZCLGU is envisioned to capacitate government personnel and enable them to understand the requisites of undertaking the PWSSMP, develop feasible PPAs in WSS sector and appropriately address potential constraints and challenges during the implementation.

- **Project No. 3: Institutional Capacity Strengthening of the ZCWD: Training on Water Planning Approach and Decision Support System using WEAP.** Mandated to ensure everyone's access to sustainable and affordable safe water supply, the ZCWD needs to sustain the gains of its ZWAT to pursue potential sources of surface water to effectively provide adequate water supply and sanitation services. In this regard, a state-of-the-art and innovative decision support system tool must be utilized by staff/personnel directly involved in the identification, assessment and analysis of potential sources of surface water supply for Zamboanga City. This training program will enable the ZCWD to be knowledgeable of the WEAP model and capable of elevating the analysis of data and information on harnessing potential water sources. In addition, the program will also enhance ZCWD's focus on using customer-oriented business and financial models designed to improve the provision of adequate and safely-managed water supply and sanitation services.

- **Project No. 4: Policy Research to Assess the Benefits of Establishing a National Knowledge, Learning and Research Center for Water Security.** The proposed policy research seeks to assess the benefits and advantages of establishing a national knowledge, learning and research center designed to provide a venue for scientific learning and sharing on water security. The program is aligned with the PWSSMP's KRA No. 1: Establishing Effective Water Supply and Sanitation Sector Institutions which not only seeks to develop master plans in water supply and sanitation, but also to establish a reliable institution/center of excellence for water security to effectively address the challenges of implementing WSS initiatives, WDM priorities, climate-smart technologies, climate resilient facilities and knowledgeable stakeholders, policy advocates and stakeholders from both public and private sectors. The study is designed to be implemented for a period of nine months. This strategic intervention will be spearheaded by the ZCLGU in collaboration with the ZCWSC (representatives of ZCWSC member-organizations).

- **Project No. 5: Impact Evaluation of the Water Audit Program: Best Practices and Lessons Learned in Program Implementation.** Since it has been identified that there is insufficient period and/or implementation of the Water Audit Program (WAP), there is a need to expand the implementation of the WAP. As such, a recommendation for the

conduct of an impact evaluation of the WAP has been forwarded to enable the ZCWD to continue the implementation of WAP for another phase in order to continue the benefits of WAP implementation. The proposed impact evaluation will include the documentation of best practices in order to replicate the benefits of implementing WAP in other areas/provinces as well. Aside from the best practices, the impact evaluation will also include the documentation of significant lessons learned in program implementation. The implementation of the impact evaluation for WAP is integral in supporting the recommendation to expand as well as extend WAP implementation as part of the Water Security Master Plan program.

- **Project No. 6: Design, Development and Implementation of a City-Level Strategic Communication Campaign Plan for Zamboanga City Water Security Master Plan.** Regional growth and development provide significant impacts to several development aspects, including understanding the impacts of climate change, water scarcity, environmental degradation and water security. The increasing local groundwater extraction of local residents in the different areas in the City is causing different environmental issues due to lack of understanding of various environmental laws and regulations on water resources extraction and development. In this regard the project proposes for the design, development and implementation of a City-level IEC campaign plan on the dissemination and popularization of the Water Security Master Plan. The project involves the following tasks (i) design of a City-Level IEC Strategy and Advocacy Plan; (ii) develop, Pre-test and Produce IEC Materials (leaflets, brochures, Komiks, Peryodikit, video/ film documentaries) and Other Collaterals; (iii) implement the IEC Campaign and Publicity Program; (iv) monitor and evaluate the IEC Campaign and Publicity Program; and (v) develop and produce knowledge products on best practices. The project is about disseminating information and popularization of the Zamboanga City Water Security Master Plan to the public. In this regard, there is a need to provide a genuine and meaningful consultation with stakeholders, dissemination information and sustain awareness through the design, development and implementation of a comprehensive and creative communication strategy and campaign plan.

- **Project No. 7: Design, Development and Implementation of City-Level Strategic Communication Campaign Plan for Zamboanga City Water Demand Management Plan.** Regional growth and development provide significant impacts to several development aspects, including understanding the impacts of climate change, water scarcity, environmental degradation and water security. The increasing need for potential water sources, including the expansion of water supply coverage in different areas should not only be prioritized but also the knowledge and understanding of the public and/or stakeholders (water supply beneficiaries) should be considered. As such the project proposes for the design, development and implementation of a City-level IEC campaign plan on the dissemination and popularization of the WDM program for Zamboanga City. This program will enable the public and/or stakeholders (water supply beneficiaries) to know the importance of water conservations practices (with reference to the water demand) specifically the understanding that water is a diminishing or depleting commodity. The project involves the following tasks (i) design of a City-Level IEC Strategy and Advocacy Plan; (ii) develop, pre-test and produce IEC Materials (leaflets, brochures, Komiks, Peryodikit, video/ film documentaries) and Other Collaterals; (iii) implement the IEC Campaign and Publicity Program; (iv) monitor and evaluate the IEC Campaign and Publicity Program; and (v) develop and produce Knowledge Products on WDM.

Long-Term Institutional Development and Capacity Strengthening Interventions

- **Detailed Institutional Capacity Assessment of the ZCWSC Personnel involved in the Development and Implementation of Water Sector Development Project.** This program will be the end result of the policy research on institutional capacity strengthening of the ZCWSC. Salient recommendations of the aforementioned study will be integral in the conduct of a detailed assessment of the member-organizations of the ZCWSC, specifically identifying the efficiency and performance of the member-organizations vis-a-vis their effectiveness in implementing their respective roles and functions. The detailed assessment will not only enable to identify the institutional development constraints and challenges, but will also identify and recommend suitable interventions to strengthen the ZCWSC member-organizations and prepared for the upcoming implementation of the PWSSMP. This long-term institutional development and capacity strengthening is one of the salient features of the Zamboanga City Water Security Master Plan and aligned with the goals, strategies and activities prescribed in the PWSSMP.

- **Design, Develop and Implement Long-Term, Comprehensive and Sustainable Institutional Capacity Strengthening Program for the ZCWSC.** The ZCWSC needs to develop a capacity building and institutional strengthening concept paper and designate suitable international financing institutions (IFIs) to finance a technical assistance project on establishing a comprehensive and long-term institutional capacity strengthening program of the ZCWSC, specifically the member-organization primarily involved in the development, implementation and monitoring of water supply and sanitation projects. This initiative will be similar to the ADB-financed Philippines Water District Development Sector Project (WDDSP) which supports active local water districts in both engineering and non-engineering interventions. With an end-goal of attaining the water supply and sanitation subsector's targets through the development of strategies, formulation of policy reforms, and identification of priority programs and projects for implementation, the PWSSMP will be the reference point for several water supply and sanitation programs and projects (both infrastructure and institutional development components) that will be undertaken by the ZCWSC.

- **WATSEC Watch: Supporting the Zamboanga City and Regional Water Sector Partnership on Water Security**. Considered as one of the basic needs of every city and/or municipality, the perennial problem on inadequate water supply sources must be carefully addressed. However, there is also a need to establish a meaningful partnership among various organizations (e.g., city government, local government agencies/organizations, private sector organizations, business and trade industries, civil society organizations, non-government organizations, etc.) to forge an alliance through the establishment of a water sector partnership on water security. This project is envisioned to cultivate innovative ideas, strategies and approaches on addressing the prevailing issues, constraints and challenges in water security. In addition, this partnership will serve as a common ground to level-off and agree on potential ideas, programs and projects that will suitably address perennial problem of inadequate water

supply. The project will advocate stakeholder engagement and participation wherein representatives from various member organizations will be trained and capacitated to perform different roles in monitoring water supply and sanitation as well as water security issues, constraints and challenges.

- **Establishment of a Knowledge, Learning and Research Center for Water Security: Zamboanga City Water Audit Program Implementation for Sustainable Institutional Partnership (WAP-Pro).** This long-term program will be the end result of the Policy Research to Assess the Benefits of Establishing a National Knowledge, Learning and Research Center for Water Security. Salient recommendations of the aforementioned study will be integral in the establishment of a knowledge, learning and research center for water security. This capacity program will help to establish the institutional structure and policy framework as required under the legal basis for the future water security knowledge, learning and research center. This initiative is similar with the establishment of the Philippine Railway Institute (PRI) through the ADB-financed transactional Technical Assistance on Railway Project Implementation Support and Institutional Strengthening. The PRI is a rail transportation research and training center jointly established by the Philippine and Japanese governments. It is being supervised by the Department of Transportation (DOTr) and deals with research and development on the management, operation and maintenance of railways and training of personnel in the rail transportation industry. The results of this study will help to appropriately establish the institutional structure as required under the policy framework necessary to manage operation and sustain the required technical manpower involved in water security (water resources, WDM, water quality).

Proposed Stakeholders' Activities and Training Programs

To strengthen stakeholder engagement and participation, it is important to develop the capacity of the stakeholders to enable them to contribute meaningfully to the work preparation of the master plan. Capacity building should happen not only at the institution level but with the individual stakeholders as well. Building the capability of both institution and individual stakeholders ensures continuous stakeholder participation and engagement.

Capacity development can take three different aspects: (i) to increase and widen the knowledge about a theory, method, system, definition, and so on; (ii) to develop skills which include adoption of new knowledge into practice, technical skills and son on; and (iii) to change or improve stakeholders’ attitude and behavior. Capacity building may take the form of in-class training as well as workshops, webinars and in some instances, on-the-job-training.

Cognizant of the background of the principal stakeholder who are the member of the ZCWSC and considering their functions and roles the following training are highly recommended to enable them to effectively contribute towards the preparation of the Water Security Master Plan and eventually help oversee the implementation of the programs, projects and activities:

- Robust Decision Making - XLRM
- Sanitation and Septage Management and Reuse/Water Reclamation
- Water System Master Planning
- Integrated Water Resource Management
- Ecosystems Based Analysis/Assessment
- Results-Based Monitoring

- Emergency Response Planning
- Vulnerability Assessment in relation to Climate Change Adaptation
- Conflict Resolution and Management
- Basic Negotiation Skills

VI. Decision Support and Analysis

Ultimately, the water security plan will require a careful evaluation of the goals and objectives in a quantifiable and meaningful way. Through the stakeholder engagement process, a set of goals and objectives have been validated, but that require further elaboration such as new infrastructure options and management decisions. Examples of objectives that have been described by the stakeholders and augmented by the consulting team include:

- Meet regulatory requirements by promoting use of water efficient measures
- Delay implementation of additional capital intensive infra projects (Water Supply Options)
- Establish basis for creating additional supply in the future
- Mainstream water audit as one of ZCWD services
- Increase awareness
- Improve Demand Projection
- Ensure that the water supply is affordable and reductions in non-revenue water are achieved.
- Assure supply reliability to customers, with only a limited number of days per year of unmet demand.

While these objectives are useful, they currently lack specificity in terms of options and alternative. For example, the objective to “delay the implementation of additional capital investment” does not provide specific guidance as to when one would begin the planning and execution of a new infrastructure project; what are alternatives to those investments? What are the metrics that would be used to trigger that development process? What are the metrics to be used to establish new water supplies and how can metrics be used to help manage new portfolios of water supplies, and might various water supply options be used to strategically meet competing objectives (e.g. water supply reliability, environment conditions, recreational uses, etc.). The process of articulating the broad objectives and defining tangible performance metrics is at the heart of the water security planning and must be supported by modern decision support tools and analysis.

XLRM Framework

To help frame the elements required to achieve water security, assessment and management, elicitation using a framework known as “XLRM” is required. XLRM organizes the important elements of deeply uncertain decision analysis like climate change by grouping them into four different categories:

- Exogenous factors (X) are outside of the control of the water managers and are often uncertain or not completely understood (e.g., climate change and demographic growth).
- Policy levers (L) are actions taken by water managers to alter the outcomes.
- Relationships (R) describe how the factors interact with one another and govern the final output. The relationships in this case are represented by climate models, rainfall runoff

models, water resource systems models which are integrated into the WEAP software platform.

- Performance measures (M) are metrics that water managers use to determine the success of various strategies under different scenarios.

Risks are managed through available levers (L) to ensure successful outcomes as measured by performance metrics (M), subject to a wide range of uncertain future conditions (X). Decision science (or risk management) offers a number of approaches when considering the uncertainty inherent in climate change adaptation analysis.

The XLRM framework was introduced to the stakeholders from the perspective of the water supply systems during online meetings. The exogenous (External) factors (X) are assumptions about population and water demand growth, water quality, disasters, and climate change. The management options or (L) levers are to optimize existing resources (WDM, NRW, rainwater harvesting), increased capacity to supply additional water through the development of new water sources. The WEAP model (R) is used to explore these relationships, and the performance measures (M) are simply a way to determine if metrics have been met. Table 47 presents potential elements that could be used within the XLRM Framework.

Table 46: XLRM Framework

X External Factors	L Management Options	R Relationship	M Metrics
Climate-climate variability and droughts	WDM	WEAP model	Water Supply Reliability
Demand (population)	New Surface Water Supply		Water Rates
Water Quality Standards	Rainwater Harvesting		Water Quality-Meeting Regulations
Source Water Quality	Bulk Water Supply		NRW
Natural and Manmade Disasters	WTP Capacity		Customer Satisfaction
	Per Capita Demand		Credit Rating
	New Groundwater Wells		
	NRW Reduction		
	Public Private Partnerships		

WEAP Model

For this project, the WEAP decision support tool is used to explore the performance of the ZCWD water system in the context of the stated goals and objectives. WEAP is an integrated, scenario-based modelling tool that helps stakeholders manage water supply resources to meet often-competing demands from cities, industries, and farms, as well as consider long-neglected interests such as wildlife habitat and vulnerable communities. Through the stakeholder-driven input and knowledge, a WEAP model is being built that represents the regional water resources system that includes the ZCWD service area. WEAP is transparent and user-friendly – and it is able to distill the growing complexity of water systems into an understandable format. Users can see current conditions and then explore future scenarios to identify options for balancing environment and development concerns amid climate uncertainty.

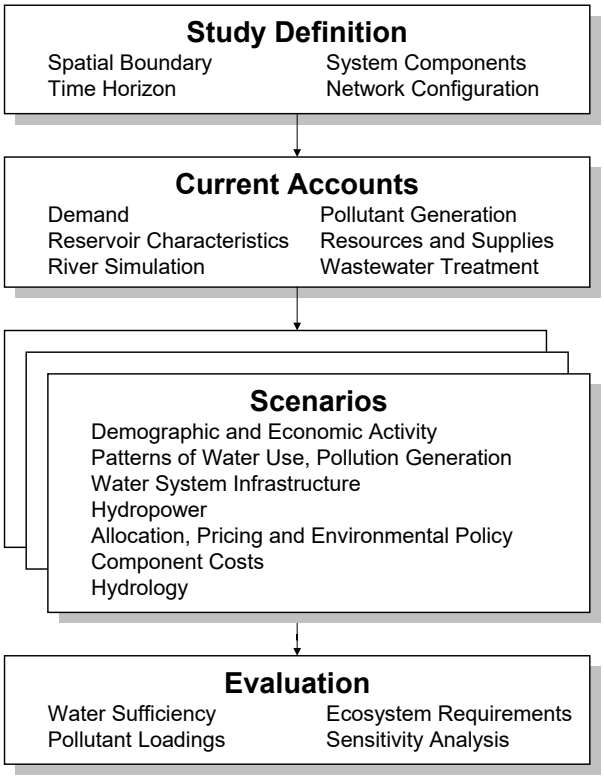


Figure 47: WEAP Application Development Flow Chart

The development of a typical WEAP application generally includes several steps, which are presented graphically in Figure 47. The study definition sets up the time frame, spatial boundary, system components and configuration of the problem. The current accounts provide a snapshot of actual water demand, pollution loads, resources and supplies for the system. Alternative sets of future assumptions are based on policies, costs and factors that affect demand, pollution, supply and hydrology. Scenarios are constructed consisting of alternative sets of assumptions or policies. Finally, the scenarios are evaluated with regard to water sufficiency, costs and benefits, compatibility with environmental targets, and sensitivity to uncertainty in key variables.

In Figure 47, the Current Accounts year serves as the base year for the model. Scenarios explore possible changes to the system up to a specified time after the Current Accounts year. The ability to carry out scenario analysis is central to WEAP. Scenarios are used to explore the implications of a wide range of future conditions and uncertainly, represented by questions that may confront a water manager, such as:

- What if new flow requirements are imposed?
- What if ecosystem requirements are tightened?
- What if land use changes within the system?
- What if climate change alters demand and supplies?

WEAP contains a series of built-in scenario management tools that allow the user to easily construct completely new scenarios or make minor modifications that tier off a parent scenario. These capabilities will be used to explore the objectives and goals based on a set of options and alternatives. The Project Team has developed a climatically driven WEAP model of the ZCWD

service area that will be used to explore the water resource management alternatives and formulate decisions contained within the Water Security Master Plan.

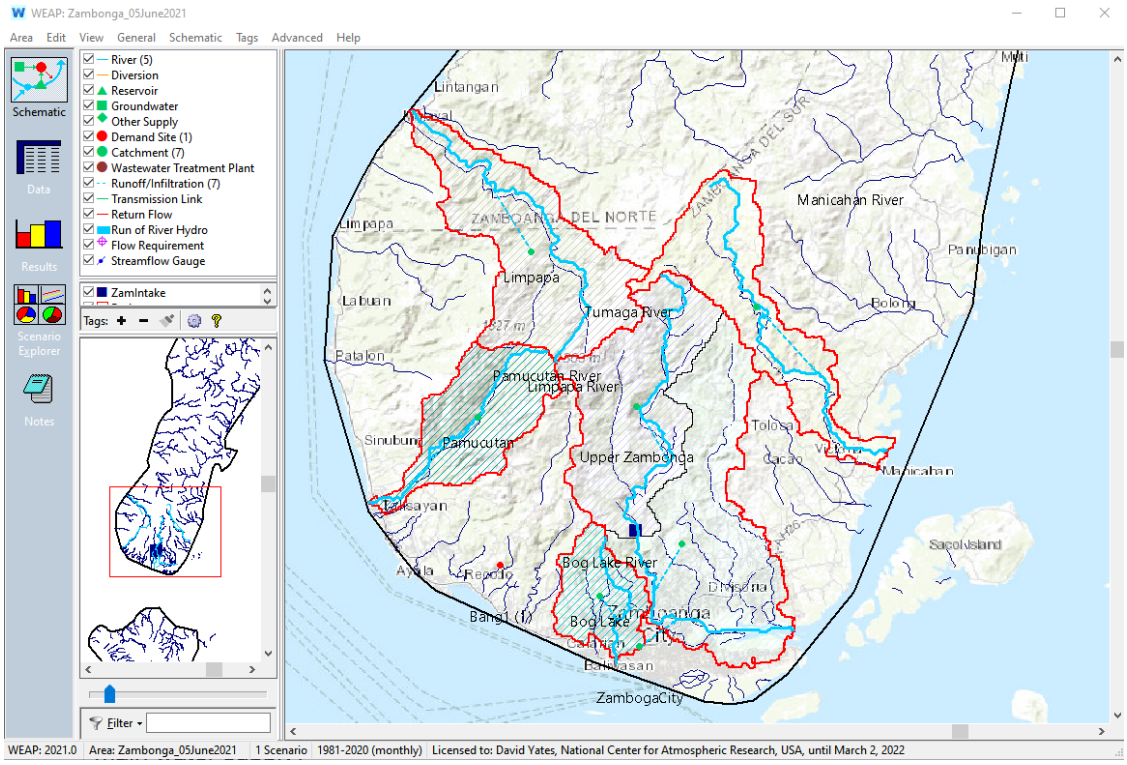


Figure 48: Initial screen shot of the WEAP ZCWD application domain, showing initial watershed boundaries, major river networks, and the Zamboanga service region

Study Definition

Evaluating the implications of managing diversions and impoundments along a river requires the consideration of the entire land area that contributes to the flow within the river – the river basin. Within WEAP it is necessary to set the spatial scope of the analysis by defining the boundaries of the river basin. Within these boundaries there are smaller rivers and streams (or tributaries) that flow into the main river of interest. Because these tributaries determine the distribution of water throughout the whole basin, it is also necessary to divide the study area into sub-basins such that we can characterize this spatial variability of river flows.

Current Accounts

The Current Accounts scenario represents the basic definition of the water system as it currently exists. Establishing current accounts requires the user to "calibrate or verify" the system data and assumptions to a point that accurately reflects the observed operation of the system. The current accounts include the specification of supply and demand data (including definitions of reservoirs, pipelines, treatment plants, pollution generation, etc.). This verification process also includes setting the parameters for WEAP's rainfall-runoff module such that WEAP can use climatic data (i.e. temperature and precipitation) to estimate water supply (i.e. river flows, aquifer recharge) and demand (evaporative water demand) in the delineated basins.

Scenarios

At the heart of WEAP is the concept of scenario analysis. Scenarios are self-consistent storylines of how a future system might evolve over time. The scenarios can address a broad range of "what if" questions. This allows evaluation of the implications of unintended changes in the system and then how these changes may be mitigated by policy and/or technical interventions. For example, WEAP may be used to evaluate the water supply and demand impacts of a range of future changes in demography, land use, and climate. The result of these analyses guide the development of response packages, which are combinations of management and/or infrastructural changes that enhance the productivity of the system. Scenarios are selectively activated in using the Manage Scenarios tool found in the Data View.

Evaluation

Once the performance of a set of response packages has been simulated within the context of future scenarios, the packages can be compared relative to key metrics. Often these relate to water supply reliability, water allocation equity, ecosystem sustainability, and cost, but any number of performance metrics and be defined and quantified within WEAP.

Water Allocation

Two user-defined priority systems are used to determine allocations of water supplies to demands (i.e., urban and agricultural), for instream flow requirements, and for filling reservoirs – demand priorities and supply preferences. Demand priorities are used to allocate water to competing demand sites and catchments, flow requirements, and reservoir storages. The demand priority is attached to the demand site, catchment, reservoir, or flow requirement and range from 1 to 99, with 1 being the highest priority and 99 the lowest. Many demand sites can share the same priority, which is useful in representing a system of water rights, where water users are defined by their water usage and/or seniority. In cases of water shortage, higher priority users are satisfied as fully as possible before lower priority users are considered. If priorities are the same, shortage will be shared equally (as a percentage of their demands).

When demands sites or catchments are connected to more than one supply source, the order of withdrawal is determined by supply preferences. Similar to demand priorities, supply preferences are assigned a value between 1 and 99, with lower numbers indicating preferred water sources. The assignment of these preferences usually reflects some economic, environmental, historic, legal and/or political realities. In general, multiple water sources are present when the preferred water source is insufficient to satisfy all of an area's water demands. WEAP treats the additional sources as supplemental supplies and will draw from these sources only after it encounters a capacity constraint (expressed as either a maximum flow volume or a maximum percent of the demand) associated with the preferred water source.

WEAP's allocation routine uses demand priorities and supply preferences to balance water supplies and demands. To do this, WEAP must assess the available water supplies at any given timestep. While total supplies may be sufficient to meet all the demands within the system, it is often the case that operational considerations prevent the release of water to do so. These regulations are usually intended to hold water back in times of shortage so that delivery reliability is maximized for the highest priority water users (often urban indoor demands). WEAP can represent this controlled release of stored water using its built-in reservoir object.

Hydrology

The hydrology module in WEAP is spatially continuous, with a study area configured as a contiguous set of sub-catchments that cover the entire extent of the river basin in question. This continuous representation of the river basin is overlaid with a water management network topology of rivers, canals, reservoirs, demand centers, aquifers, and other features (see Yates et al. 2005a and Yates et al. 2005b for details). Each sub-catchment (SC) is fractionally subdivided into a unique set of independent land use/land cover classes that lack detail regarding their exact location within the SC, but which sum to 100 percent of the SC's area. A unique climate-forcing data set of precipitation, temperature, relative humidity, and wind speed is uniformly prescribed across each sub-catchment.

A one-dimensional, quasi-physical water balance model depicts the hydrologic response of each fractional area within an SC and partitions water into surface runoff, infiltration, evapotranspiration, interflow, percolation, and baseflow components. Values from each fractional area within the SC are then summed to represent the lumped hydrologic response, with the surface runoff, interflow and baseflow being linked to a river element; deep percolation being linked to a groundwater element where prescribed; and evapotranspiration being lost from the system. Where stream-aquifer interactions are significant, the two-store water balance representation within select SCs can be reformulated by recasting the lower store as a simplified groundwater element that has hydraulic connection to associated river reaches. The hydrology module also includes a snow accumulation/melt routine based on the use of an index temperature approach.

At each time step, WEAP first computes the hydrologic flux, which it passes to each river and groundwater object. The water allocation is then made for the given time step, where constraints related to the characteristics of reservoirs and the distribution network, environmental regulations, and the priorities and preferences assigned to points of demands are used to condition a linear programming optimization routine that maximizes the demand "satisfaction" to the greatest extent possible (see Yates et al. 2005a for details). All flows are assumed to occur instantaneously; thus a demand site can withdraw water from the river, consume some, and optionally return the remainder to a receiving water body in the same time step. As constrained by the network topology, the model can also allocate water to meet any specific demand in the system, without regard to travel time. Thus, the model time step should be at least as long as the residence time of the study area.

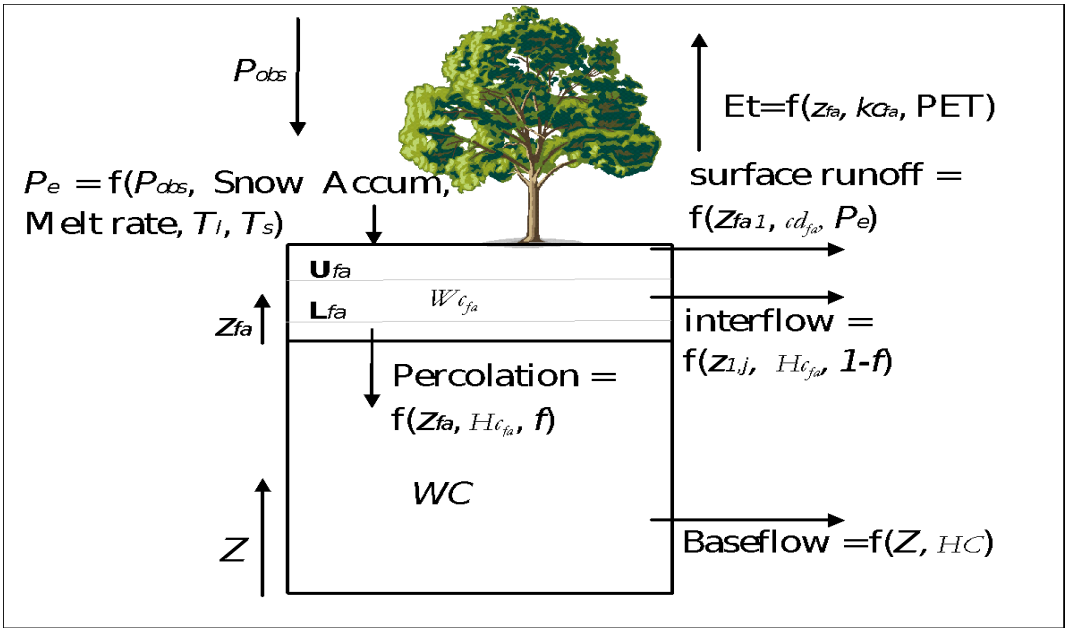


Figure 49: Screen. Diagram of the two-layer WEAP hydrology model (Yates, et. al., 2005a)

Climate Data

Daily time series of meteorological data, including precipitation, temperature, relative humidity and windspeed are used to drive the hydrologic model that is implemented within each of WEAP's catchment objects. Each catchment object is further sub-divided into 500-meter elevations bands that help characterize the spatial distribution of climate across the watershed. The project team acquired from the PAGASA daily climate data for the Zamboanga City station.

This study made use of two publicly available, gridded global datasets of the key meteorological variables that the WEAP model can make use of. The first dataset is the Climate Hazards Group InfraRed Precipitation with Station data (CHIRPS) is a 35+ year quasi-global rainfall data set. Spanning 50°S-50°N (and all longitudes) and ranging from 1981 to near-present, CHIRPS incorporates a climatology, CHPclim[70], 0.05° (~5km) resolution satellite imagery, and in-situ station data to create gridded rainfall time series that can be used for hydrologic simulation and seasonal drought monitoring. The CHIRPS dataset only provides daily rainfall, and so a second global, gridded, daily dataset was acquired and implemented- the Princeton[71] dataset, which provides daily precipitation, temperature, and windspeed on a 0.25° grid (~25 km). This dataset blends reanalysis data with observations and disaggregates in time and space, providing daily data for 1948-2016. With these data, the WEAP model can simulate the hydrologic conditions across the Zamboanga region.

[70] The Climate Hazards Center's Precipitation Climatology version 1 (CHPclim v.1.0,) is a geospatial modeling approach based on moving window regressions and inverse distance weighting interpolation. This approach combines satellite fields, gridded physiographic indicators, and in situ climate normals. The resulting global 0.05◦ 25 monthly precipitation climatology is shown to compare favorably with similar global climatology products, especially in areas with complex terrain and low station densities.

[71] A global 50-yr (1948-2016) dataset of meteorological forcings derived by combining reanalysis with observations. Available at 0.25-degree spatial resolution and 3-hourly, daily and monthly temporal resolution. Sheffield, J., G. Goteti, and E. F. Wood, 2006: Development of a 50-yr high-resolution global dataset of meteorological forcings for land surface modeling, J. Climate, 19 (13), 3088-3111

The mean annual precipitation of the PAGASA Zamboanga weather station suggests an annual average precipitation of 1200 mm, with a minimum of 677 mm in the El Niño year of 1997 and a maximum of 2100 mm in 1999. The annual average temperature is 27°C, with an apparently strong warming trend through the 1950 to 2014 period of record.

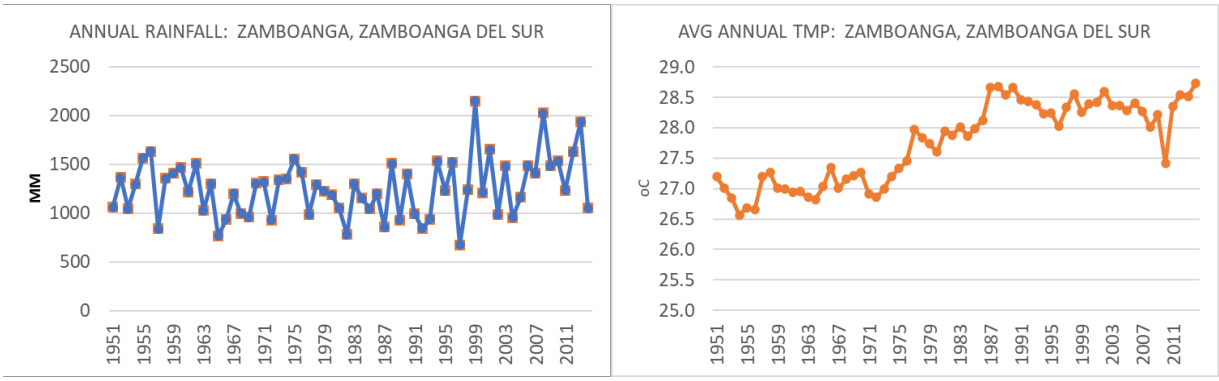


Figure 50: Annual rainfall measured at Zamboanga City Del Sur Surface (left) and annual average temperature (right)

Since we make use of the CHIRPS precipitation product, we compared its estimate of rainfall with the PAGASA Zamboanga station data. Generally, after bias correction where the CHIRPS daily rainfall was uniformly scaled by a factor of 0.85, the annual rainfalls compare favorably between CHIRPS and the Zamboanga Del Sur station for the period 1981 to 2019, with the CHIRS data extended through 2019 is the daily average of these two series and shows that the PAGASA station shows greater day-to-day variability in terms of the minimum and maximum daily rainfall, thus suggesting that the CHIRPS data has less intense rainfall than what is observed (the locally observed rainfall has higher highs, and lower-lows when compared with the CHRIPS daily rainfall for the concurrent location).

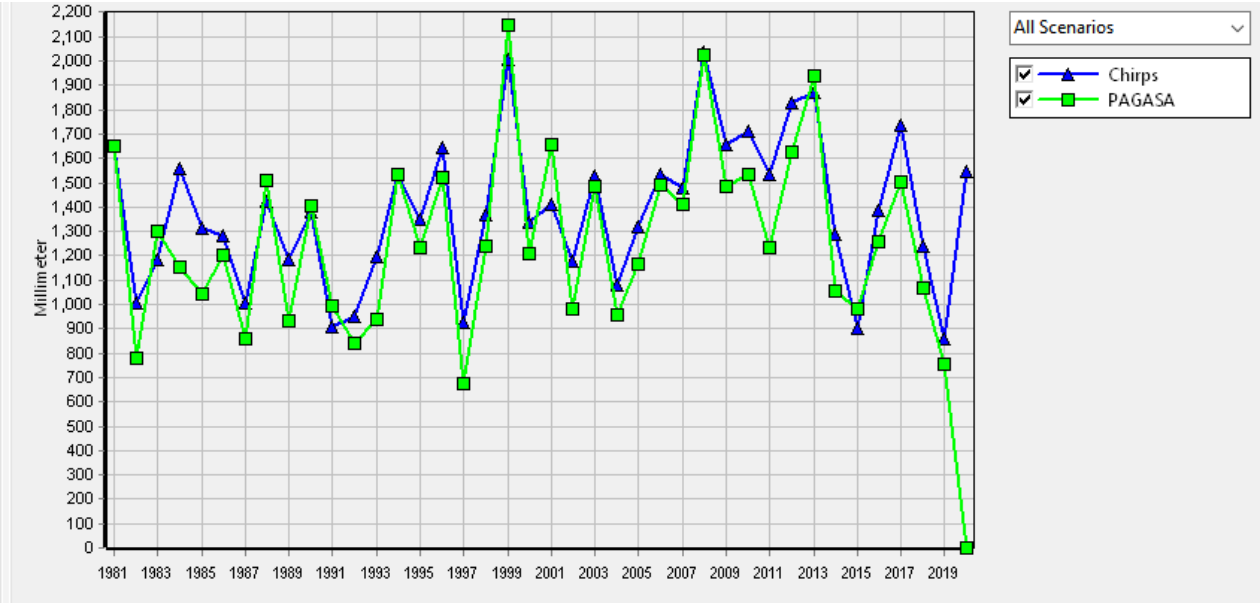


Figure 51: Total annual rainfall (mm) at Zamboanga City Del Sur for the PAGASA station (green) and the CHIRPS (blue) remotely sensed rainfall estimate[72]

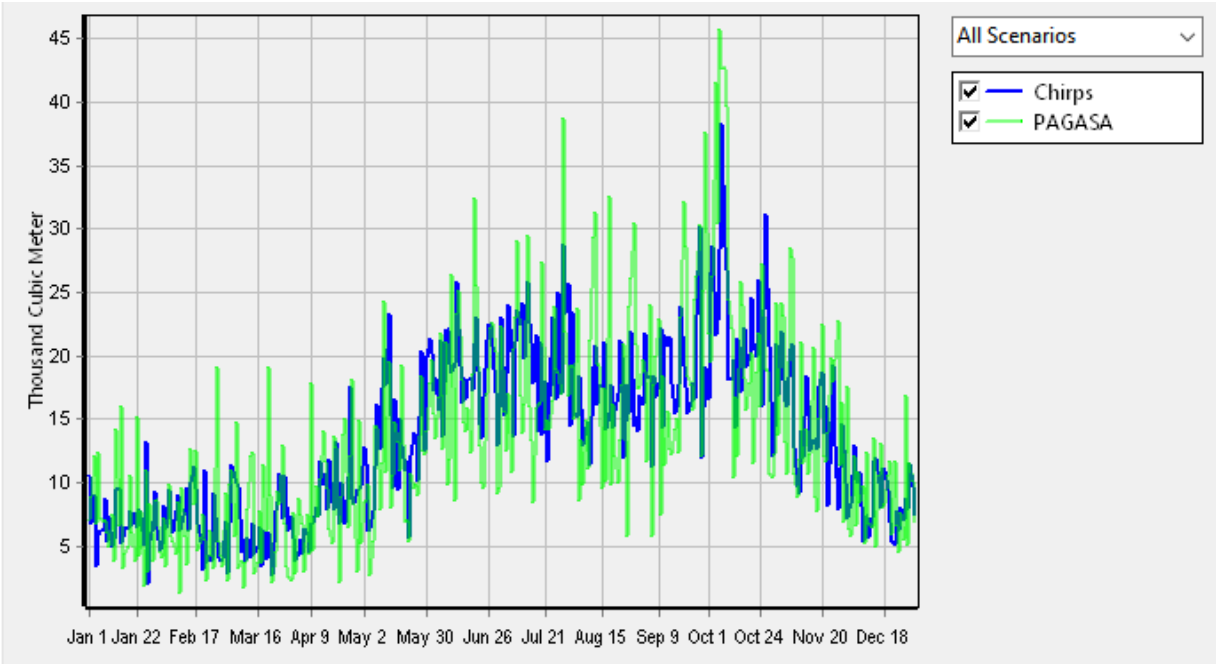


Figure 52: Comparison of daily average rainfall for the Zamboanga Del Sur location from the PAGASA observational dataset (green) and the CHIRPS remotely sensed product (blue)

[72] Note that the PAGASA data were only available through 2014, thus demonstrating the added value of the remotely sensed product that extends the historical record through the current period. Note that strong decrease in rainfall as observed at the Del Sur station and estimated by CHIRPS for the strong El Nino years of 1997, 2015, and 2019.

Overview of the ZCWD-WEAP Model

This section describes and documents the inputs and assumptions regarding the ZCWD-WEAP model. It details the representation of system components within the model and how WEAP controls the execution of these model objects. Through a sequence of screen captures and narratives, the model is documented to allow the ability to modify, update, and run the model; and analyze its results. The document provides an explanation of the attributes and assumptions made for each ZCWD-WEAP data object. Figure 53 is a screen capture of the ZCWD-WEAP model for the critically important central region of the ZCWD service area.

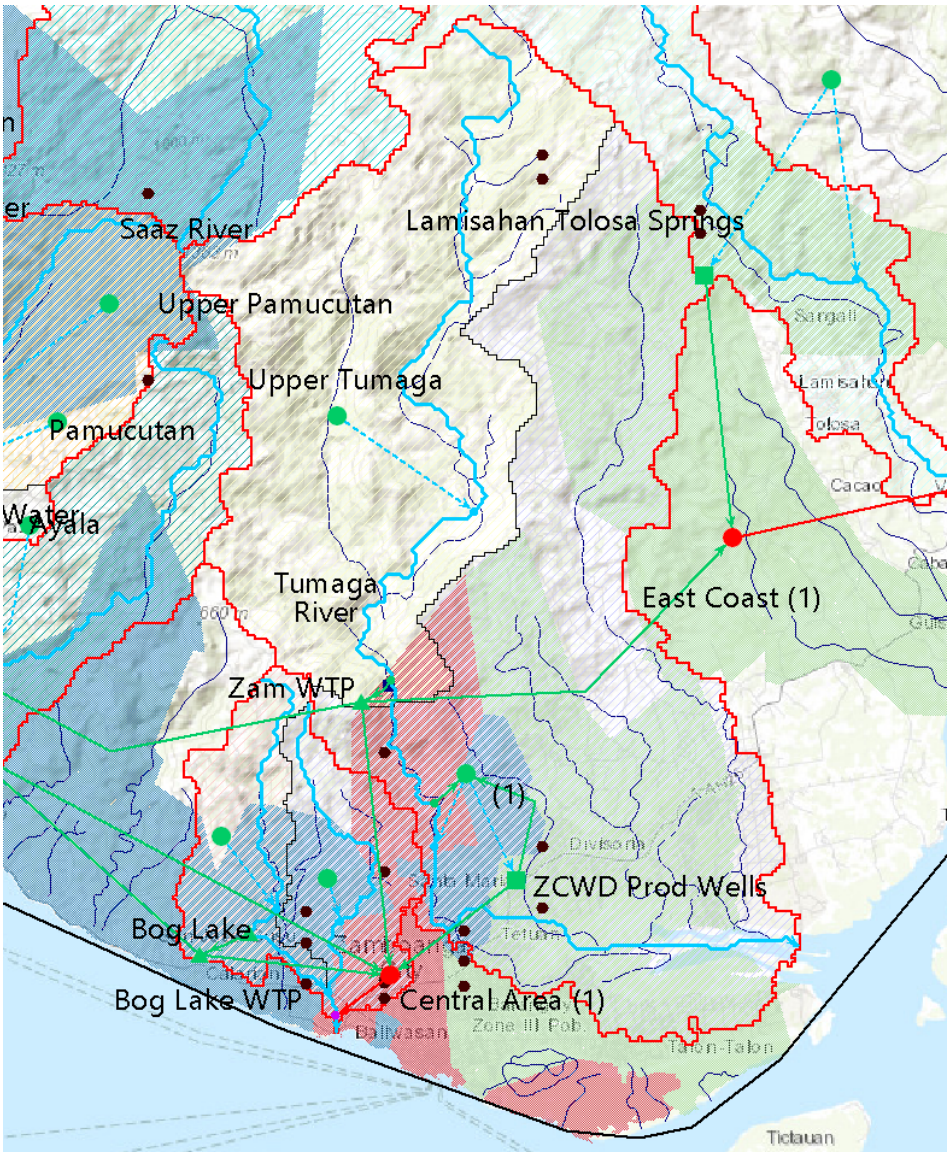


Figure 53: Screen shot of the portion of the ZCWD-WEAP model showing the main demand area of Zamboanga City (Central Area), and the watershed and supply infrastructure of the Tumaga River. The colored polygons represent the Barangays that are part of the ZCWD service area

As a water resource management model, WEAP solves the basic supply-demand allocation problem, the distribution of a water supply to a set of demands based on a prescribed set of rules. A WEAP model can represent supplies in a number of different ways. For example, water supply can be defined by historic observations of streamflow, reservoir storage and operations, and groundwater availability. Alternatively, WEAP can make use of climate data to derive available supply through a conceptual representation of the hydrologic cycle, including rainfall-runoff, streamflow, groundwater-surface water interactions, and groundwater storage. There is an advantage in the later approach, especially when studying the potential impacts of climate change on a water system, as a climatically driven WEAP model tracks water from source-to-sink, providing water budget closure. The water supply in the ZCWD-WEAP model makes use of WEAP's internal rainfall-runoff calculation, with the model driven by meteorological data on a daily time step.

The existing and future ZCWD infrastructure objects are entered into the WEAP modeling environment via WEAP's schematic model building tools, where linkages between the natural watershed (catchments, rivers, and groundwater) are made to the water management system (diversions, reservoirs, transmissions, and demands) are defined. The green circles with attending dashed lines represent catchments and their connection to a given river (e.g., the Tumaga River, the Manicahan River, and others) and is where depictions of land use and climate are made. Each catchment area is associated with a watershed boundary bounded area depicted in Figure 54 by the red and black polygon segments. The green, solid line returning to the catchment from a diversion indicates that the catchment has irrigation requirements. The red circle objects are where the municipal water demand data are entered for each Barangay, which are then aggregated to the regional level (e.g., West, Central, and Eastern demand centers). The transmission links to each demand center represents ZCWD's water supply and treatment capacity, which is defined along the transmission link from each water source (surface water, groundwater, or spring). The red dot demand objects are used to calculate demand based on population, per-capita use, and sectoral water use by activity at the Barangay level.

The green square (ZCWD Production Wells) represents a groundwater object, with dashed lines from catchments indicating their hydrologic connection to the groundwater object. A solid line originating from a groundwater object to a catchment or demand site indicates the groundwater is a source of supply for that demand. The individual numbers along a supply source or at a demand site indicate the supply preference or demand priority, respectively, which are used by WEAP's allocation logic to apportion water. The green triangles represent reservoirs or water treatment storage

Study Area and Temporal Representation

In the ZCWD-WEAP application, the adopted time-step is daily and the historic period of simulation is 1981 through 2020, for the future period simulation, the analysis time window can extend to 2099. While the spatial domain and time step have already been set, if the analyst wants to set a new period of analysis, he or she should choose the *General*, *Years and Time Steps* menu to set a new time horizon. Do not change the number of *Time Steps per Year*, which should be set to 365 (daily). The simulation is based on a calendar month and assumes a water year that same as the calendar year so begins on January 1st. We recommend that this not be changed.

ZCWD-WEAP Key Assumptions

In WEAP, the Key Assumptions are place within a WEAP model that contains data that are unique to the study area of interest. There are three broad groupings of Key Assumptions in the ZCWD-WEAP model, including *Water Use*; *Hydro*logic *Parame*ters; and Scenarios. The Water Use parameters include per-capita water use (lpcd); commercial, industrial, semi commercial, institutional, and ZCWD Facility water use in m^3/day. The *Consumption* parameters is the percent loss of water that is delivered but does not return to a treatment plant or discharge. The Hydrologic Parameters include those coefficients specific to the two-layer soil moisture model that is summarized in Figure 54. These include the variables at the land-use and sub-catchment level: Root Zone Conductivity (*RZC*, in mm/day); Runoff Resistance Factor (RRF, >= 0); Crop Coefficient (KC); and Soil Water Capacity (SWC, in mm). The Hydrologic Parameters at the Catchment Level include the Deep-Water Capacity (*DWCap*, mm); the Deep-Water Conductivity (*DWCond*, mm/day); the initial deep soil water capacity fraction (*Z2*, 0 <= *Z2* <- 1.0); and the Preferred Flow Direction (*PFD*, 0.0 for completely vertical discharge and 1.0 for completely horizontal discharge). The Precipitation Bias Correction (*PBC*) is a scalar parameter that uniformly applies to the CHIRPS precipitation data to scale the rainfall to match the PAGASA Zamboanga Del Sur station observations more closely and is currently set at a value of 0.85, implying that the CHIRPS rainfall estimates are about 15 percent greater than the local observations of PAGASA.

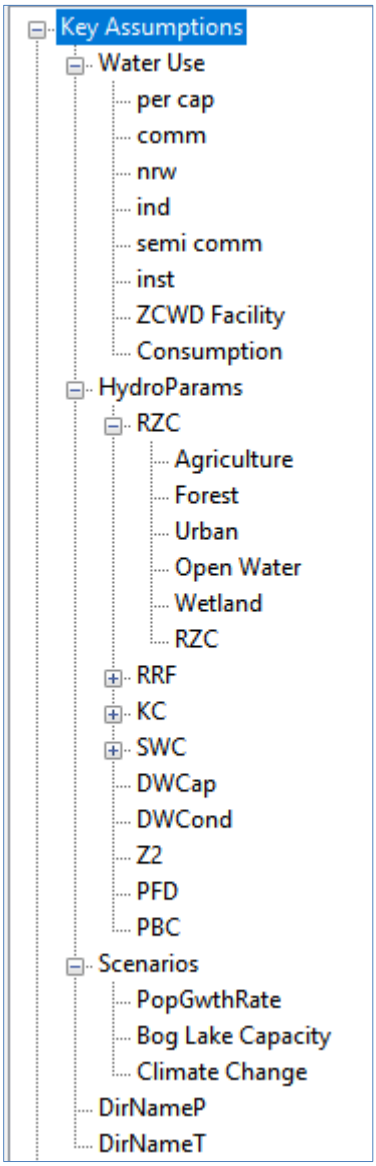


Figure 54: WEAP Hydrologic Parameters

ZCWD-WEAP Model Objects

The collection of catchment objects represents the water supply source and/or water demand in the case of a catchment objects that include irrigation. Catchment objects generate the routed streamflow that can be managed, or which leaves the modeled domain. At each time step, WEAP calculates a water mass balance for every node and link in the system, and water is dispatched to meet instream and consumptive requirements, subject to demand priorities, supply preferences and other constraints.

Catchment, River, and Groundwater Objects

The ZCWD-WEAP model divides the study domain into a set of ten catchment objects that contribute flow discharge to eight rivers, including the critically important Tumaga that drains to the South Coast and is currently the key water supply of the ZCWD; the Manicahan River to the east, which is being explored as a water supply alternative, and several other coastal rivers that serve as water supply sources, such as the Pamucutan River. The Pamucutan River is currently being used as a bulk water supply source as part of the Prime Water agreement. The model includes a groundwater basin in the southern coastal region that is hydrologically connected to the Tumaga River and serves as a set of deep production wells for the ZCWD. Each catchment object is divided into elevation and land use basins as is shown for the Upper Tumaga catchments which are the main water source to the ZCWD diversion point on the Tumaga River.

Table 47: Example of the sub-division of the Upper Tumaga catchment according to elevation band and land use

Elevation Band	Land Use	Area (ha)
Elevation 0 to 500 m	Agriculture	114
Elevation 0 to 500 m	Forest	3,331
Elevation 500 to 1000 m	Agriculture	15
Elevation 500 to 1000 m	Forest	4,856
Elevation 1000 to 1500 m	Forest	539
Elevation 1000 to 1500 m	Wetland	3

Figure 55 is a screen capture of a catchment object's data entry and shows the range of various variables and attributes that are necessary for the model, such as contributing area, climate, hydraulic conductivity and others. The blue line in the figure is the daily precipitation for the Current Accounts year of 1981.

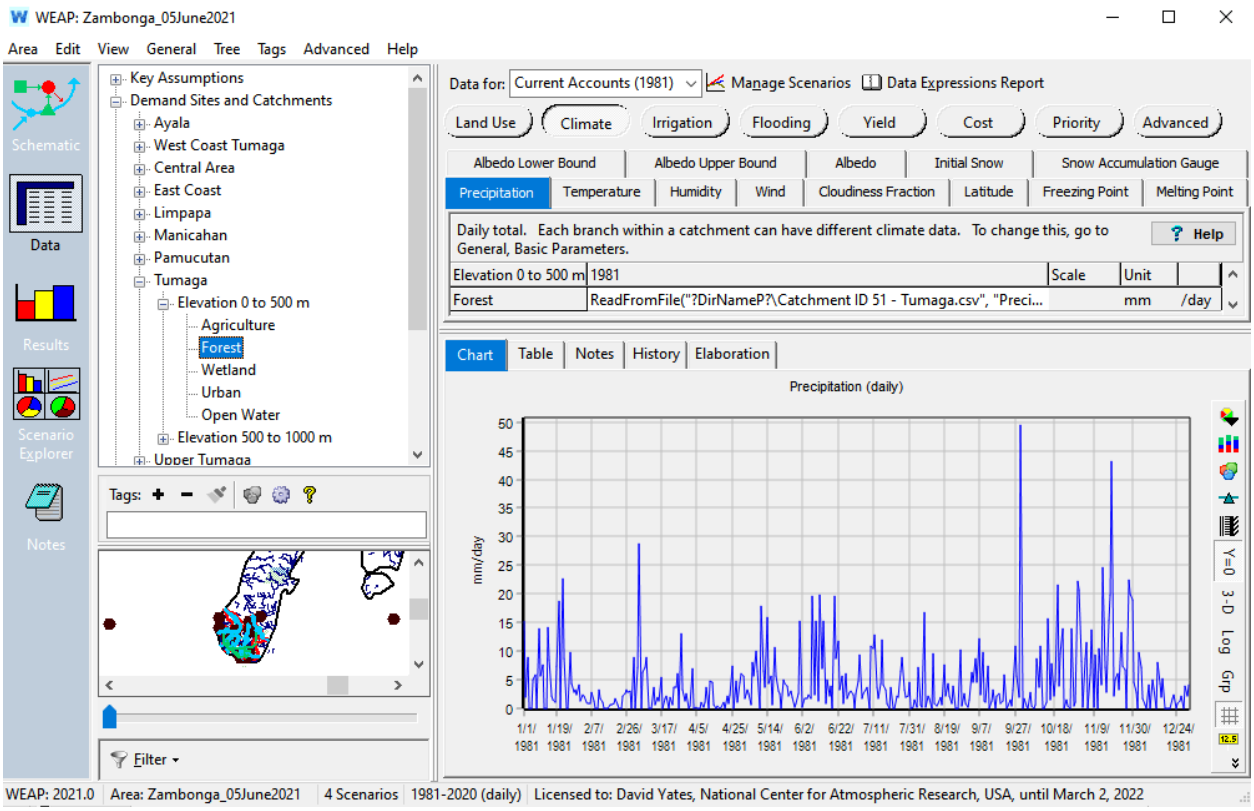


Figure 55: The Tumaga Catchment object selected from the WEAP data tree, with the Forecast Land class selected for the 0 to 500 meter elevation band

The ZCWD-WEAP model was run for the period 1981 to 2020 using a blend of the CHIRPS Data for precipitation and the Princeton Data for daily average temperature and windspeed. It was assumed that relative humidity is a constant across the domain at 75 percent. The ZCWD-WEAP model was used to simulate the streamflow for the region for this historic period, with an estimated annual flow of the Tumaga River of about 90 MM3. Figure 56 and Table 49 summarize the annual

discharge for the simulated flows for the three primary river for which the ZCWD currently receives its water supply, including the Manicahan River (blue), the Pamucutan River which is the Prime Water supply (red); and the Tumaga River (green), which is the majority water supply for the ZCWD. The Tumaga average annual flow was 84 MM3, which is slightly less than the historically observed estimate of 90 MM3. The flows the Pamucutan and Manicahan are roughly 50 percent and 60 percent of the flows of the Manicahan River on average.

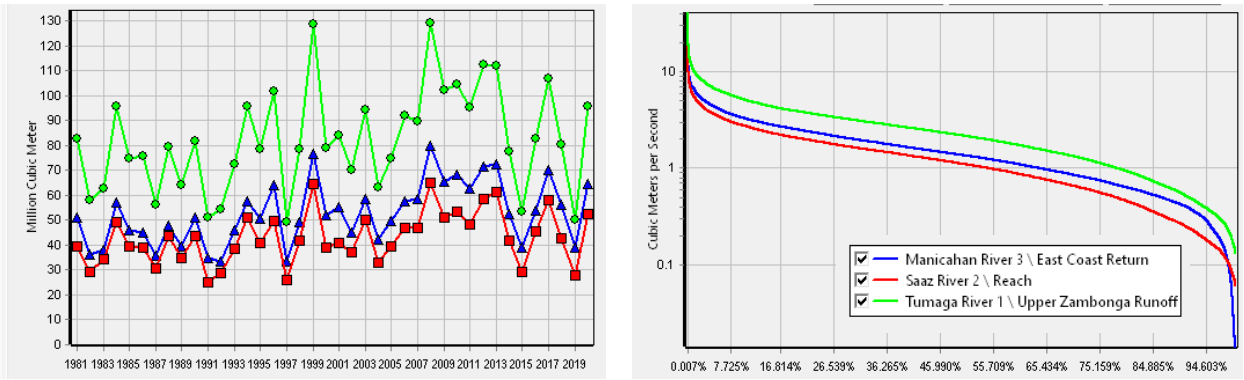


Figure 56: Simulated annual flows for key points in the ZCWD water service region as annual totals for the period 1981 through 2020 (left) and daily flows plotted as a frequency distribution on log scale for the same location. Annual avg. daily flows are 1.67, 1.36 and 2.61 cms.

Table 48: Summary of annual simulated flows for key points on in the ZCWD water service region, showing minimum, maximum, mean, median, standard deviation of the simulated flows

River (annual in MM3)	Min	Max	Mean	Median	SD
Manicahan River	35.2	84.2	55.4	54.3	13.0
Saaz River	26.7	67.6	45.0	43.7	10.7
Tumaga River	52.6	135.6	86.9	84.3	21.4

ZCWD Infrastructure Objects (Supply and Demand)

The ZCWD-WEAP model acquired and implemented the activity-based demand model as is represented in the ZCWD demand worksheet [73]. This worksheet provided data at the Barangay level for 5 categories of demand, including domestic on a per-capita basis for the estimated population per Barangay; and commercial, industrial, institutional, semi-commercial, and other ZCWD District level demand on a water use per cubic meter for the number of accounts or activities also within each Barangay. These data sets were entered per Barangay, then aggregated according to their one of the three zonal delivery regions, including west, central, and east (see Figure 57). Data for each Barangay are entered into the WEAP model, but because there are entered as “children” to the regional “parent”, WEAP makes it easy to summarize the results at the regional level, and not be burdened by the details at the Barangay level. This is

[73] Demand data was retrieved from the provided worksheet: PNWDP_Zamboanga City_constrained PSA with new NRW.xlsx

equivalent to a “Pivot Table” in Microsoft Excel. An example entry of demand data at the Barangay level is shown in Figure 58 for the Baliwasan, which is in the Central ZCWD Service Area.

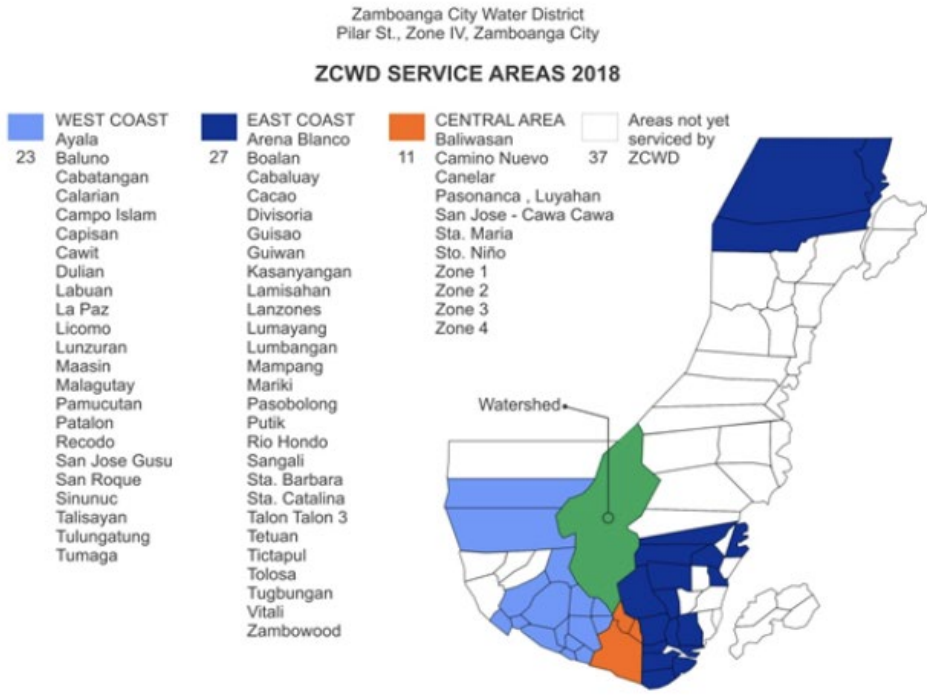


Figure 57: Summary of the Barangay and the service zones for each region

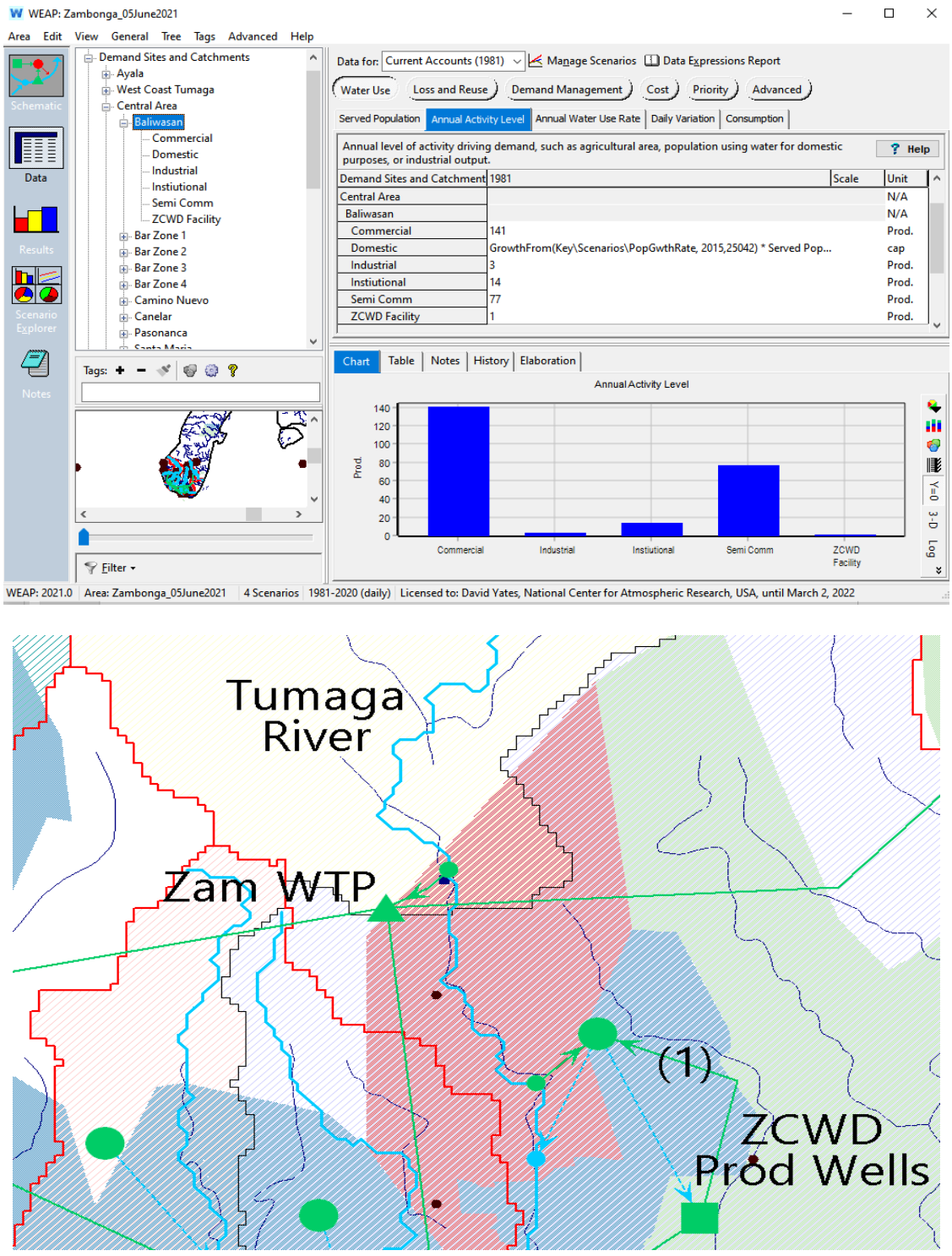


Figure 58: Demand object data entry for Barangay Baliwasan in the Central Area

The water supply system in the ZCWD-WEAP model includes the primary water supplies of the Tumaga River, which is represented as a diversion object which is constrained by the capacity of the water treatment plant. The diversion includes small amount of storage to smooth out day-to-day variability, with the estimate of that storage at 38 m^3. The green lines that extend from the Zamboanga Water Treatment Plant represent the transmission lines to the three demand centers (Eastern, Central, and Western), and it is assumed that this water source is a primary supply.

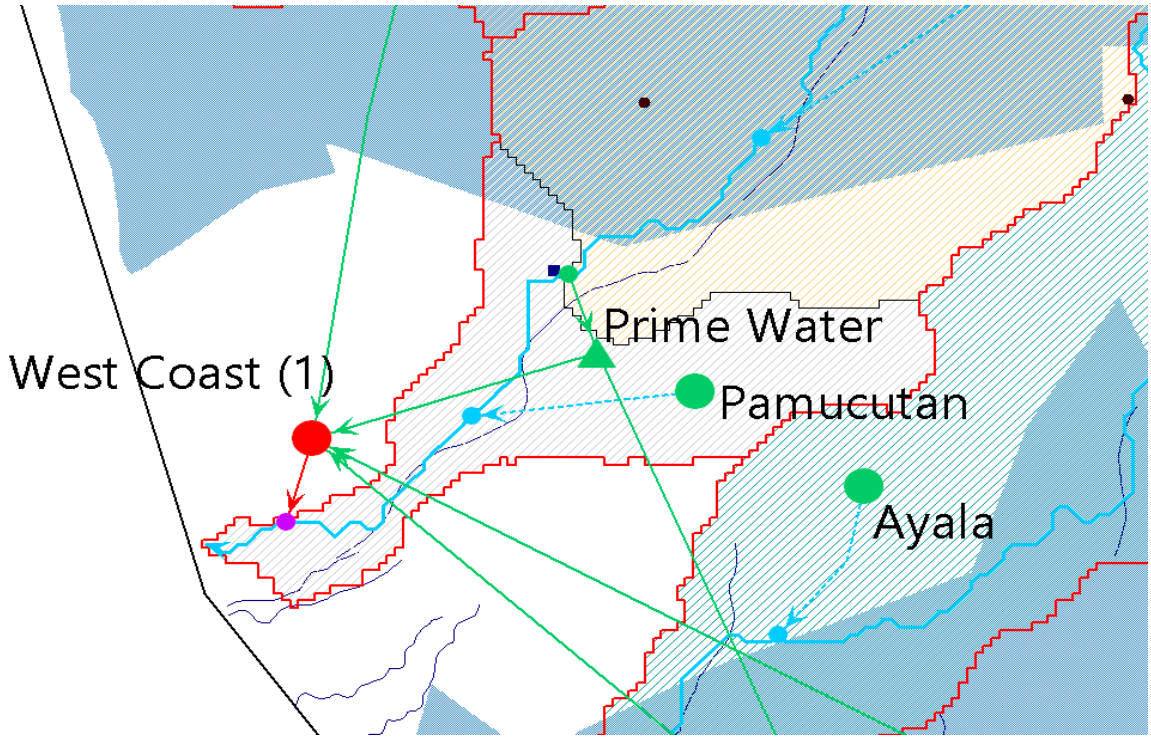


Figure 59: Location of the Diversion on the River

The Prime Water supply originates from the Pamucutan River, which lies a few kilometers away from the center of the city. Figure 59 shows the location of the diversion on the river, with a WEAP reservoir object used to represent the site storage, which is estimated to be 50,000 m^3. Its transmission links can supply water to the West Coast and Central Area Barangay users.

ZCWD-WEAP Model Example Output

The recent, historic record of water supply delivery to the ZCWD shows that the dominant source is surface water supplied by the Tumaga River. Even in 2016, a El Niño year where one would expect surface water shortage, it makes up a larger share of the total, since 2017, the share of the bulk water supply has increased as shown in Figure 60 but is limited due to the source water limitations of the facility.

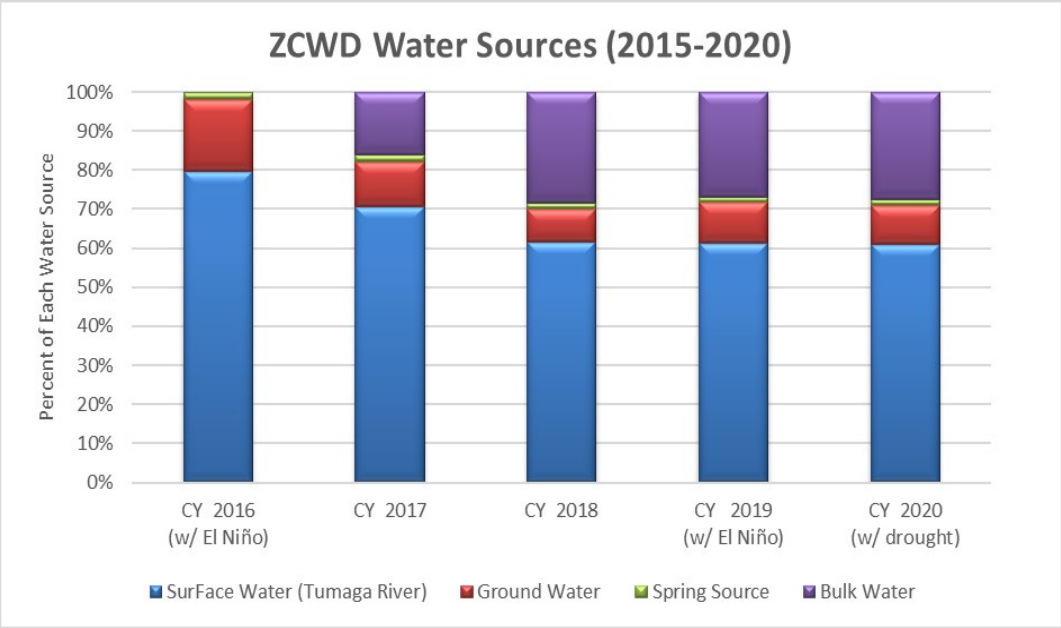


Figure 60: Historic portion of water supplied by the various sources for recent years

Shows the ZCWD simulated supply delivered by source for the period 1981 to 2020. Note that the Prime Water contribution does not begin until 2017, as that is the year the source becomes active. The number of times where water was not fully delivered on a given day was counted, and over the 40-year period (or about 14,600 days), the Central Area was short on three percent of the days, while the Western and Eastern regions were short on about eight percent of the days. This also shows the assumption that the primary supply in the Tumaga River and the Prime Water source is not always a substantial share of the water supply, as it is given a lower priority as compared to the Tumaga River and the groundwater production wells.

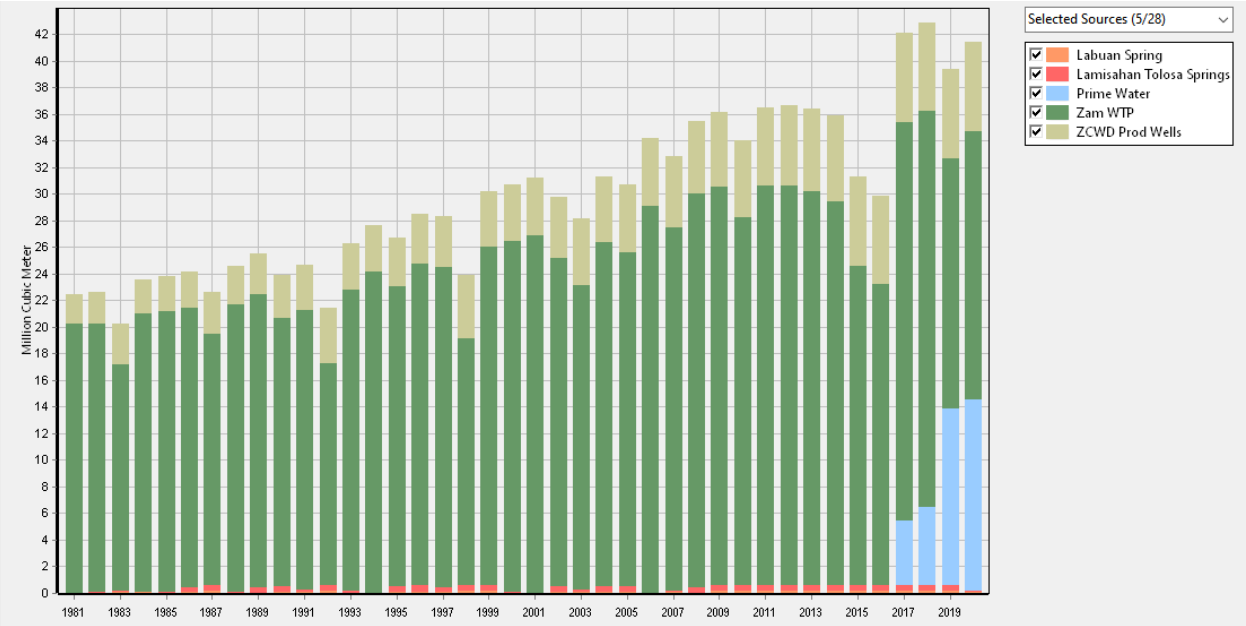


Figure 61: Supply delivered by source, includes NRW. Shortage of delivery implies reduction in water service

VII. Water Security Options and Alternatives

Water Security Options

This section describes the options that are being utilized within the ZCWD-WEAP model. Options are defined as projects or programs that essentially increase water supply, these include new water sources, expansion of existing sources, reduction in lost water (NRW) or water saving programs.

Bog Lake

Bog Lake has a surface area of 82.3 ha located in the middle of a populated area in the western area of Zamboanga City. The San Roque Bog Lake Recreation Park is a destination for nature lovers, thrill seekers, adventurers, and the park offers many activities and amenities. Due to the favorable location near Zamboanga City, the potential use of Bog Lake as a water supply source is considered an option in the WEAP model.

The Bog Lake supply is assumed to originate from a small, coastal watershed that extends northward as shown in Figure 63. The contributing area of the basin is about 1,500 ha including agriculture, forest and urban land covers that are summarized in Table 50.

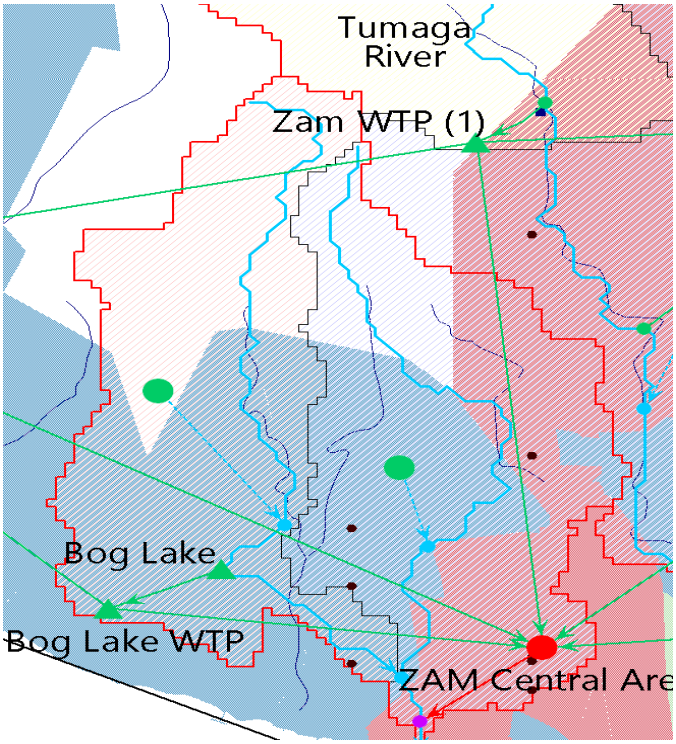


Figure 62: Bog Lake WEAP Model

Table 49: Land use and area for the watershed connected to Bog Lake

Elevation Band	Land Use	Area (ha)
Elevation 0 to 500 m	Agriculture	1,142
Elevation 0 to 500 m	Forest	99
Elevation 0 to 500 m	Urban	214
Elevation 500 to 1000 m	Agriculture	45
Elevation 500 to 1000 m	Forest	9

Within the context of the ZCWD-WEAP model and its evaluation of the performance of the ZCWD water system, the Bog Lake was explicitly modeled in terms of its ability to supply water up to 20 MLD as presented in Table 51.

Table 50: Summary of Assumptions for Bog Lake ZCWD-WEAP Model

Summary of Assumptions	Value (unit)
Water Treatment Plant Capacity	20 MLD
Water Treatment Plant Site Storage Capacity	0.15 MM3
Storage Capacity of Bog Lake	2.5 MM3
Annual Average Watershed Discharge	12 MM3
90th Percentile Low Flow into Bog Lake	7 MLD
50th Percentile Flow into Bog Lake	26 MLD

Manicahan River

The river is a 26-kilometer stretch from Bunguiao in the north down to Lapakan, Lamisan and Manicahan in the southern part of the City. It covers a portion of the heavily forested Pasonanca Watershed. Normally, it has a daily discharge of about 2 m^3 per second. It has a total catchment area of 70 km^2. The main goal of developing the Manicahan River is as a supply for the east and central coast of Zamboanga City. Construction of the WTP would benefit up to 60,000 households with a capacity of 50 MLD. The upper portion of the watershed that would serve as the diversion point covers about 47 km^2, with a mean annual flow of 2.4 m^3/s. Figure 63 on the right shows the Upper and Lower Manicahan watershed while Table 52 presents the elevation and land use area. The summary of assumptions is also presented in Table 53.

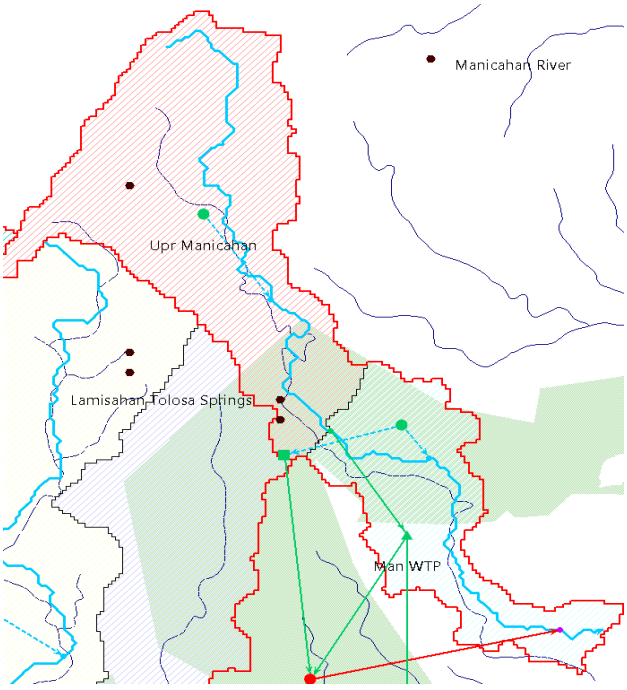


Figure 63: Manicahan River WEAP Model

Table 51: Land use and area for the watershed connected to Upper Manicahan (47 km^2 and Lower Manicahan 23 km^2)

Sub-Watershed	Elevation Band	Land Use	Area (ha)
Lower Manicahan	Elevation 0 to 500 m	Agriculture	2,132
Lower Manicahan	Elevation 0 to 500 m	Forest	6
Lower Manicahan	Elevation 0 to 500 m	Wetland	56
Lower Manicahan	Elevation 0 to 500 m	Urban	5
Lower Manicahan	Elevation 0 to 500 m	Open Water	136
Upper Manicahan	Elevation 0 to 500 m	Agriculture	1,009

Sub-Watershed	Elevation Band	Land Use	Area (ha)
Upper Manicahan	Elevation 0 to 500 m	Forest	61
Upper Manicahan	Elevation 500 to 1000 m	Agriculture	1,412
Upper Manicahan	Elevation 500 to 1000 m	Forest	2,248
Upper Manicahan	Elevation 1000 to 1500 m	Forest	4

Table 52: Summary of Assumptions for Manicahan River ZCWD-WEAP Model

Summary of Assumptions	Value (unit)
Water Treatment Plant Capacity	50 MLD
Water Treatment Plant Site Storage Capacity	0.2 MM3
Annual Average Watershed Discharge	75 MM3
90th Percentile Low Flow at Diversion	45 MLD
50th Percentile Flow at Diversion	150 MLD

The current primary water supply for the ZCWD service area is from the Tumaga River, with a drainage area of about 210 square kilometers. The contributing drainage of the Tumaga river to the ZCWD diversion point is about 90 square kilometers. Based on the available data, the annual average flow is about 5.46 cubic meters per second, with an estimated 80 percent dependable monthly flow ranging from a low of 1.66 cubic meters per second during March to a high of 4.95 m^3/s in October. The annual average yield as presented in Figure 65 is about 105 MCM, while the annual average flow for the whole basin is about 200 MM3.

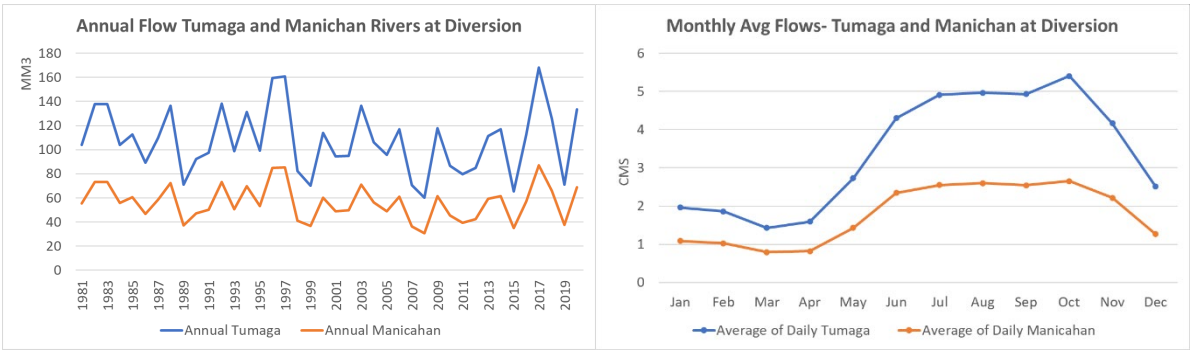


Figure 64: Annual average historic flows as estimated by the ZCWD-WEAP model for the Tumaga and Manicahan Rivers at the river's diversion points.

NRW Reduction

Almost all water districts in the Philippines suffer to some extent from losses in their distribution network. Referred to as NRW, the resulting losses hamper efforts to expand the distribution network to underserved or non-served populations. In 2020, the NRW as reported was 64 percent and varied between 50 percent and 64 percent on an annual basis since the year 2015.

Minimizing NRW is a supply-side WDM policy. In general, it is lower risk (compared to constructing new water supplies), climate resilient and is low in operating costs. LWUA guidance is for water districts to have NRW of less than 30 percent, which is a realistic future goal for ZCWD with proper funding.

The process of identifying the range and scale of the NRW problem as well as its solution is variable and may take several years, depending on available investment resources and the magnitude or rate of NRW reduction required. ZCWD has a dedicated team that is responsible for reducing NRW, utilizing a varying approach such as identification of high-water losses areas, water main replacement, and utilizing the private sector through PPP. The current focus of ZCWD NRW reduction program is to replace large water mains that were installed in 1920's and 1930's. The age of these water mains makes them susceptible to corrosion, brittleness and reduced thickness caused by internal scour; all of which could lead to significant leaks. The focus of replacing large old water mains to reduce NRW is an excellent strategy that should be aggressively pursued. Other strategies such as replacing old water meters will also help to reduce NRW and recover additional revenue caused by the under-reading of the meters.

It is critical that ZCWD keeps focusing on reducing NRW as it is the most cost effective and low risk option for increasing water security. In addition, reducing NRW is "climate proof" as compared to identifying new water sources, building infrastructure, treat, operate and distribute the additional water. In the WEAP model, NRW reduction is based on a rate of 4 percent per year which is a reduction from 60 percent to either 40 percent or 30 percent depending on the scenario being analyzed. These NRW rates and goals have been accepted by ZCWD as reasonable if adequate funding is available.

Expand groundwater wells

Groundwater wells tend to be sustainable, decentralized, cost-effective solutions to improve water-supply drought resilience for climate-change adaptation. Unlike surface water storage they are much less affected by reduced inflow during droughts and increased evaporation due to global warming. Deeper wells are also less susceptible to contamination as compared to surface water sources. Depending on the location, recharge areas and hydrogeology, water contained within the aquifer sources are from decades to centuries old. The general slow recharge of aquifers can lead to depletion and increased water drawdown if well pumping is not controlled; therefore, careful operation (pumping) and data analysis are needed in order to maintain a sustainable well.

There are 13 water permits issued to ZCWD with a total of 52.91 MLD. The 12 of the 13 water permits are for groundwater sources with a total of 14.32 MLD and one for surface water (Tumaga River) for 38.59 MLD. In the WEAP analysis contained within this report expansion of the number of wells in the general location of the existing wells is an option under consideration. Increasing the number of the wells owned and operated by ZCWD will increase and diversify the water supply system which will reduce the risk and impact of future climatic events. The expansion of the groundwater supply can only occur with an increased understanding and data of existing groundwater supply wells. Comprehensive data on water extraction rates and well levels are needed to avoid overextraction. In the WEAP model the expansion of wells is assumed to be a 25 percent increase in capacity by 2025, after which the capacity remains constant.

Emphasis on local, distributed supplies (springs) including rainwater harvesting

Local distributed supplies in the context of the WEAP model are related to springs that would serve small areas within the service area. Rainwater harvesting is also included in this portion of the WEAP analysis as it would only have a minor contribution to water security. Rainwater harvesting is of limited value as a supply source as it only replaces a small percentage of potable water demands; in addition, the capture of rainwater is low during extended droughts or El Niño

events. In the WEAP model the amount of water available from these sources remains constant throughout the planning period.

Water Demand Management

WDM has over the years emerged as both an alternative and complement to conventional water supply management. Major policy approaches to support and promote WDM can target the water users and provide through demand-side and supply-side interventions, respectively. WDM involves the adoption of policies or investment to achieve efficient water use by all residents of the city. WDM refers to getting the most use from the available water supplies through water conservation and increased water efficiency. It consists of reducing the quantity of water required to accomplish a task as it flows from the source through use and disposal. WDM includes the use of public policies, laws, water rates, and measures and practices to reduce water use, with the goal of securing long-term, reliable, affordable, and safe supply of water for the benefit of society and the environment[74]. More importantly, managing water demand ensures the ability of the water system to serve society even during times when water is in short supply.

First introduced by the USAID Be Secure project in 2015, ZCWD has implemented various components of WDM. One of the prominent results of this program in the city was the formal launching of ZCWD's WDM Program in February 2016 and the creation of the ZWAT. The ZWAT prepared water audit toolkits for Residential and Commercial water users and trained water auditors, as part of the major undertaking in mainstreaming WDM in Zamboanga City.

As part of integrating WDM a key component is understanding the water use patterns of customers utilizing a water audit. A water audit provides a better understanding of customer water use patterns, characteristics, and consumption. The data gathered during a water audit also assists in establishing a baseline for various customer segments and for future strategic and policy planning. The results of the water audits will provide ZCWD with a specific understanding of where water is used, as well as water-efficiency opportunities. In conjunction with a water audit, other WDM tools that should be investigated and implemented include community awareness, local capacity building, plumbing codes, regulation and policy revisions and as previously identified protection of catchment areas.

The goal of the ZWAT is to develop programs that can be shared with other local water districts, water service providers, and other governmental and private institutions. Another goal is to educate people—especially youth and those working in large commercial establishments—on WDM concepts and strategies, and to promote the efficient use of water through utilization of water-saving technologies.

The existing ZWAT consists of seven ZCWD employees who in addition to their assigned duties and responsibilities are part of the team; therefore, the ability to grow the ZWAT program is limited. Achieving water security requires many different approaches and programs; the expansion of the ZWAT program to include government facilities, schools and businesses is an important component.

Another aspect of WDM is the use of technologies and efficient water practices to reduce water use for domestic, commercial, and industrial users. For example, one showerhead is considered

[74]Global Water Partnership (2012). Water Demand Management: The Mediterranean Experience. Technical Focus Paper.

more efficient than another if it can accomplish the same purpose by using less water or other inputs. For domestic water use, some of the available devices and products are low-flow showerheads, shower flow restrictors, toilet-tank inserts, faucet aerators, low flush toilets, dual flush toilets, insulation of hot-water pipes, horizontal axis washing machines, low-pressure supply connections, pressure-reducing valves, water efficient landscape designs and irrigation practices. The water efficiency gains of these devices over traditional counterparts can be substantial without diminishing the fulfilment of the original purpose for which water is used. For example, ultra-low flow toilets consume as little as 20 percent of what traditional toilets consume. Toilet dams or other water displacement devices block part of the tank so that less water is required to fill the toilet following each flush.

In the industrial sector, technological devices include counter-flow washing and rinse systems, reuse of process water, recirculation of cooling water, ozone treatment for cooling towers, treatment, and reuse of blow-down and water recycling.

The extent of use of water saving devices and technologies depends largely on the market penetration of these products, the types of industries linked to the system, and the technologies available for the domestic market. As a more aggressive strategy, a municipality can enact standards for water-using appliances, at least for upcoming localities with new construction. A review of the Water Code of the Philippines and Water Crisis Act of 1995 did not show provisions on incentives and rewards for the use of water-saving devices. Only the Clean Air Act of 2004 has a provision (Section 26) for incentive schemes, but these are targeted to technologies and devices for pollution control and clean production. The 2014 Investment Priority Plan of the Bureau of Investment includes incentives for water pollution control and energy-saving technologies but none on water-saving technologies.

As a part of Zamboanga City efforts in WDM, USAID through the SURGE Project has been providing technical assistance for the strengthening of technical and institutional capacity of cities on water and sanitation. One such area of focus is WDM, a strategy that supports the closing of the gap between available supply and the increasing demand by reducing water use rather than by just augmenting supply.

As part of SURGE continuing technical assistance on WDM, SURGE reconstituting an existing Water Security TWG to a multi-sectoral WSC. The WSC is supported by a Technical Secretariat headed by the Office of the City Environment and Natural Resources (OCENR). The WSC is designed to be a multi-sectoral body that will serve as a clearinghouse for city-wide issues on water and sanitation services. It supports existing governance and operational structures of water and sanitation services provision in the City. It includes the local government of Zamboanga City, the ZCWD, business groups, academic groups, professional associations groups, NGOs/CBOs/POs, and other line agencies. In its inaugural meeting last July 28, the WSC announced the creation of the National Center for WDM in Zamboanga City.

The National Center for Water Demand Management (The Center) proposes the collaboration of the Western Mindanao State University (WMSU), a leading academic institution based in Zamboanga City and the NWRB, the national policy making and oversight body for water resources regulation in the country. The collaboration will address and hopefully close the gap between the public's awareness and appreciation of the WDM program and the potential of WDM to be a credible national program. The NWRB has recently hosted the International Virtual Conference on WDM on 18 March 2020 conferring the national interest to mainstream the management of water demand alongside water supply management programs.

The cost of implanting a WDM program and calculating the savings is a difficult analysis due the varying factors and variables involved, in addition since WDM is a new concept in the Philippines cost information is not available. In areas outside the Philippines such as the US, several EPA WaterSense programs have been enacted successfully; the varying cost of the programs between the two countries makes it difficult to determine the true cost benefit. One way to determine the positive impact of a WDM Program is by utilizing the Benefit-Cost Ratio of various WDM options, which vary from 3 to 15. In order to quantify the water savings that could be achieved through a WDM program a target level of reducing demand of 5 percent after 5 years of implementation is assumed in the WEAP model. The 5 percent goal is a reasonable metric for the water district and LGU to pursue and will reduce the cost of future water supply options.

Impounding Dam

Since the 1970's and more recently USAID and others have investigated the proposed construction of a large dam on the Tumaga River as a way to increase water supply and for generation of power for Zamboanga City. Due to the large cost of this project (PhP 6,585-12,855 million) and risk, it was not included in the ZCWD Improvement Project list. A project of this magnitude would require substantial government funding or a public private partnership (PPP).

The impounding dam project would include a 105-m high earth filled dam capable of providing 216 MLD of water, which would be used for domestic supply and hydropower. A new 146 MLD water treatment plant and 900 mm transmission main would be constructed as part of the project. (EDCOP, 2021). As a long-term water security supply solution, the impounding dam has merits but the size, risk, environmental and social impacts require careful consideration. As a general approach to achieving water security, diversification of water resources and phasing of options generally tends to be a more effective approach in particular due to the future climate change impacts. The WEAP model does not contain any elements of the impounding dam project as the focus of the model is diversified projects that can realistically be implemented by 2050.

Alternatives

Alternatives are defined in WEAP as those actions that can be taken by the water district in order to alter the outcomes of the future water conditions. Maintaining current operations and water supplies (No Action) are considered the baseline in which to compare other Alternatives. Alternatives describe specific and unique ways in which the individual options could be implemented.

The Low-Cost Alternative includes reduction of NRW from 60 to 40 percent at a rate of 4 percent per year, implementation of WDM with the goal of reducing per capita water use by 5 percent by 2025, the implementation of Bog Lake in 2027 (start of the design process) with water available in three years. Expansion of groundwater supply for the years 2025 and 2026 by 25 percent.

The High Supply Reliability Alternative includes NRW reduction to 30 percent at the same rate of 4 percent per year, same WDM reduction as in the Low-Cost Alternatives; but the two large water supply projects Bog Lake and Manicahan River have water available 2025 and 2030 respectively.

Figure 65 lists the WEAP alternatives that have been developed, implementation year and other assumptions.

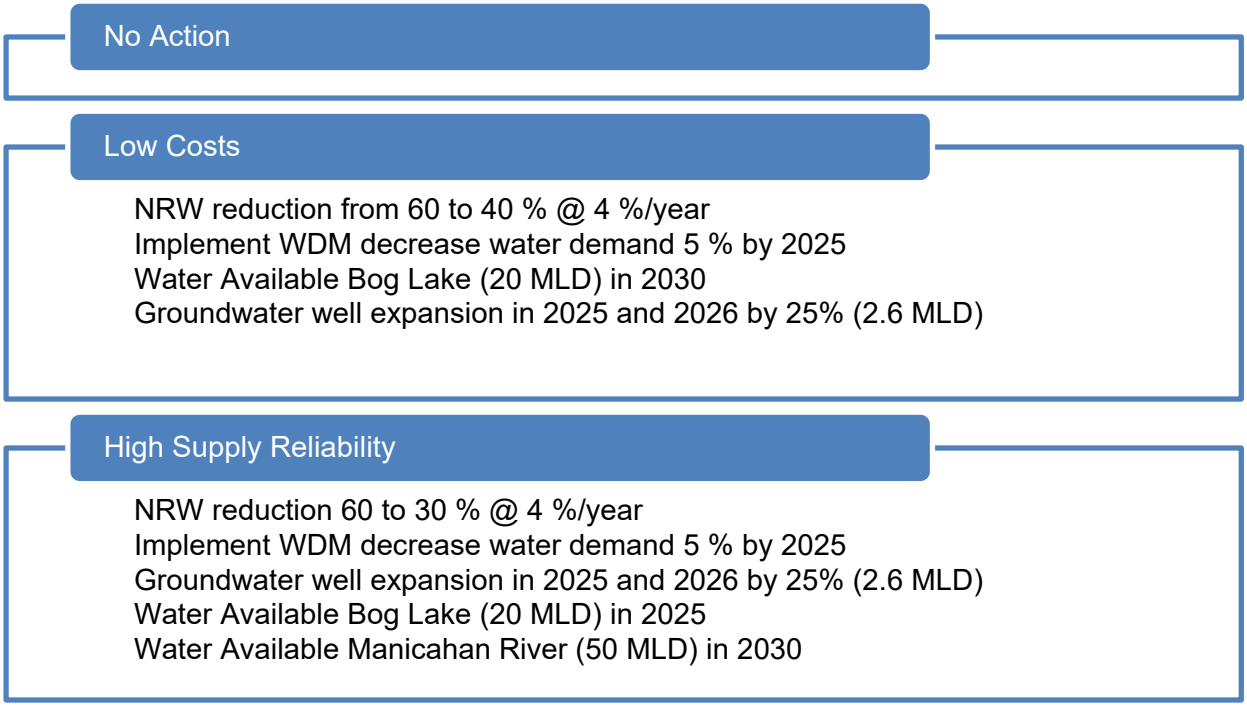


Figure 65: WEAP Alternatives

Within the ZCWD-WEAP Model capital and operating cost variables are needed as part of the financial analysis for the various options. The costs shown in Table 54 do not assume inflation or other factors that influence the value and are developed to compare one option to another. The Scenarios will be described in the next section and answer the “what if” question.

Table 53: ZCWD-WEAP Model Cost Variables and Scenarios

WEAP Options and Scenario Assumption	Timeline	Capital Cost (PhP in Million)	Operating Cost (PhP/m³)	Comments
Bog Lake (20 MLD)	2025 or 2030	260 million for 3 years (Low Cost and High Reliability)	10	2025 (High Supply Alt), 2030 (Low-Cost Alt), 3 years to implement
Manicahan River (50 MLD)	2030	PhP 520 million/year for 5 years (High Reliability)	10	2030 (High Supply Alt), 3 years to implement starting in 2027
NRW Reduction	Starting 2025	PhP 60 million/year for 10 years (Low Cost)	10	60% --> 40/30 % @ 4 % per year (Low Cost and High Reliability, respectively)

WEAP Options and Scenario Assumption	Timeline	Capital Cost (PhP in Million)	Operating Cost (PhP/m³)	Comments
		PhP 80 million /year for 14 years (High Reliability)		
New Groundwater Wells	2025	PhP 8 million for 2 years (Low Cost and High Reliability)	12	Only serving Central District, 12 CUM/day (Existing) increase by 25% in 2025. Capital Cost in 2025 and 2026
Local distributed supplies				No additional supplies
WDM	2025		0.5	5 % reduction, implemented immediately in 2020 and applied equally to all uses
Scenarios				
Water Demand Growth	2020			High 3.0 %, Low 1.5 %
Climate Projections	1950-2050			Historical and Dry (10%) Conditioned off the CESM1-CAM5 RCP8.5 Climate Projection for 2020 through 2050

WEAP Analysis

At the heart of WEAP is the concept of scenario analysis. Scenarios are self-consistent storylines of how a future system might evolve over time. The scenarios can address a broad range of "what if" questions and are the “X” or Exogenous factors in the XLRM framework. A scenario allows for the evaluation of the implications of unintended changes in the system and how these changes may be mitigated by policy and/or technical interventions. In the ZCWD-WEAP model water supply, water demand and the impacts of future climate change are the primary external factors related to these unintended changes. Scenarios can be selectively activated or changed in the WEAP model using the Manage Scenarios tool found in the Data View. The main driver of water demand are the assumptions around sectoral water use, with the estimates for each activity for the three service areas (Western, Central, and Eastern), where within each of those zones are data at the individual Barangay levels. Table 55 shows the historic sectoral estimate to 2020 and the estimated future projections that assume a 1.5 percent annual growth in population (Domestic, cap) and for each sector (Commercial, Industrial, Institutional, Semi-Commercial, and ZCWD Facility. Annex 10 is the calculation of projected population used in the WEAP analysis.

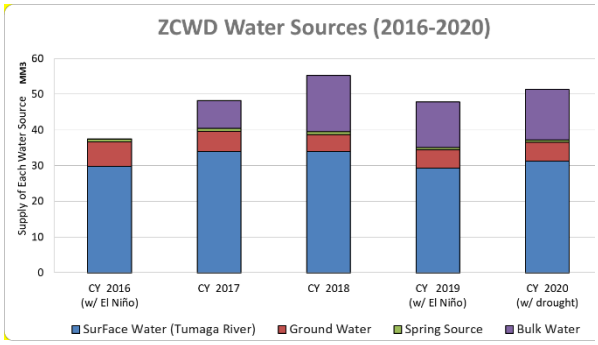
Table 54: Historical and Future Population Projection for each Sector of ZCWD based 1.5 percent Growth

Activity	2010	2015	2020	2025	2030	2035	2040	2045	2050
Commercial (Prod.)	4,343	4,679	5,040	5,430	5,849	6,301	6,788	7,313	7,878
Domestic (cap)	288,375	310,661	334,670	360,535	388,399	418,416	450,753	485,588	523,117
Industrial (Prod.)	24	26	28	30	32	35	38	40	44
Institutional (Prod.)	494	532	573	618	665	717	772	832	896
Semi Comm (Prod.)	1,553	1,673	1,802	1,942	2,092	2,253	2,427	2,615	2,817
ZCWD Facility (Prod.)	40	43	46	50	54	58	63	67	73

ZCWD WEAP Verification

Before the scenarios are explored, verification of the performance of the ZCWD-WEAP model and its ability to represent the recent past and current ZCWD water system is presented. To do this, the model was configured to simulate the water supply and demand balance for the period 2010 through 2020 and have summarized the delivery of water by source for the years 2016 through 2020 where there are concurrent data is available. Figure 66 (a) shows the historically observed primary water supply sources and their annual volumes delivered by the ZCWD. In 2016, the Prime Bulk water supply was not yet available, and it was an El Niño year, with only about 35 MM3 of water delivered. In 2017, the Prime Bulk water comes online and begins delivering water, resulting in increased deliveries from 2017 to 2020. The figure shows the portion of groundwater supplied at about 11 percent after 2016, while spring water sources represent a relatively small fraction of the total supply. Figure 66 (b) shows the ZCWD-WEAP simulation of the same and the variability of the delivery of water to meet demands. Generally, the model appears to deliver proportionally more Prime Bulk Water supply, particularly in 2017, although that is when that supply was just coming online. The pattern of delivery represented by the model generally matches the observed delivery, with reduced volume particularly in 2019, which was an El Niño year.

a.



b.

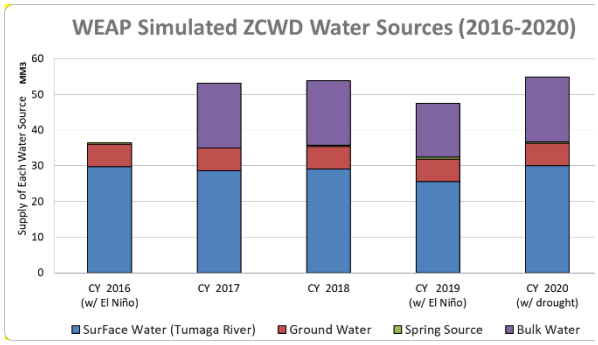
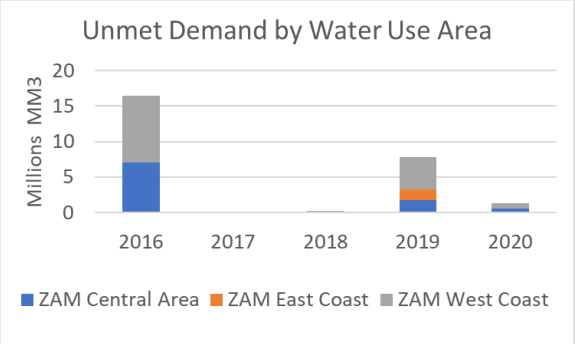


Figure 66: (a) The historical observed water supply delivered by source from 2016 to 2020; and (b) the ZCWD-WEAP model's estimate of supply delivered by source for the same years

The ZCWD-WEAP model provides additional metrics that can be used to analyze the performance of the water system in terms of both supply and demand. Figure 67(a) shows the unmet demand for the recent observational period and highlights the fact that water was in short supply without inputs from the Prime bulk water supply, with most of the shortage occurring in the east and west coast regions of the ZCWD service area. Figure 67(b) shows the daily coverage of the water supply and shows that most of the shortage occurred during the ENSO years, and particularly in the dry season from February through May.

a.



b.

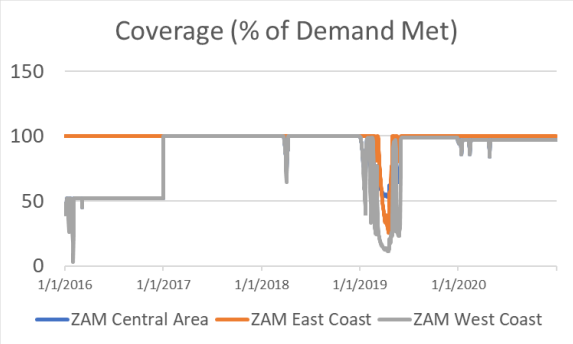


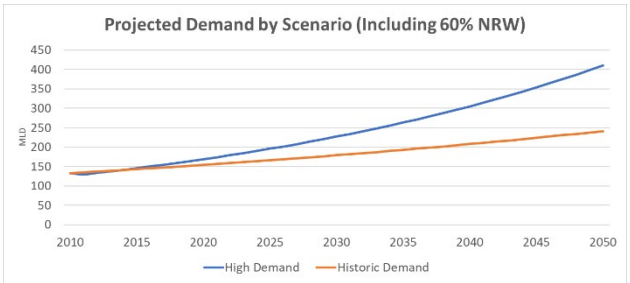
Figure 67: (a) Annual unmet demand by water use for the three demand zones (west, central, and east) for the recent years with available observations, and (b) the percent coverage for the same period and zones

Future Scenarios 2010- 2050

Each of the three WEAP alternatives were evaluated against assumptions encompassed within two different scenarios, which are described below. Each scenario makes assumptions about two primary uncertain factors, including the (i) future trends in demand growth and (ii) assumptions regarding the future climatic conditions. The first scenario assumes that future demand follows historic patterns of growth and that the future climate can be represented by the climate of the past. This narrative used to describe this scenario is "*History Repeats*" and is similar to the "Status Quo" condition with the impact of historical climate included. Water demand growth is set at 1.5 percent per year and the historical climate repeats into the future.

The second scenario is based on what happens to the water supply and demands if future water demands increase to 3 percent and the climate is drier than the historical average. The narrative used to describe this scenario is "*High and Dry*", implying higher demands and a generally driver future climate. This would tend to be the worst-case scenario for the water supply and water district's ability to supply a growing water demand to its customers, although would also represent an opportunity for the utility to expand its revenue base and increase its supply reliability. Figure 68 (a,b) summarizes the assumptions of the future demand and climate for these two scenarios.

a.



b.

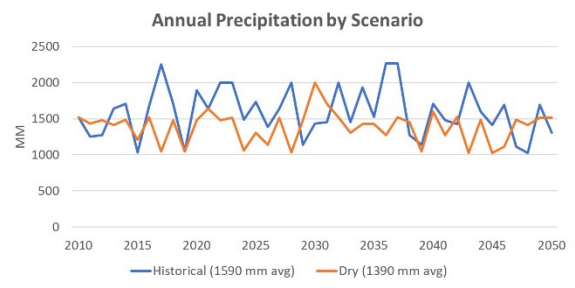
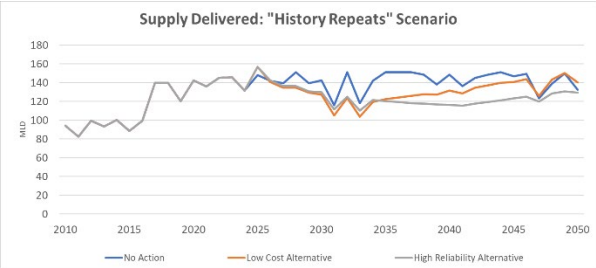


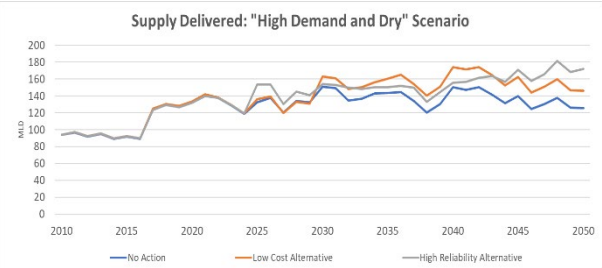
Figure 68: (a) Projected future demand for the two scenarios, showing historic trends (orange line) and a high projected demand (blue line); and (b) the annual precipitation over the Zamboanga region under assumptions that the historic climate repeats (blue line) and the climate is drier

Figure 69 shows the results for the water supply delivered and unmet demand for each of the scenario evaluated for the three alternatives. Note that the supply delivered implies the assumptions of NRW reductions for each of the alternative. A few key messages stand out from these results. Unmet demand is likely to grow into the future without actions taken to reduce NRW and perhaps invest in new water supplies. Also, with a high demand growth and a drier climate (*Hot and Dry)* the system could be even more stressed. Without any actions, the current system can supply about 151 MLD with consistency. With NRW reductions and some infrastructure investments, the necessary supply is mostly satisfied, albeit with occasional instances of unmet demand. Under the higher demand projection (*High and Dry*) and drier conditions, taking the No Action alternative would result in considerable unmet demand, which would skyrocket under conditions of rapid demand growth and a drier climate. Investments in few infrastructures such as Bog Lake and the Manicahan River would allow for consistent deliveries, but by 2050 might still be deficient in meeting all demands, even with considerable reductions in NRW.

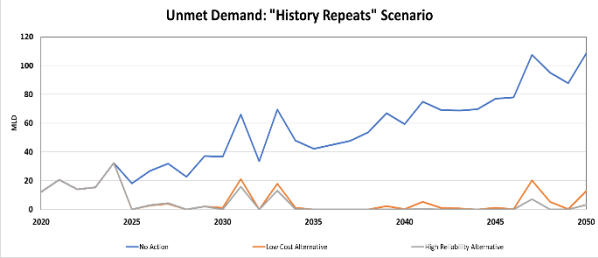
a. Supply Delivered: “History Repeats” Scenario



b. Supply Delivered: “High and Dry” Scenario



c. Unmet Demand: “History Repeats” Scenario



d. Unmet Demand: “High and Dry” Scenario

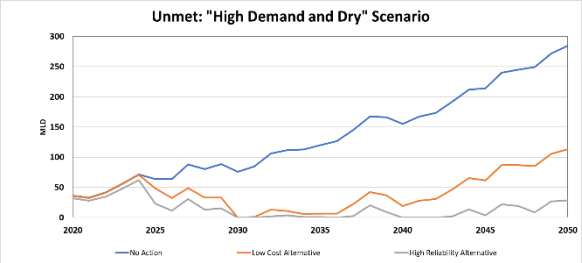


Figure 69: (a) Supply Delivered and (c) Unmet Demand for the History Repeats; and (b) Supply Delivered and (d) Unmet Demand for the High and Dry scenario given for each of the three alternatives

Figure 70 shows the supply delivered by scenario and for each alternative. Results are shown at five-year increments to simplify interpretation of results. In the ZCWD-WEAP model, legacy surface water sources are the first and primary supply source, and then the new supply sources including the Prime Bulk supply. Local springs supply is assumed to be constant, albeit modest, amount of the water supply. The new supplies then follow in priority, Bog Lake (used in both the *Low Cost* and *High Reliability* alternatives) and the Manicahan River (only in the *High Reliability* alternative). Groundwater has the lowest priority and is used when surface supplies need to be supplemented.

- *No Action Alternative:* In No-Action alternative, both scenarios show that the system supplies a maximum of about 151 MLD per year. This alternative demonstrates that the system is generally supply limited and with considerable unmet demand (see Figure 70). With the assumption of 60 percent NRW, this outcome is expected.
- *Low-Cost Alternative*: Bog Lake is moderately used in the *History Repeats* scenario, as reduction in NRW and moderate increases in demand are able to be generally supported by the existing infrastructure, with Bog Lake being use more frequently by 2050. Under the High and Dry scenario, Bog Lake is used more frequently, as high demand growth and drier conditions require more from the new supply sources. Bog Lake is used considerably under the High and Dry scenario, and might not be adequate to support high levels of demand. In fact, the storage in Bog Lake is significantly stressed under this scenario (not shown). This alternative shows that it can deliver more than 164 MLD per year under dry conditions, supported by reduction in NRW.

- *High Reliability Alternative*: This alternative can deliver more than 164 MLD per year by 2050, with reductions in NRW and the new source of Bog Lake and the Manicahan River able to meet the increased demand. If demand growth is moderate and the climate is not appreciably dry, then the Manicahan River is likely to be adequate to support future levels of demand. As a more reliable source it might make more sense to prioritize developing the Manicahan River supply over Bog Lake given the uncertainty of Bog Lake from both a water quantity and quality perspective. Due the large cost of developing the Manicahan River supply further study is warranted, therefore in the analysis Bog Lake is prioritized.

Supply Delivered by Source- *History Repeats*

Supply Delivered by Source- *High and Dry*

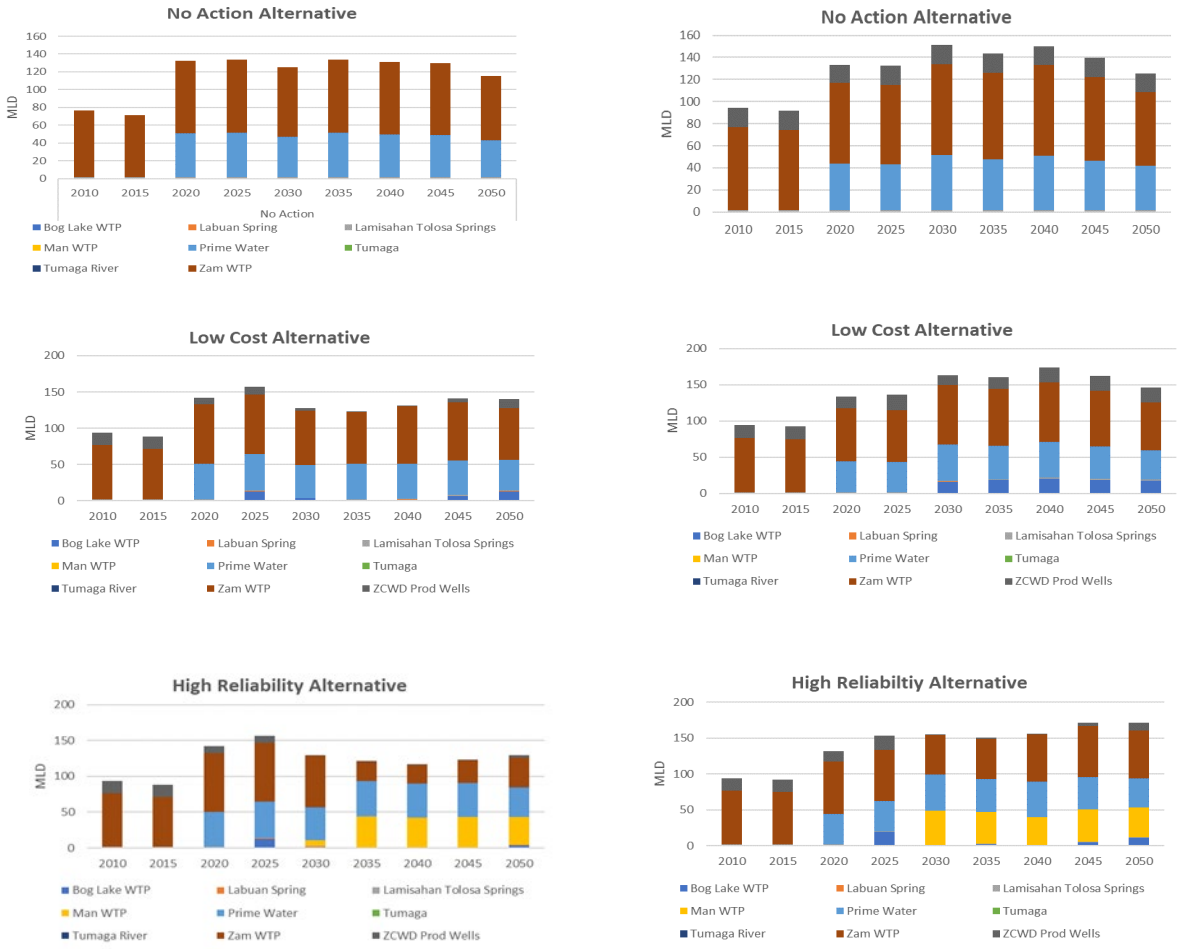


Figure 70: Supply delivered by source for both scenarios (columns) and for all three alternatives (rows)

Figure 71 shows the discounted costs of the various alternatives and scenarios. It shows that the NPV of the discounted costs of the *High Reliability* alternative are about 60 percent greater than the No Action alternatives. While the *Low-Cost* alternative is about 37 percent greater than the *No Action* alternative. The High and Dry scenario actually show smaller NPV since less water is delivered overall, reducing operating costs. Note that the analysis does not consider the revenue side of the accounting.

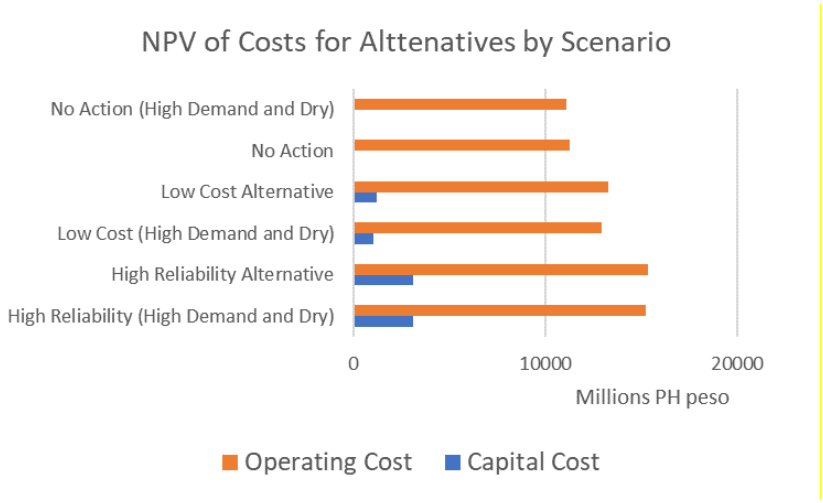


Figure 71: Discounted (4 percent) Net Present Value of the Operating and Capital Costs for the three Alternatives and for each Scenario for the full simulation period of 2010 to 2050

The Prime Water Bulk Agreement was intended as a means to ensure water security for the customers of the water district. The lack of proper planning and operational issues have created the reality that the concessionaire is unable to meet its 50 MLD water supply obligation. The analysis carried out with the WEAP model under various future climatic conditions in this study confirms that the water source for the bulk water treatment facility will continue to be inadequate to supply the contractual obligation in the future.

VIII. Financing Modalities

The implementation of these PPAs will support the goals and objectives set forth in achieving water security for Zamboanga City. Financial and economic feasibility of the project through a detailed financial and economic analysis should be first determined to ascertain sustainability and viability of the proposed programs and projects. For the water district, a water rate structure that will support the reliability and sustainability of the proposed system should be well established.

The proposed PPAs can be implemented and funded through various financing options, including but not limited to, collaboration with private sectors to control loans for both Government Financing Institutions (GFIs) and Private Financing Institutions (PFIs), private sector financing through commercial loans, and grants through international funding institutions.

General Discussion on the Financing Modalities

The funding sources can be grouped into three: (i) General Appropriations Act (GAA), (ii) Official Development Assistance (ODA), and (iii) Loans, Technical Assistance, Grants and Partnerships.

The GAA is one of the most important legislations that Congress passes annually. It defines the annual expenditure program of the national government and all of its instrumentalities. The expenditure program includes all programs and projects that are supposed to be funded out of the government's funds for the year. The main offices that assist the Office of the President in this function are: the Development Budget Coordinating Committee, the Department of Budget and Management, the Regional Development Councils, and all agencies and offices of the national government.

For the period 2022-2027, the GAA designated the following agencies for infrastructure development projects: the DA, DENR, DPWH and NIA. The GAA also specifically designated the local government support fund (LGSF) to undertake the following: (i) Assistance to Cities, (ii) Conditional Matching Grant to Provinces for Infrastructure Rehabilitation, Upgrading and Improvement, (iii) Financial Assistance to LGUs; and (iv) Disaster Rehabilitation and Reconstruction Assistance Program for LGUs.

NEDA also plays an important role in providing general administration and support to the water supply and sanitation sector by increasing its access to and in improving the water supply and sanitation situation. Investments may be shouldered through the following:

- NEDA Three-Year Rolling Infrastructure Program (TRIP) for Fiscal Years (FY) 2022-2024
- NEDA Board Committee on Infrastructure (INFRACOM) Project Development and other Related Studies (PDRS)
- NEDA Board Investment Coordination Committee –Cabinet Committee (ICC-CabCom) Regional Infrastructure Development Projects
- NEDA Board-Regional Development Committee
- NEDA 2023-2027 Public Investment Program (PIP)

The ODA is an important source of development financing at the regional, provincial, or city levels. It is a loan or a grant contracted with foreign governments with which the Philippines has

diplomatic and trade relations. It may be availed through international multilateral and bilateral lending institutions or international financial institutions which has a grant element of at least 25 percent. The ODA is intended to promote sustainable social and economic development and welfare. The countries that can be sources of ODA loans and grants are Japan, South Korea, China, USA, Australia, France, Germany, Italy, Austria, Canada, Spain and New Zealand. The international institutions and multilateral agencies that serve as sources of the ODA loans and grants are ADB, AIIB, EU IDB, IFC, World Bank, and the UN System. On the other hand, loans and grants may be coursed through such bilateral agencies as AFD, CIDA, China Exim Bank, DFAT, DFID, FINNIDA, GIZ, JICA, KOICA, Korea Exim Bank, USAID, and NZAID.[75] Among the list, World Bank, ADB, USAID, JICA, and AIIB have significant investments in the water and sanitation sector.

Financing Options for LGU

Investments may be shouldered by a portion of the Internal Revenue Allotment (IRA) regularly received by the LGU without affecting other LGU basic services. Per Joint Memorandum Circular (JMC) No.1 of the Department of Budget and Management (DBM) and the DOF, about **20 percent** of the annual IRA can be appropriated by the LGU for water system development projects. Furthermore, through the Mandanas-Garcia Ruling, the Supreme Court ruled that the just share of LGUs from the national taxes is not limited to national internal revenue taxes collected by the Bureau of Internal Revenue (BIR) but includes collections by the Bureau of Customs. With the implementation of the Mandanas-Garcia Ruling starting 2022, the National Anti-Poverty Commission (NAPC) is expecting LGUs to lay down projects to alleviate poverty. This could be an opportunity for the LGU of Zamboanga City to strengthen their planning, investment programming and budgeting linkages. In this regard, Zamboanga City Planning has earmarked PhP197 million or 6.44% of the total investment program of PhP3 Billion for water supply and sanitation projects for FY 2022.

The LGU may also request grants from the national government and congressional allocations. Likewise, the LGU may seek financing from government banks, such as the DBP. The bank, however, may require proportional assignment of the LGU's IRA in its favor to guarantee the loan repayment.

The LGU may also entertain unsolicited proposals for Joint Venture or PPP. This will entail more rigid compliance to policies and guidelines issued by the Department of Finance (DOF) and other regulatory agencies.

For small size loans, projects and financial services, the LGU as well as the WD may promote microfinancing. Microfinance is conventionally understood as financial services delivered by a variety of providers such as rural banks, nonprofits, credit unions/cooperatives, and non-banking financial institutions. Microfinance institutions (MFIs) are providing aids by providing small loans for water and sanitation to households and businesses. Another option is to promote the blending

[75] ADB- Asian Development Bank, AIIB- Asian Infrastructure Investment Bank, EU IDB - European Union Inter-American Development Bank, IFC - International Finance Corporation, AFD- Agence française de développement, CIDA - Canadian International Development Agency, DFAT - Department of Foreign Affairs and Trade (Government of Australia), DFID - Department for International Development, FINNIDA - Finnish International Development Agency, GIZ - Deutsche Gesellschaft fuer Internationale Zusammenarbeit (GIZ) GmbH, JICA - Japan International Cooperation Agency, KOICA - Korea International Cooperation Agency, USAID - United States Agency for International Development, NZAID - New Zealand Aid Programme

of grant or subsidy and a microfinance loan to reduce the required cash expenditure for consumers compared to a lump-sum upfront investment. USAID SURGE for instance, supports innovative financing in CDI Cities to increase the access to water supply and sanitation including promotion of water demand management. Small projects such as initial water service connections, construction of toilets and septic vaults, desludging services, and even replacement of fixtures and equipment that are water-efficient are being supported by MFIs and the Microfinance Council of the Philippines, Inc. (MCPI)[76].These MFIs have track records of disbursing a large volume of water and toilet loans and they working closely with local government and nongovernmental organization (NGO) programs for social marketing and demand-generation.

Financing Options for Water District

In general, investments of the water districts may be shouldered through (i) Internal cash generation (ICG), (ii) Loans from government financial institutions and bank, (iii) Loans from private banks, (iv) Grant funds from the government and congressional fund allocations, and (v) Joint venture (JV) under the PPP schemes. Water districts with enough ICG are capable of undertaking the project using its own funds. Those lacking in funds can go to the LWUA and request for financial assistance in the form of a loan. LWUA may require the water district to put up at least 10 percent of the total project cost as equity contribution. The 90 percent shall be in the form of a long-term loan subject to a 4 percent per annum interest rate with repayment term up to 25 years via annual amortizations.

Alternatively, the water district may opt for financing outside LWUA by approaching government banks like Land Bank of the Philippines (LBP), Development Bank of the Philippines (DBP) or private commercial banks like Philippine National Bank (PNB) and Bank of the Philippine Islands (BPI). However, these banks will require the water district to secure first a waiver from LWUA that permits the water district to contract the outside loan, particularly if the water district has any outstanding loan with LWUA. Bank loans usually carries 5-6 percent interest per annum, payable for a maximum period of 15 years.

In the case of ZCWD, majority of its PPAs were anchored on the water rates increase that should have been implemented as scheduled last 2020. As a consequence of the failure to secure the proposed increase in full, funding for most of the projects were curtailed and its implementation were placed on hold. Most of these projects were intended for the reduction of NRW and development of new water sources which were reprogrammed and loaned under ADB-WDDSP.

Without the implementation of the proposed water rates, ZCWD's ICG is not sufficient to fund projects it programmed for immediate implementation. Even loans from the ADB-WDDSP and to some extent from the LBP[77] are in a way tied with the implementation of the increase in water rates. Hence, considering its financial position, the following options are open to ZCWD for funding its projects;

[76] MCPI is the national network of microfinance institutions working towards sustainable, innovative and client-responsive solutions to poverty in the country. MCPI is currently comprised of 57 institutions, including 47 practitioners and 10 support institutions. Its regular members include 26 non-government organizations, 13 banks, 6 cooperatives, and 2 regional networks.

[77] ZCWD had reservations in early 2020 of availing the NSSMP grant for the STP project because management was afraid of not being able to repay the loan because the 50% equity will be drawn from the LBP loan.

- Request for financial assistance from LWUA
- Explore available Grant funds from the government and congressional fund allocations
- Joint venture (JV) under the PPP schemes.
- Seek financial assistance from the LGU as the latter is willing to assist financially.
- Explore international ODA loans and grants
- Sell non-performing assets. Proceeds from the sale to be used in financing priority NRW reduction projects.
- Work on securing LGU concurrence for the immediate implementation of the water rates increase as per the program and schedule prepared by the ZCWD.[78]

[78] With the implementation of the proposed rate hike, ZCWD can fund most of its projects through the ICG. However, the reason for the non-implementation of the rate hike is the refusal of the present local executive to increase the rates citing humanitarian considerations amidst the pandemic.

IX. Conclusions and Recommendations

Conclusions

The lack of a comprehensive water security plan and misdirected past water development initiatives for Zamboanga City have contributed to local and regional water insecurity in the past. The development of this master plan was based on state-of-the-art decision support techniques based on national and international experience. A comprehensive water supply and demand model, based on the WEAP decision support system was used along with downscaled future climate projections. The development of the Zamboanga City Water Security Master Plan with these state-of-the-art scientific analysis techniques results in the first planning document in the Philippines to specifically address the climatic impacts on future water supply in a scientific proven methodology.

In Section IV (Goals, Strategies and Objectives based on Water Risks) recommended several goals to guide the WSC to achieve water security are:

- Long-term water sustainability;
- 24/7 consistent safe water supply including adequate system pressure;
- Conservation and protection of watershed;
- Use of innovative technology and data;
- Improve operational and fiscal efficiency;
- Maintain and improve relationships, partnerships, and collaboration with stakeholders and LGU;
- Promote the value of water to the customers and instill confidence of the water district; and
- Maintain attractive investment profile.

The outcome of this study includes the ability of the ZCLGU and ZCWD to improve drought resiliency, improved access to reliable water, and reduction in water rationing. Training was provided on the WEAP software as part of capacity development which will benefit current and future water supply projects whether locally or privately funded. The ZCWD-WEAP model is the anchor of the water supply analyses carried out in this study, and from the analysis it is clear that;

- Unmet demand is likely to grow into the future without actions taken to reduce NRW with a high demand growth and a drier climate (*Hot and Dry)* the system could be even more stressed.
- Without any actions, the current system can supply about 55 MLD with some consistency. With NRW reductions and some infrastructure investments, the necessary supply is mostly satisfied, albeit with occasional instances of unmet demand.
- Under the higher demand projection (*High and Dry*) and drier conditions, taking the No Action alternative would result in considerable unmet demand, which would skyrocket under conditions of rapid demand growth and a drier climate.
- Investments in few infrastructures such as new groundwater wells, Bog Lake and the Manicahan River would allow for consistent deliveries through 2050. All this is predicated on a considerable reduction in NRW.

Figures 72 and 73 present the unmet water demand under various scenarios, as shown depending on the alternatives the unmet water demand can be as high as 300 MLD which would be a disastrous impact to the water customers of the water district. Enacting the elements recommended in this study would allow the LGU, water district, customers, and stakeholder a future of water security.

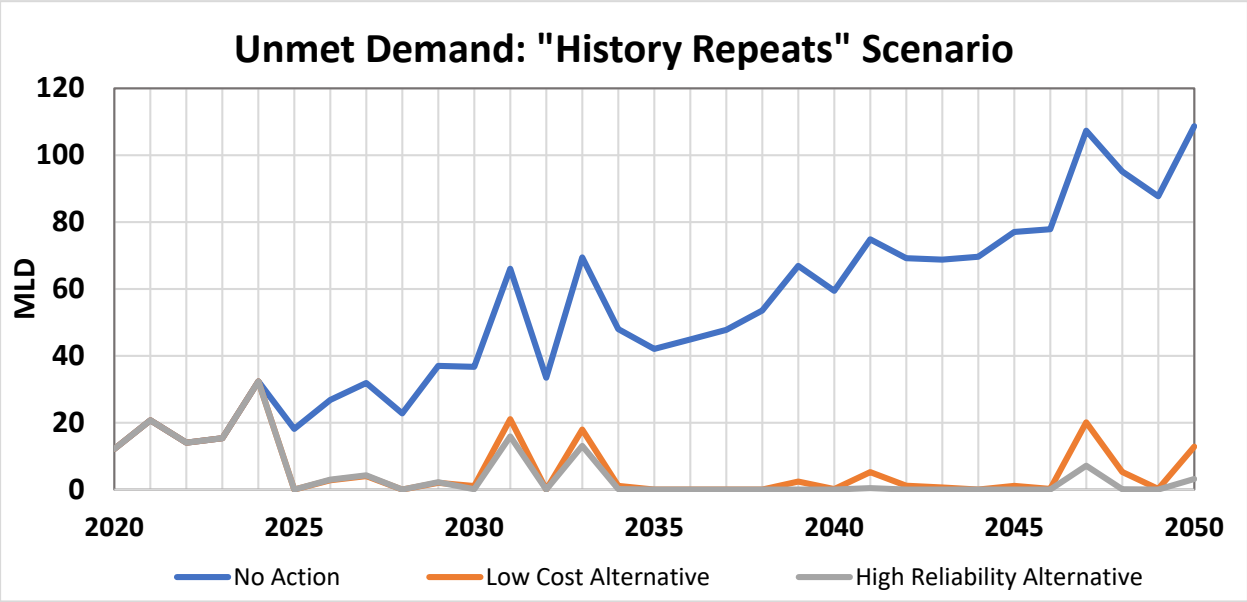


Figure 72: Unmet Demand: "History Repeats" Scenario

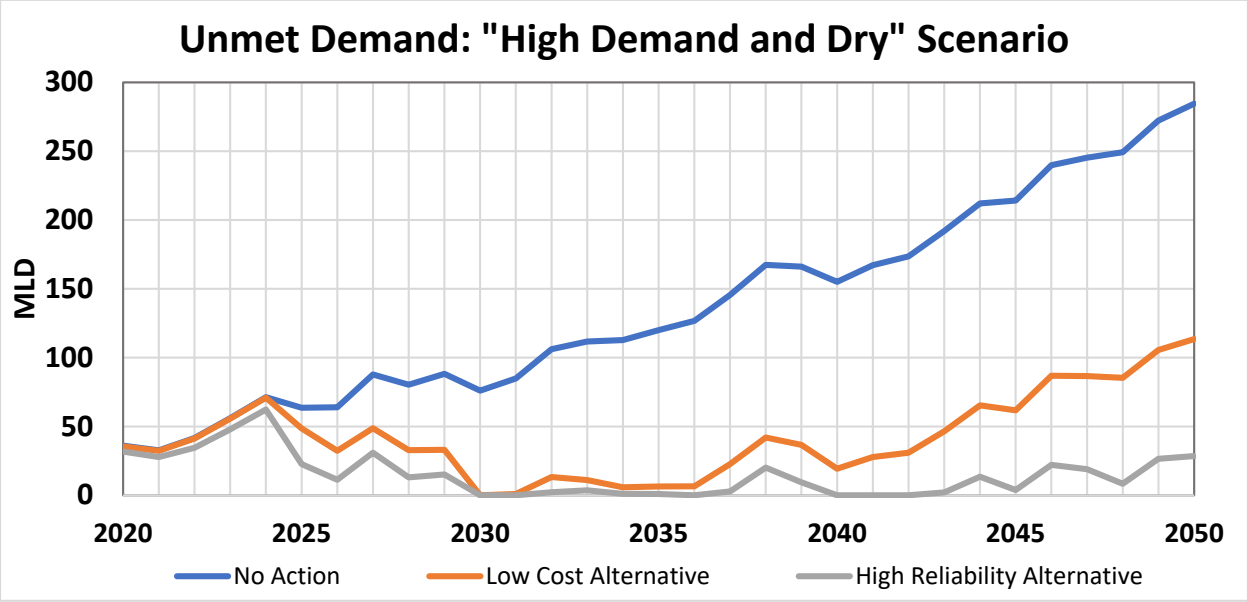


Figure 73: Unmet Demand: "High Demand and Dry" Scenario

The PWSSMP is an action plan being led by NEDA to achieve universal access to water supply and sanitation services from 2019 to 2030. It was aligned in government's goal of attaining water supply and sanitation targets under the Updated PDP 2017-2022, Clean Water Act of 2004 and

UN SDG. The Zamboanga City Water Security Master Plan is unique as it one of the first water supply plans to align with and include reform areas of the recently launched PWSSMP. Presented in Table 56 are the national priorities, reforms, programs and activities identified in PWSSMP and its synergy with the Zamboanga City Water Security Master Plan.

Table 55: Alignment of Water Security Master Plan with Philippine Water Supply and Sanitation Master Plan (2019-2030) Reform Areas (NEDA, 2019)

Priority, Reforms, Program, and Activities	Rational and Objectives	Recommendations	ZCWD Water Security Master Plan Elements
Reform Area No. 1: Establish Effective WSS Sector Institutions	Reform Area No. 1 Create master plans to foster coordinated efforts and guide the Concerned implementing agencies to attain universal access in the sector;	Enhance stakeholder engagement and responsibility for elements of the master plan; Promote the master plan as framework for water security in other areas of the Philippines	Enhance stakeholder engagement in the planning process, key involvement by the WSC The Water Security Master Plan is formatted in step-by-step framework to allow implementation in other areas of the Philippines
Reform Area No. 3: Balancing Water Supply and Demand	Reform Area No. 3 focuses on interventions in addressing water scarcity and managing the finite water resources through end-users. It balances the demand with supply while safeguarding the water ecosystem through the following measures:	Explore policies and projects to promote efficient water utilization; Develop new water sources to protect watersheds that are critical to existing and potential water sources.	Expand WDM Program New surface water source identified Prioritize NRW reduction
Reform Agenda 3.2: Adopt water demand management as a policy.		Establish policies that provide incentives to foster efficient and conscientious water users (e.g., labelling of water fixtures regarding their water consumption similar to Energy Efficiency Ratio (EER) for electric appliances, installation and retrofitting of water efficient equipment); Promote programs towards reducing NRW and increasing efficiency (e.g.,	Encourage the promotion of the National Center for Water Demand Management with Western Mindanao State University Recommend an aggressive NRW Program and expansion of ZWAT Program. Instill the importance of water and conservation to the customers of the water district.

Priority, Reforms, Program, and Activities	Rational and Objectives	Recommendations	ZCWD Water Security Master Plan Elements
		reticulating leakage detection, repair programs, and pressure reduction);	
Reform Area No. 4: Building Climate Resiliency	Reform Area No. 4 focuses on interventions in addressing issues and challenges related to climate change. It builds a climate-resilient water sector through the following measures:	Consider disaster risk reduction and climate change adaptation strategies to ensure resilient infrastructure facilities; and, Enhance the capacities of concerned entities by the government in developing and managing water-related projects.	Utilization of climate driven WEAP Model to analyze options and scenarios to achieve water security through 2050 Training of Water District, LGU and Stakeholders on climate resilient water system planning and decision making

Likewise, the Key Reform Agenda No. 6 of the PWSSMP focuses on the interventions towards the improvement of access to funding and financing for WSS through the unified resource allocation framework (UARF). This framework aims to address the fragmented and uncoordinated approach in funding and implementing WSS projects across the country and to aid the achievement of universal access and improved service standards. While the realization of this framework will still take some time to be established, a wide range of financing options for the PPAs of both the ZCLGU and ZCWD shall be carefully planned, prioritized and analyzed. This is to ensure its appropriateness and viability vis-à-vis the implementation of these PPAs. In this regard, PPAs with a clear impact of reducing the NRW followed by water source development must be given priority. It is noteworthy that the institutional development and capacity strengthening of the key stakeholders shall also be prioritized.

Without any intervention, water stress and unmet demand will substantially increase in the future. It was estimated that about 300 MLD of unmet demand is possible with a future of high-water demand and a dryer climate. NRW reduction is the most important and cost effective “water supply” program to achieve water security. The NRW program coupled with WDM and new water sources will allow Zamboanga City to move towards water security. The existing leadership and new tools are positive attributes to attain water security, all that is missing is the adequate funding and coordination.

ZCLGU and ZCWD has the leadership and tools to achieve water security; all that is missing is proper funding and internal/external coordination.

Recommendations

Recommendations for the achievement of water security for ZCLGU and ZCWD proposed in this study are based on a high-level analysis utilizing limited data and known conditions as of this date. Planning for water security is an on-going process that requires refinement as new data is obtained, regulatory and governance changes, and as climate impact projections are further refined. Considering that the analysis carried out in this Water Security Master Plan is a “snap shot” of today’s known risks, nevertheless the recommendations to achieve water security include;

Four Elements of Zamboanga City Water Security

The four elements of water security are meant to be a summary of the proposed activities needed to achieve “drought proofing” and to enhance the ability to expand service to areas outside the existing service area. The four elements are all important and need to be enacted simultaneously and with the same focus.

Figure 74: Elements of Zamboanga City Water Security

Aggressively pursue NRW reduction, prioritize programs with goals, objectives and metrics to reduce NRW to 30 percent within a specified time period, the program needs have accurate data

and include a formal plan that can be enacted with proper funding. The reduction of NRW is the lowest cost and most climate resilient option which will increase water supplies available to the customers. In general, the NRW reduction program needs to be elevated with specific actions for example:

- There must be a specific target and timeline for the ZCWD NRW Reduction Program. The target should be specific, measurable, achievable, relevant and time bound (SMART).
- Each individual project or program within the NRW reduction program should have SMART goals.
- Policies on the reduction of NRW can be adopted by the Board of Directors directing management to reduce NRW to a specific level within a specific time.
- Train personnel on NRW Reduction, in particular field staff in the identification of water loss issue. They can be trained by private water companies that have extensive successful experience in this field.
- Provide adequate financial funding for the implementation of the proposed PPAs for NRW reduction.
- Ascertain the accuracy of production volume by re-calibrating all measuring devices associated with water production. Production and billing are the major factors in calculating NRW. If either of these are not as accurate NRW results could be inaccurate.

The first step in reducing NRW is to develop an understanding of the 'big picture' of the water system, which involves establishing a water balance (also called a 'water audit' in the United States). This process helps utility managers to understand the magnitude, sources, and cost of NRW. The International Water Association (IWA)[79] has developed a standard international water balance structure and terminology that has been adopted by national associations in many countries across the world. Figure 75 presents water balance showing NRW Components.

<table>
<tr><td rowspan="6">System Input Volume</td><td rowspan="2">Authorized Consumption</td><td>Billed Authorized Consumption</td><td>Billed Metered Consumption</td><td rowspan="2">Revenue Water</td></tr>
<tr><td></td><td>Billed Unmetered Consumption</td></tr>
<tr><td rowspan="4">Water Losses</td><td>Unbilled Authorized Consumption</td><td>Unbilled Metered Consumption</td><td rowspan="5">Non-Revenue Water</td></tr>
<tr><td></td><td>Unbilled Unmetered Consumption</td></tr>
<tr><td rowspan="2">Apparent Losses</td><td>Unauthorized Consumption</td></tr>
<tr><td>Customer Meter Inaccuracies and Data Handling Errors</td></tr>
<tr><td rowspan="3">Physical Losses</td><td>Leakage on Transmission and Distribution Mains</td></tr>
<tr><td>Leakage and Overflows from the Utilities Storage Tanks</td></tr>
<tr><td>Leakage on Service Connections up to the Customer Meter</td></tr>
</table>

Figure 75: Water Balance with NRW Components

NRW = System Input Volume - Billed Authorized Consumption

[79] See more detailed descriptions of each component and their measurement in the IWA reference manual by Farley, M. and S. Trow, 2003. *Losses in Water Distribution Networks—A Practitioner's Guide to Assessment, Monitoring, and Control.* IWA Publishing: ISBN 1 900222 11 6. http://www.iwapublishing.com/template.cfm?name=isbn1900222116

Steps for Conducting a Water Balance

The utility manager needs to have certain information about the network to conduct a water balance:

- System input volume
- Billed consumption
- Unbilled consumption
- Unauthorized consumption
- Customer metering inaccuracies and data handling errors
- Network data
- Length of transmission mains, distribution mains and service connections
- Number of registered connections
- Estimated number of illegal connections
- Average pressure
- Historic burst data
- Level of supply service (24-hour, intermittent, etc)

The four basic steps to conduct a water balance are summarized below:

Step 1. Determine system input volume

Step 2. Determine authorized consumption

- Billed—total volume of water billed by the water utility
- Unbilled—total volume of water provided at no charge

Step 3. Estimate commercial losses

- Theft of water and fraud
- Meter under-registration
- Data handling errors

Step 4. Calculate physical losses

- Leakage on transmission mains
- Leakage on distribution mains
- Leakage from reservoirs and overflows
- Leakage on customer service connections

It is unlikely that ZCLGU and ZCWD will achieve water security without a significant reduction in NRW.

Expand the WDM program now, managing water demand ensures the ability of the water system to serve customers even during times when water is in short supply. Therefore, it's an important element of making the water district drought resilient.

Engage stakeholders and new tools in the planning process, ZCLGU, ZCWD, WSC, LWUA, NWRB, DENR and all other stakeholders are a critical component of the water planning process. Not only do the stakeholders bring various interests they instill a level of confidence to the customers that proper water supply planning is being achieved.

Expand water supply sources and implement new policies, an important component of water security as it pertains to climate change is the diversification of water supply sources and policies to protect water sources. Groundwater is less impacted by short climatic issues such as El Niño and provides long term water quality consistency. Increasing the use of groundwater is a relatively low risk and cost part of a new water source program. The expansion of groundwater sources has to be done withing the limited regulatory framework and regulations of the NWRB to minimize over-extraction.

Bog lake has been identified and reviewed in this master plan as a water supply option, with implementation after 2025. The hydrologic data available for Bog Lake related to quantity and quality is limited therefore additional studies are recommended to solidify this source and reduce the risk as a viable water supply option. In order to quickly determine the viability of Bog Lake as a water supply option, water quality should be investigated through a study. The water quality study should generally contain these components:

- determining possible future uses of lake;
- determining degree of existing control of the watershed by water district;
- assess the degree of hazard to the supply posed by agricultural, domestic, industrial, or recreational activities in the watershed, which may generate toxic or harmful substances detrimental to treatment processes;
- assess all waste discharges (point source and non-point sources) and activities that could impact the water supply. The location of each waste discharge shall be shown on a scale map;
- obtaining samples over a sufficient period of time to assess the microbiological, physical, chemical and radiological characteristics of the water; and
- assess the capability of the proposed treatment process to reduce contaminants to Philippine Standards.

Similar to Bog Lake, using the Manicahan River as a water supply option is based on limited data and contains risk which with proper study can be quantified and understood. The analysis carried out in this study recommends implementation of the Manicahan River as a water supply option in 2030. In order to facilitate any long-term investment requirements and the potential value of the Manicahan River as a water source, Manicahan River Feasibility Study should be started in 2022.

Enact policies to protect groundwater, watershed, and recharge zones, the protection of these areas will enhance water supply, quality and climate resiliency. For example, full control of the Pasonanca Watershed by ZCWD would allow implementation of policies and programs to totally prevent encroachments which can potentially contaminate tributaries that feed the Tumaga river and destroy flora which is important in keeping the watershed healthy.

Figure 76 is the proposed schedule for implementation of the four elements towards the attainment of water security. The NRW, WDM and investigation of Bog Lake as a water supply source are programs that should begin immediately.

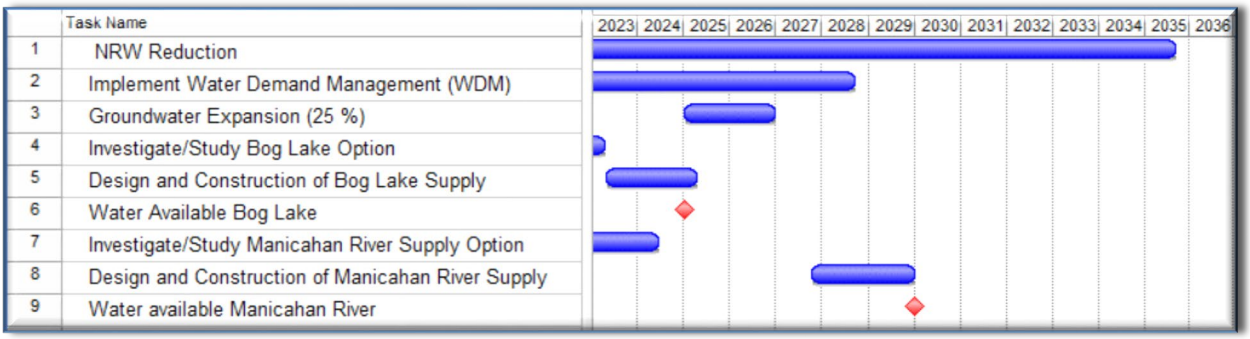


Figure 76: Implementation Schedule

Long Term Transboundary Water Supply

The identification of long-term water supply options could assist in achieving water security. But due to the relatively high cost, long distance and risks these water sources and subsequent projects should only be investigated as long-term water sources. The two long-term water supply projects identified by the stakeholders include: Malayal River in the municipality of Sibuco, Zamboanga del Norte, and Lakewood in Zamboanga del Sur. Near-term solutions (NRW reduction, WDM, etc.) and new sources presented in the previous sections should be implemented before attempts are made to secure long-term solutions.

Short- and Long-Term Institutional Development and Capacity Strengthening

Listed below are the recommended programs, projects and activities in order to allow staff to achieve the goals and objectives of this study. The short and long term interventions are based on the following: (i) Summary of Results of Survey Questionnaire, (ii) Online Stakeholder Consultation on the Preparation of the Zamboanga City Water Security Master Plan, (iii) Online Consultation Meeting with the Zamboanga City Water Security Council on the Preparation of the Water Security Master Plan (Consultation on the Pressing Issues on Water Security), (iv) Gap Analysis on Addressing Prevailing Issues, Concerns and Challenges on Water Security, and (v) SWOT for ZWAT during the Strategic Planning Session held on June 30, 2021. Further detail of these programs is presented in Section V.

Short-Term

- Policy Research on Institutional Capacity Strengthening of the Zamboanga City Water Security Council.
- City-Level Strategic Institutional Development and Capacity Building Program for the Zamboanga City Water Security Master Plan.
- Institutional Capacity Strengthening of the ZCWD: Training on Water Planning Approach and Decision Support System using Water Evaluation and Planning System (WEAP). Appendix 12 contains a proposed WEAP Training Scope of Work. ZCWD, LGU, and ZCWSC should endeavor to find immediate funding for WEAP training to better implement

and manage the WSMP (as outlined in Annex 9 and Annex 12). This may be outsourced through ODA funding – from ADB, WB, USAID, UNICEF or Mandanas cap-devt funds.
- Policy Research to Assess the Benefits of Establishing a National Knowledge, Learning and Research Center for Water Security.
- Impact Evaluation of the Water Audit Program: Best Practices and Lessons Learned in Program Implementation.
- Design, Development and Implementation of a City-Level Strategic Communication Campaign Plan for Zamboanga City Water Security Master Plan.
- Design, Development and Implementation of City-Level Strategic Communication Campaign Plan for Zamboanga City Water Demand Management Plan.

Long-Term

- Detailed Institutional Capacity Assessment of the Zamboanga City Water Security Council Personnel involved in the Development and Implementation of Water Sector Development Project.
- Design, Develop and Implement Long-Term, Comprehensive and Sustainable Institutional Capacity Strengthening Program for the Zamboanga City Water Security Council.
- WATSEC Watch: Supporting the Zamboanga City and Regional Water Sector Partnership on Water Security.
- Establishment of a Knowledge, Learning and Research Center for Water Security: Zamboanga City Water Audit Program Implementation for Sustainable Institutional Partnership (WAP-Pro).

Next Steps

Following the final submittal and approval of the Water Security Master Plan several next steps are recommended to keep the “ball moving” in respects to achieving water security. These steps include:

- Each responsible agency develops action plans, follow the reform framework developed in the National Water and Sanitation Master Plan
- Recommend that the ZCLGU, ZCWD, and ZCWSC conduct the needed review and proceed with the adoption of the WSMP through a resolution (see Annex 13)
- Promote and disseminate the Water Security Master Plan
- Immediately incorporate the WEAP model as a planning tool, identify and train “champions”, ZCWD, ZCLGU, and ZCWSC should endeavor to find immediate funding for WEAP training to better implement and manage the WSMP
- Ensure adequate funding from ZCLGU and/or ZCWD
- Begin feasibility studies of Bog Lake and Manicahan River as water supply options in 2022
- Conduct a more detailed analysis of NRW to determine what are the causes of the high NRW. Utilizing the water balance framework in this report will assist in the analysis and will help guide future the NRW Program.

These next steps should be carried out simultaneously and with urgency by ZCLGU and ZCWD. As shown in the water supply analysis in this study, the water security situation in Zamboanga is

getting worse, fortunately achieving water security is achievable based on the recommendations contained within this study and focused effort.

X. References

Corazon, Abansi & Hall, Rosalie & Siason, Ida. (2018). Water Demand Management and Improving Access to Water. 10.1007/978-3-319-70969-7_11.

City Government of Zamboanga. (2018). *Comprehensive Land Use Plan (2016-2025) Volume I.* Zamboanga City: Office of the City Planning and Development Office.

City Government of Zamboanga. (2015). *Zamboanga City Local Climate Change Action Plan 2016-2030.* Zamboanga City

City Government of Zamboanga and Palafox Associates. (2015). *Comprehensive Land Use Plan (2016-2025) Draft Final Report Volume III.* Zamboanga City: Office of the City Planning and Development Office.

City Government of Zamboanga and DPWH. (2015). *Comprehensive Land Use Plan (2016-2025) Draft Final Report Volume III.* Zamboanga City: Office of the City Planning and Development Office.

DENR (2016). *Climate Change-Responsive Integrated River Basin Management and Development Plans for the 8 Clustered River Basin.* River Basin Control Office

DENR (2008). *Water Quality Monitoring Manual.* Retrieved from Water-Quality-Monitoring-Manual-Vol.-1-ambient_14aug08.pdf (emb.gov.ph)

DENR-EMB IX. (2021). *Tumaga River Water Quality*. Retrieved from https://emb.gov.ph/wp-content/uploads/2021/03/TUMAGA-RIVER.pdf

Folland, C.K., J.A. Renwick, M.J. Salinger, N. Jiang, and N.A. Rayner (2003). *Trends and variations in South Pacific Islands and ocean surface temperatures*. Journal of Climate, 16, 2859-2874

Folland, C.K., J.A. Renwick, M.J. Salinger, and A.B. Mullan (2002). *Relative influences of the Interdecadal Pacific Oscillation and ENSO on the South Pacific Convergence. Zone*. Geophysical Research Letters, 29, 21-1-21-4 13

NEDA. (2019). *Conduct of Feasibility Study for the Zamboanga City Impounding Dam Project*. NEDA

NEDA. (2020). *Draft Philippine Water Supply and Sanitation Master Plan*. NEDA

NEDA. (2021). *Updated Philippine Development Plan*. NEDA

NIA. (2019). Annual Report. Retrieved from https://www.nia.gov.ph/?q=content/2019-annual-report

NWRB. (2020). *Water Permits in Zamboanga Peninsula.* Quezon City: National Water Regulatory Board.

PSA (2020). *Selected Statistics on Agriculture.* https://psa.gov.ph/sites/default/files/2_SSA2020_final_signed.pdf

Regional Development Council Region (2019). *Zamboanga Peninsula Regional Development Plan (2017-2022).* Philippines.

USAID. (2017). *Hydrological Vulnerability Assessment of Zamboanga City.* USAID.

USAID. (2016). *Pre-Feasibility Study Draft Report Technical Services for the Pre-Feasibility for an Impounding Dam with Conjunctive Hydroelectric Power Plant for a Sustainable Water Supply for Zamboanga City.* USAID.

WWF and BPI Foundation, Inc. (2013). *Hydrological Vulnerability Assessment of Zamboanga City.* Philippines

ZCWD. (2016-2020). *Year-End Monthly Data Sheets.* Zamboanga City Water District: Planning and Monitoring Division.

Annex 1: Population Per Barangay

Zamboanga City Population per River Basin, 2015

Barangays	Population	Watershed	Barangays	Population	Watershed
1. Arena Blanco	12,589	Tumaga	50. Mampang	34,312	Tumaga
2. Ayala	22,547	Ayala	51. Manalipa	2,143	MW
3. Baliwasan	25,042	MW	52. Mangusu	4,783	Vitali-Taguite
4. Baluno	3,155	Ayala, Tumaga	53. Manicahan	10,081	Manicahan
5. Barangay Zone I (Pob.)	4,112	MW	54. Mariki	1,775	MW
6. Barangay Zone II (Pob.)	2,143	MW	55. Mercedes	14,721	Tumaga
7. Barangay Zone III (Pob.)	1,519	MW	56. Muti	2,983	Curuan, Vitali-Taguite
8. Barangay Zone IV (Pob.)	1,309	MW	57. Pamucutan	4,059	MW
9. Boalan	8,696	Tumaga	58. Pangapuyan	590	MW
10. Bolong	6,460	Bolong	59. Panubigan	1,610	MW
11. Buenavista	6,485	Curuan	60. Pasilmanta (Sacol Island)	2,122	MW
12. Bunguiao	7,287	Bolong, Manicahan	61. Pasobolong	3,758	Tumaga
13. Busay (Sacol Island)	3,359	MW	62. Pasonanca	27,374	Tumaga
14. Cabaluay	6,350	MW	63. Patalon	8,128	MW
15. Cabatangan	13,680	Tumaga	64. Putik	19,681	Tumaga
16. Cacao	1,347	MW	65. Quiniput	3,329	Curuan
17. Calabasa	3,222	Curuan, Vitali-Taguite	66. Recodo	17,395	MW
18. Calarian	28,899	MW	67. Rio Hondo	3,326	MW
19. Camino Nuevo	7,739	MW	68. Salaan	4,073	Tumaga
20. Campo Islam	12,552	MW	69. San Jose Cawa-cawa	6,173	MW
21. Canelar	11,100	MW	70. San Jose Gusu	16,723	MW
22. Capisan	1,408	MW	71. San Roque	27,889	MW
23. Cawit	9,249	Ayala	72. Sangali	20,766	Bolong
24. Culianan	8,318	Tumaga	73. Santa Barbara	4,762	MW
25. Curuan	8,796	Curuan, Vitali-Taguite	74. Santa Catalina	17,294	MW
26. Dita	2,085	MW	75. Santa Maria	25,185	Tumaga
27. Divisoria	9,218	Tumaga	76. Santo Niño	4,129	MW
28. Dulian (Upper Bunguiao)	2,570	Bolong, Curuan, Manicahan	77. Sibulao (Caruan)	4,244	Vitali-Taguite
29. Dulian (Upper Pasonanca)	1,325	Tumaga	78. Sinubung	4,689	MW
30. Guisao	3,398	MW	79. Sinunoc	16,507	MW
31. Guiwan	14,302	Tumaga	80. Tagasilay	2,971	Vitali-Taguite
32. Kasanyangan	14,114	MW	81. Taguiti	1,460	MW
33. La Paz	7,557	Ayala	82. Talabaan	5,340	MW

Barangays	Population	Watershed	Barangays	Population	Watershed
34. Labuan	11,457	MW	83. Talisayan	8,220	MW
35. Lamisahan	2,289	Bolong, Manicahan	84. Talon-talon	34,916	Tumaga
36. Landang Gua	2,993	MW	85. Taluksangay	10,237	MW
37. Landang Laum	4,768	MW	86. Tetuan	29,785	Tumaga
38. Lanzones	3,287	Tumaga	87. Tictapul	3,817	Vitali-Taguite
39. Lapakan	1,378	Manicahan	88. Tigbalabag	1,803	Vitali-Taguite
40. Latuan (Curuan)	2,457	Curuan, Vitali-Taguite	89. Tigtabon	5,292	MW
41. Licomo	5,317	MW	90. Tolosa	2,773	Manicahan, Tumaga
42. Limaong	4,000	Vitali-Taguite	91. Tugbungan	23,837	Tumaga
43. Limpapa	5,782	MW	92. Tulungatung	9,246	Ayala
44. Lubigan	2,945	Bolong	93. Tumaga	30,824	Tumaga
45. Lumayang	1,471	Tumaga	94. Tumalutab	2,417	MW
46. Lumbangan	3,235	Tumaga	95. Tumitus	3,026	MW
47. Lunzuran	9,931	Tumaga	96. Victoria	2,802	Manicahan
48. Maasin	8,958	MW	97. Vitali	9,406	Vitali-Taguite
49. Malagutay	6,657	MW	98. Zambowood	10,166	Tumaga
			Total	**861,799**	

Note: MW - Minor Watershed
Source: PSA (2015)

Annex 2: Historical Production

Surface Sources Historical Actual Production

Name of Facilities (Location)	Rated Capacity (m^3/year)	Actual Annual Production (m^3/year)					Status as of June 2021
		2016 (w/ El Niño)	2017	2018	2019 (w/ El Niño)	2020 (w/ drought)	
Water Treatment Plant	25,185,000	23,905,443	25,279,725	25,324,507	23,843,924	24,838,967	Operational
Old Reservoir	7,300,000	5,091,542	7,824,032	7,985,430	5,027,581	5,744,923	Operational
Dumalon	730,000	776,627	904,453	690,748	459,074	692,690	Operational
Total	**33,215,000**	**29,773,612**	**34,008,210**	**34,000,685**	**29,330,579**	**31,276,580**	

Source: ZCWD, 2020

Spring Sources Historical Actual Production

Name of Facilities (Location)	Rated Capacity (m^3/year)	Actual Annual Production (m^3/year)					Status as of June 2021
		2016 (w/ El Niño)	2017	2018	2019 (w/ El Niño)	2020 (w/ drought)	
Lamisahan (Upper Lamisahan, ZC)	182,568	198,733	268,697	266,278	194,155	187,070	Operational
Lumayang (Brea, Lumayang, ZC)	65,232	73,646	83,317	76,992	56,907	54,130	Operational
Labuan (Labuan, ZC)	141,864	146,666	185,101	184,195	160,157	168,220	Operational
Tolosa (Sitio Imelda, Tolosa, ZC)	156,036	108,561	152,114	153,743	140,181	166,528	Operational
Vitali (Camalig, Vitali, ZC)	87,864	90,061	132,063	91,506	88,504	111,790	Operational
Tictapul (Sinoropan, Tictapul, ZC)	29,292	33,217	46,111	32,236	29,822	30,200	Operational
Total	**662,856**	**650,884**	**867,403**	**804,950**	**669,726**	**717,938**	

Source: ZCWD, 2020

Groundwater Historical Actual Production

Name of Facilities (Location)	Rated Capacity (m^3/year)	Actual Annual Production (m^3/year)					Status as of June 2021
		2016 (w/ El Niño)	2017	2018	2019 (w/ El Niño)	2020 (w/ drought)	
Baliwasan (Lemon Drive, Baliwasan, ZC)	161,220	193,923	81,512	12,012	-	59,011	Stand-by
Gov. Ramos (Gov. Ramos Ave, Sta. Maria, ZC)	464,028	532,869	486,756	467,476	400,245	257,557	Stand-by
Putik (MCLL Hiway, Putik, ZC)	546,408	413,106	548,216	562,979	490,335	460,340	Operational
Guiwan (Cadena de Amor, Palmeras dr., Guiwan, ZC)	696,120	560,904	661,527	676,847	590,334	597,310	Operational
Gov. Camins (Gov. Camins Ave., ZC)	1,069,980	1,016,815	662,471	168,045	703,680	830,845	Operational
San Lo Ruiz (Atilano St., San Lorenzo Ruiz, Tetuan, ZC)	353,376	401,574	233,596	-	-	234,933	Stand-by
Caputatan (Caputatan, Putik, ZC)	522,348	479,045	478,137	515,188	517,627	526,657	Operational
Lunzuran (Lunzuran, ZC)	46,980	117,485	66,126	87,354	81,509	69,755	Operational
Ayala 2 (Ayala, ZC)	135,948	245,013	14,883	4,597	-	65,448	Stand-by
Tulungatung1 (Ayala, ZC)	234,060	251,364	16,470	22,179	68,728	105,310	Stand-by
Maci-ay (Maciay Dr., Pasay Rd., San Roque, ZC)	43,368	108,795	38,486	55,812	66,121	91,108	Operational

Name of Facilities (Location)	Rated Capacity (m^3/year)	Actual Annual Production (m^3/year)					Status as of June 2021
		2016 (w/ El Niño)	2017	2018	2019 (w/ El Niño)	2020 (w/ drought)	
Brillantes (Brillantes Dr., Sta. Maria, ZC)	495,864	524,545	509,867	484,379	460,876	233,973	Operational
Trumata (Trumata Dr., Tumaga-Putik Rd., ZC)	278,040	371,064	325,899	269,985	238,767	283,045	Operational
Lupong (Lupong Rd., Cabatangan, ZC)	119,064	118,035	70,832	-	-	-	Stand-by
Pasobolong 2 (Pasobolong, ZC)	416,280	422,383	458,536	424,901	410,265	399,010	Operational
Tulungatung 2 (Resettlement Area, Tulungatung, ZC)	55,896	56,336	922	2,617	34,171	27,668	Stand-by
Divisoria (Cuvarubias Dr., Divisoria, ZC)	264,816	252,294	212,122	295,811	300,278	306,816	Operational
Lumiyap (Lumiyap, Divisoria, Zamboanga City)	287,820	314,178	300,086	339,684	342,820	374,130	Operational
Presa Mayor (Presa Mayor, Tumaga, Zamboanga City)	73,704	67,414	72,518	66,330	61,933	76,667	Operational
Cabaluay (Paso Caballo, Cabaluay, Zamboanga City)	201,276	202,138	201,840	201,938	202,217	215,337	Operational
Malasiga (Malasiga Rd., San Roque, Zamboanga City)	266,544	276,116	155,863	63,143	30,474	-	Stand-by
Total	6,733,140	6,925,396	5,596,665	4,721,277	5,000,380	5,214,920	

Source: ZCWD

Annex 3: Executive Order

Creating the Water Security Council

Republica de Filipinas
Ciudad de Zamboanga
OFICINA DEL ALCALDE

EXECUTIVE ORDER NO. BC-661-2021

AN EXECUTIVE ORDER CREATING THE ZAMBOANGA CITY WATER SECURITY COUNCIL (ZCWSC)

WHEREAS, the United Nations General Assembly, through Resolution A/64/292 of 2010, explicitly recognized access to safe and clean drinking water and sanitation as a human right that is essential for the full enjoyment of life and all human rights;

WHEREAS, Presidential Decree No. 856, otherwise known as the "Code on Sanitation of the Philippines" states that, the health of the people, being of paramount importance, all efforts of public services should be directed towards the protection and promotion of health;

WHEREAS, the City Government of Zamboanga proactively reinforces PD No. 856, the Philippine Clean Water Act of 2004 (RA 9275), Philippine Water Crisis Act of 1995 (RA 8041) and the Philippine Water Supply and Sanitation Master Plan;

WHEREAS, Ordinance No. 529, "The Environment Code of the City of Zamboanga" provides for inland water management in ensuring clean water supply, protection of underground water, water quality standards, monitoring and maintenance;

WHEREAS, the Forest Land Use Plan (FLUP) of Zamboanga City 2019-2027 strategized the protection, conservation and development of forest lands; including its watersheds and rivers systems in ensuring the sustainable supply of potable, domestic use and agricultural irrigation waters;

WHEREAS, the United States Agency for International Development (USAID) through its Strengthening Urban Resilience for Growth with Equity (SURGE) Project has been supporting the City Government of Zamboanga in strengthening and institutionalizing the city's initiatives on water and sanitation;

WHEREAS, the UNESCO states that "to achieve water security, we must protect vulnerable water systems, mitigate the impacts of water-related hazards such as floods and droughts, safeguard access to water functions and services and manage water resources in an integrated and equitable manner".

WHEREAS, despite the available water resources and the many efforts to utilize and manage these resources, the inadequacy of water supply and sanitation services remains among the major challenges of the city government.;

WHEREAS, the Zamboanga Peninsula Regional Development Plan 2017-2022 recognizes the inadequate supply of water in the region particularly in urban areas due to increasing population, growing economic activities associated with urbanization, and the impacts of climate change;

Tel Nos. (062) 991.2295 / (062) 991.6703
Telefax Nos. (062)992.0420 / (062) 991.1889
CITY HALL, N.S. VALDEROSA STREET, ZAMBOANGA CITY 7000, PHILIPPINES
www.zamboanga.gov.ph

WHEREAS, the city has felt the adverse impacts of droughts in 2016 and 2019 that particularly compellted the main water service provider to implement water rationing due to significant decrease in drinking water production/supply;

WHEREAS, the adoption of a city-wide Water Demand Management (WDM) program is not only a potent solution to balance water supply and water demand, but, is also an alternative to preserve the available water resources for future generations by reusing grey / waste water for non-domestic purposes among other interventions;

WHEREAS, to ensure adequate, safe, sustainable and resilient water supply and sanitation services in the city, there is a need to proactively engage and encourage multisectoral partnerships and collaborations with the business sector, non-government and civic organizations, indigenous people groups, religious sector, government institutions including mainstream media organizations;

WHEREAS, this Executive Order (EO) expands the compostion and broadens the scope of the TWG on Water Security that was created per EO BC 540-2000.

WHEREAS, this EO supersedes EO BC 540-2000.

NOW THEREFORE, I, MARIA ISABEL G. CLIMACO-SALAZAR, Mayor of the City of Zamboanga, by virtue of powers vested in me by law, do hereby order the following:

SECTION 1. OBJECTIVES

1.1. Strengthen the enabling environment for sustainable management of water supply and water demand;
1.2. Strengthen the capacity of water supply and waste water treatment service providers to expand and improve services;
1.3. Strengthen the collection, analysis and sharing of water and climate data;
1.4. Reduce risks from climate, natural and other related disasters; and
1.5. Engage multistakeholders participation in the governance of water resources;
1.6. Improve capacity of service providers in ensuring long-term water Security; and
1.7. Engage the expert services and adoption of water conservation-related technologies in ensuring water quality standards.

SECTION 2. CREATION AND COMPOSITION OF WATER SECURITY COUNCIL

There shall be created a Zamboanga City Water Security Council (ZCWSC) with the following composition and the City Mayor as the advisor:

Chair	: City Vice Mayor
Co-Chairperson	: General Manager, Zamboanga City Water District
Vice-Chairperson	: City Environment and Natural Resources Officer

Members :

1. Chair, SP Committee on Energy and Public Utilities
2. Chair, SP Committee on Natural Resources and Environment Protection
3. Chair, SP Committee on Health and Sanitation
4. City Administrator
5. City Planning and Development Coordinator
6. City Agriculturist
7. City Health Officer
8. City Disaster Risk Reduction Management Officer
9. Office of the City Mayor, Division Head, Barangay Affairs Office
10. Regional Executive Director, DENR IX
    - Regional Director, Environmental Management Bureau IX
    - CENRO Zamboanga City
    - PENRO Zamboanga Sibugay
11. President, Western Mindanao State University
    - Department Head, Environmental Engineering Department
    - Department Head, Sanitary Engineering
12. President, Ateneo de Zamboanga University
    - Head, Ateneo Center for Environment and Sustainability
13. President, Zamboanga City Chamber of Commerce & Industry Foundation, Inc.
14. President, Industrial Group of Zamboanga, Inc.

The memberships to the Council shall not be limited to above-mentioned as other stakeholders may be invited when the need arises.

SECTION 3. FUNCTIONS OF THE MEMBERS OF ZAMBOANGA CITY WATER SECURITY COUNCIL (ZCWSC)

3.1 Collaborates with concerned government and non-government agencies, water service providers, and stakeholders in crafting the Zamboanga City Water Security Master Plan and the Zamboanga City Septage Management Plan;

3.2 Reviews and recommends to the Local Chief Executive and the City Legislative Council relevant and responsive policies, strategies, guidelines, and innovations on water supply and sanitation development and management that serve as bases in establishing the targets and directions for water and sanitation expansion and improvement programs along the following thematic areas of concerns:

1. Water Recharge Area Restoration, Protection and Management (Watershed Area Protection)
2. Water Resources Protection, Development, and Management (Source Development, Water Supply Systems)
3. Renewable Water Resources (i.e. Rainwater Harvesting, Surface Runoff)
4. Water Conservation and Efficiency
5. Wastewater and Sewage Treatment and Re-Use
6. Septage Management

7. Point and Non-Point Water Pollution
8. Water Remediation and Rehabilitation
9. Water Supply and Sanitation Services in Emergencies

3.3 Reinforces public information, education, and communication (IEC) campaigns, advocacies and promotions on water conservation and proper and efficient water use including the installation / use of rainwater harvesting systems;
3.4 Promotes use of water efficient fixtures and products in public and private structures in coordination with the business sector which shall make available fixtures, products, and appliances that are water efficient; and
3.5 Reviews plan and programs on the construction of small impounding dams and other water supply system projects in strategic areas across the city and provide recommendations to the LGU and the water service providers.

SECTION 4. MEMBERSHIP OF THE ZCWSC. Membership in the ZCWSC is organizational. Head of organizations should automatically become members but may designate his/her permanent and one alternate representatives to the Council.

SECTION 5. SCHEDULE OF REGULAR MEETINGS. The Zamboanga City Water Security Council (ZCWSC) shall meet either virtual or face-to-face at least once every quarter or as often as necessary to promptly address and respond to pressing issues and concerns in the management of water resources, sanitation services, and water supply and demand.

SECTION 6. TECHNICAL SECRETARIAT. In addition to its being the Vice-Chairperson of the Water Security Council, the Office of the City Environment and Natural Resources Officer shall discharge the functions of technical secretariat to the Council.

SECTION 7. TECHNICAL WORKING GROUP (TWG). The TWG shall be composed of the following:

1. Office of the City Environment and Natural Resources Officer
2. Office of the City Planning and Development Coordinator
3. DENR-CENRO Zamboanga City
4. WMSU – Environmental Engineering Department
5. Zamboanga City Water District

The main function of the TWG is to provide administrative and technical support to the Council.

SECTION 8. REPORTS AND RECOMMENDATIONS. Upon recommendation of the TWG or any other entity, the Zamboanga City Water Security Council (ZCWSC) shall review, deliberate and approve any water and sanitation-related interventions including the utilization of the city's water resources.

SECTION 9. REPEALING CLAUSE. The Executive Order repeals, amends or supersedes all existing executive orders and other issuances inconsistent herewith.

Republica de Filipinas
Ciudad de Zamboanga
OFICINA DEL ALCALDE

SECTION 10. EFFECTIVITY. This Executive Order shall take effect upon signing and after 15 days from date of publication in the local newspapers.

Done in the City of Zamboanga , this 14 day of June, 2021.

MARIA ISABELLE G. CLIMACO
City Mayor

Tel Nos. (062) 991.2295 / (062) 991.6703
Telefax Nos. (062)992.0420 / (062) 991.1889
CITY HALL, N.S. VALDEROSA STREET, ZAMBOANGA CITY 7000, PHILIPPINES
www.zamboanga.gov.ph

Annex 4: Water Permits

PROVINCE	MUNICIPAL	GRANTEE	LOCATION	SOURCE	LATITUDE	LONGITUDE	GRANTED	PURPOSE	DATE_APP
ZAMBOANGA	CANDAR	ZAMBOANGA CITY WATER DISTRICT	CANDAR, ZAMBOANGA CITY	DEEPWELL	06-55-17.34	122-04-36.66	31.55	MUNICIPAL	04/29/2011
ZAMBOANGA	CANELOR MORET	ZAMBOANGA CITY WATER DISTRICT	CANELOR MORET, ZAMBOANGA CITY	DEEPWELL	06-55-5.58	122-04-08.7	2.77	MUNICIPAL	04/29/2011
ZAMBOANGA	DIVISORIA	ZAMBOANGA CITY WATER DISTRICT	DIVISORIA BOSIAN AREA, ZAMBOANGA	DEEPWELL	06-56-14.64	122-06-1.26	14.57	MUNICIPAL	04/29/2011
ZAMBOANGA	DIVISORIA	ZAMBOANGA CITY WATER DISTRICT	DIVISORIA, ZAMBOANGA	DEEPWELL	06-57-1.26	122-06-25.62	10.07	MUNICIPAL	04/29/2011
ZAMBOANGA	GUIWAN	ZAMBOANGA CITY WATER DISTRICT	GUIWAN, ZAMBOANGA CITY	DEEPWELL	06-55-33.84	122-05-25.38	18.93	MUNICIPAL	04/29/2011
ZAMBOANGA	PRESA MAYOR	ZAMBOANGA CITY WATER DISTRICT	PRESA MAYOR, ZAMBOANGA CITY	DEEPWELL	06-56-42.06	122-04-44.76	7.88	MUNICIPAL	04/29/2011
ZAMBOANGA	SAN LORENZO RUIZ	ZAMBOANGA CITY WATER DISTRICT	SAN LORENZO RUIZ, TUTUAN, ZAMBOANGA CITY	DEEPWELL	06-55-15	122-05-12.48	13.94	MUNICIPAL	04/29/2011
ZAMBOANGA	SIBUGAY	BALAGON IRRIGAORS ASSOCIATION	BALAGON, SIAY, SIBUGAY, ZAMBOANGA	BALAGON CREEK	07-46-59.06	122-54-2.66	1.60	IRRIGATION	07/14/2005
ZAMBOANGA	SIBUGAY	BALAGON IRRIGAORS ASSOCIATION	BALAGON, SIAY, SIBUGAY, ZAMBOANGA	PANDASAN CREEK	07-47-59.05	122-54-25.77	1.60	IRRIGATION	07/14/2005
ZAMBOANGA	SIBUGAY	LGU-BUUG	MABUHAY, BUUG,	SPRING	07-42-38.58	123-00-51.33	0.890	MUNICIPAL	09/14/2007
ZAMBOANGA	SIBUGAY	NATIONAL GRID CORPORATION OF THE PHILS.	STA. CLARA, NAGA, ZAMBOANGA CITY	DEEPWELL	07-48-36.72	122-41-13.20	0.029	OTHER USE (FIREFIGHTING)	07/01/2013
ZAMBOANGA	STA. MARIA	ZAMBOANGA CITY WATER DISTRICT	STA. MARIA, ZAMBOANGA CITY	DEEPWELL	06-55-48.34	122-03-57.18	15.78	MUNICIPAL	04/29/2011
ZAMBOANGA	STA. MARIA	ZAMBOANGA CITY WATER DISTRICT	STA. MARIA, ZAMBOANGA CITY	DEEPWELL	06-55-19.08	122-04-39.06	15.46	MUNICIPAL	04/29/2011
ZAMBOANGA	STA. MARIA	ZAMBOANGA CITY WATER DISTRICT	STA. MARIA, ZAMBOANGA CITY	DEEPWELL	06-55-16.38	122-03-21.06	12.62	MUNICIPAL	04/29/2011
ZAMBOANGA	STA. MARIA	ZAMBOANGA CITY WATER DISTRICT	STA. MARIA, ZAMBOANGA CITY	DEEPWELL	06-56-12	122-03-25.32	6.5	MUNICIPAL	04/29/2011

PROVINCE	MUNICIPAL	GRANTEE	LOCATION	SOURCE	LATITUDE	LONGITUDE	GRANTED	PURPOSE	DATE_APP
ZAMBOANGA	STA. MARIA	ZAMBOANGA CITY WATER DISTRICT	STA. MARIA, ZAMBOANGA CITY	DEEPWELL	06-55-57.45	122-05-31.68	15.71	MUNICIPAL	04/29/2011
ZAMBOANGA	SINUNUG	NATIONAL GRID CORPORATION OF THE PHILS.	BRGY. SINUNUG, ZAMBOANGA CITY	DEEPWELL	06-56-12	122-01-15	0.0290	OTHERS (OFFICE USE)	05/25/2010
ZAMBOANGA DEL NORTE	BACUNGAN	RAMON O. MARTINEZ	TALINGA, BACUNGAN	TALINGA SPRING	08-10-47	122-57-31	0.850	OTHERS (COMMERCIAL)	01/13/1995
ZAMBOANGA DEL NORTE	BALIGUAN	PROVINCIAL GOV'T OF ZAMBOANGA DEL NORTE	BRGY. DICULOM, BALIGUAN, ZAMBOANGA DEL NORTE	DEEPWELL	07-54-13.8	122-14-45.54	1.80	MUNICIPAL	03/27/2019
ZAMBOANGA DEL NORTE	BINIRAY	JOSE ADAZA MIRANDA	MIASAK, BINIRAY, ZAMBO. NORTE	DICAYA RIVER	08-29-38	123-17-44	20.000	IRRIGATION	01/12/1996
ZAMBOANGA DEL NORTE	DAPITAN	F.S.D.C.	ILAYA, DAPITAN	DAPITAN RIVER	08-39-45	123-25-30	35.000	IRRIGATION	11/28/1979
ZAMBOANGA DEL NORTE	DAPITAN	NEMESIO ATIS	SAN PEDRO, DAPITAN C.	SAN PEDRO CREEK	08-37-46	123-23-53	4.000	FISHERIES	01/04/1982
ZAMBOANGA DEL NORTE	DAPITAN	NEMESIO ATIS	SAN PEDRO, DAPITAN C.	SEA WATER	08-37-52	123-23-55	5.000	FISHERIES	01/04/1982
ZAMBOANGA DEL NORTE	DAPITAN	DAPITAN CITY WATER DISTRICT	CALANGRIS, DIWA-AN, DAPITAN	TALYAMAN CREEK	08-35-00	123-26-55	50.000	DOMESTIC	06/23/1995
ZAMBOANGA DEL NORTE	DAPITAN CITY	PAYAN IRRIGATOR'S ASSN. INC.	ILAYA, DAPITAN CITY	PAYAN CREEK	08-33-03	123-26-26	55.240	IRRIGATION	10/08/2007
ZAMBOANGA DEL NORTE	DAPITAN CITY	PROVINCIAL GOV'T OF ZAMBOANGA DEL NORTE	BRGY. NAPO, DAPITAN CITY, ZAMBOANGA DEL NORTE	DEEPWELL	08-41-26.89	123-29-28.29	1.00	MUNICIPAL	03/27/2019
ZAMBOANGA DEL NORTE	DAPITAN CITY	PROVINCIAL GOV'T OF ZAMBOANGA DEL NORTE	BRGY. CANLUCANI, DAPITAN CITY, ZAMBOANGA DEL NORTE	DEEPWELL	08-42-37.08	123-22-51.72	1.20	MUNICIPAL	03/27/2019
ZAMBOANGA DEL NORTE	DIPLAHAN	TAIWAN OVERSEAS MINING CO.,	KM.9 DIPLAHAN,ZAM. DEL SUR	DEEPWELL	07-41-06	122-59-06	0.060	DOMESTIC	07/22/1999
ZAMBOANGA DEL NORTE	DIPOLOG	F.S.D.C.	DIWAN, DIPOLOG CITY	LUBUNGAN RIVER.	08-24-57	123-21-20	15.000	IRRIGATION	09/26/1979

PROVINCE	MUNICIPAL	GRANTEE	LOCATION	SOURCE	LATITUDE	LONGITUDE	GRANTED	PURPOSE	DATE_APP
ZAMBOANGA DEL NORTE	DIPOLOG	F.S.D.C.	SAN JOSE, DIPOLOG	PUNTA RIVER	08-29-30	123-19-34	40.000	IRRIGATION	11/28/1979
ZAMBOANGA DEL NORTE	DIPOLOG	F.S.D.C.	LUGDUNGAN, DIPOLOG	DIPOLOG RIVER	08-35-00	123-21-40	69.000	IRRIGATION	10/03/1980
ZAMBOANGA DEL NORTE	DIPOLOG	F.S.D.C.	CAYASAN, DIPOLOG	LUBUNGAN RIVER	08-26-40	123-18-30	45.000	IRRIGATION	10/03/1980
ZAMBOANGA DEL NORTE	DIPOLOG	DIPOLOG-POLANCO IRR.	OLINGAN, DIPOLOG CITY	LAYAWAN R.	08-30-42	123-21-12	1672.000	IRRIGATION	06/01/1988
ZAMBOANGA DEL NORTE	DIPOLOG	ZAMBOANGA WATER DISTRICT	MIBANG,STA. FELOMENA	DEEP WELL	08-34-23	123-21-09	22.200	DOMESTIC	04/11/1989
ZAMBOANGA DEL NORTE	DIPOLOG	DIPOLOG CITY WATER DISTRICT	GALAS. DIPOLOG CITY	D.C. WELL FIELD	08-24-48	123-08-41	10.000	DOMESTIC	01/14/1992
ZAMBOANGA DEL NORTE	DIPOLOG	DIPOLOG CITY WATER DISTRICT	GULAYON, DIPOLOG CITY	DEEPWELL	08-33-28	123-20-46	21.830	DOMESTIC	10/29/1996
ZAMBOANGA DEL NORTE	DIPOLOG	DIPOLOG CITY WATER DISTRICT	LOBING OGIS, GALAS, DIPOLOG	DEEPWELL	08-35-26	123-20-35	17.540	DOMESTIC	10/29/1996
ZAMBOANGA DEL NORTE	DIPOLOG CITY	LILIY CONST. & DEVT. CORP.	DIPOLOP CITY. ZAM DEL NORTE	DEEPWELL	08-28-22	123-21-00	2.500	DOMESTIC	06/20/2000
ZAMBOANGA DEL NORTE	DIPOLOG CITY	ERNESTO RALPH L. TAN - ENZURE WATER SUPPLY	LORENZO III, TURNO, DIPOLOG CITY	DEEPWELL	08-34-24	123-21-58	0.52	MUNICIPAL	01/27/2015
ZAMBOANGA DEL NORTE	DIPOLOG CITY	ERNESTO RALPH L. TAN - ENZURE WATER SUPPLY	SAN JOSE VALLEY, BRGY. DICAYAS, DIPOLOG CITY	DEEPWELL	08-35-08	123-22-28	0.52	MUNICIPAL	01/27/2015
ZAMBOANGA DEL NORTE	DIPOLOG CITY	ERNESTO RALPH L. TAN - ENZURE WATER SUPPLY	MADISON COUNTY, BRGY. DICAYAS, DIPOLOG CITY	DEEPWELL	08-35-17	123-22-38	0.52	MUNICIPAL	01/27/2015
ZAMBOANGA DEL NORTE	GODGOD	LOMOGOM IRR ASSN INC	LOMOGOM, GODGOD	LOMOGOM CREEK	08-00-38	122-54-27	60.000	IRRIGATION	06/25/2004
ZAMBOANGA DEL NORTE	GULATAC	PROVINCIAL GOV'T OF ZAMBOANGA DEL NORTE	BRGY. BAYANIHAN, GULATAC, ZAMBOANGA DEL NORTE	SPRING	07-59-22.14	122-17-21.84	1.00	MUNICIPAL	03/27/2019
ZAMBOANGA DEL NORTE	JOSE DALMAN	PROVINCIAL GOV'T OF ZAMBOANGA DEL NORTE	BRGY. TABON, JOSE DALMAN, ZAMBOANGA DEL NORTE	SPRING	08-27-11.28	123-02-25.98	0.87	MUNICIPAL	03/27/2019

PROVINCE	MUNICIPAL	GRANTEE	LOCATION	SOURCE	LATITUDE	LONGITUDE	GRANTED	PURPOSE	DATE_APP
ZAMBOANGA DEL NORTE	JOSE DALMAN	PROVINCIAL GOV'T OF ZAMBOANGA DEL NORTE	BRGY. SIPAROK, JOSE DALMAN, ZAMBOANGA DEL NORTE	DEEPWELL	08-29-11.52	123-02-34.02	1.90	MUNICIPAL	03/27/2019
ZAMBOANGA DEL NORTE	KALAWIT	BATAYAN UNITED F.I.A.	KALAWIT, ZAMBOANGA DEL NORTE	RIVER	07-56-30	122-34-45	56.530	IRRIGATION	10/29/1998
ZAMBOANGA DEL NORTE	KALIPUNAN	SERES IAI	SERES, KALIPUNAN	SERES CREEK	08-23-53	123-19-20	76.690	IRRIGATION	11/25/2004
ZAMBOANGA DEL NORTE	KATIPUNAN	G. BILOG	MIAS, KATIPUNAN	MIAS CREEK			7.000	IRRIGATION	10/09/1975
ZAMBOANGA DEL NORTE	KATIPUNAN	J. TUNGUIAS	MIAS, KATIPUNAN	MIAS CREEK			3.000	IRRIGATION	10/09/1975
ZAMBOANGA DEL NORTE	KATIPUNAN	S. MIRANDA	MIAS, KATIPUNAN	BOAL-BOAL S.			5.000	IRRIGATION	10/09/1975
ZAMBOANGA DEL NORTE	KATIPUNAN	F.S.D.C.	KATIPUNAN, ZAM. DEL NORTE	PUNTA RIVER	08-26-58	123-18-43	15.000	IRRIGATION	09/26/1979
ZAMBOANGA DEL NORTE	KATIPUNAN	F.S.D.C.	MIASAK, KATIPUNAN	DICAYO RIVER	08-29-35	123-17-42	15.000	IRRIGATION	09/26/1979
ZAMBOANGA DEL NORTE	KATIPUNAN	F.S.D.C.	SINUYAK, KATIPUNAN	LUBUNGAN RIVER	08-28-37	123-19-07	40.000	IRRIGATION	09/26/1979
ZAMBOANGA DEL NORTE	KATIPUNAN	F.S.D.C.	CERES, KATIPUNAN	CERES RIVER	08-28-47	123-16-35	16.000	IRRIGATION	12/28/1979
ZAMBOANGA DEL NORTE	KATIPUNAN	F.S.D.C.	MALUGAS, KATIPUNAN	DIKAYO RIVER	08-29-56	123-17-56	55.000	IRRIGATION	03/19/1980
ZAMBOANGA DEL NORTE	KATIPUNAN	MITUNGAN IRR. ASS. INC.	KATIPUNAN, ZAM. DEL NORTE	MITUNGAN SPRING	08-25-28	123-18-32	72.000	IRRIGATION	07/24/2000
ZAMBOANGA DEL NORTE	KILAWIT	KALAWIT IA, INC	KILAWIT, ZAMBOANGA DEL NORTE	MALUB RIVER	07-55-03	122-31-15	198.870	IRRIGATION	12/29/2003
ZAMBOANGA DEL NORTE	LABASON	OSUKAN FA INC.	OSUKAN, LABASON	OSUKAN CREEK	08-03-48	122-30-48	70.000	IRRIGATION	08/01/1985
ZAMBOANGA DEL NORTE	LABASON	TRIPLE L IRRIGATORS ASSO. INC.	LABASON, ZAMBOANGA DEL NORTE	LABASON RIVER	08-02-40	122-29-50	216.000	IRRIGATION	03/03/2006
ZAMBOANGA DEL NORTE	LABASON	PROVINCIAL GOV'T OF ZAMBOANGA DEL NORTE	BRGY. LOPOC, LABASON,	DEEPWELL	08-04-1.02	122-31-33.6	2.60	MUNICIPAL	03/27/2019

PROVINCE	MUNICIPAL	GRANTEE	LOCATION	SOURCE	LATITUDE	LONGITUDE	GRANTED	PURPOSE	DATE_APP
			ZAMBOANGA DEL NORTE						
ZAMBOANGA DEL NORTE	LEON B. POSTIGO	PROVINCIAL GOV'T OF ZAMBOANGA DEL NORTE	BRGY. TALINGA, ELON B. POSTIGO, ZAMBOANGA DEL NORTE	DEEPWELL	08-10-27.96	122-27-16.56	2.00	MUNICIPAL	03/27/2019
ZAMBOANGA DEL NORTE	LILOY	LGU WATER SYSTEM	LILOY, ZAMBOANGA DEL NORTE	DEEPWELL	08-07-10	122-40-52	10.000	DOMESTIC	12/21/2001
ZAMBOANGA DEL NORTE	LILOY	PROVINCIAL GOV'T OF ZAMBOANGA DEL NORTE	BRGY. BANIGAN, LILOY, ZAMBOANG DEL NORTE	DEEPWELL	08-06-43.44	122-38-27.36	1.20	MUNICIPAL	03/27/2019
ZAMBOANGA DEL NORTE	MA. CRISTINA	DAPITAN WATER DISTRICT	AMBOGOC, MA. CRISTINA	AMBOGOC CREEK	08-38-50	123-26-40	20.000	DOMESTIC	06/23/1995
ZAMBOANGA DEL NORTE	MANUKAN	I. DALMAN	PONOT, MANUKAN	PONOT-DIOT RIVER			5.000	IRRIGATION	05/29/1975
ZAMBOANGA DEL NORTE	MANUKAN	CRYSTAL BEACH RESORT	PUNTA BLANCA, MANUKAN	DEEPWELL	08-31-00	123-04-00	0.500	RECREATIO N	09/10/1996
ZAMBOANGA DEL NORTE	MANUKAN	LOCAL GOVERNMENT OF MANUKAN	PALI, PALARANAN, MANUKAN	UNNAMED SPRING	08-29-00	123-06-00	1.000	DOMESTIC	06/24/1997
ZAMBOANGA DEL NORTE	PINAN	NIPA-AN IAI	BACUYONG, PINAN	NIPA-AN CREEK	08-29-45	123-25-37	58.000	IRRIGATION	07/01/1994
ZAMBOANGA DEL NORTE	POB. NORTH POLANCO	POLANCO WATER DISTRICT	POB. NORTH POLANCO	DEEPWELL	08-31-25	123-21-40	21.000	DOMESTIC	07/12/1999
ZAMBOANGA DEL NORTE	POLANCO	G. PATANGAN	PIAN, BANDERA	PIAN CREEK			15.000	IRRIGATION	05/29/1975
ZAMBOANGA DEL NORTE	POLANCO	F.S.D.C.	DANSULLAN, POLANCO	POLANCO RIVER	03-25-08	123-23-20	180.000	IRRIGATION	09/12/1979
ZAMBOANGA DEL NORTE	POLANCO	F.S.D.C.	NEW SIYACAB, POLANCO	POLANCO RIVER	08-24-02	123-24-35	50.000	IRRIGATION	09/12/1979
ZAMBOANGA DEL NORTE	POLANCO	F.S.D.C.	POBLACION, POLANCO	LAYAWAN RIVER	08-31-36	123-21-42	28.000	IRRIGATION	09/26/1979
ZAMBOANGA DEL NORTE	POLANCO	F.S.D.C.	MIASI, POLANCO	LAYAWAN RIVER	08-29-22	123-20-53	28.000	IRRIGATION	09/26/1979
ZAMBOANGA DEL NORTE	POLANCO	F.S.D.C.	ISING, POLANCO	LIPAAN CK.	08-34-04	123-22-58	80.000	IRRIGATION	09/26/1979

PROVINCE	MUNICIPAL	GRANTEE	LOCATION	SOURCE	LATITUDE	LONGITUDE	GRANTED	PURPOSE	DATE_APP
ZAMBOANGA DEL NORTE	POLANCO	F.S.D.C.	POLANCO, ZAMBOANGA DEL NORTE	DIPOLOG RIVER	08-32-16	123-22-15	22.500	IRRIGATION	10/03/1980
ZAMBOANGA DEL NORTE	POLANCO	FIRM BLDRS'S. REALTY CORP.	POLANCO, ZAMBOANGA DEL NORTE	DEEPWELL	08-32-26	123-21-31	0.760	DOMESTIC	05/28/1996
ZAMBOANGA DEL NORTE	POLANCO	NEW SICAYAB & DANSULLAN I.A	POLANCO, ZAMBOANGA DEL NORTE	RIVER	08-26-05	123-22-39	149.480	IRRIGATION	11/26/1998
ZAMBOANGA DEL NORTE	POLANCO	PRYCE CORPORATION	POB. NORTH POLANCO	DIPOLOG RIVER	08-32-21	123-22-02	2.880	IRRIGATION	05/11/1999
ZAMBOANGA DEL NORTE	POLANCO	LASILELA IRR. ASS. INC.	SILAWE, ZAMBOANGA DEL NORTE	LAYAWAN RIVER	08-27-51	123-21-43	241.220	IRRIGATION	07/12/1999
ZAMBOANGA DEL NORTE	POLANCO	GUISALI IAI	GUINLES, POLANCO	PINAN RIVER	08-29-26	123-24-27	324.000	IRRIGATION	05/19/2005
ZAMBOANGA DEL NORTE	RIZAL	NILABO - LONGONAN IA, INC.	UPPER LA ESPERANZA, RIZAL, ZAMBOANGA DEL NORTE	NILABO CREEK	08-33-50	123-32-33	14.27	IRRIGATION	01/27/2006
ZAMBOANGA DEL NORTE	RIZAL	NILABO - LONGONAN IA, INC.	UPPER LA ESPERANZA, RIZAL, ZAMBOANGA DEL NORTE	LONGONA N CREEK	08-33-55	123-31-57	3.22	IRRIGATION	01/27/2006
ZAMBOANGA DEL NORTE	ROXAS	PRES.M.A.ROXAS WATER DIST.	LANGATIAN, ROXAS	DEEPWELL	08-30-41	123-14-33	8.000	DOMESTIC	05/26/1995
ZAMBOANGA DEL NORTE	ROXAS	SOUTHERN ISLAND OIL MILL C./ WORLDWIDE INVESTMENT LAND MANAGEMENT & RESOURCES INC.	NABILID ROXAS ZAMBO DEL NORTE	DEEPWELL	08-30-50	123-15-20	5.050	INDUSTRIAL	01/28/1999
ZAMBOANGA DEL NORTE	ROXAS	POMS VENTURES CORPORATION/WORL DWIDE INVESTMENT LAND MANAGEMENT AND RES. INC.	NABILID, ROXAS	PAIAO RIVER	08-30-50	123-14-39	1.00	INDUSTRIAL	08/27/2009

PROVINCE	MUNICIPAL	GRANTEE	LOCATION	SOURCE	LATITUDE	LONGITUDE	GRANTED	PURPOSE	DATE_APP
ZAMBOANGA DEL NORTE	SALUG	F.S.D.C.	LANAWAN, SALUG	SALOG RIVER	08-05-59	122-44-45	27.000	IRRIGATION	21 09 2005
ZAMBOANGA DEL NORTE	SERGIO OSMENA	F.S.D.C.	PIDAGAN, S. OSMENA	SALUG RIVER	08-05-45	122-45-12	43.000	IRRIGATION	04/23/1979
ZAMBOANGA DEL NORTE	SERGIO OSMENA	YABU ADJACENT BRGYS. I.A.I.	SERGIO OSMENA, SR.	YABU RIVER	08-15-36	123-24-33	261.000	IRRIGATION	01/28/1992
ZAMBOANGA DEL NORTE	SIAYAN	PROVINCIAL GOV'T OF ZAMBOANGA DEL NORTE	BRGY. PARANG LUMBA, SIAYAN, ZAMBOANGA DEL NORTE	SPRING	08-17-52.08	123-03-12.36	3.00	MUNICIPAL	03/27/2019
ZAMBOANGA DEL NORTE	SIBUCO	IRRIG. ASSN.	LONDAY, SIBUCO	VITALI RIVER	07-18-53	122-08-48	200.000	IRRIGATION	06/22/1984
ZAMBOANGA DEL NORTE	SINDANGA	DON FEDERICO IAI	INUMAN, SINDANGA	LINGAWAN CREEK	08-11-53	123-00-41	40.000	IRRIGATION	03/14/2005
ZAMBOANGA DEL NORTE	SINDANGAN	F.S.D.C.	MARAS, SINDANGAN	INGIN RIVER	08-11-24	122-58-48	70.000	IRRIGATION	07/03/1979
ZAMBOANGA DEL NORTE	SINDANGAN	F.S.D.C.	PIAO, SINDANGAN	PIAO RIVER	08-14-05	123-00-30	39.000	IRRIGATION	11/28/1979
ZAMBOANGA DEL NORTE	SINDANGAN	SINDANGAN IAI	SINDANGAN, Zamboanga del Norte	SINDAGAN RIVER	08-11-42	123-07-00	1200.000	IRRIGATION	07/01/1994
ZAMBOANGA DEL NORTE	SINDANGAN	LAGAG-DENOYAN IAI	LAGAG, SINDANGAN	PIAO RIVER	08-16-38	123-03-02	175.670	IRRIGATION	12/14/1998
ZAMBOANGA DEL NORTE	SINDANGAN	SINDANGAN WATER DISTRICT	MANDIH, SINDANGAN	DEEPWELL	08-12-59	123-00-26	22.000	DOMESTIC	06/06/2003
ZAMBOANGA DEL NORTE	SIOCON	OLD & NEW LITUBAN BRGY. IRR.	SIOCON, ZAMBOANGA DEL NORTE	LIBUTAN RIVER	07-41-54	122-11-08	1125.000	IRRIGATION	02/26/1991
ZAMBOANGA DEL NORTE	SIOCON	TVI RESOURCES DEVT., INC.	CANATUAN, TABAYO, SIOCON	WATER FALL CREEK	07-44-48	123-16-20	502.750	DOMESTIC	08/27/1996
ZAMBOANGA DEL NORTE	SIOCON	TVI RESOURCES DEVT., INC.	SIOCON, ZAMBOANGA DEL NORTE	JP CREEK	07-44-54	122-17-11	0.190	DOMESTIC	10/29/1996
ZAMBOANGA DEL NORTE	SIOCON	TVI RESOURCES DEVT., INC.	SIOCON, ZAMBOANGA DEL NORTE	CANATUAN CREEK	07-44-15	122-16-37	24.500	INDUSTRIAL	02/11/1997

PROVINCE	MUNICIPAL	GRANTEE	LOCATION	SOURCE	LATITUDE	LONGITUDE	GRANTED	PURPOSE	DATE_APP
ZAMBOANGA DEL NORTE	SIOCON	SILVESTRE CABRAL IRRIGATORS	S. CABRAL, SIOCON	CANIBUNGAN CREEK	07-44-45	122-09-10	45.650	IRRIGATION	03/31/2004
ZAMBOANGA DEL NORTE	SIOCON	SILVESTRE CABRAL IRRIGATORS	S. CABRAL, SIOCON	SAPA LIKOD CREEK	07-44-43	122-09-15	15.620	IRRIGATION	03/31/2004
ZAMBOANGA DEL NORTE	SIOCON	SIMASFRATTI IRRIGATORS ASSOCIATION, INC.	MALIPOT, SIOCON, ZAMBOANGA DEL NORTE	SIOCON RIVER	07-45-12	122-11-6.54	559.49	IRRIGATION	10/05/2005
ZAMBOANGA DEL NORTE	SIRAWAI	CLUBP IAI	PIACAN, SIRAWAY	PIACAN RIVER	07-31-19	122-07-54	285.000	IRRIGATION	04/29/1994
ZAMBOANGA DEL NORTE	SIRAWAI	SIRAWAI PLYWOOD & LUMBER	SIRAWAI, ZAMBOANGA DEL NORTE	LINCOB CREEK	07-30-29	122-15-00	25.000	IRRIGATION	07/27/1998
ZAMBOANGA DEL NORTE	SIRAWAI	PROVINCIAL GOV'T OF ZAMBOANGA DEL NORTE	BRGY. POBLACION, SIRAWAL, ZAMBOANGA DEL NORTE	DEEPWELL	07-35-4.8	122-09-3.6	1.70	MUNICIPAL	03/27/2019
ZAMBOANGA DEL NORTE	ZAMBOANGA	ZAMBOANGA WD	UPPER POSONANCA	TUMAGA RIVER	06-58-13	122-04-07	354.000	DOMESTIC	02/24/1988
ZAMBOANGA DEL NORTE	ZAMBOANGA	FLORENCIO A. PARAISO	MAMPANG, ZAM. CITY	RAIN WATER	06-55-12	122-07-55	120.000	FISHERIES	07/27/1988
ZAMBOANGA DEL NORTE	ZAMBOANGA	MANICAHAN FARM'S I.A.	MANICAHAN,ZAM.CITY	MANICAHAN RIVER	07-02-06	122-10-37	400.000	IRRIGATION	08/09/1988
ZAMBOANGA DEL NORTE	ZAMBOANGA	TALISAYAN FIA	TALISAYAN,ZAM. CITY	TALISAYAN RIVER	07-00-51	121-57-16	66.000	IRRIGATION	09/15/1988
ZAMBOANGA DEL SUR	ALICIA	C. AQUINO	LAMBUYOGAN, ALICIA	LAMBUYOGAN RIVER			15.000	IRRIGATION	06/10/1975
ZAMBOANGA DEL SUR	ALICIA	BELLA I.A. INC.	PAYANGAN, ALICIA	BINUANGAN CREEK	07-31-38	122-56-58	137.000	IRRIGATION	01/14/1992
ZAMBOANGA DEL SUR	ALICIA	LUTIMAN IRR SERVICE ASSN	LUTIMAN, ALICIA	LUTIMAN RIVER	07-35-41	122-55-08	172.320	IRRIGATION	09/08/2003
ZAMBOANGA DEL SUR	AURORA	P JABELLO	BALINTAWAK, AURORA	TUKURAN RIVER			6.000	IRRIGATION	05/29/1975
ZAMBOANGA DEL SUR	AURORA	TITA ONG	POBLACION, AURORA	WELL	07-56-58	123-34-26	0.020	DOMESTIC	09/17/1982
ZAMBOANGA DEL SUR	AURORA	P. CARORO	SAN JOSE, AURORA	WELL	07-56-27	123-33-56	0.020	DOMESTIC	09/17/1982

PROVINCE	MUNICIPAL	GRANTEE	LOCATION	SOURCE	LATITUDE	LONGITUDE	GRANTED	PURPOSE	DATE_APP
ZAMBOANGA DEL SUR	AURORA	ANITA MAYVE	POBLACION, AURORA	WELL	07-57-06	123-35-00	0.020	DOMESTIC	09/17/1982
ZAMBOANGA DEL SUR	AURORA	N. GUMALE	POBLACION, AURORA	WELL	07-56-59	123-35-01	0.020	DOMESTIC	09/17/1982
ZAMBOANGA DEL SUR	AURORA	C. CORTEZ	POBLACION, AURORA	WELL	07-56-59	123-34-57	0.020	DOMESTIC	10/12/1982
ZAMBOANGA DEL SUR	AURORA	AIDA YANGCO	POBLACION, AURORA	WELL	07-57-16	123-34-56	0.020	DOMESTIC	10/12/1982
ZAMBOANGA DEL SUR	AURORA	JOSE TECSON	POBLACION, AURORA	WELL	07-56-21	123-34-58	0.020	DOMESTIC	10/12/1982
ZAMBOANGA DEL SUR	AURORA	G. TECSON JR.	POBLACION, AURORA	WELL	07-56-12	123-34-48	0.020	DOMESTIC	10/12/1982
ZAMBOANGA DEL SUR	AURORA	A. TECSON	POBLACION, AURORA	WELL	07-56-10	123-35-16	0.020	DOMESTIC	10/12/1982
ZAMBOANGA DEL SUR	AURORA	TIRSO APORTO	POBLACION, AURORA	WELL	07-58-00	123-34-49	0.020	DOMESTIC	10/12/1982
ZAMBOANGA DEL SUR	AURORA	LUZ FLORES	POBLACION, AURORA	WELL	07-57-00	123-34-50	0.020	DOMESTIC	09/17/1982
ZAMBOANGA DEL SUR	AURORA	KASAVIFIA INC.	KAUSWAGAN, AURORA, ZAMBOANGA DEL SUR	SAPA LUBOC CREEK	07-59-37	123-32-28.4	69.530	IRRIGATION	06/23/2006
ZAMBOANGA DEL SUR	AURORA	KASAVIFIA INC.	SAPA LUBOC, AURORA, ZAMBOANGA DEL SUR	SAPA LUBOC CREEK	07-59-37	123-32-28.4	37.500	IRRIGATION	06/23/2006
ZAMBOANGA DEL SUR	AURORA	LGU-AURORA	AURORA, ZAMBOANGA DEL SUR	DEEPWELL	07-56-41.76	123-35-43.62	4.35	MUNICIPAL	04/28/2015
ZAMBOANGA DEL SUR	AURORA	LGU-AURORA	AURORA, ZAMBOANGA DEL SUR	DEEPWELL	07-57-10.26	123-34-32.04	9.25	MUNICIPAL	05/28/2015
ZAMBOANGA DEL SUR	AURORA	NATIONAL GRID CORPORATION OF THE PHILIPPINES	BRGY. CABILINAN, ZAMBOANGA DEL SUR	DEEPWELL	07-55-51.06	123-35-26.58	0.116	OTHERS (FIREFIGHTING)	05/28/2018
ZAMBOANGA DEL SUR	AYALA	MEGA FISHING CORPORATION	DUMAGSA, AYALA, ZAM. CITY	DEEPWELL	06-59-00	120-55-46	3.350	INDUSTRIAL	12/21/2001

PROVINCE	MUNICIPAL	GRANTEE	LOCATION	SOURCE	LATITUDE	LONGITUDE	GRANTED	PURPOSE	DATE_APP
ZAMBOANGA DEL SUR	BAYOG	NATIONAL IRRIGATION ADMINISTRATION	KALAYAGAN, BAYOG	SIBUGUEY RIVER			3500.000	IRRIGATION	12/31/1975
ZAMBOANGA DEL SUR	BOBUAN BAYOG	BOCADE IRR. SERVICE ASS.	BOBUAN, BAYOG	BOBUAN RIVER	07-58-06	123-05-07	62.570	IRRIGATION	07/26/1999
ZAMBOANGA DEL SUR	BOBUAN, BAYOG	BOCADE IRR. SERVICE ASS.	CANUAYAN, BAYOG	CANUAYAN RIVER	07-57-59	123-04-13	62.570	IRRIGATION	07/26/1999
ZAMBOANGA DEL SUR	BUUG	F.S.D.C.	MAGANAY, BUUG	MUYO RIVER	07-40-51	123-02-22	80.000	IRRIGATION	05/22/1978
ZAMBOANGA DEL SUR	BUUG	F.S.D.C.	MUYO, BUUG	MUYO RIVER	07-44-34	123-06-01	25.000	IRRIGATION	10/24/1979
ZAMBOANGA DEL SUR	BUUG	F.S.D.C.	MUYO 2, BUUG	TIMUALAG RIVER	07-40-36	123-02-27	18.000	IRRIGATION	12/28/1979
ZAMBOANGA DEL SUR	BUUG	TIMICALAG ISA	LABRADOR, BUUG	TIMUALAG CREEK	07-43-44	123-03-56	90.000	IRRIGATION	05/16/1986
ZAMBOANGA DEL SUR	BUUG	MUNICIPALITY OF BUUG	SITIO BARORAO, PAMINTAYAN	BARORAO SPRING	07-41-15	123-04-53	4.500	MUNICIPAL	07/24/2007
ZAMBOANGA DEL SUR	DIMATOLING	VALENTIN O. BONCAVIL	DIMATOLING	BUBORAY RIVER			86.000	IRRIGATION	10/09/1975
ZAMBOANGA DEL SUR	DINAS	F.S.D.C.	DINAS, ZAMBOANGA DEL SUR	DINAS RIVER	07-37-42	123-20-44	107.000	IRRIGATION	09/29/1976
ZAMBOANGA DEL SUR	DINAS	F.S.D.C.	MIGPULAO, DINAS	DINAS RIVER	07-37-24	123-20-30	20.000	IRRIGATION	10/24/1979
ZAMBOANGA DEL SUR	DINAS	F.S.D.C.	EAST MIGPULAO, DINAS	DINAS RIVER	07-36-58	123-20-49	21.000	IRRIGATION	10/24/1979
ZAMBOANGA DEL SUR	DINAS	F.S.D.C.	EAST MIGPULAO, DINAS	DINAS RIVER	07-37-57	123-21-24	20.000	IRRIGATION	10/24/1979
ZAMBOANGA DEL SUR	DINAS	F.S.D.C.	DUNGGUAN, DINAS	DINAS RIVER	07-37-14	123-20-27	15.000	IRRIGATION	10/03/1980
ZAMBOANGA DEL SUR	DINAS	PEPITO A. DIVINA	SAN ISIDRO, DINAS	DIVINA SPRING	07-36-16	123-18-31	7.220	IRRIGATION	07/09/1996
ZAMBOANGA DEL SUR	DIPLAHAN	DITAY-GUINOMAN IA. INC.	GUINOMAN, DIPLAHAN	GUINOHAN CREEK	07-50-03	122-55-01	10.400	IRRIGATION	02/25/1992
ZAMBOANGA DEL SUR	DIPLAHAN	DITAY-GUINOMAN IA, INC.	GUINOMAN, DIPLAHAN	DITAY CREEK	07-50-01	122-56--3	480.000	IRRIGATION	02/25/1992
ZAMBOANGA DEL SUR	DUMALINAO	E. DAGASDAS	POBLACION, DUMALINAO	O- TUPAK CREEK			48.000	IRRIGATION	08/20/1975

PROVINCE	MUNICIPAL	GRANTEE	LOCATION	SOURCE	LATITUDE	LONGITUDE	GRANTED	PURPOSE	DATE_APP
ZAMBOANGA DEL SUR	DUMALINAO	E. LUNA	CANONAN, DUMALINAO	DUMALINAO RIVER			20.000	IRRIGATION	08/20/1975
ZAMBOANGA DEL SUR	DUMALINAO	MINDANAO COL.	SUMADAT, DUMALINAO	DUMALINAO CREEK			20.000	IRRIGATION	08/20/1975
ZAMBOANGA DEL SUR	DUMALINAO	SOUTH.MINDANAO COLLEGES,INC.	DUMADAT, DUMALINAO	DUMALINAO CREEK			20.000	IRRIGATION	08/20/1975
ZAMBOANGA DEL SUR	DUMALINAO	I. PANANG	SUMADAT, DUMALINAO	DUMALINAO RIVER			6.000	IRRIGATION	10/09/1975
ZAMBOANGA DEL SUR	DUMALINAO	CANUNAN IRRIGATORS ASSN.	DUMALINAO, ZAMBOANGA DEL SUR	DINAS DIOT RIVER	07-45-51	123-20-24	240.000	IRRIGATION	06/26/1978
ZAMBOANGA DEL SUR	DUMALINAO	NILO IRRIGATORS ASSN.	NILO, DUMALINAO	NILO RIVER	07-48-05	123-18-50	86.000	IRRIGATION	03/23/1983
ZAMBOANGA DEL SUR	DUMALINAO	PAGSUDUM I.A., INC.	DUMALINAO, ZAMBOANGA DEL SUR	DUMALINAO RIVER	07-49-13	123-22-17	70.000	IRRIGATION	09/27/1991
ZAMBOANGA DEL SUR	DUMALINAO	REYMUNDO T. OPENA	LIMAS, DUMALINAO	MARAGANG RIVER	07-49-45	123-18-20	50.500	IRRIGATION	10/15/1991
ZAMBOANGA DEL SUR	DUMALINAO	REBOCON IRRIGATORS SERVICE	REBOKON, DUMALINOA	MALUBO RIVER	07-45-00	123-25-02	112.500	IRRIGATION	05/28/1996
ZAMBOANGA DEL SUR	DUMALINAO	HILIGAYNON IRRIG. SERVICE IA	REBOKON, DUMALINAO	REBOKON RIVER	07-45-34	123-24024	84.480	IRRIGATION	11/12/1996
ZAMBOANGA DEL SUR	DUMINGAG	M. FERRAREN JR	NEW BASAK, DUMINGAG				12.000	IRRIGATION	05/29/1975
ZAMBOANGA DEL SUR	GUIPOS	BALOCAN IA, INC.	DINAS DIOT, BALONGATING, GUIPOS, ZAMBOANGA DEL SUR		07-46-8.48	123-20-12.39	393.700	IRRIGATION	06/23/2006
ZAMBOANGA DEL SUR	GUIPOS	PRIMETELL IRRIGATORS ASSOCIATION INC.	BRGY. DAAGOHOY, GUIPOS, ZAMBOANGA DEL SUR	DINAS DAKO RIVER	07-54-36.58	123-18-36.58	30.68	IRRIGATION	09/30/2016
ZAMBOANGA DEL SUR	IPIL	MR. JOSE TABAMO	IPIL, ZAMBOANGA DEL SUR	GUITUAN RIVER			7.000	IRRIGATION	10/19/1976
ZAMBOANGA DEL SUR	IPIL	F.S.D.C.	TUPILAC, IPIL	TUPILAC RIVER	07-37-49	122-27-02	45.000	IRRIGATION	10/24/1979

PROVINCE	MUNICIPAL	GRANTEE	LOCATION	SOURCE	LATITUDE	LONGITUDE	GRANTED	PURPOSE	DATE_APP
ZAMBOANGA DEL SUR	IPIL	LEA Z.A. TUPAZ	MABINI, IPIL	SURABAY RIVER	07-39-40	122-28-45	46.300	FISHERIES	11/26/1991
ZAMBOANGA DEL SUR	IPIL	EDUARDO A. PARRENAS	ZAMBOANGA DEL SUR	TIAYON RIVER	07-44-00	122-33-00	26.710	FISHERIES	12/21/1992
ZAMBOANGA DEL SUR	IPIL	IPIL-TITAY WATER DISTRICT	CAPARAN, IPIL	DEEPWELL	07-45-32	122-32-36	5.6	MUNICIPAL	11/05/2009
ZAMBOANGA DEL SUR	IPIL	IPIL-TITAY WATER DISTRICT	TAWAY, IPIL	DEEPWELL	07-46-55	122-35-04	1.00	MUNICIPAL	11/05/2009
ZAMBOANGA DEL SUR	JOSEFINA	ZAMBOANGA DEL SUR-ELECTRIC COOPERATIVE INC.	JOSEFINA, ZAMBOANGA DEL SUR	SALUG DAKU RIVER	08-15-24	123-28-10	2323.2	POWER	01/18/2011
ZAMBOANGA DEL SUR	JOSEFINA	ZAMBOANGA DEL SUR-ELECTRIC COOPERATIVE INC.	JOSEFINA, ZAMBOANGA DEL SUR	SALUG DAKU RIVER	08-16-15	123-32-54	950.4	POWER	01/18/2011
ZAMBOANGA DEL SUR	JOSEFINA	ZAMBOANGA DEL SUR-ELECTRIC COOPERATIVE INC.	JOSEFINA, ZAMBOANGA DEL SUR	SALUG DAKU RIVER	08-15-57.3	123-32-17	1069.31	POWER GENERATION	01/18/2011
ZAMBOANGA DEL SUR	KABASALAN	F.S.D.C.	CALAPAN, KABASALAN	BAUAYAN RIVER	07-46-45	122-47-53	80.000	IRRIGATION	10/24/1979
ZAMBOANGA DEL SUR	KABASALAN	F.S.D.C.	CONCEPCION, KABASALAN	BAUAYAN RIVER	07-46-46	122-47-51	40.000	IRRIGATION	12/28/1979
ZAMBOANGA DEL SUR	KABASALAN	ADELAIDA TAN	POBLACION, KABASALAN	WELL	07-47-49	122-45-37	1.000	INDUSTRIAL	10/01/1982
ZAMBOANGA DEL SUR	KABASALAN	B. WOOTON	RIVERSIDE, KABASALAN	BOOC RIVER	07-47-22	122-44-56	20.000	FISHERIES	06/22/1984
ZAMBOANGA DEL SUR	KABASALAN	ADELAIDA TAN	KABASALAN	SANTALE CREEK	07-46-00	122-47-41	10.000	FISHERIES	06/22/1984
ZAMBOANGA DEL SUR	KABASALAN	B-CALAPAN IAI	BUAYAN, KABASALAN	BUAYAN RIVER	07-48-20	122-48-52	72.000	IRRIGATION	05/30/1986
ZAMBOANGA DEL SUR	KABASALAN	POB. KABASALAN I.A., INC.	KABASALAN, ZaAMBOANGA DEL SUR	KABASALAN RIVER	07-50-15	122-46=58	600.000	IRRIGATION	08/27/1991
ZAMBOANGA DEL SUR	KUMALARANG	KUMALARANG FARMERS IRRIGATORS ASSOCIATION, INC.	KUMALARANG, ZAMBOANGA DEL SUR	KUMALARANG RIVER	07-45-26.09	123-10-41.75	200.120	IRRIGATION	12/07/2006
ZAMBOANGA DEL SUR	LABANGAN	B. ORTIZ	WEST LUYA, LABANGAN	LUYA R.			14.000	IRRIGATION	05/29/1975

PROVINCE	MUNICIPAL	GRANTEE	LOCATION	SOURCE	LATITUDE	LONGITUDE	GRANTED	PURPOSE	DATE_APP
ZAMBOANGA DEL SUR	LABANGAN	F.S.D.C.	LABANGAN	LABANGAN RIVER	07-54-35	123-26-18	80.000	IRRIGATION	10/19/1976
ZAMBOANGA DEL SUR	LABANGAN	F.S.D.C.	DIPAYA, LABANGAN	LABANGAN RIVER	07-55-12	123-20-40	27.400	IRRIGATION	10/03/1980
ZAMBOANGA DEL SUR	LABANGAN	NICANOR GEGUIERA	BULANIT, LABANGAN	TAWAGAN RIVER	07-49-42	123-29-03	8.300	FISHERIES	02/12/1991
ZAMBOANGA DEL SUR	LABANGAN	PRIMO GEGUIERA	BULANIT, LABANGAN	TAWAGAN RIVER	07-49-42	123-29-05	11.100	FISHERIES	02/12/1991
ZAMBOANGA DEL SUR	LABANGAN	GOVT. GRANT BINAYAN WS.I.A.	BINAYAN, LABANGAN	BINAYAN CREEK	07-55-28	123-24-09	6.660	IRRIGATION	07/27/1995
ZAMBOANGA DEL SUR	LAKEWOOD	ERNESTO D. AGUILAR	TUBOD, LAKEWOOD	LILY'S SPRING	07-48-38	123-12-36	0.160	COMMERCIAL	03/04/2004
ZAMBOANGA DEL SUR	LAPUYAN	F.S.D.C.	LAPUYAN	LAPUYAN RIVER	07-37-52	123-11-54	17.000	IRRIGATION	10/24/1979
ZAMBOANGA DEL SUR	LAPUYAN	CATALINO BUGAO	MARUING, LAPUYAN	MARUING CREEK	07-39-25	123-09-40	50.000	FISHERIES	04/28/1992
ZAMBOANGA DEL SUR	LAPUYAN	BRGY LUBOSAN	LUBOSAN, LAPUYAN	PILAGAN SPRING	07-40-03	123-13-42	0.150	MUNICIPAL	02/10/2005
ZAMBOANGA DEL SUR	MAGSAYSAY	SAPA ANDING AGRARIAN RC	SAPA, ANDING, MAGSAYSAY	TUKURAN RIVER	07-58-34	123-26-35	180.000	IRRIGATION	05/19/2004
ZAMBOANGA DEL SUR	MAHAYAG	BONICO IRRIGATORS ASSN.	BONIO, MAHAYAG	MANGUELES CREEK	08-07-09	123-26-18	372.000	IRRIGATION	08/09/1977
ZAMBOANGA DEL SUR	MAHAYAG	DIWAN PARASAN MABUHAY IRRIG. ASSN.	DIWAN, MAHAYAG	DIWAN CREEK	08-07-30	123-28-26	141.000	IRRIGATION	12/27/1982
ZAMBOANGA DEL SUR	MAHAYAG	BONIAO FARMERS I.A., INC.	BONIAO, MAHAYAG	GETRAN RIVER	08-08-00	123-23-00	140.250	IRRIGATION	08/27/1991
ZAMBOANGA DEL SUR	MAHAYAG	MOLAVE WATER DISTRICT	DIWAN, MAHAYAG	BOGUAG SPRING	08-07-43	123-28-43	50.000	DOMESTIC	02/25/1992
ZAMBOANGA DEL SUR	MAHAYAG	ROGELIO MABANAG	MAHAYAG	SPRING	08-07-15	123-27-17	7.200	RECREATION	09/01/1999
ZAMBOANGA DEL SUR	MAHAYAG	JOAQUIN WONG, JR.	MAHAYAG, ZAMBOANGA DEL SUR	DIWAN, SPRING	08-07-37	123-28-02	6.120	RECREATION	10/18/1999
ZAMBOANGA DEL SUR	MAHAYAG	LOCAL GOVERNMENT OF MAHAYAG	BRGY. TUBORAN, MAHAYAG, ZAMBOANGA DEL SUR	TUBORAN SPRING	08-07-00	123-25-00	20.700	MUNICIPAL	08/18/2006

PROVINCE	MUNICIPAL	GRANTEE	LOCATION	SOURCE	LATITUDE	LONGITUDE	GRANTED	PURPOSE	DATE_APP
ZAMBOANGA DEL SUR	MALANGAS	A. CASAMAYOR	LINDANG, MALANGAS	SIBUGUEY RIVER			20.000	IRRIGATION	08/20/1975
ZAMBOANGA DEL SUR	MARGO SA TUBIG	LGU- MARGO SA TUBIG	LIMAMAWAN, MARGO SA TUBIG, ZAMBOANGA DEL SUR	SUAREZ SPRING	07-34-18	123-09-46	8.100	MUNICIPAL	02/13/2007
ZAMBOANGA DEL SUR	MARGO SA TUBIG	LGU- MARGO SA TUBIG	TIGULAN, MARGO SA TUBIG, ZAMBOANGA DEL SUR	MAGALLOPAN SPRING	07-34-29	123-10-18	15.300	MUNICIPAL	02/13/2007
ZAMBOANGA DEL SUR	MARGO SA TUBIG	LGU- MARGO SA TUBIG	LIMAMAWAN, MARGO SA TUBIG, ZAMBOANGA DEL SUR	GALVEZ SPRING	07-34-17	123-09-25	9.900	MUNICIPAL	02/13/2007
ZAMBOANGA DEL SUR	MIDSALIP	F.S.D.C.	BIHILOT, MIDSALIP	BIHILOT CK.	08-04-23	123-19-53	40.000	IRRIGATION	11/29/1977
ZAMBOANGA DEL SUR	MIDSALIP	MINING CO.	MIDSALIP	BONAWAN RIVER	08-01-31	123-17-40	0.700	DOMESTIC	07/31/1980
ZAMBOANGA DEL SUR	MIDSALIP	MINING CO.	MIDSALIP	TIMHABOY RIVER	08-01-31	123-17-40	62.300	INDUSTRIAL	07/31/1980
ZAMBOANGA DEL SUR	MIDSALIP	TIMHABOY ISA	TIMHABOY, MIDSALIP	TIMHABOY RIVER	08-03-00	123-18-05	150.000	IRRIGATION	07/31/1980
ZAMBOANGA DEL SUR	MIDSALIP	GUMA-POB.A.I.A.INC.	POB.A.MIDSALIP	BUCOL CREEK	08-02-23	123-23-15	33.000	IRRIGATION	02/29/1989
ZAMBOANGA DEL SUR	MIDSALIP	TIMBABOY-POB. I.A.INC.	TIMBABOY,MIDSALIP	BUNAWAN RIVER	08-01-17	123-16-43	24.100	IRRIGATION	05/29/1990
ZAMBOANGA DEL SUR	MIDSALIP	BULORON-DUMALINAO VALLEY IAI	BULORON, MIDSALIP	MIDSALIP RIVER	08-01-06	123-21-37	295.850	IRRIGATION	04/16/1993
ZAMBOANGA DEL SUR	MIMINGAY	NATIONAL IRRIGATION ADMINISTRATION	UP. TIMONAN, MIMINGAY	D & T & M & GULTON			3000.000	IRRIGATION	08/20/1975
ZAMBOANGA DEL SUR	MOLAVE	NATIONAL IRRIGATION ADMINISTRATION	MOLAVE	SALOG R.	08-08-07	123-26-06	6450.000	IRRIGATION	07/31/1980
ZAMBOANGA DEL SUR	MOLAVE	S. EMNACEN	PELOCABAN, MOLAVE	F-PELOCABAN SP	08-09-05	123-32-37	113.000	POWER	07/31/1980

PROVINCE	MUNICIPAL	GRANTEE	LOCATION	SOURCE	LATITUDE	LONGITUDE	GRANTED	PURPOSE	DATE_APP
ZAMBOANGA DEL SUR	MOLAVE	MAGSAYSAY-KATIPUNAN I.A.I.	MALATING, MOLAVE	MALATING RIVER	08-03-47	123-25-42	294.200	IRRIGATION	01/28/1992
ZAMBOANGA DEL SUR	MOLAVE	MUN. GOVT. OF MOLAVE	MOLAVE	SPRING	08-07-57	123-28-31	25.990	DOMESTIC	11/12/1998
ZAMBOANGA DEL SUR	NAGA	HEIRS OF PEDRO CHANGCO	LA PAZ, NAGA	BACALAN RIVER	07-48-15	122-38-48	7.640	FISHERIES	08/13/1991
ZAMBOANGA DEL SUR	NAGA	CELESTIAL FARMS. INC.	LA PAZ. NAGA	DEEPWELL	07-48-40	122-39-18	1.320	DOMESTIC	01/14/1992
ZAMBOANGA DEL SUR	NAGA	CELESTIAL FARMS, INC.	LA PAZ, NAGA	DEEPWELL	07-48-57	122-39-11	2.200	INDUSTRIAL	01/14/1992
ZAMBOANGA DEL SUR	NAGA	CELESTIAL FARMS, INC.	LA PAZ. NAGA	DEEPWELL	07-48-18	122-38-49	1.320	INDUSTRIAL	01/14/1992
ZAMBOANGA DEL SUR	NAGA	CELESTIAL FARMS, INC.	LA PAZ, NAGA	BACALAN RIVER	07-47-46	122-38-39	757.000	FISHERIES	01/14/4992
ZAMBOANGA DEL SUR	NAGA	COLESTIAL FARMS INC.	LA PAZ,NAGA	BACALAN RIVER	07-47-25	122-38-17	757.000	FISHERIES	01/14/1992
ZAMBOANGA DEL SUR	OLUTANGA	PATRICIA C. BAYA	SOLAR, OLUTANGA	DEEPWELL	07-18-53	122-56-44	0.500	DOMESTIC	01/14/1992
ZAMBOANGA DEL SUR	PAGADIAN	J. PADAYHAG	PAGADIAN CITY	DEEPWELL	07-49-26	123-26-10	0.150	DOMESTIC	10/24/1979
ZAMBOANGA DEL SUR	PAGADIAN	BRGY. LUMBIA	LUMBIA, PAGADIAN CITY	LUMBIA S.	07-49-40	123-26-34	10.000	DOMESTIC	08/22/1980
ZAMBOANGA DEL SUR	PAGADIAN	LINO COLOMA	TUBURAN, PAGADIAN	DEEPWELL	07-30-23	123-27-04	0.300	DOMESTIC	07/24/1981
ZAMBOANGA DEL SUR	PAGADIAN	PAGADIAN CITY WATER DISTRICT	CABRERA ST. PAGADIAN CITY	DUMAGOC SPRING	07-49-07	123-25-29	43.500	DOMESTIC	03/12/1991
ZAMBOANGA DEL SUR	PAGADIAN	PAGADIAN CITY WATER DISTRICT	CABRERA ST. PAGADIAN CITY	BALANGAS AN SPRING	07-49-42	123-25-24	15.000	DOMESTIC	03/12/1991
ZAMBOANGA DEL SUR	PAGADIAN	PAGADIAN CITY WATER DISTRICT	CABRERA ST. PAGADIAN CITY	DUMAGOC SPRING	07-49-04	123-25-49	5.800	DOMESTIC	03/12/1991
ZAMBOANGA DEL SUR	PAGADIAN	PAGADIAN CITY WATER DISTRICT	CABRERA ST. PAGADIAN CITY	NAPOLAN SPRING	07-49-35	123-24-52	15.000	DOMESTIC	03/12/1991
ZAMBOANGA DEL SUR	PAGADIAN	ERNESTO BAYLOSIS	KAWIT, PAGADIAN CITY	PAGADIAN RIVER	07-49-20	123-27-05	25.000	FISHERIES	08/13/1991
ZAMBOANGA DEL SUR	PAGADIAN	LOWER SIBATANG SUBANIN IAI	SIBATANG, PAGADIAN CITY	SIBATANG RIVER	07-55-15	123-26-05	42.640	IRRIGATION	02/26/1993
ZAMBOANGA DEL SUR	PAGADIAN CITY	SAYAO ENTERPRISES	PAGADIAN CITY	DEEPWELL	07-49-31	123-26-22	0.290	COMMERCIAL	04/10/2001

PROVINCE	MUNICIPAL	GRANTEE	LOCATION	SOURCE	LATITUDE	LONGITUDE	GRANTED	PURPOSE	DATE_APP
ZAMBOANGA DEL SUR	PAGADIAN CITY	SALVA VICTORIA A. DELA PENA	MANGA, PAGADIAN CITY	MANGA SPRING	07-51-54	123-25-40	7.640	DOMESTIC	06/24/2002
ZAMBOANGA DEL SUR	PAGADIAN CITY	ZAMBOANGA DEL SUR MARITIME	BALANGASAN DIST., PAGADIAN	DEEPWELL	07-49-28	123-25-02	1.000	DOMESTIC	06/06/2003
ZAMBOANGA DEL SUR	PAGADIAN CITY	BARANGAY SAN PEDRO WW	SAN PEDRO, PAGADIAN CITY	DEEPWELL #1	07-49-31	123-26-36	0.348	DOMESTIC	12/12/2003
ZAMBOANGA DEL SUR	PAGADIAN CITY	BARANGAY SAN PEDRO WW	SAN PEDRO, PAGADIAN CITY	DEEPWELL #2	07-49-32	123-26-31	0.290	DOMESTIC	12/12/2003
ZAMBOANGA DEL SUR	PAGADIAN CITY	BRGY SAN PEDRO WATERWORKS	SAN PEDRO, PAGADIAN CITY	DEEPWELL #3	07-49-30	123-26-27	0.348	DOMESTIC	12/12/2003
ZAMBOANGA DEL SUR	PAGADIAN CITY	SAMSON M. LIM	RIZAL AVE., TUBURAN DISTRICT	SPRING	07-49-37	123-26-29	3.000	RECREATION	09/15/2004
ZAMBOANGA DEL SUR	PAGADIAN CITY	PAGADIAN CITY WATER DISTRICT	TAWAGAN SUR, PAGADIAN CITY	DEEPWELL #1	07-50-47	123-27-45	29.00	MUNICIPAL	11/07/2005
ZAMBOANGA DEL SUR	PAGADIAN CITY	PAGADIAN CITY WATER DISTRICT	TAWAGAN SUR, PAGADIAN CITY	DEEPWELL #2	07-51-26	123-27-42	20.00	MUNICIPAL	11/07/2005
ZAMBOANGA DEL SUR	PAGADIAN CITY	PAGADIAN CITY WATER DISTRICT	TAWAGAN SUR, PAGADIAN CITY	DEEPWELL #3	07-51-00	123-28-15	20.00	MUNICIPAL	11/07/2005
ZAMBOANGA DEL SUR	PAGADIAN CITY	ATTY. PRECY M. MORON	LUMAD, PAGADIAN, ZAMBOANGA DEL SUR	LUMAD CREEK			1.220	IRRIGATION	05/10/2006
ZAMBOANGA DEL SUR	PAGADIAN CITY	VIOLETA GILONGOS CARIAGA	LINENZA, PAGADIAN CITY	DEEPWELL	07-50-57.54	123-27-26.52	0.005	LIVESTOCK	08/08/2007
ZAMBOANGA DEL SUR	PAGADIAN CITY	ZAMBOANGA DEL SUR ELECTRIC COOP. INC.	JOSEFINA, ZAMBOANGA DEL SUR	SALUG DAKU RIVER	08-15-42.83	123-31-26.23	2028.850	POWER GENERATION	07/11/2007
ZAMBOANGA DEL SUR	PAGADIAN CITY	DAVID B. CARTOJANO	UPPER SAN TAN, TAWAGAN SUR	DEEPWELL	07-51-41	123-28-06	0.034	MUNICIPAL	09/07/2007
ZAMBOANG DEL SUR	PAGADIAN CITY	ALVIN LIM SY	BONIFACIO ST.A PAGADIAN CITY	DEEPWELL	07-49-22	123-26-21	0.02	MUNICIPAL	07/14/2005
ZAMBOANG DEL SUR	PAGADIAN CITY	PAGADIAN CITY WATER DISTRICT	TIGUMA, PAGADIAN CITY, ZAMBOANGA DEL SUR	DEEPWELL #1	07-50-13	123-57-30	12.000	MUNICIPAL	06/13/2006
ZAMBOANG DEL SUR	PAGADIAN CITY	PAGADIAN CITY WATER DISTRICT	TIGUMA, PAGADIAN CITY, ZAMBOANGA DEL SUR	DEEPWELL #2	07-51-01	123-26-56	20.000	MUNICIPAL	06/13/2006

PROVINCE	MUNICIPAL	GRANTEE	LOCATION	SOURCE	LATITUDE	LONGITUDE	GRANTED	PURPOSE	DATE_APP
ZAMBOANG DEL SUR	PAGADIAN CITY	PAGADIAN CITY WATER DISTRICT	MANGA, PAGADIAN CITY, ZAMBOANGA DEL SUR	MANGA SPRING	07-51-16	123-26-19	19.719	MUNICIPAL	06/13/2006
ZAMBOANG DEL SUR	PAGADIAN CITY	ATTY. JORGE T. ALIMONTE - HOTEL CAMILA	PAGADIAN CITY, ZAMBOANGA DEL SUR	DEEPWELL	07-49-32.13	123-26-15.40	1.3	OTHERS (HOTEL USE)	07/23/2014
ZAMBOANG DEL SUR	PAGADIAN CITY	PAGADIAN CITY WATER DISTRICT	TIGUMA, PAGADIAN CITY, ZAMBOANGA DEL SUR	DEEPWELL	07-50-50.05	123-27-45.5	5.8	MUNICIPAL	07/25/2014
ZAMBOANGA DEL SUR	PAMUCUTAN	PRIMEWATER INFRASTRUCTURE CORPORATION	PAMUCUTAN, ZAMBOANGA CITY	ANULING RIVER	07-01-58	121-57-46	752.31	MUNICIPAL	07/25/2014
ZAMBOANGA DEL SUR	PAGADIAN CITY	PAGADIAN DOCTORS HOSPITAL	PAGADIAN, ZAMBOANGA DEL SUR	DEEPWELL	07-49-28	123-26-16	0.09	OTHER USE (HOSPITAL USE)	03/27/2019
ZAMBOANGA DEL SUR	PAYAO	BULAWAN K-G IA. INC.	KULASIAN. PAYAO	KULASIAN RIVER	07-37-30	122-50-12	984.000	IRRIGATION	04/28/1992
ZAMBOANGA DEL SUR	R. LIM	ORE-LINE MINING CORP.	KM. 19 RT LIM	BC CAMPSITE CRK	07-44-59	122-22-51	0.600	DOMESTIC	10/29/1993
ZAMBOANGA DEL SUR	R. LIM	ORE-LINE MINING CORP.	KM. 19 RT LIM	BC CAMPSITE CRK	07-44-55	122-22-49	0.650	INDUSTRIAL	10/29/1993
ZAMBOANGA DEL SUR	RAMON MAGSAYSAY	F.S.D.C.	RAMON MAGSAYSAY	DIPOLOG R.	08-03-01	123-29-05	124.000	IRRIGATION	01/10/1978
ZAMBOANGA DEL SUR	RAMON MAGSAYSAY	KATIPUNAN VALLEY IAI	KATIPUNAN, R. MAGSAYSAY	LIARGAO RIVER	08-03-27	123-27-49	142.830	IRRIGATION	04/15/1994
ZAMBOANGA DEL SUR	RAMON MAGSAYSAY	JAMES T. CABARON	RAMON MAGSAYSAY	SPRING #2	77-58-44	123-01-46	0.990	DOMESTIC	08/06/2003
ZAMBOANGA DEL SUR	SIAY	F.S.D.C.	LABASAN SIAY	SULUAN R.	07-42-19	122-52-32	100.000	IRRIGATION	06/13/1978
ZAMBOANGA DEL SUR	SIAY	F.S.D.C.	LAGPING, SIAY	SIBUGUEY R.	07-29-32	122-52-30	192.000	IRRIGATION	09/26/1979
ZAMBOANGA DEL SUR	SIAY	F.S.D.C.	BATO, SIAY	BATO R.	07-45-13	122-49-33	60.300	IRRIGATION	12/28/1979

PROVINCE	MUNICIPAL	GRANTEE	LOCATION	SOURCE	LATITUDE	LONGITUDE	GRANTED	PURPOSE	DATE_APP
ZAMBOANGA DEL SUR	SIAY	F.S.D.C.	BALUCANAN, SIAY	SULUAN R.	07-42-00	122-52-35	40.000	IRRIGATION	04/07/1980
ZAMBOANGA DEL SUR	SIAY	BALINGASAN FIA	BALINGASAN, SIAY	BALINGASAN CK.	07-43-45	122-57-00	30.000	IRRIGATION	05/16/1986
ZAMBOANGA DEL SUR	SIAY	POKILACO I.ASSN.,INC.	KIMOS,SIAY	SULOAN RIVER	07-43-09	122-52-45	170.000	IRRIGATION	01/24/1989
ZAMBOANGA DEL SUR	SIAY	PRIMITIVO F. ACEBRON	LAITH, SIAY	SIBUGUEY BAY	07-44-33	122-49-01	5.400	FISHERIES	08/13/1991
ZAMBOANGA DEL SUR	SIAY	UPPER MANIHA I.A.I.	MANIHA, SIAY	MANIHA CREEK	07-45-00	122-54-20	46.600	IRRIGATION	08/27/1991
ZAMBOANGA DEL SUR	SIAY	MOLAVE HERITEGE REALTY	BUKID MONCHING, SIAY	SEA WATER	07-42-25	122-48-32	70.000	FISHERIES	08/27/1991
ZAMBOANGA DEL SUR	SIAY	MOLAVE HERITAGE REALTY	BUKID NMONCHING, SIAY	SEA WATER	07-43-28	122-48-50	70.000	IRRIGATION	08/27/1991
ZAMBOANGA DEL SUR	SIAY	MANIHA WATERWORKS & SAN. ASS	BRGY. MANIHA	UNNAMED SPRING	07-44-00	122-55-07	0.330	DOMESTIC	06/08/1999
ZAMBOANGA DEL SUR	SIAY	CAMANGA AGRARIAN REFORM	CAMANGA, SIAY	CAMANGA CREEK	07-45-05	122-54-31	162.980	IRRIGATION	03/31/2004
ZAMBOANGA DEL SUR	TALUSAN	LORENZO YWAYAN	TALUSAN	DEEPWELL	08-31-23	122-46-10	1.800	INDUSTRIAL	07/10/1990
ZAMBOANGA DEL SUR	TALUSAN	ERLINDA A. DETALLA	POBLACION, TALUSAN	DEEPWELL	07-25-25	122-48-54	0.348	DOMESTIC	04/14/1998
ZAMBOANGA DEL SUR	TAMBULIG	NATIONAL IRRIGATION ADMINISTRATION	TAMBULIG	T & I & TOLUAN CK.			2770.000	IRRIGATION	06/17/1975
ZAMBOANGA DEL SUR	TAMBULIG	NATIONAL IRRIGATION ADMINISTRATION	TAMBULIG	USUGAN R.			1668.000	IRRIGATION	08/18/1976
ZAMBOANGA DEL SUR	TAMBULIG	NATIONAL IRRIGATION ADMINISTRATION	TAMBULIG	TOLOAN CK.			137.000	IRRIGATION	08/18/1976
ZAMBOANGA DEL SUR	TAMBULIG	F.S.D.C.	LOWER TIPARAC	SALUG-DUIT R.	07-37-50	122-27-36	150.000	IRRIGATION	11/29/1977
ZAMBOANGA DEL SUR	TAMBULIG	F.S.D.C.	BALUGO, TAMBULIG	DIPOLOG R.	07-47-59	123-06-10	440.000	IRRIGATION	11/29/1977
ZAMBOANGA DEL SUR	TAMBULIG	HAPPY VALLEY ET AL I.A.	TAMBULIG	USUGAN RIVER	08-04-31	123-32-35	240.000	IRRIGATION	10/15/1991

PROVINCE	MUNICIPAL	GRANTEE	LOCATION	SOURCE	LATITUDE	LONGITUDE	GRANTED	PURPOSE	DATE_APP
ZAMBOANGA DEL SUR	TITAY	Y-CLUSTER IRRIGATORS AI	TITA ZAMBOANGA DEL SUR	PALOMOS RIVER	07-53-48	122-35-27	195.000	IRRIGATION	12/14/1998
ZAMBOANGA DEL SUR	TITAY	KAYABAN RIVER IRRIGATORS	TITAY	RIVER	07-54-27	122-33-36	3.000	IRRIGATION	08/23/1999
ZAMBOANGA DEL SUR	TITAY	PAG-LAUM IRR ASSOCIATION	TITAY	PALOMOC RIVER	07-53-54	122-33-30	240.480	IRRIGATION	09/08/2003
ZAMBOANGA DEL SUR	TITAY	IPIL-TITAY WATER DISTRICT	PUROK MANGGA, TITAY	DEEPWELL	07-52-28	122-32-10	2	MUNICIPAL	11/05/2009
ZAMBOANGA DEL SUR	TITAY	IPIL-TITAY WATER DISTRICT	MANGGA AZUSANO, TITAY	DEEPWELL	07-52-24	122-32-02	6	MUNICIPAL	11/05/2009
ZAMBOANGA DEL SUR	TUKURAN	Q. CABRALES	CORVADA, TUKURAN	TUKURAN R.			18.000	IRRIGATION	05/14/1975
ZAMBOANGA DEL SUR	TUKURAN	F. OCAMPO	TUKURAN	TUKURAN R.			12.000	IRRIGATION	05/25/1979
ZAMBOANGA DEL SUR	TUKURAN	M. OSORES	NAVALAN, TUKURAN	TUKURAN R.			21.000	IRRIGATION	06/10/1975
ZAMBOANGA DEL SUR	TUKURAN	I. PADAYBAG	CORVADA, TUKURAN	TUKURAN R.	07-52-18	123-35-10	100.000	IRRIGATION	11/24/1975
ZAMBOANGA DEL SUR	TUKURAN	R. RIVERA	CORVADA, TUKURAN	TUKURAN R.			150.000	IRRIGATION	10/18/1976
ZAMBOANGA DEL SUR	TUKURAN	A. CABATIC	MILITAR, TUKURAN	TUKURAN R.			6.000	IRRIGATION	06/17/1975
ZAMBOANGA DEL SUR	TUKURAN	Q. CABRALES	CORBADA, TUKURAN	TUKURAN R.	07-52-33	123-35-33	18.000	IRRIGATION	09/10/1975
ZAMBOANGA DEL SUR	TUKURAN	F.S.D.C.	TUKURAN	TUKURAN R.	07-52-43	123-35-55	74.000	IRRIGATION	09/29/1976
ZAMBOANGA DEL SUR	TUKURAN	F.S.D.C.	LAPIRAN, TUKURAN	TUKURAN R.	07-52-35	123-35-23	40.000	IRRIGATION	11/29/1979
ZAMBOANGA DEL SUR	TUKURAN	F.S.D.C.	CURHADA, TUKURAN	TUKURAN R.	07-52-12	123-35-12	40.000	IRRIGATION	10/24/1979
ZAMBOANGA DEL SUR	TUKURAN	F.S.D.C.	LAPIRAN, TUKURAN	TUKURAN R.	07-55-14	123-34-00	34.000	IRRIGATION	10/03/1980
ZAMBOANGA DEL SUR	TUKURAN	TUKURAN I.ASSN.INC.	TUKURAN	TUKURAN RIVER	07-53-31	123-36-26	598.000	IRRIGATION	09/26/1988
ZAMBOANGA DEL SUR	TUKURAN	MR. FRANCISCO DOSDOS	TUKURAN	TABUAN CREEK	07-54-40	123-33-00	8.000	IRRIGATION	02/14/1989
ZAMBOANGA DEL SUR	TUKURAN	TEODORICA MAGUSARA	LOWER NAVALAN, TUKURAN	SPRING	07-56-21	123-31-01	0.010	LIVESTOCK	04/29/1994

PROVINCE	MUNICIPAL	GRANTEE	LOCATION	SOURCE	LATITUDE	LONGITUDE	GRANTED	PURPOSE	DATE_APP
ZAMBOANGA DEL SUR	TUNGAWAN	JOE ROMEL ALDE	MASAN, TUNGAWAN	SEA WATER	07-36-36	122-27-01	4.630	FISHERIES	03/29/1996
ZAMBOANGA DEL SUR	TUNGAWAN	PILAR MARIA ALDE	MASAO, TUNGAWAN	SEAWATER	07-36-36	122-27-01	4.630	FISHERIES	03/29/1996
ZAMBOANGA DEL SUR	TUNGAWAN	EMILY ALDE	MASAO, TUNGAWAN	SEAWATER	07-36-36	122-27-01	4.630	FISHERIES	03/29/1996
ZAMBOANGA DEL SUR	TUNGAWAN	JESUSA TAGARO GAMON	LUNIB,VICENCIO,SAGUM	MACULAY RIVER	07-33-22	123-13-00	10.000	FISHERIES	05/29/1990
ZAMBOANGA DEL SUR	VINCENZO SAGUN	MUNICIPALITY OF V. SAGUN	LINOGUAYAN, V. SAGUN	LINOGUAYAN SPRING	07-33-00	123-10-00	17.400	DOMESTIC	04/29/1997
ZAMBOANGA DEL SUR	VITALI	VITALI DISTRICT IRR. ASS.INC	BRGY. SIBULAO	SIBULAO RIVER	07-20-27	122-15-03	124.280	IRRIGATION	07/12/1999
ZAMBOANGA DEL SUR	ZAMBOANGA	PERFECTO E. MARQUEZ	CABALUAY, ZAMBOANGA CITY	CABALUAY RIVER	07-00-40	122-10-20	14.000	IRRIGATION	05/29/1975
ZAMBOANGA DEL SUR	ZAMBOANGA	BASE METAL	AYALA ZAMBOANGA CITY	PALAWAN CK.	07-03-02	122-01-46	1.000	INDUSTRIAL	11/11/1976
ZAMBOANGA DEL SUR	ZAMBOANGA	S.M.C.	ZAMBOANGA CITY	WELL	06-55-31	122-04-51	9.700	INDUSTRIAL	07/03/1979
ZAMBOANGA DEL SUR	ZAMBOANGA	LUNZURAN HEIGHTS SUBD.	LUNZURAN, ZAMBOANGA CITY	DEEPWELL	06-57-38	122-05-22	10.000	DOMESTIC	09/26/1979
ZAMBOANGA DEL SUR	ZAMBOANGA	F.S.D.C.	ZAMBOANGA CITY	VITALI R.	07-21-10	122-15-56	40.000	IRRIGATION	10/24/1979
ZAMBOANGA DEL SUR	ZAMBOANGA	SEAFOODS CORP.	ZAMBOANGA DEL SUR	WELL	06-58-06	121-56-17	1.300	INDUSTRIAL	11/26/1980
ZAMBOANGA DEL SUR	ZAMBOANGA	IRRIG. ASSN.	ZAMBOANGA CITY	MASABA R.	07-10-54	122-12-03	130.000	IRRIGATION	03/23/1983
ZAMBOANGA DEL SUR	ZAMBOANGA	BALINSUNGAY I.A.INC.	MERCEDES,ZAM. CITY	SINGUP RIVEREK	07-01-58	122-10-34	554.000	IRRIGATION	06/27/1989
ZAMBOANGA DEL SUR	ZAMBOANGA	GOLDEN ICE KING PLANT	TETUAN,ZAMBOANGA CITY	DEEPWELL	06-54-38	122-04-36	0.005	INDUSTRIAL	12/17/1991
ZAMBOANGA DEL SUR	ZAMBOANGA	WESTERN MINDANAO POWER CORP.	MANICAHAN, ZAMBOANGA CITY	MANICAHAN CREEK	07-01-38	122-10-56	55.150	INDUSTRIAL	05/19/1998
ZAMBOANGA DEL SUR	ZAMBOANGA	TALISAYAN FIAI	ANULING PAMUCUTAN ZAMBO.CITY	SAS RIVER	07-01-28	121-57-10	36.920	IRRIGATION	03/08/1999
ZAMBOANGA DEL SUR	ZAMBOANGA	LUMPANAC IRR ASSN, INC	LUMPANAC, IMELDA ZAMBOANGA	LUMPANAC CREEK	07-39-20	122-53-39	84.892	IRRIGATION	07/16/2004

PROVINCE	MUNICIPAL	GRANTEE	LOCATION	SOURCE	LATITUDE	LONGITUDE	GRANTED	PURPOSE	DATE_APP
ZAMBOANGA DEL SUR	ZAMBOANGA CITY	COLUMBUS SEAFOODS CORP	TALISAYAN, ZABOANGA CITY	DEEPWELL #1	06-59-20	121-55-43	9.450	INDUSTRIAL	09/23/2002
ZAMBOANGA DEL SUR	ZAMBOANGA CITY	COLUMBUS SEAFOODS CORP	TALISAYAN, ZABOANGA CITY	DEEPWELL #2	06-59-21	121-55-38	9.450	INDUSTRIAL	09/23/2002
ZAMBOANGA DEL SUR	ZAMBOANGA CITY	COLUMBUS SEAFOODS CORP	TALISAYAN, ZAMBOANGA CITY	DEEPWELL #3	06-59-22	121-55-34	9.450	INDUSTRIAL	09/23/2002
ZAMBOANGA DEL SUR	ZAMBOANGA CITY	BRGY SAPA ANDING RWSS	RAMON MAGSAYSAY, ZAMBOANGA	SAPA ANDING SPRING	07-57-23	123-31-00	0.825	DOMESTIC	04/29/2004
ZAMBOANGA DEL SUR	ZAMBOANGA CITY	MARCELO MENDOZA CORPORATION	Gov. Lim Ave., Zamboanga City	DDEEPWELL	05-55-16.38	122-03-21.06	0.58	MUNICIPAL	02/07/2006
ZAMBOANGA DEL SUR	ZAMBOANGA CITY	COLUMBUS SEAFOODS CORP. - CENTURY PACIFIC FOOD INC.	PUROK 1 DUMAGSA,TALISAYAN Z.C.	DEEPWELL #4	06-59-27	121-55-38	12.620	INDUSTRIAL	03/21/2007
ZAMBOANGA DEL SUR	ZAMBOANGA CITY	COLUMBUS SEAFOODS CORP. - CENTURY PACIFIC FOOD INC.	PUROK 1 DUMAGSA,TALISAYAN Z.C.	DEEPWELL #5	06-59-31	121-55-38	12.620	INDUSTRIAL	03/21/2007
ZAMBOANGA DEL SUR	ZAMBOANGA CITY	ZAMBOANGA CITY SPECIAL ECO.ZONE AUTHORITY	SAN RAMON, ZAMBOANGA CITY	DEEPWELL	06-59-53	121-55-30	5.270	INDUSTRIAL	05/07/2007
ZAMBOANGA DEL SUR	ZAMBOANGA CITY	NATIONAL GRID CORPORATION OF THE PHILS.	BRGY. SANGALI, ZAMBOANGA CITY, ZAMBOANGA DEL SUR	DEEPWELL	07-48-36.96	122-41-13.32	0.029	OTHERS (FIREFIGHTING)	07/01/2013
ZAMBOANGA DEL SUR	ZAMBOANGA CITY	PRIMEWATER INFRASTRUCTURE CORPORATION	PAMUCUTAN, ZAMBOANGA CITY	ANULING RIVER	07-01-58	121-57-46	173.61	MUNICIPAL	02/09/2015
ZAMBOANGA DEL SUR	ZAMBOANGA CITY	NADECO REALTY CORPORATION	MCLL Rd., CULIANAN, ZAMBOANGA CITY	DEEPWELL	06-58-0.309	122-08-24.686	3.97	INDUSTRIAL	05/16/2016
ZAMBOANGA DEL SUR	ZAMBOANGA CITY	NADECO REALTY CORPORATION	MCLL Rd., CULIANAN, ZAMBOANGA CITY	DEEPWELL	06-57-56.78	122-08-23.136	5.25	INDUSTRIAL	06/28/2016
ZAMBOANGA DEL SUR	ZAMBOANGA CITY	SAN RAMON POWER INC.	BRGY. TALISAYAN, ZAMBOANGA CITY	SAAZ RIVER	07-00-3.99	121-55-40.61	4.67	INDUSTRIAL	07/29/2016

PROVINCE	MUNICIPAL	GRANTEE	LOCATION	SOURCE	LATITUDE	LONGITUDE	GRANTED	PURPOSE	DATE_APP
ZAMBOANGA DEL SUR	ZAMBOANGA CITY	LUZVIMINDA LAND HOLDINGS INC.	TETUAN DISTRICT, ZAMBOANGA CITY	DEEPWELL	06-55-28	122-04-51	14.83	INDUSTRIAL	08/21/2016
ZAMBOANGA DEL SUR	ZAMBOANGA CITY	LUZVIMINDA LAND HOLDINGS INC.	TETUAN DISTRICT, ZAMBOANGA CITY	DEEPWELL	06-55-30	122-04-51	16.67	INDUSTRIAL	08/21/2016
ZAMBOANGA DEL SUR	ZAMBOANGA CITY	SAN RAMON POWER INC. (SRPI)	BRGY. TALISAYAN, ZAMBOANGA CITY, ZAMBOANGA DEL SUR	SULO SEA	07-00-41.01	121-55-07	6388.890	INDUSTRIAL	11/27/2017

Annex 5: Water Resources

OBJECTIVE

This chapter presents the analysis on the surface water resources and hydrology situation of the Project Area. Under this heading, the general objective is to determine the net available surface water that may be utilized, taking into account the current situation and utilization in the Project Area, as well as considering future trends and the projected effects of climate change. The river in primary concern is the Tumaga River, which is also the current source of the Zamboanga Water District.

PROJECT AREA SETTING

Climate

The Philippine climate is tropical and maritime. It is characterized by relatively high temperature, high humidity and abundant rainfall. The Philippine climate is classified into four types depending on rainfall distribution and pattern (**Figure**). The four climate types are described as follows:

Type I: Two pronounced seasons. Dry from November to April, wet during the rest of the year.

Type II: No dry season with a very pronounced rainfall from November to April and wet during the rest of the tear.

Type III: Seasons are not very pronounced, relatively dry from November to April, wet during the rest of the year.

Type IV: Rainfall is more or less evenly distributed throughout the year.

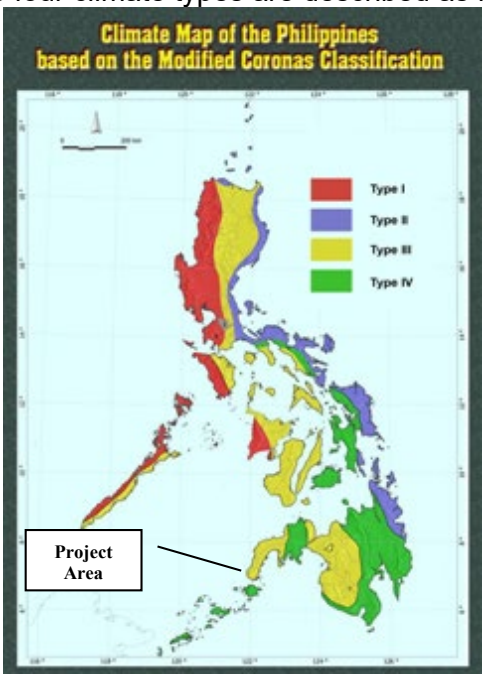


Figure 1: Climate Map of the Philippines

The Project Area is classified under Type III climate, experiencing high rainfall amount during the months of May to October.

River Basins

Delineation of river basins in the project area was done using interferometric synthetic aperture radar elevation data from NAMRIA. It was processed and analyzed using ArcMap GIS Software. Three notable watersheds were identified for possible source of water – Tumaga River, Mercedes River, and Mahihacan River, where there is an existing dam for irrigation purposes. **Figure 77** presents the delineated watersheds.

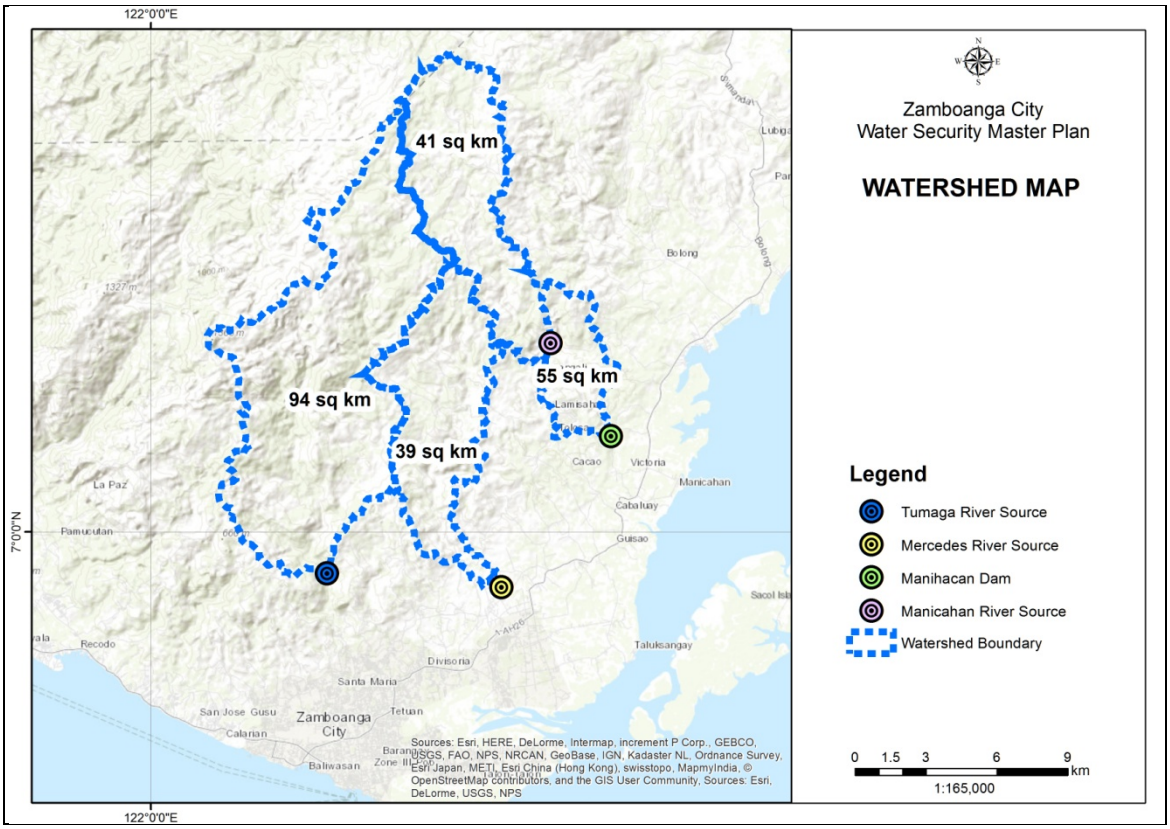


Figure 77 – Watersheds in the Project Area

Rainfall

There is a rainfall station maintained by the Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA) in Zamboanga City. Daily rainfall data is available from 1951. **Figure** presents the average monthly total rainfall of the station.

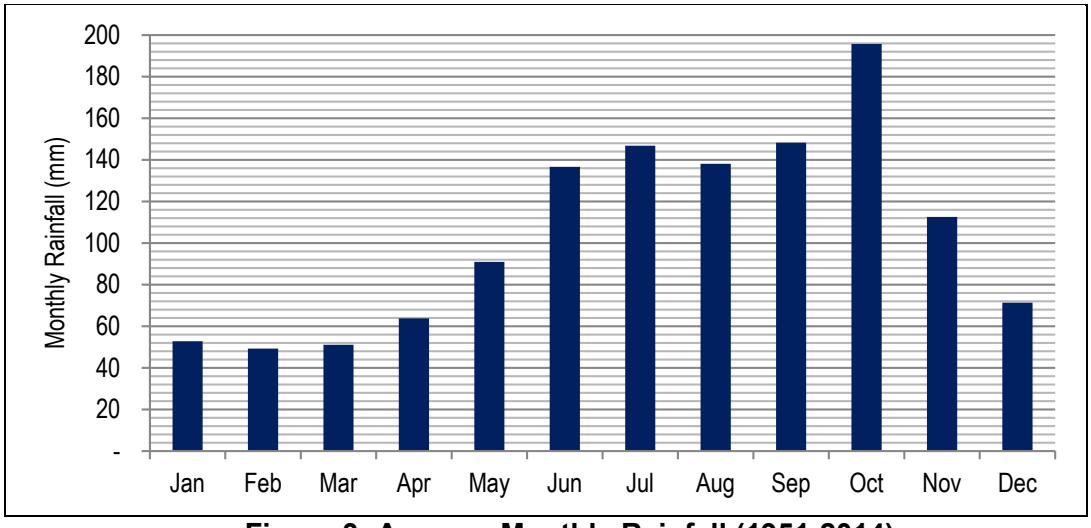


Figure 3: Average Monthly Rainfall (1951-2014)

Streamflow

The nearest river gauging station is located in Barrio Posolong, Zamboanga City, monitoring the adjacent Mercedes River. Daily streamflow data is available from 1993 to 1999. It can be accessed through a barrio road from km. 12. It is about 200 meters above the existing masonry dam of the Mercedes Irrigation System. The monitoring station drains a catchment area of about 38 km^2 and an annual average discharge of about 1.23 m^3/s.

Water Permits

Table 1 shows the list of water permits granted by the NWRB in the Project Area. Water withdrawn from rivers and creeks are mainly used for irrigation purposes. Portion of the granted water usage are dedicated for domestic consumption, as well as industrial activities.

These grantees are plotted against the watersheds being considered and presented in **Figure 4**. In order to ensure that proper discharges are allocated, applicable permits will be subtracted to corresponding water sources during the computation of the net available flows.

Table 1: Surface Water Permit Grantees in the Project Area

NO.	PERMIT	GRANTEE	LOCATION	SOURCE	GRANTED	PURPOSE
01	011679	BALINSUNGAY I.A.INC.	MERCEDES,ZAM. CITY	SINGUP RIVEREK	554.00	IRRIGATION
02	011211	MANICAHAN FARM'S I.A.	MANICAHAN,ZAM.CITY	MANICAHAN RIVER	400.00	IRRIGATION
03	011004	ZAMBOANGA WD	UPPER POSONANCA	TUMAGA RIVER	354.00	DOMESTIC
04	023444	PRIMEWATER INFRASTRUCTURE CORPORATION	PAMUCUTAN, ZAMBOANGA CITY	ANULING RIVER	173.61	MUNICIPAL
05	009562	IRRIG. ASSN.	ZAMBOANGA CITY	MASABA R.	130.00	IRRIGATION
06	011261	TALISAYAN FIA	TALISAYAN,ZAM. CITY	TALISAYAN RIVER	66.00	IRRIGATION
07	016279	WESTERN MINDANAO POWER CORP.	MANICAHAN, ZAMBOANGA CITY	MANICAHAN CREEK	55.15	INDUSTRIAL
08	016759	TALISAYAN FIAI	ANULING PAMUCUTAN ZAMBO.CITY	SAS RIVER	36.92	IRRIGATION
09	000642	PERFECTO E. MARQUEZ	CABALUAY, ZAMBOANGA CITY	CABALUAY RIVER	14.00	IRRIGATION
10	023853	SAN RAMON POWER INC.	BRGY. TALISAYAN, ZAMBOANGA CITY	SAAZ RIVER	4.67	INDUSTRIAL
11	002080	BASE METAL	AYALA ZAMBOANGA CITY	PALAWAN CK.	1.00	INDUSTRIAL

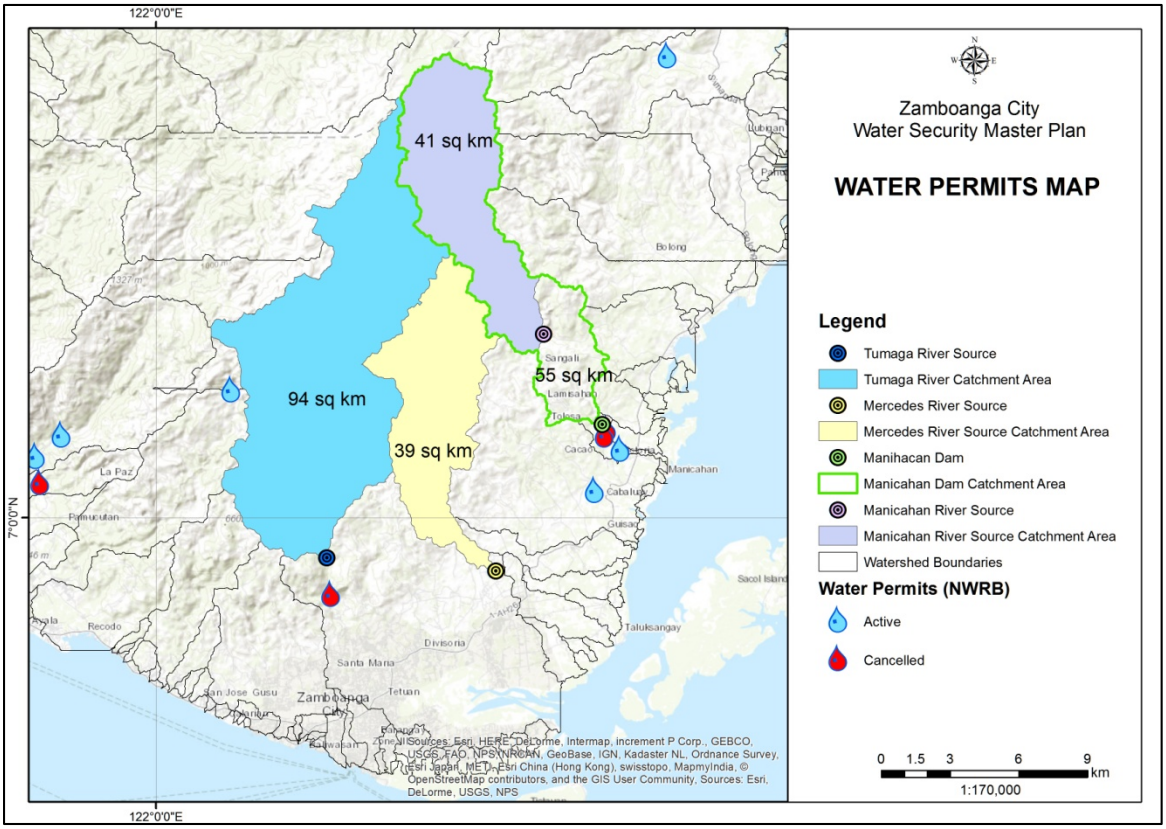


Figure 78 – Water Permits Map

RAINFALL – RUNOFF ANALYSIS

In the absence of continuous and complete streamflow data, rainfall-runoff analysis was conducted in order to relate the more abundant and recent rainfall values into corresponding discharges. Rainfall data from the Zamboanga City station were regressed with the available discharge data of Mercedes River. The resulting rainfall-runoff model (in mm) has the following equation:

$$Q_t = (Q_{t-1} * 0.616) + (RF_t * 0.0806) + 1.4045$$

Where: Q_t *= discharge at time t*
Q_{t-1} *= discharge at time t-1*
RF_t *= rainfall at time t*

FLOW DURATION ANALYSIS

Flow Duration Analysis aims to identify the behavior of a river during high and low flows, and perceivably identifies the sustainability of discharges in terms of its relationship to rainfall and base flows. It is commonly presented through the flow duration curves (FDC), where the volume of flow that is probable to occur at a given time can be identified. The resulting FDC for Tumaga River is shown in **Figure** .

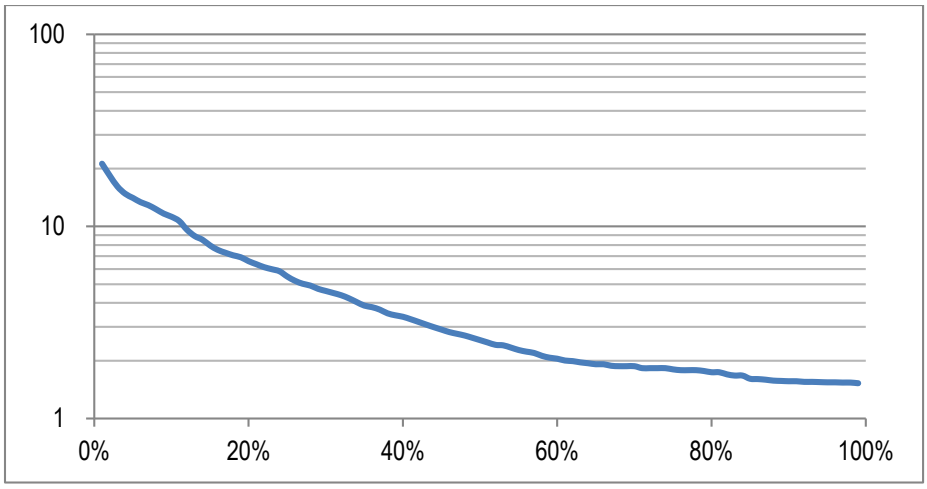


Figure 5: Tumaga River Flow Duration Curve

The shape of a flow-duration curve in its upper and lower regions is particularly significant in evaluating the stream and basin characteristics. The shape of the curve in the high-flow region indicates the type of flood regime the basin is likely to have, whereas, the shape of the low-flow region characterizes the ability of the basin to sustain low flows during dry seasons. The Tumaga River FDC presents a relatively moderate high flows curve that is probably rain-caused floods. In the low-flow region, the relatively flatter curve indicates that moderate to low flows are sustained throughout the year due to natural or artificial streamflow regulation, or due to a large groundwater capacity which sustains the base flow to the stream.

The dependable flow is defined as the volume of flow that has a probability of occurrence of 80% at a specific time. This is the flow from which the available water for extraction is based from. The flow statistics for the Tumaga River is shown below.

Table 2: Tumaga River Flow Statistics

% Probability	Flow (cms)
90%	1.564
80%	1.742
70%	1.873
60%	2.048
50%	2.559
40%	3.386
30%	4.614
20%	6.591
10%	11.231

AVAILABLE SURFACE WATER

Available surface water for extraction is computed considering the allocation for riparian flow in streams, as required by the DENR. This is equal to 10% of the computed flow in consideration. Further, the amount of granted water permits along the river of concern should also be deducted. The net available flow (cms) for the Tumaga River is shown in
Table 3.

Table 3: Tumaga River Net Available Flow

% Probability	Flow (cms)	Riparian Flow Allocation (cms)	Granted Water Permits (cms)	Net Available Water (cms)
90%	1.564	0.156	0.345	1.408
80%	1.742	0.174	0.345	1.568
70%	1.873	0.187	0.345	1.686
60%	2.048	0.205	0.345	1.843
50%	2.559	0.256	0.345	2.303
40%	3.386	0.339	0.345	3.047
30%	4.614	0.461	0.345	4.153
20%	6.591	0.659	0.345	5.932
10%	11.231	1.123	0.345	10.108

Other sources considered were the Manihacan and Mercedes River. Discharge values for these sources were obtained by using area-proportion method from the Tumaga River flows. The corresponding net available flows are presented in the following tables:

Table 56 : Mercedes River Net Available Flow – Base Case (cms)

% Probability	Flow	Riparian Flow Allocation	Granted Water Permits	Net Available Water
90%	0.695	0.070	0.345	0.626
80%	0.774	0.077	0.345	0.697
70%	0.832	0.083	0.345	0.749
60%	0.910	0.091	0.345	0.819
50%	1.137	0.114	0.345	1.024
40%	1.505	0.150	0.345	1.354
30%	2.051	0.205	0.345	1.846
20%	2.929	0.293	0.345	2.636
10%	4.992	0.499	0.345	4.492

Table 57 : Manihacan River Net Available Flow – Base Case (cms)

% Probability	Flow	Riparian Flow Allocation	Granted Water Permits	Net Available Water
90%	0.695	0.070	0.4+0.554+0.05515	0.570
80%	0.774	0.077	0.4+0.554+0.05515	0.642
70%	0.832	0.083	0.4+0.554+0.05515	0.694
60%	0.910	0.091	0.4+0.554+0.05515	0.764
50%	1.137	0.114	0.4+0.554+0.05515	0.968
40%	1.505	0.150	0.4+0.554+0.05515	1.299
30%	2.051	0.205	0.4+0.554+0.05515	1.790
20%	2.929	0.293	0.4+0.554+0.05515	2.581
10%	4.992	0.499	0.4+0.554+0.05515	4.437

Table 58 : Manihacan Dam Net Available Flow – Base Case (cms)

% Probability	Flow	Riparian Flow Allocation	Granted Water Permits	Net Available Water
90%	0.956	0.096	0.4+0.554+0.05515	0.805
80%	1.065	0.106	0.4+0.554+0.05515	0.903
70%	1.145	0.114	0.4+0.554+0.05515	0.975
60%	1.252	0.125	0.4+0.554+0.05515	1.071
50%	1.564	0.156	0.4+0.554+0.05515	1.352
40%	2.069	0.207	0.4+0.554+0.05515	1.807
30%	2.820	0.282	0.4+0.554+0.05515	2.483
20%	4.028	0.403	0.4+0.554+0.05515	3.570

10%	6.863	0.686	0.4+0.554+0.05515	6.122

CLIMATE CHANGE SCENARIO

PAGASA has climate change scenarios for years 2036-2065 including projections on the percent change in rainfall and temperature[80]. The model used assumptions underlying RCP 8.5 scenario. In the Zamboanga peninsula, the dryest possible rainfall change is at about -18.7% and the wettest possible change can reach about 16.7%.

Table 7: Percent Change in Rainfall (PAGASA Climate Change Projection for 2036-2065)

		Dec Jan Feb	Mar Apr May	Jun Jul Aug	Sep Oct Nov
Zamboanga del Norte	Lower Bound	-12.4	-16.1	-10.4	-18.7
	Median	1.9	-2.5	4.9	-0.5
	Upper Bound	13.8	8.1	12.2	10.8
Zamboanga del Sur	Lower Bound	-18.1	-8.2	-11.8	-13.3
	Median	4.4	-3.3	2.0	-0.6
	Upper Bound	13.8	16.3	16.7	6.2
Zamboanga Sibugay	Lower Bound	-11.6	-18.5	-15.4	-14.8
	Median	-0.2	1	2.3	-6.0
	Upper Bound	8.4	7.5	13.4	7.0

For conservative results, the lower bound values were used in estimating the most drastic effect of climate change to the surface water resources of the Project Area. The resulting net available water is shown in **Table 8**.

Table 8: Net Available Flow – Climate Change Scenario (cms)

% Probability	Tumaga River	Mercedes River	Manihacan River	Manihacan Dam
90%	1.400	0.622	0.567	0.800
80%	1.489	0.662	0.606	0.855
70%	1.646	0.732	0.676	0.951
60%	1.725	0.767	0.712	0.999
50%	1.984	0.882	0.826	1.157
40%	2.592	1.152	1.097	1.529
30%	3.821	1.698	1.643	2.280
20%	5.520	2.453	2.398	3.318
10%	9.590	4.262	4.207	5.805

[80] *Observed Climate Trends and Projected Climate Change in the Philippines, 2018*

IRRIGATION WATER REQUIREMENT

The study adopted existing cropping patterns from past projects in study area. The crop water requirement was computed assuming dominant clay loam soil type. Stagger period was set at 30 days for typical service areas of less than 1,000 ha.

Crop Water Requirement

The crop water requirement is the amount of water needed to meet the optimum requirement for growing rice from land soaking and land preparation to harvesting. This is represented as follows:

$$\boldsymbol{CWR} = [(\boldsymbol{kls} \times \boldsymbol{LS}) + (\boldsymbol{klp} \times \boldsymbol{LP}) + (\boldsymbol{kn} \times \boldsymbol{N}) + (\boldsymbol{kfc} \times \boldsymbol{FCR})] \times \boldsymbol{T_{units}}$$

Where:

CWR	-	*crop water requirement, mm*
kls	-	*area factor of land soaking*
LS	-	*land soaking requirement, mm*
klp	-	*area factor of land preparation*
LP	-	*land preparation requirement, mm*
kn	-	*area factor of nursery*
N	-	*nursery requirement, mm*
kfc	-	*area factor of field crop requirement*
FCR	-	*field crop requirement, mm*
Tunits	-	*number of days for calculation purposes*

Effective Rainfall

Effective rainfall is the net amount which will be available to satisfy crop requirement at a specific time. The actual amount of rainfall that can be considered effective in any area depends not only on the soils ability to absorb and store water in the crop root zone but also upon the intensity and distribution of rain, depth of standing water in the paddy, size and maintenance of farm dikes, irrigation method and water delivery interval and topography of land and drainage facilities These rainfall were summarized into decades (10-day rainfall) and the effective rainfall for each decade was determined by probability analysis as the rainfall with 80% probability of occurrence. A criterion is followed for the value of effective rainfall per decadal basis (in mm) using 80% dependable rainfall data:

- If the dependable rainfall is less than 5 mm/decade then, the effective rainfall is equal to zero.
- If the dependable rainfall is greater than 50 mm/decade, then the effective rainfall is equal to 50 added to 80% of the residual value from 50 mm.
- Otherwise the effective rainfall is equal to the dependable / probable rainfall.

Farm Water Requirement

The farm water requirement is estimated as follows:

$$\boldsymbol{FWR} = \boldsymbol{CWR} - \boldsymbol{RE}$$

Where:

FWR - farm water requirement, mm
CWR - crop water requirement, mm
RE - effective rainfall, mm

The resultant net farm water requirement, as affected by effective rainfall, varies within the cropping season but in good agreement with the crop water requirement.

Irrigation Diversion Requirement

The irrigation diversion requirement is defined as the farm water requirement plus allowances for farm waste, operational losses and conveyance losses where the overall irrigation efficiency can be derived. This is expressed as:

$$DWR = \frac{FWR}{OEff}$$

Where:

DWR - *diversion water requirement, mm*

FWR - *farm water requirement, mm*

OEff - *overall irrigation efficiency*

The overall irrigation efficiency used in the study was pegged at 55% during dry season and 50% during wet season. The resulting annual diversion water requirement was calculated to be about 1,310 mm with a maximum water duty of 1.33 liters per second. The decadal DWR is shown in

Table 59 below.

Table 59 : Decadal Diversion Water Requirement (mm)

Jan			Feb			Mar		
1	2	3	1	2	3	1	2	3
84.19	114.76	88.75	81.64	41.22	16.38	0.00	0.00	0.00
Apr			May			Jun		
1	2	3	1	2	3	1	2	3
0.00	0.00	0.00	0.00	0.00	18.03	68.26	6.65	18.06
Jul			Aug			Sep		
1	2	3	1	2	3	1	2	3
11.14	31.91	13.65	44.53	73.69	4.42	24.44	0.00	0.00
Oct			Nov			Dec		
1	2	3	1	2	3	1	2	3
0.00	0.00	20.30	75.24	88.54	95.84	99.05	101.88	88.17

The resulting irrigation water demand for the existing irrigation systems of the NIA Zambasulta RSO were likewise computed and presented in **Table 60**. Rice-rice cropping was assumed in the calculations, as it demands the highest water requirement. If diversified crops are preferred to be planted during the dry season, the presented water requirement would still be sufficient.

Table 60 : Irrigation Water Demand for Existing IS

CROPS	NAME OF CIS	AREA IN HECTARES					IRRIGATED AREA (Has.)		Irrigation Water Demand (lps) @Water Duty = 1.50 lps/ha		
		SERVICE AREA (Has)	NEW GENERATED AREA	FUSA	OPERATIONAL	NON OPTL	WET	DRY	for SERVICE AREA (Has)	for NEW GENERATED AREA	for FUSA
	NIA-Assisted/Constructed										
	G-Gravity										
	DISTRICT 1										
high value crops	Ayala CIS	187.00		152	152.00		152	152	280.50	-	228.00
high value crops	La Paz CIS	60.00		60	60.00		60	60	90.00	-	90.00
high value crops	Baluno sip	40.00		40	40.00		40	5	60.00	-	60.00
high value crops	Patalon SIP	39.00		39	24.00	15.00	24	24	58.50	-	58.50
high value crops	Malagutay SIP	50.00		50	50.00		50	50	75.00	-	75.00
rice	Preza Mayor CIS	100.00		80	65.00	15.00	65	65	150.00	-	120.00
rice	Talisayan CIS	100.00		86	86.00		86	86	150.00	-	129.00
high value crops	Sta. Rita CIS	50.00		50	50.00		50	50	75.00	-	75.00
high value crops	Labuan SIP	50.00	20	30	20.00	10.00	20	20	75.00	30.00	45.00
high value crops	Lumayang SIP (CARP)	35.00	11	24	24.00		24	24	52.50	16.50	36.00
high value crops	Sta. Rita CIS (CARP)	44.75	29.75	15.0	15.00		15	15	67.13	44.63	22.50
	SUB-TOTAL DISTRICT 1	**755.75**	**60.75**	**626**	**586.00**	**40.00**	**586**	**551**	**1,133.63**	**91.13**	**939.00**
	DISTRICT 2										
rice	Boalan CIS	35.00		30	30.00		30	30	52.50	-	45.00
rice	Bolong CIS	100.00		100	100.00		100	100	150.00	-	150.00
rice	Bunguiao CIS	95.00		72	72.00		72	72	142.50	-	108.00
rice	Curuan CIS	115.00		115	115.00		115	115	172.50	-	172.50
rice	Dabuy CIS	77.00		77	70.00	7.00	70	70	115.50	-	115.50
rice	Buenavista PIS	50.00		-			-	-	75.00	-	-
high value crops	Mangga CIS	103.00		103	103.00		103	103	154.50	-	154.50
rice	Manicahan CIS	254.00		254	254.00		254	254	381.00	-	381.00
rice	Mercedes CIS	701.00		665	516.00	149	516	516	1,051.50	-	997.50
rice	Quiniput CIS	75.00		75	75.00		75	75	112.50	-	112.50

CROPS		NAME OF CIS	AREA IN HECTARES					IRRIGATED AREA (Has.)		Irrigation Water Demand (lps) @Water Duty = 1.50 lps/ha		
			SERVICE AREA (Has)	NEW GENERATED AREA	FUSA	OPERATIONAL	NON OPTL	WET	DRY	for SERVICE AREA (Has)	for NEW GENERATED AREA	for FUSA
rice		San Isidro Bunguiao CIS	35.00		35	35.00		35	35	52.50	-	52.50
high value crops		Sinuropan CIS	36.00		36	36.00		36	36	54.00	-	54.00
high value crops		Sinuropan CIS Extension	25.00	25	-			-	-	37.50	37.50	-
rice		Tictapul CIS	5.00		5	5.00		5	5	7.50	-	7.50
rice		Tictapul CIS Extension	25.00		25	25.00		25	25	37.50	-	37.50
rice		Vitali CIS	225.00		225	60.00	165	60	60	337.50	-	337.50
high value crops		Lower Tigbao Licomo SIP	65.00	65	-			-	-	97.50	97.50	-
rice		Guisao CIS	80.00		80	80.00		80	80	120.00	-	120.00
high value crops		Licomo SIP	40.00	40	-			-	-	60.00	60.00	-
rice		Taloptap CIS	75.00		75	25.00	50	25	25	112.50	-	112.50
		SUB-TOTAL DISTRICT 2	**2,216.00**	**130.00**	**1,972**	**1,601.00**	**371**	**1,601**	**1,601**	**3,324.00**	**195.00**	**2,958**
		SUB-TOTAL (Gravity)	**2,971.75**	**190.75**	**2,598**	**2,187.00**	**411**	**2,187**	**2,152**	**4,457.63**	**286.13**	**3,897**
		P-PUMPS										
		DISTRICT 1										
high value crops		Ayala PIP	22.00		22		22.00			33.00	-	33.00
high value crops		Zamboanga City CIS I	3.00		3		3.00			4.50	-	4.50
rice		Vitali PIP	8.00		8		8.00			12.00	-	12.00
		SUB-TOTAL DISTRICT 1	**33.00**	**-**	**33.00**	**-**	**33.00**	**-**	**-**	**49.50**	**-**	**49.50**
		DISTRICT 2										
high value crops		Lumayang PIS	24.00		24		24.00			36.00	-	36.00
rice		Vitali PIP	22.00		22		22.00			33.00	-	33.00
high value crops		Buenavista PIS/Upper Buenavista CIS	30.00		24	24.00		24	24	45.00	-	36.00
		SUB-TOTAL DISTRICT 2	**76.00**	**-**	**70**	**24**	**46**	**24**	**24**	**114.00**	**-**	**105.00**
		SUB-TOTAL (Pump)	**109.00**	**-**	**103**	**24**	**79**	**24**	**24**	**163.50**	**-**	**154.50**
		SUB-TOTAL (NIA-Assisted)	**3,080.75**	**190.75**	**2,701**	**2,211**	**490**	**2,211**	**2,176**	**4,621.13**	**286.13**	**4,051.5**

CROPS		NAME OF CIS	AREA IN HECTARES					IRRIGATED AREA (Has.)		Irrigation Water Demand (lps) @Water Duty = 1.50 lps/ha		
			SERVICE AREA (Has)	NEW GENERATED AREA	FUSA	OPERATIONAL	NON OPTL	WET	DRY	for SERVICE AREA (Has)	for NEW GENERATED AREA	for FUSA
		OGA-Other Gov't Agency Assisted										
high value crops		Buenagatas CIS	-		-					-	-	-
rice		Cabaluay CIS	25.00		25	25.00		25	25	37.50	-	37.50
rice		Guiwan CIS	110.00		110	110.00		110	110	165.00	-	165.00
rice		Lunzuran CIS	5.00		5	5.00		5	5	7.50	-	7.50
rice		Manga-Bunguiao CIS	38.00		38	38.00		38	38	57.00	-	57.00
high value crops		Muti CIS	20.00		20	20.00		20	20	30.00	-	30.00
high value crops		Pamiguitan CIS	18.00		18	18.00		18	18	27.00	-	27.00
high value crops		Sapa Tomas CIS	20.00		20	20.00		20	20	30.00	-	30.00
rice		Seguinan CIS	75.00		75	75.00		75	75	112.50	-	112.50
rice		Licopon CIS	45.00		45	45.00		45	45	67.50	-	67.50
		SUB-TOTAL OGA	**356.00**	**-**	**356.00**	**356.00**	**-**	**356**	**356**	**534.00**	**-**	**534.00**
		GRAND TOTAL	**3,436.75**	**190.75**	**3,057**	**2,567**	**490**	**2,567.**	**2,532**	**5,155.13**	**286.13**	**4,585.5**

Source: NATIONAL IRRIGATION ADMINISTRATION - ZAMBASULTA RSO: O&M PLANS AND PROGRAMS COMMITMENT DATA PER CIS FOR 2019 CROPPING OPERATIONS, ZAMBOANGA CITY

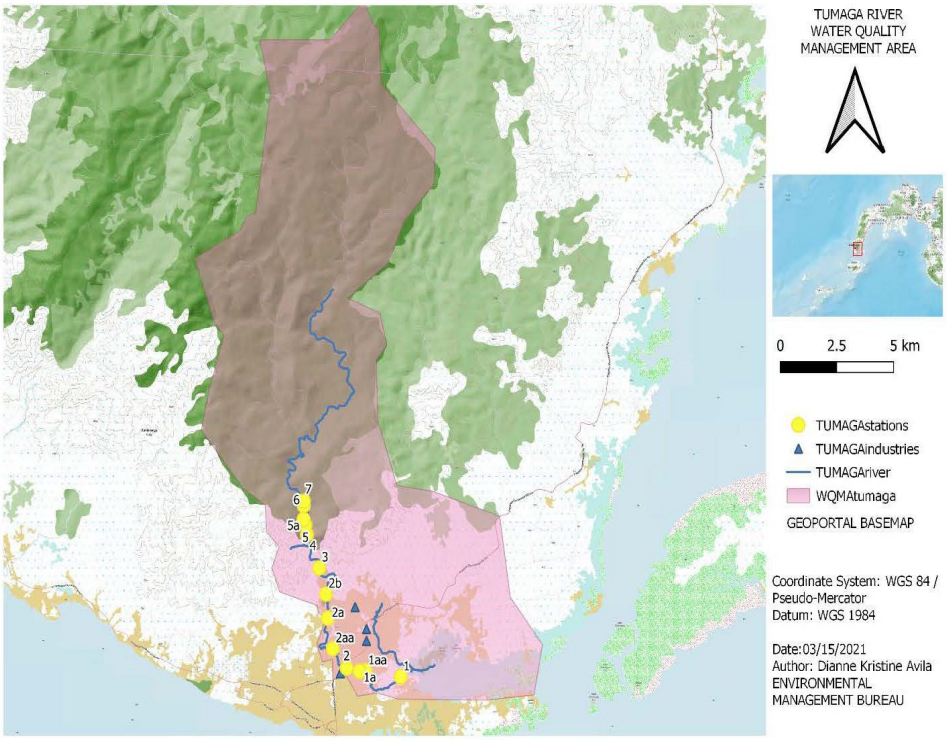
Annex 6: Tumaga River Water Quality

Tumaga River is regarded as the most important inland river in Zamboanga City. The River traverses several heavily populated areas including Pasonanca, Tumaga, Tetuan, Tugbungan and Mampang. The Tumaga River-Water Quality Management Area (TR-WQMA) was officially designated through the signing of DENR Administrative Order No. 2013-01 on 24 January 2013. As part of the requirement under the WQMA program, water quality monitoring is regularly conducted to assess the present condition of the Tumaga River. Presented in Table 1 and Figure 1 are the monitoring stations in Tumaga River.

Table 1: Location of Sampling Stations

Station No.	Location	Coordinates		Water Body Classifications
		North	East	
1	Tugbungan Bridge, Tugbungan	6º55'22.40''	122º6'22.30''	Class C
1aa	Presa Dam, Mormon's Drive Guiwan	6º55'33.00''	122º5'31.60''	
1a	Jumbo Bridge, Guiwan	6º55'33.60''	122º5'27.20''	
2	San Fernando Bridge, Guiwan	6º55'33.60''	122º5'4.20''	
2aa	Near Manaog Church, Tumaga	6º55'58.50''	122º4'44.30''	
2a	Between Pasonanca and Tumaga Boundary	6º56'37.50''	122º4'36.90''	Class B
2b	Near Philippine Public Safety College (formerly NAPOLCOM), Pasonanca	6º57'14.90''	122º4'33.70''	
3	Spillway, Kilometer 7, Upper Pasonanca, Pasonanca	6º57'41.90''	122º4'24.40''	
4	Intake, Upper Pasonanca, Pasonanca	6º58'24.50''	122º4'6.70''	Class A
5	Intake, Upper Pasonanca, Pasonanca	6º58'37.10''	122º4'4.60''	
5a	Upstream of old intake inlet, Intake, Upper Pasonanca, Pasonanca,	6º58'37.10''	122º4'4.60''	
6	Downstream of catchment basin, Intake, Upper Pasonanca, Pasonanca	6º59'1.80''	122º4'2.20''	
7	Upstream of catchment basin, Intake, Upper Pasonanca, Pasonanca	6º59'1.80''	122º4'2.20''	

Source: DENR-EMB Reqion IX



Source: EMB, Region IX

Figure 1: Tumaga River Monitoring Stations

The water quality guidelines for specific parameters being sampled in Tumaga River is presented in Table 2. The parameters are based on guidelines for water body classification included in DENR Administrative Order No. 2016-08 dated May 24, 2016.

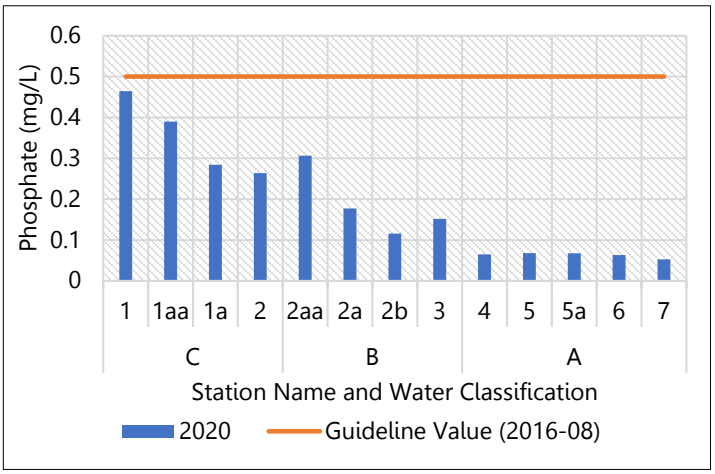
Table 2: Water Quality Guidelines (Fresh Water: Primary Parameters)

Parameters	Unit	Class				
		AA	A	B	C	D
Temperature	ºC	26-30	26-30	26-30	25-31	25-32
pH (range)		6.5-8.5	6.5-8.5	6.5-8.5	6.5-9.0	6.0-9.0
Dissolved Oxygen (minimum)	mg/L	5.0	5.0	5.0	5.0	2.0
Biochemical Oxygen Demand (BOD)	mg/L	1	3	5	7	15
Total Suspended Solids	mg/L	25	50	65	80	110
Phosphate	mg/L	<0.003	0.5	0.5	0.5	5
Nitrate	mg/L	7	7	7	7	15
Color	TCU	5	50	50	75	150
Chloride	mg/L	250	250	250	350	400
Fecal Coliform	MPN/100mL	<1.1	<1.1	100	200	400

Source: DENR DAO 2016-08

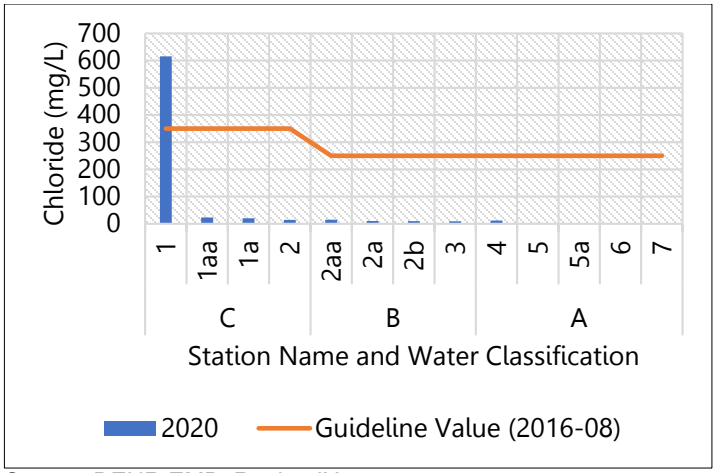
The result of the water quality monitoring in Tumaga River for year 2020 are discussed below which covers the following parameters: phosphate, chloride, total suspended solids, fecal coliform, pH, DO, color and temperature.

Phosphate. Phosphate are nutrients that come from both natural sources and human activities such as fertilizers, detergents, wastewater, among others. The phosphate levels in Tumaga River are within the guideline values ranging from 0.05 to 0.46 mg/L. Highest value was recorded in Station 1.



Source: DENR EMB, Region IX

Figure 2: Phosphate Level in Tumaga River, 2020

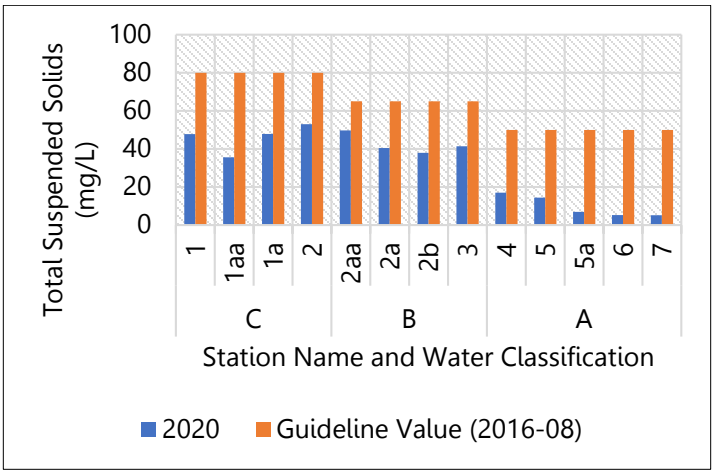


Source: DENR EMB, Region IX

Chloride. Chlorides are widely distributed in nature as salts of sodium (NaCl), potassium (KCl), and calcium ($CaCl_2$). High chloride in a freshwater body could be an indication of saltwater intrusion. The chloride levels are within the guideline values ranging from 2.61 to 23.53 mg/L except in Station 1 with chloride level of 615.72 mg/L.

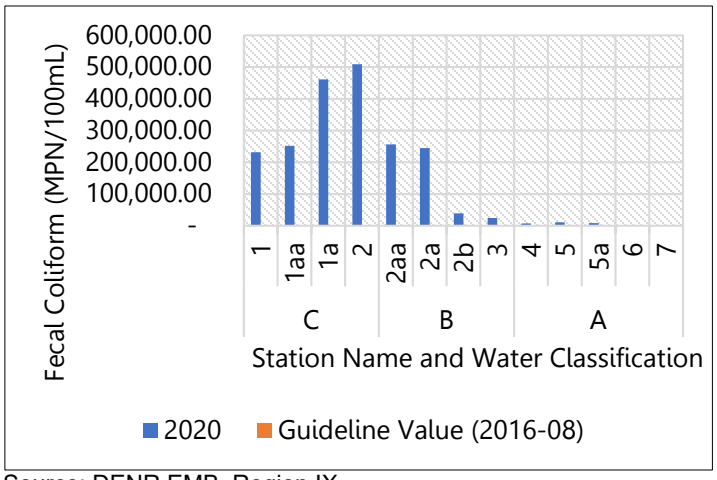
Figure 3: Chloride Level in Tumaga River, 2020

Total Suspended Solids. Total Suspended Solids (TSS) are substances suspended in water including clay, silt, decaying plant, algae, plankton, sand, microbes, animal matter, industrial wastes and sewage that cause water turbidity. For TSS, the values are within the guideline values ranging from 5.17 to 47.80 mg/L.



Source: DENR EMB, Region IX

Figure 4: TSS Level in Tumaga River, 2020

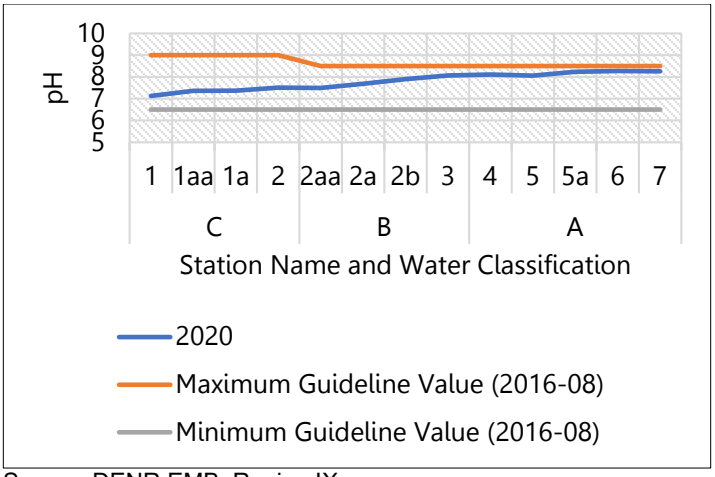


Source: DENR EMB, Region IX

Figure 5: Fecal Coliform Level in Tumaga River, 2020

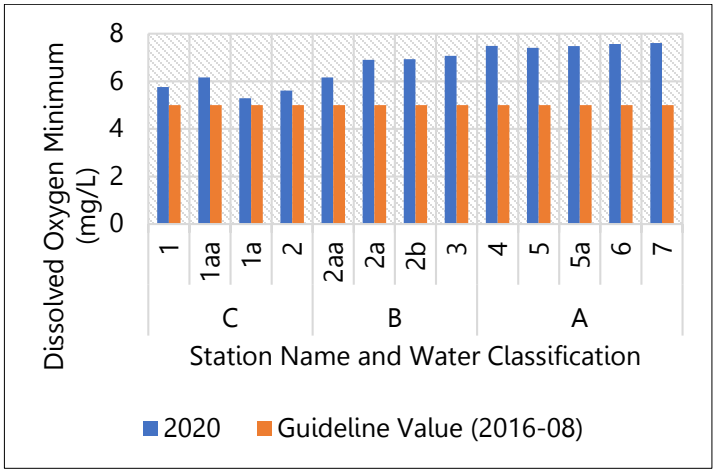
Fecal Coliform. Fecal coliform bacteriological test is an indicator that the water is free from disease-causing bacteria. The level of fecal coliform in all the sampling stations are beyond the guideline values ranging from 1,413.01 to 231,533.20 MPN/100mL. The fecal coliform values are extremely high, especially in Class C part of the river.

pH. pH is a measure of hydrogen ion concentration in liquids. The pH levels are within the guideline values ranging from 2.13 to 8.27 mg/L.



Source: DENR EMB, Region IX

Figure 6: pH Level in Tumaga River, 2020

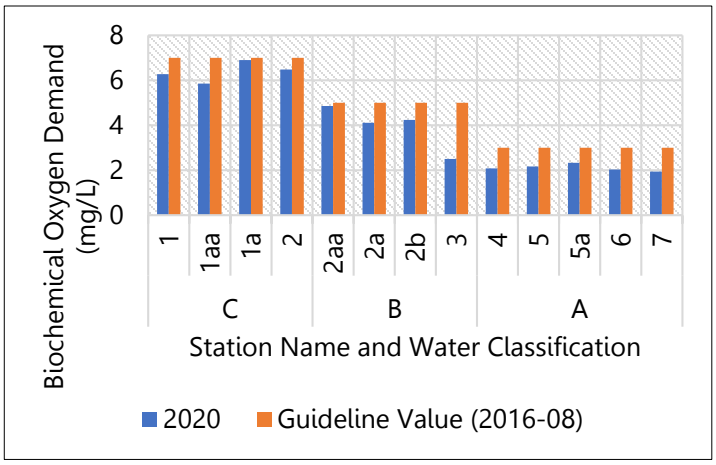


Source: DENR EMB, Region IX

Figure 7: DO Level in Tumaga River, 2020

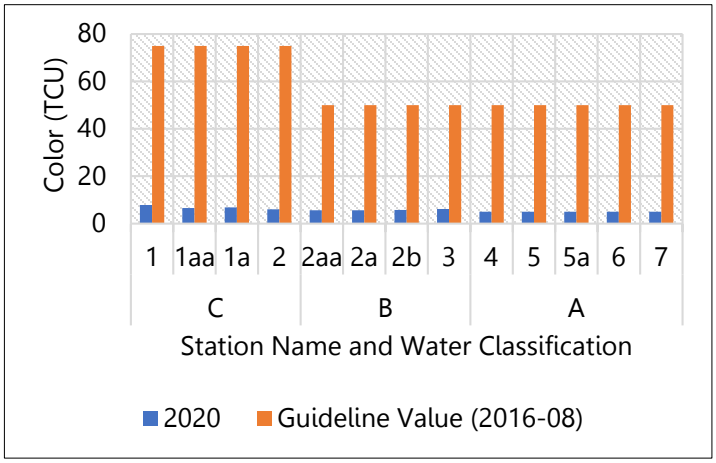
Dissolved Oxygen. Dissolved oxygen (DO) levels are considered the most important and commonly employed measurement of water quality. It is an indicator of a water body's ability to support desirable aquatic life. The DO levels for all the sampling stations are all higher than the minimum guideline values of 5 mg/L.

Biochemical Oxygen Demand. Biochemical Oxygen Demand (BOD) is a measure of the amount of oxygen removed from aquatic environments by aerobic microorganisms. BOD levels are within the guideline values ranging from 1.94 to 6.48 mg/L.



Source: DENR EMB, Region IX

Figure 8: BOD Level in Tumaga River, 2020

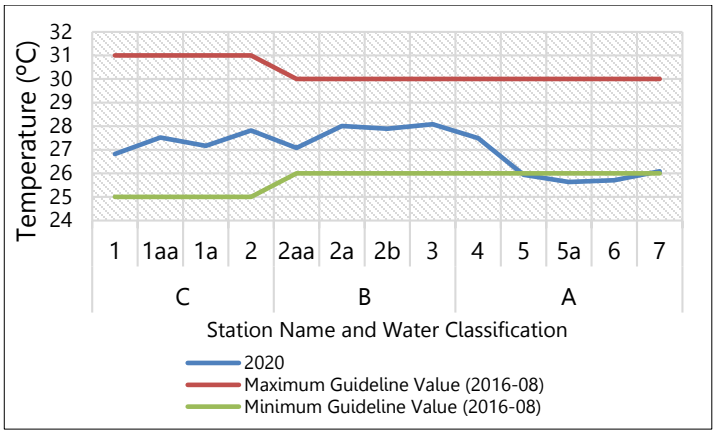


Source: DENR EMB, Region IX

Figure 9: Color Level in Tumaga River, 2020

Color. The color levels in all the sampling locations are within the guideline values ranging from 5.00 to 7.82 mg/L.

Temperature. The temperature are within the guideline values for most of the sampling stations except for Stations 5, 5a and 6 as shown in Figure 10.



Source: DENR EMB, Region IX

Figure 10: Temperature Level in Tumaga River, 2020

Annex 7: Stakeholders Consultations Conducted

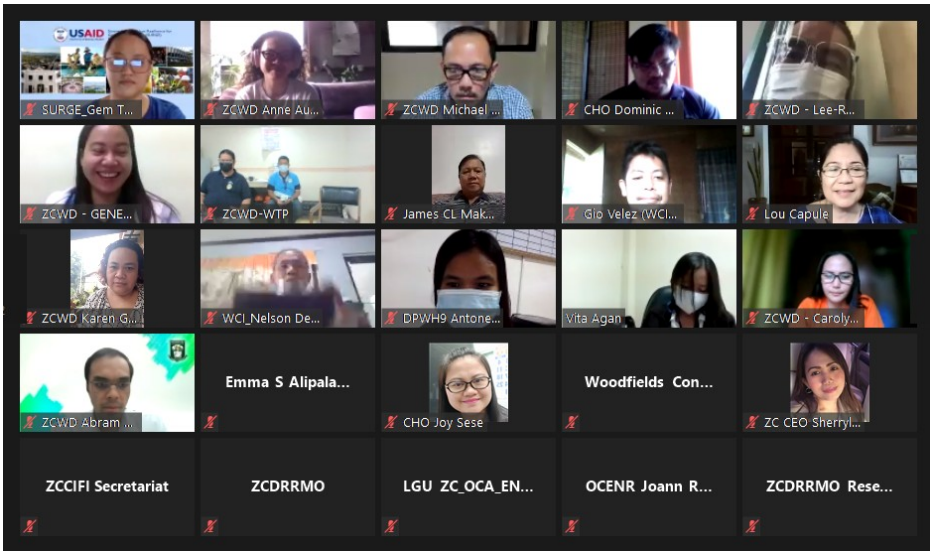
List of Stakeholders Consultations Conducted

Particulars		Objective/s	Date
1	Online Consultation with the Zamboanga City Water District	To obtain pertinent data and information from the ZCWD on the (i) water supply and sanitation improvement plan; (ii) Zamboanga Water Audit Team (ZWAT) Plan; (iii) status of non-revenue water (NRW) program and projected future activities; (iv) water supply/demand metrics and (v) other data and information necessary in the preparation of the Water Security Master Plan.	16 Jun 2021
2	Online Stakeholder Consultation on the Preparation of Water Security Master Plan	To obtain quality information from the identified stakeholders in order to understand their roles, influences, interests, expectations and other concerns in the preparation of the Water Security Master Plan. In addition, this activity also intends to develop clear communication channels between the Team, SURGE and the stakeholders.	17 Jun 2021
3	Online Stakeholder Consultation with National Irrigation Administration-Region IX	To obtain pertinent data and information from the National Irrigation Administration Region-9 (NIA-Region IX) on the (i) related water security studies available in the agency; (ii) existing irrigation system, agricultural water demand and sources in Zamboanga City; (iii) future irrigation system, projected agricultural water demand and potential sources in Zamboanga City; (iv) current programs, projects and activities (PPAs) to achieve water security; and (v) other information that will help in the preparation of the Water Security Master Plan.	8 Jul 2021
4	Two-Day Online Consultation Meeting with the Zamboanga City Water Security Council on the Preparation of the Water Security Master Plan	Seek to (i) present and discuss the salient provisions of the EO, particularly the prescribed roles and responsibilities of the member-organizations; (ii) present and discuss the summary of responses to the questionnaire previously circulated to various stakeholders and obtain the general expectations of the Council on the responses; (iii) present and elaborate the pressing issues on water security/water provision services; (iv) facilitate consultation and/or an open forum to discuss in detail the pressing issues as well as on how to appropriately address these issues; (v) introduce a framework integral in the development of a decision support mechanism to evaluate water security objectives; and (vi) identify and define the succeeding activities.	28-29 Jul 2021
5	Online Consultation Meeting with the Zamboanga City Water Security Council on Water Security Options, Scenario and Alternative Analysis	Presentation of the: (i) Water Security Options, Scenario and Alternative Analysis; (ii) Programs/Projects/Activities for Institutional Capacity Strengthening; and (iii) Potential Funding Sources and Modalities.	14 Sep 2021

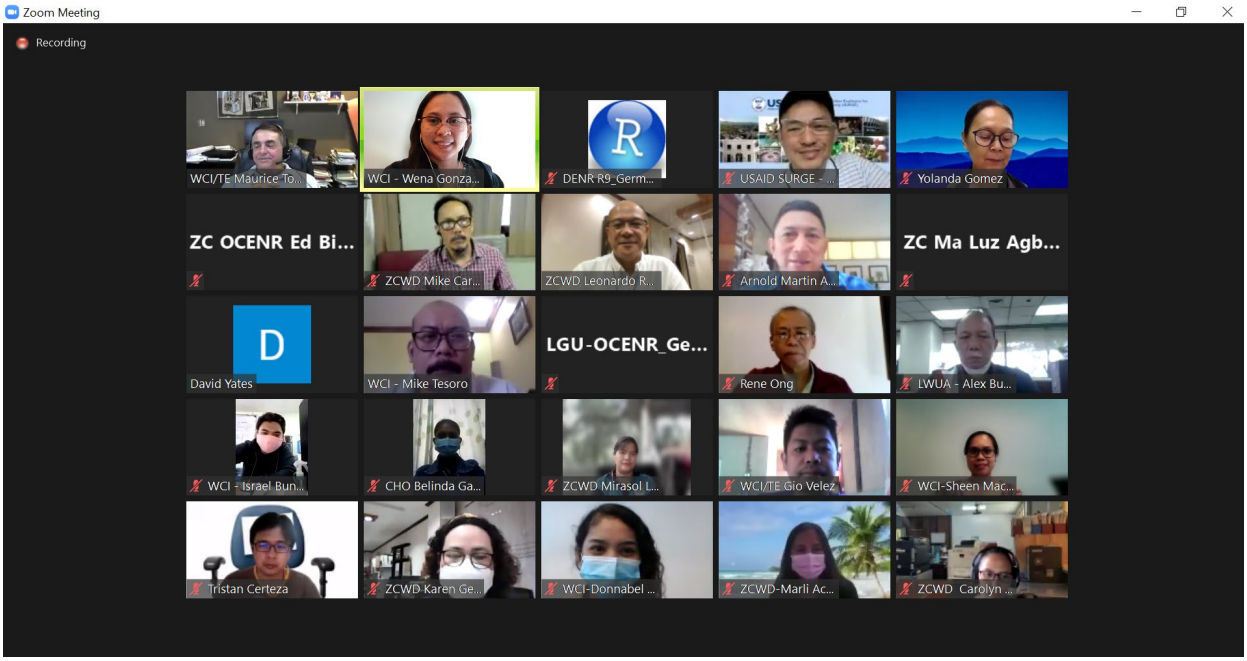
	Particulars	Objective/s	Date
6	Water Evaluation and Planning (WEAP) System Training	To capacitate the key stakeholders on the use of WEAP as the water system decision support tool	23 and 29 Sep 2021
7	Online Meeting for the Presentation and Validation of the Water Security Master Plan for Zamboanga City	To present and validate the prepared Water Security Master Plan with the Zamboanga City Water Security Council and SURGE.	29 Sep 2021

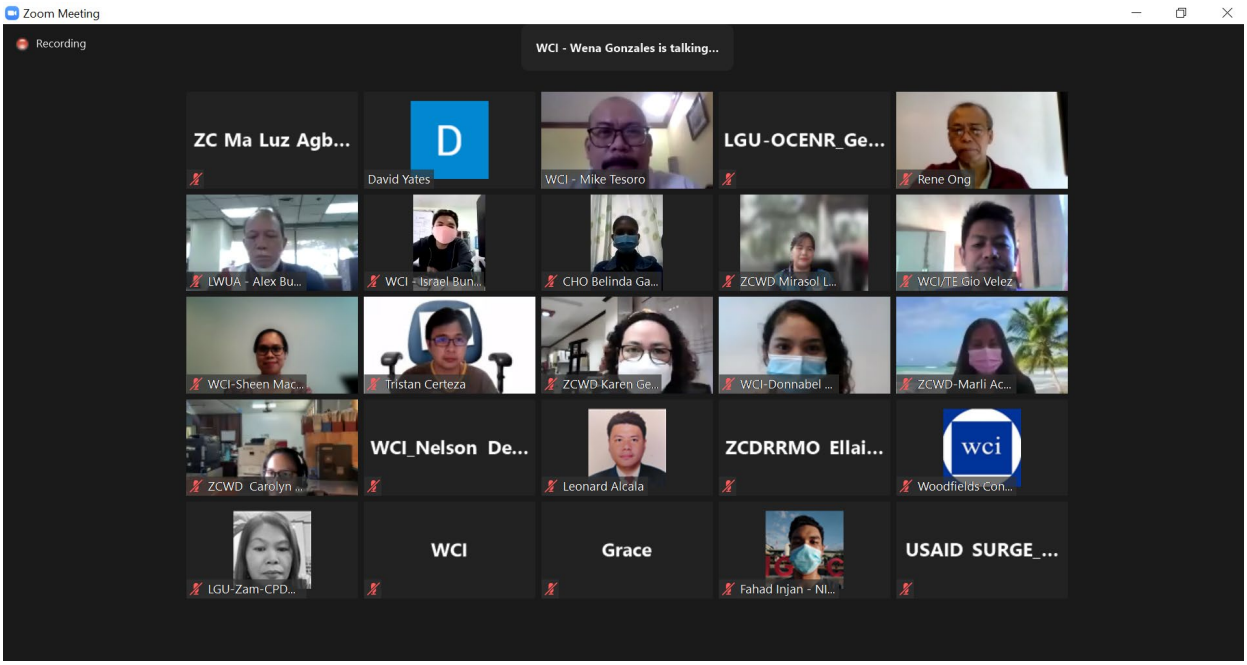
Photos of the Conducted Online Sessions

a. Project Online Kickoff Meeting (May 18, 2021)

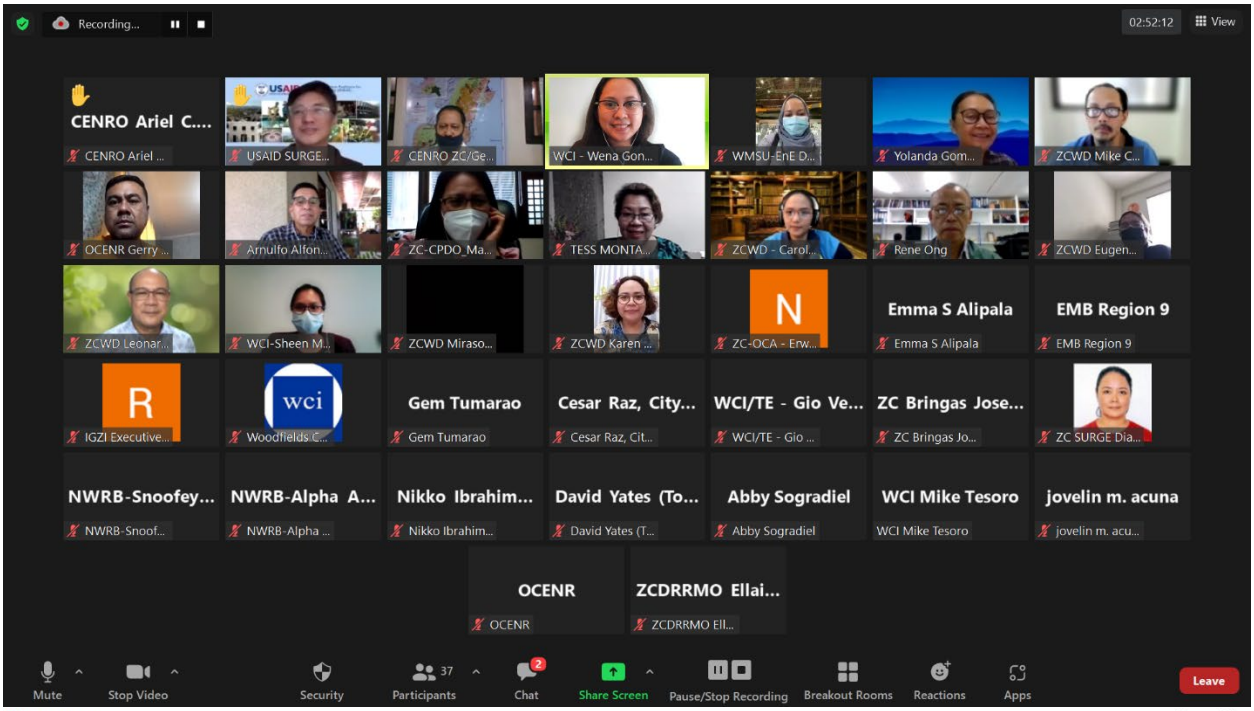


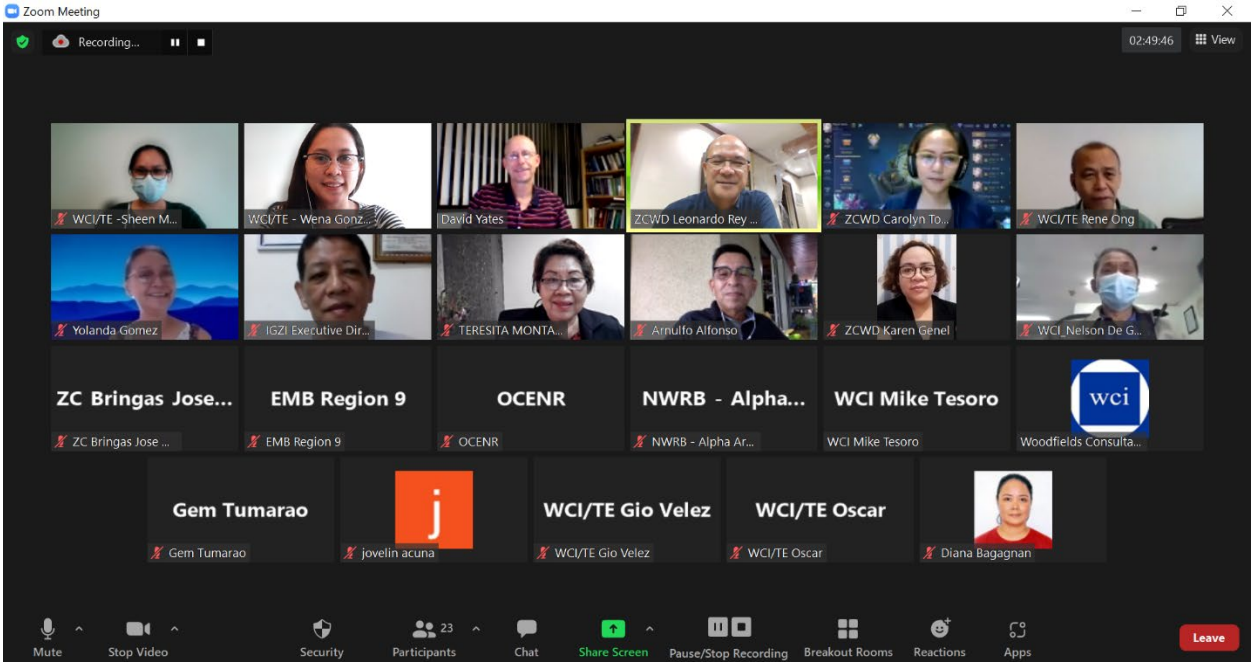
b. Online Stakeholder Consultation on the Preparation of Water Security Master Plan (June 17, 2021)



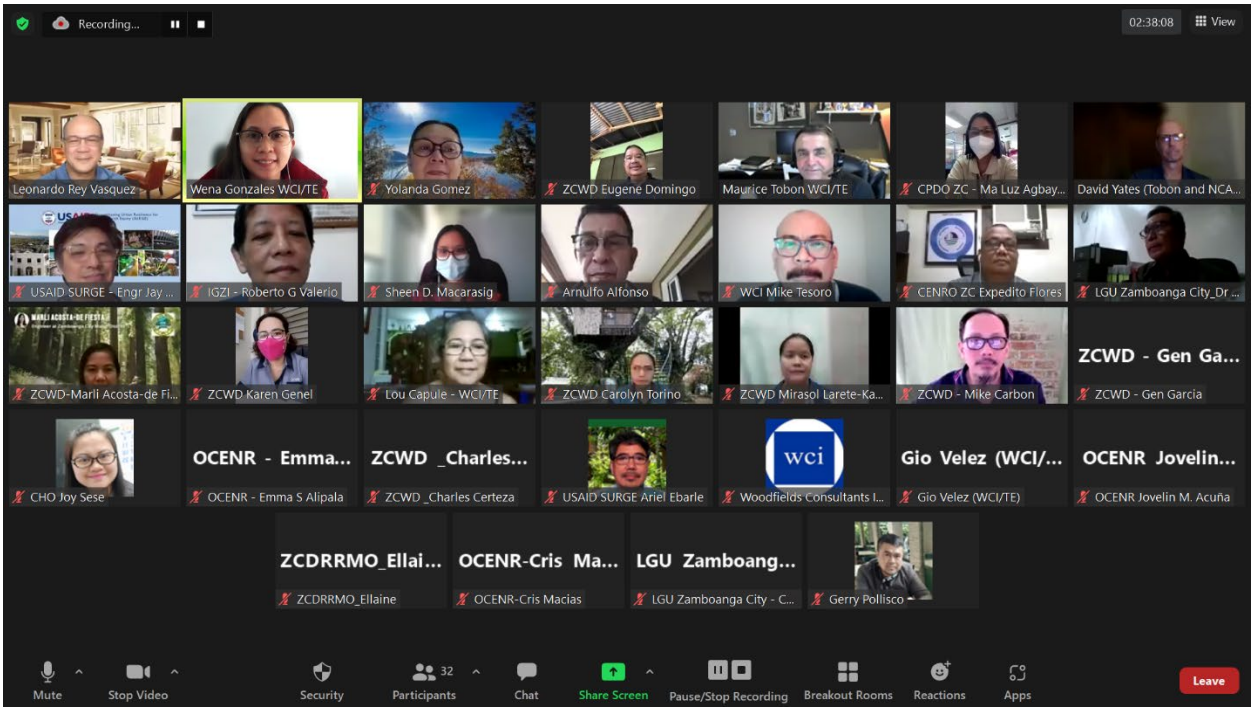


c. Two-Day Online Consultation Meeting with the Zamboanga City Water Security Council on the Preparation of the Water Security Master Plan (July 28-29, 2021)

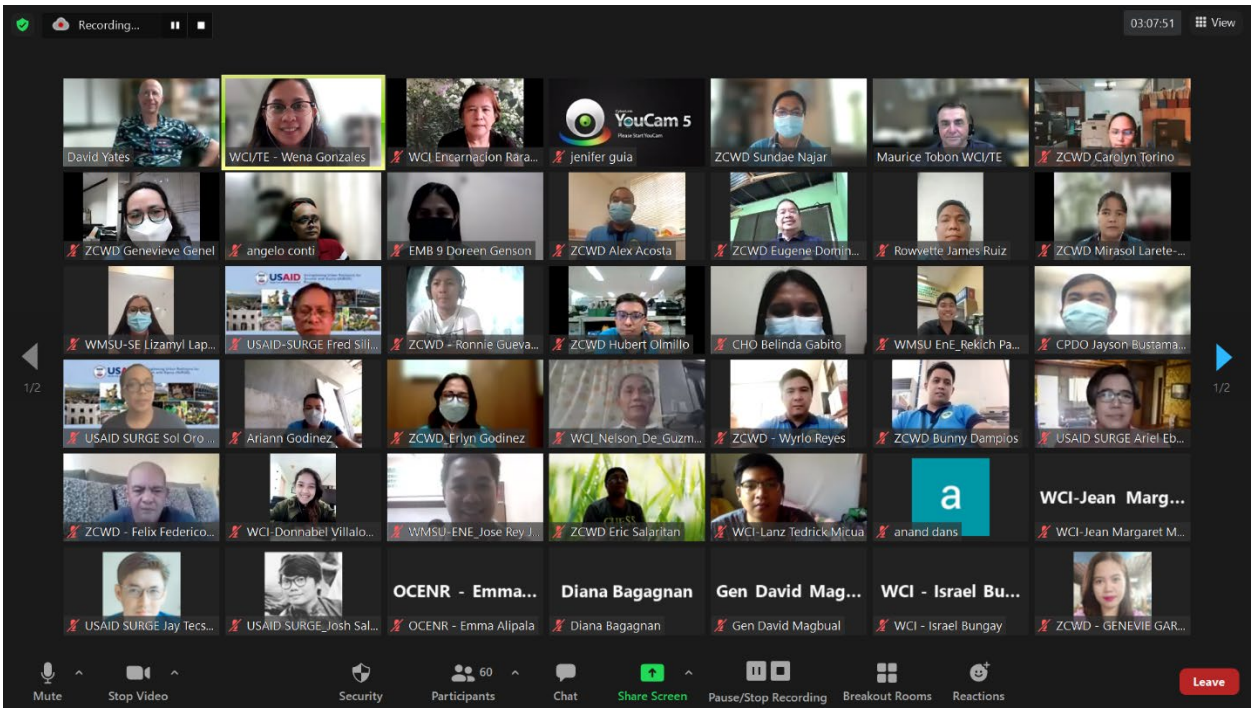


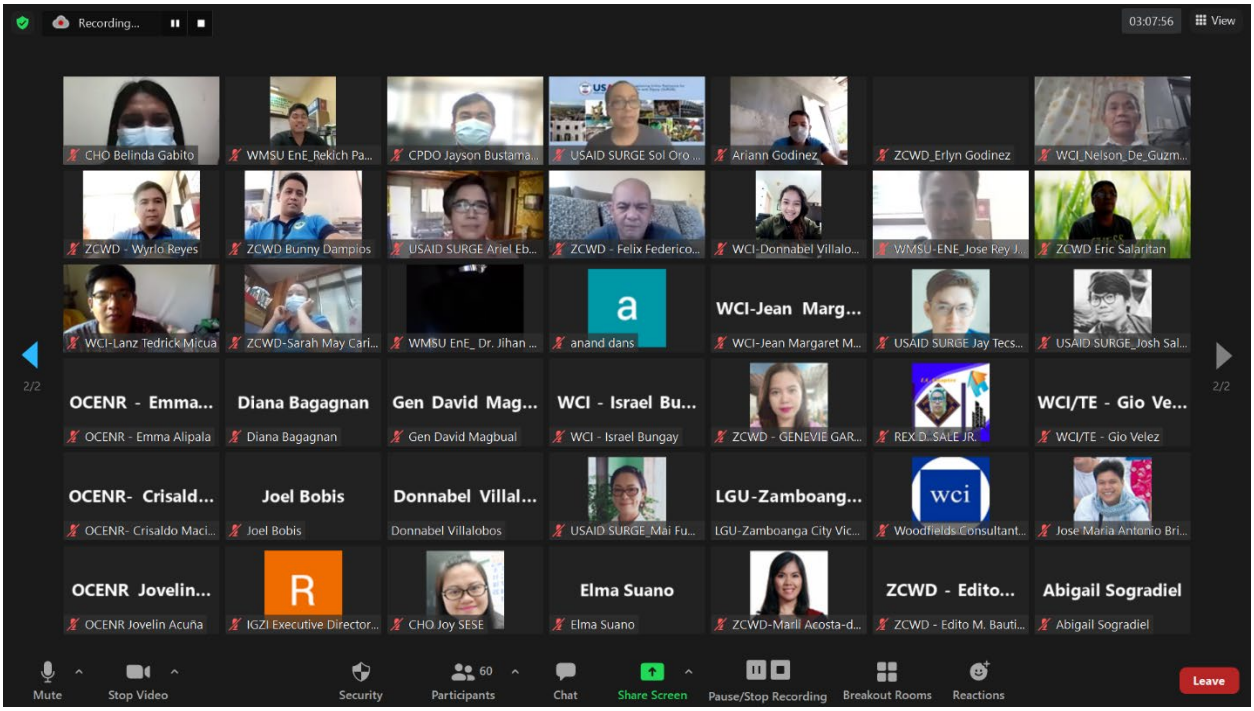


d. Online Consultation Meeting with the Zamboanga City Water Security Council on Water Security Options, Scenario and Alternative Analysis (September 14, 2021)

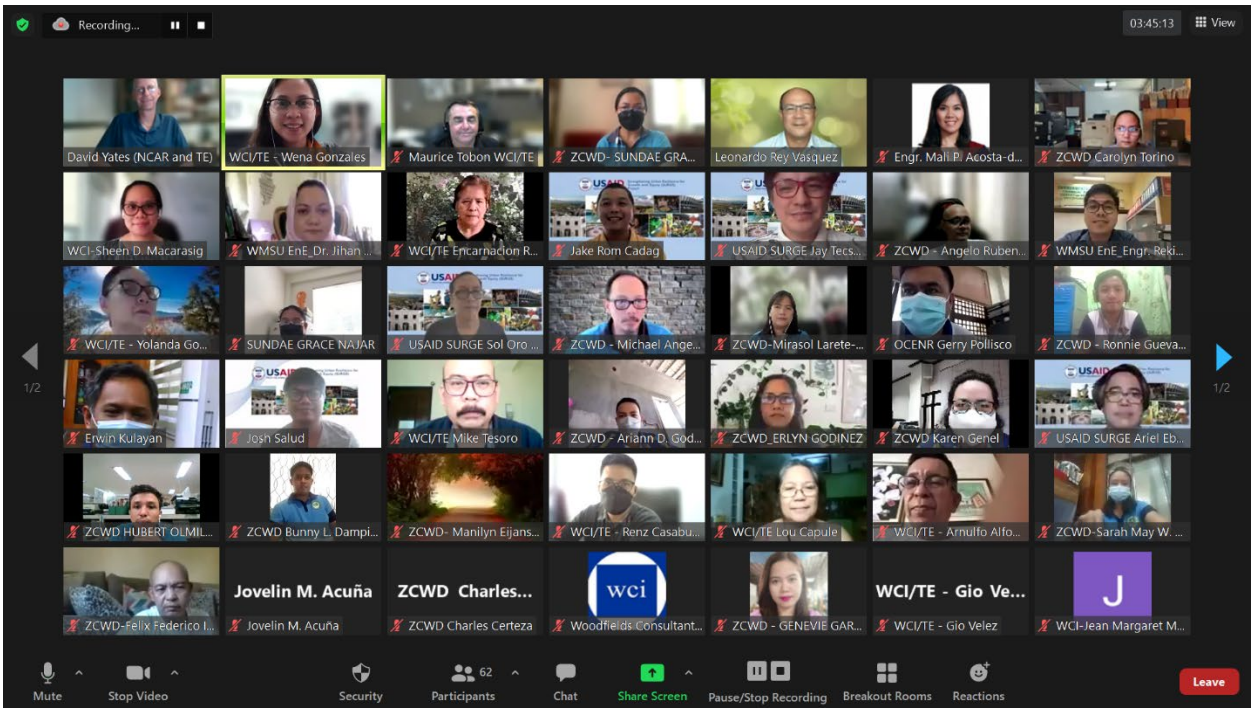


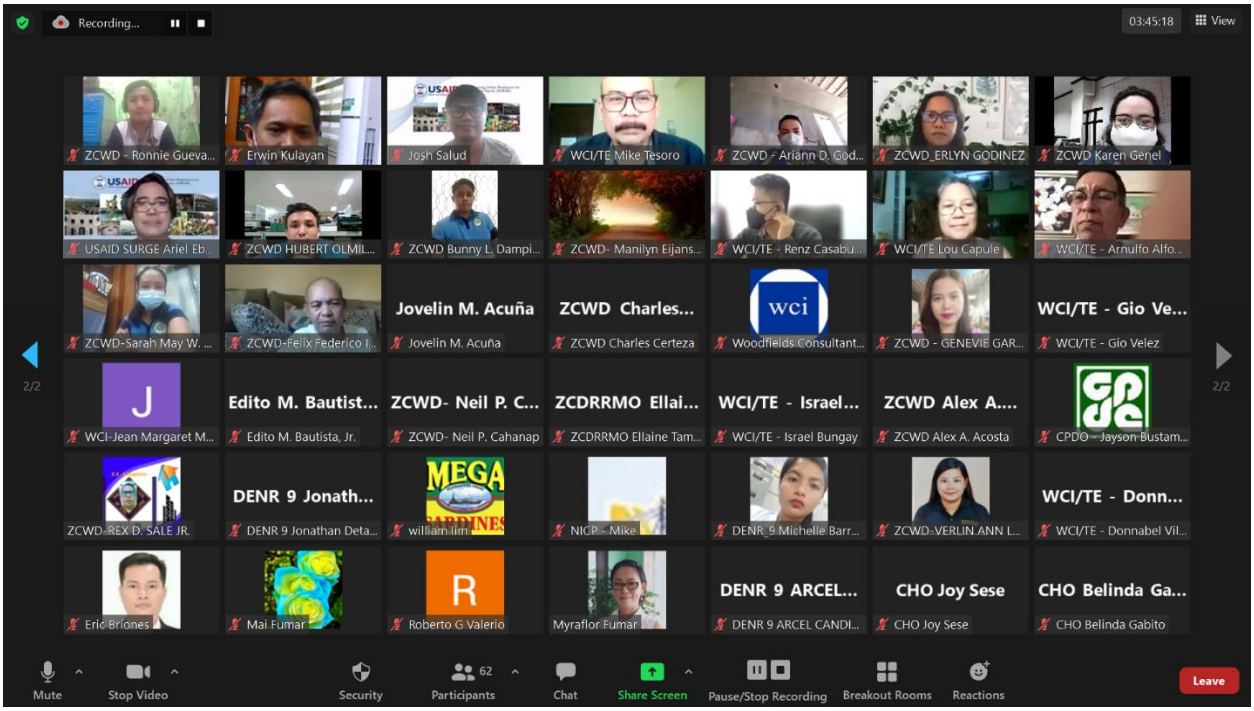
e. Water Evaluation and Planning (WEAP) System Training (September 23 and 29, 2021)





f. Online Meeting for the Presentation and Validation of the Water Security Master Plan for Zamboanga City (September 29, 2021)




Recording...
03:45:18
View
ZCWD - Ronnie Gueva...
Erwin Kulayan
Josh Salud
WCI/TE Mike Tesoro
ZCWD - Ariann D. God...
ZCWD_ERLYN GODINEZ
ZCWD Karen Genel
USAID SURGE Ariel Eb...
ZCWD HUBERT OLMIL...
ZCWD Bunny L. Dampi...
ZCWD- Manilyn Eijans...
WCI/TE - Renz Casabu...
WCI/TE Lou Capule
WCI/TE - Arnulfo Alfo...
ZCWD-Sarah May W. ...
ZCWD-Felix Federico I...
Jovelin M. Acuña
Jovelin M. Acuña
ZCWD Charles...
ZCWD Charles Certeza
Woodfields Consultant...
ZCWD - GENEVIE GAR...
WCI/TE - Gio Ve...
WCI/TE - Gio Velez
2/2
WCI-Jean Margaret M...
Edito M. Bautist...
Edito M. Bautista, Jr.
ZCWD- Neil P. C...
ZCWD- Neil P. Cahanap
ZCDRRMO Ellai...
ZCDRRMO Ellaine Tam...
WCI/TE - Israel...
WCI/TE - Israel Bungay
ZCWD Alex A....
ZCWD Alex A. Acosta
CPDO - Jayson Bustam...
2/2
ZCWD-REX D. SALE JR.
DENR 9 Jonath...
DENR 9 Jonathan Deta...
william ilm
NICP - Mike
DENR_9 Michelle Barr...
ZCWD-VERLIN ANN L...
WCI/TE - Donn...
WCI/TE - Donnabel Vil...
Eric Briones
Mai Fumar
Roberto G Valerio
Myraflor Fumar
DENR 9 ARCEL...
DENR 9 ARCEL CANDI...
CHO Joy Sese
CHO Joy Sese
CHO Belinda Ga...
CHO Belinda Gabito
Mute
Stop Video
Security
Participants
62
Chat
Share Screen
Pause/Stop Recording
Breakout Rooms
Reactions
Leave

Primary Stakeholders of the Water Security Master Plan

Stakeholder	Agency/Position
Members of the Zamboanga City Water Security Council	• Office of the City Vice Mayor (Vice Mayor) • Zamboanga City Water District (General Manager) • Office of the City Environment and Natural Resources (CENR Officer) • SP Committee on Energy and Public Utilities (Chair) • SP Committee on Natural Resources and Environment Protection (Chair) • SP Committee on Health and Sanitation (Chair) • Office of the City Administrator (City Administrator) • Office of the City Planning and Development Coordinator (CPDC Officer) • Office of the City Agriculturist (City Agriculturist) • Office of the City Health (City Health Officer) • Office of the City Disaster Risk Reduction Management (CDRRM Officer) • Office of the City Mayor (Division Head and Barangay Affairs Officer) • Department of Environment and Natural Resources Region IX (DENR-Region IX), Office of the Regional Executive Director (Regional Director, EMB IX, OCENR Zamboanga City, PENRO Zamboanga Sibugay) • Western Mindanao State University (President, Head of the Environmental Engineering Department, Head of Sanitary Engineering Department) • Ateneo de Zamboanga University (President and Head of the Ateneo Center for Environment and Sustainability) • Zamboanga City Chamber of Commerce & Industry Foundation, Inc. (President) • Industrial Group of Zamboanga, Inc. (President)
National and Regional Government Agencies	• National Irrigation Administration-Region IX (NIA-R9) • National Water Resources Board (Representative Officer) • Department of Public Works and Highways-Region IX (DPWH-Region IX) • Local Water Utilities Administration (Representative)
Other Stakeholders	• Multilateral and Bilateral Donor Agencies (ODA Projects) • Water Service Providers (WSPs) in Zamboanga City

Prior to the conduct of the consultation and assessment activity, a survey questionnaire was circulated to the stakeholders with the intention of capturing their understanding of what water security is all about and its relation to their respective agency and/or organization mandate. The main objective of the survey was to understand the roles, interests, and participation of the different stakeholders in the preparation of the master plan. Given as very limited time and interactions, the survey was considered as an appropriate and effective instrument to gather initial data and information as well as the aspirations different stakeholders, in particular the members of the Zamboanga City Water Security Council both in terms of the offices and individual respondents. Ideally, a follow up activity such as workshop, one-on-one interview with selected respondents to further discuss and verify responses should be conducted. Again, however the time limitations simply did not permit any follow through activity. What was undertaken was to present the results (summary of the results) in a plenary session with the aim of getting further inputs, discussion and or clarifications from the respondents.

The survey instrument is composed of 16 related questions, all designed to better understand the nature, functions of the stakeholder organization as it relates to the preparation of a Water Security Master Plan. As such, the questionnaire was designed to capture relevant data and information on the following:

- Organizational background (roles, functions and coverage and extent of influence, involvement in water development and management)
- Definition of water security from the respondent's perspective and as it relates to the roles/function of the organization
- Success factors in achieving water security
- Challenges and barriers in achievement of water security
- Area/s of Interest in relation to water security
- Expected involvement in the preparation of the Zamboanga City Water Security Master Plan
- Level of knowledge and understanding on water related issues
- Level of understanding on historical limitation related achieving water security
- Knowledge on best practices and programs in support to water security
- Expectations from other co-stakeholders in achieving water security
- Current plans and programs that can contribute to achievement of water security

The survey questionnaire was sent to pre-identified respondents as Google Form to facilitate convenience in responding and to have a readily available summary for better understanding.

Stakeholder Engagements

To ensure that stakeholder participation and engagement is carried out, it is necessary to map out and identify stakeholders irrespective of the potential impact of the project. Taking into account that the Water Security Master Plan will focus on domestic water supply and demand aspects of water security, the mapping and identification of stakeholders will revolve around these two important and priority focal areas but at the same time will endeavor to include other non-domestic use of water. Given these priority areas, the primary stakeholders identified are classified into groups as listed in Table 43.

Key Findings of Stakeholder Consultations

Roles, Interest and Participation of Stakeholders

A total of 13 offices have responded to the survey questionnaire. Of these 13 office respondents, majority or 10 (77 percent) are members of the WSC. In terms of individual respondents, a total of 23 individuals responded to the survey. Again, a majority of 20 (87 percent) came from the WSC members. The following are the highlights of the responses:

- *On the definition of Water Security.* Responses on these questions were observed to be largely tied up to the function of offices who responded. There is also commonality on the responses from an environmental perspective relating to the health of the ecosystem; as driver of economic development, i.e., having sufficient water to support food, energy, economic and industrial development; water for human wellbeing, i.e., access to safe water of reliable quality and quantity aspects; sustainability which translates to meeting current and future water demands
- *On achievement of Water Security*. Majority of the respondents agreed based on their agency perception that water security is being achieved. The apparent impression that water security is being achieved is more than likely related to the varying agencies and their roles and definition of water security. For example, the local offices and ZCWD both

responded at less than 100 percent agreement that water security is being achieved, it is surmised that this is the result of the previous water shortages affecting these two agencies (or water customers) more than the others.

The responses to this important question showed that majority of the respondent is in agreement that Water Security is being achieved in relation to the mandate of their respective agencies. This can be explained by the fact that on the earlier questions regarding the definition of Water Security, it was observed that the responses gathered were tied up or related to the mandated functions and roles of those who responded. For instance, for DENR , WS definition is related to environmental protection .

Thus, the responses gathered provided an apparent impression that WS is being achieved is more than likely related to the varying Agencies and their roles and definition of WS. For example, the Local Offices and ZCWD both responded at less than 100% agreement that WS is being achieved, it is surmised that this is the result of the previous water shortages affecting these two agencies (or water customers) more than the others.

- *On Identification of Success Factors in Achieving Water Security.* The question regarding success factors in achieving WS was intended to support the responses provided by respondents on an earlier question whether WS is being achieved from their agency's point of view. This is intended to get a better understanding how respondents perceived WS as it relate to current policies and programs of the agency.

    - Achieving 24/7 consistent water supply and pressure
    - Policies implemented supportive of WS
    - Political support for achieving WS
    - Availability of financial investment being made
    - Implementation of protection and conservation efforts
    - Availability of technology and expertise

- *On Identification of Challenges and Barriers in Achieving Water Security.* Similar to the questions on success factors, respondents were also asked with respect to barrier and challenges in achieving WS. While the responses came as a mixed of causes and impacts, it also clearly pointed out that challenges and barriers come as a result of deficiency in current policies and programs development and/or implementation as well as factors that are beyond control of agencies .
    - With regards to challenges and barriers, respondents identified the following:
        - Degradation of the environment
        - Insufficient water supply to meet the demand
        - Presence of financial constraints
        - Impacts of climate change
        - High water losses (NRW)
        - Weak implementation of Water Demand Management Program
        - Absence of a water security plan
        - Limited infrastructure (i.e., dams)
        - Stakeholders not being on the same page
        - Lack of understanding that water is a finite resource

- Practices that are a threat to WS (i.e., proliferation of deep wells, wastage in water use)
- Operations and Maintenance budgets for existing infrastructure not enough

- *On Interests in Water Security Aspects.* The question on which aspect of WS are respondents most interested came with 5 aspects with brief explanations as follows: Rural household water security as it relates to the provision of sufficient, safe , physically accessible and affordable water and sanitation services for health and livelihoods in rural households; economic water security as it relates to the assurance of adequate water to sustainable satisfy a country's economic growth and avoid economic losses due to water-induced disasters; urban water security as it relates to safely managed and affordable water and sanitation services for their urban communities to sustainably achieved desired outcomes; environmental water security as it related to the health of rivers, wetlands, and groundwater systems and measured progress on restoring aquatic ecosystems to health on a national and regional scale and; water related disaster security as it relates to a nation's exposure to water related disasters, their vulnerability to those disasters and their capacity to resist and bounce back.

  Along these choices, respondents indicated that they are interested in all the areas of aspects indicated in the questionnaire: rural household security, economic water security, urban water security, environmental water security, and water-related disaster security.
- *On Involvement in the Water Security Master Planning.* While it may appear that understanding WS is largely influenced by the mandate and role of the agencies of respondents, it was deemed important to establish the potential involvement of respondents in the overall Water Security Master Plan preparation to help define future the roles of agencies covered by the survey at the same time solicit support in terms of resources to ensure active participation in the WS master planning exercise and eventually in the implementation of the ZC Water Security Master Plan .

  In general, stakeholder involvement in WS Master Plan preparation is critical. Respondents identified the following as their possible involvement in the plan preparation:
  - Coordination of PPA and ensuring priority funding for WS
  - Provision of support to risk assessment-related work
  - Involvement in environmental planning and protection work
  - Data provision and sharing in the preparation of the WS master plan

- *On Level of Knowledge on Water-Related Issues.* Understanding issues that relate to water management and development is important in water security master planning. Towards this end, respondents, in general, displayed a moderate to high level of knowledge on following water related issues: (i) low availability of water supply; (ii) diminishing water quality; (iii) increasing water demand; (iv) poor access to sanitation; (v) extreme drought; and (vi) extreme flood events.
- *On Historical Limitations and its Impacts.* Similar to level of knowledge pertinent to water related issues, respondents have moderate to high level of understanding on the impacts of several historical limitations as enumerated in the questionnaire. These included: (i) inefficient infrastructure; (ii) gaps on legislations and/or implementation; (iii) poor WDM; (iv) inadequate sanitation; (v) climate change; (vi) extreme flood events; (vii) competing and conflicting uses of water; and (viii) inadequate infrastructure.

- *On Expected Interactions between and Among Stakeholders.* Respondents expects the following that among and between stakeholders: (i) commitment and full support; (ii) allocation of needed funds for water security-related efforts; (iii) involvement in monitoring the plan; and (iv) implement programs to help protect watersheds.
- *On Current PPAs that can Contribute to Achieving Water Security***.** At present, the following programs/projects and activities have been identified by respondents that can contribute towards achievement of water security: (i) development of infrastructure; (ii) natural resources management and development programs; (iii) WDM; (iv) forest land use planning; (v) septage and sewerage management program; (vi) promotion of rainwater harvesting; and (vii) practice of climate resilient agriculture (SMART agriculture).

The summary of responses showed that stakeholders have an ample knowledge on what water security and has provided a good definition of it. Majority agreed that water security is being achieved with several success factors clearly identified, but there appears to be a limited definition of water security in the context that each agency appears to have their own experience and definition of water security. However, challenges and barriers were also noted by respondents. In terms of interest, respondents identified a wide spectrum of interest across different thematic areas. Relatedly, respondents identified their perception in terms of their potential involvement in water security planning. Knowledge wise, respondent displayed medium to high level of know how same as in understanding historical limitations of water security planning. As far as limitations in achieving water security, respondents identified relevant factors they believed would hinder the success of achieving water security. Several expected interactions among and between stakeholders were also identified. Finally, respondent provided a list of current PPAs that are being implemented by their respective offices that van effectively contribute towards achieving water security.

Overall, the survey provided important data and information critical to the preparation of the master plan. It can be concluded that respondents have a good background and knowledge based with regards to water security. This moderate to high level of understanding of the concept of water security would be a plus factor and is expected to provide the project the much-needed support, buy-in and active engagement of the different stakeholders towards the preparation of the Water Security Master Plan.

Online Meeting for the Presentation and Validation of the Water Security Master Plan for Zamboanga City

USAID
FROM THE AMERICAN PEOPLE

Strengthening Urban Resilience for Growth with Equity (SURGE) Project

Water Security Master Plan for Zamboanga City

29 September 2021

USAID
FROM THE AMERICAN PEOPLE

Strengthening Urban Resilience for Growth with Equity (SURGE) Project

House Rules

- Please **turn off the video caption.**
- Please make sure that **your mic is on MUTE when the speakers are presenting. Questions will be entertained during the Q&A portion.**
- Please ensure that you are viewing the screen in **sidebar layout** to see both the speaker and presentation.
- On Recording: Please be informed that we will be recording the webinar. **The recording is purely for documentation purposes and will not be shared by the SURGE Project to anyone without prior consent.**

USAID
FROM THE AMERICAN PEOPLE

Strengthening Urban Resilience for Growth with Equity (SURGE) Project

Program of Activities

Time	Activity
10:00 a.m. – 10:05 a.m.	Preliminaries Acknowledgement of Participants
10:05-10:10 am	Opening Remarks Dr. Jake Rom D. Cadag, USAID SURGE
10:10-10:40 am	Presentation of Water Security Master Plan Engr. Maurice Tobon-Team Leader/WCI/Tobon Engineering (TE)
10:40 – 10:50am	Questions
10:50 – 10:55am	WSC TWG Resolution on Adopting and endorsing the Water Security Master Plan to CDC and SP
10:55 - 11:00am	Closing Remarks Engr. Jay Tecson, USAID SURGE

USAID
FROM THE AMERICAN PEOPLE

Strengthening Urban Resilience for Growth with Equity (SURGE) Project

Opening Remarks

Dr. JAKE ROM D. CADAG
OIC Component 1 Lead/ DRR-Resilience Specialist
USAID SURGE Project

USAID
FROM THE AMERICAN PEOPLE

Strengthening Urban Resilience for Growth with Equity (SURGE) Project

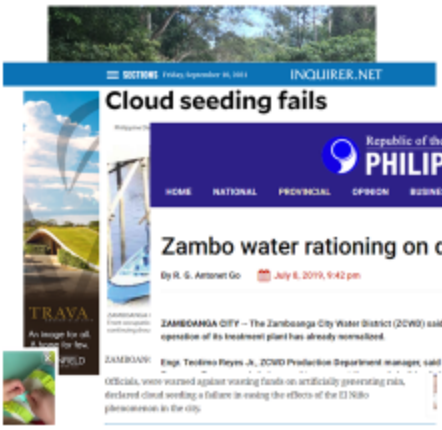
Presentation of the Water Security Master Plan

ENGR. MAURICE TOBON
Team Leader
WCI/Tobon Engineering

USAID
FROM THE AMERICAN PEOPLE

Strengthening Urban Resilience for Growth with Equity (SURGE) Project

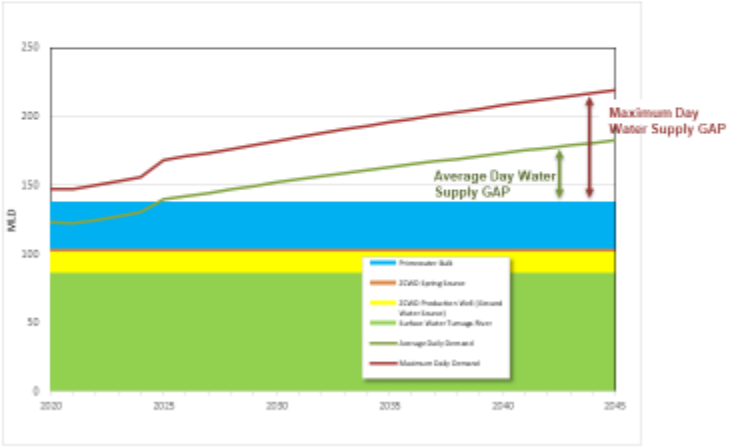
Current situation



USAID
FROM THE AMERICAN PEOPLE

Strengthening Urban Resilience for Growth with Equity (SURGE) Project

If the current situation continues the GAP Widens



USAID
FROM THE AMERICAN PEOPLE

Strengthening Urban Resilience for Growth with Equity (SURGE) Project

Water Security Master Plan what is it ?

it is a study and plan which includes;

- a water security assessment based on the analysis of supply reliability, cost, implementation, stakeholder acceptance, and downscaled climate change projections;
- recommended strategies and actions based on the analysis of the assessment results
- anchored on an integrated water resources management model Water Evaluation and Planning System platform (WEAP);
- capacity development of ZCWD and the LGU in integrating climate change into planning for current and future review of water resource development
- a comprehensive water planning support document which will benefit the current and future water users of Zamboanga City

USAID
FROM THE AMERICAN PEOPLE

Strengthening Urban Resilience for Growth with Equity (SURGE) Project

Step to the Development of the Water Security Master Plan Process

- Coordination Meeting, description of the Study Area
- Understanding of the Current Water Security Situation of Zamboanga City
- Define Goals, Strategies and Objectives Based on Water Risks
- Explore and Define Proposed Water Security Programs, Projects and Activities
- Review, Analyze, and Compare Water Security Options
- Select Preferred options
- Finalize the Water Security Master Plan

USAID
FROM THE AMERICAN PEOPLE

Strengthening Urban Resilience for Growth with Equity (SURGE) Project

Outputs

USAID
FROM THE AMERICAN PEOPLE

Strengthening Urban Resilience for Growth with Equity (SURGE) Project

What is WEAP?

- Water Evaluation and Planning Model- Decision Support Model Tool
- Why are we using it?
  - Climate Driven Hydrology
  - Integrated Supply & Demand
  - Financial Modules
  - Conservation & Demand Management Strategy Testing
  - Reservoir & Downstream Flow Analysis
  - Easily Extensible
- It is the "anchor" of the Water Security Master Plan

USAID
FROM THE AMERICAN PEOPLE

Strengthening Urban Resilience for Growth with Equity (SURGE) Project

XLRM Framework (Decision Support) is based on Stakeholder meetings

X external factors	L levers/management options	M Metrics
• Climate • Seasonal variations – storms vs droughts (antecedent conditions) • Demand (population)	• Demand Side Management • New Water Supply Sources – Bog Lake, Manicahan • Groundwater Expansion • Drought Management Actions • Conservation Marketing • New Reservoir	• Supply Reliability (how often is supply not met) • Cost of Investments • Groundwater Use • Low Flows in the River • Safe Yield

USAID
FROM THE AMERICAN PEOPLE

Strengthening Urban Resilience for Growth with Equity (SURGE) Project

WEAP Alternatives

No action

Low cost

- NRW reduction from 60 to 40 %
- Implement WDM decrease water demand 5 %
- Bog Lake (20 MLD) 2030

High Supply reliability

- NRW reduction 60 to 30 %
- Implement WDM decrease water demand 5 %
- Boglake (20 mld) 2025
- Manicahan river (50 mld) 2030

USAID
FROM THE AMERICAN PEOPLE

Strengthening Urban Resilience for Growth with Equity (SURGE) Project

Scenarios

Scenarios 2020- 2050,
Each Alternative is analyzed in the following Scenarios;

Water Demand Growth

- High 3 %
- Historical 1.26 %

Climate Projections

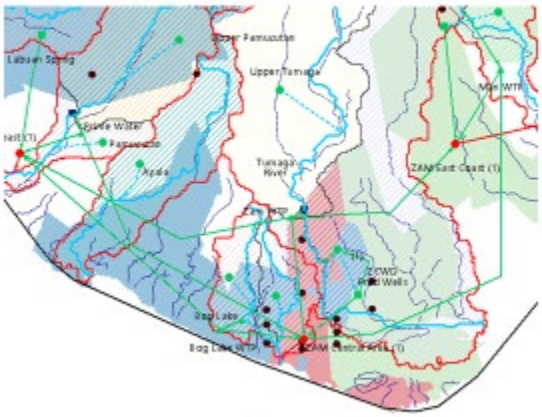
- Historic
- Dry (~ 10 % less over 30 yrs)

USAID
FROM THE AMERICAN PEOPLE

Strengthening Urban Resilience for Growth with Equity (SURGE) Project

ZCWD-WEAP Model

- Model is driven by daily climate (pcp, temp).
- Water Demands are by Barangay, aggregated to West, Central, and East
  - Domestic (per-cap * pop)
  - Commercial, industrial, sem-commercial, etc.
- Older surface water supply is prioritized, then newer, then groundwater
- NRW starts at 60%

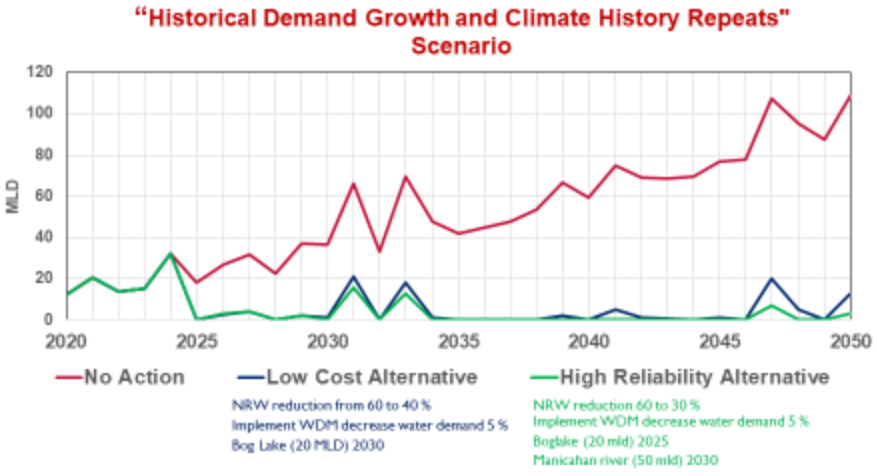


Model is not "complicated", but it does have quite a bit of detail

USAID
FROM THE AMERICAN PEOPLE

Strengthening Urban Resilience for Growth with Equity (SURGE) Project

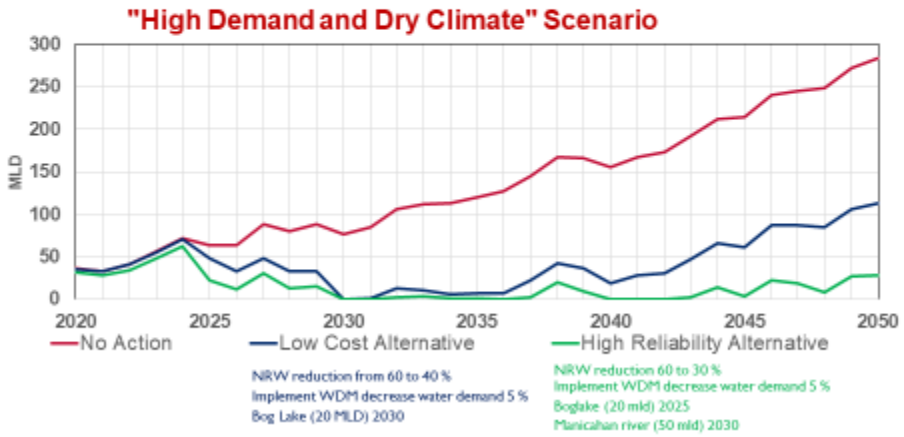
ZCWD-WEAP Analysis Results Unmet Demand



USAID
FROM THE AMERICAN PEOPLE

Strengthening Urban Resilience for Growth with Equity (SURGE) Project

ZCWD-WEAP Analysis Results Unmet Demand



USAID
FROM THE AMERICAN PEOPLE

Strengthening Urban Resilience for Growth with Equity (SURGE) Project

Conclusions

- Water stress and unmet demand will increase substantially in the future without intervention. Up to 300 mld unmet demand.
- Both water demand and climate have a large impact on the gap of unmet demand.
- NRW reduction is the most important and cost effective "water supply" program to achieve water security. The NRW program must be refocused.
- ZCWD has the leadership to achieve water security; they just need better internal/external coordination and proper funding.

USAID
FROM THE AMERICAN PEOPLE

Strengthening Urban Resilience for Growth with Equity (SURGE) Project

Recommendations

Four Elements of Water Security

Aggressively Pursue NRW Reduction

Expand WDM Program Now

Engage Stakeholders and Utilize New Tools in the Planning Process

Expand Water Supply Sources

USAID
FROM THE AMERICAN PEOPLE

Strengthening Urban Resilience for Growth with Equity (SURGE) Project

Pursue NRW Reduction

ZCWD Elements of Water Security

Aggressively Pursue NRW Reduction

- Secure Financing to replace large aging water mains
- Prioritize NRW Reduction Program
- Upgrade meters and ensure proper calibration of existing meters
- Field staff to audit water system

USAID
FROM THE AMERICAN PEOPLE

Strengthening Urban Resilience for Growth with Equity (SURGE) Project

Expand WDM Program Now

ZCWD Elements of Water Security

Expand WDM Program Now

- Actively pursue the WDM Center, expand national involvement
- Expand ZWAT Program
- Promote water saving initiatives to customers
- Instill the "Value of Water"
- Control Watershed

USAID
FROM THE AMERICAN PEOPLE

Strengthening Urban Resilience for Growth with Equity (SURGE) Project

Engage Stakeholders and New Tools

ZCWD Elements of Water Security

Engage Stakeholders and Utilize New Tools in the Planning Process

- WSC
- LGU
- DENR
- DNR
- DPWH
- LWUA
- Academia
- WEAP Planning Tool

USAID FROM THE AMERICAN PEOPLE

Strengthening Urban Resilience for Growth with Equity (SURGE) Project

Expand Water Supply Sources

ZCWD Elements of Water Security

Expand Water Supply Sources

- Expand groundwater
- Bog Lake
- Manicahan River
- Policies (groundwater, watershed, recharge, protection zones)

USAID FROM THE AMERICAN PEOPLE

Strengthening Urban Resilience for Growth with Equity (SURGE) Project

Cost (High Reliability Alternative)

Proper Funding of the NRW Program with appropriate water rates is critical

Options	Timeline	Capital Cost (million)	Operating Cost (PhP/CUM)	Comments
Bog Lake (20 mld)	2025	PhP 260 for 3 years	10	2025 (High Supply Alternative),3 years to implement
Manicahan River (50 mld)	2030	PhP 520 for 5 years	10	2030 (High Supply Alternative),3 years to implement starting in 2027
NRW Reduction	2025-2039	PhP 80 for 14 years	10	60% --> 30 % @ 4 % per year)
New Groundwater Wells	2025	PhP 8 for 2 years	12	Only serving Central District, 12 CUM/day (Existing) increase by 25% in 2025. Capital Cost in 2025 and 2026
WDM	2025		0.5	5 % reduction, implemented immediately in 2020 and applied equally to all uses

USAID
FROM THE AMERICAN PEOPLE

Strengthening Urban Resilience for Growth with Equity (SURGE) Project

Schedule of Programs and Projects to Achieve Water Security

USAID
FROM THE AMERICAN PEOPLE

Strengthening Urban Resilience for Growth with Equity (SURGE) Project

Next Steps

- Incorporate comments into Final Report
- Adoption of the Water Security Master Plan by WSC
- Each responsible Agency develops action plans, follow the reform framework developed in the National Water and Sanitation Master Plan
- Promote and disseminate the Water Security Master Plan
- Incorporate the WEAP model as a planning tool, identify and train “champions”
- Ensure adequate funding from LGU

USAID
FROM THE AMERICAN PEOPLE

Strengthening Urban Resilience for Growth with Equity (SURGE) Project

Open Forum

USAID
FROM THE AMERICAN PEOPLE

Strengthening Urban Resilience for Growth with Equity (SURGE) Project

WSC TWG Resolution on Adopting and endorsing the Water Security Master Plan to CDC and SP

MR. MICHAEL TESORO
Development Communications Specialist
WCI

USAID
FROM THE AMERICAN PEOPLE

Strengthening Urban Resilience for Growth with Equity (SURGE) Project

Closing Remarks

ENGR. JAY TECSON
Water Demand Management Consultant
USAID SURGE Project

USAID
FROM THE AMERICAN PEOPLE

Strengthening Urban Resilience for Growth with Equity (SURGE) Project

Muchisimas Gracias

For more information and queries, you may contact:

Engr. Maurice Tobon
Project Team Lead
toboneng@bellsouth.net
1 954 415 5594 (Viber, WhatsApp)

Engr. Marisheen Macarasig
Project Manager
mdeleon@wci.com.ph
0925-711-3022

Annex 8: SWOT Analysis of ZWAT

The Zamboanga Water Audit Team (ZWAT) was created after the formal launching of the ZCWD WDM Program in February 2016.[81]

STRENGTHS	**WEAKNESSES**
1. Staff competence (Level 1 Prime HR) 2. Gravity-based water system resources 3. Strategic Location of Resources 4. Well defined Vision and Mission Statement 5. Strong support from the Board of Directors 6. Systems and policies are properly cascaded 7. Developed Water Safety Plan for implementation 8. Management is innovative and open to changes 9. Established customers database system 10. Established customer feedback mechanism (customer care Facebook page) 11. Attractive Investment Profile (Category A water district) 12. Good watershed condition (Pasonanca Natural Park) 13. Availability of new bulk water supply 14. Multi-sectoral BOD members	1. Cramped working space/ Lack of storage for documents and equipment (e.g IT equipment) 2. Weak transfer of knowledge of aging workforce (Retiring seasoned employees, across all employees); absence of succession planning 3. Priority Projects are not implemented as planned 4. Unacceptable percentage of Non-Revenue Water 5. Occupational Safety and Health not fully implemented (include COVID requirements) 6. Unmet collection target (Collection Efficiency) 7. do not have asset database for the pipeline system 8. no unit assigned to be the central documents custodian 9. Marketing plan not fully implemented / no market study 10. Need to improve interdepartmental coordination and communication; absence of ISO aligned business processes 11. Need for full implementation of procurement plan **12.** Lack of proper studies for projects
OPPORTUNITIES	**THREATS**
1. Good relationship with the LGUs	

[81] The ZCWD management and Board of Directors approved a budget to support the implementation of the WDM program and created the ZWAT.

2. Availability of water resources 3. Potential for growth of consumer market 4. Income generation potential of the watershed multiple use zone via ecotourism 5. Rapid industrialization and urbanization (opportunity for business growth) 6. Strong ties with fellow water utilities 7. Political interventions/support 8. Available trainings for career enhancement 9. Introduction of water reforms 10. Aid and grants from other organizations (e.g. USAID) 11. Potential for PPP, joint ventures on infrastructure projects 12. Creation of water security council 13. opportunity to tap the services of the academe (public/ private colleges/universities) to conduct research proposals for ZCWD	1. Short- and long-term effects of climate change 2. Security threat to the water sources and facilities (e.g. man-made conflicts, sabotage, disasters) 3. Privatization of Local Water Districts (can affect tenure of employees) 4. Greater employment opportunities/ career growth outside ZCWD 5. Increasing population surrounding water sources 6. Political Agenda/ Election/ Changing Leadership 7. rural water service providers, private water refilling stations, private water supply in a subdivision 8. Endo (ZCWD cannot absorb JO workers) 9. COVID19 10. ground water extractions on rural/ even urban areas 11. negative perception on increased water rates

BROAD STRATEGIES

1. **Establish ISO aligned business processes**
   [to include processes on departmental coordination and communication; Human Resources, improvement of ZCWD Physical Office Setup, Monitoring)

   - Related strengths and weaknesses

     Strengths
     - Staff competence (Level 1 Prime HR)
     - Well defined Vision and Mission Statement
     - Strong support from the Board of Directors
     - Systems and policies are properly cascaded
     - Management is innovative and open to changes
     - Established customers database system
     - Established customer feedback mechanism (customer care Facebook page)

     Weaknesses
     - Cramped working space/ Lack of storage for documents and equipment (e.g IT equipment)
     - Weak transfer of knowledge of aging workforce (Retiring seasoned employees, across all employees); absence of succession planning
     - Occupational Safety and Health not fully implemented (include COVID requirements)
     - do not have asset database for the pipeline system
     - no unit assigned to be the central documents custodian
     - Marketing plan not fully implemented / no market study
     - Need to improve interdepartmental coordination and communication; absence of ISO aligned business processes
     - Need for full implementation of procurement plan

2. **Improve efficiency**
   [to include efficiency on distribution, planning, personnel, operations, ease of doing business, implementation of ARTA, transparency of information]

   - Related strengths and weaknesses

     Strengths
     - Gravity-based water system resources
     - Strategic Location of Resources
     - Developed Water Safety Plan for implementation
     - Good watershed condition (Pasonanca Natural Park)
     - Availability of new bulk water supply

     Weaknesses
     - Priority Projects are not implemented as planned
     - Unacceptable percentage of Non-Revenue Water

- Lack of proper studies for projects

3. **Improve relations, partnership or collaboration with stakeholders including customers**
    - Multi-sectoral BOD members

4. **Improve financial management**
    [collection efficiency, investor confidence, bank relations, performance ratio, financial Systems]

    Related Strengths and Weaknesses

    Strengths
    - Attractive Investment Profile (Category A water district)

    Weaknesses
    - Unmet collection target (Collection Efficiency)

5. **Introduce innovation on technology, processes and systems**

    Related Strengths and Weaknesses

    Strengths
    - Established customers database system
    - stablished customer feedback mechanism (customer care Facebook page)

    Weaknesses
    - Lack of proper studies for projects

PROGRAMS, PROJECTS, POLICIES, AND ACTIVITIES

PPPAs	Resources Needed	Remarks/KPIs
1. Implement NRW reduction plan	Refer to the NRW reduction plan	ZCWD developed an NRW reduction plan presented to the BOD
2. Continue the preparation for ISO certification		Completed 6 trainings Use of water efficient fixtures for ZCWD facilities
3. Development of new office complex		
4. Development of Database Asset Management		TSG (updating of the information) OG- status of valves (map database) Customers (feedback, leak reports)
5. Wastewater management (construction, and commissioning, reuse)		Sewerage (for bidding Stp) Septage management (on-going study)
6. Additional water supply		Old reservoir - 20 MLD
7. Completion or Updating of the Business Plan		Pending approval of water rates
8. Prime HR – accreditation for level 2		
9. Implement Internal Audit of the WSP		
10. Monitoring of projects		
11. Enhance customer care program		Complaints management -ensure that complaints are addressed promptly; dedicated customer service to respond to queries and complaints Introduction of online payment system Offering the water audit services Develop application to enable households conduct their own water audit
12. Expand the roster of trained water auditors by capacitating current		Activities identified based on ZWAT Action Plan 2020 Beyond

external and internal teams through re-training and/or immersion activities		Provide technical guidance to the WMSU water audit team during the re-audit of the university Conduct an evaluative water audit of the UdZ Tetuan Campus +B6+B7
13. Revise/improve current WDM materials and develop new ones to adapt to emerging and present global, national and local industry standards and best practices.		Refer to the ZWAT Action Plan 2020 Beyond Review current WDM materials e.g.: a. water audit toolkits b. water audit forms c. presentation materials and determine which needs to be revised, retained or eliminated. Identify the platforms and medium on how these materials shall be made available, published and/or disseminated. Revisit the WDM and water audit training protocols and revise them, to the extent necessary, to adapt to the global shift to web-based training activities. Gather data on current water efficient fixtures available in the market either through in-person visits, direct inquiries to suppliers via email, phone, etc.
14. Strengthen existing stakeholders' relationship through engagement, consultative and two-way partnership building activities		Resume exploratory talks with AdZU re possibility of establishing WDM information campaign and research center: to schedule with AdZU. Secure USAID SURGE's assistance to assist the ZWAT to develop digital and online training materials for Water Audit e.g.

		instructional videos, smartphone app for WDM, online calculator for cost-savings computation, etc.
15. Advocate a development of City-wide WDM through the Water Security Council		

HOW DO WE MONITOR AND EVALUATE SUCCESS?

Conduct of Periodic review of the strategic plan

WHAT ARE OUR NEXT STEPS?

1. Meeting between WMSU and ZCWD chairman (existing MOA and new MOA- creation of the national knowledge center on WDM).
2. ZCWD Chairman to advocate expansion of the water audit team in the water security council
3. Review of WDM Training Design and development of Module. Check for potential inclusion in the UDLP program.
4. Development of IEC Materials for WDM
5. Updating of the existing WDM Toolkit
6. Develop proposal for user's study, application development
7. Capture the lessons from the water security master plan and Septage FS with reuse

Annex 9: Water Evaluation and Planning (WEAP) System Training Report

Rationale and Objective

Water Evaluation and Planning System (WEAP) is an integrated, scenario-based modelling tool that helps stakeholders manage water supply resources to meet often-competing demands from cities, industries and farms, as well as consider long-neglected interests such as wildlife habitat and vulnerable communities.

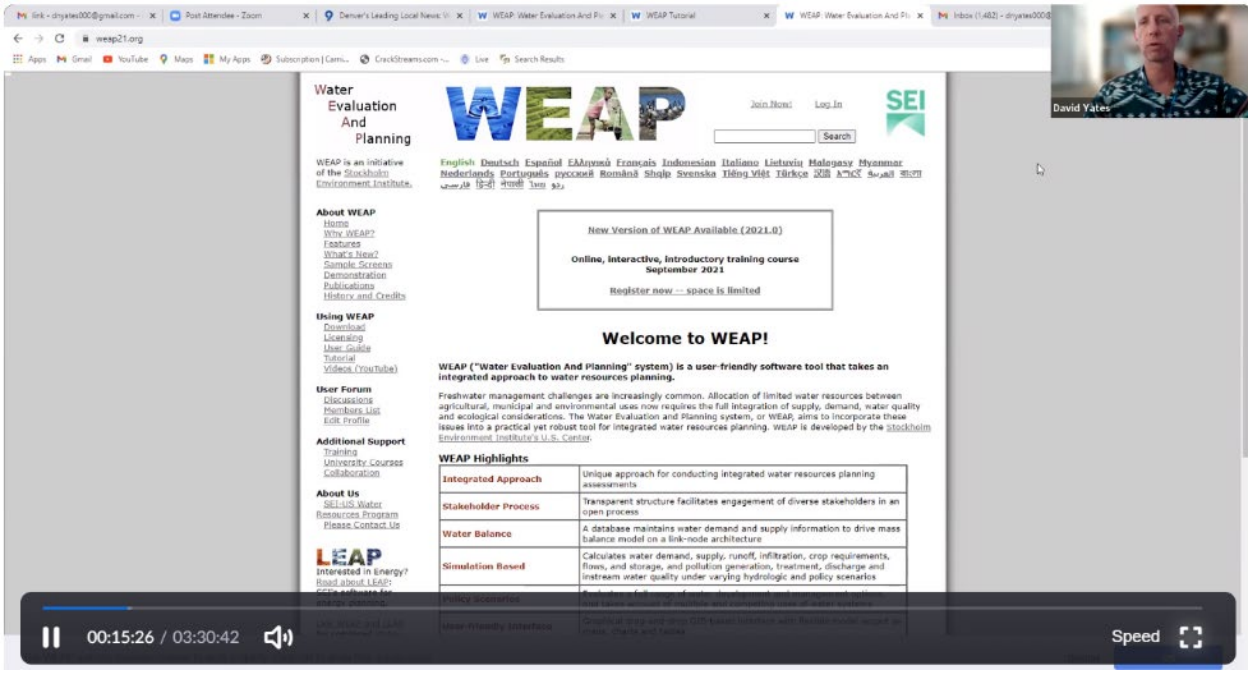
WEAP has been used as a planning and decision-making tool for the development of the Zamboanga City Water Security Master Plan. In order to inculcate understanding and knowledge as well as build capacity on the application of WEAP using on-hand information in the development of the master plan, a training was conducted by USAID SURGE through WCI/TE Project Team for selected stakeholders in Zamboanga City. Dr. David Yates, the Project Team's Water Decision Support Expert, spearheaded the said training via Zoom in two parts last September 23 and 29, 2021. The first session focused on the introduction of WEAP and its application on the masterplan using data from Zamboanga City. The second session was dedicated to coaching and getting feedback from the stakeholders on the use of the tool.

Highlights of the Training

Part 1

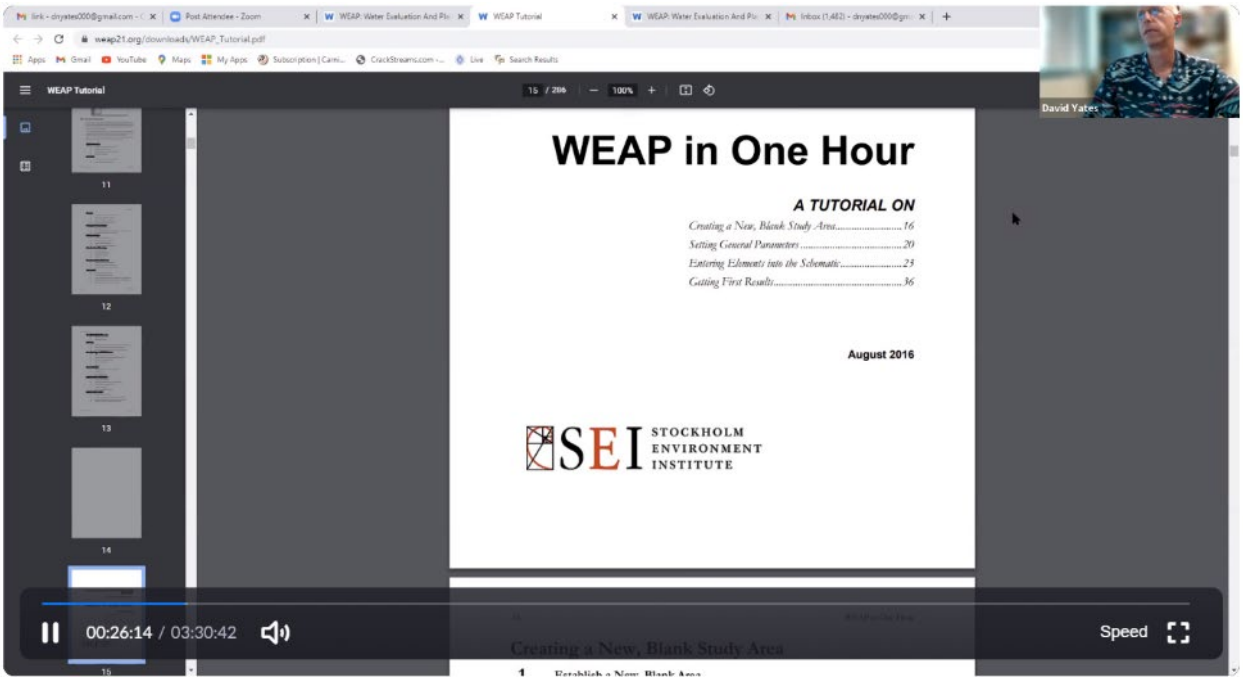
Out of 80 registrants, a total of 62 participants attended the training. Engr. Jay Tecson, Water Demand Management Consultant of USAID SURGE Project opened the activity and Engr. Maurice Tobon, Team Leader of the Zamboanga City Water Security Master Plan introduced the WEAP program as a tool and how it is used in the master plan.

Prior to the training, the participants were requested to do the following tasks: (1) Install the free version of the software thru this link: https://www.weap21.org/; (2) Watch the "WEAP in one hour" thru this link: https://www.youtube.com/c/WEAP-System; and (3) Read additional reference: https://weap21.org/downloads/WEAP_Tutorial.pdf. WEAP is a free software and can be downloaded from the software's website. Prior to download, users need to register as member of the forum where the password will be emailed after registration.

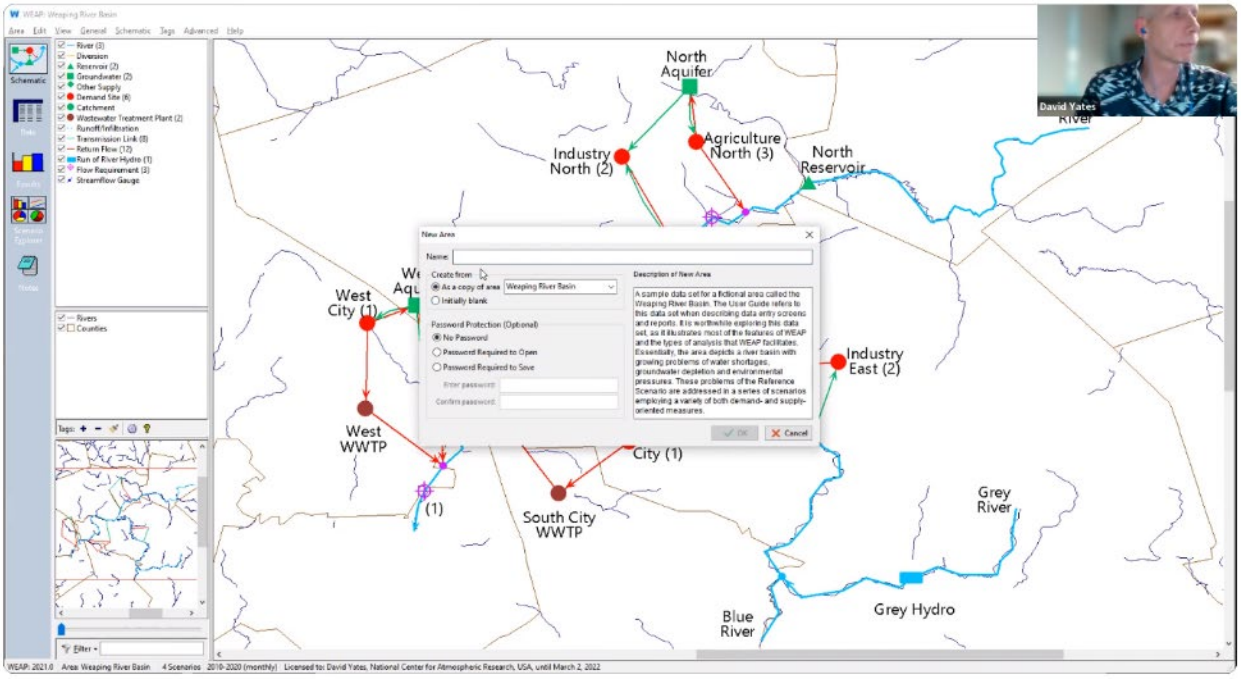


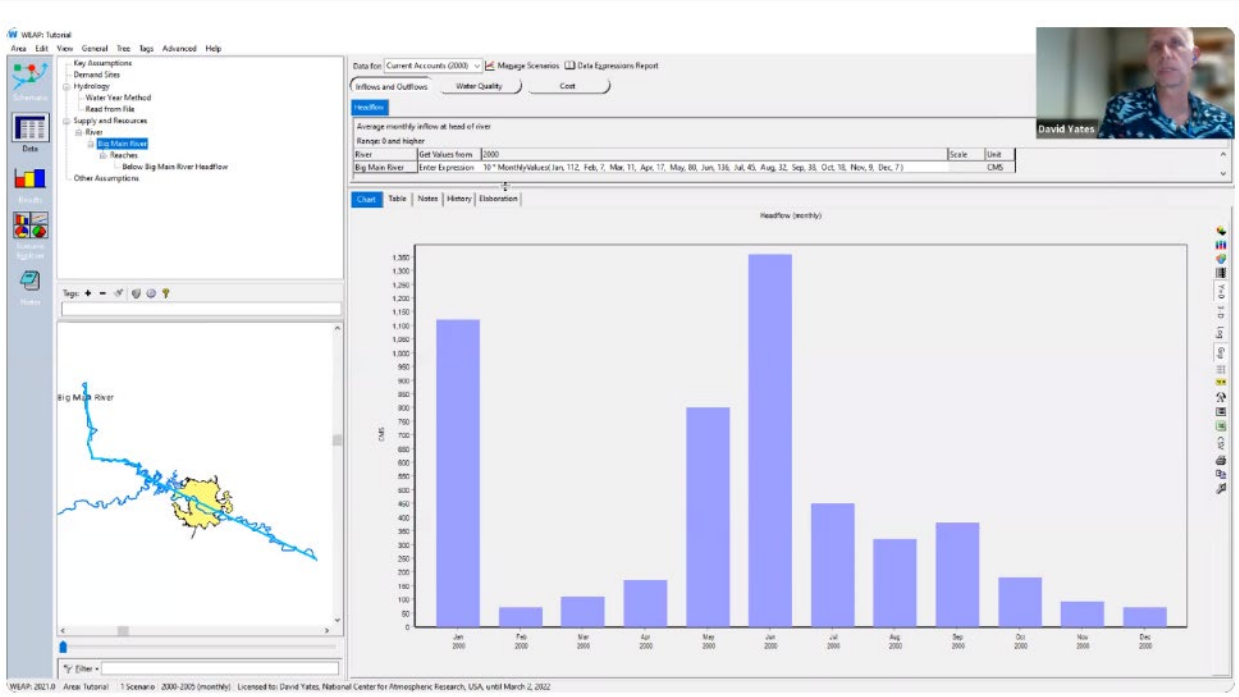
Dr. Yates inquired whether all participants have downloaded and installed the program in their computers. There were more than 10 participants who encountered issues with the installation due to (1) registration problems with the website, (2) internet connectivity, (4) installation issues with their computer, and (4) license. Dr. Yates mentioned that participants need to register with the WEAP forum to get to the link to the download site. For the license, he mentioned that participants can still run the program even if it is in Evaluation Mode and not the licensed one. To get the license, they have to make a request to WEAP forum.

The training started with Dr. Yates informing participants to use WEAP in One Hour Tutorial as reference for the step-by-step process of manipulating data in WEAP.



The whole training revolved around following the steps indicated in the tutorial.



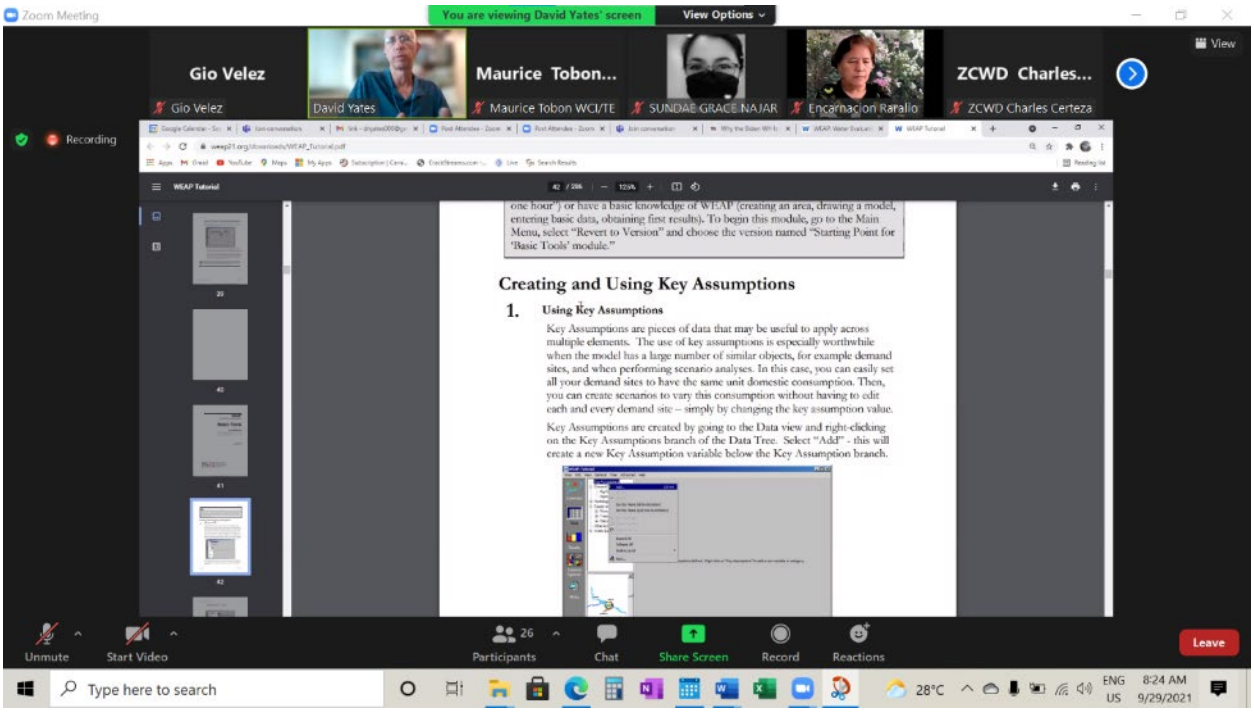


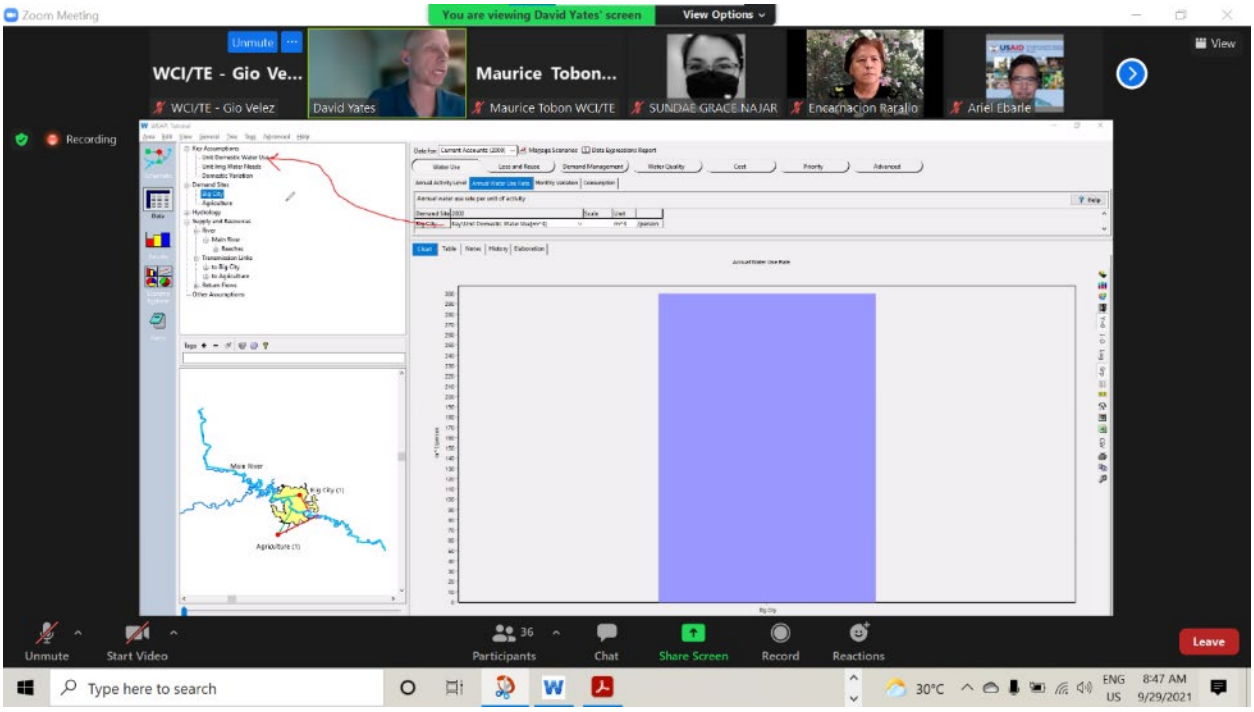
The training ended with Dr. Yates informing the participants that they can manipulate real data based on the model database that he developed for Zamboanga City. A link where they can download the data was provided after the training.

Part 2

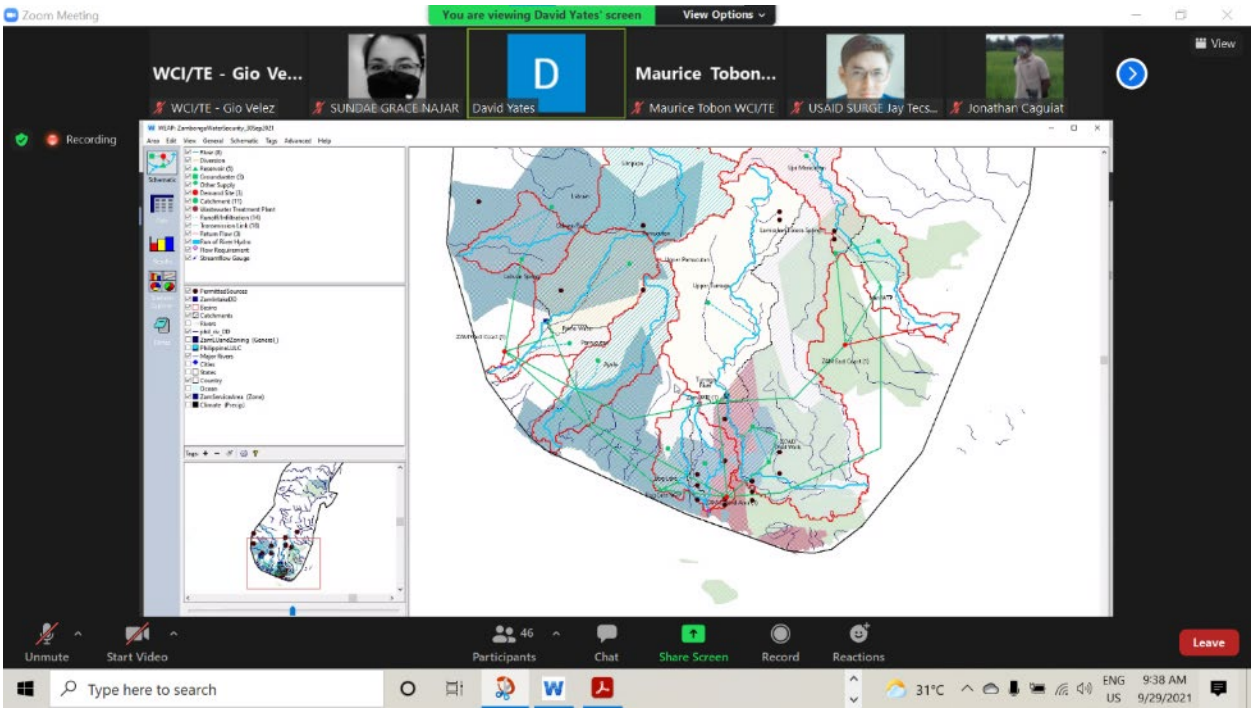
A total of 43 participants attended the second part of the training.

Dr. Yates continued the activity with a discussion on key assumptions and expression builder using the tutorial on WEAP. According to him, the use of key assumptions is especially worthwhile when the model has many similar objects, for example demand sites, and when performing scenario analyses. The expression builder, on the other hand, is a simple way of entering expressions and functions. Users can by-pass it and enter functions, references and mathematical expressions directly in the main expression window.





The session focused on getting their feedback on WEAP using the data on Zamboanga City.



Observations and Next Steps of the Training

The following are observations on the training:

- Delivering the training online is quite a challenge both for the participants and the trainer. It is difficult to maintain the participants' attention and control distractions while being online.
- This training will be more effective if done in-person. The trainer could not monitor the pace of the participants and any issues encountered by participants could easily be resolved if the activity is done via face-to-face interaction.
- There was very limited interaction between the trainer and the participants. This could be due to participants being overwhelmed on the topic and/or the topic was too technical to comprehend. This resulted to very few questions being asked by participants to the trainer.
- There was a general interest among the participants given the potential application and use of WEAP in the planning and decision making on water resource management.

The following are proposed next steps to sustain the momentum of the participants on WEAP:

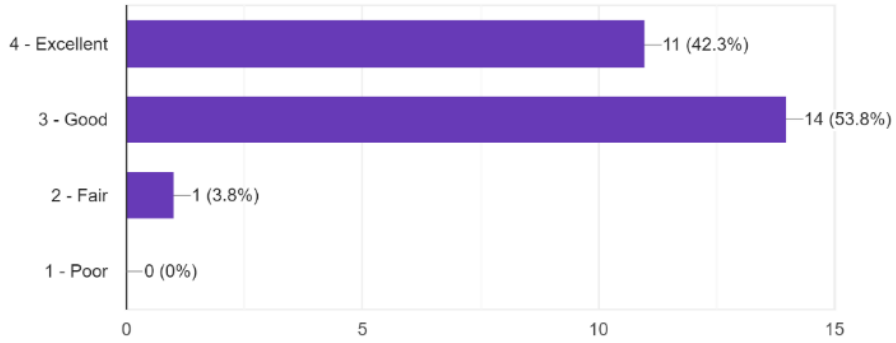
- Identify WEAP champions from the Water Security Council members.
- Provide at least 10 free licenses to the members of the council.
- Provide a link of the recorded video of the training to the participants.
- Provide an open communication between the participants and Dr. Yates in case there are further questions and clarifications on the program.
- Conduct an in-person and hands-on training on WEAP. This is contingent on funding of the Water Security Council from other sources, and the easing of COVID-19 travel restrictions.

Training Evaluation

An evaluation was circulated among the participants in order to get their feedback. A total of 26 participants sent their thoughts on the activity. In general, the participants rated the activity as either good or excellent and have met their expectations on the training. A summary of the evaluation is further presented below:

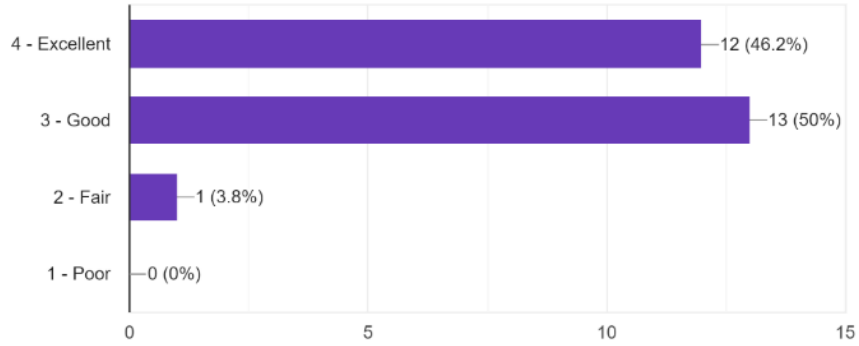
1. The objectives were clearly stated and easily understood

26 responses



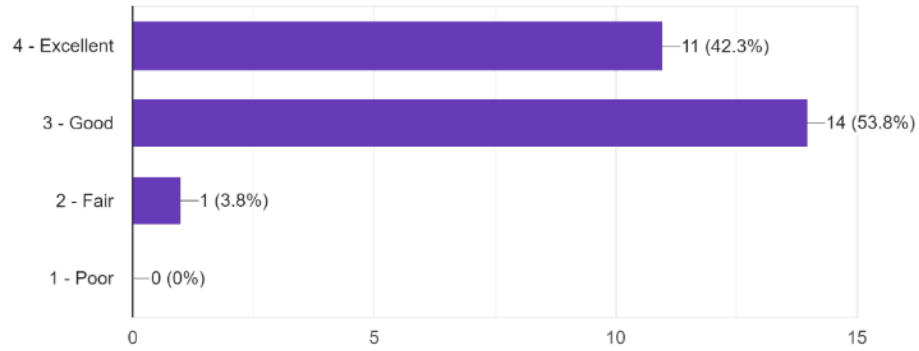
2. Program objectives were met

26 responses



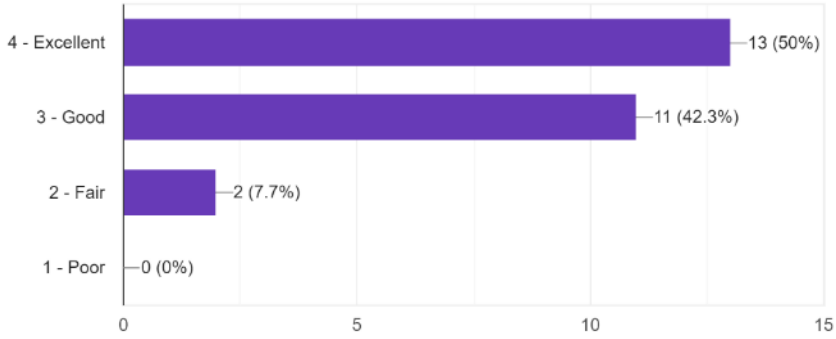
3. Training program met my personal expectations

26 responses



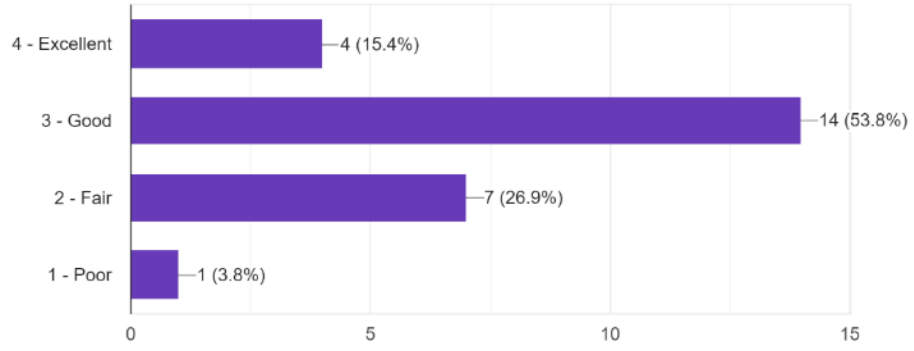
4. Comprehensiveness of the topic, e.g., covers significant things you need to know on WEAP

26 responses



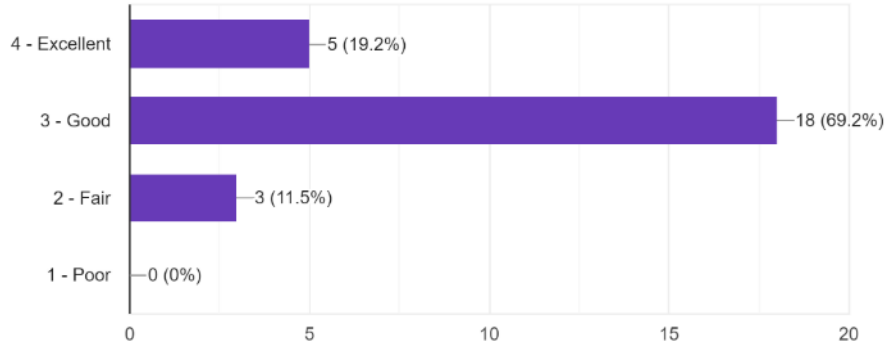
5. Time allotted for the topic

26 responses



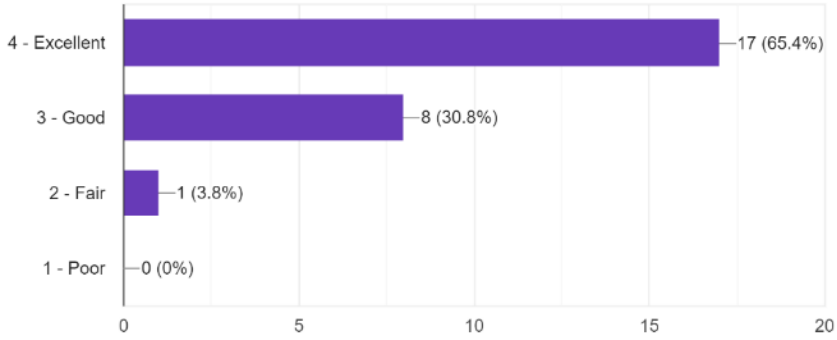
6. Level of participation of attendees

26 responses



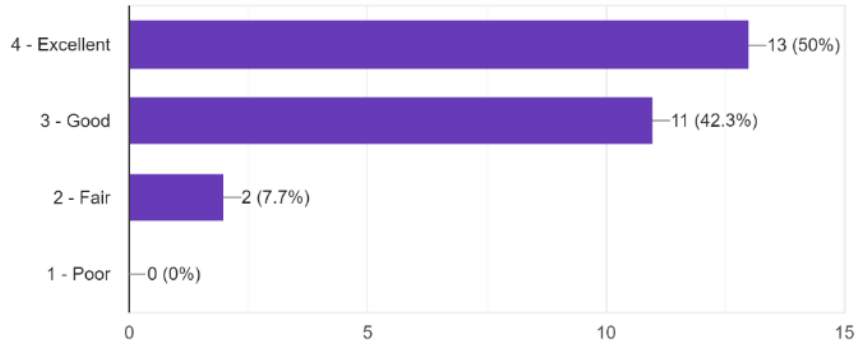
7. Effectiveness of the Resource Person

26 responses



8. Sufficiency of presentation materials

26 responses



9. What lesson/learning did you gain from the WEAP training?

- The lecture/Tutorial is kind of in a fast phase but I was able to grasp some of the vital information for the training. It will be helpful also with the copy of the toolkit.
- It's a very useful tool especially in interpreting data like the supply and demand of a specific area.
- The training is very necessary as reference for future programs and projects of the city.
- A new software can be used in a table survey setting.
- How to use some aspects of the model.
- data integration, projections based on assumptions
- Data from GIS can be used in the WEAP
- MANIPULATE AND INTERPRET THE DATA AND RESULTS OF WEAP
- Making use of the program to see what variable or activity is more water demanding.
- Basic operations using WEAP application
- Certain scenarios can be analyzed base on the consolidated data.
- applicability of the app in future planning
- WEAP id o think user friendly software program and that can provide a system for maintaining water demand and supply information
- I have learned that there is a software intended for water resources evaluation and planning.
- Still learning, did not really get into the weap software yet, however I am glad that tutorial is available and easy to understand
- The Seminar was not really designed for me as I am not a technical guy nor a computer savvy person or cannot follow much and understand online application models or things like this!
- Water resource management projections
- Basic Knowledge on simulation of WEAP
- This is new to me, and I think this training is relevant for future use.
- Features and overview of manipulating WEAP software
- Practical usage in the development water project utilizing surface water
- The creation of the so called weap areas and its attributes. With the given tutorial notes, you can do it by following the instructions given.
- Using the model to interpret data and useful for future planning of water resources
- different scenarios that can be used; using mathematical expressions and implications.
- The various scenarios and its effect.
- WEAP Basics

10. What issues or constraints did you encounter in using the WEAP software?

- Nothing.
- One of the constraints/ issues maybe is the connections and loading of the WEAP software and since it is in EVAL MODE so I have not able to save the part 1 works. Also, files like the ZAM WEAP AREA Files were not able to download due to large files.
- The plotting of the transmission/distribution line.
- The software is new to me which in my part is difficult to catch-up with but yet its interesting.
- WEAP software should more open or compatible with GIS and other geographical software.
- having access- recognition of personal email address.
- installation issues, but might be an isolated issue for my windows OS installed
- INTERNET CONNECTIVITY
- Uploading the weap program
- License
- unavailability of license
- I have not yet downloaded and install the WEAP licensed version therefore there is a limitation on data saving.
- WEAP software cannot run smoothly on low specs laptop/computer.
- none at the moment
- Did not use it. I wasn't able to download it as I do not know how to do it.
- Technical difficulty.. and not able to interact with the speaker
- Sometimes Lagging
- Its not that easy, yet very interesting!
- Hands on exercises
- Downloading the software
- It is handy for me in the future but for now since I'm not be able to use it in my job directly, at least I have the basic knowledge on how to use the said software.
- Will ZCWD need to purchase WEAP software for future use?
- have not used it yet.
- The plotting of the network.
- None

11. Which aspect of the training and/or WEAP software do you think the resource person/expert should focus on to help improve your learning?

- Important points were tackled, maybe the scenarios which made the visual result.
- The importation of data links (e.g. Excel data, pivot table)
- I have difficulty on understanding the software especially on plotting. I think its best to have a face-to-face training.

- Creating the model network and compatibility with other softwares.
- how to import excel and cad files to the model
- perhaps more on GIS coordinates integration
- Longer training time
- GRAPHS AND INTERPRETATIONS
- His expert in everything he discussed
- Very well presentation for the resource person, no comment.
- The training just needs a matter of time for the resource person to fully explained the software.
- exercises/workshop will provide grasps of the learning
- The speaker should focus more on the scenario explorer
- I think resource expert should also explain the bases of the engineering calculation/analysis being executed by the software for the users.
- The resource person is an expert of the WEAP, maybe just needed more time for the participants to learn and appreciate
- The details of the use of the model is not really for the WSC members but for the Staff or Secretariat. The WSC members just need the concepts about it and other objectives, where and what it represents and other things, not the use or the details of it.
- Get familiar with zoom app
- Nothing
- I guess this training would have been better if we did it on a usual training basis (face to face, one on one training)
- Exercises
- The resource person is an expert. Therefore, nothing so far.
- Resource person may explain or elaborate further on the other "data" in each of the subjects in the weap areas especially to others who are new to this kind of program.
- certainly the resource person did well.
- Its application to Zamboanga City project.
- In the importation of links like excel files / tables for data consolidation.
- NRW

12. In what way can WEAP be useful to your organization?

- It will be a useful for the organization since it can be able to forecast scenarios base of the figures we have presently.
- It's very useful in monitoring and evaluating the trend especially the NRW aspect for further programs in the reduction of the water losses.
- Serves as guide for implementation of programs, projects and activities of our organization.
- Watershed management since ZCWD is dependent more on its watershed in the city.
- designing water supply systems
- water resources management / monitoring vs demand

- It can be very useful considering that WEAP can consolidate the data from water flow, quality ang outflow in one application.
- PLANNING ANF PROJECTIONS
- Making use of the program to share to my Environmental Engineering students.
- Future projection for ZCWD for the next 50 years
- The WEAP can be very useful in our organization in order to visualize the different scenarios of the water supply and demand considering that we are Water Service provider.
- it can be used to manage water resources
- I’m under ZCWD DESIGN DIVISION team, so weap can help me a lot in water resources planning not only for the city of Zamboanga but also to the entire Philippines.
- ZCWD being a water provider of the city, this tool will be useful for the technical personnel in evaluating and planning for the water resource to be developed as against the growing demand of the city.
- ZCWD planning for water security
- I am not sure if we can use it!
- Water resource management, projections
- Planning and Improving of Water Resources
- Easy plotting of data
- Data presentation and analysis
- In verification of the efficiency of surface water source for future project assistance.
- I’m sure it will be useful for our organization. Through this software our engineers will be able to see holistically the water system in the AOR.
- Future planning of water resources
- for water resource management projects.
- The different scenarios in interpreting the data and to evaluate and interpret for future programs / strategies to lower the Non-Revenue Water in the system.
- Preparation of Water Master Plan

Annex 10: Institutional Development and Capacity Strengthening

USAID Strengthening Urban Resilience for Growth with Equity (SURGE) Project
Preparation of Water Security Master Plan for Zamboanga City

A. Background[82]

The Philippine Water Supply and Sanitation Master Plan (PWSSMP) indicates that the gap between available water supply and demand continues to widen in the country as some areas are already experiencing water stress and water scarcity. As such, the PWSSMP serves as the blueprint of water supply and sanitation sector (WSS) development as it defines the activities, responsible agencies, and the budget necessary to grow the WSS sector infrastructure projects. According to the PWSSMP, climate change aggravates the sector's challenges, such as "higher water demand with increasing global temperatures, rainfall variability, sea level rise, and extreme weather events, which leaves the country more vulnerable to longer droughts and floods". The performance of the WSS sector remains fragmented, and the efforts of many government agencies remain uncoordinated. In addition, the lack of oversight makes programs of the sector prone to being used as political currency at the expense of long-term goals and the communities.

B. Legal Framework of the Water Sector

1. **Constitution and Water Code of the Philippines**[83] As prescribed by Section 2, Article XII of the 1987 Philippine Constitutions, "water resource is owned by the State, including its development and utilization and shall be under the full State control and supervision." Meanwhile, as prescribed by Presidential Decree No.1067 series of 1976 or the Water Code of the Philippines, the basic water law states that: (i) all waters belong to the State; (ii) all waters that belong to the State cannot be the subject to acquisitive prescription; (iii) The State may allow the use or the development of waters by administrative concession; (iv) The utilization, exploitation, development, conservation and protection of water resources shall be subject to the control and regulation of the government through the National Water Resources Board (NWRB); and (v) Preference in the use and development of waters shall consider current usage and be responsive to the changing needs of the country. Aside from governing the appropriation of water through domestic, municipal, irrigation, power generation, fisheries, livestock raising, industrial and recreational, the Water Code adopts the policy of "first-in time, first-in right" for the water allocation among users.

2. **AmBisyon Natin 2040**[84] The Philippine government's AmBisyon Natin 2040 represents the collective long-term vision and aspiration of the Filipino people for themselves and for the country in the next 25 years. It describes the kind of life that people want to live, and how the country will be by 2040. As such, it is an anchor for development planning across at least four administrations. In addition, it is a picture of the future, a set of life goals and goals for the country as well as a plan which describes the way to get to the destination. AmBisyon Natin 2040 is the result of a long-term visioning process that began in 2015 wherein it envisaged that all sectors of society, whether public or private, should direct their efforts towards creating opportunities for Filipinos to enjoy a matatag, maginhawa at panatag na buhay. Government in particular, must use its tool of fiscal, monetary and regulatory policies to steer the development path towards enabling Filipino to attain their AmBisyon. This pertains to all dimensions of development: economic, human and physical capital, institutional, social and cultural. By 2040, the Philippines is a prosperous middle class society where no one is poor. People live long and healthy lives and are smart and innovative. The country is a high-trust society where families thrive in vibrant, culturally diverse, and resilient communities.

[82] National Economic and Development Authority (NEDA), Philippine Water Supply and Sanitation Master Plan, 2019.
[83] SURGE Project. Preparation of Water Security Master Plan for Zamboanga City: Description of the Current Water Security Situation, 2021.
[84] About AmBisyon Natin 2040 – AmBisyon Natin 2040 (neda.gov.ph)

3. **Philippine Water Supply and Sanitation Master Plan**[85] As envisioned, the Philippines Water Supply and Sanitation Master Plan (PWSSMP) sets the direction for attaining the water supply and sanitation subsector's targets through the development of strategies, formulation of policy reforms, and identification of priority program and projects for implementation. It maps out the direction towards achieving the 2030 Sustainable Development Goals, particularly Goal 6: Ensure Availability and Sustainable Management of Water and Sanitation for All. Aside from a situationer, the Plan also embedded a monitoring and evaluation mechanism to ensure that initiatives are on track. It also provide details on policy directions, needed priority programs, and ongoing and pipeline projects contributing to these programs, including the corresponding investment requirements and the financing scheme. The Plan also lays down the foundation for warranted for a closer vision of attaining water supply and sanitation goals by 2030.

4. **Multilateral and Bilateral International Financial Institutions' Initiatives on Water.** The global consensus on water supply and sanitation, environmental and climate change reflect the policies of most international agencies.

    a. *Asian Development Bank (ADB).*[86] ADB's Water for All recognizes the Asia and Pacific region's need to formulate and implement integrated, cross-sectoral approaches to water management and development as well as provide ADB with a means to more effectively meet the development challenge. In general, the policy seeks to promote water as a socially vital economic good that needs increasingly careful management to sustain equitable economic growth and reduce poverty; and advocate a participatory approach in meeting the challenges of water conservation and protection in the region. In July 2021, ADB released a Guidance Note on COVID-19 and Water in Asia and the Pacific which provides a comprehensive look at the impacts of COVID-19 pandemic on the water sector from March to December 2020, the actions taken by water service providers in response to various challenges, the potential pathways toward post pandemic recovery, and the role of the ADB in supporting water sector recovery and rejuvenation.

    b. *World Bank (WB).*[87] As the world's largest multilateral source of financing for water in developing countries, the World Bank is working closely with partners to achieve "A Water-Secure World for All," by sustaining water resources, delivering services and building resilience. In 2019, World Bank launched the program "Working Together for a Water-Secure World", the World Bank's Strategic Action Plan on Water. The Plan focuses on (i) Sustaining Water Resources (sustaining water, valuing water, storing water and sharing water), (ii) Delivering Services (universal access to water supply and sanitation, optimizing water use in agriculture) and (iii) Building Resilience (adapting to climate change and weather extremes, conflict and migration).

    c. *Asian Infrastructure Investment Bank (AIIB).*[88]The AIIB's Water Strategy ensures the availability and sustainable management of water and sanitation for all, in line with the SGDs. AIIB has a unique and catalytic role in improving the efficiency of the water sector through the application of innovative technologies. AIIB's Water Strategy Investment Focus includes (i) Water Services, (ii) Resource Management and (iii) Resilience. The Bank's investments in the three key areas of improving access to water services, increasing the availability and quality of water through improved water resources management and improving resilience to the impact of water related disasters will be guided by the following principles: (i) Principle 1-Promoting sustainable infrastructure; (ii) Principle 2-Integrated resource management; (iii) Principle 3-Mobilizing private capital and efficiencies; and (iv) Principle 4-Adopting innovative technology.

[85] National Economic and Development Authority (NEDA), Philippine Water Supply and Sanitation Master Plan, 2019.
[86] About AmBisyon Water For All: The Water Policy of the Asian Development Bank | Asian Development Bank (adb.org)
[87] WatWater Overview (worldbank.org)
[88] Water Strategy (aiib.org)

d. *Japan International Cooperation Agency (JICA).*[89] JICA's Cooperation Strategy for Water Resources Sector (water supply, sanitation and water resources management) is aligned with the goals of achieving SDGs. Japan contributes the most in the field of water and sanitation in various parts of the world, particularly in the disbursement of Official Development Assistance (ODA), and is developing a wide range of cooperation utilizing various resources and expertise accumulated not only in Japan but also in developing countries. JICA aims to further develop its operations towards the achievement of the SDGs, by improving the effectiveness, impact and sustainability of its cooperation activities.

e. *United States Agency for International Development (USAID).*[90] The US Global Water Strategy envisions on water-secure world, where people and nations have the water they need to be healthy, prosperous and resilient. In relation to this, USAID's Water and Development Plan is an agency-specific plan in conjunction with the whole-of-government Global Water Strategy wherein it provides for USAID's contribution to the US government's shared vision for a water-secure world, and links directly to the following strategic objectives in the Global Water Strategy: (i) Promote sustainable access to safe drinking water and sanitation services, and the adoption of key hygiene behaviors; (ii) Encourage the sound management and protection of freshwater resources; and (iii) Strengthen water sector governance, financing and institutions. This contribution is aligned with and complementary to other USAID investments across development sectors that promote water security.

C. National and Relevant Legislations on Water Supply and Sanitation[91]

1. National Legislations on Water Supply and Sanitation

a. *Presidential Decree No.198*, as amended, otherwise known as the Provincial Water Utilities Act of 1973 was enacted to form local water districts for provincial cities and municipalities outside of Metro Manila. The act also created the Local Water Utilities Administration (LWUA) to provide institutional, technical and financial assistance to water districts nationwide.

b. *Presidential Decree No. 856, s. 1975* or the Sanitation Code is a comprehensive legal basis which broadly covers various activities related to health and sanitation wherein the health of the people (being of paramount importance), all efforts of public services should be directed towards the protection and promotion of health.

c. *Presidential Decree No. 1206, s. 1977*, known as the Public Service Law, authorizes NWRB to supervise water supply services and regulate water tariffs, except those under the control of MWSS and LWUA.

d. *Republic Act No. 6234* an act creating the Metropolitan Waterworks and Sewerage System (MWSS) and dissolving the National Waterworks and Sewerage Authority (NAWASA). This act authorized MWSS to serve water supply and sanitation needs of Metro Manila.

The enactment of the Republic Act No. 6234 or an act creating the MWSS paved the way for MWSS to serve water supply and sanitation needs of Metro Manila, and also the dissolution of the NAWASA. The laws preceding this act include (i) Presidential Decree No. 198 or the Provincial Water Utilities Act of 1973; (ii) Presidential Decree No. 856 or the Sanitation Code of 1975; and (iii) Presidential Decree No. 1206 or known as the Public Service Law of 1977. Indicated in Table 1 below is the list of major water-related

[89] Water Strategy (aiib.org)
[90] Water and Development Strategy | U.S. Agency for International Development (usaid.gov)
[91] SURGE Project. Preparation of Water Security Master Plan for Zamboanga City: Description of the Current Water Security Situation, 2021.

legislations, orders and their salient provisions categorized into water resource management principles, governance, water supply, land acquisition, involuntary resettlement, and PPP/privatization.

TABLE 1. MAJOR WATER-RELATED LEGISLATIONS AND ORDERS[92]

Category	Legislation/Orders		Salient Provision
Water Resource Management Principles and Governance	Constitution of the Philippines (1987)		Stipulates that all water resources in the Philippines belong to, and under the control of the State
	PD No. 1067 (1976)	Water Code of the Philippines as amended	Provides the framework for water resource development and management including the rules governing the water use and it rights and obligations as well as government agency for enforcement (former NWRB). It adopts the water appropriation policy of "first in-time, first in-right".
	PD No. 424 (1974)	NWRC Charter	Creation of NWRC (now NWRB) for coordination and planning of water resource management
	RA No. 6324 (1971)	-	Creation of MWSS for water supply and sanitation services for Metro Manila
Water Supply	PD No.198 (1973)	Provincial Water Utilities	Creation of LWUA as supervising government body and water districts as local water supply service providers at the provincial level. The act also enables LWUA to provide lending facility and technical assistance to water districts.
	PD No. 1206 (1977)	Public Service Law	Mandates NWRB to supervise and regulate all water supply services except those under the jurisdiction of MWSS and LWUA
	PD No. 856 (1975)	Sanitation Code of the Philippines	Establishes various sanitation policies and standards for water supply, food processing, sanitary facilities, sewerage and sewage management, etc.
Land Acquisition and Involuntary Resettlement	RA No. 8974 (2000)	-	Known as "An Act to Facilitate the Acquisition of Right-of-Way, Site or Location for National Government Infrastructure Projects and for Other Purposes", it provides policy on land acquisition and compensation thereof in infrastructure projects implemented by national government
	IRR for Proper and Humane Relocation Procedures (1992)	-	Pursuant to relevant provisions of RA No. 7279 (Urban Development and Housing Act), this IRR is set forth to provide detailed rules and regulations on resettlement procedures.
	EO No. 215 (1987)	-	First legal framework established for privatization of public infrastructure, resulting in the implementation of about 20 power sector projects
PPP/ Privatization	RA No. 6957 (1990)	Former BOT Law	Authorizes the financing, construction, operation and maintenance of infrastructure projects by the private sector (amended by RA No. 7718 of 1994).
	RA No. 7718 (1994)	BOT Law	Amendment of RA No. 6957 of 1990, also known as the current BOT Law of the Philippines
	RA No. 8041 (1995)	National Water Crisis Act	Privatization of MWSS water facilities

Among the legislations under water resource management principles and governance, the Constitution of the Philippines (1987) stipulates that all water resources in the Philippines belong to, and under the control of the State. PD No. 1067 (1976) or the Water Code of the Philippines provides the framework for water resources development and management, including the rules governing the water use and its rights and obligations, and PD No. 424 (1974) establishes the NWRC (now NWRB) for the coordination and planning of water resource management. While RA6234 No. 6234 facilitated the creation of MWSS for water supply and sanitation services for Metro Manila. With regard to water supply, the creation of LWUA through PD No 198 (1973) as supervising government body and water districts as local water supply service providers at the provincial level. The act also enables LWUA to provide lending facility regulated technical assistance

[92] JICA Study Team. The Study of Water Security Master Plan for Metro Manila and Its Adjoining Areas (Final Report), March 2013.

to water districts. PD No. 856 or the Sanitation Code of the Philippines establishes various sanitation policies and standards for water supply, food processing, sanitary facilities, and sewerage and sewage management. PD No. 1206 or the Public Service Law which mandated NWRB to supervise and regulate all water supply services except those under the jurisdiction of MWSS and LWUA.

Indicated in Table 2 below are water sector reform legislations and their status filed in the 17th Congress. Specifically under the Senate, SB 245 or an Act Promoting Integrated Water Resource Management in the Use of the Country's Water Resources through the Rationalization of Service Areas filed by Senator Loren Legarda is currently pending in Public Services Committee. On the other hand, Representative Linabelle Ruth R. Villarica filed HB 221 or an Act Creating the National Water Resources Management Authority and Appropriating Funds Thereof is also currently pending in Government Enterprises and Privatization Committee is an important legislation that needs appropriate support from both Senate and the House. In relation to this, Representative Estellita B Suansing filed HB 4995 or an Act Creating the Department of Water Resources and Services and Appropriating Funds Thereof which is very strategic and integral in promoting sustainable water resources initiatives and programs in the country.

TABLE 2. STATUS OF WATER SECTOR REFORM LEGISLATION IN THE 17TH CONGRESS[93]

No.	Senate/House Bill Title	Author	Status
SENATE			
SB 245	An Act Promoting Integrated Water Resource Management in the Use of the Country's Water Resources through the Rationalization of Service Areas, Provision of Incentives for Infrastructure Development of Clean and Efficient Technologies, and Reorganization of the National Water Resources Board, Amending for the Purpose Certain Laws and for Other Purposes	Loren B. Legarda	Pending in Public Services Committee
SB 933	An Act Rationalizing the Economic Regulation of Water Utilities, Creating the Water Regulatory Commission and for Other Purposes	Ralph G. Recto	Pending in Public Services Committee
SB 1217	An Act rationalizing the Economic Regulation of Water Utilities, Creating the Water Regulatory Commission	Grace L.Poe	Pending in Public Services Committee
HOUSE OF REPRESENTATIVES			
HB 221	An Act Creating the National Water Resources Management Authority and Appropriating Funds Thereof	Linabelle Ruth R. Villarica	Pending in Government Enterprises and Privatization
HB 517	An Act Rationalizing the Economic Regulation of Water Utilities, Creating the Water Regulatory Commission and for Other Purposes	Bernadette Herrera-C. Dy	Pending in Government Enterprises and Privatization Committee
HB 2075	An Act Rationalizing the Economic Regulation of Water Utilities, Creating the Water Regulatory Commission and for Other Purposes	JosephineRemirez-Sato	Pending in Government Enterprises and Privatization Committee
HB 2457	An Act Rationalizing the Economic Regulation of Water Utilities, Creating the Water Regulatory Commission and for Other Purposes	Arthur C. Yap	Pending in Government Enterprises and Privatization Committee
HB 4995	An Act Creating the Department of Water Resources and Services and Appropriating Funds Thereof	Estrellita B. Suansing	Under Government Reorganization Committee TWG Deliberation
HB 5776	An Act Rationalizing the Economic Regulation of Water Utilities, Creating the Water Regulatory Commission and for Other Purposes	Maximo B. Rodriguez, Jr.	Pending in Public Works and Highways
HB 6404	An Act Rationalizing the Economic Regulation of Water Utilities, Creating the Water Regulatory Commission and for Other Purposes	Arthur C. Yap	Pending in Government Enterprises and Privatization Committee
HB 6505	An Act Instituting a New Water Code, Amending the Purpose PD No. 1067 Otherwise known as the Water Code of the Philippines and for Other Purposes	Michelle M. Antonio	Pending in Natural Resources Committee

[93] USAID. Policy Brief No. 7 of Arangkada Philippines: Water (A Project of the Joint Foreign Chambers of the Phiippines), September 2018.

HB 6828	An Act Mandating Each City or Municipality to Create a River Development Authority for the Preservation, Protection and Development of All Rivers, River Systems and Natural Waterways within its Jurisdiction, Defining its Powers and Functions and Appropriating Funds Thereof	Maximo B. Rodriguez, Jr.	Pending in Local Government Committee

2. **Water Related Organizations**[94] There are more than 30 national agencies involved in the water sector but ten of which are key agencies involved in the planning, financing, implementation, operation and regulation of the water sector outside Metro Manila. Presented in Table 3 are the major water-related organizations/institutions and their responsibility or key functions.

TABLE 3. WATER RELATED ORGANIZATIONS[95]

Organization	Responsibility
National Water Resources Board (NWRB)	Primarily involved in coordinating and regulating the water-related activities consistent with the principles of Integrated Water Resource Management (IWRM), issuing water permits, supervising and regulating operations of water utilities in the entire country. Its regulatory function for water utilities is limited by the exclusion of areas under the jurisdiction of LWUA, MWSS, LGU-managed water systems, and Rural Waterworks and Sanitation Associations (RWSAs). Although it is mandated by the Water Code to lead the sector development as well as advises NEDA on issues related to water resources development projects and programs, NWRB has very limited resources (both human resource and financial). In this regard, there is a proposition to replace NWRB with a new National Water Resources Management Council (NWRMC) to reinforce governance of the water sector.
Department of Public Works and Highways (DPWH)	It acts as the engineering and construction arm of the government and primarily tasked to plan, design, construct, and maintain infrastructure particularly the national roads, flood control, and small-scale water impounding and supply projects, among other projects financed and constructed by the government. The agency undertakes water resources development initiatives through its following offices: (i) Bureau of Research and Standards, that conducts hydrological surveys and data gathering; (ii) Unified Project Management Office-Major Flood Control Management Cluster (UPMO-FCMC), that oversees major flood control projects; (iii) Project Management Office-Rural Water Supply (PMO-RWS), that is responsible for foreign-assisted rural water supply projects; and (iv) Project Management Office-Small Water Impounding Projects (PMO-SWIM), that supervises locally-funded and foreign-assisted SWIM projects
Department of Environment and Natural Resources (DENR)	It is tasked with the protection, conservation and management of the environment and natural resources of the country that include forests and watershed areas. It is also responsible for the promulgation of the policies and guidelines for the control of water, air and land pollution. The Department has four bureaus (i) Environmental Management Bureau (EMB), which designs, plans and programs and prepare environmental quality standards to prevent and control pollution; (ii) Mines and Geosciences Bureau (MGB), that undertakes the monitoring and mapping of groundwater resources throughout the country; (iii) Forest Management Bureau (FMB), ensures the effective protection, development and conservation of forestlands and watersheds; and (iv) Protected Area and Wildlife Bureau (PAWB) which is mandated to establish, manage and develop the National Integrated Protected Areas (NIPAS) in the country. It also includes two attached agencies, the National Mapping and Resources Inventory Authority (NAMRIA) and Laguna Lake Development Authority (LLDA).
National Economic and Development Authority (NEDA)	It is the economic development and planning agency and tasked formulate policies on water resources and its subsequent approval. In addition, the evaluation, appraisal and approval of major development projects and policies, including those related to the water sector is being undertaken by the Investment Coordination Committee (ICC) of the NEDA Board. The Sub-Committee on Water Resources (SCWR) of the NEDA Board Committee on Infrastructure (INFRACOM) enables the stakeholders from both government and non- government organizations share data, coordinate, and provide advices on the conduct of studies as well as policy recommendations to the NEDA Board.
National Irrigation Administration (NIA)	It is a Government-Owned and Controlled Corporation (GOCC) and has the mandate of overseeing the sustainable development and management of irrigation systems nationwide that is supportive of the agricultural development program of the government. NIA is an attached agency of the Department of Agriculture (DA) and constructs multi-purpose projects primarily intended for irrigation as well as for other uses that include hydraulic power development, domestic water supply, flood control, drainage, and reforestation. It has strengthened its decentralized regional office operations.

[94] SURGE Project. Preparation of Water Security Master Plan for Zamboanga City: Description of the Current Water Security Situation, 2021.
[95] JICA Study Team. The Study of Water Security Master Plan for Metro Manila and Its Adjoining Areas (Final Report), March 2013.

Local Water Utilities Administration (LWUA)	It is a GOCC which has been given the mandate of promoting and overseeing the development of water supply systems in provincial cities and municipalities outside of Metro Manila. LWUA exercises regulatory functions over urban water supply aside from Metro Manila. It formulates and implements quality and performance standards of service for water districts. The agency extends financial and advisory services to the water districts and LGU-managed utilities as part of its institutional development initiatives for the water service providers (WSPs).
Local Government Unit (LGUs)	The Local Government Code of 1991 (RA 7160) has devolved the powers and functions from the national government to the LGUs to include the delivery of basic services and facilities such as safe potable water to their constituents. The responsibility for policy formulation, planning and regulatory functions on water, sewerage and sanitation is among the tasks that have been devolved to local government units. In providing reliable water supply to the community, the LGU may have the option to (i) both directly provide and finance these services; (ii) encourage the involvement of the private sector in both provision and financing through management, service contract or concession arrangement; and (iii) enter into a joint venture agreement and other locally generated income in financing or securing external borrowings for water supply development. The LGUs are also responsible for the overall supervisors of the Barangay and Rural Waterworks and Sanitation Associations (BWSAs/RWSAs) that have been formed to operate and manage Level I and Level II systems.
Department of Interior and Local Government (DILG)	It extends general administration and capacity building support in all aspects of local governance to the LGUs, including water and sanitation concerns DILG's Office of the Project Development Services (OPDS), through the Water Supply and Sanitation Unit (WSSU), is presently managing the provision of Water Supply Program or Salintubig (Sagana at Ligtas na Tubig Para sa Lahat). An undertaking of DOH, DILG and the National Anti-Poverty Commission (NAPC), the program aims at providing water supply systems to identified waterless municipalities and waterless thematic areas (barangays, health centers, and resettlement sites) all over the country.
Department of Health (DOH)	It is mandated to regulate water supply quality and set standards on water testing, treatment and sanitation. These functions are being undertaken through the Environmental Health Services (EHS) and the Bureau of Research Laboratories (BRL). The EHS is responsible for water supply and sanitation programs and implementing intervention to avert environment-related diseases while BRL undertakes monitoring activities on the quality of water.
Department of Budget and Management (DBM) and Department of Finance	It is mandated to promote the sound and efficient use of government resources. It also formulates the overall resource allocation strategy and the medium-term expenditure plan, and prepares annual budget clearance from DBM to process a proposed infrastructure project using the national budget. The Department of Finance (DOF) is responsible for national fiscal policy and management. Its Corporate Affairs Group (CAG) undertakes the supervision over GOCCs such as MWSS.

D. Capacity Building for Water Supply and Sanitation Sector Infrastructure Development

Infrastructure development is an important factor that allows for sustainable economic development, and provides a solid starting point for the steady ascension of social well-being indicators in the long run.[96] With reference to developing and implementing various water sector infrastructure projects, capacity building is the process by which a government institution, government entity, and national government agencies personnel obtain, improve, and retain the knowledge and skills, including appropriate tools and equipment, and other resources needed to do their jobs competently. Similarly, capacity building allows local government units (LGUs), government organizations, national government agencies (NGAs) and personnel to perform at a greater capacity despite the number of tasks and responsibilities attributed to their involvement in the development, implementation and monitoring of various water sector infrastructure development projects. Capacity building has a variety of contexts and interpretations based on documented historical perspectives. During the 70s, the focus of capacity development was designated for improving individual capacity, particularly in providing scholarships and on-the-job trainings. However, individual training alone failed to prosper in capacity development. As embezzlements became prevalent during the 80s, auditing came into focus and capacity building initiatives on restructuring and redesigning of organizations succeeded to avoid embezzlements.

With the onset of the 90s, an increased understanding the wider institutional framework emerged and the need to focus on outcomes emerged. It was during this time when the World Bank introduced the concept of monitoring the performance and that institutional development and/or capacity building must be an

[96] https://doc-research.org/our-events/capacity-building-infrastructure-development-emerging-economies/

important objective of development aid. However, throughout the 90s, institutional capacity strengthening was still a secondary objective of many aid projects with no clear cut definitions and ways of achieving it. By 2000, the information revolution has brought tremendous growth in the democratization and decentralization of national authorities which causes international organizations to reassess their roles and competencies in offering development aid.
These processes are being designed through facilitative and participatory approaches, and should be responsive and accountable to national priorities and objectives. Beginning 2010s, various perspectives interrogates the idea of capacity building theoretically and explores the variety of meanings, constructions and practices especially in the context of developing and developed countries.

E. Institutional Capacity Strengthening

The need for adequate institutional capacity strengthening is one of the leading issues in water sector infrastructure development, and yet the concept of institutional capacity strengthening remains complex as well as difficult to grasp and put into practice. With reference to existing literatures available on institutional capacity strengthening, “it occurs by acquiring resources (human, financial, networks, knowledge, systems and culture) and integrating them in a way that leads to change in individual behavior and ultimately to more efficient and effective operations of institutions and organizations.” The World Bank defines institutional capacity strengthening in infrastructure development as investment in people, institutions, practices, that will enable countries and its governments to achieve the infrastructure development projects’ development objectives.

Meanwhile, institutional capacity has relationship with governance, with regard to accelerating infrastructure development as both stand for the ability to manage the challenges and opportunities brought by the changing environment. Likewise, the aspect of capacity building for government officials can enhance their ability to address development issues, implement projects and deliver projects on time. Strengthening institutional capacity will connect government officials, the private sector, project stakeholders, civil society and non-government organizations, and will facilitate cooperation among various sectors involved in the development, implementation and monitoring of water sector infrastructure development projects.

1. Improving Organizational and Technical Capabilities of LGUs and NGAs

This strategy aims to improving the technical and organizational capabilities of personnel from both LGUs and NGAs involved in implementing water sector infrastructure development projects. In the water sector infrastructure development projects in particular, this strategy has become common and it is the one mostly considered as capacity building and/or institutional strengthening approach. Activities include: (i) technical assistance in terms of personnel improvement through capacity building and institutional strengthening programs; (ii) technical training of local personnel on skills upgrading either locally and in form of scholarships abroad; (iii) improvement of management and financial systems; and (iv) improved working conditions and work area procedural improvements. This strategy has definitely improved technical and organizational capabilities of many institutions, at least in the short-term. The value of training and skills improvement are undoubtedly important for capacity development and should be encouraged.

2. Setting Strategic and Attainable Goals for LGUs and NGAs

The aim of this strategy is to help induce a policy or a general direction that can guide actions and the development of capacity in the long-term. The advantage with this strategy is that it is simple. Ideas developed can be compared to experiences in various infrastructure development projects elsewhere. The problem is on whether this strategy is really taken into account in a most appropriate way. Otherwise, it will most likely result into a failure of organizations involved in water sector infrastructure development projects implementation.

F. Mandates Implemented by the National Government, Regional and City Government on Water Supply and Sanitation Sector

1. **Updated Philippine Development Plan (PDP) 2017-2022.**[97] The PDP has been formulated to lay down the foundation for inclusive growth, a high-trust and resilient society, and a globally competitive knowledge economy. The Updated PDP will lead the Philippines back to the vision of strongly rooted, comfortable and secure life. Under the Updated PDP 2017-2022, the following strategies related to water resources are identified: (i) Pursue water supply and sanitation (WSS) policies, plans and programs in accordance with the key reform agenda identified in the Philippine Water Supply and Sanitation Master Plan (PWSSMP); (ii) Pursue initiative on attaining water security; (iii) Adopt a common/unified framework for resource allocation for WSS and review the National Sewerage and Septage Management Program (NSSMP) to accelerate the provision of WSS services; (iv) Optimize funds for irrigation development and strengthen technical capacities for the development and maintenance of irrigation facilities guided by the National Irrigation Master Plan; and (v) Improve coordination between flood management efforts and undertakings in other sectors.

2. **Philippine Water Supply and Sanitation Master Plan (PWSSMP).**[98] The PWSSMP is an action plan being led by NEDA to achieve universal access to water supply and sanitation services from 2019 to 2030. It was aligned with the government's goal of attaining water supply and sanitation targets under the PDP 2017-2022. The Clean Water Act of 2004 and United Nations (UN) Sustainable Development Goals (SDG). The highlights concerning Zamboanga City as described in the PWSSMP are as follows: (i) Water Availability, Water Stress and Water Scarcity (the NWRB has identified Zamboanga City as one of the nine water-critical urban areas where water is consumed intensely); and (ii) List of Programs, Projects and Activities (an estimated amount of PhP20.46 billion allocated for water supply projects and PhP339 million for sanitation projects are identified for Zamboanga City).

3. **Mandate for Water Sector Infrastructure Development**

   According to a recent report from the Board of Investments, of the country's total population, 14.5% are still not served by Water Service Providers and 337 municipalities located mostly in the nation's 10 poorest provinces are still considered waterless as of 2015. The situation in Metro Manila is better with two water concessionaires performing relatively well at the end of 2015. Further, irrigation service to support agricultural production increased slightly from 56.57% of the total potential irrigable area in 2014 to 57.33% in 2015. Despite the increase, this fell short of the targeted total irrigable area of 70.91% for irrigation in the same year. Meanwhile, on flood management, DPWH has increased the protected flood-prone areas through construction of flood management structures to 18.33% out of the total 717,524 km identified flood-prone areas nationwide in 2015. DPWH has implemented a total of 1,295 flood control projects in 2015 alone. NIA is currently implementing the construction of the Chico River Pump Irrigation Project, particularly on the installation of electric motor-driven pumps, construction of pumping station and appurtenant structures and construction of canals. Meanwhile, the New Centennial Water Source-Kaliwa Dam Project was recently issued an Environmental Compliance Certificate (ECC) which entitled the project to proceed with construction of the project.

   a. *National Irrigation Administration (NIA).*[99] The NIA is a government-owned and controlled corporation (GOCC) primarily responsible for irrigation development and management. NIA formulates and adopt policies for the management and operations of NIA, and to prescribe, amend and repeal, with the approval of the President of the Philippines, rules and regulations governing the manner in which the general business of NIA may be conducted. The Rationalization Plan aims to improve the delivery of service and productivity thru the merger of offices and streamlining their functions, and the creation of irrigation management offices out of the irrigation systems offices and

[97] SURGE Project. Preparation of Water Security Master Plan for Zamboanga City: Description of the Current Water Security Situation, 2021.
[98] Ditto
[99] https://www.nia.gov.ph/?q=content/offices-and-functions

provincial irrigation offices. The Irrigation Management Transfer Program is a major component of Plan and NIA started implementing its 5-year phased Rationalization Plan in 2008.

b. *Metropolitan Waterworks and Sewerage System (MWSS).*[100] MWSS is the government's chief agency on water and sewerage services, and ensures that their concessionaire's action is equally guided by its Vision and Mission. MWSS is mandated to operate and maintain the waterworks system to ensure an uninterrupted and adequate supply and distribution of potable water and other purposes and the proper operation and maintenance of sewerage systems in its service area which includes the whole of Metro Manila, parts of Cavite and Rizal.

TABLE 4. WATER SECTOR MANDATE FOR INFRASTRUCTURE DEVELOPMENT[101]

SECTOR	POLICY	REGULATION			PROJECT PLANNING	IMPLEMENTATION	
		Entry	Operating Standards	Pricing		Construction	Operations/ Maintenance
Water Districts	NWRB	LWUA	LWUA	LWUA	NWRB/ Private	Private	Private
Private Systems	NWRB	NWRB	NWRB	NWRB	Private	Private	Private
MWSS	NWRB	n/a	MWSS	MWSS	MWSS	Private	Private
LGU	LGU Policy	NWRB	NWRB	NWRB/ LGU	LGU	LGU	LGU/ Private

4. Water Sector Infrastructure Flagship Projects implemented by NGAs and GOCCs

Under the NIA is consistent on its performance in the development and implementation of infrastructure flagship projects (IFPs), specifically on its compliance in the preparation and implementation of water sector infrastructure projects, particularly on project progress reporting requirements. Currently, the DPWH is implementing the "Improvement of the Remaining Sections along Pasig River (Del Pan Bridge-Napindan Channel" together with the Balo-i Plains Flood Control Project, while the NIA is currently at the project development/conceptualization stage for the Asbang Small Reservoir Irrigation and the Ilocos Norte Irrigation Project Phase 2. In addition, NIA's Tumauini River Multipurpose Project is currently at the detailed engineering design/procurement stage of implementation.

TABLE 5. WATER SECTOR INFRASTRUCTURE FLAGSHIP PROJECTS IMPLEMENTED BY NGAS AND GOCCS[102]

NO.	PROJECT TITLE	AGENCY	PROJECT DESCRIPTION
A. Project Development/Conceptualization Stage			
1.	Asbang Small Reservoir Irrigation	NIA	Construction of a reservoir dam and irrigation facilities in Matanao, Davao del Sur. The project seeks to irrigate around 1,660 hectares.
2.	Ilocos Norte Irrigation Project Stage 2	NIA	Construction of a 126.41-meter high storage dam across the Palsiguan River in the Municipality of Lagayan, Province of Abra and an after bay dam in Nueva Ecija.
3.	Ipo Dam No.3	NIA	Construction of a dam downstream of the Ipo Dam and upstream of the Bustos Dam to serve as catchment for spillage from Angat Dam and to mitigate flooding within the area.
4.	Bohol Northeast Basin Multipurpose Project	NIA	Includes a two (2) multi-purpose storage dams, five (5) diversion dams, trans basin tunnel, hydro-electric power plant, and irrigation and drainage facilities, to irrigate around 12,500 hectares.
B. Implementation (Budgeting)			

[100] https://www.mwss.gov.ph/
[101] NEDA Institutional Capacity Strengthening of NGAs and/or GOCCs involved in the Development, Implementation and Monitoring of Infrastructure Flagship Projects: A Policy Paper on Institutional Capacity Strengthening, November 2020.
[102] Ditto

	Aqueduct No. 7	MWSS	Construction of additional 15.5 km. aqueduct to serve as replacement to the existing Aqueducts 1 and 2 whose functionality has diminished due to age. The project aims to ensure reliability and improve operational flexibility of raw water conveyance to the Metro.
B. Implementation (Detailed Engineering Design/Procurement)			
5.	Ambal-Simuay River and Rio Grande de Mindanao River Flood Control Projects	DPWH	Construction of various flood control management structures such as construction of dikes/revetments, parallel dikes, retaining walls, flood gates, and channel dredging and excavation (for cut-off and new channel), among others.
6.	Cavite Industrial Area Flood Management Project	DPWH	Construction and improvement of flood mitigation structures covering 151.50 square kilometers within the San Juan River Basin and Maalimango Drainage Area in Cavite.
7.	Tumauini River Multipurpose Project	NIA	Construction of an 81.6-meter central core zoned type of rock and earth filled storage dam across the Tumauini River in Isabela. It includes an after bay dam, new irrigation facilities, improvement and upgrading of existing facilities, and institutional development.
8.	New Centennial Water Source – Kaliwa Dam	MWSS	This is an integrated system that includes a 600 million liters per day (MLD) Kaliwa Dam, with intake and other appurtenant facilities and a 2,400 MLD capacity raw water conveyance tunnel.
9.	Panay River Basin Integrated Development Project	NIA	Construction of a high reservoir dam, floodway, conveyance of bulk raw water supply, hydropower generation management, which is intended to serve 26,800 hectares of agricultural land.
B. Implementation (Construction)			
10.	Improvement of the Remaining Sections along Pasig River (Del Pan Bridge-Napindan Channel	DPWH	Construction and improvement of revetment, parapet wall and appurtenant drainage improvement works along the Pasig River, from Delpan Bridge to immediate vicinity of Napindan Hydraulic Control Structure to reduce the vulnerability of individuals and families in Metro Manila from flooding.
11.	Balo-I Plains Flood Control Project	DPWH	The project will put up a 3,086.78 meter-flood protection system in the plains of Balo-I, Lanao del Norte to prevent the overflowing of Agus River and save the agricultural areas from inundation.
12.	Chico River Pump Irrigation Project	NIA	Installation of electric motor-driven pumps, construction of pumping station and appurtenant structures and construction of canals.
C. Review			
13.	Gregorio Del Pilar Impounding Project	NIA	Construction of an 89-meter center clay core rock fill dam, spillway, 12-km trans basin tunnel, power plant with installed capacity of 18 MW, and irrigation and drainage facilities.

5. Expanding Water and Wastewater Coverage[103]

Though strengthened regulation of the sector is seen as a key element to expanding coverage in the country in a sustainable manner, various projects and programs are already being implemented, which are engaged in providing the necessary funds to make this a reality. Some noteworthy projects/programs are:

a. *Sagana at Ligtas na Tubig Para sa Lahat (Salintubig.* This multi-billion peso National Government program aims to expand water and sanitation coverage among the 455 waterless communities throughout the country, while reducing the incidence of water-borne and sanitation-related diseases.

b. *Water District Sector Development Program (WDSDP).* Worth US 60 million and funded by the ADB, WDSDP aims to expand coverage and improve health conditions in identified localities served by water districts.

[103] SURGE Project. Preparation of Water Security Master Plan for Zamboanga City: Description of the Current Water Security Situation, 2021.

c. *Unified Framework for WSS Sector Financing.* Development of this framework was funded by the World Bank. It is envisaged to provide a way to ensure the optimal use of available funds (donor, private and public) in the sub-sector, diverting the different categories of funds to where they are needed and have the most impact in terms of expanding water supply and sanitation coverage. It is also meant to avoid fund duplication, as often occurs.

d. *National Sewerage and Sanitation Management Program (NSSMP).* The goal of the NSSMP is to improve water quality and protect public health in urban areas of the Philippines by 2020. The objectives are to enhance the ability of local implementers to build and operate wastewater treatment systems for urban centers and promote the behaviour change and supporting environment needed for systems to be effective and sustainable. The main strategy is to facilitate a bottom-up, demand-driven project development process by providing national government support/subsidies and incentives.

e. *Philippines Water Supply and Sanitation Master Plan.* The Plan serves as the roadmap to achieve the country's long-term targets of universal access to 2025 for water supply and 2028 for sanitation. The plan will incorporate: (i) Strategies, policy reforms, priority programs and projects over the short-, medium-, and long-term to achieve access targets; (ii) Inputs from previous roadmaps (e.g. National Sewerage and Septage Management Program, Water Supply Roadmap) and programs (e.g. Eco-efficient Water Infrastructure Program, Unified Financing Framework Program); (iii) Capacity-building programs to ensure the various government agencies involved will be able to carry out the strategies and programs to be laid down in the plan.

6. Zamboanga Peninsula Regional Development Plan (2017-2022 Midterm Update)[104]

This development plan captures policy directions, strategies and programs addressing current regional development issues and concerns in Zamboanga Peninsula. The following strategies related to the water resources were identified:

a. Sustain the implementation and rehabilitation of irrigation systems in the region. The funding and implementation of rehabilitation of Communal Irrigation System (CIS) and Small Water Impounding System (SWIP) shall be accelerated to sustain the provision of water for rice lands across the region;
b. Prioritize the funding of major irrigation projects;
c. Conduct preliminary investigation on supplemental water sources for CIS and allocate funds to augment and sustain the supply of irrigation water;
d. Provide adequate, safe and sustainable water supply and explore and develop new water sources to meet existing and growing demand;
e. Public and private facilities shall be required to establish sewage and septage treatment plants for treating wastewater;
f. Incorporate water collection system in school building design of DPWH/DepEd;
g. Zamboanga Peninsula Water Districts to conduct Isotope studies for watershed within their areas of responsibility;
h. Improve disaster flood mitigation and response and reduce adverse effects; and
i. Mitigate flood damage in principal river basin.

G. Priority Reforms, Programs and Directions for National Water Resources and Water Supply and Sanitation Sector

1. Policy Directions

[104] SURGE Project. Preparation of Water Security Master Plan for Zamboanga City: Description of the Current Water Security Situation, 2021.

a. *Philippine Development Plan 2017-2022*. The PDP has been clear in addressing the issues and challenges faced by the WSS Sector. The following key development plans are listed under water resources and WSS sector.

TABLE 6. DEVELOPMENT PLANS UNDER PDP'S WATER RESOURCES AND WSS SECTOR[105]

Water Resources	Water Supply and Sanitation
• Create an apex body to address its fragmented structure • Create master plans that will foster coordinated efforts across the country • Institutionalize a science-based river basin approach by the apex body that integrates the IWRM principles • Strengthen coordination and linkages by NWRB and NEDA with partner institutions across the different subsectors toward achieving adequate access and sustainable water resources management • Enhance the capacities of concerned entities by the government in developing and managing water-related projects • Expedite the processing of water permits by deputizing and capacitating local and regional agents • Review and strengthen existing laws and regulations on water resources • Prioritize surface water source development for water-critical areas • Incorporate groundwater recharge system in the development of the surface water source for critical areas according to prescribed standards • Use eco-efficient water infrastructure to address water demand and supply mismatch • Explore measures to promote efficient water utilization	• Pursue institutional reforms to encourage and guide investments in WSS • Create an independent economic regulatory body for the WSS sector for a transparent and consistent regulation • Establish a unified financing framework with a definite scope and streamlined process to consolidate and make more accessible all available financial resources to support the WSS projects • Prepare a WSS master plan to guide the concerned implementing agencies to attain universal access in the sector • Support plans to broaden the scope of the NSSMP to improve the response from LGUs and WDs • Assist WDs by the government in expanding the coverage of reliable water service at affordable rates by reducing NRW while ensuring economically viable operations • Ensure water security in water-critical areas and NCR by (i) developing new water sources; (ii) protecting watersheds critical to existing and potential water sources; (iii) explore technologies in water supply; (iv) expand sewerage and sanitation infrastructure; and (v) maximize and maintain Angat Dam and all its accessory structures

b. *Creation of an Apex Body*. The PDP identified the creation of an apex body for the water supply, sewerage and sanitation subsectors as a primary strategy to address the fragmented structure and uncoordinated efforts of government units and agencies across the country. The continued and fragmented management and regulation of water resources and services hinder the enactment and implementation of comprehensive, integrated and doable long-term solutions to deal with lasting sector issues and attain universal access targets. The apex body shall address the fundamental governance and institutional issues of the sector by being the single entity that will be in-charge of the overall policy-making, planning, programming, policy formulation, and management for the sector. It will coordinate, monitor and evaluate sector performance and take appropriate action as needed. It will also make way for an integrated and coordinated planning and implementation of programs and projects that promote synchronized, sustainable and science-based management of the country's water resources that would address the imbalance in water resource utilization, reduced water availability, declining water quality, recurrent flooding, and other water-related issues in many parts of the country.

c. *Creation of an independent economic regulatory body*. The creation of an independent economic regulatory body shall address the fragmented, poorly enforced, and low-coverage regulatory regime in the WSS sector. This single entity shall consolidate the economic regulatory powers of various water agencies into one national body that shall have the power to grant and revoke licenses, as well as the authority to set standards and targets for both private and public water utilities. The proposed measure seeks to achieve the following objectives: (i) Achieve universal access to improved water and sanitation services for the entire country through an effective economic regulatory system that can compel

[105] National Economic and Development Authority (NEDA), Philippine Water Supply and Sanitation Master Plan, 2019.

expansion and improvement of service; (ii) Encourage private sector participation in the development of water and sanitation services; (iii) Protect the interests of consumers; (iv) Regulate wastewater tariffs (i.e. sewerage and septage); and (v) Address the conflicts of interest inherent in the current regulatory agencies.

2. Reform Agenda of the Philippine Water Supply and Sanitation Master Plan

The Philippine Water Supply and Sanitation Master Plan (PWSSMP) presents the eight reform areas that have been identified to prioritize interventions for the water supply and sanitation sector. These reform areas are based on the WSS issues and challenges as described in the master plan. The eight reform areas presented in Table 7 below.

TABLE 7. EIGHT REFORM AREAS AND THEIR RESPECTIVE FOCUS[106]

Reform Agenda	Focus
• RA1: Establishing Effective WSS Sector Institutions • RA2: Strengthening Regulatory Environment • RA3: Balancing Water Supply and Demand • RA4: Building Climate Resiliency • RA5: Creating and Ensuring Effective WSS Services • RA6: Enabling Access to Funding and Financing • RA7: Managing Data and Information • RA8: Driving Research and Development	• Addressing the fragmented sector • Regulating and managing water resources and WSPs, including water tariffs • Managing and maximizing finite water resources with end-users • Adapting to climate change • Ensuring effective and sustainable WSS services and service providers • Improving access to funds • Ensuring availability and accessibility of reliable WSS data • Investing on research and innovations

H. Issues, Challenges and Constraints in Implementing Water Supply Sanitation Sector Projects[107]

A gap analysis matrix is presented and described in Table 2 based on the consultation and Q&A session conducted during the first day of the two-day online consultation meeting with the Zamboanga City Water Security Council on the Preparation of Water Security Master Plan for Zamboanga City.

1. *Lack of and/or insufficient potential surface water sources*[108]*, including other surrounding areas.* The main source of Zamboanga City Water District (ZCWD) is the Tumaga River wherein the water treatment facility is located in Brgy. Pasonanca, Zamboanga City. However, supply from Tumaga River barely meets the requirements of the water treatment plants as the river's current source is barely enough to supply the town proper and some of its adjacent barangays. As such, several studies have been conducted to identify other potential sources of surface water other than the existing and depleting water resources. One of the studies is the USAID Water Security for Resilient Economic Growth and Stability (Be Secure) Project which identified six major river systems[109] in Zamboanga City as potential alternative surface water sources. The identified rivers include the Vitali River, Curuan River, Balong River, Manicahan River, Culiahan River and Ayala River. In this regard, the Manicahan River which has headwaters also coming from the Pasonanca National Park may be developed as an additional domestic water source to feed into ZCWD's system. As their development is contingent on population density projections, an alternative would be to optimize first

[106] National Economic and Development Authority (NEDA), Philippine Water Supply and Sanitation Master Plan, 2019.
[107] Zamboanga City Water Security Council participated in the Online Consultation Meeting on the Preparation of the Zamboanga City Water Security Master Plan held on 28 July 2021.
[108] Determining the available water sources in an area depends on the hydrologic cycle and its various compartments: rainfall, surface water, groundwater and any man-made impoundment.
[109] These rivers were identified based on their large catchment basins and high discharge. Several ground water sources were also identified.

existing spring sources in these barangays while the other one is to identify potential water sources in adjoining and/or surrounding localities. To address this insufficiency, there is an urgent need to expedite the approval, funding and implementation of the Feasibility Study and Conceptual/Basic Design for the Tumaga River Impounding Dam and Multi-Purpose Dam Project to abate this impending problem.

TABLE 8. PWSSMP REFORM AGENDA AND THEIR RESPECTIVE PROPOSED REFORMS[110]

Reform Agenda	Rationale and Objectives	Proposed Reforms
1. Reform Agenda No. 1: Establishing Effective WSS Sector Institutions	Reform Agenda No. 1 establishes an effective WSS sector institution through the following objectives: ▪ Create an apex body to address its fragmented structure of the sector and institutionalize a science-based river basin approach that integrates the IWRM principles. ▪ Create master plans to foster coordinated efforts and guide the concerned implementing agencies to attain universal access in the sector. ▪ Strengthen NWRB and NEDA's coordination with partner institutions across different subsectors.	Reform Area 1.1: Create and establish the Water Sector apex body. This reform includes the following: ▪ Promote an integrated WSS sector to gain support from partner institutions and stakeholders ▪ Establish options and mechanisms to expedite and support the smooth implementation of the PWSSMP while the creation of the Apex Body is yet underway. ▪ Build the capacity of the newly created apex body to follow the IWRM principle Reform Area 1.2: Foster integrated and coordinated WSS efforts with LGUs (e.g., at the provincial and municipal or city level), partner institutions, and stakeholders. The reform includes the following ▪ Prepare provincial and municipal levels master plans to help achieve the targets by translating PDP targets and SDGs commitments to local targets and commitments. ▪ Develop integrated WSS initiatives with LGUs. These initiatives may be piloted in priority municipalities, and then later modalities may be replicated or improved towards efficient and effective delivery of services. ▪ Develop and implement WSS programs that focus on delivery of services to far-flung, hard-to-reach and poverty-stricken areas. The nature and modality of providing the services may entail development and adoption of a right-based local governance framework that promotes gender equality and social inclusion while considering potential national government subsidies similar to the subsidy for missionary areas in the energy sector, poverty-friendly tariff, and/or other cost-sharing arrangements to support and ensure cost recovery and a sustainable O&M of services.
2. Reform Agenda No. 2: Strengthening Regulatory Environment	Reform Agenda No. 2 aims to strengthen the existing regulatory environment consistent with the PDP through the following objectives: ▪ Pursue institutional reforms to encourage and guide investments in the WSS sector. ▪ Create an independent economic regulatory body for the WSS sector for transparent and consistent regulation ▪ Expedite the processing of water permits by deputizing and capacitating local or regional agents. ▪ Review and strengthen existing laws and regulations on water resources	Reform Area 2.1: Support the creation and establishment of the Water Regulatory Commission (WRC) as well as address the economic regulation concerns. This reform includes the following: ▪ Adopt measures to facilitate the approval of the WRC bill ▪ Review and improve the regulatory guidelines of LWUA, NWRB, MWSS to become more responsive to current situation ▪ Review, rationalize and improve NWRB guidelines for granting Certificates of Public Convenience or CPCs (e.g., private bulk water supplier intending to sell to WDs, LGU-level CPC requiring Sangguniang Bayan (SB) resolution) ▪ Establish a Public-Private Partnership (PPP) framework suitable for WSPs. This guideline may (i) review and revise the 2013 NEDA JV Guidelines; (ii) review and improve the LWUA guidelines for regulating PPP transactions; (iii) enable independent review of PPP proposals by LWUA; and (iv) suspend processing of PPP proposals pending update of 2013 NEDA JV Guidelines Reform Area 2.2: Address the resource regulation concerns. This reform includes the following: ▪ Review, rationalize and improve NWRB guidelines for granting water permits ▪ Review existing water permits to weed out speculators ▪ Enforce issued permits and corresponding limits (e.g., volume granted must not exceed volume required) ▪ Review water permits granted to NIA to free up water sources for water supply ▪ Reduce conflict by publishing all hearing decisions in NWRB's website

[110] National Economic and Development Authority (NEDA), Philippine Water Supply and Sanitation Master Plan, 2019.

3. Reform Agenda No. 3: Balancing Water Supply and Demand	Reform Agenda No. 3 focuses on interventions in addressing water scarcity and managing the finite water resources through end-users. It balances the demand with supply while safeguarding the water ecosystem through the following measures ▪ Explore policies and projects to promote efficient water utilization ▪ Prioritize surface water source development for water-critical areas ▪ Incorporate groundwater recharge system in the development of the surface water source for critical areas wherever possible and in accordance with prescribed standards ▪ Use and design eco-efficient water infrastructure to address water demand and supply mismatch. ▪ Develop new water sources to protect watersheds that are critical to existing and potential water sources	Reform Area 3.1: Optimize available water resources. This reform includes the following: ▪ Increase drainage and sanitation facilities for wastewater management and incorporate treatment facilities for potential re-use. Wastewater management shall include drainage and excess water from agriculture. ▪ Integrate and prioritize run-off storage (detention and retention basins) in flood mitigation projects to maximize utilization of surface water for various uses. ▪ Intensify behavioral change initiatives towards promoting improved sanitation for better, safer, and affordable water supply ▪ Promote the development of non-traditional alternative water sources, such as rainwater harvesting and reuse of treated wastewater ▪ Prioritize development of surface water sources for water-critical areas and incorporate groundwater recharge system ▪ Adopt IWRM in water resources and watershed management. IWRM entails environmental and social safeguards and the sustainability of the water ecosystem Reform Area 3.2: Adopt water demand management as a policy. This reform includes the following: ▪ Intensify behavioral change initiatives towards efficient and conscientious use of water. ▪ Adopt provincial or district bulk (surface) water supply systems and encourage multi-purpose reservoir development and optimization ▪ Establish policies that provide incentives to foster efficient and conscientious water users (e.g., labeling of water fixtures regarding their water consumption similar to Energy Efficiency Ratio (EER) for electric appliances, installation and retrofitting of water efficient equipment) ▪ Promote programs towards reducing NRW and increasing efficiency (e.g., reticulating leakage detection, repair programs, and pressure reduction) ▪ Use reclaimed water (e.g. wastewater/grey water) to reduce the need for fresh water supply meant for other uses.
4. Reform Agenda No. 4: Building Climate Resiliency	Reform Agenda No. 4 focuses on interventions in addressing issues and challenges related to climate change. It builds a climate-resilient WSS sector through the following measures: ▪ Consider disaster risk reduction and climate change adaptation strategies to ensure resilient infrastructure facilities. ▪ Enhance the capacities of concerned entities by the government in developing and managing water-related projects	Reform Area 4.1: Enhance WSS systems and structures to become climate-resilient. This reform includes the following: ▪ Disseminate PAGASA climate projections, Mines and Geosciences Bureau (MGM) Geohazard maps, and explain the implications of climate change on all water sources and WSS infrastructure. ▪ Enforce design of WSS infrastructures based on DPWH Design Considerations and Specifications for climate-hydraulic structures, and existing codes (e.g., National Structural Code of the Philippines or NSCP) ▪ Issue guidelines to require climate-resilient design standards of all developers ▪ Build capacity of WSS projects with a climate lens ▪ Incorporate septage treatment in plans for emergency and disaster response ▪ Encourage DENR to enter into more co-management agreements with other agencies, LGUs, RBOs, WQMAs for the protection and rehabilitation of watersheds Reform Area 4.2: Optimize available water sources as a result of climate change (e.g., extreme weather, intensive rainfall, flood and drought). This reform includes the following: ▪ Implement DPWH Design Guidelines integrating retention and retarding basins in flood control and drainage projects ▪ Promote use and storage of rainwater. This guideline may include issuance of policies and installation of rainwater harvesting and storage structures in all government and public buildings and, the issuance of local ordinances by

		LGUs to immediately require rainwater harvesting, storage and use of all new developments within their jurisdiction and give existing structures a lead time (about five years) to comply with this requirement.
5. Reform Agenda No. 5: Creating and Ensuring Effective WSS Services	Reform Agenda No. 5 focuses on interventions for WSPs. It aims to address the issues and challenges that hinder the effective delivery of WSS services to its target beneficiaries and franchise area. It ensures an effective and sustainable WSS services and providers with cost-efficient and well-designed WSS structures, and adequate institutional capability to efficiently operate and maintain the water supply and sanitation systems. This area has the following measures: ▪ Enhance the capacities of concerned entities by the government in developing and managing water-related projects. ▪ Support plans to broaden the scope of the NSSMP to improve the response from LGUs and WDs ▪ Assist WDs by expanding the coverage of reliable water service at affordable rates and reducing NRW while ensuring economically-viable operations ▪ Expand sewerage and sanitation infrastructure	Reform Area 5.1: Define the most appropriate institutional arrangement for WSS provision. This reform includes the following: ▪ Adopt the most effective institutional arrangement for WSS provision, which is less fragmented and oriented towards efficient and sustainable operations ▪ Increase the coverage of WDs by operationalizing non-functional WDs and requiring WDs to attain 100 percent service coverage ▪ Recommend changes in certain governmental regulations that negatively affect WD operations ▪ Evaluate the effectiveness of past and existing programs that are directed at the poor and waterless communities (SALINTUBIG, Assistance to Municipalities) ▪ Assess the performance of LGU-run utilities and determine the sustainability thereof ▪ Study and develop alternative models of PPP or Public Social Partnership (PSP) for medium-sized WSPs where the community is the partner of government ▪ Review and revise the existing Joint Venture guidelines to ensure that consumers are well protected Reform Area 5.2: Build capacities of the institutions. This reform includes the following: ▪ Develop and implement capacity building program for LWUA. Increase current manpower of LWUA from 447 to appropriate level to enable the agency to meet increasing demand ▪ Empower LWUA to recommend the appropriate capacity building programs for WDs ▪ Develop LGU-run water utilities into financially viable and sustainable organizations ▪ Strengthen DILG to effectively assist in the development of LGU-run utilities ▪ Provide assistance (technical, managerial, financial, legal) to enable WDs and other WSPs to properly evaluate unsolicited proposals to properly evaluate unsolicited proposals for JVs ▪ Review and propose amendments to PD 198 to enable less politicization of WDs (appointment of the Board of Directors and appropriate sanctions) ▪ Build DILG and DOH's partnerships with civil society, NGOs, academe and businesses to broaden capacity building assistance to poor and waterless municipalities ▪ Develop and implement a capacity building program for other agencies that have a key role in the development of the WSS sector – NWRB, MWSS, DPWH, DOH, NEDA, DOF and DBM. Reform Area 5.3: Strengthen sector planning and development. This reform includes the following: ▪ Build the capacity of the apex body on WSS planning and development using the IWRM principle towards national delivery of WSS services
6. Reform Agenda No. 6: Enabling Access to Funding and Financing	Reform Agenda No. 6 focuses on interventions geared to improve access to funding and financing for WSS services through the objective: ▪ Establish a unified financing framework (UFF) with a definite scope and streamlined	Reform Area 6.1: Implement the UFF in the sector in accordance with the PWSSMP Reform Area 6.2: Review and improve financing policies and coverage. This reform includes the following: ▪ Review and improve LWUA financing policies. This reform may include increased capitalization of LWUA. ▪ Review coverage of WQMA fund ▪ Expand the funding and coverage of NSSMP

	process to consolidate and other financial resources for WSS projects.	Reform Area 6.3: Build capacity and offer technical assistance to WSPs and LGUs in accessing financing. This reform includes the following: ▪ Enable effective use of Level III funds for LGUs through a design, build, and operationalize scheme. ▪ Explore other funding and financing sources
7. Reform Agenda No. 7: Managing Data and Information	Reform Agenda No.7 focuses on interventions in addressing the issues and challenges related to availability, accessibility, reliability, and use of WSS data and information. It ensures availability and accessibility of reliable and sound WSS data for planning, programming and policy formulation – consistent with the PDP 2017-2022	Reform Area 7.1: Harmonize and integrate WSS data. With the creation and establishment of an apex body, data sets from other agencies on WSS must be combined and integrated into one WSS database under the responsibility of the apex body. This reform includes the following: ▪ Formulate the guidelines and framework for the harmonization and integration of WSS data ▪ Design a comprehensive WSS data structure ▪ Harmonize and integrate WSS data platform with PSA to make it accessible to the public Reform Area 7.2: Establish and operationalize the Philippine WSS Information System (PWSSIS). This reform includes the following: ▪ Design the PWSSIS ▪ Establish the WSS data center in the apex body ▪ Develop and deploy a comprehensive PWSSIS ▪ Develop and streamline programs to establish baseline data (e.g., pertaining to SDG, coverage and other relevant indicators) ▪ Roll out existing PWSSIS at NWRB (if apex body has not been yet established) or the National Water Management Council (if the EO creating this strengthened NWRB is signed by the President), and provide funding support. Reform Area 7.3: Build capacity of the apex body and PWSSIS-trained data custodians. This reform includes roll-out and training of the PWSSIS nationwide (e.g. apex body, provinces, and cities/municipalities) Reform Area 7.4: Draft and enact policies that will compel data custodians to regularly enter and upload WSS related data.
8. Reform Agenda No. 8: Managing Data and Information	Reform Agenda No.8 focuses on interventions related to research and development, innovative solutions, technologies, or policies that restrict use of potential technologies related to WSS.It explores technologies in water supply.	Reform Area 8.1: Establish a Research and Development (R&D) Division (or its equivalent). This division oversees the accreditation of WSS-related new technologies at the apex body. This reform includes the following: ▪ Create a division at the apex body for the review and approval of WSS-related technologies ▪ Build the capacity of the division Reform Area 8.2: Improve accreditation of new WSS-related technologies Reform Area 8.3: Adopt innovative technologies and cost-effective solutions. This reform includes the following: ▪ Conduct R&D studies (e.g., tie-up with academe, WSS partners and experts) ▪ Roll out studies approved for implementation ▪ Develop and adopt advance infrastructure design and construction methodology solutions Reform Area 8.4: Ensure availability of government financial support of local WSS-related interventions. This reform includes the following: ▪ Establish and implement government financial support of local WSS-related interventions ▪ Tap local inventors and scientists with attractive government support

2. *Lack of and/or insufficient information on the use of isotopic and nuclear techniques to ensure clean ground water sources.* During rainy season, quick infiltration of silt and debris in the Tumaga River is a perennial problem as it becomes heavily silted during the rainy season. In the same manner, groundwater contamination is also one of the issues in zoning, monitoring and development of water resources management policies. In this regard, the use of isotopic and nuclear techniques could be a solution to address these constraints but this method has not been introduced yet. Therefore, the lack of and/or insufficient information on the use of isotopic and nuclear techniques to ensure clean ground water sources should be appropriately addressed. Scientists[111] from the University of the Philippines-Diliman (UP Diliman) and the Department of Science and Technology-Philippine Nuclear Research Institute (DOST-PNRI) used nuclear techniques to analyze the salinity of the groundwater sources in Pampanga. In this regard, a capacity building and/or technology transfer activity on the use of the isotopic and nuclear techniques for the ZCWD to ensure clean freshwater and groundwater supply to ZCWD concessionaires.

3. *Insufficient monitoring and enforcement of EO 524-harvesting, storage utilization of rainwater.* Based on the processing capacity of water treatment plants from Tumaga River, water shortages are presently affecting the City[112] Similarly, the insufficient water supply is directly affecting the operations of the Zamboanga City Water District particularly during the dry season/El Nino period.[113] However, despite these conditions, there is still insufficient monitoring and enforcement of EO 524: An Ordinance Requiring the Proper Harvesting, Storage and Utilization of Rainwater in the City of Zamboanga, Appropriating Funds and Providing Penalties for Violations and for Other Purpose.

I. Priority Programs: Key Actions (Hard Components)[114]

The priority programs support the reforms areas through: (i) WSS potential projects and (ii) identified projects.

1. WSS Potential Projects[115]

The cost of infrastructure investments was derived based on anticipated demand based on projected population, economic growth, and factored investments to ensure continuous delivery of WSS services of existing systems. The computation included the anticipated upgrade of existing service levels (e.g., Level I, Level II and Level III). The computation was used due to limited data collected at the regional consultations. The provinces provided their list of potential projects, but the projected impact of these projects is not enough to achieve the national targets. As such, the lists of projects collected are classified at identified projects

2. Identified Projects[116]

The participants of regional consultations listed current and potential WSS projects. Majority of these projects are in the conceptual stage. In addition, government agencies provided their list of projects through consultations. For Region XII, with a total population of 3,629,783, the gap in access to water supply is at 832,841, while the gap in the access to sanitation is at 245,591. As such, the total budget requirement (in millions) is at 42.683 billion. Specifically, the budget requirement for 2022 is PhP 27.156 billion and the budget requirements set for 2030 is 15.527 billion.

[111] The study was led by Dr. Sunshine P. Tan of UP Diliman's Environmental Engineering Program, under the mentorship of Dr. Angel Bautista VII of the DOST-PNRI's Nuclear Analytical Techniques Applications Section. The study also received assistance from the Mines and Geosciences Bureau of the Department of Environment and Natural Resources and the Micro Analysis Laboratory, Tandem Accelerator of Tokyo University.
[112] USAID Water Security for Resilient Economic Growth and Stability (Be Secure) Project. Technical Services for Preparing Vulnerability Assessments of Water Resources in Zamboanga City: Final Report. Geoscience Foundation, Inc. February 2016.
[113] It is predicted that effects of climate change will result in more extreme conditions in the coming decades with the periods of drought presently experienced by Zamboanga City getting worse.
[114] National Economic and Development Authority (NEDA), Philippine Water Supply and Sanitation Master Plan, 2019.
[115] Ditto
[116] Ditto

TABLE 9. GAP ANALYSIS MATRIX ON ADDRESSING PREVAILING ISSUES, CONCERNS, AND CHALLENGES ON WATER SECURITY[117]

Issue/Concern	Description of the Gap	Relevant Applicable Policy	Suggested Actions to Bridge the Gap	Recommended Projects/ Programs	Responsible Party
1. "Lack of and/or insufficient potential surface water sources, including in other surrounding areas"	Although there have been several studies conducted on identifying potential freshwater sources, there is still no definitive results on the potential freshwater sources	a) PD 1067-Water Code and its Amended IRR[118] (b) PD 198-Provincial Water Utilities Act 1973[119] (c) PD 856 Code of Sanitation (d) RA 9275 Clean Water Act (e) RA 8041 Water Crisis Act (f) PD 424 and its Amendments[120] (g) Zamboanga Peninsula Regional Development Plan 2017-2022[121] (h) Zamboanga City Comprehensive Development Plan & Comprehensive Land Use Plan[122] (i) EO BC-661-2021-Zamboanga City Water Security Council[123] (j) Executive Order No.524-Rainwater Harvesting[124]	Expedite the completion as well as commission additional studies/projects on identifying potential freshwater sources within and surrounding areas	Feasibility Study and Conceptual/Basic Design for the Tumaga River Impounding Dam and Multi-Purpose Dam Project	City Government of Zamboanga (CGZ) and City Engineering Office (CEO) & Zamboanga City Water District (ZCWD)
2. "Lack of and/or insufficient information on the use of isotopic techniques to ensure clean freshwater"	Groundwater contamination is one of the issues in zoning, monitoring and crafting of water resources management policies, but the use of isotope and nuclear techniques have not been introduced yet		Introduce the use of isotopic and nuclear techniques used by DOST's Philippine Nuclear Research Institute (PNRI) to ensure the utilization of clean freshwater sources	Capacity Building on the Use of Isotopic & Nuclear Techniques in Ensuring Freshwater Supply to Zamboanga City Water District Concessionaires	City Government of Zamboanga (CGZ) and City Engineering Office (CEO) and Zamboanga City Water District (ZCWD), Zamboanga City Water Security Council (WSC)
3. "Insufficient monitoring and enforcement of EO 524-harvesting storage utilization of rainwater"	There is insufficient adoption of efficient practices, designs, fixture, materials and methods to collect rainwater in commercial buildings		Intensity the adoption of EO 524 particularly in designing rainwater collection fixtures in commercial establishments	Adoption of EO 524 on Rainwater Harvesting Fixtures in Commercial Building Designs/Plans	City Government of Zamboanga (CGZ) and City Engineering Office (CEO)
4. "Lack of or insufficient information on the results of the water impounding dam FS"	Insufficient/lack of information on the results of pre-feasibility study for Zamboanga City Impounding Dam Project financed by NEDA		Facilitate regular issuance of information on the updates of various ongoing infrastructure projects in the water sector	Feasibility Study & Basic Conceptual Design of Zamboanga City Water Impounding Dam Project	City Government of Zamboanga (CGZ) and Zamboanga City Water District (ZCWD)
5. "Varying levels of awareness and knowledge about water security"	Personnel of the Zamboanga City Water Security Council members have varying degree of awareness and knowledge on water security		Recommend an institutional capacity building program to increase the awareness and knowledge on water security	Institutional Capacity Strengthening on Water Security Awareness and Knowledge Training	City Government of Zamboanga (CGZ) and Zamboanga City Water Security Council (WSC)
6. "Insufficient period and/ or implementation of Water Audit Program"	The ongoing implementation of the Water Audit Program needs to be expanded to cover other areas		Recommend and support the extension and expansion of the Water Audit Program	Zamboanga City Water Audit Program: Phase 2 (Expansion Phase)	City Government of Zamboanga (CGZ) and Zamboanga City (ZCWD)
7. "Lack of potential financing facilities and modalities for water sector infrastructure development projects"	There is a significant and urgent need to identify potential financing facilities and modalities to finance several infrastructure development projects in the water sector		Initiate a request to national and international financing institutions to introduce and offer available facilities and modalities to finance projects	Conduct of Market Sounding Exercise and Financing Assistance from International Financing Institutions	City Government of Zamboanga (CGZ) Zamboanga City Water District (ZCWD) and Water Security Council

[117] The issues and concerns described in the Gap Analysis Matrix were obtained from respondents and/or representatives of the Zamboanga City Water Security Council participated in the Online Consultation Meeting on the Preparation of the Zamboanga City Water Security Master Plan held on 28 July 2021.
[118] Under PD 1067 of 1976, the Water Code governs the appropriation of water, i.e., the acquisition of rights over the use, taking, or diverting of water from natural resources. Such appropriation of water is legally allowed by the code for the following purposes: domestic, municipal, irrigation, power generation, fisheries, livestock raising, industrial and recreational.
[119] PD 198 of 1973 refers to the declaration of national policy favoring local operation and control of water systems; authorizing the formation of local water districts and providing for the government and administration of such districts; chartering a national administration to facilitate improvement of local water utilities to optimize public service from water utility operations.
[120] PD 424 of 1074 refers to the creation of a National Water Resources Council to coordinate and integrate water resources development in the country.
[121] The Zamboanga Peninsula Regional Development Plan (2017-2022) supports the attainment of accelerating growth and regional contribution to the Philippine Development Plan (2017-2022).
[122] The six-year Zamboanga City Comprehensive Development Plan (2017-2022) "seeks to establish Zamboanga as a Metropolitan City with robust biodiversity and sustainable development that is globally competitive, where investments thrive through good governance and industry".
[123] EO BC-661-2021 is an Executive Order creating the Zamboanga City Water Security Council to strengthen the enabling environment for sustainable management of water supply and water demand.
[124] EO 524 requires the adoption of efficient practices, designs, materials, fixtures, equipment, and methods that reduce water consumption (e.g. rainwater harvesting and recycling.

J. PWSSMP Priority Programs: Key Actions (Hard Components)

The priority programs support the reforms areas through: (i) WSS potential projects and (ii) identified projects.

3. WSS Potential Projects[125]

The cost of infrastructure investments was derived based on anticipated demand based on projected population, economic growth, and factored investments to ensure continuous delivery of WSS services of existing systems. The computation included the anticipated upgrade of existing service levels (e.g., Level I, Level II and Level III). The computation was used due to limited data collected at the regional consultations. The provinces provided their list of potential projects, but the projected impact of these projects is not enough to achieve the national targets. As such, the lists of projects collected are classified at identified projects

4. Identified Projects[126]

The participants of regional consultations listed current and potential WSS projects. Majority of these projects are in the conceptual stage. In addition, government agencies provided their list of projects through consultations. For Region XII, with a total population of 3,629,783, the gap in access to water supply is at 832,841, while the gap in the access to sanitation is at 245,591. As such, the total budget requirement (in millions) is at 42.683 billion. Specifically, the budget requirements for 2022 are PhP 27.156 billion and the budget requirements set for 2030 is 15.527 billion.

TABLE 10. INVESTMENT REQUIREMENTS TO ACHIEVE WATER SUPPLY AND SANITATION SECTOR TARGETS[127]

Region	Population	Gap in Access to Water Supply	Gap in Access to Sanitation	Total Budget Requirement (in Php M)	Budget Requirements for 2022 (in PhP M)	Budget Requirements for 2030 (in PhP M)
CAR	1,722,006	137,516	523,458	20,418	12,415	8,003
Region I	5,026,128	210,460	271,458	57,674	37,363	20,311
Region II	3,451,410	-	92,934	38,446	27,389	11,057
Region III	11,218,177	201,026	756,951	106,659	76,431	30,228
Region IV-A	14,414,774	1,659,631	926,875	213,918	148,721	65,197
Region IV-B	2,963,360	674,207	520,886	33,410	22,733	10,677
Region V	5,796,989	1,407,084	672,902	51,574	33,026	18,549
Region VI	7,536,383	1,457,642	1,186,720	81,691	57,366	24,325
Region VII	7,396,898	2,609,319	1,229,842	101,637	75,299	26,339
Region VIII	4,440,150	594,882	1,314,215	54,415	36,681	17,734
Region IX	3,629,783	832,841	245,591	42,683	27,156	15,527
Region X	4,689,301	545,846	260,214	59,744	40,318	19,426
Region XI	4,893,318	679,003	396,798	55,758	35,705	20,053
Region XII	4,545,276	265,247	610,714	66,251	45,842	20,409
Region XIII	2,596,709	214,780	431,633	31,364	22,711	8,653
BARMM	3,781,387	1,760,648	1,310,520	52,539	34,493	18,046
Total:	88,102,050	13,250,132	10,751,711	1,068,186	733,657	334,529

[125] National Economic and Development Authority (NEDA), Philippine Water Supply and Sanitation Master Plan, 2019.
[126] Ditto
[127] Ditto

5. Prioritizing Projects to Achieve National Targets[128]

The ensure that funded infrastructure projects shall contribute to timely achievement of the national targets; the prioritizing framework is as follows:

(i) High priority is given to WSS infrastructures where 100% of target beneficiaries belong to households with access to safe water supply and households without access to basic sanitation.
(ii) Higher priority is given to WSS infrastructure deemed feasible and ready for implementation.

As such, summary of identified programs and projects, the following are provided:

DILG Assistance to Municipalities, it has a total of 1.04 billion (water supply) and 188 million (sanitation) of project cost implemented in 2019-2023, covering a total number of beneficiaries of 1,667,138 (8% of the total population) and 322,992 (2% of the total population) household beneficiaries, respectively. On the other hand, the DILG Salintubig has a total of 1.549 billion project cost implemented from 2019-2023, covering 863,992 (4%) households or 4% which you have included in the project cost implemented in 2019-2023. Similarly, LWUA has a total budget of 10.74 billion which will be discussed during the contract (Refer to Table 11).

TABLE 11. SUMMARY OF IDENTIFIED PROGRAM AND PROJECTS[129]

Agency	Infrastructure Type	Project Cost Implemented in2019-2023	Project Cost Implemented in 2024-2030	Household Beneficiaries	Percent Population Covered
DILG Assistance to Municipalities	Water Supply	1,045,348,178.00	-	1,667,138	8%
	Sanitation	188,120,000.00	-	322,049	2%
DILG Salintubig	Water Supply	1,549,641,000.00	-	863,992	4%
	-	-	-	-	-
LWUA	Water Supply	10,740,560,000,000	26,795,000.00	4,748,123	24%
CAR	Water Supply	2,446,676,640.00	3,691,462,000.00	448,430	100%
	Sanitation	1,705,802,100.00	-		
	WSS	2,000,000.00	-		
Region I	Water Supply	7,328,294,801.35	1,003,845900.80	1,241,079	100%
	Sanitation	100,000,000.00	8,950,884,500.50	-	-
	WSS	3,000,000.00	-	-	-
Region II	Water Supply	3,014,049,000.00	13,944,709,000.00	845,036	96%
	Sanitation	1,508,000,000.00	1,263,120,000.00		
Region III	Water Supply	34,342,093,000.00	1,935,100,000.00	2,174,945	72%
	Sanitation	210,000,000.00	57,625,816,000.00		
	WSS	2,502,010.00	67,000,000.00		
Region IV-A	Water Supply	2,052,000.00	-	1,547,066	39%
MIMAROPA Region	Water Supply	4,104,450,000.00	1,916,950,000.00	765,497	100%
	Sanitation	6,182,000,000.00	383,980,730.00		
	WSS	8,000,000.00	-		
Region V	Water Supply	3,505,270,000.00	3,878,586,000.00	1,341,295	100%
	Sanitation	51,100,000.00	7,368,140,000.00		
	WSS	80,050,000.00	200,000.00		
Region VI	Water Supply	-	10,000,000.00	474,538	25%
	Sanitation	-	80,000,000.00		
Region VII	Water Supply	1,261,910,000.00	2,562,899.000.00	1,412,468	74%
	WSS	35,000,000.00	-		
Region VIII	Water Supply	730,500,000.00	1,401,677,420.45	999,767	82%
	Sanitation	-	338,000,000.00		
	WSS	1,000,000.00	-		
Region IX	Water Supply	370,900,000.00	21,876,771,600.00	870,000	97%

[128] National Economic and Development Authority (NEDA), Philippine Water Supply and Sanitation Master Plan, 2019.
[129] Ditto

	Sanitation	2,000,000.00	905,971520.00		
	WSS	155,835,000.00	-		
Region X	Water Supply	8,556,430,000.00	8,892,800,000.00	828,170	70%
	Sanitation	4,392,481,420.00	2,299,036,910.00		
	WSS	257,100,100.00	15,000,000.00		
Region XI	Water Supply	5,172,767,764.00	792,794,028.00	1,154,438	87%
	Sanitation	5,273,572,000.00	541,992,000.00		
Region XII	Water Supply	32,160,000.00	474,946,000.00	1,000,291	82%
	Sanitation	170,000.00	91,420,000.00		
	WSS	790,280,000.00	64,000,000.00		
Region XIII	Water Supply	24,900,000.00	8,512,441,000.00	548,645	87%
	Sanitation	-	3,104,550,000.00		
BARMM	Water Supply	4,331,952,110.00	10,691,005,026.67	725,449	100%
	WSS	11,742,740,000.00	8,060,535,614.00	-	-
	Sanitation	12,800,000.00	41,600,000.00	-	-
	Water Supply	75,224,405,325.35	77,921,319,975.91	-	-
	WSS	31,167,865,520.00	94,704,909,274.50	-	-
	Sanitation	1,347,567,100.00	187,800,000.00	-	-
Total:		**107,739,837,945.35**	**172,814,029,250.42**	**16,377,714**	**72%**

K. Programs, Projects and Activities Aligned with the Eight Reform Agenda of PWSSMP

There are several program, projects and activities (PPAs) which are considered priority programs which are aligned or supportive of the eight reform agenda through: (i) WSS potential projects and (ii) the identified projects. Indicated in Table 12 below are water supply and sanitation infrastructure development projects (physical and non-physical) identified and/or listed in the Philippine Water Supply and Sanitation Master Plan (PWSSMP) and the Zamboanga City Water Security Master Plan (ZC-Water Security Master Plan). Projects and activities contributing to the realization of sector targets and goals, especially for the short term, are identified to facilitate their implementation alongside the operationalization of the PWSSMP. Assessment was made on the basis of the reform activities and their schedule of implementation.

Under Reform Agenda No. 3: Balancing Water Supply and Demand, the following projects are included in the PWSSP (i) Cahumban Water System (Cost: P76.4 million); (ii) Water Impounding Facilties (Cost: P19 billion); (iii) Rancho Frio a Banguiao Water System (Cost: P121million); and (iv) Zamboanga City Water Demand and Impounding Program (Cost: P30.5 million). Under the same reform agenda, the following projects are included and proposed under the ZC-Water Security Master Plan : (i) Construction of Rainwater Collection System (Cost: P20 million); (ii) Construction of Impounding Dam (216 MLD): Bulk water supply and hydroelectric power (Cost: P6.6 billion); (iii) Expansion of Groundwater Sources (Cost:P17 million); (iv) Water source development: Manicahan River (50MLD) (Cost: P2.7 billion); (v) Water source development: Bog Lake (20 MLD) (Cost: P790 million); (vi) Cahumban Water System (Cost: P76.1 million; (vii) Water Source Development in Sitio Latap, Brgy. Limpapa (Cost: P120.4 million); (viii) Bunguiao Water System (Cost: P59 million); (ix) Watershed Protection/ Rehabilitation Program: Perimeter Fencing (Cost: P197 million); (x) Rehabilitation and Expansion of Sewer line (Cost: P28.5 million); (xi) Mainline Replacement Program and Water Distribution Network Expansion and Improvement Program (Cost: P735 million); and (xii) Treated Water Production Augmentation Program (Cost: P123 million).

With regard to Reform Agenda No. 1: Establishing Effective WSS Sector Institutions, the following PPAs are included and/or identified under the ZC-Water Security Master Plan : (i) Policy Research on the Assessment of Benefits for the Establishment of a National Knowledge, Learning and Research Center for Water Security (Cost: P25 million); (ii) WAP Impact Evaluation: Best Practices and Lessons Learned in Program Implementation (Cost: P5 million); (iii) City-level Strategic Communication Campaign Plan for ZC Water Security Master Plan (Cost: P10 million); (iv) WATSEC Watch: Supporting the Zamboanga City and Regional Water Sector Partnership (Cost: P15 million); (v) Establishment of a Knowledge, Learning and Research Center for Water Security (Cost: 250 million); (vi)WAP-Pro: ZC WAP Implementation for Sustainable Institutional Partnership (Cost: P25 million); and (vii) City-level Strategic Communication Campaign Plan for ZC WDM Plan (Cost: P5 million). Several PPAs are indicated in Table 12 below.

TABLE 12. MATRIX OF IDENTIFIED PROGRAMS, PROJECTS AND ACTIVITIES FROM THE PWSSMP[130] AND ZC-WATER SECURITY MASTER PLAN [131] ALIGNED WITH THE EIGHT REFORM AGENDA[132]

Reform Agenda	Key Actions (Based on Philippine Water Supply and Sanitation Master Plan)	PPAs as indicated in the PWSSMP (for Zamboanga City LGU)	PPAs as Identified by the ZC-Water Security Master Plan (for Zamboanga City LGU)
Reform Agenda No. 1: Establishing Effective WSS Sector Institutions	▪ Identify champions in Upper and Lower Houses to sponsor the creation of the Water Sector Apex Body (DoW ▪ Adopt an appropriate policy that defines effective service delivery of water supply and sanitation services – rights-based local water governance framework –that ensures meeting the normative content of the human rights to WSS ▪ Develop and pilot-implement a local water supply and sanitation governance framework that enables LGUs to realize their obligation of ensuring access to WSS and where the LGUs shall drive the effective provision of WSS services ▪ Consider the creation of a local WSS development office that will help plan and coordinate WSS activities and coordination at the local level with national agencies ▪ Advocate and include provision and ensuring of acceptable and sustainable access to WSS services as a criteria in awarding Seal of Good Local Governance (SGLG) to LGUs ▪ Develop and pilot-implement the integrated provision of water supply and sanitation services in selected water utilities ▪ Review and improve current cost recovery framework and tariff setting methodologies (water districts, LGU-run water utilities, other WSPs) to adopt a more responsive methodology that will promote financial sustainability ▪ Prepare provincial WSS master plan based on the regional roadmaps prepared under the PWSSSMP. The Provincial WSS Master Plans shall be the basis for the preparation of the local (city and municipal) WSS development plans ▪ Develop a program that will prioritize WSS investments in far-flung and security risk areas	▪ None	▪ Policy Research on the Assessment of Benefits for the Establishment of a National Knowledge, Learning and Research Center for Water Security (Cost: P25 million) ▪ WAP Impact Evaluation: Best Practices and Lessons Learned in Program Implementation (Cost: P5 million) ▪ City-level Strategic Communication Campaign Plan for ZC Water Security Master Plan (Cost: P10 million) ▪ WATSEC Watch: Supporting the Zamboanga City and Regional Water Sector Partnership (Cost: P15 million) ▪ Establishment of a Knowledge, Learning and Research Center for Water Security (Cost: 250 million) ▪ WAP-Pro: ZC WAP Implementation for Sustainable Institutional Partnership (Cost: P25 million) ▪ City-level Strategic Communication Campaign Plan for ZC WDM Plan (Cost: P5 million)

[130] Philippine Water Supply and Sanitation Master Plan
[131] Zamboanga City Water Security Master Plan
[132] SURGE Project. Preparation of Water Security Master Plan for Zamboanga City: Description of the Current Water Security Situation, 2021.

	▪ Develop strategic WSS communication plans and IEC campaigns targeting the public to promote WSP's services, plans and programs		
Reform Agenda No. 2: Strengthening Regulatory Environment	▪ Review Sec. 31 of PD 198: "A district shall have the power to enter into contracts with any person for the purpose of performing any functions of the district: provided, that the Board of Directors may not by contract delegate any of the discretionary powers vested in the board by this Title." ▪ Review and improve NEDA JV Guidelines to tailor to Water District conditions ▪ Review awarded JV contracts ▪ Capacitate and increase tariff review staff of LWUA and NWRB ▪ Improve tariff formula to take into consideration water demand management, small water service providers, poor communities, power cost adjustment, consumer price index (CPI) ▪ Adopt technologies to lower energy costs ▪ Develop common data report for all water service providers. Data Annual Report to be submitted by all water utilities as input to Annual Benchmarking Report of all water service providers ▪ Identify champions in Upper and Lower Houses to sponsor WRC Bill. NEDA to declare WRC as priority legislation and endorse it to the Legislative-Executive Development Advisory Council (LEDAC) ▪ Review and rationalize NWRB guidelines for granting of water permits and CPCs to weed out speculators; Check and verify water rights: volume granted should not exceed volume required; NWRB to require the following in water permit applications: (a) MOA with water district for private bulk water supplier (intending to sell to WD; and (b) Sangguniang Bayan (SB) resolution (For LGU level CPC. ▪ Review water permits granted to NIA to free up water sources for water supply ▪ Publish all hearing decisions in NWRB website	▪ None	▪ ZC WSC Policy Research on Institutional Capacity Strengthening (ICS) (Cost: P20 million) ▪ City-Level Strategic Institutional Development and Capacity Building Program of the ZC Water Security Master Plan (Cost: P10 million) ▪ ICS of ZC WSC: Training on Water Planning Approach and Decision Support System using WEAP (Cost: P5 million) ▪ ICS of ZC WSC Personnel involved in Development and Implementation of Water Sector Development Projects (Cost: P20 million) ▪ Long-Term, Comprehensive and Sustainable ICS for ZC WSC (Cost: P25 million) ▪ Water–Isotope Capacity Building and Demonstration Project (Cost: P5 million)
Reform Agenda No. 3: Balancing	▪ Conduct of a nationwide comprehensive inventory/assessment of the country's current/available water resources potential to	▪ Cahumban Water System (Cost: P76.4 million) ▪ Water Impounding Facilties (Cost: P19 billion) ▪ Rancho Frio an Banguiao Water System	▪ Construction of Rainwater Collection System (Cost: P20 million)

Water Supply and Demand	determine (a) available water (surface water, groundwater) for use; and (b) water resource-scarce LGUs/areas/cities ▪ Advocate development of bulk water supply system projects that could cover multiple LGUs using surface water sources ▪ Develop and pilot-implement provincial and/ or clustered-LGU bulk water supply projects to serve as sustainable and feasible model for future water supply development ▪ Increase drainage and septage. Wastewater treatment facilities for potential re-use of treated water ▪ Integrate and prioritize run-off storage (detention and retention basins) in flood mitigation projects to maximize utilization of surface water for various uses ▪ Implement and strengthen watershed protection programs; adopt IWRM approach in water resources and watershed management ▪ Information, education and communication (IEC) on Water Demand Management (water efficiency, water conservation, rainwater harvesting, reuse of treated wastewater, reduction of non-revenue water (NRW) ▪ Introduce the use of water efficient technologies or devices to reduce per capita consumption; Use incentives and disincentives (e.g., tariff) as a mechanism to encourage behavioral change; Implement NRW reduction programs (leak detection and control, establish district metered areas (DMAs), install mother meters ▪ Provide incentives to encourage implementation of sanitation related projects; Increase awareness by continuous information dissemination regarding proper sanitation, treatment and reuse of wastewater/grey water	(Cost: P121million) ▪ Zamboanga City Water Demand and Impounding Program (Cost: P30.5 million)	▪ Construction of Impounding Dam (216 MLD): Bulk water supply and hydroelectric power (Cost: P6.6 billion) ▪ Expansion of Groundwater Sources (Cost:P17 million) ▪ Water source development: Manicahan River (50MLD) (Cost: P2.7 billion)\ ▪ Water source development: Bog Lake (20 MLD) (Cost: P790 million) ▪ Cahumban Water System (Cost: P76.1 million) ▪ Water Source Development in Sitio Latap, Brgy. Limpapa (Cost: P120.4 million) ▪ Bunguiao Water System (Cost: P59 million) ▪ Watershed Protection/ Rehabilitation Program: Perimeter Fencing (Cost: P197 million) ▪ Rehabilitation and Expansion of Sewer line (Cost: P28.5 million) ▪ Mainline Replacement Program and Water Distribution Network Expansion and Improvement Program (Cost: P735 million) ▪ Treated Water Production Augmentation Program (Cost: P123 million)
Reform Agenda No. 4: Building Climate Resiliency	▪ Widely disseminate and explain PAGASA climate projections and their impacts on water ▪ Widely disseminate and explain Geohazard Maps from Mines and Geosciences Bureau ▪ Locate WSS infrastructure in high risk areas and develop risk mitigation measures vulnerable structures ▪ Design WSS infrastructure based on the DPWH Design Considerations, Guidelines and Specifications (DCGS) for climate resilient hydraulic structures; construct new WSS infrastructure in low-risk areas	▪ None	▪ None

	▪ Issue guidelines requiring all land developers and LGUs to adopt the DPWH Guidelines for climate resilient hydraulic infrastructures ▪ Review all major WSS proposed projects to check if climate considerations were already integrated ▪ Develop and implement capacity building programs designed for WSS personnel and officials ▪ Establish DPWH Administrative Order (AO) requiring retention or retarding basins for flood control and drainage systems ▪ Widely disseminate and implement abovementioned DPWH AO ▪ Request and accomplish establishment of order from the Office of the President (OP) requiring all NGAs and LGUs to install rain water harvesting (RWH) and storage facilities in all their existing government buildings (national and local) and to include the same in future construction ▪ DILG to establish Memorandum Order (MO) instructing all LGUs to pass ordinances requiring RWH and storage for all future development in their areas ▪ LGUs to issue local ordinances in accordance with OP order and DILG MO ▪ Tap LGU Leagues (Union of Local Authorities of the Philippines or ULAP, League of Provinces of the Philippines (LPP), League of Cities of the Philippines (LCP), League of Municipalities of the Philippines (LMP) as partners for dissemination and monitoring of compliance. ▪ Request and accomplish establishment of OP order for all government buildings and new constructions including in resettlement areas to have RWH and use water efficient water fixtures issued ▪ Revise Building Code and Plumbing Code to include water efficiency standards ▪ Hold consultations on the proposed standards, prepare draft Guidelines and conduct consultations with concerned sectors ▪ DENR to enter into co-management agreements with other agencies, LGUs and multi-stakeholder organizations such as RBOs and Watershed Councils for the protection and rehabilitation of the watersheds within their areas		

	▪ Water Service Providers (WSPs) to prepared WSS Emergency Response Plans; Orient and build capacity for Disaster Risk Reduction of WSS officials and staff		
Reform Agenda No. 5: Creating and Ensuring Effective WSS Services	▪ Adopt the proposed institutional arrangement for water supply and sanitation service provision (which is also the landscape for implementing the investment program) ▪ Implement and expedite a program to operationalize the non-functional water districts and encourage the creation of new water districts ▪ Implement a program to assess the LGU run water utilities – operations and capacity needs –to improve their performance. Priority for assessment will be those who will be part of the PWSSIIP ▪ Develop and pilot-implement a business/ management model where the government, and CBOs enter a partnership/JV arrangement to operate and maintain a water utility ▪ Recommend improvements/changes to certain governmental regulations (mainly COA, DBM, DENR and NWRB) that will enable WDs to be run efficiently and effectively as commercial enterprises. There are certain government regulations that hamper the operational procedures of the WDs which could be reviewed and streamlined ▪ Conduct an evaluation of the effectiveness of other programs to accelerate access especially those directed at the poor and waterless municipalities (Salintubig, Assistance to Municipalities and other programs for community-based water organizations) ▪ Conduct a capacity needs assessment of LWUA and the WDs ▪ Develop and implement a responsive capacity building program for LWUA and the WDs ▪ Seek approval of budget increase for LWUA's programs ▪ Study the feasibility of setting up Regional Training Centers for WDs and LGU-run utilities	▪ Bulk Water Distribution Line (Cost: P850 million) ▪ Feeder line/Water Services Expansion (Cost: P264 million) ▪ Mainline Replacement Project (Cost: P105 milion) ▪ NRW Reduction Program (Cost: P16 million) ▪ Sewerage Treatment Plant (Cost: P339 million)	▪ Water Supply Systems (Artesian Wells, Reservoirs, Pumping Stations and Conduits) (Cost: P39 million) ▪ Implementation of the National Sewerage and Septage Management Program (NSSMP) (Cost: P177 million) ▪ Construction of Bulk water supply receiving line (50 MLD from PrimeWater) (Cost: P580 million) ▪ Infiltration Gallery for Dumalon Water Source (Cost: P4.8 million) ▪ Implementation of NRW Reduction Program (Pipe replacement Phase 1) (Cost: P102 million) ▪ Implementation of NRW Reduction Program (Pipe replacement Phase 2) (Cost: P590 million) ▪ Pamucutan-Ayala Pipelaying (Cost: P12 million) ▪ Construction/Rehabilitation/ Improvement of Mangusu Water System (Cost: P8.7 million) ▪ Water system at Dulian-Cabatangan (Cost: P7.8 million) ▪ Feeder line/Water Services Expansion (Cost: P10 million) ▪ Rehabilitation of Raw Water Transmission Line of ZCWD WTP (Cost: P106.2 million) ▪ Installation of AR, Blow-off in ZCWD Pipeline Network (Cost: P12.6 million)
Reform Agenda No. 6: Enabling Access to Funding and Financing	▪ Implement the UFF in the sector in accordance with the PWSSMP ▪ Review and improve LWUA financing policies ▪ Propose and implement increased capitalization of LWUA	▪ Water Demand Management Program ▪ Materials Recovery Facility for Every Barangay ▪ Sanitary Landfill ▪ WinS (WaSH in Schools)	▪ Transboundry water supply: Malayal River in the municipality of Sibuco, Zamboanga del Norte

	▪ Develop and implement a program to train and assist WSPs and LGUs in accessing financing ▪ Develop and adopt policies to require GFIs to offer more flexible terms ▪ Expand the funding/and coverage of NSSMP ▪ Explore other fund/financing sources	▪ Zero Open Defecation	▪ Transboundry water supply: Lakewood in Zamboanga del Sur ▪ Septage Treatment Plant/ Septage Management Plan ▪ Network expansion: Pipelaying of 40 kms pipe ▪ Development of Watershed Security Plan ▪ Integrated Water Resource Management ▪ Implementation of Water Safety Plan ▪ Water demand management program including Water Audit ▪ Wins (WASH in Schools) ▪ Zero Open Defecation ▪ Robust Decision Making – XLRM ▪ Sanitation and Septage Management ▪ Ecosystems Based Analysis and Assessment ▪ Results-Based Monitoring ▪ Emergency Response Planning ▪ Vulnerability Assessment in relation to Climate Change Adaptation ▪ Conflict Resolution and Management ▪ Basic Negotiation Skills ▪ Computer Software System for Data Analysis
Reform Agenda No. 7: Managing Data and Information	▪ Roll out and promote use of the PWSSMP database; Train/turnover regional data handling and monitoring to NEDA ROs ▪ Formulate Guidelines and Framework for the Harmonization and integration of WSS data ▪ Create Management Information System (MIS) Division at Apex Body ▪ Establish WSS Data Center at Apex Body ▪ Develop and deploy comprehensive WSS information System (that is building on existing WSS-related databases, such as PWSSMP database, NWRB Listing Tubig, WD data from LWUA, WS-related data from DILG, Sanitation-related data	▪ None	▪ None

	from DOH and DPWH, etc. as well as integrating with WSS related data sources such as PSA, DPWH BRS, etc. ▪ Develop and streamline programs for the establishment of baseline data (e.g., pertaining to SDG, coverage, and other relevant indicators) ▪ Completely and efficiently roll out existing WS Information System at NWRB, with supporting funding ▪ Roll out and train Apex Body and data custodians on WSS Information System ▪ Draft law compelling data custodians to timely and regularly enter and upload WSS related data		
Reform Agenda No. 8: Driving Research and Development	▪ Create Research and Development (R&D) Division at Apex Body ▪ Create Division at Apex Body to be responsible in the review and approval of WSS related technologies ▪ Build capacity of Division responsible in the review and approval of WSS related technologies ▪ Establish improved accreditation process of WSS-related new technologies ▪ Conduct R&D Studies (i.e., tie-up with academe, WSS partners and experts) ▪ Roll out studies approved for implementation ▪ Establish and implement government financial support on local WSS-related intentions ▪ Tap local investors and scientist with attractive government ▪ Develop and adopt advance infrastructure design construction methodology solutions ▪ Develop and deploy comprehensive WSS Information System	▪ None	▪ None

Annex 11: Population Projections used in WEAP Analysis

Demand Site Annual Activity Level

Levels, All Branches, Branch: Demand Sites and Catchments, Levels: 2, Scenario: No Action

	-->	1.50%																																
	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
ZAM Central Area\Baliwasan (N/A)	8,687	8,818	8,950	9,084	9,220	9,359	9,499	9,642	9,786	9,933	10,082	10,233	10,387	10,542	10,701	10,861	11,024	11,189	11,357	11,528	11,701	11,876	12,054	12,235	12,419	12,605	12,794	12,986	13,181	13,378	13,579	13,783	13,989	14,199	14,412
ZAM Central Area\Bar Zone 1 (N/A)	1,274	1,293	1,313	1,333	1,353	1,373	1,393	1,414	1,436	1,457	1,479	1,501	1,524	1,547	1,570	1,593	1,617	1,641	1,666	1,691	1,716	1,742	1,768	1,795	1,822	1,849	1,877	1,905	1,934	1,963	1,992	2,022	2,052	2,083	2,114
ZAM Central Area\Bar Zone 2 (N/A)	947	961	976	990	1,005	1,020	1,035	1,051	1,067	1,083	1,099	1,115	1,132	1,149	1,166	1,184	1,202	1,220	1,238	1,257	1,275	1,295	1,314	1,334	1,354	1,374	1,395	1,416	1,437	1,458	1,480	1,502	1,525	1,548	1,571
ZAM Central Area\Bar Zone 3 (N/A)	1,211	1,229	1,247	1,266	1,285	1,304	1,324	1,344	1,364	1,384	1,405	1,426	1,447	1,469	1,491	1,514	1,536	1,559	1,583	1,606	1,630	1,655	1,680	1,705	1,731	1,757	1,783	1,810	1,837	1,864	1,892	1,921	1,949	1,979	2,008
ZAM Central Area\Bar Zone 4 (N/A)	1,454	1,476	1,498	1,520	1,543	1,566	1,590	1,613	1,638	1,662	1,687	1,712	1,738	1,764	1,791	1,817	1,845	1,872	1,900	1,929	1,958	1,987	2,017	2,047	2,078	2,109	2,141	2,173	2,206	2,239	2,272	2,306	2,341	2,376	2,412
ZAM Central Area\Camino Nuevo (N/A)	2,381	2,417	2,453	2,490	2,527	2,565	2,604	2,643	2,682	2,723	2,763	2,805	2,847	2,890	2,933	2,977	3,022	3,067	3,113	3,160	3,207	3,255	3,304	3,354	3,404	3,455	3,507	3,559	3,613	3,667	3,722	3,778	3,834	3,892	3,950
ZAM Central Area\Canelar (N/A)	6,215	6,309	6,403	6,499	6,597	6,696	6,796	6,898	7,002	7,107	7,213	7,321	7,431	7,543	7,656	7,771	7,887	8,006	8,126	8,248	8,371	8,497	8,624	8,754	8,885	9,018	9,154	9,291	9,430	9,572	9,715	9,861	10,009	10,159	10,311
ZAM Central Area\Pasonanca (N/A)	18,825	19,107	19,394	19,685	19,980	20,280	20,584	20,893	21,206	21,524	21,847	22,175	22,508	22,845	23,188	23,536	23,889	24,247	24,611	24,980	25,355	25,735	26,121	26,513	26,910	27,314	27,724	28,140	28,562	28,990	29,425	29,866	30,314	30,769	31,231
ZAM Central Area\Santa Maria (N/A)	16,197	16,440	16,687	16,937	17,191	17,449	17,711	17,977	18,246	18,520	18,798	19,080	19,366	19,656	19,951	20,250	20,554	20,863	21,175	21,493	21,816	22,143	22,475	22,812	23,154	23,502	23,854	24,212	24,575	24,944	25,318	25,698	26,083	26,474	26,871
ZAM Central Area\Santa Nino (N/A)	2,784	2,825	2,868	2,911	2,954	2,999	3,044	3,089	3,136	3,183	3,231	3,279	3,328	3,378	3,429	3,480	3,532	3,585	3,639	3,694	3,749	3,805	3,862	3,920	3,979	4,039	4,099	4,161	4,223	4,287	4,351	4,416	4,483	4,550	4,618
ZAM East Coast\Boalan (N/A)	2,328	2,363	2,398	2,434	2,471	2,508	2,545	2,584	2,622	2,662	2,702	2,742	2,783	2,825	2,867	2,910	2,954	2,998	3,043	3,089	3,135	3,182	3,230	3,279	3,328	3,378	3,428	3,480	3,532	3,585	3,639	3,693	3,749	3,805	3,862
ZAM East Coast\Cabaluay (N/A)	1,961	1,991	2,021	2,051	2,082	2,113	2,145	2,177	2,210	2,243	2,276	2,311	2,345	2,380	2,416	2,452	2,489	2,526	2,564	2,603	2,642	2,681	2,722	2,763	2,804	2,846	2,889	2,932	2,976	3,021	3,066	3,112	3,159	3,206	3,254
ZAM East Coast\Cacao (N/A)	290	294	298	303	307	312	317	321	326	331	336	341	346	352	357	362	368	373	379	384	390	396	402	408	414	420	427	433	439	446	453	460	466	473	481
ZAM East Coast\Divisoria (N/A)	5,454	5,535	5,618	5,703	5,788	5,875	5,963	6,053	6,143	6,236	6,329	6,424	6,520	6,618	6,718	6,818	6,921	7,024	7,130	7,237	7,345	7,455	7,567	7,681	7,796	7,913	8,032	8,152	8,274	8,398	8,524	8,652	8,782	8,914	9,048
ZAM East Coast\Guisao (N/A)	106	108	109	111	113	114	116	118	119	121	123	125	127	129	131	133	135	137	139	141	143	145	147	149	152	154	156	158	161	163	166	168	171	173	176
ZAM East Coast\Guiwan (N/A)	12,273	12,457	12,644	12,833	13,026	13,221	13,420	13,621	13,825	14,033	14,243	14,457	14,674	14,894	15,117	15,344	15,574	15,808	16,045	16,285	16,530	16,778	17,029	17,285	17,544	17,807	18,074	18,345	18,621	18,900	19,183	19,471	19,763	20,060	20,361
ZAM East Coast\Kasanyangan (N/A)	2,479	2,516	2,553	2,592	2,631	2,670	2,710	2,751	2,792	2,834	2,876	2,920	2,963	3,008	3,053	3,099	3,145	3,192	3,240	3,289	3,338	3,388	3,439	3,491	3,543	3,596	3,650	3,705	3,760	3,817	3,874	3,932	3,991	4,051	4,112
ZAM East Coast\Lamisahan (N/A)	449	456	463	470	477	484	491	498	506	513	521	529	537	545	553	561	570	578	587	596	605	614	623	632	642	652	661	671	681	692	702	712	723	734	745
ZAM East Coast\Lanzones (N/A)	337	342	348	353	358	364	369	375	380	386	392	397	403	409	416	422	428	435	441	448	454	461	468	475	482	490	497	504	512	520	527	535	543	552	560
ZAM East Coast\Laumayang (N/A)	332	337	342	347	353	358	363	369	374	380	386	391	397	403	409	415	422	428	434	441	448	454	461	468	475	482	489	497	504	512	519	527	535	543	551
ZAM East Coast\Lumbangan (N/A)	763	774	786	798	810	822	834	847	859	872	885	899	912	926	940	954	968	983	997	1,012	1,027	1,043	1,058	1,074	1,090	1,107	1,123	1,140	1,157	1,175	1,192	1,210	1,228	1,247	1,266
ZAM East Coast\Mampang (N/A)	2,119	2,151	2,183	2,216	2,249	2,283	2,317	2,352	2,387	2,423	2,459	2,496	2,533	2,571	2,610	2,649	2,689	2,729	2,770	2,812	2,854	2,897	2,940	2,984	3,029	3,074	3,120	3,167	3,215	3,263	3,312	3,362	3,412	3,463	3,515
ZAM East Coast\Pasobolong (N/A)	1,388	1,409	1,430	1,452	1,474	1,496	1,518	1,541	1,564	1,587	1,611	1,635	1,660	1,685	1,710	1,736	1,762	1,788	1,815	1,842	1,870	1,898	1,926	1,955	1,985	2,014	2,045	2,075	2,107	2,138	2,170	2,203	2,236	2,269	2,303
ZAM East Coast\Putik (N/A)	10,045	10,195	10,348	10,504	10,661	10,821	10,983	11,148	11,315	11,485	11,657	11,832	12,010	12,190	12,373	12,558	12,747	12,938	13,132	13,329	13,529	13,732	13,938	14,147	14,359	14,574	14,793	15,015	15,240	15,469	15,701	15,936	16,175	16,418	16,664
ZAM East Coast\Rio Hondo (N/A)	368	374	379	385	391	396	402	408	415	421	427	434	440	447	453	460	467	474	481	488	496	503	511	518	526	534	542	550	558	567	575	584	593	602	611
ZAM East Coast\Sangali (N/A)	2,569	2,607	2,646	2,686	2,726	2,767	2,809	2,851	2,894	2,937	2,981	3,026	3,071	3,117	3,164	3,211	3,260	3,308	3,358	3,408	3,460	3,511	3,564	3,618	3,672	3,727	3,783	3,840	3,897	3,956	4,015	4,075	4,136	4,198	4,261
ZAM East Coast\Santa Barbara (N/A)	656	666	676	686	697	707	718	728	739	750	762	773	785	796	808	820	833	845	858	871	884	897	911	924	938	952	966	981	996	1,011	1,026	1,041	1,057	1,073	1,089
ZAM East Coast\Santa Catalina (N/A)	4,747	4,818	4,890	4,963	5,038	5,113	5,190	5,268	5,347	5,427	5,509	5,591	5,675	5,760	5,847	5,934	6,023	6,114	6,205	6,299	6,393	6,489	6,586	6,685	6,785	6,887	6,990	7,095	7,202	7,310	7,419	7,531	7,644	7,758	7,875
ZAM East Coast\Talon Talon (N/A)	12,701	12,891	13,085	13,281	13,480	13,682	13,888	14,096	14,307	14,522	14,740	14,961	15,185	15,413	15,644	15,879	16,117	16,359	16,604	16,853	17,106	17,363	17,623	17,888	18,156	18,428	18,705	18,985	19,270	19,559	19,852	20,150	20,452	20,759	21,071
ZAM East Coast\Tetuan (N/A)	18,730	19,011	19,296	19,586	19,880	20,178	20,480	20,788	21,099	21,416	21,737	22,063	22,394	22,730	23,071	23,417	23,768	24,125	24,487	24,854	25,227	25,605	25,989	26,379	26,775	27,176	27,584	27,998	28,418	28,844	29,277	29,716	30,162	30,614	31,073
ZAM East Coast\Tictapul (N/A)	433	439	446	452	459	466	473	480	487	495	502	509	517	525	533	541	549	557	565	574	583	591	600	609	618	628	637	647	656	666	676	686	696	707	718
ZAM East Coast\Tolosa (N/A)	513	521	528	536	544	553	561	569	578	587	595	604	613	623	632	641	651	661	671	681	691	701	712	722	733	744	755	767	778	790	802	814	826	838	851
ZAM East Coast\Tugbunan (N/A)	6,741	6,842	6,944	7,049	7,154	7,262	7,371	7,481	7,593	7,707	7,823	7,940	8,059	8,180	8,303	8,427	8,554	8,682	8,812	8,944	9,079	9,215	9,353	9,493	9,636	9,780	9,927	10,076	10,227	10,380	10,536	10,694	10,855	11,017	11,183
ZAM East Coast\Vitali (N/A)	694	704	715	725	736	747	758	770	781	793	805	817	829	842	854	867	880	893	907	920	934	948	963	977	992	1,006	1,022	1,037	1,052	1,068	1,084	1,101	1,117	1,134	1,151
ZAM East Coast\Zambowood (N/A)	2,302	2,336	2,371	2,407	2,443	2,480	2,517	2,555	2,593	2,632	2,671	2,711	2,752	2,793	2,835	2,878	2,921	2,965	3,009	3,054	3,100	3,147	3,194	3,242	3,290	3,340	3,390	3,441	3,492	3,545	3,598	3,652	3,707	3,762	3,819
ZAM West Coast\Ayala (N/A)	5,202	5,280	5,359	5,440	5,521	5,604	5,688	5,774	5,860	5,948	6,037	6,128	6,220	6,313	6,408	6,504	6,602	6,701	6,801	6,903	7,007	7,112	7,218	7,327	7,437	7,548	7,661	7,776	7,893	8,011	8,132	8,254	8,377	8,503	8,631
ZAM West Coast\Baluno (N/A)	292	296	301	305	310	315	319	324	329	334	339	344	349	354	360	365	371	376	382	387	393	399	405	411	417	424	430	437	443	450	456	463	470	477	484
ZAM West Coast\Cabatangan (N/A)	5,327	5,407	5,488	5,570	5,654	5,739	5,825	5,912	6,001	6,091	6,182	6,275	6,369	6,465	6,562	6,660	6,760	6,861	6,964	7,069	7,175	7,283	7,392	7,503	7,615	7,729	7,845	7,963	8,082	8,204	8,327	8,452	8,578	8,707	8,838
ZAM West Coast\Calarian (N/A)	11,370	11,540	11,713	11,889	12,067	12,248	12,432	12,619	12,808	13,000	13,195	13,393	13,594	13,798	14,005	14,215	14,428	14,644	14,864	15,087	15,313	15,543	15,776	16,013	16,253	16,497	16,744	16,995	17,250	17,509	17,772	18,038	18,309	18,584	18,862
ZAM West Coast\Campo Islam (N/A)	1,409	1,430	1,452	1,473	1,496	1,518	1,541	1,564	1,587	1,611	1,635	1,660	1,685	1,710	1,736	1,762	1,788	1,815	1,842	1,870	1,898	1,926	1,955	1,984	2,014	2,044	2,075	2,106	2,138	2,170	2,202	2,235	2,269	2,303	2,338
ZAM West Coast\Capisan (N/A)	308	312	317	322	327	332	336	342	347	352	357	362	368	373	379	385	391	396	402	408	414	421	427	433	440	446	453	460	467	474	481	488	496	503	511
ZAM West Coast\Cawit (N/A)	1,706	1,732	1,758	1,784	1,811	1,838	1,866	1,894	1,922	1,951	1,980	2,010	2,040	2,071	2,102	2,133	2,165	2,198	2,231	2,264	2,298	2,333	2,368	2,403	2,439	2,476	2,513	2,551	2,589	2,628	2,667	2,707	2,748	2,789	2,831
ZAM West Coast\Dulian (N/A)	109	110	112	114	116	117	119	121	123	124	126	128	130	132	134	136	138	140	142	144	147	149	151	153	156	158	160	163	165	168	170	173	175	178	181
ZAM West Coast\La Paz (N/A)	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
ZAM West Coast\Labuan (N/A)	838	851	863	876	890	903	916	930	944	958	973	987	1,002	1,017	1,032	1,048	1,064	1,080	1,096	1,112	1,129	1,146	1,163	1,180	1,198	1,216	1,234	1,253	1,272	1,291	1,310	1,330	1,350	1,370	1,390
ZAM West Coast\Lunzuran (N/A)	2,642	2,682	2,722	2,763	2,805	2,847	2,889	2,933	2,977	3,021	3,067	3,113	3,159	3,207	3,255	3,304	3,353	3,403	3,454	3,506	3,559	3,612	3,666	3,721	3,777	3,834	3,891	3,950	4,009	4,069	4,130	4,192	4,255	4,319	4,384
ZAM West Coast\Maasin (N/A)	921	934	948	963	977	992	1,007	1,022	1,037	1,053	1,068	1,084	1,101	1,117	1,134	1,151	1,168	1,186	1,204	1,222	1,240	1,259	1,277	1,297	1,316	1,336	1,356	1,376	1,397	1,418	1,439	1,461	1,483	1,505	1,527
ZAM West Coast\Malagutay (N/A)	4,245	4,309	4,373	4,439	4,506	4,573	4,642	4,711	4,782	4,854	4,927	5,000	5,076	5,152	5,229	5,307	5,387	5,468	5,550	5,633	5,718	5,803	5,890	5,979	6,068	6,159	6,252	6,346	6,441	6,537	6,635	6,735	6,836	6,939	7,043
ZAM West Coast\Pamucutan (N/A)	254	257	261	265	269	273	277	281	286	290	294	299	303	308	312	317	322	327	331	336	341	347	352	357	362	368	373	379	385	390	396	402	408	414	421
ZAM West Coast\Patalon (N/A)	335	340	345	350	356	361	366	372	377	383	389	395	401	407	413	419	425	432	438	445	451	458	465	472	479	486	493	501	508	516	524	532	540	548	556
ZAM West Coast\Recodo (N/A)	2,008	2,038	2,069	2,100	2,131	2,163	2,196	2,229	2,262	2,296	2,331	2,365	2,401	2,437	2,474	2,511	2,548	2,587	2,625	2,665	2,705	2,745	2,786	2,828	2,871	2,914	2,957	3,002	3,047	3,093	3,139	3,186	3,234	3,282	3,332
ZAM West Coast\San Jose Cawa (N/A)	2,891	2,934	2,978	3,023	3,068	3,114	3,161	3,208	3,256	3,305	3,355	3,405	3,456	3,508	3,561	3,614	3,668	3,723	3,779	3,836	3,893	3,952	4,011	4,071	4,132	4,194	4,257	4,321	4,386	4,452	4,518	4,586	4,655	4,725	4,796
ZAM West Coast\San Jose Gusu (N/A)	7,784	7,901	8,019	8,140	8,262	8,386	8,512	8,639	8,769	8,900	9,034	9,169	9,307	9,446	9,588	9,732	9,878	10,026	10,177	10,329	10,484	10,641	10,801	10,963	11,127	11,294	11,464	11,636	11,810	11,987	12,167	12,350	12,535	12,723	12,914
ZAM West Coast\San Roque (N/A)	15,787	16,024	16,265	16,508	16,756	17,007	17,263	17,521	17,784	18,051	18,322	18,597	18,876	19,159	19,446	19,738	20,034	20,334	20,639	20,949	21,263	21,582	21,906	22,235	22,568	22,907	23,250	23,599	23,953	24,312	24,677	25,047	25,423	25,804	26,191
ZAM West Coast\Sinunoc (N/A)	7,466	7,578	7,692	7,807	7,924	8,043	8,164	8,286	8,410	8,536	8,665	8,794	8,926	9,060	9,196	9,334	9,474	9,616	9,761	9,907	10,056	10,206	10,359	10,515	10,673	10,833	10,995	11,160	11,327	11,497	11,670	11,845	12,023	12,203	12,386
ZAM West Coast\Talisayan (N/A)	432	439	445	452	459	466	473	480	487	494	502	509	517	525	533	541	549	557	565	574	582	591	600	609	618	627	637	646	656	666	676	686	696	707	717
ZAM West Coast\Tulungatung (N/A)	2,384	2,420	2,456	2,493	2,531	2,569	2,607	2,646	2,686	2,726	2,767	2,809	2,851	2,893	2,937	2,981	3,026	3,071	3,117	3,164	3,211	3,259	3,308	3,358	3,408	3,459	3,511	3,564	3,617	3,672	3,727	3,783	3,839	3,897	3,955
ZAM West Coast\Tumaga (N/A)	17,298	17,558	17,821	18,088	18,360	18,635	18,915	19,198	19,486	19,779	20,075	20,376	20,682	20,992	21,307	21,627	21,951	22,280	22,615	22,954	23,298	23,648	24,002	24,362	24,728	25,099	25,475	25,857	26,245	26,639	27,038	27,444	27,856	28,273	28,698

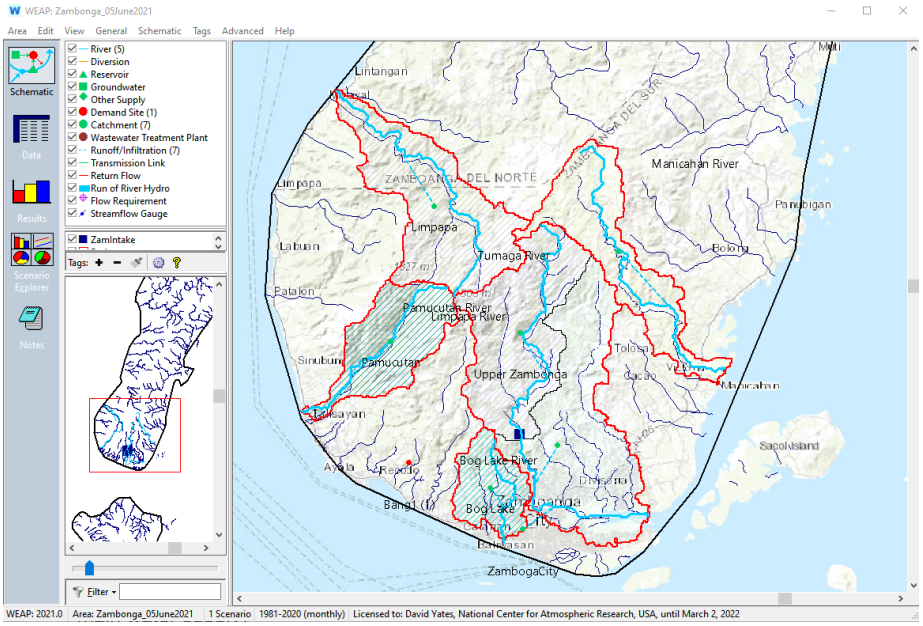
Demand Site Annual Activity Level

Levels, All Branches, Branch: Demand Sites and Catchments, Levels: 2, Scenario: No Action

	-->	3.00%																																	
	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
ZAM Central Area\Baliwasan (N/A)	8,687	8,818	8,950	9,084	9,220	9,497	9,782	10,075	10,378	10,689	11,010	11,340	11,680	12,031	12,391	12,763	13,146	13,540	13,947	14,365	14,796	15,240	15,697	16,168	16,653	17,153	17,667	18,197	18,743	19,305	19,885	20,481	21,096	21,728	22,380
ZAM Central Area\Bar Zone 1 (N/A)	1,274	1,293	1,313	1,333	1,353	1,393	1,435	1,478	1,522	1,568	1,615	1,664	1,713	1,765	1,818	1,872	1,928	1,986	2,046	2,107	2,170	2,236	2,303	2,372	2,443	2,516	2,592	2,669	2,750	2,832	2,917	3,004	3,095	3,187	3,283
ZAM Central Area\Bar Zone 2 (N/A)	947	961	976	990	1,005	1,035	1,066	1,098	1,131	1,165	1,200	1,236	1,273	1,311	1,351	1,391	1,433	1,476	1,520	1,566	1,613	1,661	1,711	1,762	1,815	1,870	1,926	1,984	2,043	2,104	2,168	2,233	2,300	2,368	2,440
ZAM Central Area\Bar Zone 3 (N/A)	1,211	1,229	1,247	1,266	1,285	1,323	1,363	1,404	1,446	1,490	1,534	1,580	1,628	1,676	1,727	1,779	1,832	1,887	1,943	2,002	2,062	2,124	2,187	2,253	2,321	2,390	2,462	2,536	2,612	2,690	2,771	2,854	2,940	3,028	3,119
ZAM Central Area\Bar Zone 4 (N/A)	1,454	1,476	1,498	1,520	1,543	1,589	1,637	1,686	1,737	1,789	1,842	1,898	1,954	2,013	2,074	2,136	2,200	2,266	2,334	2,404	2,476	2,550	2,627	2,705	2,787	2,870	2,956	3,045	3,136	3,230	3,327	3,427	3,530	3,636	3,745
ZAM Central Area\Camino Nuevo (N/A)	2,381	2,417	2,453	2,490	2,527	2,603	2,681	2,762	2,844	2,930	3,018	3,108	3,201	3,298	3,396	3,498	3,603	3,711	3,823	3,937	4,056	4,177	4,302	4,432	4,565	4,701	4,842	4,988	5,137	5,292	5,450	5,614	5,782	5,956	6,134
ZAM Central Area\Canelar (N/A)	6,215	6,309	6,403	6,499	6,597	6,795	6,999	7,209	7,425	7,648	7,877	8,113	8,357	8,607	8,866	9,132	9,406	9,688	9,978	10,278	10,586	10,904	11,231	11,568	11,915	12,272	12,640	13,019	13,410	13,812	14,227	14,653	15,093	15,546	16,012
ZAM Central Area\Pasonanca (N/A)	18,825	19,107	19,394	19,685	19,980	20,580	21,197	21,833	22,488	23,163	23,857	24,573	25,310	26,070	26,852	27,657	28,487	29,342	30,222	31,129	32,062	33,024	34,015	35,035	36,086	37,169	38,284	39,433	40,616	41,834	43,089	44,382	45,713	47,085	48,497
ZAM Central Area\Santa Maria (N/A)	16,197	16,440	16,687	16,937	17,191	17,707	18,238	18,785	19,349	19,929	20,527	21,143	21,777	22,431	23,104	23,797	24,511	25,246	26,003	26,783	27,587	28,415	29,267	30,145	31,049	31,981	32,940	33,929	34,946	35,995	37,075	38,187	39,332	40,512	41,728
ZAM Central Area\Santa Nino (N/A)	2,784	2,825	2,868	2,911	2,954	3,043	3,134	3,228	3,325	3,425	3,528	3,634	3,743	3,855	3,971	4,090	4,212	4,339	4,469	4,603	4,741	4,883	5,030	5,181	5,336	5,496	5,661	5,831	6,006	6,186	6,371	6,563	6,760	6,962	7,171
ZAM East Coast\Boalan (N/A)	2,328	2,363	2,398	2,434	2,471	2,545	2,621	2,700	2,781	2,864	2,950	3,039	3,130	3,224	3,320	3,420	3,523	3,628	3,737	3,849	3,965	4,084	4,206	4,332	4,462	4,596	4,734	4,876	5,022	5,173	5,328	5,488	5,653	5,822	5,997
ZAM East Coast\Cabaluay (N/A)	1,961	1,991	2,021	2,051	2,082	2,144	2,209	2,275	2,343	2,413	2,486	2,560	2,637	2,716	2,798	2,882	2,968	3,057	3,149	3,243	3,341	3,441	3,544	3,651	3,760	3,873	3,989	4,109	4,232	4,359	4,490	4,624	4,763	4,906	5,053
ZAM East Coast\Cacao (N/A)	290	294	298	303	307	317	326	336	346	356	367	378	389	401	413	426	438	451	465	479	493	508	523	539	555	572	589	607	625	644	663	683	703	724	746
ZAM East Coast\Divisoria (N/A)	5,454	5,535	5,618	5,703	5,788	5,962	6,141	6,325	6,515	6,710	6,912	7,119	7,332	7,552	7,779	8,012	8,253	8,500	8,755	9,018	9,288	9,567	9,854	10,150	10,454	10,768	11,091	11,424	11,766	12,119	12,483	12,857	13,243	13,640	14,050
ZAM East Coast\Guisao (N/A)	106	108	109	111	113	116	119	123	127	130	134	138	143	147	151	156	160	165	170	175	181	186	192	197	203	209	216	222	229	236	243	250	257	265	273
ZAM East Coast\Guiwan (N/A)	12,273	12,457	12,644	12,833	13,026	13,417	13,819	14,234	14,661	15,101	15,554	16,020	16,501	16,996	17,506	18,031	18,572	19,129	19,703	20,294	20,903	21,530	22,176	22,841	23,526	24,232	24,959	25,708	26,479	27,273	28,092	28,934	29,802	30,696	31,617
ZAM East Coast\Kasanyangan (N/A)	2,479	2,516	2,553	2,592	2,631	2,710	2,791	2,875	2,961	3,050	3,141	3,235	3,332	3,432	3,535	3,641	3,751	3,863	3,979	4,098	4,221	4,348	4,478	4,613	4,751	4,894	5,041	5,192	5,347	5,508	5,673	5,843	6,019	6,199	6,385
ZAM East Coast\Lamisahan (N/A)	449	456	463	470	477	491	506	521	536	553	569	586	604	622	641	660	680	700	721	743	765	788	811	836	861	887	913	941	969	998	1,028	1,059	1,090	1,123	1,157
ZAM East Coast\Lanzones (N/A)	337	342	348	353	358	369	380	391	403	415	428	440	454	467	481	496	511	526	542	558	575	592	610	628	647	666	686	707	728	750	772	796	819	844	869
ZAM East Coast\Laumayang (N/A)	332	337	342	347	353	363	374	385	397	409	421	434	447	460	474	488	503	518	533	549	566	583	600	618	637	656	676	696	717	738	761	783	807	831	856
ZAM East Coast\Lumbangan (N/A)	763	774	786	798	810	834	859	885	911	939	967	996	1,026	1,056	1,088	1,121	1,154	1,189	1,225	1,261	1,299	1,338	1,378	1,420	1,462	1,506	1,551	1,598	1,646	1,695	1,746	1,798	1,852	1,908	1,965
ZAM East Coast\Mampang (N/A)	2,119	2,151	2,183	2,216	2,249	2,316	2,386	2,457	2,531	2,607	2,685	2,766	2,849	2,934	3,022	3,113	3,206	3,302	3,402	3,504	3,609	3,717	3,828	3,943	4,062	4,183	4,309	4,438	4,571	4,708	4,850	4,995	5,145	5,299	5,458
ZAM East Coast\Pasobolong (N/A)	1,388	1,409	1,430	1,452	1,474	1,518	1,563	1,610	1,659	1,708	1,760	1,812	1,867	1,923	1,980	2,040	2,101	2,164	2,229	2,296	2,365	2,436	2,509	2,584	2,661	2,741	2,824	2,908	2,996	3,085	3,178	3,273	3,371	3,473	3,577
ZAM East Coast\Putik (N/A)	10,045	10,195	10,348	10,504	10,661	10,981	11,310	11,650	11,999	12,359	12,730	13,112	13,505	13,910	14,328	14,757	15,200	15,656	16,126	16,610	17,108	17,621	18,150	18,694	19,255	19,833	20,428	21,041	21,672	22,322	22,992	23,681	24,392	25,124	25,877
ZAM East Coast\Rio Hondo (N/A)	368	374	379	385	391	402	414	427	440	453	466	480	495	510	525	541	557	574	591	609	627	646	665	685	706	727	748	771	794	818	842	868	894	921	948
ZAM East Coast\Sangali (N/A)	2,569	2,607	2,646	2,686	2,726	2,808	2,892	2,979	3,068	3,160	3,255	3,353	3,454	3,557	3,664	3,774	3,887	4,004	4,124	4,247	4,375	4,506	4,641	4,781	4,924	5,072	5,224	5,381	5,542	5,708	5,879	6,056	6,237	6,425	6,617
ZAM East Coast\Santa Barbara (N/A)	656	666	676	686	697	717	739	761	784	807	832	857	882	909	936	964	993	1,023	1,054	1,085	1,118	1,151	1,186	1,221	1,258	1,296	1,335	1,375	1,416	1,458	1,502	1,547	1,594	1,641	1,691
ZAM East Coast\Santa Catalina (N/A)	4,747	4,818	4,890	4,963	5,038	5,189	5,345	5,505	5,670	5,840	6,016	6,196	6,382	6,573	6,771	6,974	7,183	7,398	7,620	7,849	8,084	8,327	8,577	8,834	9,099	9,372	9,653	9,943	10,241	10,548	10,865	11,191	11,526	11,872	12,228
ZAM East Coast\Talon Talon (N/A)	12,701	12,891	13,085	13,281	13,480	13,885	14,301	14,730	15,172	15,627	16,096	16,579	17,076	17,589	18,116	18,660	19,220	19,796	20,390	21,002	21,632	22,281	22,949	23,638	24,347	25,077	25,829	26,604	27,402	28,225	29,071	29,943	30,842	31,767	32,720
ZAM East Coast\Tetuan (N/A)	18,730	19,011	19,296	19,586	19,880	20,476	21,090	21,723	22,375	23,046	23,737	24,449	25,183	25,938	26,716	27,518	28,343	29,194	30,070	30,972	31,901	32,858	33,844	34,859	35,905	36,982	38,091	39,234	40,411	41,623	42,872	44,158	45,483	46,847	48,253
ZAM East Coast\Tictapul (N/A)	433	439	446	452	459	473	487	502	517	532	548	565	582	599	617	635	655	674	694	715	737	759	782	805	829	854	880	906	933	961	990	1,020	1,050	1,082	1,114
ZAM East Coast\Tolosa (N/A)	513	521	528	536	544	561	578	595	613	631	650	670	690	710	732	754	776	800	824	848	874	900	927	955	983	1,013	1,043	1,075	1,107	1,140	1,174	1,209	1,246	1,283	1,322
ZAM East Coast\Tugbunan (N/A)	6,741	6,842	6,944	7,049	7,154	7,369	7,590	7,818	8,052	8,294	8,543	8,799	9,063	9,335	9,615	9,903	10,200	10,506	10,821	11,146	11,481	11,825	12,180	12,545	12,921	13,309	13,708	14,120	14,543	14,979	15,429	15,892	16,368	16,860	17,365
ZAM East Coast\Vitali (N/A)	694	704	715	725	736	758	781	805	829	854	879	905	933	961	989	1,019	1,050	1,081	1,114	1,147	1,181	1,217	1,253	1,291	1,330	1,370	1,411	1,453	1,497	1,542	1,588	1,635	1,684	1,735	1,787
ZAM East Coast\Zambowood (N/A)	2,302	2,336	2,371	2,407	2,443	2,516	2,592	2,670	2,750	2,832	2,917	3,005	3,095	3,188	3,283	3,382	3,483	3,588	3,695	3,806	3,920	4,038	4,159	4,284	4,412	4,545	4,681	4,822	4,966	5,115	5,269	5,427	5,589	5,757	5,930
ZAM West Coast\Ayala (N/A)	5,202	5,280	5,359	5,440	5,521	5,687	5,858	6,033	6,214	6,401	6,593	6,791	6,994	7,204	7,420	7,643	7,872	8,108	8,352	8,602	8,860	9,126	9,400	9,682	9,972	10,272	10,580	10,897	11,224	11,561	11,908	12,265	12,633	13,012	13,402
ZAM West Coast\Baluno (N/A)	292	296	301	305	310	319	329	339	349	359	370	381	393	404	417	429	442	455	469	483	497	512	528	543	560	577	594	612	630	649	668	688	709	730	752
ZAM West Coast\Cabatangan (N/A)	5,327	5,407	5,488	5,570	5,654	5,824	5,998	6,178	6,364	6,555	6,751	6,954	7,162	7,377	7,599	7,826	8,061	8,303	8,552	8,809	9,073	9,345	9,626	9,914	10,212	10,518	10,834	11,159	11,493	11,838	12,193	12,559	12,936	13,324	13,724
ZAM West Coast\Calarian (N/A)	11,370	11,540	11,713	11,889	12,067	12,429	12,802	13,186	13,582	13,989	14,409	14,841	15,287	15,745	16,218	16,704	17,205	17,721	18,253	18,801	19,365	19,946	20,544	21,160	21,795	22,449	23,122	23,816	24,531	25,266	26,024	26,805	27,609	28,438	29,291
ZAM West Coast\Campo Islam (N/A)	1,409	1,430	1,452	1,473	1,496	1,540	1,587	1,634	1,683	1,734	1,786	1,839	1,894	1,951	2,010	2,070	2,132	2,196	2,262	2,330	2,400	2,472	2,546	2,622	2,701	2,782	2,866	2,952	3,040	3,131	3,225	3,322	3,422	3,524	3,630
ZAM West Coast\Capisan (N/A)	308	312	317	322	327	336	347	357	368	379	390	402	414	426	439	452	466	480	494	509	524	540	556	573	590	608	626	645	664	684	704	725	747	770	793
ZAM West Coast\Cawit (N/A)	1,706	1,732	1,758	1,784	1,811	1,865	1,921	1,979	2,038	2,099	2,162	2,227	2,294	2,363	2,434	2,507	2,582	2,659	2,739	2,821	2,906	2,993	3,083	3,176	3,271	3,369	3,470	3,574	3,681	3,792	3,906	4,023	4,143	4,268	4,396
ZAM West Coast\Dulian (N/A)	109	110	112	114	116	119	123	126	130	134	138	142	146	151	155	160	165	170	175	180	185	191	197	203	209	215	221	228	235	242	249	257	264	272	280
ZAM West Coast\La Paz (N/A)	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3
ZAM West Coast\Labuan (N/A)	838	851	863	876	890	916	944	972	1,001	1,031	1,062	1,094	1,127	1,161	1,195	1,231	1,268	1,306	1,346	1,386	1,427	1,470	1,514	1,560	1,607	1,655	1,704	1,756	1,808	1,863	1,918	1,976	2,035	2,096	2,159
ZAM West Coast\Lunzuran (N/A)	2,642	2,682	2,722	2,763	2,805	2,889	2,975	3,065	3,157	3,251	3,349	3,449	3,553	3,659	3,769	3,882	3,999	4,119	4,242	4,369	4,500	4,635	4,774	4,918	5,065	5,217	5,374	5,535	5,701	5,872	6,048	6,230	6,417	6,609	6,807
ZAM West Coast\Maasin (N/A)	921	934	948	963	977	1,006	1,037	1,068	1,100	1,133	1,167	1,202	1,238	1,275	1,313	1,353	1,393	1,435	1,478	1,522	1,568	1,615	1,664	1,713	1,765	1,818	1,872	1,928	1,986	2,046	2,107	2,171	2,236	2,303	2,372
ZAM West Coast\Malagutay (N/A)	4,245	4,309	4,373	4,439	4,506	4,641	4,780	4,923	5,071	5,223	5,380	5,541	5,708	5,879	6,055	6,237	6,424	6,617	6,815	7,020	7,230	7,447	7,670	7,901	8,138	8,382	8,633	8,892	9,159	9,434	9,717	10,008	10,308	10,618	10,936
ZAM West Coast\Pamucutan (N/A)	254	257	261	265	269	277	285	294	303	312	321	331	341	351	362	372	384	395	407	419	432	445	458	472	486	501	516	531	547	563	580	598	616	634	653
ZAM West Coast\Patalon (N/A)	335	340	345	350	356	366	377	389	400	412	425	437	451	464	478	492	507	522	538	554	571	588	605	624	642	662	681	702	723	745	767	790	814	838	863
ZAM West Coast\Recodo (N/A)	2,008	2,038	2,069	2,100	2,131	2,195	2,261	2,329	2,399	2,471	2,545	2,621	2,700	2,781	2,864	2,950	3,039	3,130	3,224	3,321	3,420	3,523	3,629	3,737	3,849	3,965	4,084	4,206	4,333	4,463	4,596	4,734	4,876	5,023	5,173
ZAM West Coast\San Jose Cawa (N/A)	2,891	2,934	2,978	3,023	3,068	3,160	3,255	3,353	3,453	3,557	3,664	3,773	3,887	4,003	4,123	4,247	4,374	4,506	4,641	4,780	4,923	5,071	5,223	5,380	5,541	5,708	5,879	6,055	6,237	6,424	6,617	6,815	7,020	7,230	7,447
ZAM West Coast\San Jose Gusu (N/A)	7,784	7,901	8,019	8,140	8,262	8,510	8,765	9,028	9,299	9,578	9,865	10,161	10,466	10,780	11,103	11,436	11,779	12,133	12,497	12,872	13,258	13,656	14,065	14,487	14,922	15,369	15,831	16,305	16,795	17,298	17,817	18,352	18,902	19,470	20,054
ZAM West Coast\San Roque (N/A)	15,787	16,024	16,265	16,508	16,756	17,259	17,777	18,310	18,859	19,425	20,008	20,608	21,226	21,863	22,519	23,194	23,890	24,607	25,345	26,105	26,889	27,695	28,526	29,382	30,263	31,171	32,106	33,070	34,062	35,084	36,136	37,220	38,337	39,487	40,671
ZAM West Coast\Sinunoc (N/A)	7,466	7,578	7,692	7,807	7,924	8,162	8,407	8,659	8,919	9,186	9,462	9,746	10,038	10,339	10,649	10,969	11,298	11,637	11,986	12,345	12,716	13,097	13,490	13,895	14,312	14,741	15,183	15,639	16,108	16,591	17,089	17,602	18,130	18,674	19,234
ZAM West Coast\Talisayan (N/A)	432	439	445	452	459	473	487	501	517	532	548	564	581	599	617	635	654	674	694	715	736	759	781	805	829	854	879	906	933	961	990	1,019	1,050	1,081	1,114
ZAM West Coast\Tulungatung (N/A)	2,384	2,420	2,456	2,493	2,531	2,606	2,685	2,765	2,848	2,934	3,022	3,112	3,206	3,302	3,401	3,503	3,608	3,716	3,828	3,943	4,061	4,183	4,308	4,437	4,570	4,708	4,849	4,994	5,144	5,298	5,457	5,621	5,790	5,963	6,142
ZAM West Coast\Tumaga (N/A)	17,298	17,558	17,821	18,088	18,360	18,910	19,478	20,062	20,664	21,284	21,922	22,580	23,257	23,955	24,674	25,414	26,176	26,962	27,771	28,604	29,462	30,346	31,256	32,194	33,159	34,154	35,179	36,234	37,321	38,441	39,594	40,782	42,005	43,266	44,564

Annex 12: WEAP Training Scope of Work

For the Zamboanga Water Security Master Plan the WEAP decision support tool was used to explore the performance of the ZCWD water system in the context of the stated goals and objectives. WEAP is an integrated, scenario-based modelling tool that helps stakeholders manage water supply resources to meet often-competing demands from cities, industries, and farms, as well as consider long-neglected interests such as wildlife habitat and vulnerable communities. The ZCWD-WEAP model was built to represent the regional water resources system that includes the ZCWD service area. WEAP is transparent and user-friendly – and it is able to distill the growing complexity of water systems into an understandable manner. Users can see current conditions and then explore future scenarios to identify options for balancing environment and development concerns amid climate uncertainty.



Although the model is easy-to-use, there are inherent complexities in formulating a WEAP model to reflect the realities of the water system and requires some level of knowledge and skill to ensure the model can be effectively used. As a follow-on activity in support of the Water Security Plan, Dr. Yates will conduct five 2-hour WEAP trainings on the general use of the WEAP software and application of the ZCWD WEAP model. A User Manual will be created in order document the model and to allow trained staff to make modifications in order to carry out further water supply analysis.

Tasks:

- One training session (2-hours) as an introduction to WEAP utilizing the online tutorial example. This training is focused on trainees who have never used WEAP, if all trainees are familiar with WEAP this time will be allotted to training activities listed below.
- Conduct online training for ZCWD and Other “WEAPers”, based on 4, 2-hour hour online training blocks. Training would include both understanding of the basic ZCWD-WEAP modeling components and basic modifications to the ZCWD-WEAP model and interpretation of results.

- Create a ZCWD-WEAP user document that shows the important components of the model to help gain understanding and give direction on making changes to model assumptions, create alternative scenarios, create water system alternatives, etc.

Outputs:

- Understanding the components of a WEAP model including assumptions and scenarios.
- Training and increased level of understanding of the ZCWD-WEAP model and how it is used for water supply planning.
- The ability to make basic modifications to the ZCWD-WEAP model in order to carryout analysis and interpretation of results.
- ZCWD-WEAP User Manual.

It is anticipated all training and development of the User Manual can be carried out in approximately 8 weeks.

Annex 13: WSC Resolution to Adopt the Water Security Master Plan

"A RESOLUTION FOR THE ADOPTION OF THE ZAMBOANGA CITY WATER SECURITY MASTER PLAN (ZC-WSMP) AND ITS ENDORSEMENT TO THE ZAMBOANGA CITY COUNCIL THEREOF"

WHEREAS, the United Nations General Assembly, through Resolution A/64/292 of 2010, explicitly recognized access to safe and clean drinking water and sanitation as a human right that is essential for the full enjoyment for the full enjoyment of life and all human rights;

WHEREAS, Presidential Decree No. 856, otherwise known as the "Code on Sanitation of the Philippines" states that, the health of the people, being of paramount importance, all efforts of public services should be directed towards the protection and promotion of health;

WHEREAS, the City Government of Zamboanga proactively reinforces PD No. 856, the Philippine Clean Water Act of 2004 (RA 9275), Philippine Water Crisis Act of 1995 (RA 8041) and the Philippine Water Supply and Sanitation Master Plan;

WHEREAS, Ordinance No. 529, "The Environment Code of the City of Zamboanga" provides for inland water management in ensuring clean water supply, protection of underground water, water quality standards, monitoring and maintenance;

WHEREAS, the Forest Land Use Plan (FLUP) of Zamboanga City 2019-2027 strategized the protection, conservation and development of forest lands; including its watersheds and rivers systems in ensuring the sustainable supply of potable, domestic use and agricultural irrigation waters;

WHEREAS, the United States Agency for International Development (USAID) through its Strengthening Urban Resilience for Growth with Equity (SURGE) Project has been supporting the City Government of Zamboanga in strengthening and institutionalizing the city's initiatives on water and sanitation;

WHEREAS, the UNESCO states that "to achieve water security, we must protect vulnerable water systems, mitigate the impacts of water-related hazards such as floods and droughts, safeguard access to water functions and services and manage water resources in an integrated and equitable manner".

WHEREAS, the Zamboanga Peninsula Regional Development Plan 2017-2022 recognizes the inadequate supply of water in the region particularly in urban areas due to increasing population, growing economic activities associated with urbanization, and the impacts of climate change;

WHEREAS, the city has felt the adverse impacts of droughts in 2016 and 2019 that particularly compelled the main water service provider to implement water rationing due to significant decrease in drinking water production/supply;

WHEREAS, the adoption of a city-wide Water Demand Management (WDM) program is not only a potent solution to balance water supply and water demand, but, is also an alternative to preserve the available water resources for future generations by reusing grey/waste water for non-domestic purposes among other interventions;

WHEREAS, Executive Order No. BB-661-2021, "An Executive Order Creating the Zamboanga City Water Security Council (ZCWSC)" provides for the establishment of the ZCWSC and for the ZCWSC guide the design and development of the Water Security Master Plan for Zamboanga City;

WHEREAS, to appropriately address the perennial problem of (i) lack of and/or insufficient water supply, (ii) lack of and/or insufficient potential surface water sources, (iii) insufficient understanding on the science of water security, and (iv) lack of potential financing facilities and modalities for anticipated water sector infrastructure development projects; there is a need to design, develop and implement a Water Security Master Plan for Zamboanga City that will serve as the basis and guidance of subsequent water and sanitation programs, projects and activities, including watershed management given the impacts of climate change.

WHEREAS, this Council Resolution (EO) recognizes USAID SURGE's efforts in the completion of the Water Security Master Plan as one of the outcomes inherent with the creation of the Zamboanga City Water Security Council (ZCWSC) as per EO BC 661-2021.

AS IT IS HEREBY RESOLVED, We, the Council Members, the Council Chair, Co-Chair, and Vice Chair, do hereby promulgate the resolution, **"A RESOLUTION FOR THE ADOPTION OF THE ZAMBOANGA CITY WATER SECURITY MASTER PLAN (ZC-WSMP) AND ITS ENDORSEMENT TO THE ZAMBOANGA CITY COUNCIL THEREOF"**, to strategically address prevailing water security issues of the city as well as provide solutions, guidance, and directions for improving overall water security conditions.

Elements of the Water Security Master Plan for Zamboanga City

The four elements of water security serve as a summary of proposed activities necessary to attain "drought proofing" of the Zamboanga City Water District and to enhance the potential for service expansion to other areas. The four elements are essential and recommended to implement simultaneously:

(i) *Intensify NRW (non-revenue water) Reduction*. Aggressively pursue NRW reduction, prioritize programs with goals, objectives and metrics to reduce NRW to 30 percent within specified time period. The intensified NRW reduction is the lowest cost and most climate resilient option which is envisioned to increase water supply to customers.

(ii) *Immediate WDM (water demand management) Expansion*. Managing water demand ensures the ability of the water system to adequately serve customers in the event of inadequate water supply, making it an important element of being drought resilient.

(iii) *Extensive Stakeholder Engagement in the Planning Process*. The collaboration among the Zamboanga City LGU, Water Security Council, Local Water Utilities Administration, Department of Environment and Natural Resources, and other organizations is an essential component in participatory water planning process.

(iv) *Expand Water Supply Sources and Implement New Policies*. One of the essential components of water security is the diversification of water supply sources, including the effective implementation of policies to protect water sources. The enactment of policies to protect

groundwater, watershed and recharge zones are expected to enhance water supply, water quality and climate resiliency.

ADOPTED, during the Special Council Session in the City of Zamboanga, this _____ day of October, 2021

ATTY. ROMMEL AGAN
Vice Mayor, Zamboanga City
Chair, ZCWSC

LEONARDO REY VASQUEZ
General Manager, ZC Water District
Co-Chair, ZCWSC

ENGR. REYNALDO GONZALES
Officer, Office of City ENR
Vice-Chair and Secretariat, ZCWSC