

# Manicahan and Ayala Offline Basins

Green-Gray Partnership  
Project for Philippine Cities  
and Municipalities

Zamboanga City, Mindanao

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L'ENVIRONNEMENT MONDIAL

CONSERVATION  
INTERNATIONAL









# About the Green-Gray Partnership

Climate change can no longer be ignored. The raging waters of typhoons Ondoy in 2009 and Haiyan 2013 are seared in Philippine collective memory. In the span of three weeks in 2020, three typhoons battered the country, inflicting over a hundred fatalities and at least PHP 25 billion (USD 518 million) worth of damage. The Philippines urgently needs to harness nature to uplift communities not just because it's better for the planet, but because making the most of available resources is an economic necessity.

In the last quarter of 2021, just as the Philippines was reining in the pandemic, Conservation International and AECOM began the Green-Gray Partnership Project with eleven local cities and municipalities to kickstart the adoption of nature-based solutions.

Integrating green natural systems into gray infrastructure provides multi-function and cost-effective solutions. Green-gray combines natural elements with hard infrastructure to protect and restore natural processes and create healthier urban environments. The combination allows the creation of natural habitats or system functionality (green infrastructure) in a resilient and optimized manner (gray infrastructure). Many green-gray solutions incorporate wetland and forest habitats. As with all habitat creation/restoration projects, the success of these initiatives depends on an understanding of the ecological structure and function of the target habitats.

Green-gray infrastructure approaches can apply in coastal, freshwater, and terrestrial settings and accomplish a variety of project goals. The typical infrastructure services such as flood management, coastal protection, and improving water quality are delivered alongside other benefits such as safeguarding biodiversity, providing livelihoods, increasing public space, and even financial returns to local communities through carbon credits.

A key reference for this engagement is the *Practical Guide to Implementing Green-Gray Infrastructure* by the Green-Gray Community of Practice, which is led by Conservation International. The guide, published in 2020, provides green-gray case studies and walks

readers through the process of project preparation, design, and implementation. It also defines the critical elements of the green-gray approach:

1. Using science and engineering to produce operational efficiencies;
2. Using natural processes to maximize benefits (i.e. ecosystem services);
3. Increasing the value provided by projects by including social, environmental, and economic benefits; and
4. Using collaborative processes to organize, engage, and focus interests, stakeholders, and partners.

Conservation International selected the pioneer batch of Green-Gray partner cities and municipalities based on the following criteria:

- **Commitment to a Resilient Future** Good track record and strong interest for pursuing a climate-resilient future for their locality;
- **Drivers of Change** Positioned as municipal leaders for a sustainable future for the Philippines;
- **Rich and Diverse Natural Assets** Representation of the abundant biodiversity of the Philippines; and
- **Vulnerability to Impacts of Climate Change** Exposure to the impacts of climate change.

The Green-Gray Partnership Project was meant to equip local governments units (LGUs) with capacities to identify opportunities for the adoption of nature-based solutions and prepare concept notes to rally support for pilots. At the beginning of the project, it was essential to transfer knowledge of green-gray infrastructure through the guide and workshops focusing on case studies. This built a base from which the local governments drew from in order to craft a Statement of Intent and a Concept Design Note (Annex 1), both of which are contained in this document.

This document, containing a high-level design and assessment, may be used by the local governments to seek support for project preparation (in which the concept should be refined with further studies), detailed design, and implementation. Support may be sought from national government, financing institutions, grant giving foundations, and private sector partners.

Zamboanga City, Mindanao, Philippines

# Manicahan and Ayala Offline Basins

Improving Zamboanga’s Water Security through a Green-Gray Infrastructure approach in Manicahan & Ayala Watersheds



**Location**  
 Zamboanga City,  
 Zamboanga Peninsula, Mindanao  
**Proposed Site**  
 Manicahan and Ayala Watershed  
**Key Thematic Area**  
 Watershed  
**Key Issue**  
 Rehabilitation of the Watershed to  
 improve rainwater collection and  
 storage  
**Green-Gray Solution**  
 Offline Series of Catchment Basins  
**Proposed Implementation**  
 Timeframe  
 2-5 years

- Executing Agencies**
- Office of the City Environment and Natural Resources
  - Office of the City Planning and Development Coordinator
  - City Engineer’s Office
  - City Disaster Risk Reduction Management’s Office
  - Office of the City Agriculturist

**Project Aim**  
 The proposed Green-Gray Infrastructure Solution aims to align with the objectives and goals that were set in the watershed management and development plans (WMDPs) by using a nature-based approach in addressing the following: river channel erosion and prevention of landslide; peak runoff during strong rains and typhoons that can cause flooding in the downstream areas; collection, treatment and storing of rainwater for non-potable use; improvement of water quality through reforestation and sedimentation; and enhance biodiversity that can improve eco-tourism and provide additional livelihoods for the community.

**2,579**

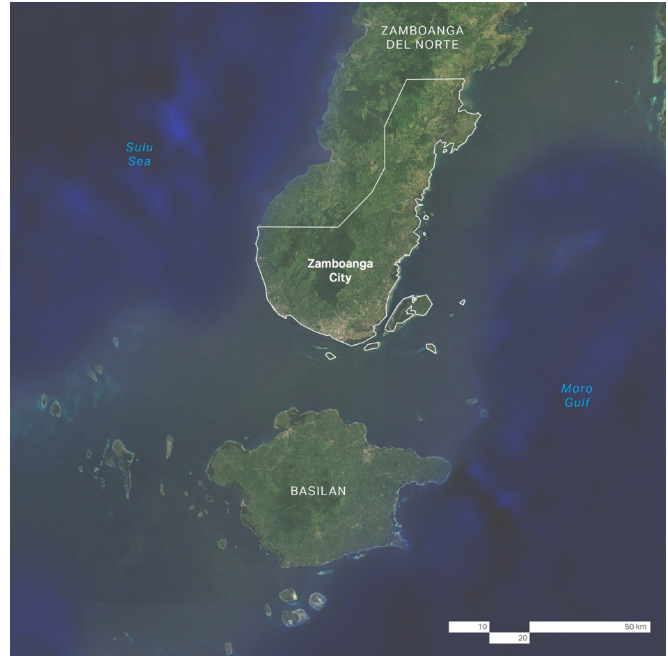
Benefitting Residents from Improved Water Supply

source:  
 Zamboanga FLUP  
 2019-2027

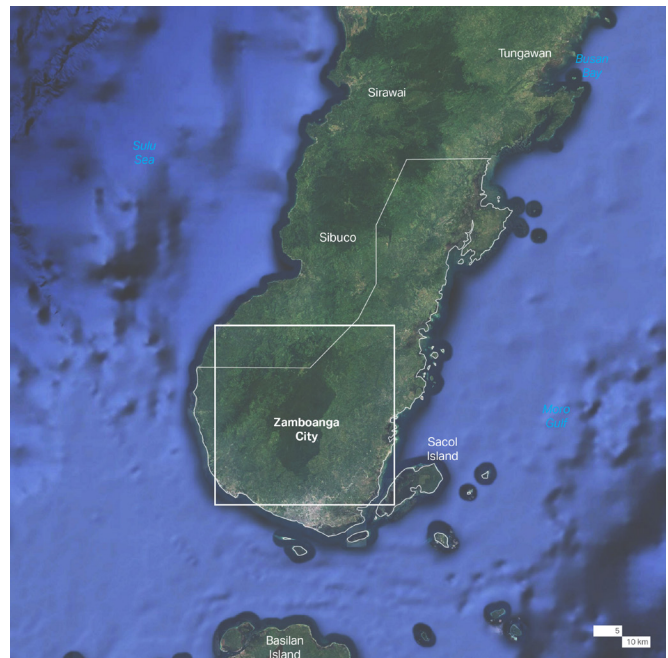
**5,040**

Metric tons of CO<sub>2</sub> captured

Based only on assumptions and estimates; for verification in next stage



Zamboanga Location Map



Zamboanga Green-Gray Partnership Project Location Map





**Overview**

Water resources in Zamboanga City’s watersheds are expected to be depleted due to observed and projected changes in temperature and rainfall. Climate change impact agricultural farmlands, residents, and business establishments especially during prolonged droughts which interrupt economic activities and induce social problems in the city.

The proposed green-gray infrastructure project at the Ayala and Manicahan watersheds aims to compliment the Pasonanca impounding dam in improving water security of Zamboanga City. The nature-based solutions, with support of local initiatives, regional and national policy programs, will also help reduce the issues of freshwater supply while ensuring robust biodiversity accentuated with eco-tourism.

In conjunction with the interventions of Zamboanga City Water Security Council’s Water Security Master Plan, the greening projects’ synergy at the watersheds and buffer zones of the Pasonanca watershed of the Natural Park, the green-gray solution explores the Ayala and Manicahan watersheds as supplementary sources of freshwater through a development of a series of offline catchment basins.

**Sustainable Development Goals (SDG) Targets**

<p><b>5</b> GENDER EQUALITY</p>	<p><b>9</b> INDUSTRY, INNOVATION AND INFRASTRUCTURE</p>	<p><b>13</b> CLIMATE ACTION</p>
<p><b>6</b> CLEAN WATER AND SANITATION</p>	<p><b>11</b> SUSTAINABLE CITIES AND COMMUNITIES</p>	<p><b>15</b> LIFE ON LAND</p>
<p><b>8</b> DECENT WORK AND ECONOMIC GROWTH</p>	<p><b>12</b> RESPONSIBLE CONSUMPTION AND PRODUCTION</p>	<p><b>17</b> PARTNERSHIPS FOR THE GOALS</p>



## Rationale

Water resources of Zamboanga City's watersheds are depleting over the years associated with the increasing frequency and magnitude of climate-induced hydro-meteorological hazards. There are six identified watersheds in the city, 11 major river systems emanating from these, and at least 19 communal irrigation systems are being used for irrigation and agricultural purposes.

The Manila Observatory findings shows that the mean daily temperature in the city will increase during the period 2011-2065 relative to the baseline mean. This increase in the City's temperature is higher and faster than the global projected temperature increases of 2.0°C by 2100. In terms of rainfall, there was an overall decadal decrease in mean precipitation across all months. With these weather anomalies, the city's main water service provider, the Zamboanga City Water District (ZCWD), observed drastic changes water levels, particularly in the Tumaga River over a short span of time. Sixty percent of the city water supply is sourced from the river, which courses from the Pasonanca Natural Park.

Of the total land area, about 51.45% or 79,440.48 hectares are classified as forest lands. In terms of land uses, 55,726 hectares or 36% of the city's total land area has a policy designation of Protection and Conservation including: all National Integrated Protected Areas System (NIPAS) areas, natural closed canopy and open canopy forests, mangrove forests, Indigenous Community Conserved Area and areas under the forestry reform code of the Philippines.

Based on 2020 Census, the city's population is 977,234 at 2.28% growth rate. Zamboanga City has two protected areas under NIPAS; these are Pasonanca Natural Park (PaNP) and Great and Little Sta. Cruz Islands Protected Landscape and Seascape. The two protected areas account for 8.04% of the city's total land area. PaNP, at 17,414 hectares, is the only remaining close canopy forest in the city mainly composed of dipterocarp species. The park is flanked Ayala Watershed on the west and Manicahan Watershed on the east.

As to the water requirements for irrigation and other agricultural purposes, there are 10 barangays on the sides of the Ayala and Manicahan watersheds directly influenced by their water supply. The barangays have a total area of 8,925.07 hectares; of which 3.75% forms part of the buffer zones of the natural park. Within the two watersheds, the population is expected to grow more than 93,300 by 2025. Both are under co-management agreement between the City LGU and Environment and Natural Resources (DENR) Region IX. It is important to note that two other watersheds, Limpapa and Limpapa-Labuan, surrounding PaNP have Certificate of Ancestral Domain Titles (CADTs).

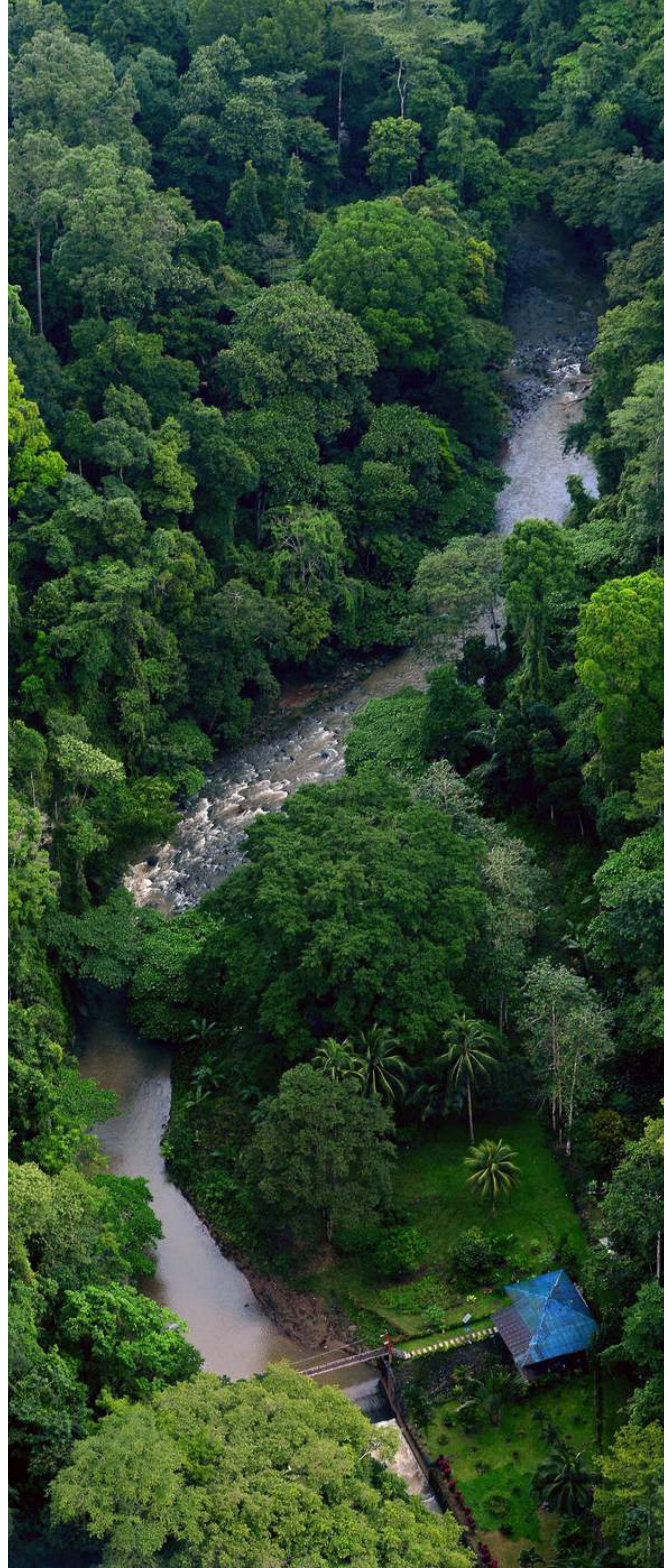
The residents and business establishments of Zamboanga City have endured the inconvenience of rotational water interruptions lasting 2-4 hours especially during prolonged droughts induced by the El Niño phenomenon. The primary effect in urban areas would be the interruption of economic activities, while the decrease in precipitation and contamination of water supply are identified as secondary impacts. Loss of land and saltwater intrusion are perceived as tertiary impacts with increased incidence of water-borne and vector-related diseases. In the 2017 Annual Report of the Department of Health, only 94.78% of the city's households have had access to improved, safe water, with only 73.75% enjoying the benefits of a Level 3 water supply connection.

The Zamboanga Peninsula Regional Development Plan 2017-2022 recognizes the inadequate supply of water due to increasing population, economic activities, and impact of climate change. Addressing this concern, the Zamboanga City Water Security Council was organized, and the Water Security Master Plan was crafted. The plan recommends synergized greening project in the watersheds and buffer zones of the natural park. The objectives are to enhance the city's climate adaptation capacity, mitigate the greenhouse gas emissions, and serve as water buffers.





*State of Pasonanca River in Zamboanga's watershed*



*State of Tumaga River in Zamboanga's watershed*



## Project Proposal

The local government of Zamboanga City is already planning and preparing a dam project upstream of Tumaga River. However, the current water shortages need immediate action. The proposed green-gray infrastructure problem develops alternative fresh water sources for the city in the Ayala and Manicahan watersheds.

This will be done through a development of a series of offline catchment basins that can collect surface runoff coming from the uplands. These basins will be built using available rocks and sediments in the area. The small reservoirs can hold water and allow rainwater to be absorbed by the earth when it rains. This approach will help reduce the issues of water supply while ensuring that biodiversity can thrive. This type of approach will also reduce the impact on the existing ecosystem and local communities of the watersheds as well as carry the potential of becoming a tourist attraction.

### Ayala Water

The average annual rainfall received by the Ayala watershed is 42,611,900 cubic meters (m<sup>3</sup>). The recent estimate of the mean daily run-off is placed at 11,640 m<sup>3</sup> that converts to an annual volume of only 4,248,600 m<sup>3</sup>. This severe reduction is reflective of the current situation wherein the river has been noted to dry up before the outlet during long rainless periods. Approximately 38,363,300 m<sup>3</sup> of rainwater (91%) ends up elsewhere: upstream, a significant volume is diverted for the Baluno water system that supplies nearby barangays; downstream, the small irrigation system installed by National Irrigation Authority draws water that supplies paddy rice fields in the lowlands

### Manicahan Water

The main channel of Manicahan River is 30,828 meters long from the uppermost portion to the outlet. It is fed by three rivers and five creeks and has a drainage density of 29 lineal meters per hectare. Stream flow, as measured by Zamboanga City Water District in 2018, is at 2.04 m<sup>3</sup> per second. Annual rainfall in the watershed is 71,004,200 m<sup>3</sup> with a discharge of 64,333,440 m<sup>3</sup>. This means that there is much surface water potential benefit as only 9.39% is reverted to the atmosphere through evapotranspiration, absorption as groundwater recharge, or diversion outside the watershed for irrigation and other purposes.

Both watersheds already have a Watershed Sustainable Management and Development Plan 2020-2028. Other aligned policies for this proposal to maximize the conservation and restoration of nature while achieving the effects of conventional gray infrastructure are:

### Local government

- **Enhanced National Greening Program (NGP)**, with DENR as the lead implementer through CENRO Zamboanga City implements sustainable management of natural resources through resource conservation, protection, and productivity enhancement at the buffer zones;
- **City Ordinance No. 519 - Environmental Code of City of Zamboanga**, with operative principles on the city's watershed and other protection forest shall be rehabilitated, protected and conserved and ensuring its capacity to provide the necessary ecological services;
- **City Ordinance No. 524**, aims to promote the collection, storage and harvesting of rain water, among others from agricultural lands and other land development to augment water supply; and to reduce run-off causing flooding in sealed ground surfaces;
- **Sangguniang Panglunsod Resolution No. 566** (5 June 2002), declared as protection forest the six (6) identified watershed by DENR IX covering 38,600 hectares of forestlands of Zamboanga City with Ayala and Manicahan watersheds were prioritized for management;
- **Pasonanca Natural Park Management and Development Plan 2019-2028**, approved and adopted by PAMB which include the management focus on conservation of natural forests, habitats and ecosystems; sustainable ecosystem services focus on water; and climate change and natural disasters risk resiliency;
- **Forest Land Use Plan (FLUP) for Zamboanga City**, approved and adopted by the City Council had identified water catchment areas within and around the Pasonanca watersheds and providing regulations and establishments of infrastructure projects; including watersheds and rivers' system in ensuring sustainable supply of potable, domestic use and agricultural irrigation waters;



- **Executive Order No. BC-661-2021**, creating the Zamboanga City Water Security Council tasked to collaborate with concerned government and non-government agencies, water service providers and stakeholders in crafting the Zamboanga City Water Security Master Plan;
- **Executive-Legislative Agenda 2020 – 2022**, it was crafted jointly and mutually agreed upon by the Executive branch and Legislative branch of City Government of Zamboanga pursuant to DILG Memo Circular No. 2019-114 involving the CSOs, NGOs and had prioritized PPAs providing among others, the protection and preservation of forest ecosystems; environmentally critical and disaster vulnerable areas shall be mitigated through low carbon footprint, greening and conservation of protected areas; and
- **Emergency Response and Climate Resilient Business Plan including Water Demand Program**, adopted by the ZCWD, the main water service provider seeking to address the high incidence of 'Non-Revenue Water' loss; forged agreements with the academe in institutionalizing the propagation of the program in schools citywide; and a local university as its training partner;



*State of Zamboanga's farmland during period of drought*

## National and regional governments

- **DENR Administrative Order No. 2013-01**, declares Tumaga River as a Water Quality Management Area (WQMA), aims to protect, thru stakeholders' collaboration, the water body and its tributaries by keeping the water quality of Tumaga River which can supply 90,000 cubic meters per day for domestic, commercial and industrial uses; with approved Year 2021 WQMA Action Plan to address water quality issues and problems in the area;
- **Regional Development Plan 2017-2022**, adopted by the Regional Development Council IX, the primary institution that coordinates and sets the direction of all economic and social development efforts in the region where local efforts related and integrated with regional and national development, in its plan indicated that the city being the Growth Center for Zamboanga Peninsula strategized development towards ecological integrity, resiliency and infrastructure development;
- **Co-Management Agreement (November 26, 2006)**, entered into between the Zamboanga City LGU and DENR which had prioritized the Ayala and Manicahan watersheds for the formulation of watershed management and development plans reviewed by the City Development Council (CDC) with assistance by the USAID's EcoGovernance Project. Also, the agreement created and make operational the Watershed Management Council (WMC) chaired by the City Mayor.

## Green-gray infrastructure impact

Utilizing green-gray infrastructure in the Ayala and Manicahan may unlock multiple benefits including:

- Reduce water shortages
- Improve groundwater recharge
- Restore the forest ecosystems
- Generate jobs associated with forest management in which indigenous communities can be involved
- Sustainable tourism growth

Ultimately, the pilot can make a case for the municipality wide adoption of nature-based strategies to:

- Reliably supply all residents with clean water and sanitation
- Conserve critical habitats and its endangered species

## Sustainable Development Goals (SDG) Targets



Undertake reforms to give women equal rights to economic resources, as well as access to ownership and control over land and other forms of property, financial services, inheritance and natural resources, in accordance with national laws



By 2030, achieve universal and equitable access to safe and affordable drinking water for all

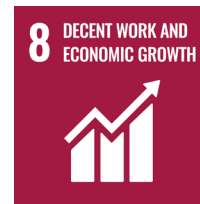
By 2030, achieve access to adequate and equitable sanitation and hygiene for all and end open defecation, paying special attention to the needs of women and girls and those in vulnerable situations

By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally

By 2030, substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity

Protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes

Support and strengthen the participation of local communities in improving water and sanitation management



Promote development-oriented policies that support productive activities, decent job creation, entrepreneurship, creativity and innovation, and encourage the formalization and growth of micro-, small- and medium-sized enterprises, including through access to financial services





Develop quality, reliable, sustainable and resilient infrastructure, including regional and transborder infrastructure, to support economic development and human well-being, with a focus on affordable and equitable access for all

By 2030, upgrade infrastructure and retrofit industries to make them sustainable, with increased resource-use efficiency and greater adoption of clean and environmentally sound technologies and industrial processes, with all countries taking action in accordance with their respective capabilities



Strengthen efforts to protect and safeguard the world's cultural and natural heritage

By 2030, significantly reduce the number of deaths and the number of people affected and substantially decrease the direct economic losses relative to global gross domestic product caused by disasters, including water-related disasters, with a focus on protecting the poor and people in vulnerable situations

Substantially increase the number of cities and human settlements adopting and implementing integrated policies and plans towards inclusion, resource efficiency, mitigation and adaptation to climate change, resilience to disasters, and develop and implement, in line with the Sendai Framework for Disaster Risk Reduction 2015-2030, holistic disaster risk management at all levels



By 2030, achieve the sustainable management and efficient use of natural resources

Develop and implement tools to monitor sustainable development impacts for sustainable tourism that creates jobs and promotes local culture and products

## Sustainable Development Goals (SDG) Targets



Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries

Integrate climate change measures into national policies, strategies and planning

Promote mechanisms for raising capacity for effective climate change-related planning and management in least developed countries and small island developing States, including focusing on women, youth and local and marginalized communities



Ensure the conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services, in particular forests, wetlands, mountains and drylands, in line with obligations under international agreements

Promote the implementation of sustainable management of all types of forests, halt deforestation, restore degraded forests and substantially increase afforestation and reforestation globally

By 2030, ensure the conservation of mountain ecosystems, including their biodiversity, in order to enhance their capacity to provide benefits that are essential for sustainable development

Take urgent and significant action to reduce the degradation of natural habitats, halt the loss of biodiversity and, by 2020, protect and prevent the extinction of threatened species

Integrate ecosystem and biodiversity values into national and local planning, development processes, poverty reduction strategies and accounts



Strengthen domestic resource mobilization, including through international support to developing countries, to improve domestic capacity for tax and other revenue collection

Mobilize additional financial resources for developing countries from multiple sources

Adopt and implement investment promotion regimes for least developed countries

Promote the development, transfer, dissemination and diffusion of environmentally sound technologies to developing countries on favourable terms, including on concessional and preferential terms, as mutually agreed

Enhance international support for implementing effective and targeted capacity-building in developing countries to support national plans to implement all the sustainable development goals, including through North-South, South-South and triangular cooperation

Encourage and promote effective public, public-private and civil society partnerships, building on the experience and resourcing strategies of partnerships



## Indicative Implementation Arrangements

Precise implementation arrangements remain to be determined at the pre-design preparation phase, but it is foreseen that the project shall be led and monitored by the Office of the City Environment and Natural Resources, Office of the City Planning and Development Office, City Engineer's Office, City Disaster Risk Reduction Management Office.

Support may be sought from the Office of the City Agriculturist and Western Mindanao State University (WMSU) which manages an Experimental Forest in the Pasonanca Buffer Zone. Partnership with the national government may happen through the Department of Environment and Natural Resources.

## Monitoring and Evaluation Plan

The progress and success of the project can be measured by tracking the following indicators:

- Improved forest cover in the Ayala and Manicahan watersheds
- 24/7 availability of potable water for all households

To establish the GGI as an effective solution to substitute conventional infrastructure projects, a set of metrics should be established to evaluate its results:

- Monitoring of flood level at the downstream area, river channels, and detention chamber of the catchment basins
- Monitoring of water quality in the catchment basin
- Monitoring of the growth and survival rate of the reforested areas
- Monitoring of water consumption and demand of surrounding communities that are benefiting from the catchment basin.

## Due Diligence

This document contains a green-gray infrastructure design concept and high-level assessments. More details are required in order to refine this concept into a robust and detailed proposal; thus, the project preparation phase for this project should include:

- Feasibility Study
- Environmental and social impact assessment or environmental and social management framework
- Stakeholder consultations at national and project level implementation including with indigenous people, if relevant
- Gender assessment and action plan
- Operations and maintenance plan, if relevant
- Loan or grant operation manual, as appropriate
- Co-financing commitment letters

If required, the preparation of this project may include the following studies:

- Diagram of the theory of change
- Economic and financial model with key assumptions and potential stressed scenarios
- Pre-feasibility study
- Evaluation report of previous project
- Results of environmental and social risk screening

## Conservation International's Diversity, Equity, and Inclusion (DEI) framework

At Conservation International (CI), we are committed to promoting human rights by reducing equity gaps and facilitating the enhancement of social and environmental sustainability. All of our projects are held to strict social and environmental principles as agreed upon and laid out by internationally accepted standards such as the Community, Biodiversity, and Carbon standard, as well as the Global Environmental Fund (GEF) and Green Climate Fund (GCF) safeguards. However, CI is taking our responsibility to communities and the environment even further with a commitment to tracking and monitoring Diversity, Equity, and Inclusion (DEI) benefits through our Environmental and Social Safeguards System (CISS), a system that exceeds international standards. To achieve maximum socio-environmental and climate benefits plus long-term sustainability of any project, we believe that communities must be at the center and actively participate in the design of any conservation initiative in which we engage. Central to this, CI engages communities in:

1. Developing the project components, including governance, management processes, and distribution mechanisms in a consultative, transparent and participatory manner with relevant stakeholders (Conservation Agreements ensure that all parties are heard and decisions are made jointly).
2. Addressing gender inequality in all of our conservation programming, monitoring, and reporting efforts.
3. Guaranteeing the long-term financial viability of the project through optimizing project implementation while maximizing benefits.
4. Prioritizing non-monetary benefits whenever possible to increase the number of beneficiaries and better guarantee long-term project success.



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## ANNEX

# Design Note

## Statement of Problem and Thematic Area

The Manicahan and Ayala Watershed Management and Development Plans (WMDPs) have laid out comprehensive assessments of both watersheds and identified key issues that has a great impact to the environment and to the communities within and surrounding the watershed. It has provided a framework for policy-related measures and the physical planning and development of the watersheds. Both watersheds have similar issues relating to protection of the natural environment, enhancement of the livelihood of the surrounding communities, improvement of water quality and storage capacity, and protection of the surrounding communities from nature-induced calamities. According to both WMDPs, the environmental quality of the watersheds has deteriorated due to unregulated development, improper agricultural practices, mining activities and deforestation. Aside from this, a major issue being experienced in each watershed is the risk of erosion and landslide. To mitigate these issues the WMDPs have proposed strategies to improve the condition of the watersheds.



*Overview of Ayala watershed*



## Project Aim

The proposed Green-Gray Infrastructure Solution aims to align with the objectives and goals that were set in the WMDPs by using a nature-based approach in addressing the following: river channel erosion and prevention of landslide; peak runoff during strong rains and typhoons that can cause flooding in the downstream areas; collection, treatment and storing of rainwater for non-potable use; improvement of water quality through reforestation and sedimentation; and enhance biodiversity that can improve eco-tourism and provide additional livelihoods for the community. The GGI will be used to implement the strategies that were set in the WMDP not only through programming but also providing an infrastructure that will not create a huge environmental impact.

The proposed GGI is not meant to replace the Pasonanca mega dam in terms of supplying water to Zamboanga City, the main purpose of this is to provide a supplementary water source that has lesser environmental impacts on the watershed. This new approach aims to be a new model for watershed protection and conservation that can be scaled up in the other watersheds of the city and the region.



*Overview of Manicahan watershed*

## Green-Gray Infrastructure Strategy

A catchment basin that is a combination of both a retention and detention pond is proposed to be located off-stream to avoid disruption to natural flow connectivity of both Ayala and Manicahan Watersheds' river channels. These catchment basins will serve as a multi-purpose infrastructure solutions that will improve water quality, provide a source of non-potable water supply, and reduce peak runoff during strong rains. The catchment basin shall be created by excavating an area close to the river channel and using the material for the basin embankment. The water flowing in the channel will be diverted to the catchment basin through a vegetated diversion channel that will filter the water from contaminants. Each catchment basin will have two chambers for water retention (wet pond) and water detention (dry pond). The retention chamber will be used for natural treatment of the water through the process of sedimentation and will provide communities a source of non-potable water supply (additional Abstraction and Treatment facility may be provided if there is a need to convert the water for potable use). The detention chamber will be used for reducing the peak runoff during strong rains by storing surface runoff water and gradually releasing it back to the river channel. This will prevent potential overspill along the channel to reduce riverbank erosion and prevent flooding at the downstream areas.

Additionally, a proposed reforestation program surrounding the catchment basins will be required especially if the area selected has been deforested. The reforested area will help stabilize the integrity of the catchment basin, as well as improve the water quality by acting as natural filters. Increased forest cover also allows higher storing capacity and absorption of water within the watershed.

This approach can only be successful if it can be done in a series of catchment basins along the river channel. A single catchment basin will be unable to solve the issues identified. For the purpose of this conceptual design approach, a typical catchment basin design shall be provided as a guide for the LGU on the principles about the infrastructure. As further studies would be required in identifying the right locations of the catchment basins, a list of considerations will be provided to the LGU for the next stage of the project where scoping and site selection will be conducted as part of the pre-design stage.

### Considerations for Site Selection for the Catchment Basin

- The catchment basin should be close to the river channel to easily divert waterflow to the catchment basin and release back to it.
- The site should not be located on steep slopes unless it is geotechnically checked.
- It should be located close to a groundwater source to ensure that the retention pond shall have enough water to sustain the process of sedimentation during dry season.
- The surrounding of the catchment basin should be within forest cover. In case the area is deforested, a reforestation program shall be included as part of the GGI approach.
- Ideally, these catchment basins should be away from any developments to avoid contamination of water as well as potential pollution from inhabitants.

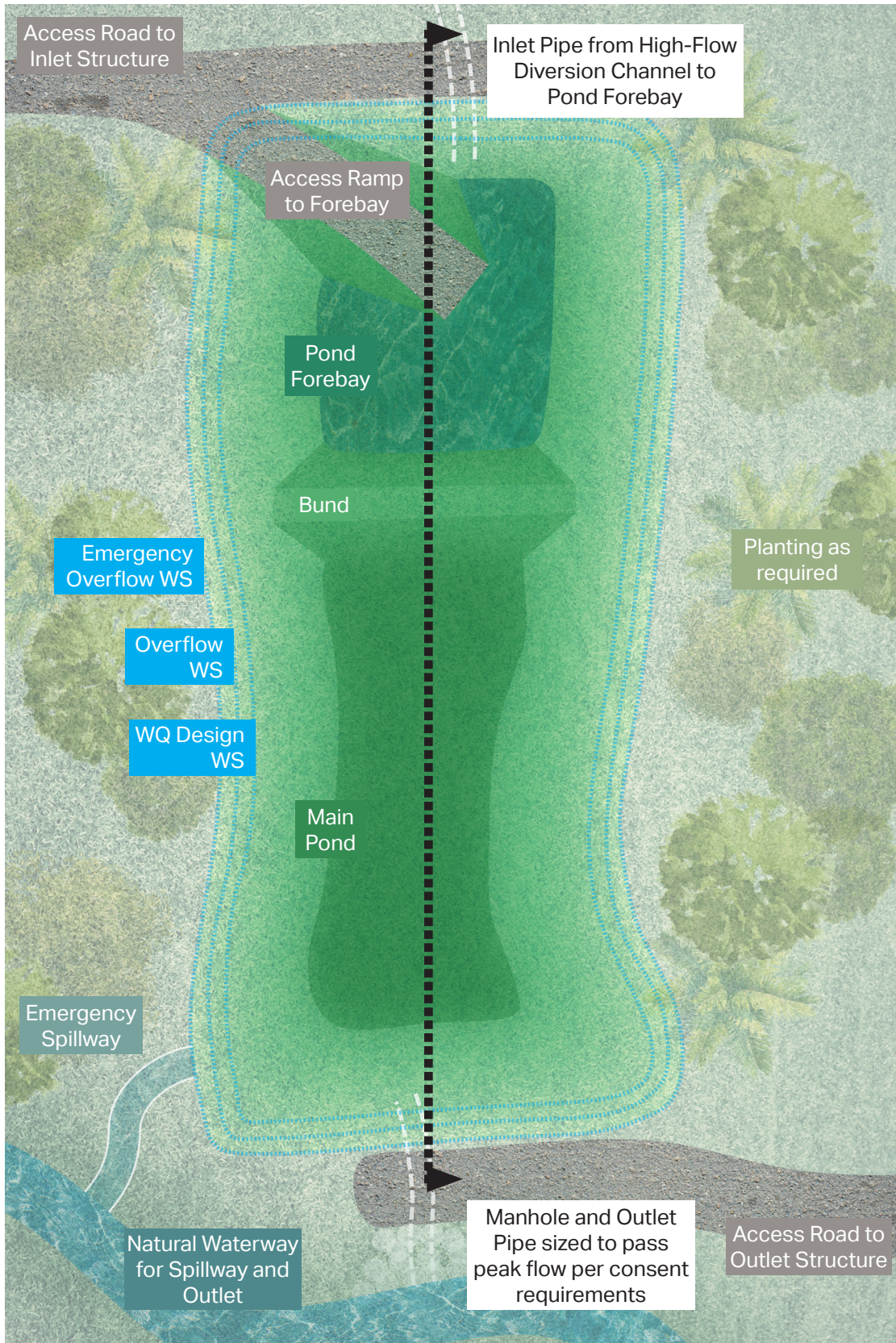




Zamboanga GGI Concept Strategy Plan



### Green-Gray Infrastructure Strategy



Zamboanga GGI  
Concept Strategy  
Typical Blow-up Plan

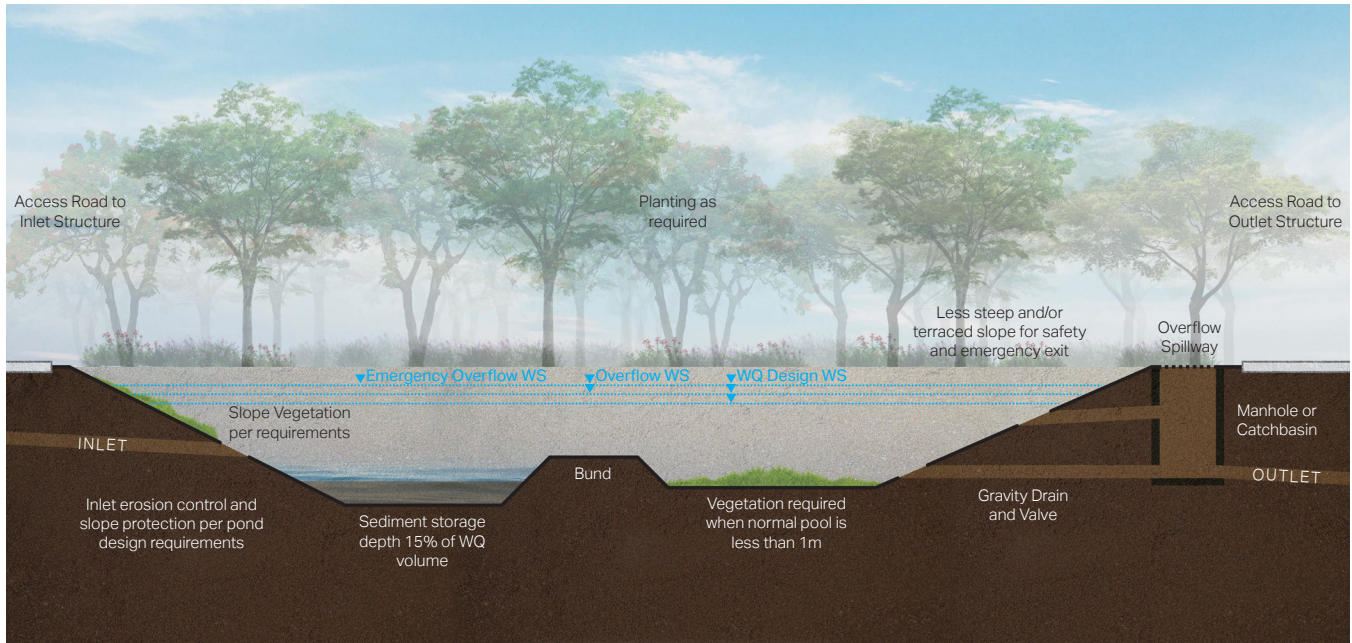
**0.4 km**

estimated total  
land area for  
catchment  
basin

**1.0 ha**

estimated total  
land area for  
reforestation  
surrounding  
catchment  
basin





Zamboanga GGI Concept Strategy Typical Section



**Slope vegetation**

Catchbasin slope edges lined with vetiver grass for slope protection.



**Catchbasin**

Collection point for excess water from waterways during wet season. Same space also acts as sediment trap and natural filter for non-potable water.



**Reforestation**

Required planting surrounding introduced catchbasin to act as its natural filter and slope edge protection.

## Benefits of a GGI Solution

The proposed GGI solution will provide additional water supply to the surrounding community for domestic and agricultural consumption. It will also help enhance the biodiversity in the watersheds and increase the eco-tourism potential of Zamboanga.. It also prevents sudden flooding at the downstream thus reducing potential damages and casualties. Aside from reduction in flooding, the GGI solution also aims to reduce landslides through the reforestation program and regulating the overspill of surface runoff during strong rains.

## Integrated Holistic Approach

The proposed GGI Solution is a pilot project that is envisioned to be potentially scaled-up or replicated in the other parts of the country. Whilst the proposed solution is addressing the key issue at hand, it is important to note that addressing the root cause of the problem is essential– in this case, regulation of forest land use and conservation of the watersheds.

## Implementation Period

A timeline of 2-5 years is estimated to prepare, implement, and construct this GGI solution. Due to lack of data and information readily available, additional studies and scoping work shall be required to validate and collect more information regarding the key issues identified by the LGU and the assumptions that have provided during the concept design stage. The proposed project timeline shall cover the following phases:

### 1. Predesign Phase

*3-5 months;*

This will include all the necessary study, scoping and data collection needed to establish, verify, and gather information required to proceed with a detailed engineering design.

### 2. Design Phase

*2-4 months*

A detailed engineering design shall be required to fully develop the conceptual design after using the verified data to accurately design the infrastructure according to the required specifications to address the key issue.

### 3. Implementation Phase

*12-36 months*

This will include the compliance to the required regulations/standards, seeking of approval of concerned agencies, and observance of due diligence. Upon obtaining the necessary approval and permits, the construction of the infrastructure or implementation of the prescribed program shall be done.

### 4. Operation, Maintenance and Adaptive Management

*periodical*

This shall include periodic monitoring of the infrastructure, maintenance and repair if required, evaluation of the impacts to surrounding communities, rehabilitation and retrofitting if required.

For Zamboanga City, implementation of the WDMP should be strictly followed to ensure that the objectives and the proposed outcomes of the recommendations can be met within the target time that were initially proposed by the LGU.



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## Facts and figures

# 1.

AECOM launched when a handful of employees from design and engineering companies shared a dream of creating an industry-leading firm dedicated to making the world a better place.

# 2.

AECOM became an independent company formed by the merger of five entities. While our official founding was in 1990, many of our predecessor firms had distinguished histories dating back more than 120 years.

# 3.

Since then, more than 50 companies have joined AECOM and, in 2007, we became a publicly traded company on the New York Stock Exchange.

# 4.

As the world's trusted infrastructure consulting firm with an unrivaled heritage delivering design, planning, engineering, consulting and construction management solutions.

## AECOM in the Philippines

Established in 1996, AECOM in the Philippines has grown into a 200+ strong team of planners, engineers, environmental scientists, geologists, landscape architects and technical management specialists driven by a common purpose to deliver a better world.

## Creating Sustainable Legacies

We are leading the change towards a more sustainable and equitable future by partnering with our clients to provide solutions that help them achieve their environmental and social value ambitions and advancing sustainable business operations to help prevent the worst impacts of climate change.



47,000 people



Fortune 500 #163



Work across seven continents



2 Million Work Hours Awards



Revenue \$13.2 billion in fiscal year 2020



100% Rating on Corporate Equality Index / Best Places to Work for LGBT Equality 2021

## Accolades

- ENR rankings No 1
- Environment Firm
- Transportation Design Firm
- Facilities Design Firm
- Mixed-Used Buildings
- Education Buildings
- Aviation
- Highways
- Chemical Remediation
- Top 10 Military Friendly company 2020
- Military Friendly® Top 10 Company
- Military Friendly® Top 10 Supplier
- Diversity Program
- Military Friendly® Top 10 Employer
- Military Friendly® Top 10 Spouse Employer
- National safety council: 155 Perfect Record Awards
- Achieved a minimum of 12 consecutive months without a recordable injury or illness.
- For each award, achieved a minimum of one million consecutive hours without an injury or illness that resulted in days away from work and zero fatalities.





Bogota, Colombia (C) Conservation International

**Since 1987, Conservation International (CI) has worked to spotlight and secure the critical benefits that nature provides to humanity.**

Combining fieldwork with innovations in science, policy and finance, we’ve helped protect more than 6 million square kilometers (2.3 million square miles) of land and sea across more than 70 countries. Today, with offices in more than two dozen countries and a worldwide network of thousands of partners, our reach is truly global. But we couldn’t have made it this far without you. Your contributions support our work to protect nature for the benefit of us all.

CI’s work in Asia-Pacific began in 1989 with a pledge to protect some three dozen of the Earth’s biodiversity hotspots, including the Philippine archipelago and the Sundaland rainforests of Southeast Asia.

Since then, our focus in Asia-Pacific has expanded across the region to include other ocean and forest areas considered critical to human well-being. We help improve food security, support innovative financing for conservation projects and establish protected area networks that encompass essential ecosystems.

CI’s unique combination of experience with ecosystem conservation and restoration, community co-design, and stakeholder leadership allows us to advise and lead [green-gray initiatives](#) around the world in collaboration with local, regional and national governments and engineering partners.

## Priorities

- **Stabilizing our climate by protecting and restoring nature**
- **Doubling ocean protection**
- **Expanding planet-positive economies**



## About AECOM

AECOM is the world's trusted infrastructure consulting firm, delivering professional services throughout the project lifecycle — from planning, design and engineering to program and construction management. On projects spanning transportation, buildings, water, new energy and the environment, our public- and private-sector clients trust us to solve their most complex challenges. Our teams are driven by a common purpose to deliver a better world through our unrivaled technical expertise and innovation, a culture of equity, diversity and inclusion, and a commitment to environmental, social and governance priorities. AECOM is a *Fortune 500* firm and its Professional Services business had revenue of \$13.2 billion in fiscal year 2020. See how we are delivering sustainable legacies for generations to come at [aecom.com](https://www.aecom.com) and [@AECOM](https://twitter.com/AECOM).