CLIMATE CHANGE ADAPTATION FRAMEWORK

Mandaue City, Cebu

MANDAUE RESILIENCE NETWORK

#iamresilientmandaue

LUNGSOD NG MANDAUE
LALAWIGAN NG CEBU

DILG

PARTNERS FOR RESILIENCE

Cordaid

INSTITUTE FOR CLIMATE AND SUSTAINABLE CITIES

PHILIPPINE RED CROSS

Wetlands INTERNATIONAL

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

MANDAUE RESILIENCE NETWORK

#iamresilientmandaue

CLIMATE CHANGE ADAPTATION FRAMEWORK

Mandaue City, Cebu

CLIMATE CHANGE ADAPTATION FRAMEWORK (CCAF)

The CCAF is a 10-year climate planning and resource mobilization approach that promotes a multi-stakeholder and evidence-based approach to building resilience strategies that protect local resources and increase community resilience against the impacts of climate change and other aggravating natural and anthropogenic hazards. With the help of Partners for Resilience (2016– 2020), the CCAF supports LGUs through the following:

1. Complementing local planning processes. The CCAF is anchored on the understanding that climate-resilient planning leads to improved development planning. The tools used encourage evidence-based baseline data-gathering, climate change and disaster risk assessments and analysis, and strategy building based on localized priorities. It also provides guidance toward comprehensive integrated analysis that enables (eco)systems-wide programs to address vulnerability that can be assimilated across existing mandated plans.

2. Establishing multi-stakeholder cooperation platforms. The CCAF espouses a people-centered approach to planning, placing the voice of those highly vulnerable at the center of decision making. Bringing together government, civil society, academe, climate experts, private sector, and key livelihood/community sectors into the discussion ensures context-based action plans that are responsive to their immediate and long-term needs. This strategy guarantees a shared understanding of what needs to be done, which in return strengthens local ownership of formulated plans. Subsequently, it fosters conscious efforts and drive to develop and improve local capacities to increase the chances of successful execution.

3. Mobilizing resources for resilience action. The planning process is paired with resource mobilization strategies to secure resources that support program implementation.

The aim is to ensure that LGUs achieve a level of financial/resource security by maximizing the use of their Annual Investment Plans and supplementing this by accessing financing from provincial to national partners and other relevant financing institutions. Through engaging various stakeholders, LGUs also engage civil society and private sector partnerships as a means of leveraging interests, resources, and action to contribute to local development initiatives.

Mandaue City is the first City in Philippines that invested in an extensive process of community-based climate risk assessments that led to an in-depth understanding of the critical impacts of climate change for communities in the city, especially on their water resources and watersheds, economics through supply chain and informal settlers' families. Building upon the lessons from Surigao Municipalities through HIPADA and Guiuan, they also applied the CCAF approach in 2019 in cooperation with members of the Mandaue Resilience Network, the multi-stakeholder cooperation platform working on resilience and climate action. Mandaue Resilience Network is composed of Mandaue City Local Government Unit, University of the Philippines Cebu Center for Environmental Informatics (UP Cebu CENVI) and Member of Partners for Resilience Catholic Organization for Relief and Development Aid (Cordaid), Philippine Red Cross Cebu Chapter and Wetlands International together with other members of Technical Working Group for the development of LCCAP of Mandaue City such as DILG Mandaue, Mandaue Cebu Chambers of Commerce, other Civil Society Organizations in Mandaue City.

The Mandaue LCCAP was developed in view of the assessments and analysis from the CCAF and will be adopted by the LGU of Mandaue City.

MANDAUE
RESILIENCE
NETWORK
#iamresilientmandaue

I. INTRODUCTION

I. INTRODUCTION

Mandaue City is a first class, highly urbanized city in the island province of Cebu located in Region 7 of Central Visayas, Philippines. It is a coastal city located on the central-eastern region of Cebu with coordinates $10^{O}20'N$ $123^{O}56'E$. Neighboring borders are Mactan Island in the southwest coast where Lapu-Lapu City is found, and the Municipality of Consolacion to the north-east by the Camotes Sea, and to the west and south by Cebu City.

Land Use and Urbanization

In Cebu Island there are three independent cities namely: Cebu, Lapu-Lapu and Mandaue. These cities are not under a provincial supervision due to their status as Highly Urbanized Cities (HUCs) per Section 452 of Republic Act 7160 considering population and income, and for geographical and statistical purposes, these cities are grouped together under 6^{th} District of Cebu. Mandaue City forms a part of the Cebu Metropolitan area that has a total land area of 3,284.761 hectares (34.87 km^2). Based on the size of land area among Metro Cebu Local Government Units (LGUs), Mandaue City is the sixth smallest government unit with only 3.18% of the total land area of Metro Cebu, and less than 1% of the total land area of the Province of Cebu.

During the 2015 PSA census, a total population of 362,654 with 94,547 total households and a population density of 110 persons per hectare (10,000/km^2 or 26,000/sq mi) was recorded.

The urban transformation of Mandaue happened at the latter part of the 1960s, from a "dormitory town" of Cebu City as many student or worker migrants or transients stayed or settled in Mandaue to a commercial and manufacturer's location of business. Its urbanization pattern is described by planners as "finger stellar or a continuing spatial expansion radiating from the urban core, along the major arterial roads, directed towards

other barangays emerging as a secondary growth centers". Future development direction considered is multi-nodal urban form by providing outer circumferential road network where points of business activities are interconnected (CLUP 2019-2029). At present, all the 27 Barangays and the CSSEAZ are considered as urban Barangays. The City South Special Economic Administrative Zone (CSSEAZ) or the South Point was established in mid-1990s adding up to the list of total barangays in Mandaue City. *(CLUP Vol. 1, p.3, 6)*

Mandaue City's recent actual land utilization classification are residential – 983.912 has. (35.98%), commercial – 514.098 has. (18.80%), industrial – 349.38 has. (12.78%), institutional – 82.687 has. (3.02%), parks/playgrounds and other recreational spaces – 6 has. (0.22%), agriculture – 34.133 has. (1.25%), aquaculture and marine culture – 33.281 (1.22%), reclaimed areas – 184.614 has. (5.62%), foreshore land – 200.70 has. (6.11%), infrastructure/utilities (roads, waterway, rivers) – 220,742 has. (8.07%). In the span of 35 years, there is an increase of 771.168 has. There is no forestland land use in Mandaue.

Land elevation of Mandaue is described as less than 100 meters (330 feet) where 30% of the total land area is within 2-5% slope; 32% of the land area has a slope of 5-20%; and 37% of the total land area is within the 20-30 % slope.

Demographic Profile

Based on the PSA 2015 census, Mandaue has a total population of 362,654 with 94,547 total number of households and a population density of 110 persons per hectare. In 2015 PSA census, the topmost densely populated barangay was Mantuyong (482) and 21 barangays whose population reached 100 persons and more per hectare were Guizo (237), Cambaro (222), Labogon (218), Basak (212), Looc (189), Ibabao-Estancia (178), Alang-Alang (172), Pagsabungan (156), Paknaan (155), Tabok (142), Tipolo (142), Subangdaku (141), Casuntingan (135), Maguikay (121), Cubacub (119), Centro (116), Opao (111), Cabancalan (107), Jagobiao (107, Banilad (105), and Bakilid (101).

Of these 22 topmost densely populated barangays, seven (7) barangays are located in coastal areas of Mandaue namely: Paknaan, Jagobiao, Opao, Labogon, Looc, Basak, and Umapad with a total population of 119,363 individuals and 29,448 total households.

The total land area of these seven (7) coastal barangays is 854.982 hectares excluding the CSSEAZ (184.614 has) and foreshore (200.7 has) areas. Of these coastal barangays, only Barangay Umapad had a population density that did not reach 100 persons per hectare (2015 PSA census).

The proportion of male and female population is at 50.38 : 49.62 (182,715 male and 179,939 female). The age range between 0 months to 18 years old has an almost equal ratio while those in age range of 60 years and above has a greater female population.

The vulnerable sector from the demographic profile is described as by age, disability and health status. From the City Health Office data, population in ages 0-5 months are 5,432; 6-11 months are 4,657; 1-12 years old are 130,465; 13-17 years old are 80,187; senior citizen of ages 60 and up are 21,926; and persons with disability (PWD) are 5,473; and malnourished children are 309.

Population projection of Mandaue City is 2.46% growth rate annually in 2010 which is slightly higher compared to national growth rate of 2.2% (*CLUP Vol.1, p.2)*. By year 2030, it is expected to total at 522,165 from 362,654 in 2015. The build-up of greenhouse gases generated over a long period of time is intensified by population growth and Mandaue City's rapid population growth is attributed to its being an industrialized urban area. Rapid population growth is a driver of climate change. However, in Mandaue City population growth in 2010-2015 data showed a downturn of 1.73%.

Informal Settler Families (ISF). There are 23 Barangays (85%) populated by informal settler families who organized themselves into a total of 159 associations with 14,598 members. Of these, the 5,656 members are located in government lots, the 8,320 members

are located in private lots while 622 members on record are classified as no record of its location (HUDO 2020).

The barangays with organized ISF associations are as follows: Paknaan (35 associations), Subangdaku (11), Umapad (9), Banilad (9), Cabancalan (8), Maguikay (8), Looc (8), Tingub (7), Alang-Alang (6), Casuntingan (6), Labogon (6), Opao (6), Basak (5), Canduman (5), Cubacub (5), Jagobiao (5), Tipolo (5), Mantuyong (3), Guizo (3), Tabok (3), Casili (2), Pagsabungan (2), and Cambaro (1) (see Figure 1.)

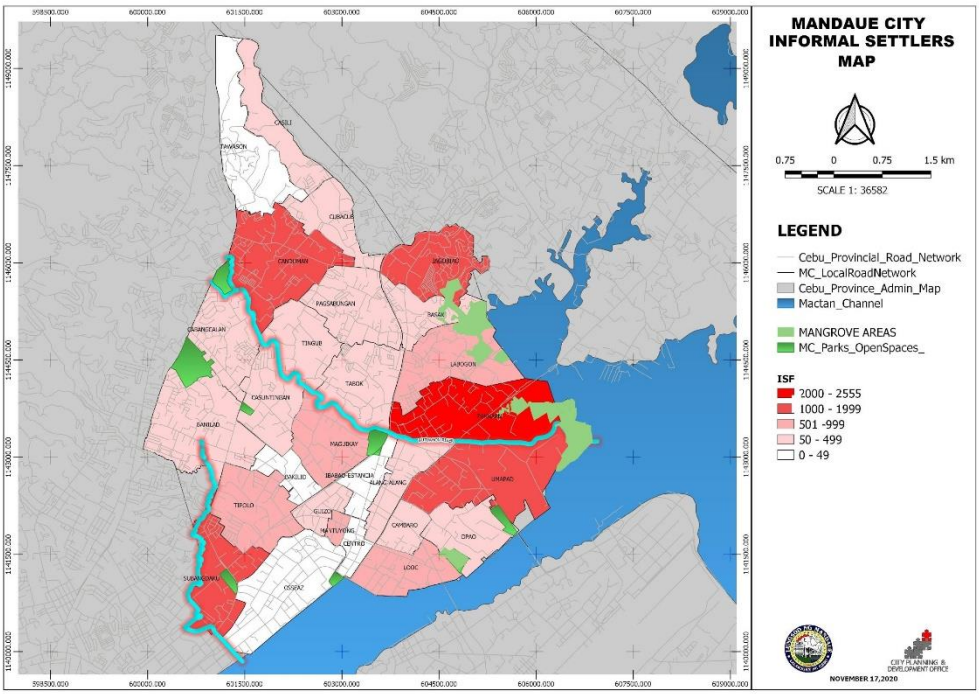

Figure 1. *Mandaue City Informal Settlers Map*

Source:

Resource Inventory

Infrastructure. A total of 67,219 buildings were inventoried in 27 Barangays and CSSEAZ with 41,633 buildings (62%) are affected by hazards. These buildings were profiled as to the hazards it would be impacted by. Fire placed at risk the 24,273 buildings (58%). This is followed by flood with 13,132 buildings (32%); earthquake with 1,954 buildings (5%); garbage with 1,024 buildings (2.46%); health risk with 964 buildings (2.32%); open

defecation with 171 buildings (0.41%); and typhoon with 115 buildings (0.28%. These are based on the building footprint map generated by CPDO to ease the process of analyzing risk in the city. It could provide line of sight analysis for future development, planning, and visualization as well. It would effectively guide Mandaue City to monitor assets and detect change with respect to the hazards. Knowing where structures are positioned can show where access to the rear of property is constrained in terms of access. Important for public safety, like in the event of fire, there is not enough room between two structures. From the public works perspective, if a facility extends on an easement across a piece of property, better to know where vehicles can get in to be able to do repairs is critical.

Road Network, Bridges and Transportation Resource. A total of 139.14 kilometers length of road network currently available for land transportation in Mandaue City are classified as local roads (105.35 kms) and national roads (33.79 kms). From the local road network, the CSSEAZ road network measures at 6.03 kms. These roads are made of concrete paved measured at 61.47 kms, asphalt paved at 56.27 kms, gravel surface at 2.61 kms, and earth road at 5.39 kms. Majority (54%) of the volume of vehicles using the road network are cars and motorcycles, while the remaining are cargo trucks and public transports.

The City has a total of 25 bridges of which 19 bridges have load capacity of 20 tons each, and 15 bridges have 15 tons each; and the 23 are made up of concrete and two (2) are steel bridges. Ancillary road services are also available for pedestrian crossing; sidewalks, overpass and skywalk; waiting sheds; traffic signal system; road signage

The City has two (2) public land transportation terminals - the North Bus Terminal and Parkmall used by buses, v-hires, and jeepneys servicing commuters between Mandaue City and to other cities – Cebu, Lapu-Lapu and Danao; and to other municipalities – Consolacion, Liloan and Compostela. Tricycles or pedicab are also used to ply inter-city transport. It has

no public or government owned seaport facilities but it has nine (9) private wharves or port facilities used for both passenger and cargo vessels. These ports are used by eleven (11) shipping routes domestically and internationally.

Electricity. All 27 Barangays have 100% access to electric power distribution system facilities serviced by the Visayan Electric Company (VECO) to 94,547 households. According to the CLUP 2019-2022, a total of 569 million kilowatt hour (kWh) electrical energy in 2012 was consumed in Mandaue City. It was projected to increase to 663 million kWhr in 2014 and 868 kWhr in 2017. The use of renewable energy for power generation is considered as an alternative and/or as supplemental.

Water Sources and Deepwells. Water supply and its distribution system of Mandaue City is primarily serviced by Metropolitan Cebu Water District (MCWD). In 2017 inventory of MCWD, a total of 2,297 deep wells were accounted with one in abandoned state. These are commercial (698), domestic (1,256), industrial (50), institutional (70), City-owned (222) and abandoned (1) deep wells (see Figure 2).

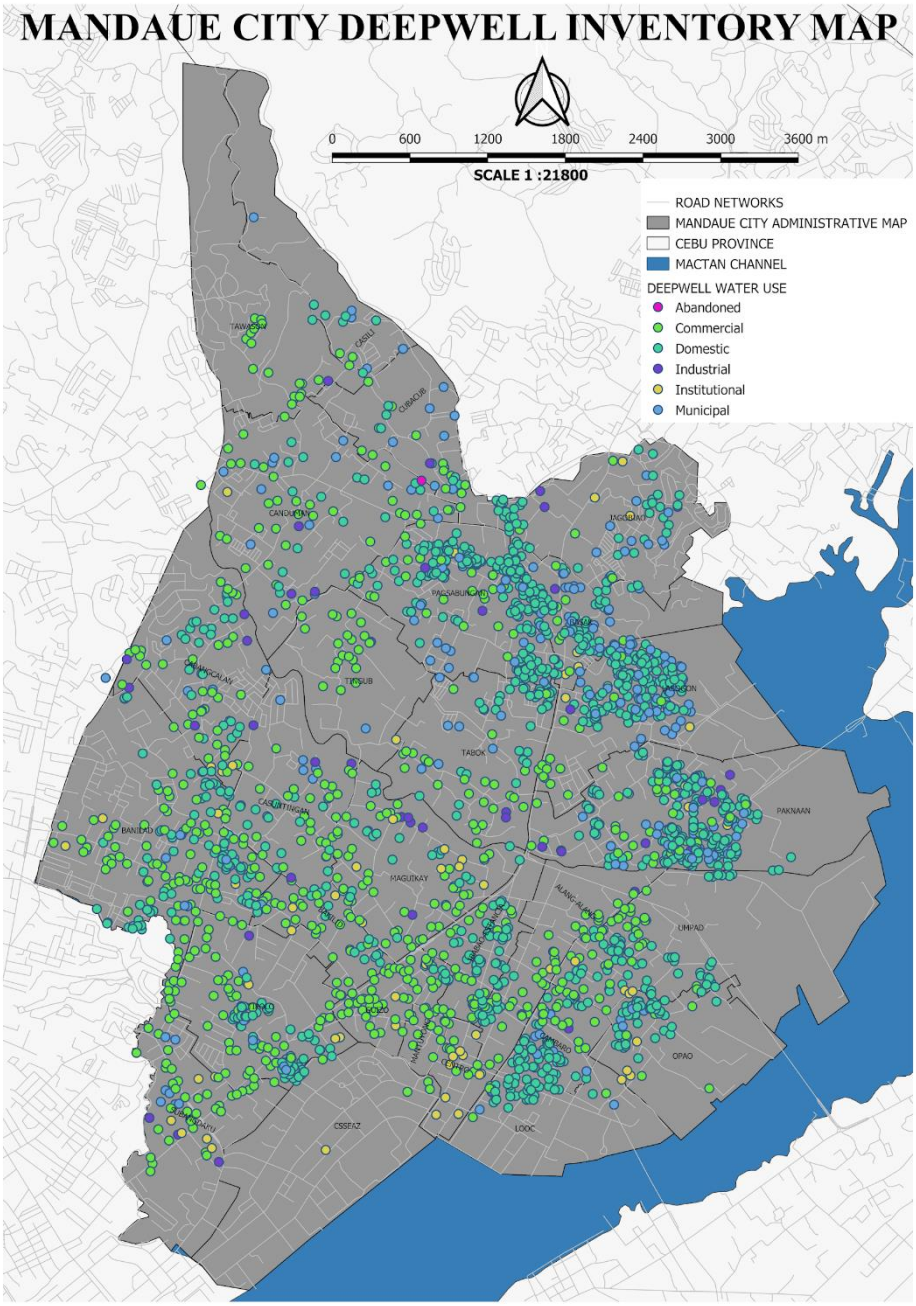

Figure 2. *Mandaue City Deepwell Inventory Map*

Source:

Based on the MCWD data, the total demand for water in Mandaue City is 548,898 cubic meters (m^3) in 2020 provided through its 32,758 service connection. Only 38% or 208,000 m^3 from the total demand are being served by MCWD while the 267,000 m^3 of water are sourced from other waterworks system Mandaue City. There are five (5) waterworks systems operating in five (5) barangays serving the population of Mandaue City namely: Canduman Waterworks System, Tabok Rural Waterworks (TARUWAS), Tingub Waterworks

Cooperative, Casuntingan Waterworks Resource Cooperative, and Labogon Waterworks and Sanitation Association, Inc.

Communal faucets also serving the demand for water which are located in nine barangays, namely: Umapad (2), Casuntingan (1), Paknaan (3), Alang-Alang (3), Labogon (1), Maguikay (1), Opao (1), Subangdaku (9), and Looc (13). There are 34 communal faucets that complement the supply gap of MCWD water supply system in Mandaue City *(CLUP 2012-2029)*.

Mangrove Forest. In 2018, the city commissioned a study to characterize the biodiversity status of its remaining mangrove forest. The study accounted nine (9) true mangrove species compared to Philippine mangrove species total to 30 to 40 mangrove species; eleven (11) associate flora and seventeen (17) associated fauna. It is categorized as the North Patch (31 ha) and South Patch (42 ha) with presence of important and globally threatened species *Avicennia rumphiana* (IUCN Vulnerable) and *Ceriops decandra* (IUCN Near Threatened). These mangrove stands are located along the coastline of barangays Labogon, Jagobiao and Basak (North Patch); and barangays Paknaan and Umapad (South Patch).

Natural Parks of the city are the (1) Butuanon River Viewing Deck located in Barangay Ibabao-Estancia; (2) Mangrove Boardwalk in Barangay Paknaan, and (3) Mandaue Green Learning Park in Barangay Umapad.

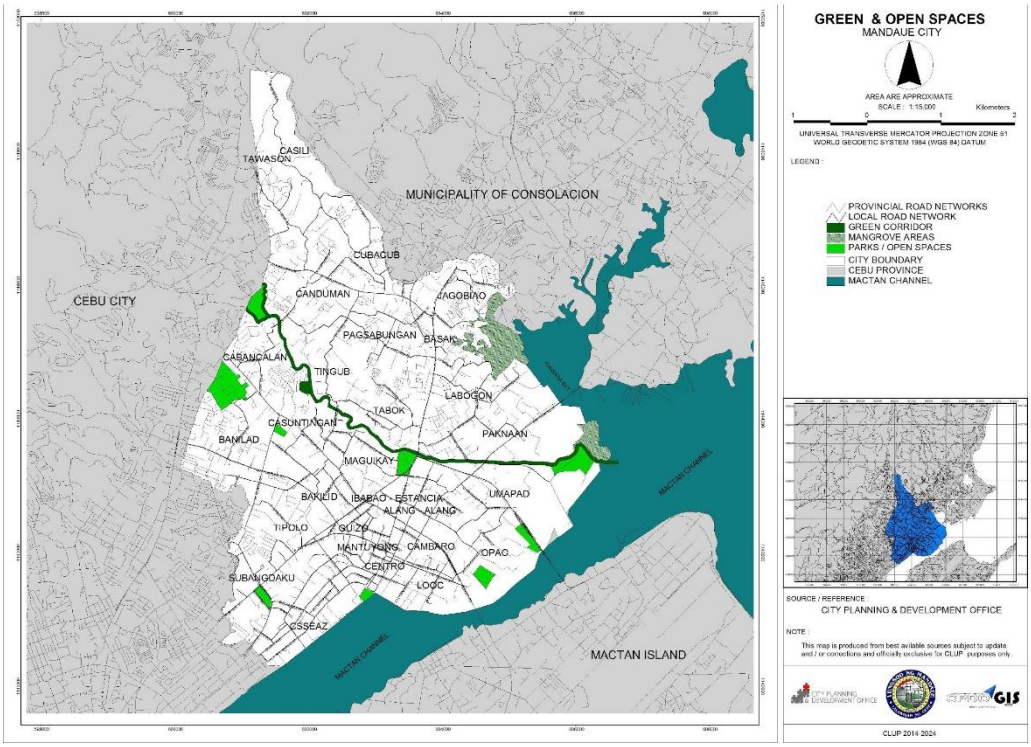

Figure 3. *Green & Open Spaces Mandaue City*

Source:

Material Recovery Facilities (MRF). Out of the 27 Barangays, only five (5) Barangays have established a functional MRF, namely in barangays Subangdaku, Tabok, Canduman, Pagsabungan and Jagobiao.

Key Economic Sector

Based on Mandaue Information System Office (MISO 2020), there are 19,179 businesses registered in the city of Mandaue located in the 27 barangays. The major economic sub-sectors of the city manufacturing and commerce and trade and agriculture. For each sector, it occupies a combined land area of 614 hectares for trade and commerce, 355 hectares for manufacturing, per City Land Use Plan data culled from city agriculture office, 34.133 hectares of agriculture lands of which 33.281 hectares are utilized for Aquaculture and Marine Culture (fish ponds).

The growing local economy is due to the increase of industrial and commercial establishments locating in Mandaue City. Consequently, it attracts employees, workers,

professionals and businessmen that led to the increasing influx of residential subdivisions, townhouses and condominiums.

Fisherfolks. The Office of the City Agriculture recorded 317 registered fisherfolks residing in Barangays Labogon, Opao, Jagobiao, Paknaan, Umapad and Looc.

Urban Gardeners. At least 818 urban gardeners in 25 Barangays have organized and actively engaged in urban gardening for their sources of food and livelihood; and only Barangays Banilad and Looc do not have organized urban gardeners. (CAO 2019, 2020)

Climate Profile and Projections

The type of climate in Region 7 under Cebu Province and particularly in the City of Mandaue is classified under Type III based on the Modified Corona's Classification of Climate. Type III climate is described as rainfall is more or less evenly distributed throughout the year, and this type of climate resembles Type II more closely since it has no dry season and pronounced maximum rain period is from December to February.

Mean Temperature. Increased temperatures ranging from 0.9 – 1.8 degrees under RCP 4.5 and 1.3 – 2.2 degrees in the mid-21st century (2036-2065) in Cebu relative to 1971-2000 baselines. Generally, all seasons becoming warmer with projected mean temperatures reaching >30˚C from March to November, (PAGASA, 2018).

Table 1. *CLIRAM of the projected seasonal change in mean temperature (in degree Celsius) in the mid-21st century (2036-2065) for Cebu; baseline period: 1971-2000*

Season /Baselines	Scenario	Range	Degree change	Projected Value
DJF = 26.8	RCP4.5	Lower bound Upper bound	1.0 1.7	27.8 28.5
	RCP 8.5	Lower bound Upper bound	1.3 2.0	28.1 28.8
MAM = 28.4	RCP4.5	Lower bound Upper bound	1.0 1.7	29.4 30.1
	RCP 8.5	Lower bound	1.3	29.7

		Upper bound	2.2	30.6
JJA =28.2	RCP4.5	Lower bound Upper bound	0.9 1.7	29.1 29.9
	RCP 8.5	Lower bound Upper bound	1.4 2.2	29.6 30.4
SON = 27.9	RCP4.5	Lower bound Upper bound	1.0 1.8	28.9 29.7
	RCP 8.5	Lower bound Upper bound	1.3 2.2	29.2 30.1

Source:

Total Rainfall. Projected possible reduction of up to 17.7% (RCP 4.5) to 21.3% (RCP8.5) in total rainfall in September to November; with minimal decreases in rainfall the rest of the year (PAGASA, 2018). Likewise, the data also projects a possible increase of rainfall up to 31% (RCP 4.5) to 22.4% (RCP 8.5) during the months of December to February.

Table 2. *CLIRAM of the projected seasonal change in TOTAL RAINFALL (in millimeters) in the mid-21st Century (2036-2065) for Cebu; baseline period: 1971-2000*

Season /Baselines	Scenario	Range	Projected % change	Projected amount (mm)
DJF = 324.0	RCP4.5	Lower bound Upper bound	-7.1 31.7	301.1 426.9
	RCP 8.5	Lower bound Upper bound	-15.4 22.4	274.1 396.7
MAM = 228.3	RCP4.5	Lower bound Upper bound	-3.7 9.2	219.8 249.4
	RCP 8.5	Lower bound Upper bound	-3.2 10.2	221.1 251.5
JJA = 595.1	RCP4.5	Lower bound Upper bound	-12.4 1.0	521.3 601.2
	RCP 8.5	Lower bound Upper bound	-15.8 3.6	501.1 616.6
SON = 607.4	RCP4.5	Lower bound Upper bound	-17.7 1.5	499.9 616.4
	RCP 8.5	Lower bound Upper bound	-21.3 2.7	478.0 623.5

Source:

Sea Level Rise. Across the Philippines, sea levels are expected to increase by approximately 20cm by the end of 21st century (PAGASA, 2018) with an annual mean sea level increasing at a rate of 1.74 mm per year (NOOA, 2018). Data from University of Hawaii Sea Level Center (UHSLC) on the area of Bantayan Island Cebu shows an increase of 0.001m to 0.003m per year from 2018-2025; this has been validated by *in-situ* observations gathered in 2018. Although further data gathering is required to confirm the local occurrence of sea level rise in Mandaue City (ICSC, 2018).

Extreme Weather Events. Based on PAGASA's climate modeling, 3 of 5 suggest a significant decrease in frequency of tropical cyclones, while 4 of 5 models agree on a projected increase in intensity (PAGASA, 2018).

Mandaue City's record of previous tropical cyclones in the last 30 years includes: Typhoon Nitang (August 1984), Typhoon Ruping (November 1990), Typhoon Yolanda (November 2013) with varying wind speeds from 220km/hr during Typhoon Ruping and 126km/hr during Typhoon Yolanda.

Likewise, local weather/PAGASA station in Mactan City, Cebu provide data on the occurrence of extreme heat and dry spell events. 2,463 days with maximum temperature of >35˚C in 2050, and 5,693 dry days, showing an increasing trend from 2020 estimates (PAGASA, 2011).

Table 3. *Frequency of extreme events in 2020 and 2050 under medium range emissions scenario*

Province	Station	No of Days w Tmax >35˚C			No of Dry Days		
		OBS	2020	2050	OBS	2020	2050
CEBU	Mactan	25	1488	2463	7112	5720	5693

Source:

MANDAUE RESILIENCE NETWORK

#iamresilientmandaue

II. HAZARDS AND VULNERABILITIES

II. HAZARDS AND VULNERABILITIES

As an urban area and a major metropolitan city, Mandaue deals with a multitude of confounding risks and hazards including climate change, disaster, environment degradation, as well as long-standing concerns, such as rapid urbanization and poverty. Then, there is the emergence the global Covid-19 pandemic. This section highlights the climate-induced impacts affecting the city, while acknowledging the underlying relationships between the various aggravating/confounding factors.

The following findings on the impacts of climate change in Mandaue City were identified through community-based climate risk assessments, secondary research and scenario-building activities from partner sectors in the academe and non-government organizations, among others.

Increased Temperature and Reduced Rainfall

A. Dry-spells or droughts

Dry spell and droughts in Mandaue City are associated with the increase in mean temperature and reduced rainfall within the area. According to the assessments, these happen occasionally during the periods of January to May. This affects all sectors in the city due to its impacts on access and availability of water for basic needs and livelihoods; as well as reductions in water flows for key wetland ecosystems.

According to the Metropolitan Cebu Water District (MCWD), Cebu has experienced El Nino 3 times: 1997-1998, 2015-2016 and April 2019; which has caused a reduction in their primary water sources for Mandaue City of up to 54% reduction of surface water source from Carmen (35,000 cmd to 19,000 cmd), 69% reduction from Jaclupan weir (33,000 – 10,000 cmd), 86% reduction from Buhisan source (5,000 to 700 cmd) during those period. Of

the total population (94,547HH), 35% are dependent on water supply from MCWD, which puts 32,758HH vulnerable to these fluctuations in water supply.

Although El Nino is not directly associated with climate change, projections indicating reduced rainfall and an increasing trend in dry days experiencing over 35˚C in the coming years and may lead to similar effects.

Reduced river flows and water levels caused by decreasing rainfalls may negatively impact the deep well sources on which the remaining 65% (61,789HH) depend for their water supply for domestic use. This is compounded by the reduction of ground water recharge due to built-up areas, improper solid waste and septage management due to lack of standard safe disposal of the treated septage from toilets/septic tanks; using unsealed septic tanks will lead to increased pollution of water channels.

Key economic sectors also foresee negative impacts due to limited access and disruptions to water for industrial and commercial uses; particularly the 19,179 registered businesses engaged in food industry, factories, agriculture (34.133ha), aquaculture (33.281 ha), among others. The latter two may also be negatively impacted by the increasing temperatures that will affect crop cycles/growth, as well as ocean sea surface temperatures affecting fishing seasons and the quantity of fish-catch.

B. Typhoons and heavy rainfall days

As a coastal city, Mandaue is highly exposed to the elements during typhoon occurrences, especially in the 7 coastal barangays including Brgy. Jagobiao, Basak, Labogon, Opao, Paknaan, Looc and Umapad, where 119, 363 individuals are known to reside, (PSA, 2015).

Likewise, areas along the river channels were also identified as danger zones due to their exposure to elements during typhoon, making them vulnerable to the strong winds, heavy rain and flooding events.

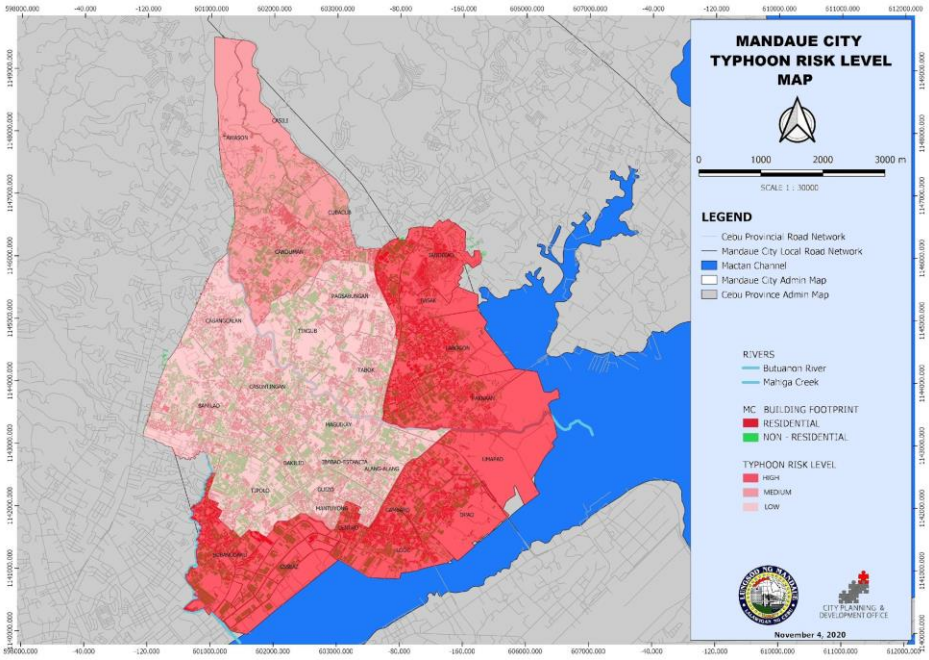

Figure 4. *Mandaue City Typhoon Risk Level Map*
Source:

Climate Risk Assessment findings also indicate that typhoons and heavy rainfall days will have a big impact on vulnerable communities, and informal settler families located along the river banks and coastal areas, where 22,878 low-quality/light material shelters along with other residential areas, schools and even hospitals are located (CBMS, 2018). It is also expected to cause disruptions electricity services of which (42%) is supplied through submarine cables from the Leyte Power Plant as well as water service to 32% of households (from MCWD) that requires electricity. Further disruptions are expected in economic activity, resources and operations of all registered businesses, especially the 2,267 business located along the coast. Particularly, agriculture and aquaculture activities will be affected by loss of crops and damage to investments (ie. fishponds) due to the heavy wind and rains.

C. Flooding

Topographically, the city is basically a catch basin wherein all storm water that passes through and inundates the areas of Mandaue before it drains to Mactan channel; as such they are highly susceptible to flooding whether it is associated with extreme weather events

such as tropical cyclones/typhoons, or even just heavy rainfall days due to increased seasonal rainfall.

The CRA findings indicate that flooding is frequently experienced in the city during the rainy season months of June to January, with floods ranging from 0.5-1.5 meters. 3 types of flooding were identified:

- **Coastal Flooding** caused by heavy rainfall and influenced by high tide affects 27 (24%) out of total 111 sitios or Puroks in 7 coastal barangays including Barangays Basak, Labogon, Jagobiao, Looc, Paknaan, Opao and Umapad
- **River Flooding** caused by heavy rainfall, compounded by spill-over from river channels affects 7 out of 13 barangays along the Butuanon river including Barangays Tabok, Casuntingan, Tingub, Casili (lower portion), Canduman, Umapad, Paknaan.
- **Urban Flooding** caused by heavy rainfall, compounded by lack of drainage and improper waste management affects all 27 (100%) of barangay and the 197 *sitios/puroks.*

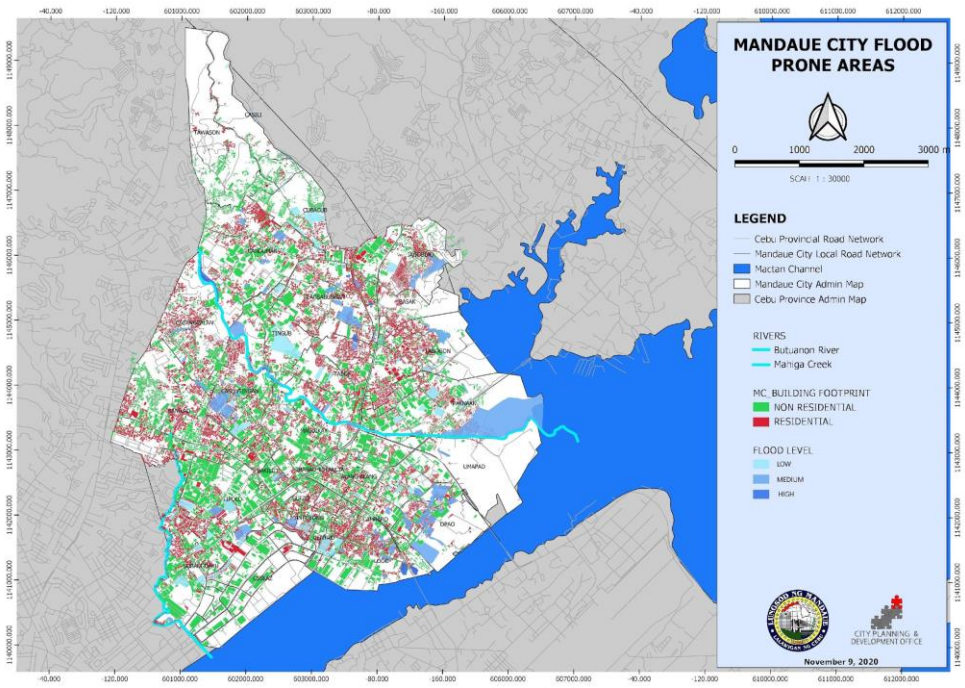

Figure 5. *Mandaue City Flood Prone Areas*
Source:

In summary, 232 (68.44%) out of 339 sitios are vulnerable to various flooding events and the compounding facts. A total of 13,132 buildings (20% of city infrastructure) will be affected by the flooding leading to disruptions in regular functions such as school and work, government activity, business operations and aqua/agricultural activities, among others. CRA findings also indicate that 781 deep wells along the coastal areas are projected to be greatly affected by contamination during times of flood – these deep wells are used for domestic, commercial, government, and industrial purposes.

Climate Projections

Climate projections developed by UP CENVI in its Phil- Light Detection and Ranging (LiDAR) supported by Department of Science and Technology (DOST) through its NICHE centers for R&D, presented the following scenarios:

A. Extreme Flooding

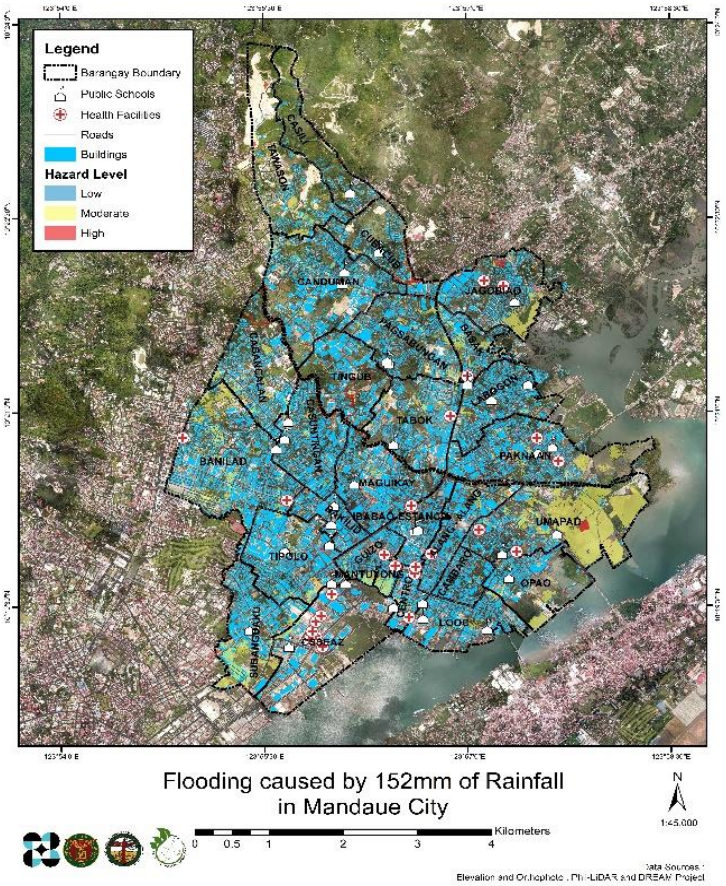

Figure 6. *For a 152mm of rainfall event for 24 hours in Mandaue*
Source:

- 495 buildings (residential, commercial, or industrial) or less than 1% of all structures in the city including one public school are at high risk.
- 8,120 (13.2%) buildings including one public school and a health facility will be at moderate risk.
- At low risk will be 1,214 (2%) buildings.
- Roads affected reach 1.54 kilometers in high risk areas, 16.94 kilometers in moderate risk areas, and 4.77 kilometers in low risk areas.
- Projected population exposed under current development and population growth trends by 2065: 273,432.97

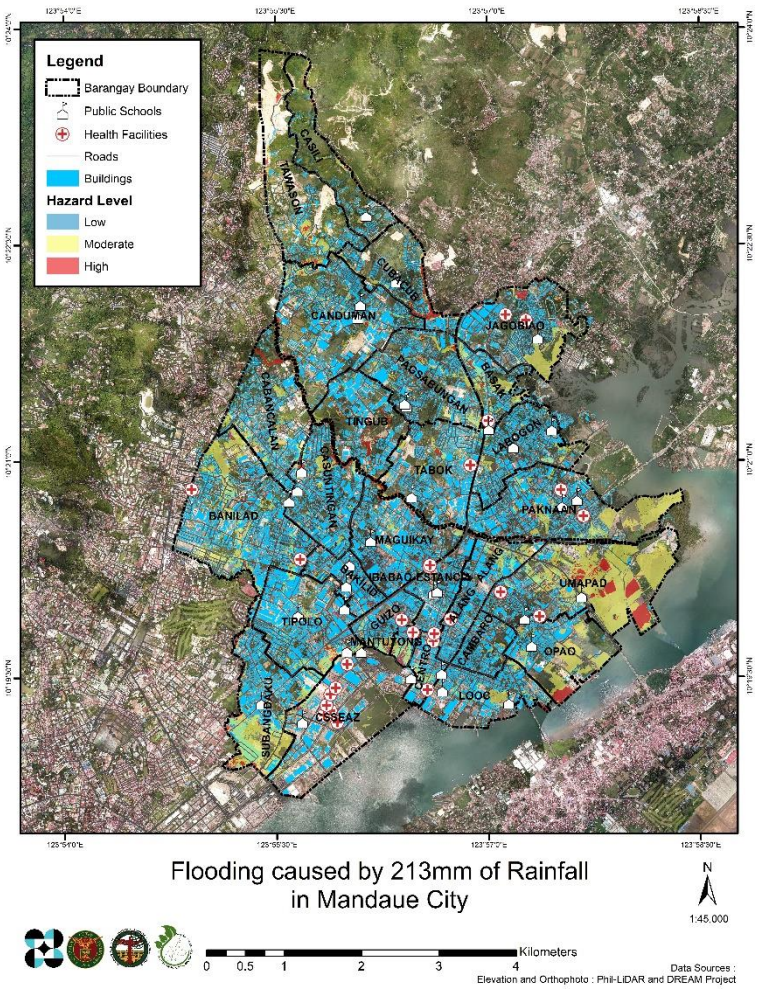

Figure 7. *For a 213mm of rainfall event for 24 hours in Mandaue*
Source:

- 1,099 buildings (residential, commercial, or industrial) or around 1.8% of all structures in

the city including one public school are at (high risk.(1.5m))

- 10,950 (13.2%) buildings including two public schools and a health facility will be at (moderate risk.0.5m)
- At low risk will be 1,849 (3%) buildings(low risk below 0.5m)
- Roads affected reach 3.10 kilometers in high risk areas, 31.38 kilometers in moderate risk areas, and 6.37 kilometers in low risk areas.(below 0.5m)
- Projected population exposed under current development and population growth trends by 2065: 359,786.43

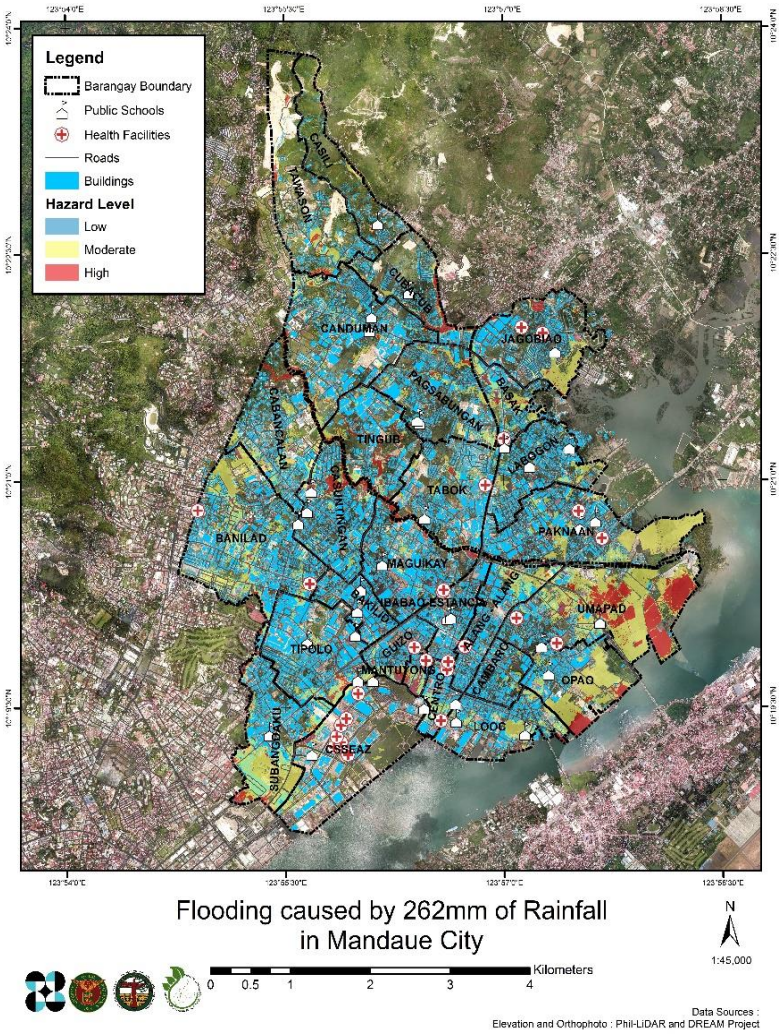

Figure 8. *For a 262mm of rainfall event for 24 hours in Mandaue*
Source:

- 2,061 buildings (residential, commercial, or industrial) or around 3.3% of all structures in

the city including one public school are at high risk.

- 12,274 (around 20%) buildings including four public schools and three health facilities will be at moderate risk.
- At low risk will be 2,372 (3.9%) buildings.
- Roads affected reach 4.82 kilometers in high risk areas, 44.61 kilometers in moderate risk areas, and 7.49 kilometers in low risk areas.
- Projected population exposed under current development and population growth trends by 2065: 1,081,671.57

B. Storm Surge

Annual Extreme Sea Level Events: 2036 -2065: Extreme sea levels (ESLs) are defined as the combined height of the astronomical tide and storm surge (i.e. the storm tide) and mean sea level.

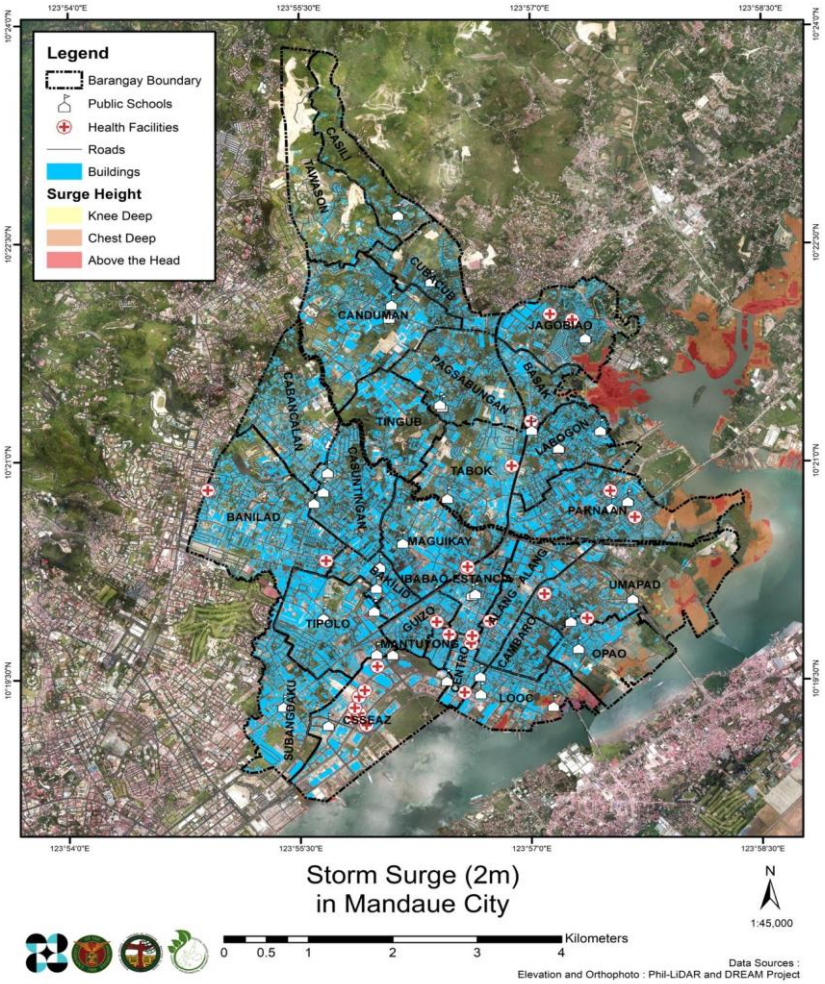

Figure 9. *For a 2 meter storm surge*
Source:

ESLs can cause coastal floods that threaten community assets, water resources and livelihood due to rising mean sea levels that are already magnifying the frequency and severity of ESLs that lead to coastal floods

- 6 out of 27 brgys will be affected under 5 meters storm surge (Looc, Opao, Umapad, Paknaan, Lobogon, Jagobiao),
- 268 structures including one public school are at high risk, 332 structures are at moderate risk, Roads that may be affected by a 2-meter storm surge span 764 meters in high risk zones and 948 meters in moderate risk zones.
- Current population exposure: 106,740, exposed business 2414. Projected population exposed under current development and population growth trends by 2065: 273,432.97.

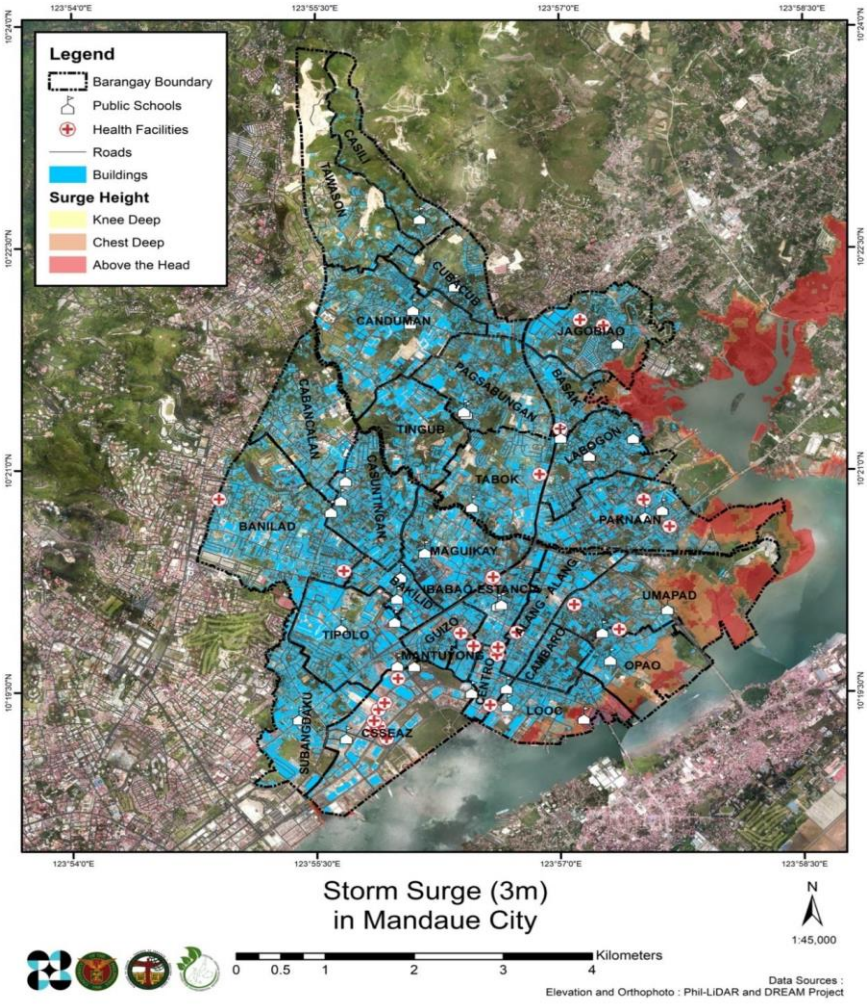

Figure 10. *For a 3 meter storm surge*
Source:

- 7 out of 27 brgys will be affected under 5 meters storm surge (Looc, Opao, Umapad, Paknaan, Lobogon, Jagobiao, Basak),

- 498 structures including one public school are at high risk, 1,010 structures are at moderate risk, 54 structures are at low risk.

- Roads that may be affected by a 3-meter storm surge span 1.65 kilometers in high risk zones and 4.19 kilometers in moderate risk zones.

- Current population exposure: 106,740, exposed business 2963. Projected population exposed under current development and population growth trends by 2065: 359,786.43

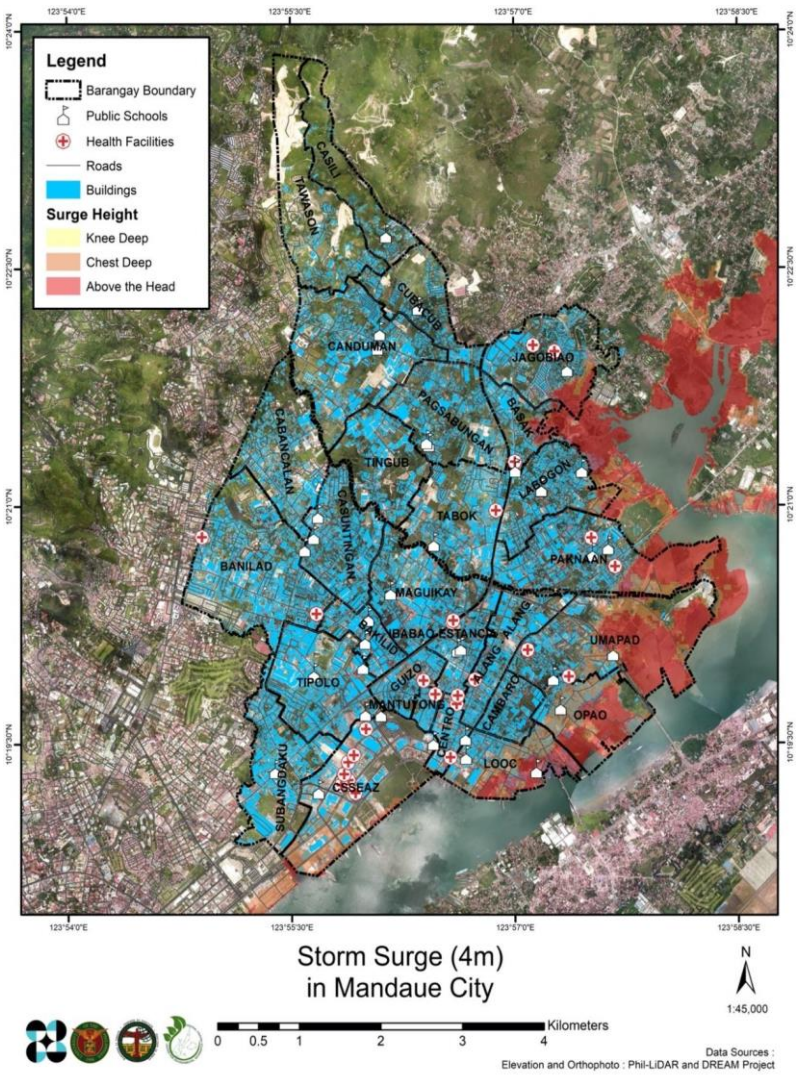

Figure 11. *For 4 meter storm surge*
Source:

- 7 out of 27 barangay and CSSEAZ will be affected under 5 meters storm surge (Looc, Opao, Umapad, Paknaan, Lobogon, Jagobiao, Basak)

- 1,567 structures including one public school are at high risk, 3,706 structures including 2 public schools are at moderate risk, 34 structures are at low risk,

- Roads that may be affected by a 4-meter storm surge span 6.15 kilometers in high risk zones, 16.39 kilometers in moderate risk zones and 82 meters in low risk zones

- Current population exposure: 106,740, exposed business 2963. Projected population exposed under current development and population growth trends by 2065: 359,786.43

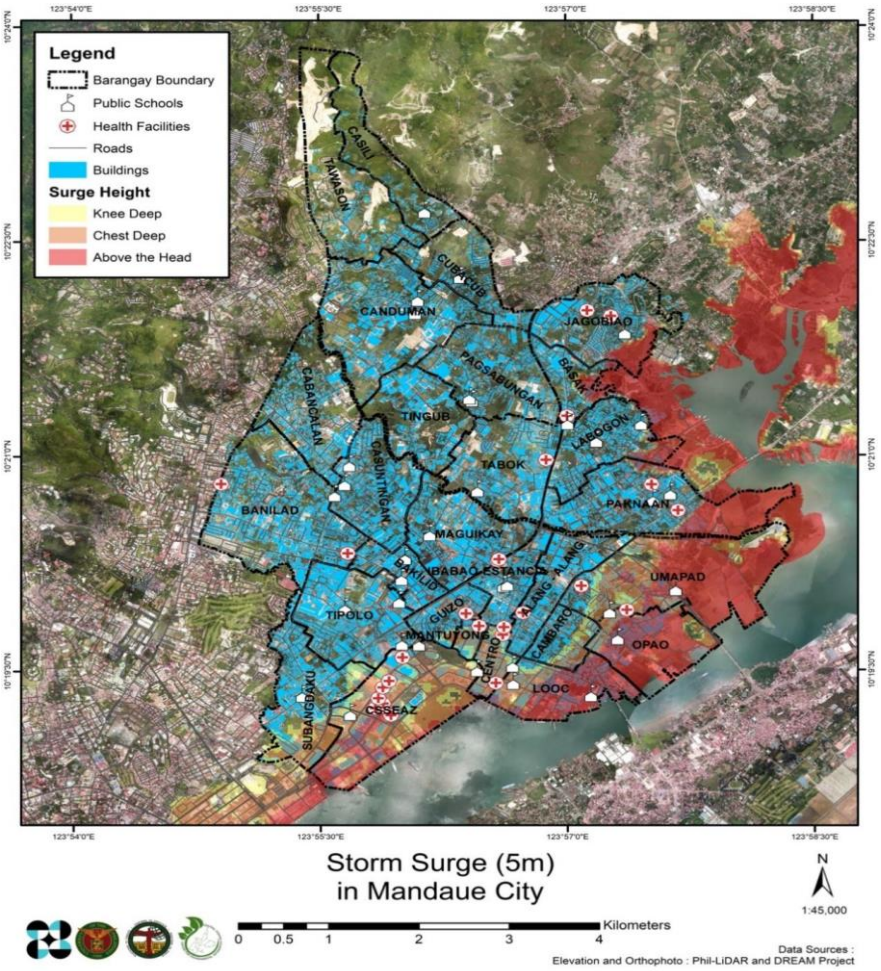

Figure 12. *For 5 meters storm surge*
Source:

- 10 out of 27 brgys and CSSEAZ will be affected under 5 meters storm surge (Mantuyong, centro, Cambaro, Looc, Opao, Umapad, Paknaan,Lobogon, Jagobiao, Basak), 9 out of 27 brgys will be affected under 5 meters storm surge
- 4,841 structures including three public schools and one health facility are at high risk,
- 4,381 structures including three public schools and six health facilities are at moderate risk,
- 2,357 structures including two public schools and two health facilities are at low risk.
- Roads that may be affected by a 5-meter storm surge span 24.53 kilometers in high risk zones, 30 kilometers in moderate risk zones, and 9.76 kilometers in low risk zones.
- Current exposed population 134242, exposed business: 5171. Projected population exposed under current development and population growth trends by 2065: 452,486.88

C. Sea Level Rise

The projected rise in sea levels for Mandaue City is expected to have detrimental impacts on water resources, health and migration of residents. As illustrated in the map, 895 out of 2,297 deep wells are already showing signs of salt water intrusion, all located within the 12 barangays along the coast of the city (JICA, 2010). Since these are being used for domestic (55%), commercial (30%), city and barangay LGUs (10%), institutional (3%), industrial (2%), this could have lasting and detrimental impacts on the affected communities and establishments.

The worsened quality and quantity of water may also lead to increased incidences of water-borne and vector-borne diseases and possibly even forced migration of communities living in high-risk areas.

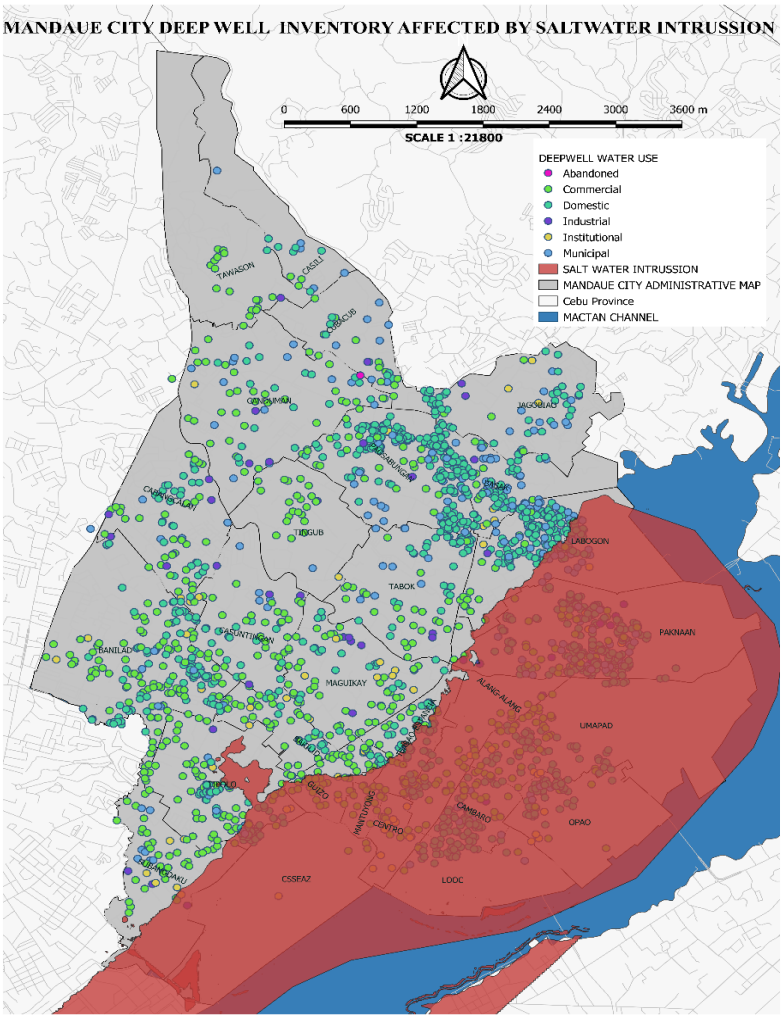

Figure 13. *Mandaue City Deepwell Inventory Affected by Saltwater Intrusion*
Source:

UP Cebu CENVI further developed projection scenarios on the possible implications of sea level rise at various levels and their impacts on the coastal communities. The sea level rise maps were based on the outputs of Project NOAH. Meanwhile, flood maps were developed based on simulations using the city's terrain, land cover, and different rainfall scenarios. These rainfall scenarios were computed using rainfall intensity duration frequency analysis of PAGASA's precipitation records.

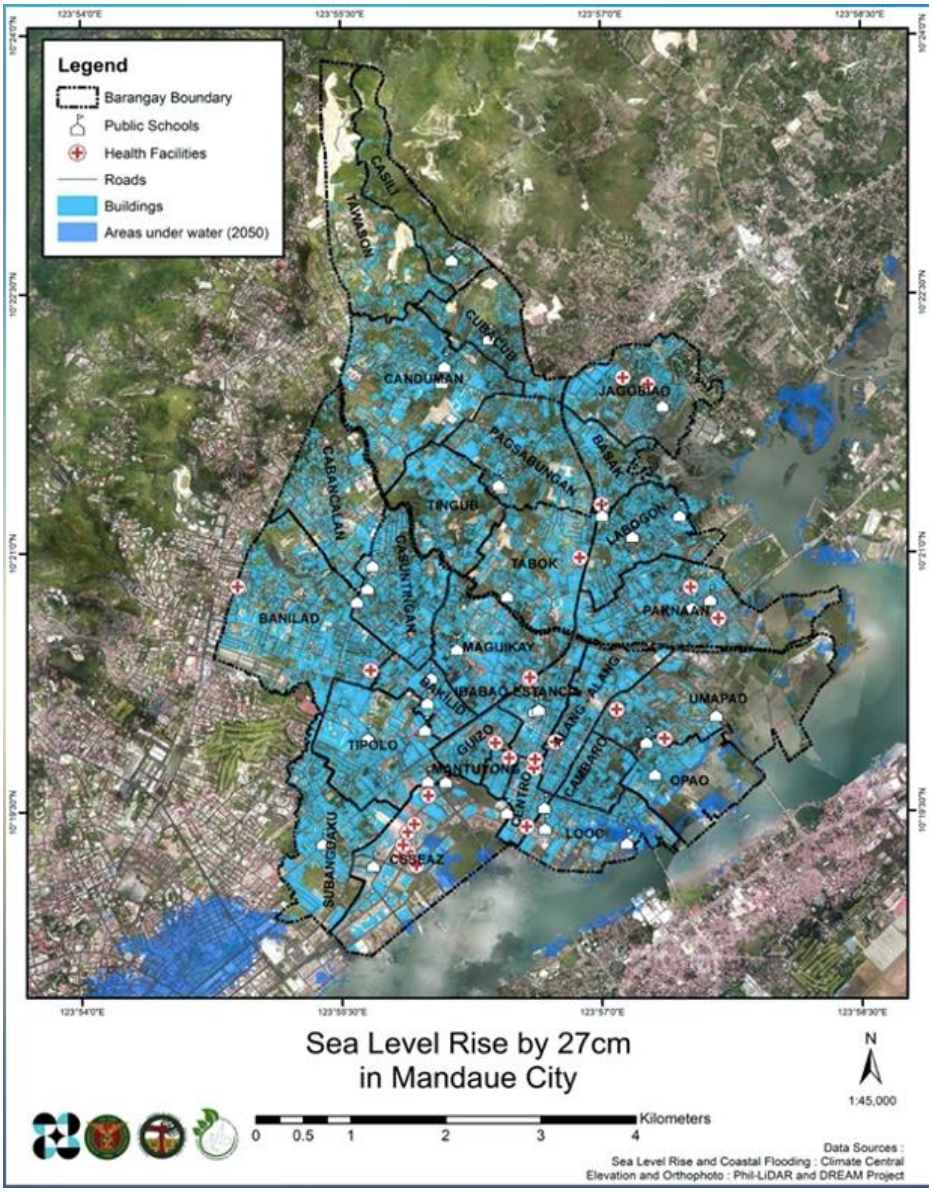

Figure 14. *Sea Level rise of 27cm*
Source:

- 3 Coastal brgys (Looc, Opao, Umapad) and CSSEAZ will be affected by Sea level rise

- Business along the coastal brgys will be affected
- Projection for 2050 sea level rise shows 860 structures and one public school affected by the rising sea levels. Roads spanning 3.3 kilometers are affected.

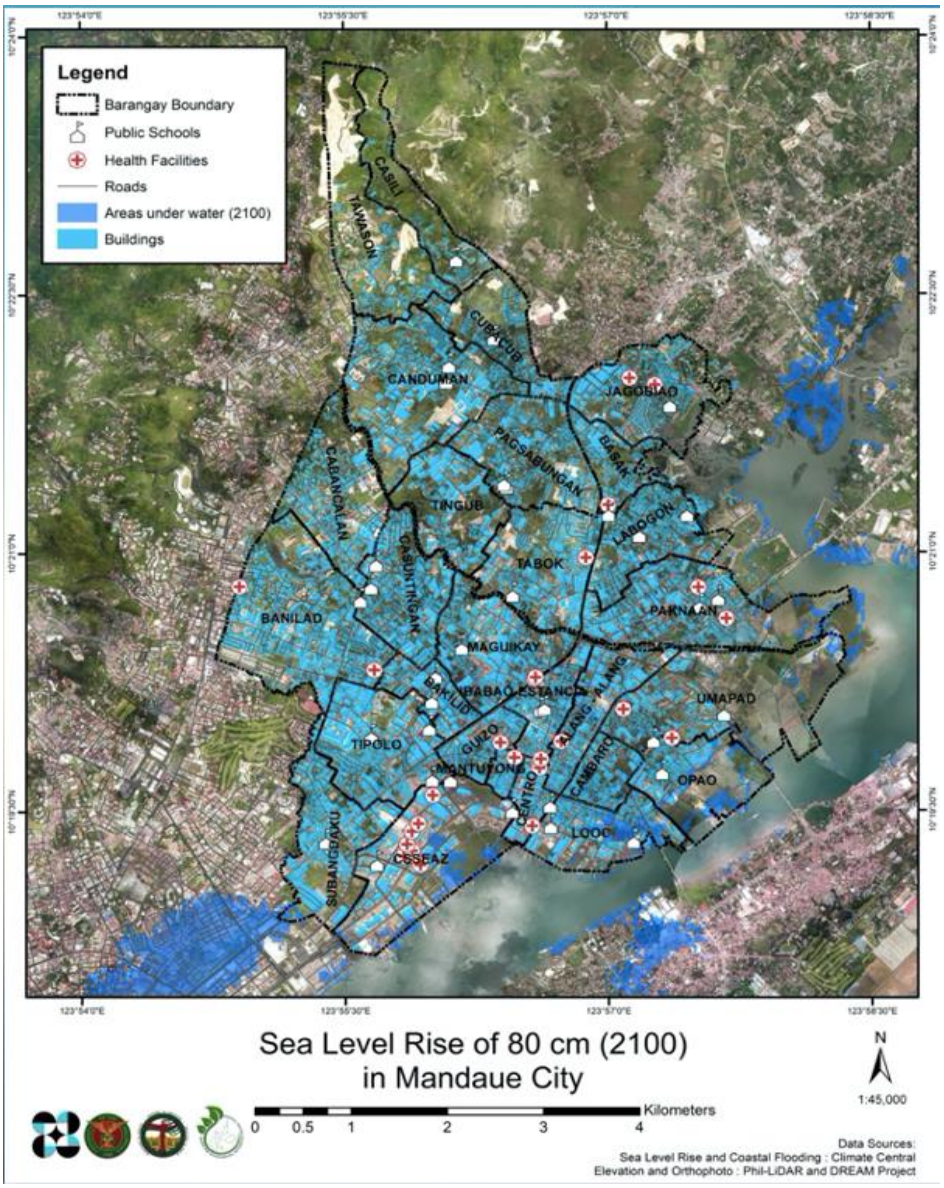

Figure 15. *Sea level rise of 80 cm*
Source:

- CSSEAZ and (6 brgys) Looc, Opao, Umapad, Alang-alang, Paknaan and Jagobiao will be affected both residential and business
- Saltwater intrusion of freshwater aquifers and sources) potentially affecting all 2297 wells in Mandaue including primary source of MCWD in Canduman, Cubacub, Cabanclan.

MANDAUE RESILIENCE NETWORK
#iamresilientmandaue

III. CLIMATE IMPACTS AND ADAPTIVE CAPACITY OF CRITICAL SYSTEMS OF INTEREST

III. CLIMATE IMPACTS AND ADAPTIVE CAPACITY OF CRITICAL SYSTEMS OF INTEREST

Rational for Prioritization

"Mandaue, a **green city** with **sustainable economic development** focused on high quality manufactured consumer products, guided by responsive governance thus ensuring better living standards for its citizenry."

In line with the long-term vision of Mandaue City, the Mandaue Resilience Network (MRN), tasked to lead the local climate planning process, identified critical systems of interest (SOI) for their value and contributions to the achievement of that vision so that strategic action can be plotted towards building resilience to climate impacts. Each of these SOIs were analyzed in-depth, with the support of various experts/practitioners to understand the nature of their vulnerabilities and adaptive capacities.

Vulnerable Communities

This particularly focuses on the vulnerable Informal Settler Families (ISFs), a growing demographic of those who immigrated into the City for various reasons, often living in areas that have been identified as susceptible to multiple hazards. This sector focuses on 13,839 ISF households or 340,219 people spread across 23 Barangays. (HUDO, 2020)

Climate Stimuli: Increased temperature, urban heat island effect, increased rainfall during DJF, decreased rainfall , occurrence of typhoons/tropical cyclones

Hazards: Drought/dry spell, typhoon, heavy rainfall/low pressure areas, storm urges, flashfloods, coastal and river flooding, air pollution

Biophysical Impacts: damage to fishponds/aquaculture and other livelihood investments, destruction of property (homes and schools), natural resources and life; contaminated source of water (deep wells), and decrease in level of water availability

Socioeconomic Impacts:

- Limited supply of potable water could lead to increased incidence and/or faster spread of diseases such as water-related diseases and respiratory diseases caused by improper hygiene;
- Low fish catch and/or low crop productivity means limited income/limited livelihood opportunities that could cause increased financial worry for ISFs already struggling with poverty and malnutrition;
- Congestion and crowded housing are confounding factors (not caused by climate stimuli) and coupled with uncontrolled (solid) waste management could result to social conflict. The urban poor coupled with in most blighted condition, bear a huge encumbrance of the solid waste burden. The combination of these rather challenging set-up has resulted in increased overcrowding, poor sanitary conditions, lack of water and an unprecedented accumulation of solid waste which have triggered a myriad of urban problems.

Adaptive Capacity:

- Local government units are willing to implement relocation and livelihood programs (via TESDA) for affected households of association members and at least 14,598 people are members of ISF association; 15 of which are located in private lots, and 42 in government owned lots.
- Flood control management programs for the river areas No sewer and poor drainage system;
- Water connection is being explored for houses in ISF areas in addition to deep wells for domestic use and desalination projects for coastal *barangays*

- Metropolitan Cebu Water District (MCWD) cannot supply the demand of water consumption in Mandaue City, and they are therefore dependent on supply sources from Cebu City and other areas;
- There is low awareness by communities, living nearby wetland areas, on importance of forest ecosystems and ecosystem services and weak implementation of forest protection and knowledge campaigns due to limited funds and man power for law enforcement
- Programs available for family planning, feeding programs, fishery and urban gardening, water sanitation and hygiene (WASH) and zero open defecation programs available in various LGUs across Mandaue City. Although, while programs are available in some areas, they are also not always continued, and there are only limited WASH programs.

Wetland Ecosystems

The major wetland ecosystems of Mandaue is composed of river, mangrove and coastal areas. Specifically, it consists of approximately 15km stretch of the Butuanon-Mahiga river system and the approximately 74 hectares of mangrove forests divided into North and South clusters. The mangrove ecosystems shelter 9 mangrove species, 2 of which are threatened mangrove species and other associated species of flora and fauna. Another important component of the wetlands is the coastline facing the Mactan Channel and Cansaga Bay.

Climate Stimuli: Increasing temperatures, decreasing rainfall (JJA, SON), increased rainfall (DJF), typhoons, and sea level rise

Hazards: Flooding, soil erosion, landslides, drought/dry spell, typhoons/tropical cyclones, storm surges, salt water intrusion and ocean acidification

Biophysical Impacts: Loss of vegetation, increased pollution (air and water), loss of aquatic productivity and habitat quality, destabilized riverbanks, sedimentation/siltation of

river systems, reduced/loss of protection from mangroves and reduced/loss of mangrove forests and other ecosystem services

Socioeconomic Impacts:

- Destruction of properties, injury or death to individuals living near the wetland ecosystems;
- Decline of aquatic resources for personal or commercial uses could lead to loss of income/livelihood opportunities for communities' dependent on fisheries;
- Decreased quality of waters may also cause increase incidence of water-borne and vector-borne diseases;
- Low recharge of headwaters and damage to mangrove forests could cause higher cost of rehabilitation and management

Adaptive Capacity

- Programs for regular river and coastal clean up, patrolling and enforcement of mangrove areas but only limited implementation due to budget constraints and limited manpower to manage law enforcement
- Information education campaigns have been conducted to communities living in wetland adjacent areas, but there is still low awareness on the importance of wetland ecosystems and its benefits to local communities.
- There is regular collection of solid waste as per the solid waste management plan (SWMP) but there is still improper waste management from adjacent communities/relocated families
- There is an approved ordinance on mangrove protection and a plan for the Mangrove Eco- park/Coastal Green Park
- Regular monitoring of water quality together with government units along the Butuanon River.

- Existing rainwater harvesting tanks in some public facilities and private establishments are underutilized.

Water Resources

As a highly urbanized area, there is increased pressure on availability and accessibility of fresh/potable water within the City. Based on the latest census, the city must cater to the water needs of 362,654 total population or 98,907 total households (PSA, 2015) and 18,159 registered businesses within their jurisdiction. At present 65% source their water from individual deep wells or those managed by associations, of which there are currently 2297 that can be found in the city. The remaining 35%, 32,758 households, receive their water directly from Metropolitan Cebu Water District (MCWD) of which only 21% is sourced within Mandaue's MCWD source, while the remaining 79% is outsourced from Carmen, Jaclupan, and Buhisan watershed (MCWD, 2017).

Climate Stimuli: Increased temperature, reduced rainfall (JJA, SON), increased rainfall (DJF), sea level rise, increased sea surface temperature and tropical cyclones

Hazards: Dry spells, heavy rainfall, storm surge and flash floods, coastal and river flooding, salt water intrusion and ocean acidification

Biophysical Impacts: reduced surface water, low water supply through the MCWD, low recharge of the aquifer, drying up of deep wells, salt water intrusion to deep wells, damaged water systems

Socioeconomic Impacts:

- Reduced water supply for industrial and commercial use could lead to increased competition of water supply, and possible disruption in manufacturing;
- Increased competition on water supply could cause an increased in cost of services and thus have implications on household roles and expenses;

- Scarcity of water may lead toto possibility of water-borne diseases, and sanitation problems for local communities' schools and even government services and conflict between users due to unfavorable/unavailable water supply.
- Decreasing quality of water from deep well sources and wetlands may cause increased incidence of water-borne diseases and vector-borne diseases, increased morbidity and birth defects

Adaptive Capacity:

- Presence of waterworks in barangay Tabok, Tingub, Casuntingan, Labogon and Canduman and ongoing monitoring of the 2,297 deep wells by MCWD and CHO
- There is a water catchment ordinance under the existing building code
- There are existing water refilling stations for access to potable water
- Highly dependent on MCWD and watersheds outside Mandaue City
- Protection and management of water source is limited
- There is limited open spaces to encourage water recharge for ground water.
- Expected increase in population between 2020-2030 is expected to cause problems in terms of supplying the increased water demand from communities and businesses.

Supply Chain

In line with Mandaue's vision for sustainable economic development, this system refers to the efficiency and sustainability of processes from source of raw goods such as wood/fibers (furnitures), seaweeds (food industry), cereal grains (beverages) to the manufacturing and delivery of finished products to consumers. There are a total of 18,159 registered businesses spread across the 27 barangays (FY2020), of which 12.5% coastal businesses, 13% river businesses and 72% urban businesses whose income and operations would be affected by:

Climate Stimuli: Increased temperature, decreasing rainfall, sea level rise, typhoons

Hazards: Dry Spell, heavy rainfall, flooding, flash floods, typhoons and tropical cyclones

Biophysical Impacts: Damage to roads and infrastructure, limited/low agriculture and industrial and manufacturing productivity, inefficient service industry

Socioeconomic Impacts:

- Scarcity of and/ lack of access to raw materials supply may cause an increase in production cost, leading to loss of income and possible massive unemployment. And even malnutrition;
- Lack of transportation logistics, improper solid waste management and ineffective drainage systems contribute to delays and disruptions in supply chain from source to delivery during critical events (typhoons, heavy rainfall days);

Adaptive Capacity:

- Continuously increasing number of business establishments in Mandaue, including micro businesses, but still a significant number of unregistered business
- Active participation of MCCI, trade industry associations, fisher folks and urban gardeners and scraper association and other organized vendors
- High dependence on supply of goods and raw materials from neighboring LGUs
- No existing policies to support supply chain network, sources of goods and manage cost fluctuations

MANDAUE RESILIENCE NETWORK

#iamresilientmandaue

IV. EMERGING CLIMATE CHANGE ADAPTATION STRATEGIES

IV. EMERGING CLIMATE CHANGE ADAPTATION STRATEGIES

Acknowledging the vulnerability of critical systems within and between neighboring cities in Cebu, Mandaue City, local government leaders and stakeholders have identified 2 key strategies to increase collaboration to address and increase resilience against climate change impacts.

Vulnerable Communities and Wetland Ecosystems6

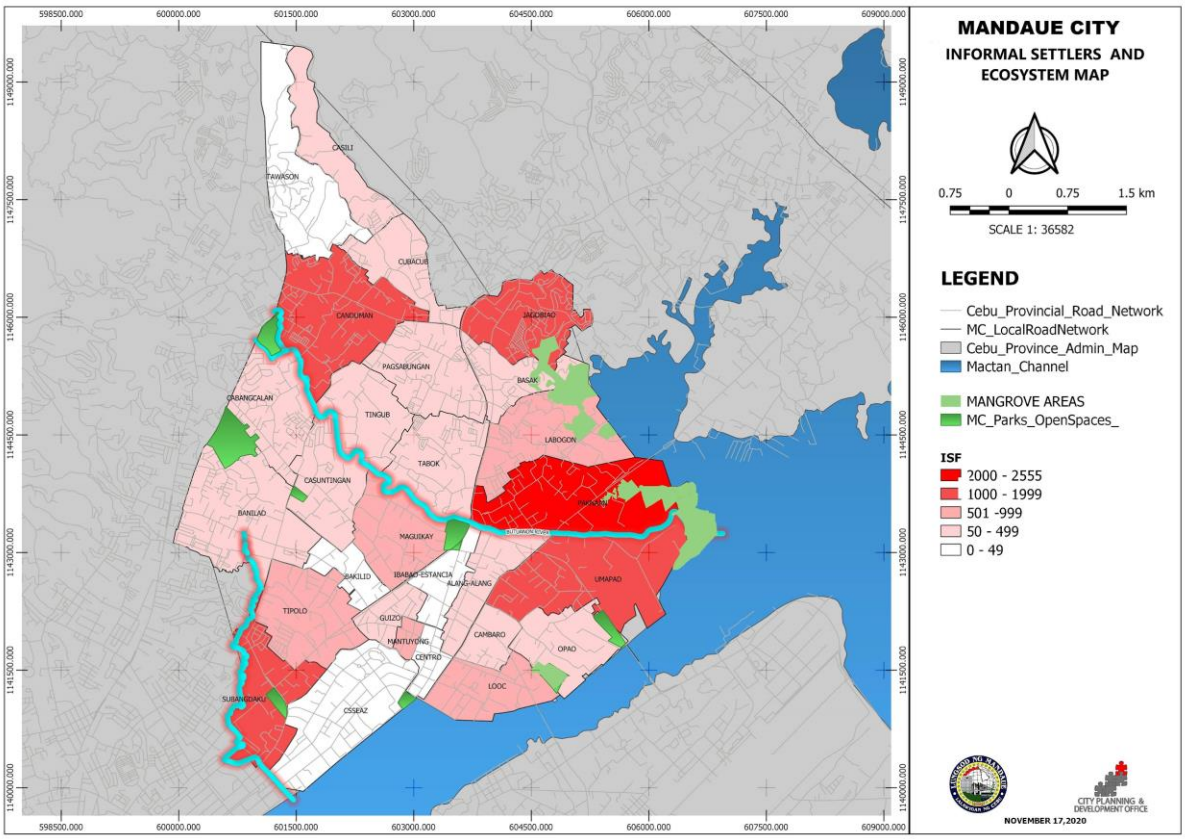

Figure 16. *Mandaue City Informal Settlers and Ecosystem Map*
Source:

Table 4.

Outcome	Project/ Programs	Activities	Output Indicators	Prioritization			Implementing Entity	Collaborating Partners	Resources Required	Budget Required
				ST	MT	LT				
For Vulnerable Informal Settler Families										
Climate change adaptive and disaster resilient homes for every (ISF) family in Mandaue City having access to opportunities for socio-economic development achieved through partnership among participative and empowered communities and various stakeholders.	1. Housing Program and Relocation Site +E7:E12	1.1. Profiling of Housing Program Beneficiaries	baseline profile			/			human resources	
		1.2. 9.2 (???) Maharlika, Tipolo site development	300 HH			/		SHFC/LGU	lot area, housing cost, electricity and water connection	26 million

		1.3. Casili Relocation Site (LOT Acquisition Only)	250 HH			/		DSHUD/LGU/NGO/NHA	lot area, housing cost, electricity and water connection	250 Million
	2. Group Housing Program	2.1. Formulation of Local Housing Trust Fund	housing trust fund availed			/		LGU/IPI/HDMF/NHA	lot area, housing cost, electricity and water connection	Subject for updating 20-29 budget c/o HUDO (80%)
		2.2. Construction of MMVHAI, Subangdaku Housing	282 Households to be constructed			/		Vicentian Foundation/LGU/ CDMC Costractor	lot area, housing cost, electricity and water connection	still coordinating w/ CDMC contractor for MOA Signing
	3. Low Rise Housing project, enter into joint venture with private developer for the horizontal development based on RA 7179	3.1. Allocate budget for site development from IRA,	Year 2018-2020 = 8,461HH; Year 2021-2023 = 8,707HH; Year 2024-2026 = 8,968HH; Total = 26,136 HH			/		NHA/DSHUD/LGU/SHFC/HABITAT FOR HUMANITY/GAWAD KALINGA/JPIC/ TUBIG PAG ASA/WATER & LIFE/HOMELESS FEDERATION/ PACSIL,CEBU CONTRACTORS ASSOCIATION/ DSWD REGION VII/DOLE/ACA	lot area, housing cost, electricity and water connection	125 million

								DEME SECTORS/FORGE/MANDAUE CHAMBER OF COMMERCE		
		3.2. Matching Funds to invite partners to provide funds for housing and resettlement	baseline profile			/			human resources	
		3.3. Implementation of Community Mortgage Program (CMP)	300 HH			/		SHFC/LGU	lot area, housing cost, electricity and water connection	26 illion
	4. Lot Acquisition modalities, Secure tenure arrangement on land	4.1. Conduct inventory of land, profiling of the land identified: name of owners, characteristics, price, etc. for possible negotiation	250 HH			/		DSHUD/LGU/NGO/NHA	lot area, housing cost, electricity and water connection	250 llion

	5. Partner-ships with Pag ibig, SHFC, private developers and other NGO'	5.1. Coordination with agencies for its suitability: DENR/MGB/ NHA etc.	housing trust fund availed			/		LGU/IPI/HDMF /NHA	lot area, housing cost, electricity and water connection	subject for updating 20-29 budget c/o HUDO(80%)
Access to potable water for ISF and communities along coastal areas and riverbanks	6. WASH (Water Sanitation Hygiene)	6.1. Conduct of Yearly water testing and monitoring on all deep wells and other sources of water	Water is treated and is safe for domestic use and drinking; and Healthy and clean environment, ,, deepwells and other sources of water are safe from contaminations of bacterais			/	CHO	CHO/ LGU/CEO/HUDO/ BLGU/ MCENRO/ RRF/NGO/PFR /DGS/ MCWD	Funds, Water Sample Test Kits, Labor	2,000,000
		6.2. Collaboration with other institutions for assistance /funds	Access funds and projects are fully implemented	/			CHO	CHO/ LGU/CEO/HUDO/ BLGU/ MCENRO/ RRF/NGO/PFR /DGS/ MCWD/ CBO	Logistics	100,000

		6.3. Training on water electrolysis device household level	1,003 HH of ISF/indigent families acquired electrolysis device for 23 Barangays			/	DRRMO	CHO/ LGU/CEO/HUDO/ BLGU/ MCENRO/NGO /PFR/DGS/ MCWD/ DRRMO/ PDRRMO	Plastic Galoons, Faucet, electrical rod, EDI (Electrodialysis dessalinator), PH Tester, Labor	1,600,000
		6.4. Installation of rain water catchment per sitio	organized water management group/sitio constructed water catchments in 405 sitios spread in 27 Barangays in Mandaue City			/	DGS-CEO-BLGU	PDRRMO, PFR, BLGU, NGO, LGU	Plastic Drums containers, angle barss, faucets, labors	1,300,000
		6.5. Monitoring and Evaluation	Conducted # of periodic M&E activities			/	CHO, HUDO	CHO/ LGU/CEO/HUDO/ BLGU/ MCENRO/NGO /PFR	Logistics	100,000
10,028.00 of ISF have access to alternative livelihood (more job &	7. Livelihood and Employment project support (critical	Review profile (per community) of beneficiaries to determine existing sources of income	baseline profile of livelihood and employment beneficiaries	/			HUDO, BLGUs	LGU/BLGU,PESO/COOPERATIVES/PO's/NGO's, PSA(POPCOM-POPDEV),	Logistics	30,000

livelihood opportunities and stable income for ISF and vulnerable communities …increased of health safety/ reduced poverty	areas mangrove, riverside etc)	classification of ISF. Beneficiaries need to be members of Mandauec City Cooperatives or any cooperative						HUDO, OSM		
		7.1. Identification of beneficiaries	# of beneficiaries	/			HUDO, BLGUs	BLGUs, HUDO, Purok Leaders - OSM	Logistics	10,000
		7.2. Conduct skills and livelihood trainings	# of training conducted, #of beneficiaries	/			PESO, COOP	DOLE/ TESDA / LGU/ BLGU/ DTI/ DSWD/ CSWS/ PESO/ MCCI/ COOPERATIVES/ PFR/ PO's/ NGO's/ MIPAC/ MCCI OSM	transportation allowance, training, meals and snacks, training materials	1,600,000
		7.3. Networking with MCCI Business sector for skills-to-job matching (Jobs fair - for employment) and linkages /partnership of new businesses (Business	# of beneficiaries linked/employed to MCCI for Job/ Business Partnership	/			LGU, MIPAC	CHO/ LGU/CEO/HUDO/ BLGU/ MCENRO/NGO/PFR/DGS/ MCWD/ DRRMO/ PDRRMO	Logistics	100,000

		Sector)								
		7.4. Starting and growing a business (Capital for business)	#of business started and		/		BPLO	PDRRMO, PFR, BLGU, NGO, LGU	Feasibility Studies	10,000,000
		7.5. Monitoring and evaluation	Amount of Sales and Revenue Report/ Accomplishment Report/ Job Employment and Increase of Income			/		PESO, COOP, MIPAC & MCCI, HUDO, OSM	Logistics	100,000
	8. Main-stream Purok Manage-ment system	8.1. Coordination with barangay LGU	# of brgy participating in Purok system		/		**OSM**	DENR/ MCENRO/ DA/ LGU/ BLGU/ ACADEME/ PUROK MEMBERS, BLGU, MDRRMO, HUDO	LOGISTICS,FOOD AND ACCOMODATION	4,500,000
		8.2. Conduct orientation on Purok system	# of orientations and # of participants; # of organized		/		HUDO, BLGUs	BLGUs, HUDO, Purok Leaders - OSM	Logistics	10,000

			BPOT in 27 Barangays (Priority baranagys along the coastal and riverside)							
		8.3. Creation of Purok Database	# of purok members registered			/	PESO, COOP	BLGU, HUDO, LGU	3rd Party for development of Purok Database	12,500,000
		8.4. Monitoring and Evaluation	# of reports submitted, # of active purok leaders and officers, # of purok projects; P			/	LGU, MIPAC	OSM, HUDO,	Logistics	
For Wetland Ecosystems										
Adopt an Integrated Ecosystem Management approach (Butuanon river-Mangrove-Nearshore area), a strategy to promote altogether the	9. Butuanon-Mahiga Rivers Watershed Management Board	9.1. Conduct of Regular meeting/planning	6 of meetings conducted/yr 6 of resolutions passed and adopted/yr	/			LGU(MCENRO as Secretariat)	DENR EMB, River Dischargers, DILG, DPWH, CHED, DepEd, NEDA, BFAR, DOH LGUs-Cebu City, Business Sector/CCCI/MCCI MCWD, Academe,		30,000

conservation and sustainable use of the interrelated and inter-dependent ecosystems. All stakeholders following integrated ridge-reef ecosystem management system								NGO (Cebu Uniting for Sustainable Waters), PCAPI7 BLGUs/HOAs/ISF		
		9.2. Assist/Coordinate in the Conduct of Research and Evaluation of Butuanon River Interventions such as but not limited to bio remediation interventions	research and evaluation studies conducted research/evaluation results/recommendations adopted by the board	/						400,000
		9.3. Assist/Coordinate in the Conduct of Beautification through Community Involvement for Butuanon River Rehabilitation (Ii.e. Bamboo Planting, Community Home Gardening)	No. of bamboo balls planted Area planted/rehabilitated No. community home gardens trained or	/						150,000

			implemented							
	10. Flood control projects along Butuanon River	10.1. Assist in Feasibility Study and Planning	FS/Plan (and budget)		/		DPWH	CPDO, CEO, MCENRO BLGUs		30,000
		10.2. Facilitate permit compliance with relevant laws for site preparation, moblization, construction completion including SW disposal or clean up by the DPWH/Contractors	No. of permits/clearances released/issued for the project		/		MCENRO, DENR EMB	CPDO, CEO, BLGUs		30,000
		10.3. Assist in Monitoring and Evaluation	No. of monitoring conducted			/	DPWH, CPDO	CEO, MCENRO BLGUs		60,000
	11. Eco-fencing of Butuanon River stretch	11.1. Profiling and mapping of ISF/HOAs and business establishments/River Dischargers located along BR stretch	No. of ISF/establishments profiled and mapped	/			MCENRO	CPDO, HUDO, Brgys	GIS	150,000
		11.2. IEC of affected ISFs/HOAs	No. of IEC conducted to ISFs/HOAs	/			MCENRO	HUDO, Brgys	IEC materials, etc (graphics/layo	150,000

		along BR stretch	and BLGUs						ut, printing)	
		11.3. Installation of eco-fence in collaboration with local stakeholders (i.e. community/village-based groups, ISF, business sector/MCCI)	1.06 Kilometers pilot areas ecofence installed in Butuanon River		/		MCCI, LGU	CPDO, MCENRO, DGS, CEO BLGUs, ISF/HOAs, community/village-based groups		300,000
		11.4. Monitoring and Enforcement	Sustained monitoring and surveillance No. of violations recorded No. of monitoring/surveillance conducted			/	MCENRO, HUDO, BLGUs	DENR EMB, , City Agri	Orientations/ trainings on apprehension, enforcement management, etc	500,000
		11.5. Assist in the Preservation and maintenance of eco-fence	Eco-fence maintained and preserved.			/	MCCI, LGU	BLGUs		300,000

	12. Intervention for informal settlers along Butuanon River and Mahiga Rivers	12.1. Profiling and mapping of ISF along the river stretch	No. of affected ISF properly profiled and mapped	/			HUDO, BLGUs	CPDO, OSM	GIS	90,000
		12.2. IEC on affected ISF from 2 rivers	No. of IEC conducted to ISF and brgys	/			MCENRO, BLGUs	HUDO, OSM	IEC materials, etc (graphics/layout, printing)	750,000
		12.3. Facilitate in providing programs/skills development for affected ISF	No. of ISF provided with skills/livelihood trainings	/			LGU, MCCI, BLGUs	OSM, HUDO, PESO, DOLE, TESDA	livelihood and skills training, business development progrmans	150,000
	13. Establishment of garbage "trapper" in selected sites of Butuanon and Mahiga Rivers	13.1. Site selection and profiling of selected sites/areas for trap establishment	Location of traps and site profile	/			MCENRO, DENR EMB	BLGUs, SWMB	GIS	60,000
		13.2. Establishment of Traps along river stretch	10 of traps installed along river stretch/yr	/			BLGUs, MCENRO	SWMB, River Dischargers	materials and labor for traps	240,000
		13.3. IEC to adjacent communities/ Brgys and	No. of IEC conducted and target communities/	/			BLGUs, MCENRO	SWMB, River Dischargers	IEC materials, etc (graphics/layout, printing)	150,000

		commercial establishments along BR/MR	Brgys and commercial establishments reached							
		13.4. Regular Garbage Collection and Maintenance	Volume of trash collected).	/			BLGUs, DGS	MCENRO	traps/design, garbage collector,trucks	90,000
		13.5. Monitoring and Enforcement	Sustained monitoring and survellance No. of violations recorded No. of monitoring/ survellance conducted			/	MCENRO, BLGUs	DENR EMB	Orientations/ trainings on apprehension, enforcement management, etc	c/o 3.4 budget
	14. Water Quality monitoring in place with other stakeholders	14.1. Site selection and profiling	No. monitoring site identified and mapped	/			MCENRO, DENR EMB	SWMB, BLGUs	GIS	60,000
		14.2. Conduct Regular Monitoring	Sustained monitoring and survellance No. of monitoring			/	MCENRO, DENR EMB	SWMB, BLGUs	monitoring equipment and reagents	1,200,000

			conducted No. of sites monitored							
		14.3. IEC to adjacent communities/ Brgys and commercial establishments along BR/MR (especially those discharging wastewater)	No. of IEC conducted No. target communities/ Brgys and commercial establishments reached	/			MCENRO, BLGUs	DENR EMB, SWMB	IEC materials, etc (graphics/layout, printing)	300,000
	15. Solid Waste Management (i.e. MRF, segregation, schedule collection, recycling system and diversion programs)	15.1. Conduct IEC in Brgys, schools and selected establishment	No. of targets groups/individuals reached by IEC campaign No. of IEC campaign conducted No. of IEC materials distributed	/			BLGUs, MCENRO	DENR EMB, DepEd, River Dischargers	IEC materials, etc (graphics/layout, printing)	300,000
		15.2. MRF establishment in brgys	Increase the number of brgys with functional	/			BLGUs	MCENRO, DENR EMB	construction materials, training/IEC materials	

			MRF from the current 5 brgy							
		15.3. Segregation at source and segregated collection	Regular weekly collection and segregation	/			BLGUs	MCENRO, DENR EMB		150,000
		15.4. Monitoring and Enforcement	No. of violations recorded No. of monitoring/surveillance conducted			/	MCENRO	DENR EMB	RDO, camera, recording materials	1,000,000
Develop and implement integrated mangrove forest management system of Mandaue (i.e. building with nature approach) To make Mandaue a model of mangrove protection,	16. Maintained Carbon Sink by establishing the MC Mangrove EcoPark (coastal green park)	16.1. Ecological Mangrove and other mangrove studies conducted	No. of studies conducted No. of studies' recommendation/ methods replicated or adopted	/			Academe, NGOs, private individuals/ researchers/MCENRO	City Agri, BLGUs, CPDO	GIS	1,000,000
		16.2. IEC to BLGUs/communities/ISFs and Establishments affecting mangrove	No. of targets groups/individuals reached by IEC campaign No. of IEC	/			MCENRO,	City Agri, BLGUs, HUDO	IEC materials, etc (graphics/layout, printing)	300,000

urban resilience, empowers multi-stakeholders to work together in Mandaue City Environmental and development plans, policy, regulation, priorities to compliment on sustainable forest/mangrove management		areas	campaign conducted No. of IEC materials distributed No. of brgys with mangrove nursery							
		16.3. Conduct Monitoring and Enforcement	Sustained monitoring and survellance No. of violations recorded/ or violaters apprehended			/	MCENRO	City Agri, BLGUs PNP	Equipment (Binoculars, Drones), Orientations/ trainings on apprehension, enforcement management, etc	1,000,000
	17. Community/ village-based protection and rehabilitation (i.e. establishment of mangrove nursery/ Propaga-	17.1. Establishment of mangrove nursery in Brgy Jajobiao	No. of seedlings produced/ planted No. hectares planted 3 brgys with mangrove nursery	/			City Agri, BLGUs,POs,	DENR/BFAR NGOs/Academe	nursery materials and supplies	450,000
		17.2.	No. of	/			City Agri,	POs	training	180,000

	tion, monito-ring, etc)	Training for mangrove propagation and nursery establish-ment	individuals trained No. of village-based groups/POs/brgys trained with mangrove nrusery				NGOs/Academe, BLGUs	DENR/BFAR	specialist from DENR, BFAR, City Agri, Academe/NGOsetc. training materials	
		17.3. Skills training and business/livelihood development training	No. of individuals trained No. of trainings conducted	/			LGU, MCCI, BLGUs	TESDA, DTI, DOT, Academe, NGOs	training specialist from DTI, DOT, PESO, etc. training materials	480,000
		17.4. IEC to communities/ villages among or brgys with mangroves and other stakeholdes	No. of targets groups/individuals reached by IEC campaign No. of IEC campaign conducted No. of IEC materials distributed	/			MCENRO, City Agri, BLGUs	CVO/Pos /HUDO NGOs /Academe	IEC materials, etc (graphics/lay-out, printing)	450,000
		17.5. Monitoring and	Nursery and planted areas maintained			/	Brgys/POs NGOs	MCENRO, City Agri		500,000

		Maintenance	and monitored							
	18. Intervention for ISFs/HOAs regarding Mangrove Forest Destruc-tion and Conver-sion	18.1. Profiling and mapping of vulnerable ISFs/HOAs	No. of affected ISFs/HOAs properly profiled and mapped	/			MCENRO, BLGUs, HUDO	CPDO	GIS	150,000
		18.2. IEC on vulnerable/affected or displaced ISFs/HOAs	No. of IEC conducted	/			MCENRO, BLGUs	HUDO	IEC materials, etc (graphics/layout, printing)	c/o 8.2 IEC budget
		18.3. Coordinate with other dept/gov't agency for relocation/resettlement program	No. of vulnerable families/ISF properly relocated from BR/MR stretch	/			HUDO, BLGUs	HUDO, DGS, CPDO, BLGUs		60,000
		18.4. Facilitating programs/skills development (including resource mobilization for groups) for vulnerable/ affected ISFs/HOAs,	No. of vulnerable ISFs/HOAs provided with skills/lively-hood trainings	/			LGU, MCCI, BLGUs	MCENRO, HUDO, DOLE, TESDA,	livelihood and skills training, business development programs	300,000
Harmonize development and conservation	19. Environmental projects/programs	19.1. Conduct Natural Resource Inventory	Natural resource inventory (including			/	NGOs, Academe, researchers/ institutions	MCENRO, CPDO, OSM, HUDO SP/CMO	GIS Equipment/Devices/Soft-ware	3,000,000

plans to mitigate impacts of big future infrastruc-ture projects of MC (i.e. building with nature approach)	to mitigate impacts of developm ent projects (i.e. reclamatio n, coastal roads) to coastal communiti es and mangrove forest	(including resource valuation study)	resource valuation?)					DENR, DFAR, DPWH, DOT, CSO Brgys, Youth, POs Business Sector/MCCI	Technical personnel	
		19.2. Conduct Scientific studies/baseli ne assessment as reference for EIAs of reclamation development (with academe and research institutions/i ndividuals)	Scientific/bas eline studies available as reference for decision-making and modelling			/	NGOs, Academe, researchers/ institutions	MCENRO, CPDO, OSM, HUDO SP/CMO DENR, DFAR, DPWH, DOT, CSO Brgys, Youth, POs Business Sector/MCCI	GIS Equipment/De vices/Software Technical personnel	5,000,000
		19.3. Assist in training programs for livelihood and business enhance-ment or skills development for communities struggling with	Vulnerable communities/ individuals trained on skills and business development as well as on environment al planning and decision-making			/	MCENRO, CPDO, OSM, BLGUs	PESO, DOLE, DTI, SP/CMO DENR, DFAR, DPWH, DOT , Youth, POs CSOs,NGOs, Academe Business Sector/MCCI	livelihood and skills training, business development programs	1,000,000

		environment-tal conflicts								

Supply of Goods and Resources

Mandaue City is dependent on neighboring LGUs for a major source of water, food, and raw material supply, the efficiency, resilience and sustainability is contingent on collaboration, partnerships and proper management of these sources. The following interventions on the supply of goods and resources were designed towards establishing external partnerships and increasing internal capacity and infrastructure. As such this strategy aims to secure sustainable access to water resources and basic goods in Mandaue City by 2029. This will be achieved by:

- Ensuring sufficient supply of basic goods and resources from source to delivery to consumers, at all times by 2029.
- Managing the impacts of salt water intrusion and increasing supply of water by 70% by 2029

Table 5.

Outcomes	Project/ Program	Activities	Output Indicators	Prioritization			Implementing Agencies	Collaborating Partners	Resources Required	Budget
				ST	MT	LT				
For water resources										
Development of an integrated water management system of Mandaue City management	1. Establishment of a Mandaue a local water management board through Executive Order	1.1. Institutionalized the Mandaue Local Water Management Board through Ordinance and Executive	Updated database for all barangays	/			MCENRO, CPDO	CPDO, MCENRO, CEO, CHO,SP, All Barangays		50,000

system adopted and implemented in all barangays with the participation of local communities.	and Ordinance	Order								
		1.2. Conduct coordination meeting to all barangays for the establishment of a Local water management board	Updated water resource database	/			CPDO	Wetlands International, MRN		200,000
		1.3. Consultation of integrated Water Management System framework across all levels of governance (Review and Update Related Policy)	Reviewed and updated policy	/			MCENRO, CEO, CHO	UPCENVI, USC-WRCFI, MRN		50,000
		1.4. Knowledge Management System related activities	Functional local management body	/			MCENRO, CPDO	Barangay based local water work bodies (MCCI,		50,000

		(1.a Data gathering – secondary, e.g Level of salt water intrusion 1.b Document and Policy Review - Ordinance on Water Extraction						MCWD, DENR, NWRB, water refilling stations), SP		
		1.5. Technical Dialogue or Summit of Stakeholder	Water Management Plan, M & E System	/			MCENRO, CPDO	MCWD, DENR		50,000
		1.6. Drafting of the Management Plan	Approved Mgt Plan	/			MCENRO, CPDO			
		1.7. Implementation/Adoption of the framework		/						
		1.8. Information Education Campaign (IEC)	# of IEC materials produced and distributed # of target brgys/individu	/			MCENRO, CPDO	Barangay based local water work bodies (MCCI, MCWD, DENR,		50,000

			als reached through IEC					NWRB, water refilling stations)		
Optimum procurement solution for long term efficient and climate-resilient water supply infrastructure needs of the city	2. Public Private Partnership to finance, design and construct all the components for water supply systems namely : source facilities, treatment facilities, pumping facilities, storage facilities, transmission and distribution facilities	2.1. Facilitate/ commissioning of desalination plants/ projects that would cover the supply-demand gap between the consumers of MCWD and the supply of water.	# of resolutions/endorsement/permits/clearances issued to support the project		/	/	CEO, MCENRO, CPDO	MCWD, USC-WRCFI	Fund source/ technical PPP staff	300,000
Consolidated efforts, resources and commitment towards the implementation of a mutually beneficial	3. Inter-LGU watershed rehabilitation	3.1. Intercity watershed assessment	XX% of watershed assessment		/		MCENRO, OSM	SP Committee on Environment	Reciprocal watershed cham-pions and technical staff & pooled funds for project/ activity	500,000

watershed rehabilitation system based on evidence-based assessments									implementation	
		3.2. Formation of intercity watershed board	Board created	/			MCENRO, OSM	LGUs of Cebu, Consolacion, Talisay, DENR	Dedicated technical staff identified	200,000
		3.3. Development of Watershed Rehabilitation Plan	Water Rehabilitation Plan	/			MCENRO, OSM	LGUs of Cebu, Consolacion, Talisay, DENR	Pooled funds and dialogue facilitator/coordinator	2,000,000
Secured water storage and natural recharge to enhance water reserves and secure sufficient resources for current and future needs	4. 3R's – WATER RECHARGE, REUSE, RETENTION	4.1. Training on water recharge, retention and Re-use	# of trainings conducted # of participants/ brgy trained	/			MCENRO, OSM	LGUs of Cebu, Consolacion, Talisay, DENR	Technical training, pooled funds	300,000
		4.2. Implementation of water Recharge technologies/ practices (Infiltration pits, tree planting, gully plugs, contour	# of recharge technologies installed in selected brgys	/			MCENRO, OSM, CEO	DENR, MRN, OSM	Technical training	50,000

		farming)								
		4.2.a. Site selection	# of sites identified	/			MCENRO, OSM, CEO	DENR, CPDO, DGS	Technical training	30,000
		4.2.b. Purchases of materials	X materials purchased	/			MCENRO, OSM, DGS	DGS, CEO	Technical training	500,000
		4.2.c. actual implementation of water recharge technologies and practices	# recharge technologies completed/installed	/			MCENRO, OSM, CEO	DGS, DENR, MCWD	Technical training	300,000
		4.3. Water Retention (Rain catchment, mini dams, dug wells)	# of retention technologies and infrastructures installed in selected brgys		/		MCENRO, OSM, CEO	DGS, DENR, MCWD	Technical training	100,000
		4.3.a. Site selection for rain water catchment, minidams, dug wells	# of sites identified	/			MCENRO, OSM, CEO	DGS, DENR, MCWD	Technical training	30,000
		4.3.b. actual implementation of water recharge technologies and practices	# recharge technologies completed/installed	/			MCENRO, OSM, CEO	DGS, DENR, MCWD	Technical training	300,000
		4.4. Water Re-use technologie							Technical training	

		s								
		4.4.a. Waste water collection	# of targeted STP concessionaries identified	/			MCENRO, CPDO, CEO	DGS, DENR, MCWD	Technical training, survey/study funds	500,000
		4.4.b. Support construction of desalination plant for adequate water supply	# of resolutions/endorsement/permits/clearances issued to support the project #water supply connection added from Desalination plant		/		MCENRO, CEO, CPDO	EMB, MCWD, SP	Funds	2,000,000
		4.4.c. Water technologies for Urban farmers	# of DIY drip irrigation in X brgys # of DIY drip irrigaion implemented by X individuals/HH	/			MCENRO, CEO, CPDO	MCWD, DENR	Technical training, funds	500,000
A rationalized flood control program by developing a	5. Continuity of Drainage Master Plan Recommendati	5.1. Proposed Sewage Treatment Plant in	# of sewage treatment constructed			/	MCENRO, CEO, CPDO	MCWD, EMB, DPWH	Funds, technical team	10,000,000

detailed engineering design to be prioritized in the implementation in six years'time	ons for Recharge Areas		communities along the river wherein the wastewater is then channeled into a treatment facility prior to disposal into the river. (Re-use)							
		5.2.	Installation of retention structures like enhancement or rehabiliation of detention basin or recharge areas in Cabancalan and Tipolo (retention)	# of retention structures constructed			/	CPDO, CEO	DPWH, MCENRO	Funds, technical team	62,600,000,000
		5.3.	Installation of service drainage	# and length of drainage lines			/	CPDO, CEO	DPWH, OSM	Funds, technical	520,400,000

			lines to all twenty seven (27) barangays	constructed						team	
		5.4.	Installation of u-ditches and flood gates	# of u ditches and flood gates installed			/	CPDO, CEO	DPWH, OSM	Funds, technical team	54,282,500
		5.5.	Widening and improvement of natural waterways and creek	Length of drainage line improved			/	CPDO, CEO	DPWH, OSM	Funds, technical team	711,200,000
		5.6.	Interventions for Butuanon River, Cabancalan Wetland, Tipolo Creek, Basak Creek Phase 2	Length of river banks, creeks rehabillitated and wetland master plan finalized and approved			/	CPDO, MCENRO	Wetlands International, DPWH	Funds, technical team	1,279,495,190
		5.7.	Interventions for all water catchments	all catchments effectively drain water			/	CPDO, CEO	DPWH,	Funds, technical team	3,243,193,056.35

		5.8.	Interventions for Butuanon River, Cabancalan Wetland, Tipolo Creek, Basak Creek Phase 1	Length of river banks, creeks rehabillitated and wetland master plan implemented			/	CPDO, CEO	DPWH,	Funds, technical team	2,179,699,426.36
		5.9.	Installation of new drainage lines under special conditions or traversing private developments/properties	Length of drainage line improved			/	CPDO, CEO	DPWH	Funds, technical team	283,200,000
For Supply Chain											
Development of Mandaue Supply Chain Framework to promote upgraded cost-related benefits/activiti	6. Supply chain mapping for consumer, manufacturers ,distributors and retailers-supply and	6.1.	Knowledge Management System related activities (1.a Data gathering – secondary, -	xx Portal Database on Producers and Manufactures ,distributors and retailers-supply and demand (not	/			CPDO, MISO, MIPAC	DTI VII, BPLO, CTO,	Funds, technical assistance	1,500,000

es and innovation for manufacturing/industry that will also ensure resilience and/or sustainability, responsiveness, and security.	demand		current supply chain dynamics	only in mandaue but for cebu province)						
MSMEs supported and adopted the rationalized supply chain infrastructure including physical and informational assets to ensure business continuity.		6.2.	Ensure enactment of supply chain policy support	· XX Functional local Supply Chain Management Body (EO)	/			CPDO	SP, DTI	Funds	100,000
		6.3.	Supply Chain stakeholder conference	# of trainings conducted # of participants/brgy trained"	/			CPDO, MISO, MIPAC	BPLO, DTI	Funds, manpower (secretariat)	500,000
		6.4.	Document and Policy Review :Mainstreaming of all business stakeholders framework	xx of business stakeholders framework per brgy.	/			CPDO	SP, BPLO, DTI	Funds, manpower (secretariat)	300,000

			across all levels of governance							
		6.5.	Drafting of the Supply Chain Management Framework Plan	· XX Supply Chain Management Framework Plan	/			CPDO	SP, MIPAC, BPLO	Funds, manpower (secretariat)	100,000
		6.6.	Implementation/Adoption of the framework	xx% of framework adopted or implemented	/			CPDO	SP, MIPAC	Funds, manpower (secretariat)	200,000
		6.7.	Information Education Campaign (IEC)	# of IEC materials produced and distributed # of target brgys/individuals reached through IEC	/			CPDO, MCENRO	Barangays, OSM	Funds, manpower (secretariat)	200,000
		6.8.	Identify gaps /bottlenecks infrastructures, access to information	# gaps identified			/	CTO	MIPAC	Funds, manpower (secretariat)	

		, policies								
	7. Online accessibility of supply and demand	7.1. Business continuity planning for different business	· XX% Fully online registraton of all business line			/	CPDO, CEO	Barangay based MSME's, BPLO	Funds, manpower (secretariat)	100,000
		7.2. Access of micro enterprises to big supplier	# of micro entreprises that have access to big supplier			/	CPDO	Barangay based MSME's	Funds, manpower (secretariat)	100,000
Secure, simplified connectivity and linkages between people, systems and data that matter to SCM governance	8. Effective collaboration of business	8.1. Strengthening the linkages of retailers and producers (rural-urban linkages)-building	· XX Reviewed and updated policy (Investment Code)			/	MIPAC	BPLO	Funds, manpower (secretariat)	200,000
Optimized, increased the innovative use of storage assets	9. Rationalized warehousing for climate Resilient	9.1. Establishing sufficient storage capacity (climate risk proof) effectively link all warehouses via private partnership	xx% utilized storage Installed			/	MIPAC	CTO, MCCI	Funds, manpower (secretariat), facilitator	1,000,000

		with chambers of commerce								
By 2029 Mandaue City should have installed cold storage facilities especially connected to the satellite markets	10. Public cold storage for products	10.1. Inventory of public cold storage	# of public storage operated			/	CPDO, MCENRO, DGS, CAO	CEO	Funds, technical team	500,000
		10.2. Installation of public storage facilities to satellite markets	# of public storage installed			/	CPDO, CEO		Funds, technical team	3,000,000
	11. Improve Urban gardening at the barangay level and private sector	11.1. Inventory of urban gardeners / barangay/ sector	# of urban gardeners per barangay and per private sector	/			CPDO, MCENRO	CAO	Funds	1,000,000

MANDAUE RESILIENCE NETWORK

#iamresilientmandaue

V. EMERGING CLIMATE CHANGE MITIGATION STRATEGIES

V. EMERGING CLIMATE CHANGE MITIGATION STRATEGIES

In 2016, a study on greenhouse gas emissions in Mandaue City was conducted as part of the Asia-Pacific Economic Corporation Low Carbon Model Town project. Since then, the report has been the primary source of information regarding emissions reduction initiatives in the City.

The baseline data gathered in 2015 estimates the GHG emissions total at 1.13 million Tco2, with a projection of 223% increase in emissions by the year 2030. The largest emission generating sectors coming from transport (0.55million tco2) and industry (0.45million Tco2), with additional information on emissions from commercial, residential and industrial sectors were included as well. (LCMT, 2016)

A research conducted by UP Cebu also indicated that the rapid development of Mandaue City has resulted into higher local temperatures as vegetation and natural landscapes are changed into buildings and structures. The findings report that transport and industrial emission, compounded by heavily build-up areas, contributes to developing hot zones in areas that correspond to industrial development zones of the city (GuHeat, 2019). Likewise, the GuHeat research findings also relay that cooler zones are noticeable near waterways, mangroves and vegetation, which seems to be reducing over the years.

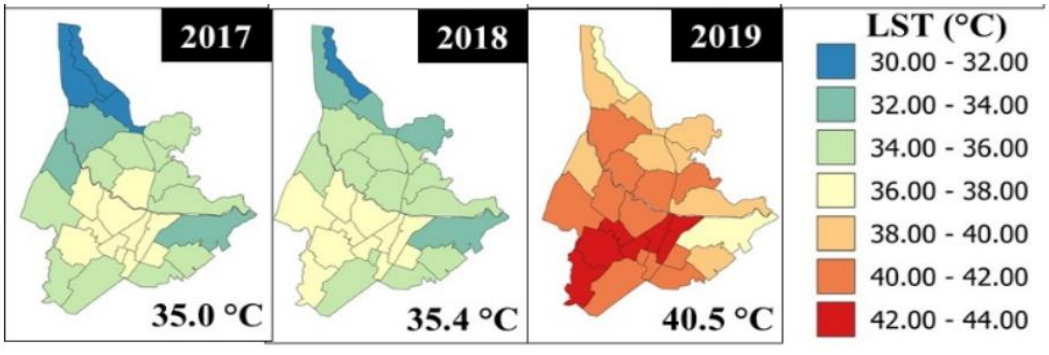

Figure 17. *GuHEAT research maps on annual average surface temperature, as shared by Doc. Aiza Cortes, UP Cebu*

In light of these findings, Mandaue City developed a three-fold mitigation strategy: 1) Greenhouse Gas Inventory, 2) Low Emissions Development Strategies and 3) Green Urban Development.

Mandaue's Greenhouse Gas Inventory

Building on the preliminary guidance from the LCMT, Mandaue City aims to develop a local greenhouse gas inventory that will prioritize emissions from the sectors of waste, transportation and industry of government institutions and community level. Other sectors that will be considered include residential energy consumption, forestry and agriculture.

- To gather information on greenhouse gas emissions to inform stakeholders and key industries on their carbon emissions
- To use the greenhouse gas inventory as a) basis to develop/support Mandaue's plans to be a Green City, by reducing or managing GHG/Carbon Emissions and b) to assess the performance of program in the city to reduce greenhouse gas emissions.

Key strategies include capacity building; data gathering, monitoring and knowledge management; policy advocacy and institutionalization of a low emissions development agenda.

Mitigation Strategies

In line with Mandaue's pursuit of green city development, their climate mitigation objective is to reduce carbon emissions by 15% by 2020 and 30% by 2030 in the city (LCMT, 2016), in support to and in complementation with its current and future demand for energy, transportation and management of waste.

Likewise, green urban development strategies have also been identified to develop or rehabilitate ecosystems to enhance carbon sinks and other benefits of open/natural spaces within the city.

Table 6.

Outcome Indicators	Program/Project	Activities	Resources Required	Budget
GHG Inventory	1. GHG Capacity building	1.1. Interdepartment /offices GHG training	Accommodations, Training facilities, Resource speaker, Meals, etc. Series training.	300,000.00
	2. GHG baseline data (Waste, Transpo and industry, energy use govt institutions) 1st wave	2.1. Mapping of Data Needs and data sources	Core group meeting, Facilitator (GHGI expert)	100,000.00
		2.2. Formation of GHG inventory team	Series of meetings	500,000
		2.3. Partnership with academe institution	Series of meetings, Budget needed is dependent on agreements in the MOA*	
		2.4. Capacity building on GHG (tools and GhG computation)	Facilitator (GHGI expert)	100,000
		2.5. Data gathering	Data collection team: Gadgets and personnel, operational costs	200,000
		2.6. Data consolidation and analysis	Personnel, tools, operational costs; GIS mapping*, technical writer	100,000
		2.7. Reporting	Technical writer* (consultant/job-order)	100,000
	3. GHG baseline data (focusing on: residential energy , forestry, agriculture emissions) 2nd wave	3.1-7. Same activities as Project 2.	Same as above	1,000,000.00

	4. 4GHG Monitoring	4.1. Development of database (and capacity 4development for use of database)		
		4.2. Conduct regular monitoring	I.T. officer/data-base developer, training/trainer	1,500,000.00
		4.3. Knowledge management on whole GHG inventory database process	Personnel, operational cost, etc	1,500,000.00
	5. GHG Policy Advocacy	5.1. Stakeholders consultation (community, indsutry, legistlative	Documenter*	500,000.00
		5.2. Low Emissions Development Institutionalization	IEC materials development, communication*, meetings and consultations,	200,000
Green Job generation	6. Green Building Program (scope: within the control of LGU, or private/business sectors)	6.1. 1.0 Baseline data for Certified Buildings. Clarification of the sources of data for monitoring green buildings (green spaces are lands with vegetation, open space, parks in government and private lots. It could also mean CERTIFIED	Funds Trainings BERDE Examination	100,000 300,000.00 300,000.00

		green buildings by certifying body) 6.2. Promotion of Green Building Certification 6.3. Dialogue on "Green Spaces among Green Loop/ Green Corridor Dev't" (Cebu, Mandaue, Lapu-Lapu and Municipality of Cordova) 6.4. Enhance partnership with Phil. Green Bldg. Council (PGBC)		
Reduce Electricity Consumption	7. Renewable energy (use of Photovoltaic/solar cell roofing): The projecti will start with the facilities owned by the city government including Old Mandaue Presidencia (current city hall) and sports complexes, followed by hospitals, schools and barangay halls.	7.1. Conduct baseline study on the potential for energy sources through solar rooftop and for computing for rainwater harvesting		
		7.2. Tagging of institutions, businesses applying REs		
		7.3. Review & Integration		

		of RE and energy efficiency use in Business Permit and Licensing System		
Better traffic mgt, and road side security; reduce electricity consumption, improved road use efficiency	8. Smart Corridor	8.1. Installation, maintenance and monitoring of LED streetlights with solar panels and wifi devices lined along the corridor	Personnel, equipment, tools	400,000
Use of low carbon emission fuel	9. E-trikes	9.1. Encourage the E-trikes feasibility study		200,000.00
Low-carbon emission vehicles/hybrid vehicles/mass transport	10. Bike lane corridor	10.1. Full implementation of planned (+/-) 60 kms. bike lane		
Comprehensive and Integrated Solid Waste Management (SWM) Plan for the City of Mandaue Reduce the volume of waste collected by the City and reduce costs of hauling	11. SWM (recycling and diversion system)	11.1. Strict segregation of waste and dispose it properly at designated landfills and recycling and diversion facility 11.2. Collect fees for the waste disposal (including HH) 11.3. Imposed heavy fine to those who throw wastes recklessly/indiscriminately (especially along water bodies) 11.4. Reduce/Eliminate	Manpower from BLGUs Synchronized IEC Materials Establishment of Materials Recovery Facility (MRF) Enactment of SWM Policies and Projects from the City and BLGUs SWM Equipment (Biodigester & Shredder Machines)	150M/yr

		the use of polyethylene bags (plastic holiday) 11.5. Encourage the waste recycle and waste reuse 11.6. Promote market opportunities for the recycled waste products 11.7. Enforce regulations and standards for the waste management 11.8. Raise public awareness on waste generation and disposal	GPS for garbage truck Participation of HH, Non-HH & Scrappers/junkshops/recycling facility on the recycling program of the City	
To maintain and enhance/increase green spaces and corridors of Mandaue as carbon sinks, in support to environmental conservation and management.	12. Mangrove sanctuary/protected area (73.7 hectares) protection and enhancement	12.1. Monitoring and Surveillance	monitoring euipment (CCTV, binoculars, cameras, GPS, etc), Training support Manpower	200,000.00/year
		12.2. IEC	Manpower, IEC materials and equipment	250,000.00/year
		12.3. Enhancement and maintenance	Seedlings, Manpower, Area for planting, Mangrove Nursery	150,000/year
		12.4. community-based Eco-tourism	Manpower and materials, Training support	1M/yr
		12.5. Ecological/ Research Studies	baseline date, Manpower/resources,	1M/yr

	13. Establishment and maintenance of Green Spaces/Corridors		Equipment	
		13.1. Implement of the Butuanon River Program (Class D, DAO-05-2014)		1.5M/yr
		13.2. IEC	Manpower, IEC materials and equipment	100,000/yr
		13.3. Baseline studies of green spaces	Manpower/technical support	300000 for yr 1
		13.4. Enhancement/ Propagation/Maintenance	Seedlings, Manpower Area for planting, Mangrove Nursery	150,000 per year

See Annex # for action plans and budget

MANDAUE RESILIENCE NETWORK
#iamresilientmandaue

VI. RESOURCE MOBILIZATION

VI. RESOURCE MOBILIZATION

In order to ensure the timely implementation of strategies, below is the resource mobilization plan developed by the MRN:

Table 7. *Vulnerable Informal Settler Families and Wetland Ecosystems*

Project/Programs	Activities	Target Resource Windows	Requirements	Focal Point
1. Housing Program and Relocation Site+E7:E12	1.1. Profilling			
	1.2. 9.2 Maharlika, Tipolo site development	20% Development Fund for 2021	For Endorsement with the RDC	HUDO
	1.3. Casili Relocation Site (LOT Acquisition Only)	Continuing appropriation of 20% Development Fund 2020 Php30 Million for Site Development	Refer to CPDO	
2. Group Housing Program	2.1. Formulation of Local Housing Trust Fund	20% from developer	C/o DSHUD	
	2.2. MMVHAI, Subangdaku Housing	Vicentian Foundation	Proposal to be submitted	
3. Low Rise Housing project, enter into joint venture with private developer for the horizontal development based on RA 7179	3.1. Allocate budget for site development from IRA,	Department of Human Settlements and Urban Development (Covers Maharlika, Tipolo and other relocation sites)	Community Base Initiative Approach (CBIA) in collaboration with NHA	
	3.2. Matching Funds to invite partners to provide funds for housing and resettlement	Department of Human Settlements and Urban Development (Covers Maharlika, Tipolo and other relocation sites)	HOA Accredited Members	
	3.3. Community Mortgage Program(CMP)	Department of Human Settlements and Urban Development (Covers Maharlika, Tipolo and other relocation sites)	Local plan and City Ordinance for approval, needs to be approved and endorsed in order to access the funding	
4. Lot Acquisition modalities, Secure	4.1. Conduct inventory of land, profiling of the land identified:	Continuing appropriationg for 20% Development Fund 2020	Offer To sell	

tenure arrangement on land	name of owners, characteristics, price, etc. for possible negotiation	Php 20M (For victims of calamities and informal settlers)		
5. Partnerships with Pag ibig, SHFC, private developers and other NGO'	5.1. Coordination with agencies for its suitability: DENR/MGB/NHA etc.	Department of Human Settlements and Urban Development (Covers Maharlika, Tipolo and other relocation sites)	Offer To sell	
6. WASH (Water Sanitation Hygiene)	6.1. Yearly water testing and monitoring on all deep wells and other sources of water	CHO, MCWD, PFR	List of Inventory of Deep Well and other sources, results of water test, project proposal	CHO
	6.2. Collaboration with other institutions for assistance/funds	CHO,CENRO, CEO	Series of Meetings, Project Proposals, Feasibility Studies	CHO
	6.3. Training on water electrolysis device household level	PFR, PDRRMO, DRRMO	Orientation, Project Proposals	DRRMO
	6.4. Installation of rain water catchment per sitio	PFR, PDRRMO, DRRMO	Orientation, Project Proposals	DRRMO
	6.5. Monitoring and Evaluation	LGU	Submission of complete data and list of beneficiaries	CHO, HUDO
7. Livelihood and Employment project support (critical areas mangrove, riverside etc)	Review profile (per community) of beneficiaries to determine existing sources of income classification of ISF. Beneficiaries need to be members of Mandauec City Cooperatives or any cooperative	Partnership building with Non-government organizations; NGAs with budget for livelihood programs: Explore PSF or PCF	Memorandum of Agreement with new partners	COOP, PESO, HUDO
	7.1. Identification of beneficiaries	BLGU	Proposal development/ requirements from fund windows	
	7.2. Conduct skills and livelihood trainings	TESDA, DTI, PESO, COOPERATIVES, PFR,	Beneficiaries Profile, Letter of Proposal, MOU/MOA with partners Gas	

	7.3. Networking with MCCI Business sector for skills-to-job matching (Jobs fair - for employment) and linkages/partnership of new businesses (Business Sector)	Regular activity of PESO; Covered by PESO budget, MIPAC-MCCI	For Employment: Training Certificate, Resume, MedCert For New Business: Business Permit and Clearances and Letter of Intent to MCCI	MPAC, PESO
	7.4. Starting and growing a business (Capital for business)	DTI, DOLE, Cooperative Office, PFR	Business Proposal, Business Permit, DTI Permit and other clearances	MPAC, PESO
	7.5. Monitoring and evaluation	Partnership building with Non-government organizations; NGAs with budget for livelihood programs /Coop Office	Manpower	
8. Mainstream Purok Management system	8.1. Coordination with barangay LGU	LGU funds	Coordination with BLGU for Participants	OSM
	8.2. Conduct orientation on Purok system			
	8.3. Creation of Purok Database		Brgy Data and Records	
	8.4. Monitoring and Evaluation			
9. Butuanon-Mahiga Rivers Watershed Management Board	9.1. Regular meeting/planning	MHRWMB	*technical *personnel/representation	MCENRO
	9.2. Assist/Coordinate in the Conduct of Research and Evaluation of Butuanon River Interventions such as but not limited to bio remediation interventions	MHRWMB	*research already identified *funds available	MCENRO
	9.3. Assist/Coordinate in the Conduct of Beautification through Community Involvement for Butuanon River Rehabilitation (Ii.e. Bamboo Planting, Community Home Gardening)	MHRWMB	*materials *funds/budget	MCENRO

10. Flood control projects along Butuanon River	10.1. Assist in Feasibility Study and Planning	DPWH	FS/Plan	DPWH
	10.2. Facilitate permit compliance with relevant laws for site preparation, moblization, construction completion including SW disposal or clean up by the DPWH/Contractors	20% Development Fund for 2021	*permits/documents	MCENRO
	10.3. Assist in Monitoring and Evaluation	20% Development Fund for 2022	*manpower	DPWH
11. Eco-fencing of Butuanon River stretch	11.1. Profiling and mapping of ISF/HOAs and business establishments/River Dischargers located along BR stretch	20% Development Fund for 2023	*manpower *communication *budget allocation	MCENRO
	11.2. IEC of affected ISFs/HOAs along BR stretch	20% Development Fund for 2024	*IEC design/material *technical support/experience for IEC production and IEC campaign *IEC target identified	MCENRO
	11.3. Installation of eco-fence in collaboration with local stakeholders (i.e. community/village-based groups, ISF, business sector/MCCI)	MCCI/business sector	*materials *funds	DGS
	11.4. Monitoring and Enforcement	20% Development Fund for 2024	*manpower *monitorng communictions	CEO/DGS
	11.5. Assist in the Preservation and maintenance of eco-fence	20% Development Fund for 2025	*manpower *budget allocation	DGS
12. Intervention for informal settlers along Butuanon River and Mahiga Rivers	12.1. Profiling and mapping of ISF along the river stretch	20% Development Fund for 2026	*manpower *communication *budget allocation	MCENRO
	12.2. IEC on affected ISF from 2 rivers	20% Development Fund for 2027	*IEC design/material *technical support/experience for IEC production and IEC	MCENRO

			campaign *IEC target identified	
	12.3. Facilitate in providing programs/skills development for affected ISF	PESO/DOLE/Business Sector	*manpower *training programs *budget	HUDO
13. Establishment of garbage "trapper" in selected sites of Butuanon and Mahiga Rivers	13.1. Site selection and profiling of selected sites/areas for trap establishment	20% Development Fund for 2027	*manpower *technology design *budget	DENR
	13.2. Establishment of Traps along river stretch	DENR 20% Development Fund for 2027		MCENRO
	13.3. IEC to adjacent communities/Brgys and commercial establishments along BR/MR	20% Development Fund for 2027	*IEC design/material *technical support/experience for IEC production and IEC campaign *IEC target identified	MCENRO
	13.4. Regular Garbage Collection and Maintenance	20% Development Fund for 2027	*manpower/SW collection *budget allocation	BGLU/DGS
	13.5. Monitoring and Enforcement	20% Development Fund for 2027	*manpower *communication *budget allocation	MCENRO
14. Water Quality monitoring in place with other stakeholders	14.1. Site selection and profiling	DENR 20% Development Fund for 2028	*water quality meter *technical personnel *budget allocation	MCENRO
	14.2. Conduct Regular Monitoring	DENR 20% Development Fund for 2029	*water quality meter *technical personnel *budget allocation	MCENRO
	14.3. IEC to adjacent communities/Brgys and commercial establishments along BR/MR (especially those discharging wastewater)	DENR 20% Development Fund for 2030	*IEC design/material *technical support/experience for IEC production and IEC campaign *IEC target identified	MCENRO
15. Solid Waste Management (i.e.	15.1. Conduct IEC in Brgys, schools and selected establishment	Cost Structure budget (6%)	*IEC design/material *technical support/experience	MCENRO

MRF, segregation, schedule collection, recycling system and diversion programs)			for IEC production and IEC campaign *IEC target identified	
	15.2. MRF establishment in brgys	Cost Structure budget (6%)	*budget *area for MRF establishment *budget allocation	BLGU
	15.3. Segregation at source and segregated collection	Cost Structure budget (6%)	*manpower/SW collection *budget allocation	BLGU
	15.4. Monitoring and Enforcement	Cost Structure budget (6%)	*manpower *communication *budget allocation	MCENRO
16. Maintained Carbon Sink by establishing the MC Mangrove EcoPark (coastal green park)	16.1. Ecological Mangrove and other mangrove studies conducted	Green Green Green of DBM or other grants/extrenal funding	*technical expertise *availability of funds	MCENRO
	16.2. IEC to BLGUs/communities/ISFs and Establishments affecting mangrove areas	DENR /City Agru 20% Development Fund for 2032 FPE/DMBM/Landbank?Devt Bank	*IEC design/material *technical support/experience for IEC production and IEC campaign *IEC target identified	MCENRO
	16.3. Conduct Monitoring and Enforcement	DENR /City Agru 20% Development Fund for 2032 FPE/DMBM/Landbank?Devt Bank	*manpower *communication *budget allocation	MCENRO
17. Community/ village-based protection and rehabilitation (i.e. establishment of mangrove nursery/propagation, monitoring, etc)	17.1. Establishment of mangrove nursery in Brgy Jajobiao	DENR /City Agru 20% Development Fund for 2032 FPE/DMBM/Landbank?Devt Bank	*materials *manpower *budget allocation *area for nursery establishment	BLGU
	17.2. Training for mangrove propagation and nursery establishment	DENR /City Agru 20% Development Fund for 2032 FPE/DMBM/Landbank?Devt Bank		MCENRO
	17.3. Skills training and business/livelihood development training	PESO/DOLE/DTI/DOT Business sector	*manpower *business plan/livelihood plan or programs/projects	MCENRO

			*budget	
	17.4. IEC to communities/villages among or brgys with mangroves and other stakeholdes	DENR /City Agru 20% Development Fund for 2032 FPE/DMBM/Landbank?Devt Bank	*IEC design/material *technical support/experience for IEC production and IEC campaign *IEC target identified	MCENRO
	17.5. Monitoring and Maintenance	DENR /City Agru 20% Development Fund for 2032 FPE/DMBM/Landbank?Devt Bank	*manpower *communication *budget allocation	MCENRO
18. Intervention for ISFs/HOAs regarding Mangrove Forest Destruction and Conversion	18.1. Profiling and mapping of vulnerable ISFs/HOAs	DENR /City Agru 20% Development Fund for 2032 FPE/DMBM/Landbank?Devt Bank	*manpower *communication *budget allocation	MCENRO
	18.2. IEC on vulnerable/affected or displaced ISFs/HOAs	DENR /City Agru 20% Development Fund for 2032 FPE/DMBM/Landbank?Devt Bank	*IEC design/material *technical support/experience for IEC production and IEC campaign *IEC target identified	MCENRO
	18.3. Coordinate with other dept/gov't agency for relocation/resettlement program	HUDO/HLURB	*manpower *relocation plan *budget	HUDO
	18.4. Facilitating programs/skills development (including resource mobilization for groups) for vulnerable/affected ISFs/HOAs,	PESO/DOLE/DTI/DOT Business sector	*manpower *business plan/livelihood plan or programs/projects *budget	MCENRO
19. Environmental projects/programs to mitigate impacts of development projects (i.e. reclamation, coastal roads) to coastal communities and	19.1. Conduct Natural Resource Inventory (including resource valuation study)	Green Green Green of DBM or other grants/extrenal funding	technical expertise availability of funds	MCENRO
	19.2. Conduct Scientific studies/baseline assessment as reference for EIAs of reclamation development (with academe and research institutions/individuals)	Green Green Green of DBM or other grants/extrenal funding	technical expertise availability of funds	MCENRO

mangrove forest	19.3. Assist in training programs for livelihood and business enhancement or skills development for communities struggling with environmental conflicts	PESO/DOLE/DTI/DOT Business sector	technical expertise availability of funds	PESO/HUDO

Table 8. *Supply of Goods and Resources*

Project/Program	Activities	Target Resource Window	Requirements	Focal Point
12. Establishment of a Mandaue a local water management board through Executive Order and Ordinance	12.1. Institutionalized the Mandaue Local Water Management Board through Ordinance and Executive Order	CMO	Ordinance & Executive Order	CPDO
	12.2. Conduct coordination meeting to all barangays for the establishment of a Local water management board	MCENRO, City Mayor's Office	Activity Design	CPDO
	12.3. Consultation of integrated Water Management System framework across all levels of governance (Review and Update Related Policy)	CMO	Policy evaluation related to water management ordinance	CPDO
	12.4. Knowledge Management System related activities (1.a Data gathering – secondary, e.g Level of salt water intrusion 1.b Document and Policy Review - Ordinance on Water Extraction	CMO	Knowledge management plan	CPDO
	12.5. Technical Dialogue or Summit of	CMO	Activity design	CPDO

	Stakeholder			
	12.6. Drafting of the Management Plan	CMO	EO and creation of TWG	CPDO
	12.7. Implementation/Adoption of the framework			
	12.8. Information Education Campaign (IEC)	CMO	Communication plan	CPDO
13. Public Private Partnership to finance, design and construct all the components for water supply systems namely : source facilities, treatment facilities, pumping facilities, storage facilities, transmission and distribution facilities	13.1. Facilitate/ Commissioning of desalination plants/ projects that would cover the supply-demand gap between the consumers of MCWD and the supply of water.	CMO	Pre-feasibility/Feasibility studies	CPDO
14. Inter-LGU watershed rehabilitation	14.1. Intercity watershed assessment	CMO	Terms of Reference	CPDO
	14.2. Formation of intercity watershed board	MCENRO, City Mayor's Office	MOA	CPDO
	14.3. Development of Watershed Rehabilitation Plan	MCENRO, City Mayor's Office	Terms of Reference	CPDO
15. 3R's – WATER RECHARGE, REUSE, RETENTION	15.1. Training on water recharge, retention and Re-use	MCENRO, City Mayor's Office	Activity design	CPDO
	15.2. Implementation of water Recharge technologies/ practices (Infiltration pits, tree planting, gully plugs, contour farming)	MCENRO, City Mayor's Office	Activity design, POWE	CPDO
	4.2.a. Site selection	MCENRO, City	Activity design	CPDO

		Mayor's Office		
	4.2.b. Purchases of materials	MCENRO, City Mayor's Office	Canvass	CPDO
	4.2.c. actual implementation of water recharge technologies and practices	CMO	Activity design	CPDO
	15.3. Water Retention (Rain catchment, mini dams, dug wells)	CMO	POWE, activity design	CPDO
	4.3.a. Site selection for rain water catchment, minidams, dug wells	CMO	POWE, activity design	CPDO
	4.3.b. actual implementation of water recharge technologies and practices	CMO	POWE, activity design	CPDO
	15.4. Water Re-use technologies			
	4.4.a. Waste water collection	CMO	Feasibility study	CPDO
	4.4.b. Support construction of desalination plant for adequate water supply	CMO	Feasibility study	CPDO
	4.4.c. Water technologies for Urban farmers	CMO	Activity design	CPDO
16. Continuity of Drainage Master Plan Recommendations for Recharge Areas	16.1. Proposed Sewage Treatment Plant in communities along the river wherein the wastewater is then channeled into a treatment facility prior to disposal into the river. (Re-use)	CMO	Feasibility study	CPDO
	16.2. Installation of retention structures like enhancement or rehabiliation of detention basin or recharge areas in Cabancalan and Tipolo (retention)	CMO	Feasibility study	CPDO

	16.3. Installation of service drainage lines to all twenty seven (27) barangays	CMO	POWE	CPDO
	16.4. Installation of u- ditches and flood gates	CMO	POWE	CPDO
	16.5. Widening and improvement of natural waterways and creek	CMO	POWE	CPDO
	16.6. Interventions for Butuanon River, Cabancalan Wetland, Tipolo Creek, Basak Creek Phase 2	CMO	POWE	
	16.7. Interventions for all water catchments	CMO	POWE	
	16.8. Interventions for Butuanon River, Cabancalan Wetland, Tipolo Creek, Basak Creek Phase 1	CMO	POWE	
	16.9. Installation of new drainage lines under special conditions or traversing private developments/properties	CMO	POWE	
17. Supply chain mapping for consumer, manufacturers ,distributors and retailers- supply and demand	17.1. Knowledge Management System related activities (1.a Data gathering – secondary, -current supply chain dynamics	CMO	Knowledge Management Plan	CPDO
	17.2. Ensure enactment of supply chain policy support	CMO	Board creation	CPDO
	17.3. Supply Chain stakeholder conference	CMO	Activity design	CPDO
	17.4. Document and Policy Review :Mainstreaming of all business	CMO	Scope of Survey	CPDO

	stakeholders framework across all levels of governance			
	17.5. Drafting of the Supply Chain Management Framework Plan	CMO	Terms of Reference	CPDO
	17.6. Implementation/Adoption of the framework	CMO	SCM Plan	CPDO
	17.7. Information Education Campaign (IEC)	CMO	Communication Plan	CPDO
	17.8. Identify gaps /bottlenecks infrastructures, access to information, policies	CMO	Validated issues and concerns	CPDO
18. Online accessibility of supply and demand	18.1. Business continuity planning for different business	CMO	Agreed online platform	CPDO
	18.2. Access of micro enterprises to big supplier	CMO	Agreed online platform	CPDO
19. Effective collaboration of business	19.1. Strengthening the linkages of retailers and producers (rural-urban linkages)- building	CMO	Organizational chart	CPDO
20. Rationalized warehousing for climate Resilient	20.1. Establishing sufficient storage capacity (climate risk proof) effectively link all warehouses via private partnership with chambers of commerce	CMO	Feasibility study	CPDO
21. Public cold storage for products	21.1. Inventory of public cold storage	CMO	Inventory Plan	CPDO
	21.2. Installation of public storage facilities to satellite markets	CMO	Inventory Plan	CPDO

22. Improve Urban gardening at the barangay level and private sector	22.1. Inventory of urban gardeners / barangay/ sector	CMO	Inventory Plan	CPDO

Table 9. *Mitigation Strategies*

Program/Project	Activities	Target Resource Window	Requirements	Focal Point
13. GHG Capacity building	13.1. Inter-department/offices GHG training	CMO	activity design, EO for GHG inventory	MCENRO
14. GHG baseline data (Waste, Transpo and industry, energy use govt institutions) 1st wave	14.1. Mapping of Data Needs and data sources	PSF	proposal, LGU capacity assesment	MCENRO
	14.2. Formation of GHG inventory team	PSF	proposal, LGU capacity assesment	MCENRO
	14.3. Partnership with academe institution	PSF	proposal, LGU capacity assesment	MCENRO
	14.4. Capacity building on GHG (tools and GhG computation)	PSF	proposal, LGU capacity assesment	MCENRO
	14.5. Data gathering	PSF	proposal, LGU capacity assesment	MCENRO
	14.6. Data consolidation and analysis	PSF	proposal, LGU capacity assesment	MCENRO
	14.7. Reporting	PSF	proposal, LGU capacity assesment	MCENRO
15. GHG baseline data (focusing on: residential energy , forestry, agriculture emissions) 2nd wave	3.1-7. Same activities as Project 2.	PSF	proposal, LGU capacity assesment	MCENRO
16. 4GHG Monitoring	16.1. Development of database (and capacity 4development for use of database)			MCENRO
	16.2. Conduct regular monitoring	20% DF	approved LCCAP, CDC	MISO

			approval	
	16.3. Knowledge management on whole GHG inventory database process	20% DF	approved LCCAP, CDC approval	MISO
17. GHG Policy Advocacy	17.1. Stakeholders consultation (community, indsutry, legistlative	20% DF	approved LCCAP, CDC approval	MCENRO
	17.2. Low Emissions Development Institutionalization	20% DF	approved LCCAP, CDC approval	MCENRO
18. Green Building Program (scope: within the control of LGU, or private/business sectors)	18.1. 1.0 Baseline data for Certified Buildings. Clarification of the sources of data for monitoring green buildings (green spaces are lands with vegetation, open space, parks in government and private lots. It could also mean CERTIFIED green buildings by certifying body) 18.2. Promotion of Green Building Certification 18.3. Dialogue on "Green Spaces among Green Loop/ Green Corridor Dev't" (Cebu, Mandaue, Lapu-Lapu and Municipality of Cordova) 18.4. Enhance partnership with Phil. Green Bldg. Council (PGBC)	OBO Budget	Baseline of electric consumption of identified buildings, MOA with private sectors, GHG Inventory Activity Design	OBO
19. Renewable energy (use of Photovoltaic/solar cell roofing): The projecti will start with the facilities owned by the city government including Old Mandaue Presidencia (current city hall) and sports complexes, followed by hospitals, schools and barangay halls.	19.1. Conduct baseline study on the potential for energy sources through solar rooftop and for computing for rainwater harvesting	OBO Budget	Activity design	OBO
	19.2. Tagging of institutions, businesses applying REs	OBO Budget	PHILGBC Qualifying Exam	OBO
	19.3. Review & Integration of RE and energy efficiency use in Business Permit and Licensing System	DBP under the Financing Utilities for Sustainable Energy Development	BLGF Certification, SP	MCENRO

		(FUSED) program		
20. Smart Corridor	20.1. Installation, maintenance and monitoring of LED streetlights with solar panels and wifi devices lined along the corridor	DBP under the Financing Utilities for Sustainable Energy Development (FUSED) program	BLGF Certification, SP	MCENRO
21. E-trikes	21.1. Encourage the E-trikes feasibility study	DBP under the Financing Utilities for Sustainable Energy Development (FUSED) program	BLGF Certification, SP	MCENRO
22. Bike lane corridor	22.1. Full implementation of planned (+/-) 60 kms. bike lane	CMO	Smart City Plan	CPDO
23. SWM (recycling and diversion system)	23.1. Strict segregation of waste and dispose it properly at designated landfills and recycling and diversion facility 23.2. Collect fees for the waste disposal (including HH) 23.3. Imposed heavy fine to those who throw wastes recklessly/indiscriminately (especially along water bodies) 23.4. Reduce/Eliminate the use of polyethylene bags (plastic holiday) 23.5. Encourage the waste recycle and waste reuse 23.6. Promote market opportunities for the recycled waste products 23.7. Enforce regulations and standards for the waste management 23.8. Raise public awareness on waste generation and disposal	CMO	LTPRP, FS	CPDO/TEAM

24. Mangrove sanctuary/protected area (73.7 hectares) protection and enhancement	12.1. Monitoring and Surveillance	DBM Green Green Green 20% Devt. Plan Business sectors MCCI, CMO	*baseline data/information *legislation/ordinance *technical and equipment for research *funding/budget allocation	City Agri/MCENRO
	12.2. IEC	DBM Green Green Green, MCCI, CMO 20% Devt. Plan	*IEC design/material *technical support/experience for IEC production and IEC campaign *IEC target identified	MCENRO
	12.3. Enhancement and maintenance	DBM Green Green Green 20% Devt. Plan	*MOA with the BRGY on mangrove protection and maintenance *materials for nursery establishments and mangrove planting *technical support/training *area for planting	City Agri
	12.4. community-based Eco-tourism	DBM Green Green Green 20% Devt. Plan , Local Government Support Fund - Assistance to Cities (LGSF-AC)	*ecotourism plan/strategy *training/support	Tourism Office/MCENRO
	12.5. Ecological/ Research Studies	DBM Green Green Green 20% Devt. Plan , Local	*baseline data/information *technical and equipment for research	MCENRO

		Government Support Fund - Assistance to Cities (LGSF-AC)	*funding/budget allocation	
13. Establishment and maintenance of Green Spaces/Corridors	13.1. Implement of the Butuanon River Program (Class D, DAO-05-2014)	DBM Green Green Green 20% Devt. Plan , Local Government Support Fund - Assistance to Cities (LGSF-AC)	*identified programs for Butuanon *technical and equipment for monitoring *funding/budget allocation	MCENRO
	13.2. IEC	DBM Green Green Green 20% Devt. Plan , Local Government Support Fund - Assistance to Cities (LGSF-AC)	*IEC design/material *technical support/experience for IEC production and IEC campaign *IEC target identified	MCENRO/City Agri
	13.3. Baseline studies of green spaces	Green Green Green DBM/Landbank	*technical description/land use *manpower/technical support	MCENRO/CPDO
	13.4. Enhancement/ Propagation/Maintenance	DBM Green Green Green, Landbank 20% Devt. Plan , Local Government Support Fund - Assistance to Cities (LGSF-AC)	*MOA with the BRGY on green space maintenance *materials for nursery establishments and mangrove planting *technical support/training *area for planting	

Annexes include: Impact Chain Analysis and Problem Trees; Full strategies.