



# Pre-Feasibility Study on Wastewater, Watershed & Solid Waste Management Cagayan de Oro City, Philippines

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June 2013  
Final Summary Report



## **A. Project Setting and Background**

1. Following the application submitted by the City Government of Cagayan de Oro City, the Cities Development Initiative for Asia (CDIA) is providing the support in the areas of solid waste management, wastewater treatment, drainage, watershed management, resettlement and capacity development, following the policy of providing assistance to medium-sized Asian cities to bridge the gap between their development plans and the implementation of their infrastructure investments. IDOM has been contracted to carry out the Prefeasibility Study. The main objectives of this technical assistance are the following:

1.1. To prepare a Pre-Feasibility Study including an Integrated Urban Infrastructure Investment Program for Cagayan de Oro City that consists primarily of: Cagayan de Oro River Watershed Management, Wastewater Management and Solid Waste Management.

1.2. To prepare a Resettlement Plan to address the informal settlements along the riverbank of Cagayan de Oro River including both on-site rehabilitation and relocation options.

1.3. To assist Cagayan de Oro City in the identification of financial resources, particularly from the private sector, to implement the integrated urban infrastructure investment program; and

1.4. To identify capacity gaps in the Local Government Unit and develop a complimentary plan that allows the LGU to implement the integrated urban infrastructure investment program successfully.

### ***Project Location***

2. Cagayan de Oro (CdeO) is the capital city of the province of Misamis Oriental, in the northern of Mindanao Island, in front of the Macajalar Bay (at the North). It is the regional centre for the Northern Mindanao (Region X).

3. It is bordered by the municipalities of Opol to the west of the city, and Tagoloan to the east, and by the provinces of Bukidnon and Lanao del Norte to the South-West and South-East respectively.

### ***Physical Conditions of CDEO***

4. Coastal plains, riverbanks, the plateau, valleys and mountains characterize Cagayan de Oro City territory. The main portion of the population is located at the lower areas, following the river banks and the coastal strip. The majority of the city's population resides in the low-lying areas along the two main rivers (Cagayan de Oro River and Iponan River) and the coast. These two rivers affect the city significantly while 95% of the CdeO River watershed is in the upstream province of Bukidnon.

**Figure 1: Cagayan de Oro Location Map**



5. The urban districts with the highest population density are prone to flash-floods during heavy tropical rain events. Two severe floods have devastated the city recently: typhoon Sendong in December 2011 and typhoon Auring in 2009.
6. Some of the central urban areas are also exposed to daily tidal variations amplifying the flash-floods at high-tide.

### ***Population and Economy***

7. Cagayan de Oro is classified as a Highly Urbanized City, with an official registered population of 602,088 inhabitants (census May 1, 2010), with an average annual population growth rate of 2.54% since 2007, higher than the country average.
8. In terms of economic activities<sup>1</sup>, agricultural activities account for the main activities focused on farming (corn, root crops, pineapples and bananas).
9. Other industries that thrive in CdeO include construction, manufacturing, wholesale and retail trading, food and service industry. The city is also engaged in the import and export of goods and commodities.
10. Tourism and other recreation industries are the most widespread businesses in the city.
11. Within the Philippines CdeO ranks number one in Dynamism of Local Economy and on the top three in other aspect such as Cost of Doing Business (3), Infrastructure (2), Responsiveness to Business Needs (3) and Quality of Life (3).
12. The city is administered through 2 congressional districts and 80 Barangays with 63 being urban accounting for 92.3% of the city's population.

<sup>1</sup> Based on Cagayan de Oro City Analysis from Comprehensive Land Use (CLUP).

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### ***Situation on Environmental Infrastructures***

13. The city has detected several needs in the environmental management sector related to Sanitation and Drainage, Watershed and Solid Waste Management. These three sectors greatly affect CdeO citizens, particularly informal settlers and the orderly development of the city.

### ***Social***

14. Informal settlement is still common and the settlers are particularly vulnerable in flood-prone areas, such as the Cagayan de Oro River banks and coastal areas.

15. The recent Sendong event affected some 10,000 families, mostly informal settlers.

### ***Conclusion***

16. Cagayan de Oro needs to achieve a healthy balance between increased economic development and urbanization on one hand and environmental security and management on the other.

17. The previous mentioned issues (Sanitation, Watershed and Solid Waste Management, as well as resettlement) are considered a high priority for the local government who is considering for a program of infrastructure investment.

## **B. Solid Waste Management**

### ***Situation Analysis***

18. The current practice in CdeO is the collection of mixed waste with waste minimization strategies (as stipulated in RA 9003) being implemented sporadically and at a minimum.

19. Domestic Solid Waste and similar from business is mainly collected by a Private Company hired by the City - BAI who collects about 2/3 of the total waste deposited in the dumpsite (2011); although some barangays and other private haulers also take part of the waste collection for those areas that are not covered by the private collector. The city also collects waste from the resettlements sites.

20. The total volume of waste collected during 2011 amounted to 272,826 m<sup>3</sup>, equivalent to approx. 71,480 t (estimated to be just 64% of waste generated). With the increase in population, the volume of waste being generated will also increase.

21. The collected waste is taken to the existing dumpsite which is about twenty five years old, located in Upper Dagong, Bgy. Carmen. The Carmen dumpsite has almost been filled to capacity. It is necessary to transfer waste disposal activities to an appropriate engineered Sanitary Landfill (SLF) in a new area.

22. Two groups of informal waste pickers (317 families) help in the recovery of recyclable materials by gleaning the recyclable waste materials from the mixed waste dumped in the waste disposal facility.

23. A new site has been identified by the City in Barangay Pagatpat for the new SLF.

### **Strategy and Prioritized Projects**

24. The strategy proposed for the prioritization of projects to improve significantly Solid Waste Management is:

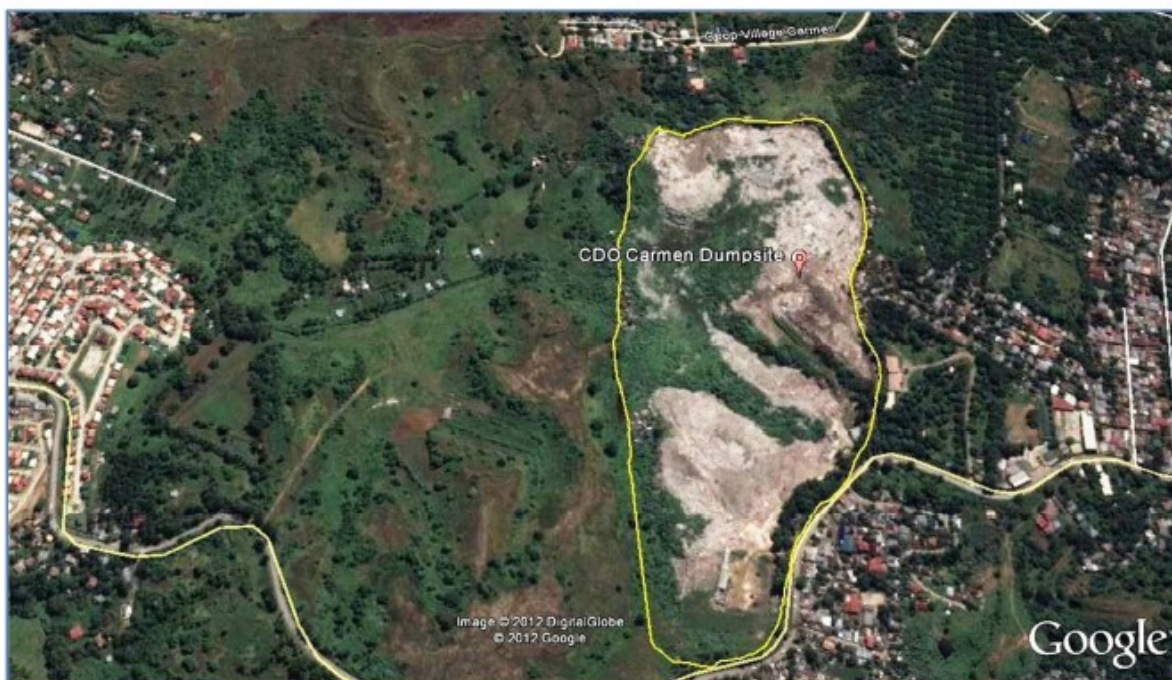
- 24.1. Implement the basic infrastructures required for the solid waste generated every day in the city. These infrastructures must comply with the legislation in force:
  - 24.1.1. Make the disposal sites available.
- 24.2. Reduce the cost of the system, making it affordable and sustainable, and extending the service as much as possible to avoid solid waste being scattered in an uncontrolled manner.
  - 24.2.1. Current collection arrangements are not optimized. Service is not provided to all people in CdeO.
- 24.3. Implement the basic hierarchy for the solid waste management: Reduce–Reuse– Recycle–Recover–Dispose.
  - 24.3.1. Improve the conditions for recovery of materials in the landfill site.
  - 24.3.2. Actions such as MRF should be implemented as a business-oriented activity.

25. To effectively meet solid waste management needs, three priority projects were selected:

- 25.1. Improved operations and closure of the Carmen dumpsite.
- 25.2. Construction of a new Sanitary Landfill in Barangay Pagatpat (including composting and recycling facilities).
- 25.3. The building of a Solid Waste Transfer Station in Barangay Agusan.

### **Carmen Dumpsite Controlling, Remediation and Closure**

26. The main objective is to adapt the present dumpsite to a Controlled Dumpsite (RA 9003), for the operation during the interim period until the new SLF is operative, and subsequently its final closure.



**Figure 2: Carmen Dumpsite area (Source: Google Earth year 2011)**



27. In addition, some proposed structures will enhance operations in the dumpsite. This project will include:

- 27.1. Access control: fencing the plot and introduce control procedures for the pickers and operators.
- 27.2. Perimeter and internal roads.
- 27.3. Rainfall and run-off water diversion and control.
- 27.4. Deposited waste conditioning (reshaping) and provision of an interim soil cover (20 cm of soils or clayish materials).
- 27.5. Base embankment, acting as a reference for the slope formation of the final configuration.
- 27.6. Leachate collection and control: construction of leachate drainage trenches.
- 27.7. Landfill gas control wells, as a preliminary venting network.

28. The defined actions will also achieve extra room for the waste disposal (expected until 2015) and also improve the environment. The situation of the pickers will also improve as risks, such as health, safety and access conditions, will be reduced.

29. Once this interim operations period has terminated and when waste dumping has ceased at the site, the dumpsite will be closed following the technical requirements of the RA 9003. The works related to the closure involve:

- 29.1. Final reshape of the waste filling: slopes 1H:3V, 5 m wide berms every 10 m height, 10% slope at the top of the dumpsite towards peripheral run-off water channels.
- 29.2. Dumpsite Capping: Provision of 0.60 m final soil-cover (Clayish materials).
- 29.3. Landfill Gas extraction and treatment system. Construction of gas wells; lay out of conveyance pipes; and installation of a compact extraction and gas flaring station.

Investment, operation and maintenance costs

<i>Concept</i>	<i>Stage 1. Operation Improvement</i>	<i>Stage 2. Final Closure</i>	<b>TOTAL</b>
<b>Investment</b>	1,271,500 USD 52.77 M PhP	2,821,000 USD 117.07 M PhP	<b>4,092,500 USD</b> <b>169.84 M PhP</b>
<b>Operation &amp; Maintenance</b>	421,470 USD/year 17.49 M PhP/year	63,800 USD/year 2.65 M PhP/year	

Financial Analysis outcome:

➤ Waste Management Fee assumed	903.65 PhP/ton
➤ FIRR	12.00 %
➤ FNPV	8,000 PhP
➤ Required annual income	72.52 Million PhP

**Construction of New Sanitary Landfill in Barangay Pagatpat**

30. According to Ordinance No.12081-2011, the New Sanitary Landfill will be located in Barangay Pagatpat, at Sitio Pamalihi. This site is a narrow valley, from SW to NW, with a height difference of approximately 90 m.

31. The construction of the new SLF in Barangay Pagatpat will require of the following main works:

- 31.1. Access road conditioning: 7 m minimum width, maximum slope of 10%, safety fences where required, asphalted road.
- 31.2. Site preparation works where the landfill and landfill related installations are to be developed. Including excavation, filling and internal roads.
- 31.3. SLF cell construction, following the requirements set out in the IRR of the RA 9003. The Cell excavation with a maximum slope is 1:2 (V:H).
- 31.4. Soil protection layer comprised of geosynthetic and natural clayish materials. Leachate collection bottom network. Cell 1 will have a capacity of 1.24 million cubic meters.
- 31.5. SLF facilities: fence, access control booth, internal roads, buildings (offices and social rooms), scavenging site and area for recyclables storage, pilot composting plant, leachate pond and run-off water retention pond and leachate treatment plant.

32. The SLF will comprise of 3 cells, with a total capacity of 4.55 Million cu.m, and an estimated life span of 21 years.

Investment, operation and maintenance cost:

<i>Concept</i>	<i>Stage 1. Cell#1 and initial works</i>	<i>Future Stages. Cells #2 and #3; Final Closure</i>	<b>TOTAL</b>
<b><i>Investment</i></b>	17,772,500 USD 737.56 M PhP	13,862,000 USD 575.27 M PhP	<b>31,634,500 USD</b> <b>1,312.83 M PhP</b>
<b><i>Operation &amp; Maintenance</i></b>	851,230 USD/year 35.33 M PhP		

Financial Analysis outcome:

➤ Treatment Charge (fee) assumed .....	1,875.88 PhP/ton
➤ FIRR .....	12.01 %
➤ FNPV .....	178,000 PhP
➤ Required annual income .....	150.71 Million PhP

***Build A Solid Waste Transfer Station in Barangay Agusan***

33. The Solid Waste Transfer Station consists of a compaction system to improve the long distance waste haul. The waste is discharged into the compaction unit through a hopper located at a higher ground level, where the collection trucks unload the collected waste.

34. The hauling containers (20 cu.m) are taken by heavy duty trucks and transported to the disposal site (Carmen Dumpsite or later the new SLF) where the compacted waste is discharged.

35. The proposed Transfer Station is designed for the most populated areas in the eastern part of CdeO: brangays Bugo, Puerto, Agusan, Tablón and Cugman. The location has been decided working on the principal of the Center of Gravity of the Waste generation for the five barangays: brgy. Agusan.



**Figure 3: Left: Transfer Station for Solid Waste (Container with compaction unit underneath the hopper). Right: closed container.**

- 36. The works for the implementation of the transfer plant will include:
  - 36.1. Earth movement and civil works for construction of the Transfer Station and Operations building.
  - 36.2. Supplies: electricity, water, drainage...
  - 36.3. Equipment: compaction unit, hopper, high volume closed containers (3 units), Transfer truck.

Investment, operation and maintenance cost:

<i>Concept</i>	<i>Transfer Station</i>
<b>Investment</b>	1,035,000 USD / 42.97 M PhP
<b>Operation &amp; Maintenance</b>	75,000 USD/year / 3.11 M PhP/year

Financial Analysis outcome:

➤ Waste transfer fee (assumed) .....	115.63 PhP/ton
➤ FIRR .....	12.03 %
➤ FNPV .....	60,000 PhP
➤ Required annual income .....	9.29 Million PhP

**Financial and Economic Analysis Key Outcomes**

37. No reference price exists for waste management to be used as the base for the calculation of the increase of cost for the scenario with the proposed projects.

**Table 1. Estimated Solid Waste Management fee of the overall SWM System**

Carmen Dumpsite	Pagatpat SLF	Transfer Station	Waste Collection (existing)	TOTAL
903.65 PhP/t	1,875.88 PhP/t	115.63 PhP/t	1,130.16 PhP/t	<b>4,225.32 PhP/t</b>
				<b>802.0 PhP/person/y</b>

38. The charge on Waste Management for the overall SWM system, covering the cost of the three prioritized projects previously explained (cost of services including business profit



margin) and the existing waste collection, would amount to 4,225 PHP/t. Therefore, the average annual billing in concept of Waste Management fee would amount to 4,010 PHP/year per household, which is equivalent to 0.83% of the GDP per household.

39. The Economic Analysis for the Solid Waste Sector projects is based on the following assumptions:

- 39.1. Investment Costs. Sum of the estimated "Economic Cost", resulting from the deduction of project taxes and corrected value of the non-qualified manpower costs from the estimated investment costs for the prioritized projects.
- 39.2. O&M Costs. Sum of the estimated Cost for Operation and Maintenance of the prioritized infrastructures.
- 39.3. Resettlement Cost and Transportation. Cost related to the resettlement of the families living by the dumpsite and working in the recycling of waste. Cost related to commuting for the waste pickers (the waste pickers' houses to the SLF).
- 39.4. Externalities. External cost in terms of the impact of the amenities (Cost).
- 39.5. Externalities. Reduction of the impact (Benefit) due to corrective measures adopted in the amenities: treatment of leachate in the SLF.
- 39.6. Reduction of Fuel. Savings in fuel for trucks due to an optimisation of the transit distance for the collection and hauling trucks. Reduction of emissions.
- 39.7. Carbon Credits. Landfill gas collection and controlled combustion implies a reduction of the GHG emissions in relation to the Carmen dumpsite and the SLF in Brgy. Pagatpat. The value has been estimated as equivalent to Carbon Credits.
- 39.8. Consumer satisfaction. Equivalent to the calculated financial cost (proposed waste management fee).
- 39.9. Indirect Economic Impact. Benefit related to the carry-over effect of the investment over the regional economy.

40. The outcome of the Economic Analysis shows that the implementation of the proposed Solid Waste management infrastructure is economically feasible since EIRR exceeds the EOCC of 15%. EIRR is 23.6% with net present value (NPV) of PhP183.57 million. The implementation of the Solid Waste Management projects is economically feasible.

41. Sensitivity tests were conducted on the key variables of the economic analysis:

**Table 2. Economic Assessment Sensitivity Test for the Solid Waste Component**

		ENPV (Million PhP)	EIRR
<b>Base Case Scenario</b>		183.57	23.6 %
<b>Sensitivity Case Scenario</b>	a) +20% investment and replacement cost.	35.50	16.4 %
	b) -20% benefit.	-118.33	9.8 %
	c) combined a) and b) cases.	-226.40	5.0 %
	d) 1-year lag in cost and benefits	159.65	23.6 %
	e) No indirect economic impact	-236.13	8.4 %

42. For further information, see Appendix 1. Solid Waste Management Final Report

### **C. Wastewater Management**

#### ***Situation Analysis***

43. **Domestic Waste Water Generation.** The city has no sewerage system and the existing rivers and creeks provide a natural drainage system. The discharge of untreated wastewater into rivers and Macajalar Bay; however, poses a serious threat to environmental degradation as well as human health.

44. Currently, Cagayan De Oro River receives some 12,000.00 cu.m/day of domestic wastewater from inhabitants in Barangays along the river basin.

45. Domestic Wastewater combined with rain runoff flows is collected in ditches and flows in discharge points and then untreated into the river.

46. **Sanitation.** The primary sanitation facilities of residences, offices, and other small commercial establishments are Septic Tanks, and are unable to achieve the required pollution parameters required by DENR. Sludge is also retained in the septic tanks.

47. **Waste Water management.** Continuous discharge of untreated domestic wastewater into the Cagayan De Oro River has deteriorated the water quality.

48. **Water Supply.** In CdeO, the piped water supply reaches over 74,000 connections (about 350,000 residents) and institutional clients. Those not served by Cagayan de Oro Water District (COWD) rely on shallow wells, dug wells, springs, ground water sources or surface water.

#### ***Strategy and Prioritized Projects***

49. Sanitation strategy is based on:

49.1. Providing a short term solution for the existing waste water treatment system based mainly on Septic Tanks. Emptying the tanks at a minimum of every five years and treating sludge in a septage treatment plant.

49.2. Stop, reduce and control the drainage of polluted wastewater into the Cagayan de Oro River, in the short to medium term, by constructing an interceptor system and sewage pipe along both sides of the CdeO River.

49.3. Construction of a centralized WWTP to treat the wastewater from the interceptor pipes before discharging it into the river and the sea. This is focused in the populated urban areas along the Cagayan de Oro River.

49.4. Obligatory sanitation systems for all new developments according to the densities of developments; the least dense may use septic tanks and constructed wetlands, while higher density developments will use sewerage system and centralized WWTP.

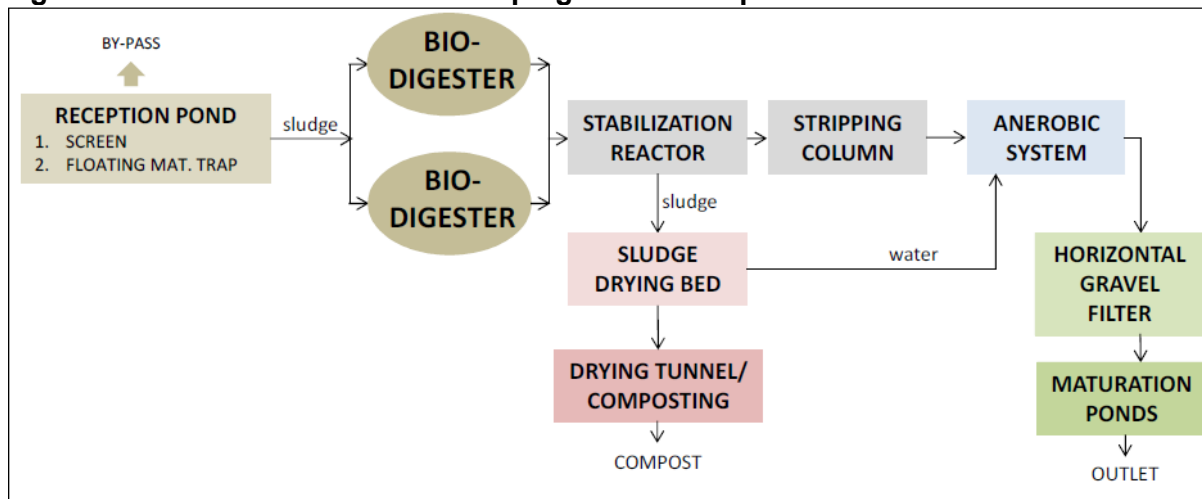
49.5. Connect new developments to the WWTP.

- 49.6. Incremental implementation of long-term system of sewerage pipe network for the whole city over the next 25 years as the city expands and redevelops, repairs and builds new roads.
- 49.7. In the long term, taking into consideration that the rapid growth of the city means that the level of population is expected to surpass million (within 20 years), a full-blown sewerage pipe network is required and needs to be implemented incrementally over the next 20 to 30 years
- 50. The three prioritized projects mentioned earlier are identified within this Pre-feasibility Study:
  - 50.1. Carmen dumpsite; improved operations and closure.
  - 50.2. Construction of a new Sanitary Landfill in Barangay Pagatpat (including composting and recycling facilities).
  - 50.3. Agusan Transfer Station (optimized Solid Waste transportation).

**Construction of a Septage Treatment Plant**

51. The proposed system is based on a Septage Treatment Plant with a capacity for 120 m3/day. In principle the system should be based on a modular, standardized and custom-designed state-of-art technology which is efficient, reliable and available at an affordable price.

**Figure 4: Flowchart of a DEWATS septage treatment plant**



- 52. According to the flowchart, the facility is composed of the following treatment units:
  - 52.1. Receiving and Screening Point
  - 52.2. Anaerobic digester and expansion chamber.
  - 52.3. Stabilization Reactor
  - 52.4. Dewatering process to separate sludge solids from water
  - 52.5. Composting of sludge
  - 52.6. Anaerobic Baffle Reactor and Anaerobic Filter
  - 52.7. Horizontal Gravel Filter
  - 52.8. Maturation Ponds

53. The Septage Treatment Plant will be located on the site of the new planned Sanitary Landfill, in Barangay Pagatpat, in order to create synergies with composting and leachate treatment.

Investment, operation and maintenance cost:

Concept	Septage Treatment plant
<b>Investment</b>	1,084,100 USD / 44.99 M PhP
<b>Operation &amp; Maintenance</b>	95,000 USD/year / 3.94 M PhP/year

Financial Analysis outcome:

➤ Treatment Charge (fee) .....	0.47 PhP/m <sup>3</sup> <i>(assumed to be charged to the fresh water fee)</i>
➤ FIRR .....	12.42 %
➤ FNPV .....	1,267,000 PhP
➤ Required annual income .....	11,19 Million PhP

**Construction of the Interceptor and Sewer System**

54. The project consists of the construction of an interceptor module on each discharge point in the Cagayan de Oro River banks. Interceptors will be designed to capture 100% of the sanitary streams from all urban areas that are now discharging wastewater into the Cagayan de Oro River during dry season. The waste water will be taken to the central wastewater treatment plant (WWTP).

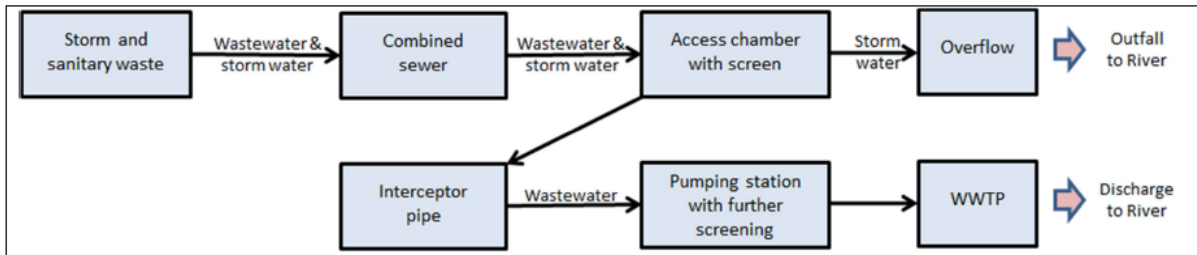
**Figure 5: Interceptor System in CdeO**



55. During the rainy season, the overflow feature of the interceptor will discharge all rainwater to Cagayan de Oro River and mostly wastewater will be collected to be treated.

56. The project will consist of:
- 56.1. 7 km pipe ø24" @ right bank
  - 56.2. 7 km pipe ø24" @ left bank
  - 56.3. River crossing siphon.

**Figure 6: Flowchart of the interception system and piping layout**



Investment, operation and maintenance cost:

Concept	Interceptor and Sewer System
<b>Investment</b>	9,611,500 USD / 398.88 M PhP
<b>Operation &amp; Maintenance</b>	96,115 USD/year / 3.99 M PhP/year

The results of the Financial Analysis for the Interception-Collection System are:

➤ Treatment Charge (fee) .....	2.63 PhP/m <sup>3</sup> (Assumed to be charged to the fresh water fee)
➤ FIRR .....	12.02 %
➤ FNPV .....	694,000 PhP
➤ Required annual income .....	62.62 Million PhP

**Construction of a Central Wastewater Treatment Plant**

57. A Conventional activated sludge wastewater treatment system has been chosen because the soft treatment systems cannot guarantee the required discharge standards, mainly during the rainy season. This WWTP will be located at Barangay Bonbon area.

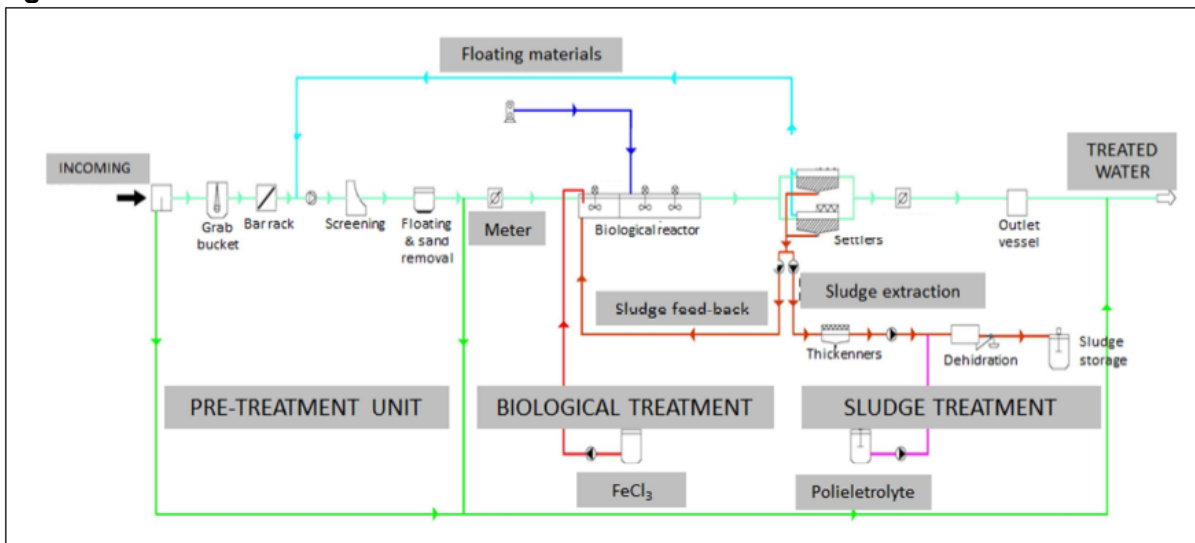
58. Characteristics of the inlet waster and outlet requirements are shown in the following table:

**Table 3: Wastewater Treatment Plant operational parameters**

<i>Maximum inlet Flow</i>		12,000 m <sup>3</sup> /day	
<i>Equivalent population</i>		200,000 equiv.inhab.	
	<i>Incoming Load</i>	<i>Effluent</i>	<i>Yields</i>
SS	2,800 kg/day	< 35	> 90%
BOD <sub>5</sub>	3,400 kg O <sub>2</sub> /day	< 25	> 90%
COD	5,500 kg O <sub>2</sub> /day	< 125	> 90%



Figure 7: WWTP flowchart



59. The proposed system could also eliminate Nitrogen through a biological process and Phosphorous through chemical precipitation.

Investment, operation and maintenance cost:

Concept	Wastewater Treatment Plant
<b>Investment</b>	10,136,125 USD / 420.65 M PhP
<b>Operation &amp; Maintenance</b>	724,900 USD/year / 30.08 M PhP

Financial Analysis outcome:

➤ Treatment Charge (fee) .....	4.01 PhP/m <sup>3</sup> <i>(assumed to be charged to the fresh water fee)</i>
➤ FIRR .....	12.00 %
➤ FNPV .....	27,000 PhP
➤ Required annual income .....	95.48 Million PhP

**Financial and Economic Analysis Key Outcomes**

60. A possible sanitation fee charged with the freshwater fee that would recover the capital and O&M costs plus a profit margin for the sanitation services would amount to 7.11 PHP/m<sup>3</sup>. This value is 26.4% of the current cost of drinkable water (26.90 PHP/m<sup>3</sup> in 2012).

61. The annual average billing per household in concept of the sanitation fee amounts to 2,170 PHP/year, which is equivalent to 0.42% of the GDP (per household).

62. The Economic Analysis for the Wastewater Sector projects is based on the following assumptions:

- 62.1. Investment Costs. Sum of the estimated "Economic Cost", resulting from the deduction of project taxes and corrected value of the non-qualified manpower costs from the estimated investment costs for the prioritized projects.
- 62.2. Replacement costs. Sum of the estimated replacement costs of the equipment of the prioritized projects.

- 62.3. O&M Costs. Sum of the estimated Cost for Operation and Maintenance of the prioritized infrastructures.
- 62.4. Health Benefits. Related to the cost reduction of household and government health care assistance and the savings in cost related to the productive time lost due to water-borne diseases.
- 62.5. Consumer satisfaction. Equivalent to the calculated financial cost (proposed waste management fee).
- 62.6. Incremental tourist expenditure. Quantified as the reduction of tourism losses due to a healthier situation in CdeO as consequence of the projects.
- 62.7. Indirect Economic Impact. Benefit related to the carry-over effect of the investment over the regional economy.

63. The results of the Economic Analysis show that the proposed sanitation facilities and infrastructure is economically feasible. EIRR is 44.23% with net present value (NPV) of PHP 991 million. With the EIRR exceeding the EOCC of 15%, the implementation of the sanitation subproject is economically feasible.

**Table 4. Economic Assessment Sensitivity Test for Sanitation projects**

		ENPV (Million PhP)	EIRR
<b>Sensitivity Case Scenario</b>	<b>Base Case Scenario</b>	991.13	44.23 %
	a) +20% investment and replacement cost.	815.82	34.37 %
	b) -20% benefit.	573.54	31.27 %
	c) Combined a) and b) cases.	398.22	24.12 %
	d) 1-year lag in cost and benefits	860.29	44.23 %
	e) No indirect economic impact	634.67	28.04 %

## D. Watershed Management

### *Situation Analysis*

64. **Watershed Management Coordination.** At present, there are initiatives to address problems of the watersheds; however, all of these are fragmented.

65. This lack of coordination can be attributed to the disconnection between the watershed boundaries and the administrative jurisdiction.

66. The development of a master plan to guide efforts and the setting up of a Central Coordination entity for the watershed management in charge of joining efforts and coordinate actions (preventive and corrective measures) would be recommendable.

67. **Watershed Degradation.** Many activities such as vegetation cover, agricultural activities, urban developments and paving projects and industrial activities such as mining (land excavation, dredging) and forest exploitation have a big influence on the amount of water flowing downstream in the watershed. Many of these activities are occurring at the upper areas of the watershed, sometimes illegally.

68. **Risk Reduction Management.** CdeO has just prepared a Disaster Risk Reduction Plan.

69. **Reforestation.** Forest land in CdeO accounts for just 12% of the total area. Reforestation of watershed areas has a beneficial effect in the prevention of soil erosion while also acting as carbon dioxide sumps.

### ***Strategy and Prioritized Projects***

70. The strategy for the Watershed Management Projects considers the influence of several environmental factors on the behavior of the watershed, such as soil conditions, and just those related to large infrastructures that have already been addressed in previous studies.

70.1. Upstream Rural Watershed actions. Mainly focused on the recovery of the soil conditions that allow a reduced run-off coefficient and avoid solid materials being swept along by the water and deposited as sediments, modifying the river flow conditions and water quality.

70.2. Urban Watershed management actions, with the aim to reduce the side effects caused by heavy -but not extreme- rain over the human activities in populated areas.

70.3. Peri-urban Watershed management actions. Recovery of riverbank, especially those that were affected by typhoon Sendong and that have been identified as no-build zones.

71. The above mentioned actions will help to minimize the effects caused by the conditions of climate change and flood events. These watershed and stormwater management actions are dealt with in the City's Disaster Risk Reduction and Management Plan (DRRMP), which have been reviewed by the Consultant Team Specialist.

### ***Upstream Rural Watershed Actions, Integration with Ecotourism***

72. The focus of this project is environmental, following the principles and concepts in Integrated Flood Management. **It is expected that the current surface runoff coefficient of the area and nearby areas of the watershed will decrease from 0.7 to some 0.3, doubling the water retention capacity of the area.**

73. The boundaries have been previously set by CdeO, and a total forest land area of 3,000 ha had been delineated for this project, and is located in the forest of the City in Brgys. Tumpagon, Pigsag-an, Tuburan, Taglimao, Tagpangi, and Dansolihon.

74. The main activities (components) involved in the Ecotourism and Ecoforestry project are:

74.1. Improvement of Existing Access Road.

74.2. Delineation, Survey and Mapping.

74.3. Community organization and development.

74.4. Reforestation of areas surrounding the Ecotourism Park, following the Principles of Ecoforestry. Reforestation will be based on the use of suitable tree species to produce high quality plantations of native tree species.

74.5. Development of Agroforestry Areas. Focused on areas with slopes ranging from 18-50%.

- 74.6. Specific Plantations, identified by the interest from a point of view of soil protection, site adaptation and socio-economy: Bamboo and Rattan.
- 74.7. Soil and Water Conservation measures will be established and constructed in the site depending on the extent of soil erosion and availability of materials: Mechanical/Engineering measures and Biological/Vegetative measures.
- 74.8. Ecotourism infrastructures and facilities. Capability Building for local communities.
- 74.9. Assessment and Capability building of CLENRO and other City Offices.

75. The estimated cost for the Rural Watershed Management project referred to the Ecotourism sector, amounts to 2,842,300 USD for an 8-year period, includes investment, operation and maintenance costs. Subsequently, O&M costs will be 26,500 USD.

<i>Concept</i>	<i>Septage Treatment plant</i>
<b>Investment</b>	2,599,300 USD / 107.87 M PhP
<b>Operation &amp; Maintenance (8 years)</b>	243,000 USD / 10.08 M PhP
<b>Operation &amp; Maintenance (beyond 8<sup>th</sup> year)</b>	26,500 USD/year / 1.10 M PhP/year

**Urban Watershed Management: Catchment Ponds and Public Easements Along the Rivers**

76. The implementation of this kind of infrastructures will allow localized flooding events in the lower parts of the city due to storms to be reduced (floods lasting about several hours and some 50 cm flood depth).

- 76.1. Location: Open spaces within the city, such as parks or non-build areas. Some ponds can be interconnected to create a higher retention capacity network; and also considered in new urban development zones.
- 76.2. Design parameters: A catchment pond with a water retention capacity of 1,100 m<sup>3</sup>, occupying a 1,500 m<sup>2</sup> area can be adapted to local conditions and types of soils. This design will be able to harvest the water from 14 Ha considering the total rain as runoff water (1 hour storm with a precipitation of 7.5 mm)<sup>2</sup>.

The water inlet and outlet (overflow) points and speed controlling and protection systems (such as riprap) will be part of the design..

- 76.3. A total of 160 catchment ponds have been considered.

Investment, operation and maintenance cost:

<i>Concept</i>	<i>Catchment Ponds</i>
<b>Investment</b>	7,500,000 USD / 311.25 M PhP
<b>Operation &amp; Maintenance</b>	200,000 USD/year / 8.30 M PhP/year

**Peri-Urban Watershed Management: Selected Riverbanks Reforestation**

77. The project has been brought forward taking into consideration the comments and proposals received during the workshops conducted during the PFS. The degradation or

<sup>2</sup> Average water poured during Sendong.

river banks (informal and/or formal new settlements, loss of green cover, dredging activities...) is perceived as a relevant issue for flood prevention.

78. This project aims to restore and bring back the forest vegetation along the Cagayan de Oro River banks in which specific strips of land have been declared as no build zone. This proposed project is consistent with the mandate of the City through CLENRO to reforest river banks, as well as being in line with the goals and objectives of the National Greening Program.

79. Given that the project deals with the reforestation and sustainable management of planted trees, they will contribute to reducing (carbon sink) the amount of carbon dioxide in the atmosphere that contributes to greenhouse effect and climate change. Therefore, it can be registered as a REDD+ Project.

80. This project will be implemented in a stretch of about 15 km from the river mouth of Cagayan de Oro River heading upstream, varying in width from 4 to 15 meters on both sides of the river.

81. Component activities:

81.1. Site Preparation. Delineation of the specific areas that are in need of planting, paying attention to the river layout and topography of the river banks: zoning plan for plantations. Species identification must be undertaken by specialists.

81.2. Nursery establishment and development. This Reforestation program will depend highly on the production and availability of good quality seedlings. One central and several satellite nurseries will be established in strategic locations for easy transport and handling.

81.3. Organization and Capacity Building. The program and the nurseries will be under the CLENRO who should assist communities in establishing plantation campaigns. Participants should be provided with training to ensure the success of the reforestation and that specific care and maintenance is to be carried out for the planted areas.

81.4. Planting implementation. Planting activities are expected to be carried out by the citizens and NGOs that usually participate in these activities, under the organization of the barangays and communities.

82. Subsequent maintenance of the reforested areas will be performed by the barangays and supported by CLENRO: periodical cleaning from residues, clearing from shrubs, drainage maintenance, cleaning of sediments accumulation, etc...

83. Total investment budget for the implementation of the Reforestation project in the CdeO River banks amount to 250,000 USD for a period of 6 years (investment plus O&M). Subsequently, operation and maintenance costs will be 18,000 USD.

<i>Concept</i>	<i>Septage Treatment plant</i>
<i>Investment</i>	184,000 USD / 7.64 M PhP
<i>Operation &amp; Maintenance (6 years)</i>	66,000 USD / 2.74 M PhP
<i>Operation &amp; Maintenance (beyond 6<sup>th</sup> year)</i>	18,000 USD/year / 0.75 M PhP/year



**Financial and Economic Analysis Key Outcomes**

84. Results of the analysis show that the implementation of the proposed Watershed Management infrastructure is economically feasible for the base case since EIRR exceeds the EOCC of 15%. EIRR is 20.9% with net present value (NPV) of PhP 44.92 million.

**Table 5. Economic Assessment Sensitivity Test for Watershed Management projects.**

		ENPV (Million PhP)	EIRR
<b>Sensitivity Case Scenario</b>	<i>Base Case Scenario</i>	44.92	20.9 %
	a) +20% investment and replacement cost.	-13.97	13.7 %
	b) -20% benefit.	-33.16	11.3 %
	c) combined a) and b) cases.	-92.06	7.3 %
	d) 1-year lag in cost and benefits	38.97	20.9 %
	e) No indirect economic impact	-184.03	4.9 %

85. The results obtained from the sensitivity test show negative figures, revealing that the project is not robust against the potential uncertainties and variation of the parameters of the project.

**E. Resettlement Framework**

**Strategy and Objectives**

86. The Resettlement Framework drafted within the scope of the PFS is focused on the 10,195 families who are informally settling along Cagayan De Oro River.

87. The guiding policy and principles for resettlement followed in the PFS are set out in the document “Involuntary Resettlement”, Asian Development Bank, Manila 1995.

88. The following are the objectives of the Resettlement Framework:

- 88.1. To avert another calamity to happen by protecting the underprivileged families settling within the danger areas of the city as well as the environment.
- 88.2. To ensure that the informal settlers are relocated with tenurial security to an affordable housing program with options to choose from and improve their living environment.
- 88.3. To involve them in the process of resettlement and project implementation as well as the strict compliance with laws and resettlement standards approved by national and international organizations.
- 88.4. To ensure the smooth assistance packages and other entitlement programs.
- 88.5. To improve socio-economic condition of marginalized sector thru sustainable development.
- 88.6. To inform and educate them on their share of responsibility in the society by participating in awareness campaign and advocacy on clean and green environment.

88.7. To address the growing concern on housing and informal settlements.

88.8. To rehabilitate Cagayan de Oro River.

### ***The Project Components and Resettlement Actions***

89. The project is focused on the Housing and Resettlement of an estimated total of 10,195 vulnerable informal settler families along the Cagayan de Oro River (source: CPDO).

90. The components are socialized housing, basic infrastructure services or community facilities, such as school buildings for elementary and high school, day-care center, health center with lying-in clinic, market and covered court/multipurpose facility and other social services. The resettlement program encompasses housing options, livelihood entitlement, transportation assistance and food support.

91. The project has also taken into consideration the economic integration, enhancing opportunities of informal economy and strengthening the formal sector, and economic development of the cities on a global scale.

92. Housing options offers off-site-in-city and off-city resettlement. In-situ or On-site resettlement is not appropriate as option, given that the 10,195 families settle within the danger areas.

92.1. Off Site-In-City Relocation: development of resettlement sites outside the areas presently occupied by households, but within the jurisdiction of the same LGU.

Medium Rise Building or High Rise Building types of structures are recommended for social or low cost housing option<sup>3</sup>, and could also be used for urban renewal of blighted areas within the city.



**Figure 8: Karangalan Village, Medium Rise Housing Projects of NHA in Pasig City, Metro Manila (Left) and Medium Rise Housing Project in Punta, Sta. Ana Manila. Housing Program for homeless people initiated by Jaime Cardinal Sin Foundation with Gawad Kalinga (Right)**

92.2. Off-City Resettlement: Location of land should be appropriate for residential use far from danger areas.

<sup>3</sup> Location for in-city resettlement should be in accordance to the CLUP and safe areas from disasters.



**Figure 9: LGU of Province of Bukidnon's Housing and resettlement facilities in partnership with the National Housing Authority and private developers**

93. Other approaches to resettlement options to be considered by LGU for implementation:

- 93.1. Resettlement Projects - These can be undertaken through joint-venture arrangements with private partners or under the sites and services program of the NHA.
- 93.2. Community Mortgage Program (CMP) with the LGU as originator and/or NHMFC as the funding organization.
- 93.3. Regular Low-Cost Housing Projects - These can be undertaken through joint-venture arrangements with private partners; and can be financed through DBP, Landbank, PNB or other private banks; or from the equivalent 20 percent (20%) of total subdivision project cost allocation of private developers for LGU<sup>4</sup>.
- 93.4. Medium Rise Housing and Rental Housing – this could be through a joint venture arrangement with the NHA. Technical assistance can be provided by the NHA.
- 93.5. Core Shelter Housing Assistance - This is program of the Department of Social Welfare and Development that provides technical assistance to families affected by disasters through the building of a standard typhoon-resistant core housing unit at minimal cost.

### ***Compensation and Entitlement***

94. In addition to housing, other assistance such as transportation, livelihood development, food assistance and educational assistance are offered to relocatees that move from having settled along the riverbanks, for a smooth transition process. The summary of the costs for the resettlement of the identified families is:

<sup>4</sup> UDHA, HLURB Board Resolution No. 806 of 2007

**Table 6. Estimated cost of CARP for the resettlement of ISF of CDO River.**

SUMMARY OF ESTIMATED COSTS .....		Total PHP	3,221,335,000
		Total USD	76,698,500
<i>(USD 1,00 = PhP 42,00)</i>			
A.	Housing Assistance	<i>PhP</i>	3,058,500,000
B.	Pre-Relocation (Including Materials for Public Information)	<i>PhP</i>	1,000,000
C.	Relocation/Mobilization of ISFs	<i>PhP</i>	81,560,000
D.	Post-Relocation Entitlements	<i>PhP</i>	27,575,000
E.	Community Facilities (for new resettlement sites)	<i>PhP</i>	52,700,000

**F. Capacity Development Plan**

**Capacity needs Assessment**

95. The methodology used to elaborate the present document is a standard methodology used in Capacity Building Development and includes the following steps:

- 95.1. Review the Local Government Code of 1991 R.A. 7160 in relation to the mandated roles and responsibilities of the key government Inter agencies the City Planning and Development Office as the lead city office of the project supported by the CLENRO for concerns about the Solid Waste Management, Waste Water Management and Watershed, and likewise CSWD for the Resettlement, and the CE for the infrastructure needs of the project.
- 95.2. Focus Interviews with identified inter agencies: CPDO, CLENRO, CSWD, CEO, CHO, DILG.
- 95.3. Assessment analysis of the present situation of the inter agencies and recommendation for the improvement and enhancement of their capacity.
- 95.4. Analyze data improvement to be considered in the preparation of the pre-feasibility study.
- 95.5. Propose a Capacity Development Plan to address as fully as possible the real training needs of the mentioned stakeholders.
- 95.6. Estimate economical costs to develop the outlined Plan.

**Proposed Capacity Development Plan**

- 96. During the development of the PFS works, the following Stakeholder were identified:
  - 96.1. Barangays and residents: There are 80 Barangays in CdeO; however, for practical reasons the number of attendees was restricted, and as such, not all of them were invited to the Workshops. Representativeness and particular involvement in the main issues that are part of the PFS was considered for the invitation purposes.
  - 96.2. DENR: including some key departments in reference with the scope of the PFS, such as Forestry and Environmental Management.

- 96.3. City Offices, among them: City Planning and Development Office (CPDO), City Local Environment and Natural Resources Office (CLENRO), City Social Work and Development Office (CSWDO), City Health Office (CHO), City Agriculture Office (CAO), City Department of Interior and Local Government (DILG), City Engineer Office (CEO).
- 96.4. Other entities, such as Cagayan de Oro Waster District (COWD), ABC (Association of Barangay Chairmen), NGOs and POs.

### ***Training Events and On-The-Job Training During Pfs Stage***

97. The Consultant Team has worked with the personnel for almost 5 months, discussing, exchanging points of view and knowledge (local knowledge and international approach). During these meetings, the Consultant Team identified some of the training needs that would improve the implementation of the PFS components, not just considering the regulations and institutional factors, but also technical capabilities and competences.

98. Although this task has not been a formal activity, the results, discussed with the Consultant team members has served to outline the basic approach to training needs.

### ***Financial Needs and Proposed Financing Plan***

99. The following table presents the basic competencies and the training needs for the stakeholders, including a unitary budget for each activity.

100. The estimated annual budget to develop the activities is 150,000 USD, equivalent to 6.23 Million PhP.

101. The following steps to be taken are to define the priorities in the city departments and to set nominate the attendee(s) for each action.



FIELD	Title	Institutional Stakeholders	Objective	Type	Estimated Unitary Cost
LEGISLATION	Local Government Code of 1991 RA 7160. Other Environmental Laws.	LGUs staff and Barangay	Knowledge of the basic legislation to interpret and carry out the law.	WS	500 USD
	R.A. 9003.		Knowledge of legislation on SW to interpret and carry out the law.	WS	500 USD
	R.A. 7279: Housing Act		Knowledge of legislation on Housing requirements to interpret and carry out the law.	WS	500 USD
MANAGERIAL	Workplace organisation	Head officer of LGUs. Staff of LGUs	Improve motivation among the department staff and capabilities to develop the assigned tasks.	WS	1,000 USD
	Motivation and Coaching	Head officer of LGUs.	Improve motivation among the department staff. Follow-up of relevant staff (intermediate level)	WS	1,000 USD
FINANCIAL	Financial Mangement	High level staff (University educ.). Budget, finance and managing responsibilities from CPDO, CLENRO and CEO.	Advanced knowledge on financial aspects of projects, enabling to make decisions on financing systems, alternatives, etc.	UD, SC	5,000 USD/attendee
TECHNICAL	Project Mangement	High level staff (University background), and managing responsibilities in CPDO, CLENRO and CEO.	Knowledge on development of complex infrastructure projects: tendering, relevant construction companies, international specialists, planning, time framework, project monitoring, budget control, etc.	ICO	2,500 USD/attendee
				UD, SC	
TECHNICAL	Works Management.	Project Managers in the relevant departments (CEO, CLENRO, CPDO), university background, and works development responsibilities.	Competence in Contract Management of infrastructure works, works supervision and commissioning (Design, Terms of Reference, General Conditions for Works, supervision and commissioning procedures).	ICO	1,800 USD/attendee +200 studying material
				UD, SC	
TECHNICAL	Technical Training on Solid Waste Management and Infrastructures.	Medium and High level staff with technical responsibilities in SWM, mainly from CLENRO.	Competence in Solid Waste Management: planning and infrastructures, technologies, procedures, basic design, operation.	UD, SC	
				TS	250 USD
				ICO	1,000 USD
				EL	100 USD
TECHNICAL	Technical Training on Sanitation/Waste Water Management and Infrastructures.	Medium and High level staff with technical responsibilities in Sanitation and Wastewater, mainly from CLENRO.	Competence in Sanitation and Wastewater Management: planning and infrastructures, technologies, procedures, basic design, WWTP, operation.	UD, SC	
				ICO	1,000 USD
				EL	100 USD
TECHNICAL	Technical Training on Hidrology and Hidrogeology.	Medium and High level staff with technical responsibilities in Watershed Management, mainly from CLENRO.	Competence in Hidrology to understand and implement corective masures, watershed magement and water management planing.	UD, SC	
				CA	2,400 USD
				EL	100 USD
TECHNICAL	Technical on Agroforestry, Reforestation and Ecological agriculture.	Medium and High level staff with technical responsibilities in Watershed Management, mainly from CLENRO.	Competence in basic techniques of Agroforestry, reforestation planning and development, ecological agriculture.	UD, SC	
				CA	2,400 USD
				EL	100 USD
TECHNICAL	Urban Development and Resettlement.	Medium and High level staff with technical responsibilities in Resettlement activities.	Competence in urban development, urban planning and resettlement.	UD, SC	
				CA	2,400 USD
				EL	100 USD
COMMUNICATIONS	Media developmentS for Information and Education Campaigns	Staff focused on educational aspects	Advanced knowledge on presentation techniques, media communication and use of current technologies	UD, SC	
				CA	2,400 USD
				EL	100 USD
MISCELLANEOUS	Information about on-going projects in the LGUs	All the staff of the related departments.	Raise awareness of projects developed by the department, facilitating the understanding and importance of the work. Gain ownership of the projects	IN	

Type legend : WS : Workshop  
 ICO : Course by International Certification Organisations  
 UD : University Degree  
 SC : Specialisation course  
 TS : Training Sessions, Conferences,...  
 EL : E-learning activities  
 CA : Consultant Assistance  
 IN : Internal sessions



**H. Financial Plan, Proposed Financing Options**

103. The following financing options have been taken into consideration during the preparation of the PFS and have been assessed for each particular case:

- 103.1. Public-private-partnership (PPP) modality (in the most appropriate form for each project).
- 103.2. Self-funding by CdeO tax base and/or raising more bank debt.
- 103.3. New funding generated by issue of municipal bonds by CdeO City.
- 103.4. Special funding obtained from Philippines regional and national sources.
- 103.5. Special funding obtained from international funding sources.

104. Normally, projects which require great investment and implying some technological capabilities are recommended to be financed using a PPP modality.

105. The summary of the financing options proposed for each identified project are shown in the following table.

**Table 7. Recommended Financing Option for the prioritized projects of the PFS.**

<i>Component</i>	<i>Project and Recommended Financing Option</i>		
<b>Solid Waste Management</b>	<u>Carmen Dumpsite</u> Stage 1. City budget (CEO and CLENRO). Stage 2. PPP model (DB)	<u>Pagatpat SLF</u> PPP model (DBOT or DBOFT)	<u>SW Transfer Station</u> PPP model (DBOT or DBFOT)
<b>Waste Water Management</b>	<u>Interception-Collection system</u> PPP model (DB)	<u>Wastewater Treatment Plant</u> PPP model (DBO or DBOF)	<u>Septage Treatment Plant</u> PPP model (DBO or DBFO)
<b>Watershed Management</b>	<u>Rural Watershed – Ecotourism.</u> * Access road. PPP model (DB) * Rest of the project. Municipal funds	<u>Urban Watershed – Catchment Ponds.</u> PPP model (DB)	<u>Reforestation of Riverbanks.</u> Local Funds (i.e. City Calamity Fund)

## I. Municipal Revenues and Expenditures – Project Impact On Budget

106. For the calendar year 2012, the estimated revenue generated will be around PHP 1.78 billion (or approximately USD 43 million). The majority (55%) of this revenue is from local taxes and charges, while 45% is paid by the national government as a share of national tax revenue, in the form of the Internal Revenue Allotment (IRA). The main local taxes are:

- 106.1. Real Property Tax
- 106.2. Business and Other Local Taxes
- 106.3. Fees and Charges
- 106.4. Receipts from Economic Enterprises operated by the City

107. This sizeable tax base has been growing strongly in recent years; from 2010 to 2012, local tax receipts are estimated to have increased at 11% per annum. On the other hand, IRA receipts from the national government (and therefore outside the direct control of CdeO) have been decreasing, but still remain a significant source of revenue for the city.

108. The City also has a good collection efficiency record, with the single exception of real estate taxes.

109. The CdeO balance sheet, as at 31 December 2011, shows Total Assets of around PHP 4.74 billion, of which 762 million PhP (or 16%) is in the form of Cash, while PHP 3.34 billion relates to Property, Plant, and Equipment (net of depreciation).

110. On the credit side of the balance sheet, Total Liabilities amount to PHP 1.67 billion, and Government Equity totals PHP 3.07 billion.

111. According to the Balance Sheet, at present (October 2012), loans payable are estimated to be around PHP 1 billion, rising from PHP 0.853 billion as of 31 December 2011. The total expenditure allocated for interest and loan repayments (2012) is PHP 249 million (or around 14% of total budgeted expenditure for 2012, which stands at PHP 1.78 billion).

112. Most of the prioritized projects under this PFS are recommended to be financed through PPP models, adopting the specific form depending of the particular characteristics and requirements. This PPP funding system has no bearing on the 20% codal limitation on borrowings by the city. However the city will have to make the required arrangement to ensure the money to pay the provider of the services through the existing taxes or new tariffs, such as solid waste management fee, sanitation fee, etc. These new tariff shall be assessed taking into consideration a system that lessen the burden on low income families or some kind of direct subsidies for those families.

113. The projects, or components of the projects, that are proposed to be financed directly by the City budget have a modest cost and therefore their impact on the local budget will not be relevant.

## J. Implementation Arrangements

114. It is considered that the participation of the Private sector is a good alternative to develop a specific service on solid waste and wastewater sectors management. This will provide knowledge acquisition for the members of the LGUs and a transfer of risk to the service provider.

115. It is recommended that the Municipality implements **an office for Solid Waste Management** (suggested within CLENRO structure), empowered to implement the

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infrastructures and services involved in the PFS, not as a construction or service provider office, but acting as a supervision entity in the case that the services are outsourced (PPP model). This office should also give advice about taxes, regulatory issues and support information and awareness campaigns on Solid Waste.

116. In the case of the management of the wastewater system for the city, it is proposed to be planned between several offices of the city, such as CPDO, CLENRO, CEO **in coordination with the COWD**. COWD's experience on water management, distribution and on hydraulic projects is a key factor to implement the proposed wastewater treatment system. The role of COWD in water fee collection is also of great interest to guarantee the required income (wastewater management fee) to make financially viable the proposed projects.

117. For the implementation of the watershed management projects, the CEO is the key department within the city to develop the construction works identified in the projects, such as the Catchment Ponds and the access road to the ecotourism areas. The CLENRO has a relevant role in the reforestation and ecoforestry projects, counting with a forestry department.

#### **K. Identified Projects Facts Sheets**

118. Fact sheet for the prioritized projects of the PFS for Wastewater, Watershed and Solid Waste management sector are included in the Appendix.



<b>Solid Waste Management</b>	
<b>Project</b>	<b><i>Carmen Dumpsite Improved Operation and Final Closure</i></b>
<b>Description</b>	<p><b>Improved Operation and Closure</b> of the existing dumpsite at barangay Carmen in order to adapt the present current situation (uncontrolled dumpsite) to get as closer as possible to the situation for a Controlled Dumpsite, required according to the RA 9003. These works will be focus on reshaping the waste mass, interim soil cover, drainage of leachate, run-off water diversion and landfill gas evacuation</p> <p>This will provide an extension of the dumpsite operation until 2015.</p> <p>Works will enable to go on with the SW management at the site for the interim period until the new sanitary landfill is ready for operations.</p> <p>After the operations period, the dumpsite shall be <b>closed</b> following the technical requirements of the RA 9003.</p> <p>A landfill gas collection and combustion in a flare is a potential Clean Development Mechanism to be undertaken.</p>
<b>CAPEX and OPEX</b>	<p>Stage 1. CAPEX ..... 55.77 M PhP ; OPEX ..... 17.49 M PhP/y</p> <p>Stage 2. CAPEX ..... 117.07 M PhP ; OPEX ..... 2.65 M PhP/y</p>
<b>Financial Analysis</b>	<p>FIRR ..... 12% FNPV ..... 8,000 PhP</p> <p>Required Annual Income ..... 72.52 Million PhP</p> <p>Waste Management Fee ..... 903.65 PhP/ton</p>
<b>Economic Analysis</b>	<p>The economic evaluation of the three proposed projects on the Solid Waste Management Sector is positive EIRR of 23.6% (higher that the EOCC of 15%) and an ENPV of PhP 183.57 Million.</p>
<b>Financing options</b>	<p>City budget (CEO and CLENRO) for 1<sup>st</sup> Stage.</p> <p>For 2<sup>nd</sup> Stage, a PPP system is recommendable, especially DBO or DBOT (<i>possibly as a continuation of the DBO/DBOT for the new SLF</i>)</p> <p>Including CDM from landfill gas (DBO / DBOT).</p>
<b>Environmental impacts</b>	<p>Positive: reduction of the dumpsite negative effect on water, ground water, and atmosphere.</p> <p>Negative: the interim cover and corrective measures will not allow a complete correction of environmental affections.</p>
<b>Social impacts</b>	<p>People recovering recyclable on the dumpsite will improve the working conditions (healthier environment). Controlled access to the dumpsite.</p> <p>Works to improve the operations will disturb the waste pickers due to the presence of machinery and periodic soil cover of the waste. Also the usual dumping area will move.</p>
<b>Implementation issues</b>	<p>The 1<sup>st</sup> stage of the project shall be implemented as soon as possible and the dumpsite lifetime is expected to be extended until 2015.</p> <p>The improved operations shall go on until the new SLF is ready to receive the waste.</p> <p>Updated topography required and periodic updated too.</p>

<b>Solid Waste Management</b>	
<b>Project</b>	<b><i>New Sanitary Landfill. Pagatpat</i></b>
<b>Description</b>	<p>The New Sanitary Landfill will be located in Barangay Pagatpat (Ordinance NO.12081-2011). Area of the site 32 Ha.</p> <p>The new SLF will require of the following main works:</p> <ul style="list-style-type: none"> <li>- Access road conditioning.</li> <li>- Site preparation works, including earth excavation and filling works, internal road.</li> <li>- SLF cell construction (IRR of the RA 9003 requirements): Earthworks, Embankment, Cell base lining (geosynthetics + clay).</li> <li>- Facilities construction. Buildings and facilities: Fencing, Access Control, Offices and social rooms, scavenging site &amp; recyclables storage area, Composting area, Leachate management and treatment and run-off water pond.</li> <li>- 3 Cells = Lifetime span 21 years.</li> <li>- Partial and Total closure of cells and SLF.</li> </ul> <p><i>[The STP for the Sanitation sector is proposed to be built in this site.]</i></p>
<b>CAPEX and OPEX</b>	<p>Only for Cell#1. CAPEX ..... 737.565 M PhP ; OPEX ..... 35.83 M PhP  <i>(SLF complete development and closure -3 Cells-. CAPEX: 1,312.83 M PhP)</i></p>
<b>Financial Analysis</b>	<p>FIRR ..... 12.01% FNPV ..... 178,000 PHP            Required Annual Income ..... 150.71 Million PhP            Waste Management Fee ..... 1,875.88 PhP/ton</p>
<b>Economic Analysis</b>	<p>The economic evaluation of the three proposed projects on the Solid Waste Management Sector is positive EIRR of 23.6% (higher than the EOCC of 15%) and an ENPV of PhP 183.57 Million.</p>
<b>Financing options</b>	<p>The recommendation is to use a PPP agreement, in particular a DBO or DBOT (or even a DBOF) <i>(possibility to link the end on this project with the final closure of Carmen Dumpsite)</i></p> <p>Including CDM from landfill gas (DBO / DBOT).</p>
<b>Environmental impacts</b>	<p>Positive: environmental friendly landfill complying with regulations and equipped with the required facilities for leachate and gas treatment.</p> <p>Negative: the construction will involve the cutting down of trees and moving vegetation affecting soil erosion. Usual effect of intensive civil works in the area. Surrounding environment will feel the presence of waste and its effects, despite all corrective measure being undertaken.</p>
<b>Social impacts</b>	<p>People recovering recyclable on the dumpsite will improve the working conditions (picking area, recyclable storage, and amenities). Controlled access to the dumpsite and progressive formalization of waste recovery works.</p> <p>Demographic pressure in the new area (new people accessing the site).</p>
<b>Implementation issues</b>	<p>There should be coordination between Carmen Dumpsite Closure and the opening of the new SLF.</p> <p>Important to empower CLENRO staff as waste management controllers to supervise the operation of the sanitary landfill.</p> <p>Detailed studies are required: topographic, geotechnical, hydrogeological</p>

<b>Solid Waste Management</b>	
<b>Project</b>	<b><i>Agusan Solid Waste Transfer</i></b>
<b>Description</b>	<p>The Transfer Station is designated to the long distance hauling of the solid waste collected and subsequently compacted in the serviced area. The final destination of the waste is the Carmen dumpsite or the new SLF in Pagatpat.</p> <p>Barangays serviced: Bugo, Puerto, Agusan, Tablon and Cugman. This means an estimated population of 92,548 inhabitants.</p> <p>The design capacity is to process up to 50 t/day.</p> <p>The project includes a single compaction system, closed containers and hauling truck.</p>
<b>CAPEX and OPEX</b>	CAPEX ..... 42.97 M PhP ;      OPEX ..... 3.11 M PhP/year
<b>Financial Analysis</b>	<p>FIRR ..... 12.03%                      FNPV ..... 60,000 PHP</p> <p>Required Annual Income ..... 9.29 Million PhP</p> <p>Waste Management Fee ..... 115.63 PhP/ton</p>
<b>Economic Analysis</b>	The economic evaluation of the three proposed projects on the Solid Waste Management Sector is a positive EIRR of 23.6% (higher than the EOCC of 15%) and an ENPV of PhP 183.57 Million.
<b>Financing options</b>	The recommendation is to use a PPP agreement, in particular a DBO or DBOT
<b>Environmental impacts</b>	<p>Positive: reduction of the overall fuel consumption used for waste collection with the corresponding reduction in emissions (CO<sub>2</sub>, NO<sub>x</sub>, particles...).</p> <p>Negative: the surroundings of the transfer station may suffer sporadic episodes of bad odors (although the waste is not to remain more than 24 h in the plant).</p>
<b>Social impacts</b>	<p>The overall level of transit of trucks will be reduced significantly with a reduction in the number of trucks crossing the city center on their way to the dumpsite (later to the SLF).</p> <p>On the other hand local traffic in the proximity of the transfer station will increase.</p>
<b>Implementation issues</b>	<p>This project is not linked to the construction of the new SLF.</p> <p>The precise site for the construction of the transfer station should be decided by the city, considering the need to purchase the plot, (not included in the cost of the project).</p> <p>The savings in the number of collection trucks, can be considered as direct savings or can be used to extend the collection services to other areas of the city.</p>

<b>Wastewater Sector</b>	
<b>Project</b>	<b><i>Septage Treatment Plant</i></b>
<b>Description</b>	<p>Construction of a treatment plant to serve the whole City of Cagayan de Oro with a capacity of up to 120 m<sup>3</sup>/day, based on a Decentralized Wastewater Treatment System (DEWATS) (a modular, standardized and custom-designed state-of-art technology).</p> <p>The plant includes an aerobic composting process for the final sludge (possibility to compost together with organic domestic waste).</p> <p>Located in the Sanitary landfill site, at Pagatpat.</p>
<b>CAPEX and OPEX</b>	CAPEX ..... 44.99 M PhP ;      OPEX ..... 3.94 M PhP/year
<b>Financial Analysis</b>	<p>FIRR .....12.42%                      FNPV ..... 1,267,000 PHP</p> <p>Required Annual Income ..... 11.19 Million PhP</p> <p>Sanitation charge (fee) ..... 0,47 PhP/cu.m (*)</p>
<b>Economic Analysis</b>	The economic evaluation of the three proposed projects on the Sanitation Sector is positive EIRR of 44.23% (higher that the EOCC of 15%) and an ENPV of PhP 991.13 Million.
<b>Financing options</b>	The project could be directly finance by the City given the level of investment required. However, the recommendation is to consider a PPP agreement, in particular a DBO or DBOT type.
<b>Environmental impacts</b>	<p>Positive: controlled treatment of the sludge from Septic tanks. Enhanced treatment capacity of the septic tanks. Recovery of a resource (compost).</p> <p>Negative: Construction works. Subsequently mobilization of trucks transporting the septage to the plant.</p>
<b>Social impacts</b>	<p>Improved environment in the city and reduction in the risk illness due to poor sanitation.</p> <p>People will have to carry out periodic cleaning of the septic tanks.</p>
<b>Implementation issues</b>	<p>This project is based on the strict fulfillment of the conditions introduced in the Septage Ordinance awaiting approval.</p> <p>CLENRO and the COWD should coordinate the supervision of the system (performance of the law) and tariff collection.</p>

(\*) Referred to cu.m of drinking water supplied by COWD



<b>Wastewater Sector</b>	
<b>Project</b>	<b>Interception - Collection System</b>
<b>Description</b>	<p>With the aim of controlling the waste water discharged into the Cagayan de Oro River, the construction of an interceptor module on each discharge points in river banks is proposed.</p> <p>The system is designed to capture the sanitary waters flows from all the barangays discharging into the river in the urban area under two different conditions:</p> <ul style="list-style-type: none"> <li>- Dry season, all wastewater will be collected.</li> <li>- Rainy season, the overflow feature of the interceptor will discharge all rainwater into River</li> </ul> <p>The wastewater is taken to the treatment facilities (also identified in this PFS).</p> <p>The project will consist of two 7 Km pipe ø24" on each bank of the Cagayan de Oro River and a siphon under the river bed (estimated 200 m).</p>
<b>CAPEX and OPEX</b>	CAPEX ..... 398.88 M PhP ;      OPEX ..... 3.99 M PhP/year
<b>Financial Analysis</b>	<p>FIRR ..... 12.02%                      FNPV ..... 694,000 PHP</p> <p>Required Annual Income ..... 62.62 Million PhP</p> <p>Sanitation charge (fee) ..... 2.63 PhP/cu.m (*)</p>
<b>Economic Analysis</b>	The economic evaluation of the three proposed projects in the Sanitation Sector is a positive EIRR of 44.23% (higher that the EOCC of 15%) and an ENPV of PhP 991.13 Million.
<b>Financing options</b>	The recommendation is to use a PPP agreement, in particular a DB since there is not special requirement for its operation once it is constructed.
<b>Environmental impacts</b>	<p>Positive: wastewater (even that partially treated in the septic tanks) will not get to the river, and as such contamination will be reduced.</p> <p>Negative: heavy construction works will generate some local pollution and may temporally affect the river area.</p>
<b>Social impacts</b>	<p>Reduction of potential illness due to water pollution. Works demanding manpower and business opportunities in the city.</p> <p>People living by the river banks will be affected by the works (machinery, access and circulation restrictions...). Some 120 families (informal settlers in the no-build zone) might be especially affected in the area where the siphon is to be build.</p>
<b>Implementation issues</b>	<p>The participation of the CEO for supervision is important.</p> <p>This project is linked to the construction of the WWTP</p> <p>CLENRO and the COWD should coordinate for tariff collection.</p>

(\*) Referred to cu.m of drinking water supplied by COWD

<b>Wastewater Sector</b>																									
<b>Project</b>	<b>Wastewater Treatment Plant</b>																								
<b>Description</b>	<p>To treat the wastewater, a reliable system has been proposed, capable of treating the waste water in a wide range of pollution conditions and occupying a reasonable area: a conventional Activated Sludge wastewater treatment plant will ensure treatment during the wet and dry season.</p> <p>Proposed location: Barangay Bonbon. Approx. 1.6 Ha surface required.</p> <p>The design criteria is presented in the following table:</p> <table border="1" data-bbox="568 564 1257 788"> <thead> <tr> <th colspan="2"><i>Maximum inlet Flow</i></th> <th colspan="2">12,000 m<sup>3</sup>/day</th> </tr> <tr> <th colspan="2"><i>Equivalent population</i></th> <th colspan="2">200,000 equiv.inhab.</th> </tr> <tr> <th></th> <th><i>Incoming Load</i></th> <th><i>Effluent (mg/l)</i></th> <th><i>Yields</i></th> </tr> </thead> <tbody> <tr> <td>SS</td> <td>2,800 kg/day</td> <td>&lt; 35</td> <td>&gt; 90%</td> </tr> <tr> <td>BOD<sub>5</sub></td> <td>3,400 kg O<sub>2</sub>/day</td> <td>&lt; 25</td> <td>&gt; 90%</td> </tr> <tr> <td>COD</td> <td>5,500 kg O<sub>2</sub>/day</td> <td>&lt; 125</td> <td>&gt; 90%</td> </tr> </tbody> </table> <p>Able to biologically eliminate Nitrogen and chemically Phosphorous.</p>	<i>Maximum inlet Flow</i>		12,000 m <sup>3</sup> /day		<i>Equivalent population</i>		200,000 equiv.inhab.			<i>Incoming Load</i>	<i>Effluent (mg/l)</i>	<i>Yields</i>	SS	2,800 kg/day	< 35	> 90%	BOD <sub>5</sub>	3,400 kg O <sub>2</sub> /day	< 25	> 90%	COD	5,500 kg O <sub>2</sub> /day	< 125	> 90%
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<b>CAPEX and OPEX</b>	CAPEX ..... 420.65 M PhP ;      OPEX ..... 30.08 M PhP/year																								
<b>Financial Analysis</b>	<p>FIRR ..... 12.00%      FNPV ..... 27,000 PHP</p> <p>Required Annual Income ..... 95.48 Million PhP</p> <p>Sanitation charge (fee) ..... 4,01 PhP/cu.m (*)</p>																								
<b>Economic Analysis</b>	The economic evaluation of the three proposed projects in the Sanitation Sector is a positive EIRR of 44.23% (higher than the EOCC of 15%) and an ENPV of PhP 991.13 Million.																								
<b>Financing options</b>	The recommendation is to use a PPP agreement, in particular a DBO or DBOT (or even a DBOF).																								
<b>Environmental impacts</b>	<p>Positive: clean water discharged into the river.</p> <p>Negative: heavy construction works will generate some local pollution and may temporarily affect the river area. The identified available site for the WWTP is by the mangrove area close to the mouth of Cagayan de Oro River. The City must coordinate the delineation of the mangrove area and the preparation of an Environmental Impact Assessment.</p>																								
<b>Social impacts</b>	<p>Reduction of potential illness due to water pollution. Works demanding manpower and business opportunities in the city. Technology transfer.</p> <p>People living by the WWTP may suffer some inconvenience such as occasional bad odors.</p>																								
<b>Implementation issues</b>	<p>The participation of the CEO for supervision is important as this project is linked to the construction and connection of the Interceptor collection system.</p> <p>CLENRO and the COWD should coordinate for the tariff collection.</p>																								

(\*) Referred to cu.m of drinking water supplied by COWD



<b>Watershed Management</b>	
<b>Project</b>	<b><i>Rural Watershed: Ecotourism and Ecoforestry Project</i></b>
<b>Description</b>	<p>The main targets of the project are (i) Improvement of <b>run-off coefficient</b> of the soils (from 0.7 to 0.3), (ii) Increase the <b>retention of soil</b>, (iii) Improvement of <b>livelihood conditions</b> for inhabitants different that illegal mining or trees cutting.</p> <p>Location area: forest land area occupying <b>3,000 Ha</b> of the rural brys (Tumpagon, Pigsag-an, Tuburan, Taglimao, Tagpangi, and Dansolihon) in the upper Iponan River Watershed. Poor land cover, with less than 10% forest cover and steep sloped areas. It is a previously logged-over forested area which is currently being used for illegal tree cutting.</p> <p>Main Components:</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> Access road improvement and construction.</li> <li><input type="checkbox"/> Surveys and mapping.</li> <li><input type="checkbox"/> Agroforestry Area Development.</li> <li><input type="checkbox"/> Development of ecotourism infrastructures.</li> <li><input type="checkbox"/> Rain-forestation.</li> <li><input type="checkbox"/> Rattan plantations and Bamboo plantations (river banks).</li> <li><input type="checkbox"/> Soil and water conservation infrastructures.</li> <li><input type="checkbox"/> Capacity building, networking and marketing.</li> </ul>
<b>CAPEX and OPEX</b>	CAPEX ..... 107.87 M PhP ;      OPEX ..... 10.08 M PhP/year
<b>Economic Analysis</b>	The economic evaluation of the three proposed projects on the Watershed Management Sector is positive for the Base Case, EIRR of 16.4% (slightly higher than the EOCC of 15%) and an ENPV of PhP 12.22 Million; but turn into negative values in the Sensitivity Tests.
<b>Financing options</b>	<p>Several options, given that it is a multi-faceted project:</p> <ol style="list-style-type: none"> <li>1. The city has the financial capacity to fund the entire project (some of the funding might be obtained from other sources).</li> <li>2. Some other organization might carry it out (with partnership and financial support from the city and other local, regional, and national contributors); i.e. commercially-oriented NGOs, any local, regional, or national tourism agencies...</li> <li>3. A private sector corporation.</li> </ol>
<b>Environmental impacts</b>	<p>Positive: Improvement of the watershed and most environmental friendly economic activities in the project area. Forest and plantations act as a sump for CO2.</p> <p>Negative: some infrastructures (tourism, trails, water protection works) will be necessary and may affect (limited) the environment. Increased the number of visitors.</p>
<b>Social impacts</b>	<p>Alternative activities and economy. Difficulties for the adaptation of the existing inhabitants.</p> <p>Increased number of visitors.</p>
<b>Implementation issues</b>	IEC and capacitation of the citizens of the affected barangays is crucial for the correct implementation.

<b>Watershed Management</b>	
<b>Project</b>	<b><i>Urban Watershed Management: Catchment Ponds</i></b>
<b>Description</b>	<p>The aim of this project is to provide some of the necessary infrastructure to manage the uncontrolled flow of storm water or water runoff and direct them towards storage structures or retaining ponds or catchments:</p> <ul style="list-style-type: none"> <li>✓ Prevention of a quick discharge of the runoff to waster.</li> <li>✓ Prevent localized flooding (prevention of peak flows).</li> </ul> <p>Construction of water collection ponds in flood-prone areas (water catchment ponds). Applicable for new development sites and for existing urban areas. Supported by the legislation (RA 6716 of 1989 and RA 7160 of 1991).</p> <p>Total of 160 catchment ponds, with design based on harvesting the precipitation of 1 hour (7.5 mm) from 14 Ha: capacity of 1,100 m<sup>3</sup>.</p>
<b>CAPEX and OPEX</b>	CAPEX ..... 311.25 M PhP ; OPEX ..... 8.30 M PhP/year
<b>Economic Analysis</b>	The economic evaluation of the three proposed projects on the Watershed Management Sector is positive for the Base Case, EIRR of 16.4% (slightly higher than the EOCC of 15%) and an ENPV of PhP 12.22 Million; but turn into negative values in the Sensitivity Tests.
<b>Financing options</b>	The recommended option for its implementation is a Design-Build (DB) contract with a private company.
<b>Environmental impacts</b>	<p>Positive: water conservation and sedimentation of solid that are swept along by the storm water. Water infiltration.</p> <p>Negative: change of the natural flow of water.</p>
<b>Social impacts</b>	<p>Possibility of alternative uses of the retained water.</p> <p>Insects and plants growing in the ponds. Area occupied by the ponds cannot be dedicated to other social uses in the city.</p>
<b>Implementation issues</b>	<p>Delineation and detailed study of the specific areas where the ponds can be constructed.</p> <p>Works would count on the coordination and supervision of the CLENRO and CEO, who can carry out the maintenance tasks.</p>

<b>Watershed Management</b>	
<b>Project</b>	<b><i>Urban Watershed Management: Reforestation of Cagayan de Oro River Banks</i></b>
<b>Description</b>	<p>Implementation <b>Area for Reforestation:</b></p> <ul style="list-style-type: none"> <li>o Stretch of about 15 km from the river mouth of Cagayan de Oro River going up stream.</li> <li>o Variable width from 4 to 15 meters on both sides, designated basically to no-build zones.</li> </ul> <p><b>Establishment and development of plant Nursery:</b> One central and several satellite nurseries established in strategic locations for easy transport and handling. Production of enough planting materials required by the project.</p> <p>The project is proposed as part of the <b>National Greening Program</b> and as <b>REDD+ Project</b> of the City.</p>
<b>CAPEX and OPEX</b>	CAPEX ..... 7.64 M PhP ;      OPEX ..... 2.74 M PhP/year
<b>Economic Analysis</b>	The economic evaluation of the three proposed projects on the Watershed Management Sector is positive for the Base Case, EIRR of 16.4% (slightly higher than the EOCC of 15%) and an ENPV of PhP 12.22 Million; but turn into negative values in the Sensitivity Tests.
<b>Financing options</b>	This initiative can be best funded as traditional public works initiatives (i.e. from the <i>City Calamity Fund -LDRRMF-</i> ).
<b>Environmental impacts</b>	Positive: recovery of vegetation of riverbanks. Plantations are a sump for CO <sub>2</sub> . Negative: no identified.
<b>Social impacts</b>	Raising awareness as it is considered collaboration with NGOs and citizens of the barangays. Some additional employment opportunities in the city can be developed. Planted areas are not available for informal settlers.
<b>Implementation issues</b>	Participation of NGOs and barangays. CLENRO is the managing and supervising entity.