4.5 Study for Project Evaluation

4.5.1 Project Implementation Schedule

The Section 4.7 on the Project Implementation details the implementation plan for the programs related to river dredging, cut-off channel and retarding ponds, which were selected as priority projects for the Davao River.

From the first year, the detailed design of each project will be carried out. After the detailed design, PQ and tendering of construction work will be conducted and the construction work is planned to be completed in tenth year. The relocation and land acquisition are anticipated to be started in the second year of the detailed design and will be completed in the fourth year when the construction work will be commenced.

Table 4.5.1 Implementation Plan of the F/S Projects

Item		Months	Year									
			1	2	3	4	5	6	7	8	9	10
1	Detailed Design	18										
2	Land Acquisition	36										
3	PQ and Tendering	12										
4	Construction Works	84										
4-1	Contract Package No.1 Dredging	72										
4-2	Contract Package No.2 Cut-off	48										
4-3	Contract Package No.3 Retarding Pond	84										

Source: Project Team

4.5.2 Consulting Engineering Services

It is anticipated that DPWH will implement the project, but by contracting consultants to prepare the documents related to detailed design, pre-qualification requirements (PQ) and tender. In addition, the consultants will assist in bidding and contracting during the pre-construction stage and in supervising the construction work.

The duration of engineering services for the detailed design is anticipated to be 18 months, and the duration for the consulting services related to the construction supervision is planned to be 84 months (or 7 years excluding construction defects period).

4.5.3 Project Benefit

(1) Introduction

The benefits generated by flood control projects are various. For example, there are the reduction of direct damage to properties and livelihoods, creation of new safe land enabling social and economic development and others. In this study, among the effects of flood control project, the benefits are estimated by calculating the “expected annual average damage reduction”. The expected reduction of annual flood damage cost is computed by comparing the damage cost when the project is implemented “With-case” and when the project is not implemented “Without-Case (or present situation)” per flood intensity.

The documents referred to conduct the economic evaluation are the “Manual on Economic Study of Flood Control Projects” published by the Ministry of Land, Infrastructure, Transport and Tourism of Japan, the reports resulting from past JICA studies on flood control projects, the guidelines and orders disseminated by DPWH, NEDA and others.

(2) Economic Benefit

Based on the Comprehensive Land Use Plan (CLUP) of Davao City and Ordinance No. 0257-17, Series of 2017, which is the "Ordinance approving the schedule of market values of all lands and base unit construction as basis in the 2018 general revision of real property assessment in Davao City and to take effect beginning calendar year 2019", the following assets are targeted in this study.

- ✓ Residential land and buildings;
- ✓ Commercial land and buildings;
- ✓ Industrial land and buildings;
- ✓ Agricultural land and buildings; and
- ✓ Mixed used land and buildings.

To calculate the economic benefit, the assets value was set per barangay by reflecting the Ordinance No. 2057-17, census data, and the "Preparatory Survey for Flood Risk Management Project for Cagayan de Oro River" which was conducted by JICA in 2014, in the same Mindanao Island.

The evaluation of the Feasibility Study (F/S) and Pre-Feasibility Study (Pre-F/S) for Davao River is more detailed than the evaluation of the Master Plan Study which covers the entire City. Concretely, in the F/S and Pre-F/S, the value set per mesh is set more precisely by reflecting the building value per size, statistical data such as annual income per type of business and other factors.

(3) Benefit Computation

As explained in paragraph (1), the economic benefit or "expected annual average damage reduction" in this study is calculated by comparing the assumed economic amount of damage of when "no project is implemented (without case)" and when "projects are implemented (with case)". The assumed economic amount is calculated by using the Davao River Flood Simulation results per flood-scale.

The methodology and damage rate used to compute damage cost for the F/S and Pre-F/S are the same as the ones used for the Master Plan Study, and refer to the "Manual on Economic Study of Flood Control Projects" published by the Ministry of Land, Infrastructure, Transport and Tourism of Japan in April 2005.

Regarding the damage to infrastructures, a review on the Major Extreme Events and Disasters, especially Hydro-Meteorological hazards which occurred from 2010 to 2019 was conducted. As shown in Table 4.5.2, percentage of the damage to infrastructure ("(c) Infrastructure" in the table) compared to the general assets ("(a) Agriculture" + "(b) Private" in the table) is about 30% (0.3) in average. Resulting from this review, the ratio to calculate damage to infrastructures was set as 0.3, and the damage cost to infrastructures is calculated by multiplying the amount of damage to general assets by 0.3.

Table 4.5.2 Damage caused by major Hydro-Meteorological hazards in the Philippines from 2010 to 2019

Year	Damage Cost from Past Disasters (In Million PhP)				Damage Cost to Agriculture and Private Sectors	Percentage of the damage to Infrastructure compared to Agriculture and Private Sectors
	(a) Agriculture	(b) Private (housing, communication)	(c) Infrastructure	TOTAL *(a)+(b)+(c)*	*(a)+(b)*	*(c)/[(a)+(b)]*
2010	11,760	425	199	12,384	12,185	2%
2011	18,726	3,116	8,759	30,601	21,843	40%
2012	34,268	2,860	7,820	44,948	37,128	21%
2013	31,921	58,180	14,308	104,409	90,101	16%
2014	42,717	274	10,535	53,526	42,991	25%
2015	19,532	30	8,349	27,910	19,562	43%
2016	21,148	0	13,633	34,782	21,148	64%
2017	4,319	0	2,045	6,364	4,319	47%
2018	41,025	225	26,197	67,446	41,249	64%
2019	6,273	0	3,422	9,695	6,273	55%
Total from 2010 until 2019	231,689	65,110	95,266	392,065	296,799	32%

Source: Project Team from the data published by the Office of Civil Defence (OCD), "Major Natural Extreme Events and Disasters, 2010-2019"

Regarding the indirect damage, the Post Disaster Needs Assessment (PDNA) report of the Typhoon Odette which occurred in December 2021 and affected Region 11, and the post-disaster recovery plan of Bohol were reviewed. Table 4.5.3 shows the outline of the damage caused by Typhoon Odette in the Province of Bohol.

According to the terminology of PDNA, damage is defined as direct impacts valued at agreed replacement (not reconstruction) unit prices, on assets, stock (including final goods, goods in process, raw materials, materials, and spare parts), and property. The assessment of damage considers the level of damage in terms of whether an asset can be rehabilitated or repaired or if the asset has been destroyed completely.

Losses is defined as indirect impacts referring to flows that will be affected, such as production declines, reduced incomes, and increased expenditures, over a time period until the economy and assets are recovered. The estimates are quantified at present value.

In the case of Typhoon Odette in Bohol, the losses cost is equivalent to around 70% of the damage cost. However, due to the difficulties to identify the real causes of the damage (wind or water), the ratio to compute indirect damage was set as 0.3 in this study. Therefore, the indirect damage cost is calculated by multiplying the amount of direct damage by 0.3.

Table 4.5.3 Outline of the Damages and Losses caused by Typhoon Odette in Bohol

SUB-SECTORS	DAMAGES	LOSSES
INFRASTRUCTURE SECTOR		
Transportation	1,028,250,000.00	10,367,000.00
Power Supply	958,836,152.90	1,815,627,233.49
Water Supply	219,750,000.00	335,940,000.00
Irrigation System	102,629,780.00	38,747,054.00
Telecom	55,782,200.00	15,165,000.00
Flood Control	266,000,000.00	
SUBTOTAL	**2,631,248,132.90**	**2,215,846,287.49**
SOCIAL SECTOR		
Housing	31,036,295,900.00	1,157,011,479.00
Education	2,007,323,046.11	352,809,200.00
Health and Nutrition	431,944,151.30	7,102,855.00
SUBTOTAL	**33,475,563,097.41**	**1,516,923,534.00**
PRODUCTIVE SECTOR		
Agriculture	4,572,616,378.50	13,113018,105.33
Industry, Trade, and Services	2,648,994,516.01	5,735,619,990.00
Tourism	516,548,619.00	6,803,900,000.00
Mining	11,561,500.00	3,648,721.00
SUBTOTAL	**7,749,721,013.51**	**25,656,186,816.33**
GRAND TOTAL	**P43,856,532,243.82**	**P29,388,956,637.82**

Source: Project Team from the PDNA report prepared by the Regional DRRM Council of Region 7 in February 2022

Table 4.5.4 shows the damage cost if no project is implemented (without case) and Table 4.5.5 shows the damage cost if F/S projects are implemented (with case).

Table 4.5.4 Damage Cost if "no project is implemented (without case)"

		W=1/2	W=1/3	W=1/5	W=1/10	W=1/25	W=1/50	W=1/100
Direct Damage		**5.596**	**6.995**	**12.435**	**21.308**	**33.405**	**42.548**	**50.989**
	Agriculture	0.842	1.053	1.914	3.370	5.398	6.232	6.789
	Commerce	0.119	0.148	0.192	0.503	1.158	1.755	2.378
	Industry	0.128	0.160	0.495	1.019	1.831	2.500	3.159
	Institution	0.598	0.747	1.257	1.928	2.935	3.824	4.717
	Residences	2.580	3.225	5.629	9.464	14.243	18.134	21.493
	Mix Use Facilities	0.038	0.047	0.078	0.107	0.131	0.285	0.686
	Infrastructure	1.291	1.614	2.870	4.917	7.709	9.819	11.767
Indirect Damage		**1.679**	**2.098**	**3.730**	**6.392**	**10.022**	**12.765**	**15.297**
Total Damage		**7.275**	**9.093**	**16.165**	**27.700**	**43.427**	**55.313**	**66.285**

Source: Project Team

Table 4.5.5 Damage Cost if "projects are implemented (with case)"

		W=1/2	W=1/3	W=1/5	W=1/10	W=1/25	W=1/50	W=1/100
Direct Damage		1.192	1.231	1.470	2.512	16.294	26.166	35.051
	Agriculture	0.075	0.086	0.113	0.350	2.484	4.273	5.393
	Commerce	0.067	0.068	0.072	0.080	0.413	0.827	1.437
	Industry	0.001	0.003	0.007	0.048	0.795	1.335	1.910
	Institution	0.030	0.031	0.043	0.332	1.585	2.453	3.325
	Residences	0.740	0.753	0.891	1.113	7.236	11.207	14.847
	Mix Use Facilities	0.002	0.004	0.006	0.008	0.022	0.033	0.050
	Infrastructure	0.275	0.284	0.339	0.580	3.760	6.038	8.089
Indirect Damage		**0.358**	**0.369**	**0.441**	**0.754**	**4.888**	**7.850**	**10.515**
Total Damage		**1.550**	**1.600**	**1.911**	**3.265**	**21.183**	**34.016**	**45.566**

Source: Project Team

(4) Expected annual average damage reduction

Based on the results of the Flood Simulation of Davao River, the expected annual average damage reduction is computed as shown in Table 4.5.6.

Table 4.5.6 Expected annual average damage reduction if F/S projects are implemented

	Annual average exceedance probability	Amount of Damage (Billion PhP)			Average Damage per reach	Probabilities per reach	Annual Average Damage Reduction	Aggregated annual average damage = Expected
		Without Project (1)	With Project (2)	Damage Reduction (1)-(2)				
W=1/1	1.000	0.000	0.000	0.000				
W=1/2	0.500	7.275	1.550	5.725	2.862	0.500	1.431	1.431
W=1/3	0.333	9.093	1.600	7.494	6.609	0.167	1.102	2.533
W=1/5	0.200	16.165	1.911	14.254	10.874	0.133	1.450	3.983
W=1/10	0.100	27.700	3.265	24.435	19.345	0.100	1.934	5.917
W=1/25	0.040	43.427	21.183	22.244	23.340	0.060	1.400	7.317
W=1/50	0.020	55.313	34.016	21.297	21.771	0.020	0.435	7.753
W=1/100	0.010	66.285	45.566	20.719	21.008	0.010	0.210	7.963

Source: Project Team

4.5.4 Economic Evaluation

(1) Preconditions for Economic Evaluation

The parameters of the "Preparatory Survey for Flood Risk Management Project for Cagayan de Oro River" were refereed to set the ratio to convert financial cost into economic cost.

Regarding the Social Discount Rate (SDR), the Investment Coordination Committee (ICC) led by the NEDA Board has updated the rate from 15% to 10%, through the ICC Memorandum on the Revisions on ICC Guidelines and Procedures (Updated Social Discount Rate for the Philippines) dated as of September 30, 2016. In this study, both cases (SDR=10% and 15%) were considered as part of the sensitivity analysis.

Regarding the Operations and Maintenance (OM) cost, the cost for maintenance dredging was added to the usual OM cost (0.5% of the construction cost).

Table 4.5.7 Parameters set to convert financial cost into economic cost

Parameters	Value
Discount rate (NPV/BC Ratio, NEDA)	10% ~ 15%
Price Contingency escalation rate (Foreign)	0.013
Price Contingency escalation rate (Local)	0.021
Local cost conversion factor (Direct construction cost)	0.79
Local cost conversion factor (House compensation cost)	0.57
Local cost conversion factor (Administration cost)	0.97
Local cost conversion factor (Consulting service cost)	1.19

Source: Project Team

(2) Economic Cost

Financial cost is divided into local currency (LC) and foreign currency (FC) depending on the funding source. The purpose of this categorization is to apply the conversion factors to the LC when converting financial cost into economic cost. Since LC is related to Conversion is conducted with a view to eradicating "market distortions" of the local economy, and transfer payments (taxes and duties) and price contingency are not taken into account in financial cost.

Table 4.5.8 shows the economic cost converted from the financial cost and Table 4.5.9 the investment schedule in economic cost.

Table 4.5.8 Financial Cost and Economic Cost

Financial Cost

	LC	FC	Total (Billion PhP)
1 Project Management	0.282	0.418	0.700
2 Preparation, Resettlement	0.899	0.000	0.899
3 Constrution & Procurement	5.619	9.359	14.978
Dredging	0.419	0.698	1.118
Cut-off	0.639	1.064	1.703
Retarding Pond	4.561	7.597	12.157
4 Consulting Service	1.011	1.685	2.696
5 Contingency	1.435	0.888	2.323
Price Contingency	1.104	0.335	1.439
Physical Contingency	0.332	0.552	0.884
6 Technical Training Cost	0.000	0.000	0.000
TOTAL	9.246	12.349	21.595

Economic Cost

	LC	FC	Total (Billion PhP)
1 Project Management	0.274	0.418	0.691
2 Preparation, Resettlement	0.512	0.000	0.512
3 Constrution & Procurement	4.439	9.359	13.798
Dredging	0.331	0.698	1.030
Cut-off	0.505	1.064	1.568
Retarding Pond	3.603	7.597	11.200
4 Consulting Service	1.204	1.685	2.888
5 Contingency	1.466	0.888	2.353
Price Contingency	1.127	0.335	1.463
Physical Contingency	0.338	0.552	0.891
6 Technical Training Cost	0.000	0.000	0.000
TOTAL	7.894	12.349	20.243

Source: Project Team

Table 4.5.9 Investment schedule (Economic Cost)

	PM	PR	CP	CS	Cont	TTC	Economic Investment per Year (in Billion PhP)	Percentage (Yearly / Total Investment)
	Project Management	Preparation, Resettlement	Constrution & Procurement	Consulting Service	Contingency	Technical Training Cost		
Year 1	0.069	0.171	0.000	0.289	0.235	0.000	0.764	3.77%
Year 2	0.069	0.171	0.000	0.289	0.235	0.000	0.764	3.77%
Year 3	0.069	0.171	0.000	0.289	0.235	0.000	0.764	3.77%
Year 4	0.069	0.000	2.294	0.289	0.235	0.000	2.888	14.27%
Year 5	0.069	0.000	2.294	0.289	0.235	0.000	2.888	14.27%
Year 6	0.069	0.000	2.294	0.289	0.235	0.000	2.888	14.27%
Year 7	0.069	0.000	1.772	0.289	0.235	0.000	2.365	11.68%
Year 8	0.069	0.000	1.772	0.289	0.235	0.000	2.365	11.68%
Year 9	0.069	0.000	1.772	0.289	0.235	0.000	2.365	11.68%
Year 10	0.069	0.000	1.600	0.289	0.235	0.000	2.193	10.83%
Total	**0.691**	**0.512**	**13.798**	**2.888**	**2.353**	**0.000**	**20.243**	**100.00%**

Source: Project Team

(3) Results of Economic Evaluation

Table 4.5.10 shows the cost and benefits cash flow of the proposed F/S for Davao River, when the SDR is 10% and Table 4.5.11 when SDR is 15%. The evaluation period considered is equivalent to the "anticipated implementation period + 50 years after the completion of the project".

When the SDR is 10%, the Economic Internal Rate of Return (EIRR) is 15.32 %, Economic Net Present Values (ENPV) is PhP 9.99 Billion and Cost-Benefit Ratio (CBR) is 1.895.

When the SDR is 15%, ENPV is PhP 0.30 Billion and CBR is 1.110.

Therefore, the proposed is evaluated as economically adequate in both cases.

For reference, when the SDR is 20%, EIRR remains unchanged at 15.32 %, ENPV is PhP -2.60 Billion and CBR is 0.709.

Table 4.5.10 Cost and benefits Cash Flow of the proposed F/S for Davao River (SDR=10%)

Year		No. of Year after completion	Project Cost	O/M Cost	Total	Accumulated Cost	Annual Cost after discount	Annual Benefit	Annual Benefit after discount	Net Benefit
2022	0		0.764		0.764	0.764				-0.764
2023	1		0.764		0.764	1.528	0.695		0.000	-0.764
2024	2		0.764		0.764	2.292	0.631		0.000	-0.764
2025	3		2.888		2.888	5.180	2.170		0.000	-2.888
2026	4		2.888		2.888	8.067	1.972		0.000	-2.888
2027	5		2.888		2.888	10.955	1.793		0.000	-2.888
2028	6		2.365		2.365	13.320	1.335		0.000	-2.365
2029	7		2.365		2.365	15.685	1.214		0.000	-2.365
2030	8		2.365		2.365	18.049	1.103		0.000	-2.365
2031	9		2.193		2.193	20.243	0.930		0.000	-2.193
2032	10	*1*	0.000	0.000	0.000	20.243	0.000	5.917	2.281	5.917
2033	11	*2*	0.000	0.337	0.337	20.243	0.118	5.917	2.074	5.580
2034	12	*3*	0.000	0.337	0.337	20.243	0.107	5.917	1.885	5.580
2035	13	*4*	0.000	0.337	0.337	20.243	0.098	5.917	1.714	5.580
2036	14	*5*	0.000	0.337	0.337	20.243	0.089	5.917	1.558	5.580
2037	15	*6*	0.000	0.337	0.337	20.243	0.081	5.917	1.416	5.580
2038	16	*7*	0.000	0.337	0.337	20.243	0.073	5.917	1.288	5.580
2039	17	*8*	0.000	0.337	0.337	20.243	0.067	5.917	1.171	5.580
2040	18	*9*	0.000	0.337	0.337	20.243	0.061	5.917	1.064	5.580
2041	19	*10*	0.000	0.337	0.337	20.243	0.055	5.917	0.967	5.580
2042	20	*11*	0.000	0.337	0.337	20.243	0.050	5.917	0.880	5.580
2043	21	*12*	0.000	0.337	0.337	20.243	0.046	5.917	0.800	5.580
2044	22	*13*	0.000	0.337	0.337	20.243	0.041	5.917	0.727	5.580
2045	23	*14*	0.000	0.337	0.337	20.243	0.038	5.917	0.661	5.580
2046	24	*15*	0.000	0.337	0.337	20.243	0.034	5.917	0.601	5.580
2047	25	*16*	0.000	0.337	0.337	20.243	0.031	5.917	0.546	5.580
2048	26	*17*	0.000	0.337	0.337	20.243	0.028	5.917	0.496	5.580
2049	27	*18*	0.000	0.337	0.337	20.243	0.026	5.917	0.451	5.580
2050	28	*19*	0.000	0.337	0.337	20.243	0.023	5.917	0.410	5.580
2051	29	*20*	0.000	0.337	0.337	20.243	0.021	5.917	0.373	5.580
2052	30	*21*	0.000	0.337	0.337	20.243	0.019	5.917	0.339	5.580
2053	31	*22*	0.000	0.337	0.337	20.243	0.018	5.917	0.308	5.580
2054	32	*23*	0.000	0.337	0.337	20.243	0.016	5.917	0.280	5.580
2055	33	*24*	0.000	0.337	0.337	20.243	0.015	5.917	0.255	5.580
2056	34	*25*	0.000	0.337	0.337	20.243	0.013	5.917	0.232	5.580
2057	35	*26*	0.000	0.337	0.337	20.243	0.012	5.917	0.211	5.580
2058	36	*27*	0.000	0.337	0.337	20.243	0.011	5.917	0.191	5.580
2059	37	*28*	0.000	0.337	0.337	20.243	0.010	5.917	0.174	5.580
2060	38	*29*	0.000	0.337	0.337	20.243	0.009	5.917	0.158	5.580
2061	39	*30*	0.000	0.337	0.337	20.243	0.008	5.917	0.144	5.580
2062	40	*31*	0.000	0.337	0.337	20.243	0.007	5.917	0.131	5.580
2063	41	*32*	0.000	0.337	0.337	20.243	0.007	5.917	0.119	5.580
2064	42	*33*	0.000	0.337	0.337	20.243	0.006	5.917	0.108	5.580
2065	43	*34*	0.000	0.337	0.337	20.243	0.006	5.917	0.098	5.580
2066	44	*35*	0.000	0.337	0.337	20.243	0.005	5.917	0.089	5.580
2067	45	*36*	0.000	0.337	0.337	20.243	0.005	5.917	0.081	5.580
2068	46	*37*	0.000	0.337	0.337	20.243	0.004	5.917	0.074	5.580
2069	47	*38*	0.000	0.337	0.337	20.243	0.004	5.917	0.067	5.580
2070	48	*39*	0.000	0.337	0.337	20.243	0.003	5.917	0.061	5.580
2071	49	*40*	0.000	0.337	0.337	20.243	0.003	5.917	0.055	5.580
2072	50	*41*	0.000	0.337	0.337	20.243	0.003	5.917	0.050	5.580
2073	51	*42*	0.000	0.337	0.337	20.243	0.003	5.917	0.046	5.580
2074	52	*43*	0.000	0.337	0.337	20.243	0.002	5.917	0.042	5.580
2075	53	*44*	0.000	0.337	0.337	20.243	0.002	5.917	0.038	5.580
2076	54	*45*	0.000	0.337	0.337	20.243	0.002	5.917	0.034	5.580
2077	55	*46*	0.000	0.337	0.337	20.243	0.002	5.917	0.031	5.580
2078	56	*47*	0.000	0.337	0.337	20.243	0.002	5.917	0.028	5.580
2079	57	*48*	0.000	0.337	0.337	20.243	0.001	5.917	0.026	5.580
2080	58	*49*	0.000	0.337	0.337	20.243	0.001	5.917	0.024	5.580
2081	59	*50*	0.000	0.337	0.337	20.243	0.001	5.917	0.021	5.580
Total (in Billion			**20.243**	**16.530**	**36.772**		**13.131**	**295.850**	**24.880**	
							EIRR			**15.32%**
							Social Discount Rate			**10%**
							NPV			**9.99**
							B/C			**1.895**

Source: Project Team

Table 4.5.11 Cost and benefits Cash Flow of the proposed F/S for Davao River (SDR=15%)

Year		No. of Year after completion	Project Cost	O/M Cost	Total	Accumulated Cost	Annual Cost after discount	Annual Benefit	Annual Benefit after discount	Net Benefit
2022	0		0.764		0.764	0.764				-0.764
2023	1		0.764		0.764	1.528	0.664		0.000	-0.764
2024	2		0.764		0.764	2.292	0.578		0.000	-0.764
2025	3		2.888		2.888	5.180	1.899		0.000	-2.888
2026	4		2.888		2.888	8.067	1.651		0.000	-2.888
2027	5		2.888		2.888	10.955	1.436		0.000	-2.888
2028	6		2.365		2.365	13.320	1.022		0.000	-2.365
2029	7		2.365		2.365	15.685	0.889		0.000	-2.365
2030	8		2.365		2.365	18.049	0.773		0.000	-2.365
2031	9		2.193		2.193	20.243	0.623		0.000	-2.193
2032	10	*1*	0.000	0.000	0.000	20.243	0.000	5.917	1.463	5.917
2033	11	*2*	0.000	0.337	0.337	20.243	0.073	5.917	1.272	5.580
2034	12	*3*	0.000	0.337	0.337	20.243	0.063	5.917	1.106	5.580
2035	13	*4*	0.000	0.337	0.337	20.243	0.055	5.917	0.962	5.580
2036	14	*5*	0.000	0.337	0.337	20.243	0.048	5.917	0.836	5.580
2037	15	*6*	0.000	0.337	0.337	20.243	0.041	5.917	0.727	5.580
2038	16	*7*	0.000	0.337	0.337	20.243	0.036	5.917	0.632	5.580
2039	17	*8*	0.000	0.337	0.337	20.243	0.031	5.917	0.550	5.580
2040	18	*9*	0.000	0.337	0.337	20.243	0.027	5.917	0.478	5.580
2041	19	*10*	0.000	0.337	0.337	20.243	0.024	5.917	0.416	5.580
2042	20	*11*	0.000	0.337	0.337	20.243	0.021	5.917	0.362	5.580
2043	21	*12*	0.000	0.337	0.337	20.243	0.018	5.917	0.314	5.580
2044	22	*13*	0.000	0.337	0.337	20.243	0.016	5.917	0.273	5.580
2045	23	*14*	0.000	0.337	0.337	20.243	0.014	5.917	0.238	5.580
2046	24	*15*	0.000	0.337	0.337	20.243	0.012	5.917	0.207	5.580
2047	25	*16*	0.000	0.337	0.337	20.243	0.010	5.917	0.180	5.580
2048	26	*17*	0.000	0.337	0.337	20.243	0.009	5.917	0.156	5.580
2049	27	*18*	0.000	0.337	0.337	20.243	0.008	5.917	0.136	5.580
2050	28	*19*	0.000	0.337	0.337	20.243	0.007	5.917	0.118	5.580
2051	29	*20*	0.000	0.337	0.337	20.243	0.006	5.917	0.103	5.580
2052	30	*21*	0.000	0.337	0.337	20.243	0.005	5.917	0.089	5.580
2053	31	*22*	0.000	0.337	0.337	20.243	0.004	5.917	0.078	5.580
2054	32	*23*	0.000	0.337	0.337	20.243	0.004	5.917	0.068	5.580
2055	33	*24*	0.000	0.337	0.337	20.243	0.003	5.917	0.059	5.580
2056	34	*25*	0.000	0.337	0.337	20.243	0.003	5.917	0.051	5.580
2057	35	*26*	0.000	0.337	0.337	20.243	0.003	5.917	0.044	5.580
2058	36	*27*	0.000	0.337	0.337	20.243	0.002	5.917	0.039	5.580
2059	37	*28*	0.000	0.337	0.337	20.243	0.002	5.917	0.034	5.580
2060	38	*29*	0.000	0.337	0.337	20.243	0.002	5.917	0.029	5.580
2061	39	*30*	0.000	0.337	0.337	20.243	0.001	5.917	0.025	5.580
2062	40	*31*	0.000	0.337	0.337	20.243	0.001	5.917	0.022	5.580
2063	41	*32*	0.000	0.337	0.337	20.243	0.001	5.917	0.019	5.580
2064	42	*33*	0.000	0.337	0.337	20.243	0.001	5.917	0.017	5.580
2065	43	*34*	0.000	0.337	0.337	20.243	0.001	5.917	0.015	5.580
2066	44	*35*	0.000	0.337	0.337	20.243	0.001	5.917	0.013	5.580
2067	45	*36*	0.000	0.337	0.337	20.243	0.001	5.917	0.011	5.580
2068	46	*37*	0.000	0.337	0.337	20.243	0.001	5.917	0.010	5.580
2069	47	*38*	0.000	0.337	0.337	20.243	0.000	5.917	0.008	5.580
2070	48	*39*	0.000	0.337	0.337	20.243	0.000	5.917	0.007	5.580
2071	49	*40*	0.000	0.337	0.337	20.243	0.000	5.917	0.006	5.580
2072	50	*41*	0.000	0.337	0.337	20.243	0.000	5.917	0.005	5.580
2073	51	*42*	0.000	0.337	0.337	20.243	0.000	5.917	0.005	5.580
2074	52	*43*	0.000	0.337	0.337	20.243	0.000	5.917	0.004	5.580
2075	53	*44*	0.000	0.337	0.337	20.243	0.000	5.917	0.004	5.580
2076	54	*45*	0.000	0.337	0.337	20.243	0.000	5.917	0.003	5.580
2077	55	*46*	0.000	0.337	0.337	20.243	0.000	5.917	0.003	5.580
2078	56	*47*	0.000	0.337	0.337	20.243	0.000	5.917	0.002	5.580
2079	57	*48*	0.000	0.337	0.337	20.243	0.000	5.917	0.002	5.580
2080	58	*49*	0.000	0.337	0.337	20.243	0.000	5.917	0.002	5.580
2081	59	*50*	0.000	0.337	0.337	20.243	0.000	5.917	0.002	5.580
Total (in Billion			**20.243**	**16.530**	**36.772**		**10.091**	**295.850**	**11.203**	
							EIRR			**15.32%**
							Social Discount Rate			**15%**
							NPV			**0.30**
							B/C			**1.110**

Source: Project Team

(4) Sensitivity Analysis

To check the economic adequacy in case of project cost increase and benefit decrease, a sensitivity analysis was conducted. In all cases, the economic internal rate of return (EIRR) exceeds the current social discount rate of 10%. Therefore, it can be concluded that the project can be evaluated as adequate from the viewpoint of investment efficiency.

Table 4.5.12 Results of Sensitivity Analysis

		EIRR (%)
Case 0	Base Case	15.32
Case 1	Project Cost: increase of 10%	14.41
Case 2	Project Cost: increase of 20%	13.61
Case 3	Benefit: Decrease of 10%	14.27
Case 4	Benefit: Decrease of 20%	13.15
Case 5	Project Cost: increase of 10% and Benefit: Decrease of 10%	13.40
Case 6	Project Cost: increase of 20% and Benefit: Decrease of 20%	11.59

Source: Project Team

For reference, the break-even point analysis shows the EIRR of 10.0% when project cost increases by 85.5% under the condition that there is no change in benefit as well as when benefit decreases by 44.2% under the condition that there is no change in project cost.

(5) Economic Evaluation for the Project Cost applying Results of RAP Study

An economic evaluation is carried out on the project cost estimated by applying the RAP study results, which was estimated as the reference value in Section 4.4.5(2).

When the SDR is 10%, the Economic Internal Rate of Return (EIRR) is 10.15 %, Economic Net Present Values (ENPV) is PhP 0.49 Billion and Cost-Benefit Ratio (CBR) is 1.260. Therefore, it is evaluated as economically adequate.

For reference, when the SDR is 15%, EIRR remains unchanged at 10.15 %, ENPV is PhP -8.43 Billion and CBR is 0.687. When the SDR is 20%, EIRR remains unchanged at 10.15 %, ENPV is PhP -10.66 Billion and CBR is 0.441.

In addition, for reference, the break-even point analysis shows the EIRR of 10.0% when project cost increases by 2.3% under the condition that there is no change in benefit as well as when benefit decreases by 2.2% under the condition that there is no change in project cost.

4.5.5 Revision of the Davao River Master Plan (M/P)

As explained in the Section 4.5.2 (1), to conduct the economic evaluation of the Feasibility Study (F/S) and Pre-Feasibility Study (Pre-F/S) for Davao River, the value set per mesh to compute benefit was reset in a more precise way. Concretely, unlike the M/P which covers the entire city, the value set per mesh in the areas surrounding Davao River, is reflecting the building value per size, statistical data such as annual income per type of business and other factors.

In this section, the economic evaluation of Davao River Master Plan is revised by using the same mesh value as the F/S and Pre F/S and revised project cost.

(1) Revised expected annual average damage reduction

The target flood-scale of Davao M/P is 100-year flood. Therefore, if the proposed projects are implemented (With-Case) the damage are expected to be null, and the expected annual average damage reduction is calculated as bellow.

Table 4.5.13 Expected annual average damage reduction if M/P projects are implemented

	Annual average exceedance probability	Amount of Damage (Billion PhP)			Average Damage per reach	Probabilities per reach	Annual Average Damage Reduction	Aggregated annual average damage = Expected annual average damage reduction
		Without Project (1)	With Project (2)	Damage Reduction (1)-(2)				
W=1/1	1.000	0.000	0.000	0.000				
W=1/2	0.500	7.275	0.000	7.275	3.637	0.500	1.819	1.819
W=1/3	0.333	9.093	0.000	9.093	8.184	0.167	1.364	3.183
W=1/5	0.200	16.165	0.000	16.165	12.629	0.133	1.684	4.867
W=1/10	0.100	27.700	0.000	27.700	21.933	0.100	2.193	7.060
W=1/25	0.040	43.427	0.000	43.427	35.564	0.060	2.134	9.194
W=1/50	0.020	55.313	0.000	55.313	49.370	0.020	0.987	10.181
W=1/100	0.010	66.285	0.000	66.285	60.799	0.010	0.608	10.789

Source: Project Team

(2) Revised economic cost

Table 4.5.14 shows the revised economic cost converted from the financial cost and Table 4.5.15 the revised investment schedule in economic cost.

Table 4.5.14 Financial Cost and Economic Cost

Financial Cost

	LC	FC	Total (Billion PhP)
1 Project Management	0.788	1.166	1.954
2 Preparation, Resettlement	2.552	0.000	2.552
3 Constrution & Procurement	15.690	26.135	41.826
Dredging	0.419	0.698	1.118
Cut-off	0.639	1.064	1.703
Retarding Pond	4.561	7.597	12.157
Widening	0.749	1.248	1.997
Retarding Pond (4)	9.323	15.528	24.851
4 Consulting Service	2.824	4.704	7.529
5 Contingency	4.008	2.479	6.487
Price Contingency	3.083	0.937	4.019
Physical Contingency	0.926	1.542	2.468
6 Technical Training Cost	0.000	0.000	0.000
TOTAL	25.864	34.484	60.348

Economic Cost

	LC	FC	Total (Billion PhP)
1 Project Management	0.765	1.166	1.931
2 Preparation, Resettlement	1.455	0.000	1.455
3 Constrution & Procurement	12.395	26.135	38.531
Dredging	0.331	0.698	1.030
Cut-off	0.505	1.064	1.568
Retarding Pond	3.603	7.597	11.200
Widening	0.592	1.248	1.840
Retarding Pond (4)	7.365	15.528	22.893
4 Consulting Service	3.361	4.704	8.065
5 Contingency	4.093	2.479	6.571
Price Contingency	3.147	0.937	4.084
Physical Contingency	0.945	1.542	2.487
6 Technical Training Cost	0.000	0.000	0.000
TOTAL	22.068	34.484	56.553

Source: Project Team

Table 4.5.15 Investment schedule (Economic Cost)

	PM	PR	CP	CS	Cont	TTC	Economic Investment per Year (in Billion PhP)	Percentage (Yearly / Total Investment)
	Project Management	Preparation, Resettlement	Constrution & Procurement	Consulting Service	Contingency	Technical Training Cost		
Year 1	0.063	0.171	0.000	0.264	0.215	0.000	0.713	1.26%
Year 2	0.063	0.171	0.000	0.264	0.215	0.000	0.713	1.26%
Year 3	0.063	0.171	0.000	0.264	0.215	0.000	0.713	1.26%
Year 4	0.063	0.000	2.294	0.264	0.215	0.000	2.837	5.02%
Year 5	0.063	0.000	2.294	0.264	0.215	0.000	2.837	5.02%
Year 6	0.063	0.000	2.294	0.264	0.215	0.000	2.837	5.02%
Year 7	0.063	0.000	1.772	0.264	0.215	0.000	2.314	4.09%
Year 8	0.063	0.000	1.772	0.264	0.215	0.000	2.314	4.09%
Year 9	0.063	0.000	1.772	0.264	0.215	0.000	2.314	4.09%
Year 10	0.063	0.000	1.600	0.264	0.215	0.000	2.143	3.79%
Year 11	0.100	0.942	0.000	0.417	0.340	0.000	1.799	3.18%
Year 12	0.100	0.000	0.000	0.417	0.340	0.000	0.857	1.52%
Year 13	0.100	0.000	0.000	0.417	0.340	0.000	0.857	1.52%
Year 14	0.100	0.000	0.613	0.417	0.340	0.000	1.470	2.60%
Year 15	0.100	0.000	0.613	0.417	0.340	0.000	1.470	2.60%
Year 16	0.100	0.000	3.475	0.417	0.340	0.000	4.332	7.66%
Year 17	0.100	0.000	2.862	0.417	0.340	0.000	3.719	6.58%
Year 18	0.100	0.000	2.862	0.417	0.340	0.000	3.719	6.58%
Year 19	0.100	0.000	2.862	0.417	0.340	0.000	3.719	6.58%
Year 20	0.100	0.000	2.862	0.417	0.340	0.000	3.719	6.58%
Year 21	0.100	0.000	2.862	0.417	0.340	0.000	3.719	6.58%
Year 22	0.100	0.000	2.862	0.417	0.340	0.000	3.719	6.58%
Year 23	0.100	0.000	2.862	0.417	0.340	0.000	3.719	6.58%
Total	**1.931**	**1.455**	**38.531**	**8.065**	**6.571**	**0.000**	**56.553**	**100.00%**

Source: Project Team

(3) Revised economic evaluation

Table 4.5.16 shows the revised cost and benefits cash flow of the proposed M/P for Davao River, when the SDR is 10% and Table 4.5.17 when SDR is 15%. The evaluation period considered is equivalent to the "anticipated implementation period + 50 years after the completion of the project".

When the SDR is 10%, the Economic Internal Rate of Return (EIRR) is 15.37 %, Economic Net Present Values (ENPV) is PhP 12.98 Billion and Cost-Benefit Ratio (CBR) is 1.728.

When the SDR is 15%, ENPV is PhP 0.41 Billion and CBR is 1.087.

Therefore, the proposed is evaluated as economically adequate in both cases.

For reference, when the SDR is 20%, EIRR remains unchanged at 15.37 %, ENPV is PhP -2.82 Billion and CBR is 0.728.

Table 4.5.16 Cost and benefits Cash Flow of the proposed M/P for Davao River (SDR=10%)

Year		No. of Year after completion	Project Cost	O/M Cost	Total	Accumulated Cost	Annual Cost after discount	Annual Benefit	Annual Benefit after discount	Net Benefit
2023	1		0.713		0.713	0.713				-0.713
2024	2		0.713		0.713	1.427	0.590		0.000	-0.713
2025	3		0.713		0.713	2.140	0.536		0.000	-0.713
2026	4		2.837		2.837	4.977	1.938		0.000	-2.837
2027	5		2.837		2.837	7.814	1.762		0.000	-2.837
2028	6		2.837		2.837	10.651	1.601		0.000	-2.837
2029	7		2.314		2.314	12.966	1.188		0.000	-2.314
2030	8		2.314		2.314	15.280	1.080		0.000	-2.314
2031	9		2.314		2.314	17.594	0.981		0.000	-2.314
2032	10		2.143		2.143	19.737	0.826		0.000	-2.143
2033	11		1.799		1.799	21.536	0.631	5.917	2.074	4.118
2034	12		0.857	0.337	1.194	22.393	0.381	5.917	1.885	4.723
2035	13		0.857	0.337	1.194	23.250	0.346	5.917	1.714	4.723
2036	14		1.470	0.340	1.811	24.720	0.477	5.917	1.558	4.106
2037	15		1.470	0.343	1.814	26.191	0.434	5.917	1.416	4.103
2038	16		4.332	0.361	4.693	30.522	1.021	9.194	2.001	4.501
2039	17		3.719	0.375	4.094	34.241	0.810	9.194	1.819	5.100
2040	18		3.719	0.389	4.108	37.960	0.739	9.194	1.654	5.086
2041	19		3.719	0.404	4.122	41.678	0.674	9.194	1.503	5.071
2042	20		3.719	0.418	4.137	45.397	0.615	9.194	1.367	5.057
2043	21		3.719	0.432	4.151	49.116	0.561	9.194	1.242	5.043
2044	22		3.719	0.447	4.165	52.834	0.512	9.194	1.129	5.028
2045	23		3.719	0.461	4.180	56.553	0.467	9.194	1.027	5.014
2046	24	*1*	0.000	0.461	0.461	56.553	0.047	10.789	1.095	10.328
2047	25	*2*	0.000	0.461	0.461	56.553	0.043	10.789	0.996	10.328
2048	26	*3*	0.000	0.461	0.461	56.553	0.039	10.789	0.905	10.328
2049	27	*4*	0.000	0.461	0.461	56.553	0.035	10.789	0.823	10.328
2050	28	*5*	0.000	0.461	0.461	56.553	0.032	10.789	0.748	10.328
2051	29	*6*	0.000	0.461	0.461	56.553	0.029	10.789	0.680	10.328
2052	30	*7*	0.000	0.461	0.461	56.553	0.026	10.789	0.618	10.328
2053	31	*8*	0.000	0.461	0.461	56.553	0.024	10.789	0.562	10.328
2054	32	*9*	0.000	0.461	0.461	56.553	0.022	10.789	0.511	10.328
2055	33	*10*	0.000	0.461	0.461	56.553	0.020	10.789	0.465	10.328
2056	34	*11*	0.000	0.461	0.461	56.553	0.018	10.789	0.422	10.328
2057	35	*12*	0.000	0.461	0.461	56.553	0.016	10.789	0.384	10.328
2058	36	*13*	0.000	0.461	0.461	56.553	0.015	10.789	0.349	10.328
2059	37	*14*	0.000	0.461	0.461	56.553	0.014	10.789	0.317	10.328
2060	38	*15*	0.000	0.461	0.461	56.553	0.012	10.789	0.288	10.328
2061	39	*16*	0.000	0.461	0.461	56.553	0.011	10.789	0.262	10.328
2062	40	*17*	0.000	0.461	0.461	56.553	0.010	10.789	0.238	10.328
2063	41	*18*	0.000	0.461	0.461	56.553	0.009	10.789	0.217	10.328
2064	42	*19*	0.000	0.461	0.461	56.553	0.008	10.789	0.197	10.328
2065	43	*20*	0.000	0.461	0.461	56.553	0.008	10.789	0.179	10.328
2066	44	*21*	0.000	0.461	0.461	56.553	0.007	10.789	0.163	10.328
2067	45	*22*	0.000	0.461	0.461	56.553	0.006	10.789	0.148	10.328
2068	46	*23*	0.000	0.461	0.461	56.553	0.006	10.789	0.135	10.328
2069	47	*24*	0.000	0.461	0.461	56.553	0.005	10.789	0.122	10.328
2070	48	*25*	0.000	0.461	0.461	56.553	0.005	10.789	0.111	10.328
2071	49	*26*	0.000	0.461	0.461	56.553	0.004	10.789	0.101	10.328
2072	50	*27*	0.000	0.461	0.461	56.553	0.004	10.789	0.092	10.328
2073	51	*28*	0.000	0.461	0.461	56.553	0.004	10.789	0.084	10.328
2074	52	*29*	0.000	0.461	0.461	56.553	0.003	10.789	0.076	10.328
2075	53	*30*	0.000	0.461	0.461	56.553	0.003	10.789	0.069	10.328
2076	54	*31*	0.000	0.461	0.461	56.553	0.003	10.789	0.063	10.328
2077	55	*32*	0.000	0.461	0.461	56.553	0.002	10.789	0.057	10.328
2078	56	*33*	0.000	0.461	0.461	56.553	0.002	10.789	0.052	10.328
2079	57	*34*	0.000	0.461	0.461	56.553	0.002	10.789	0.047	10.328
2080	58	*35*	0.000	0.461	0.461	56.553	0.002	10.789	0.043	10.328
2081	59	*36*	0.000	0.461	0.461	56.553	0.002	10.789	0.039	10.328
2082	60	*37*	0.000	0.461	0.461	56.553	0.002	10.789	0.035	10.328
2083	61	*38*	0.000	0.461	0.461	56.553	0.001	10.789	0.032	10.328
2084	62	*39*	0.000	0.461	0.461	56.553	0.001	10.789	0.029	10.328
2085	63	*40*	0.000	0.461	0.461	56.553	0.001	10.789	0.027	10.328
2086	64	*41*	0.000	0.461	0.461	56.553	0.001	10.789	0.024	10.328
2087	65	*42*	0.000	0.461	0.461	56.553	0.001	10.789	0.022	10.328
2088	66	*43*	0.000	0.461	0.461	56.553	0.001	10.789	0.020	10.328
2089	67	*44*	0.000	1.461	1.461	56.553	0.002	10.789	0.018	9.328
2090	68	*45*	0.000	2.461	2.461	56.553	0.004	10.789	0.017	8.328
2091	69	*46*	0.000	3.461	3.461	56.553	0.005	10.789	0.015	7.328
2092	70	*47*	0.000	4.461	4.461	56.553	0.006	10.789	0.014	6.328
2093	71	*48*	0.000	5.461	5.461	56.553	0.006	10.789	0.012	5.328
2094	72	*49*	0.000	6.461	6.461	56.553	0.007	10.789	0.011	4.328
2095	73	*50*	0.000	7.461	7.461	56.553	0.007	10.789	0.010	3.328
Total (in Billion			**56.553**	**55.696**	**112.249**		**18.711**	**642.586**	**32.336**	
								EIRR		**15.37%**
								Social Discount Rate		**10%**
								NPV		**12.98**
								B/C		**1.728**

Source: Project Team

Table 4.5.17 Cost and benefits Cash Flow of the proposed M/P for Davao River (SDR=15%)

Year		No. of Year after completion	Project Cost	O/M Cost	Total	Accumulated Cost	Annual Cost after discount	Annual Benefit	Annual Benefit after discount	Net Benefit
2023	1		0.713		0.713	0.713				-0.713
2024	2		0.713		0.713	1.427	0.539		0.000	-0.713
2025	3		0.713		0.713	2.140	0.469		0.000	-0.713
2026	4		2.837		2.837	4.977	1.622		0.000	-2.837
2027	5		2.837		2.837	7.814	1.411		0.000	-2.837
2028	6		2.837		2.837	10.651	1.227		0.000	-2.837
2029	7		2.314		2.314	12.966	0.870		0.000	-2.314
2030	8		2.314		2.314	15.280	0.757		0.000	-2.314
2031	9		2.314		2.314	17.594	0.658		0.000	-2.314
2032	10		2.143		2.143	19.737	0.530		0.000	-2.143
2033	11		1.799		1.799	21.536	0.387	5.917	1.272	4.118
2034	12		0.857	0.337	1.194	22.393	0.223	5.917	1.106	4.723
2035	13		0.857	0.337	1.194	23.250	0.194	5.917	0.962	4.723
2036	14		1.470	0.340	1.811	24.720	0.256	5.917	0.836	4.106
2037	15		1.470	0.343	1.814	26.191	0.223	5.917	0.727	4.103
2038	16		4.332	0.361	4.693	30.522	0.501	9.194	0.982	4.501
2039	17		3.719	0.375	4.094	34.241	0.380	9.194	0.854	5.100
2040	18		3.719	0.389	4.108	37.960	0.332	9.194	0.743	5.086
2041	19		3.719	0.404	4.122	41.678	0.290	9.194	0.646	5.071
2042	20		3.719	0.418	4.137	45.397	0.253	9.194	0.562	5.057
2043	21		3.719	0.432	4.151	49.116	0.221	9.194	0.488	5.043
2044	22		3.719	0.447	4.165	52.834	0.192	9.194	0.425	5.028
2045	23		3.719	0.461	4.180	56.553	0.168	9.194	0.369	5.014
2046	24	*1*	0.000	0.461	0.461	56.553	0.016	10.789	0.377	10.328
2047	25	*2*	0.000	0.461	0.461	56.553	0.014	10.789	0.328	10.328
2048	26	*3*	0.000	0.461	0.461	56.553	0.012	10.789	0.285	10.328
2049	27	*4*	0.000	0.461	0.461	56.553	0.011	10.789	0.248	10.328
2050	28	*5*	0.000	0.461	0.461	56.553	0.009	10.789	0.215	10.328
2051	29	*6*	0.000	0.461	0.461	56.553	0.008	10.789	0.187	10.328
2052	30	*7*	0.000	0.461	0.461	56.553	0.007	10.789	0.163	10.328
2053	31	*8*	0.000	0.461	0.461	56.553	0.006	10.789	0.142	10.328
2054	32	*9*	0.000	0.461	0.461	56.553	0.005	10.789	0.123	10.328
2055	33	*10*	0.000	0.461	0.461	56.553	0.005	10.789	0.107	10.328
2056	34	*11*	0.000	0.461	0.461	56.553	0.004	10.789	0.093	10.328
2057	35	*12*	0.000	0.461	0.461	56.553	0.003	10.789	0.081	10.328
2058	36	*13*	0.000	0.461	0.461	56.553	0.003	10.789	0.070	10.328
2059	37	*14*	0.000	0.461	0.461	56.553	0.003	10.789	0.061	10.328
2060	38	*15*	0.000	0.461	0.461	56.553	0.002	10.789	0.053	10.328
2061	39	*16*	0.000	0.461	0.461	56.553	0.002	10.789	0.046	10.328
2062	40	*17*	0.000	0.461	0.461	56.553	0.002	10.789	0.040	10.328
2063	41	*18*	0.000	0.461	0.461	56.553	0.001	10.789	0.035	10.328
2064	42	*19*	0.000	0.461	0.461	56.553	0.001	10.789	0.030	10.328
2065	43	*20*	0.000	0.461	0.461	56.553	0.001	10.789	0.026	10.328
2066	44	*21*	0.000	0.461	0.461	56.553	0.001	10.789	0.023	10.328
2067	45	*22*	0.000	0.461	0.461	56.553	0.001	10.789	0.020	10.328
2068	46	*23*	0.000	0.461	0.461	56.553	0.001	10.789	0.017	10.328
2069	47	*24*	0.000	0.461	0.461	56.553	0.001	10.789	0.015	10.328
2070	48	*25*	0.000	0.461	0.461	56.553	0.001	10.789	0.013	10.328
2071	49	*26*	0.000	0.461	0.461	56.553	0.000	10.789	0.011	10.328
2072	50	*27*	0.000	0.461	0.461	56.553	0.000	10.789	0.010	10.328
2073	51	*28*	0.000	0.461	0.461	56.553	0.000	10.789	0.009	10.328
2074	52	*29*	0.000	0.461	0.461	56.553	0.000	10.789	0.008	10.328
2075	53	*30*	0.000	0.461	0.461	56.553	0.000	10.789	0.007	10.328
2076	54	*31*	0.000	0.461	0.461	56.553	0.000	10.789	0.006	10.328
2077	55	*32*	0.000	0.461	0.461	56.553	0.000	10.789	0.005	10.328
2078	56	*33*	0.000	0.461	0.461	56.553	0.000	10.789	0.004	10.328
2079	57	*34*	0.000	0.461	0.461	56.553	0.000	10.789	0.004	10.328
2080	58	*35*	0.000	0.461	0.461	56.553	0.000	10.789	0.003	10.328
2081	59	*36*	0.000	0.461	0.461	56.553	0.000	10.789	0.003	10.328
2082	60	*37*	0.000	0.461	0.461	56.553	0.000	10.789	0.002	10.328
2083	61	*38*	0.000	0.461	0.461	56.553	0.000	10.789	0.002	10.328
2084	62	*39*	0.000	0.461	0.461	56.553	0.000	10.789	0.002	10.328
2085	63	*40*	0.000	0.461	0.461	56.553	0.000	10.789	0.002	10.328
2086	64	*41*	0.000	0.461	0.461	56.553	0.000	10.789	0.001	10.328
2087	65	*42*	0.000	0.461	0.461	56.553	0.000	10.789	0.001	10.328
2088	66	*43*	0.000	0.461	0.461	56.553	0.000	10.789	0.001	10.328
2089	67	*44*	0.000	1.461	1.461	56.553	0.000	10.789	0.001	9.328
2090	68	*45*	0.000	2.461	2.461	56.553	0.000	10.789	0.001	8.328
2091	69	*46*	0.000	3.461	3.461	56.553	0.000	10.789	0.001	7.328
2092	70	*47*	0.000	4.461	4.461	56.553	0.000	10.789	0.001	6.328
2093	71	*48*	0.000	5.461	5.461	56.553	0.000	10.789	0.001	5.328
2094	72	*49*	0.000	6.461	6.461	56.553	0.000	10.789	0.000	4.328
2095	73	*50*	0.000	7.461	7.461	56.553	0.000	10.789	0.000	3.328
Total (in Billion			**56.553**	**55.696**	**112.249**		**11.827**	**642.586**	**12.860**	
							EIRR			**15.37%**
							Social Discount Rate			**15%**
							NPV			**0.41**
							B/C			**1.087**

Source: Project Team

(4) Sensitivity Analysis

To check the economic adequacy in case of project cost increase and benefit decrease, a sensitivity analysis was conducted. In all cases, the economic internal rate of return (EIRR) exceeds the current social discount rate of 10%. Therefore, it can be concluded that the project can be evaluated as adequate from the viewpoint of investment efficiency.

Table 4.5.18 Results of Sensitivity Analysis

		EIRR (%)
Case 0	Base Case	15.37
Case 1	Project Cost: increase of 10%	14.33
Case 2	Project Cost: increase of 20%	13.41
Case 3	Benefit: Decrease of 10%	14.64
Case 4	Benefit: Decrease of 20%	13.83
Case 5	Project Cost: increase of 10% and Benefit: Decrease of 10%	13.60
Case 6	Project Cost: increase of 20% and Benefit: Decrease of 20%	11.87

Source: Project Team

For reference, the break-even point analysis shows the EIRR of 10.0% when project cost increases by 70.7% under the condition that there is no change in benefit as well as when benefit decreases by 54.9% under the condition that there is no change in project cost.

4.5.6 Environmental Evaluation

(1) Compliance of Environmental Compliance Certificate

Environmental and social consideration study was undertaken based on the section 3.13.2 [Environmental Legal Framework in Philippines]. Though the Project is recognized as an environmental enhancement project; the EMB decided to categorized Category-B from the viewpoint of the scale of retarding ponds. So the EMB Region XI Office (EMB-XI) has been taken over. A Project Description Sheet PDS, see Annex 5 in details) was submitted to the EMB-XI for commencement of the EIS study in August 2021. The draft EIS report was submitted in April 2022 for their review. The EIS was approved by the EMB Region-XI; and ECC license was issued at August 15, 2022. Table 4.5.19 summarizes the PDS.

Table 4.5.19 Outline of the Project (PDS)

Project Name	Priority Projects for Flood Control in Davao River in Davao City
Project Proponent	DPWH Flood Control Management Cluster (UPMO-FCMC)
Office Address	DPWH 2nd St., Port Area, Manila
Type of Project	Environmental Enhancement
Project Location	Davao City, Davao River Basin
Total Project Area	+ River Dredging: Expected excavated volume - 2.0 MCM + Cut-Off Works: Expected excavated volume - 1.7MCM + Retarding Ponds: Expected excavated volume - 28.2MCM
Project Contact Person	Ramon A. Arriola III Project Director
Project Contact Number	+632-5304-3813/ +632-5304-3752 arriola.ramon@dpwh.gov.ph

Note: Total project area is based on the M/P.
Source: PDS

The ECC license was issued with the following conditions:

- To formulate a dredging master plan before implementation of the Project;
- To secure disposal site for the dredged/ excavated soil generated by the construction; and
- To submit the detailed engineering design prior to project implementation.

It is required to amend the ECC with above examination after the Study. Any update, suggestion etc. will be reflected in to the EIS report in the amendment if necessary.

(2) Scoping

Scoping was undertaken in the environmental and social consideration study; the results are in the section "4.6.2 Environmental Impact".

(3) Environmental Evaluation

The details of environmental evaluation and environmental management and monitoring plan (EMP/ EMoP) are described in the section "4.6.2 Environmental Impact". The following policies are given for formulation of the Priority projects based on the results of basic study and planning of the M/P.

- Natural conservation/ restoration social impact especially resettlement shall be considered in to project design and construction method even though sensitive areas such as protected forests and mangroves are excluded from the project site.
- Mitigation of air/ water pollution shall be incorporated with construction method.
- Compliance with ECC, Environmental and social consideration guideline of JICA as well shall be obtained in the F/S so as to mitigate environmental and social impacts.

4.5.7 Socio-economic Evaluation

(1) Principle

Philippine is known as the country with many disasters in the world; therefore the Government of Philippine has declare “Philippine Disaster Risk. Reduction and Management Act of 2010 (RA10121)”; and emphasized reduction of damage to human life and infrastructures by the disasters.

The Priority project aims to reduce flood risk along the Davao River; so as to mitigate damage to socio-economic value in Davao City through evaluation of damage by Davao River flood in 2013, Cyclone Vinta in 2017, etc.

(2) Estimated Level of Resettlement by the Priority Project

Total number of households to be relocated is estimated 100HHs or less (see section “4.6.3 Land Acquisition and Resettlement”).

(3) Preventive Relocation by the Priority Projects

The most of the households to be relocated have resided near the Davao River where it is high risk area and not suitable for dwellings. Therefore resettlement under the Priority project must encourage preventive relocation to protect their life and assets.

(4) Socio-economic Aspects on the Preventive Relocation

1) Protection of the Human Life

The preventive relocation by the Priority projects could encourage mitigation of damage to human life by relocation to out of high flood risk area.

2) Protection of the Assets

The preventive relocation by the Priority projects could encourage mitigation of damage to private assets and public infrastructures so as to enhance sustainable socio-economic activities.

(5) Social Evaluation

For above reasons, resettlement to be proposed is not only to secure necessary space for the project site but also to mitigate flood risk; and then project design was formulated with minimizing scale of resettlement, consensus with project affected households.

4.5.8 Technical Evaluation

Section 4.3 details the construction plan for the priority projects of the F/S. As a result of a detailed examination, the technical feasibility, safety, reliability and appropriateness of the proposed structures were confirmed. This section describes the summary of the technical evaluation results of the riverbed dredging, retarding ponds, and cut-off works projects.

(1) Riverbed Dredging

The target area of the dredging works is the area from the river mouth until 23 kilometers. The submerged dredging will be the main part of this work. Therefore, the use of pump dredger, grab dredger and backhoe dredger is possible. In addition, grab dredging, sand pumps capable of dredging gravel and others, as well as the Japanese ejector construction technology can also be applied.

1) Pump Dredging (From the river mouth until 10 km)

In addition to the pump dredger owned by the Region Office of DPWH, the use of micro dredger and soft mud dredger is possible.

2) Backhoe Dredging (From 10 km to 23 km)

As a result of interviews with the District Engineering Office of DPWH, backhoes are recommended over pump dredging due to the difficulty of operation during floods. Therefore, backhoe dredging is feasible from a technical point of view.

(2) Retarding Ponds

Three retarding ponds are planned to be constructed. RP-8 is planned on the right bank at around 29.0 kilometers from the river mouth, RP-9 on the left bank at 27.2 kilometers and RP-11 on the left bank at 23.8 kilometers.

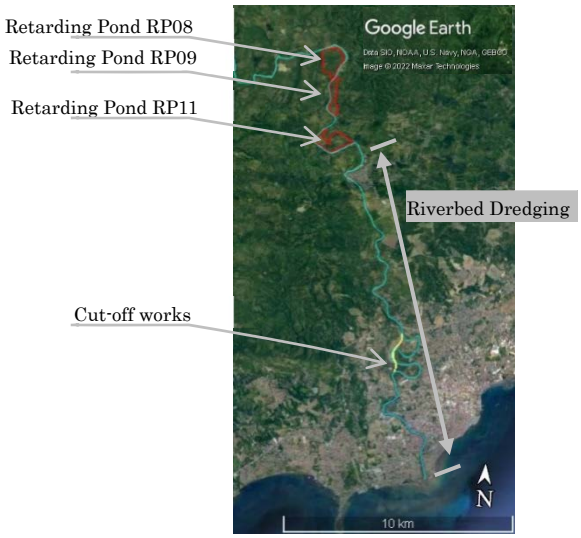
Since the excavated soil volume is anticipated to be large, it is recommended the parallel construction of RP-8 and RP-11 is recommended. During the construction of the surrounding embankment, a temporary cofferdam will be built with steel sheet piles and other materials if needed. Once the dry condition is established, the excavation works, construction of protection blocks and concrete banks will be implemented. On the retarding ponds side, impermeable sheets will be placed and gabion revetments will be constructed after the completion of excavation works.

(3) Cut-off Works

This project is to linearize the meandering river section from 6.5 kilo post to 12.7 kilo post. Since the road will be disconnected due to this cut-off works, the construction of a new bridge will be needed. During the construction of the channel and initial stage of the bridge construction, procedures to avoid the intrusion of water will be needed, in order to carry out this project in dry condition.

4.5.9 Overall Evaluation of the Project (Examination of Alternatives)

The detailed alternatives comparison analysis for the riverbed dredging, retarding ponds and cut-off works is explained in section 4.1.5. In this section, the overall evaluation results of the recommended alternatives are described.



Source: Project Team

Figure 4.5.1 Location of the projects targeted by the F/S

(1) Zero Option

The option of no implementation of the F/S projects is not recommended based on the following reasons:

- Annual loss of economy is estimated approximately 5.9 billion pesos.
- Davao City has highly prioritized flood controls as one of the urgent issues.

The Environmental Assessment Law, Japan defines “Zero Option” as ”Option of no implementation of the project, or alternative which does not cause environmental impact”. This definition has no gap with the JICA-GL. The followings are the results of evaluation of Zero Option:

- Non-structural measures will not cause significant impacts; however, implementation without structural measures could not expect sufficient effects. Non-structural measures shall be obtained with combination and supplement of structural measures so as to expect increase of the project effect.
- Other possible flood controls which could reach the project goal will be “control of land use of the flood prone area through resettlement”, “land reclamation/ leveling of flood prone area”, “switch of housing to high floored houses, e.g.”, e.g. However, these are not affordable and realistic to a wide urbanized city such as Davao City.

(2) Results of the alternatives comparison analysis

1) Riverbed Dredging

As a result of comparing four alternatives for riverbed dredging, the Alternative 3 was adopted as the most recommended alternative, from the viewpoint of flood protection (or reduction of flood damage). Alternative 3 is proposing riverbed dredging directions by preserving (avoid dredging in) the 100 meters section in the upstream and 100 meters in the downstream of each bridge, and by implementing bridge protection measures for the Davao Bridge.

2) Retarding Ponds

Regarding the retarding ponds, two alternatives (with or without spillway) were compared. Alternative 1 which is the alternative with the spillway was adopted from the viewpoint of economic efficiency, and safety of the structure (avoidance of structure breakage) in case floods exceeding the design flood scale occur.

3) Cut-off Works

Regarding the cut-off works, different standard cross-sections and bank revetment structures of the river channel were compared. As a result, for the northern section of the cut-off works (from 10.04 to 12.50 kilo post), the Alternative 1 (compound inverted trapezoid cross section with a width of 111 meters in addition to the ROW) was adopted from the viewpoint of economy, sustainability, flexibility and environmental impact.

For the southern section (from 6.50 to 9.48 kilo post), the Alternative 1 (compound inverted trapezoid cross section with a width of 111 meters in addition to the ROW) was adopted from the viewpoint of economy, sustainability, flexibility and environmental impact.

(3) Comprehensive evaluation of the F/S

Table 4.5.20 summarizes the comprehensive evaluation results of the F/S projects. The feasibility of each project was confirmed from the points of view of economic feasibility, socio-economic suitability, and environmental and technical safety and soundness.

Table 4.5.20 Comprehensive Evaluation Results of the F/S for the Davao River

Project / Evaluation axis	Entire F/S	*Projects composing the F/S (Recommended projects based on the comparison of alternatives)*			
		Riverbed Dredging	***Retarding Ponds***	***Cut-Off Works (Northern Section)***	***Cut-Off Works (Southern Section)***
		Alternative 3: Preservation of the 200 meters in the upstream and downstream of each bridge, and bridge protection measures for Davao Bridge	***Alternative 1: With spillway***	***Alternative 1: compound inverted trapezoid cross section with a width of 111 meters in addition to the ROW, without any expectation to the actual flood capacity of the channel***	***Alternative 1: compound inverted trapezoid cross section with a width of 111 meters in addition to the ROW, without any expectation to the actual flood capacity of the channel***
a. Flood Protection Level (Expected damage reduction)	Target Flood: 10-year return period flood	*Reduction of 97% of the inundated area caused by a 10-year return period flood. The flow velocity increase in the upstream and downstream of the bridges is expected to not exceed 116% of the actual velocity.*	*Until 2032: 5 to 10-year return period flood; Until 2045: 25 year-return period flood; With the implementation of M/P:100-year flood*	*Target Flood capacity: 1,700 cubic meters per second (Corresponding to the 100-year return period flood targeted by the Master Plan)*	
b. Economic Effectiveness	Total cost: PhP 21.59 Billion EIRR:15.32% NPV:10.00 B/C:1.896 *SDR=10%	*Direct Construction Cost: PhP 0.36 Billion*	*Direct Construction Cost: PhP 7.09 Billion*	*Direct Construction Cost: PhP 0.49 Billion (Including the construction cost of a new bridge with a length of 110 meters) Cost for households relocation and land acquisition: PhP 0.45 Billion*	*Direct Construction Cost: PhP 0.34 Billion (Including the construction cost of a new bridge with a length of 110 meters) Cost for households relocation and land acquisition: PhP 0.11 Billion*
c. Feasibility in regards with social and legal restrictions	Including the proposed dump site, the project will not be located in the natural conservation area. The public consultation meetings with stakeholders will be required.	*The proposed locations for the project implementation and dump sites are not included in the natural conservation area.*			*Kagan Community is located within the area where the project is planned to be implemented and will need to be relocated. Therefore the continuation of information sharing on the project and dialogue with the Community will be needed.*

Project / Evaluation axis	Entire F/S	*Projects composing the F/S (Recommended projects based on the comparison of alternatives)*			
		Riverbed Dredging	***Retarding Ponds***	***Cut-Off Works (Northern Section)***	***Cut-Off Works (Southern Section)***
		Alternative 3: Preservation of the 200 meters in the upstream and downstream of each bridge, and bridge protection measures for Davao Bridge	***Alternative 1: With spillway***	***Alternative 1: compound inverted trapezoid cross section with a width of 111 meters in addition to the ROW, without any expectation to the actual flood capacity of the channel***	***Alternative 1: compound inverted trapezoid cross section with a width of 111 meters in addition to the ROW, without any expectation to the actual flood capacity of the channel***
d. Feasibility from the technical viewpoint to construct countermeasures:	Phased construction is possible.	*Phased construction is possible.*	*Phased construction is possible.*	*Phased construction is possible.*	
e. Sustainability	Sustainable. However, maintenance dredging is required.	*Sustainable.*	*Sustainable.*	*Sustainable. In addition, the volume of maintenance dredging to ensure the expected flood capacity (by avoiding the raise of riverbed) is estimated to be minimal.*	
f. Flexibility	Future revision is possible.	—	*After the construction of the structure, overflow from the surrounding dike can be avoided by the effect of the spillway, during floods exceeding the design flood scale.*	*The proposed landfill and maintenance of the new river channel is appropriate.* *However, the landfill of the actual river channel will require the installation of new drainage facilities to drain a maximum of 1.4 square kilometers in the actual meandering area (due to the changes in the drainage network).* *The revision of the cross section (such as increase of the flood capacity) will be relatively easy if the needs occur in the future.*	*The proposed landfill and maintenance of the new river channel is appropriate.* *However, the landfill of the actual river channel will require the installation of new drainage facilities to drain a maximum of 2.6 square kilometers in the actual meandering area (due to the changes in the drainage network).* *The revision of the cross section (such as increase of the flood capacity) will be relatively easy if the needs occur in the future.*
g. Social and natural environment impacts	Households relocated: 104 Relocation and land acquisition will be needed especially in the areas affected by the construction of the cut-off works.	*Households relocated: 0*	*Households relocated: 1* *The volume of excavation is lesser than the case without spillway.*	*Households relocated: 0* *The needed land acquisition will be large but the current river channel will not need any maintenance.*	*Households relocated: 103* *The needed land acquisition will be large but the current river channel will not need any maintenance.*

Project / Evaluation axis	Entire F/S	*Projects composing the F/S (Recommended projects based on the comparison of alternatives)*			
		Riverbed Dredging	***Retarding Ponds***	***Cut-Off Works (Northern Section)***	***Cut-Off Works (Southern Section)***
		Alternative 3: Preservation of the 200 meters in the upstream and downstream of each bridge, and bridge protection measures for Davao Bridge	***Alternative 1: With spillway***	***Alternative 1: compound inverted trapezoid cross section with a width of 111 meters in addition to the ROW, without any expectation to the actual flood capacity of the channel***	***Alternative 1: compound inverted trapezoid cross section with a width of 111 meters in addition to the ROW, without any expectation to the actual flood capacity of the channel***
	The inhabit of Designated Endangered Species (animals and plants) was not confirmed in the target area. However, to minimize the impact to the natural environment during the project implementation, water and air pollution measures will be promoted. After the completion of the F/S, the retarding ponds may be used as new places for nature restoration.			*The area where the cut-off works is planned is actually designated as "open-space" in the Comprehensive Land Use Plan (CLUP). Such lands are expected to provide recreational functions in the future. Therefore, the construction of easy slope (low-gradient river slope) is expected to ensure the accessibility to river.*	*The area where the cut-off works is planned is actually designated as "open-space" in the Comprehensive Land Use Plan (CLUP). Such lands are expected to provide recreational functions in the future. Therefore, the construction of easy slope (low-gradient river slope) is expected to ensure the accessibility to river.*
Others		–	—		*With the landfill of the existing river channel, the bridge actually under construction (DPWH-RO11) may become unnecessary.*
Evaluation Result	The Projects composing the F/S are appropriate from the viewpoint of economic efficiency, technical feasibility, sustainability and flexibility. On the other hand, the project may generate social impacts such as the relocation of the Kagan Community. Regarding this point, the				

Project / Evaluation axis	Entire F/S	*Projects composing the F/S (Recommended projects based on the comparison of alternatives)*			
		Riverbed Dredging	***Retarding Ponds***	***Cut-Off Works (Northern Section)***	***Cut-Off Works (Southern Section)***
		Alternative 3: Preservation of the 200 meters in the upstream and downstream of each bridge, and bridge protection measures for Davao Bridge	***Alternative 1: With spillway***	***Alternative 1: compound inverted trapezoid cross section with a width of 111 meters in addition to the ROW, without any expectation to the actual flood capacity of the channel***	***Alternative 1: compound inverted trapezoid cross section with a width of 111 meters in addition to the ROW, without any expectation to the actual flood capacity of the channel***
	impacts can be reduced by sharing the information on the project and continuing the dialogue with the Community. In addition, regarding the impacts on the natural environment (such as noise, water quality, etc.) during the construction, they can be reduced by devising construction methods. Therefore, it was evaluated that the project as a whole is appropriate.				

Source: Project Team

4.6 Environmental and Social Considerations

4.6.1 Categorization

Category "A" under the JICA-GL

Reason: The project site would cause adverse impacts which are described in the Guidelines for Environmental and Social Considerations (April 2010).

4.6.2 Environmental Impact

(1) Outline of the Project

The project outline, which environmental and social considerations study was undertaken for, is described in Table 4.6.1.

Table 4.6.1 Outline of the Project

Components	Location	Description
A. Riverbed dredging	Up to Approx. 23km upstream from the river mouth	Dredging volume: approx. 2 million m^3
B. Cut-off works (COW)	Approx. 7.13km from the river mouth	Total of approx. 700m with 110m width
C. Retarding ponds (RPs)	From the river mouth: RP11 : approx. 24km RP09 : approx. 27km RP08 : approx. 29km	Area Capacity RP11 : 0.67km^2, 4.5MCM RP09 : 0.37km^2, 2.2MCM RP08 : 0.75km^2, 4.7MCM

Source: Project Team

(2) Environmental Baseline

Environmental baseline was surveyed in [stage 1: Basic study] and [stage 2: Master Plan]. The results are described in the section [2.1 - 2.4]. The results found in the EIS study was described in the section [4.6.2(6): Results of Environmental and Social Considerations Study].

(3) Philippine Legal Framework Related to Environment and Organizations

Legal Framework and Gap Analysis between Philippines and JICA Guideline are described in the section [3.13.2: Environmental Legal Framework in Philippines] and [3.13.3: Gap Analysis between JICA Guideline and Philippine System] respectively.

(4) Alternative Analysis

Analysis on "Zero-option including without projects" was described in the section [4.5.9 Overall Evaluation of the Project (Examination of Alternatives)]; while alternative analysis of 3 components examined in the FS is in the section [4.1.5: Preliminary Design of Structure Measures of the Priority Project Targeted for Feasibility Study for Riverine Flood in Davao River].

(5) Scoping and TOR of Environmental and Social Consideration Study

1) Scoping

Scoping of the three (3) components are indicated in the section [3.16.4 Scoping].

2) TOR of the Environmental and Social Consideration Study

An environmental and social consideration study (EIS study, RAP study was separately taken) was designed based on the above scoping and the Philippine EIS system. The following table is described TOR.

Table 4.6.2 TOR of the EIS Study

Items	Survey Methods	Evaluation Method
Air quality	(1) Data collection and analysis from EMB, etc. (2) Air quality measurement at 3 locations CO, NO2, SO2, PM10, PM2.5 with 24 hours sampling	Compliance with the Philippine standard, examination of possible impact by the Project.
Water quality	(1) Data collection and analysis from EMB, etc. (2) Water quality measurement at 4 locations pH, TSS, Phosphorus, BOD, oil & grease, EC/ chloride, coliform, heavy metals (Cd, As, Pb, Cr) and mercury (3) Direct observation on the inflow of wastewater	Compliance with the Philippine standard, examination of possible impact by the Project. Forecast of turbid water spread.
Waste	(1) Data collection (2) Examination of possible disposal site (3) Direct observation on the illegal dumping to the river	Volume of dredging/ excavated soil Examination of possible reuse
River sediment	(1) Data collection and analysis (2) Soil quality measurement at 4 locations Items: Heavy metals (Cd, As, Pb, Cr), mercury, sulfide	Compliance with standards, pollution source
Noise/ vibration	(1) Data collection and analysis (2) Noise measurement at 3 location (2 locations for vibration)	Compliance with standards, pollution source
Subsidence	Data collection and analysis	Geological condition, examination of construction methodology
Odor	N/A	N/A
Protected Area	N/A	N/A
Ecosystem	(1) Data collection and analysis (2) Hearing with relevant organizations, communities, etc. (3) observation (4) Sampling, trap	Inventory, impact evaluation
Hydrology Geology/ Topography	(1) Data collection and analysis (2) Hearing with relevant organizations, communities, etc. (3) Geological/ topographical survey (separately conducted)	Impact evaluation
Resettlement	RAP Study (see details section [4.6.3 Land Acquisition and Resettlement])	
Poor, vulnerable	(1) Data collection and analysis (2) Hearing with relevant organizations, communities, etc. (3) Public consultation	Socio economic profile of PAPs
Indigenous Peoples	N/A	N/A
Local economies Utilization of land and local resources	(1) Data collection and analysis (2) Hearing with relevant organizations, communities, etc. (3) Public consultation	Community perception, examination on possible interruption
Water usage	N/A	N/A
Existing social infrastructures and services	(1) Data collection and analysis (2) Hearing with relevant organizations, communities, etc. (3) Public consultation (4) Site observation (5) Traffic survey (traffic volume, hearing)	Community perception, examination on possible interruption
Local economies	(1) Data collection and analysis (2) Hearing with relevant organizations, communities, etc. (3) Public consultation (4) Site observation	Community perception, examination on possible interruption

Items	Survey Methods	Evaluation Method
Community severance	(1) Data collection and analysis (2) Public consultation	Community perception, examination on possible interruption
Local conflicts of interest		
Cultural heritage	N/A	N/A
Landscape	(1) Data collection and analysis (2) Hearing with relevant organizations, communities, etc. (3) Public consultation (4) Site observation	Community perception, examination on possible interruption
Gender	(1) Data collection and analysis (2) Hearing with relevant organizations, communities, etc. (3) Public consultation	Community perception, examination on possible interruption
Children's rights		
Infectious diseases	(1) Data collection and analysis (2) Hearing with relevant organizations, communities, etc.	Community perception, examination on possible interruption
Labor conditions		
Accidents		
Global warming	N/A	N/A

Source: Project Team

(6) Results of Environmental and Social Consideration Study

1) Urban Environment, Pollution

(a) Air Quality

Air quality measurement with five (5) items indicated in Table 4.6.3, Table 4.6.4 and Figure 4.6.1 was conducted.

Table 4.6.3 Items of Air Quality Measurement

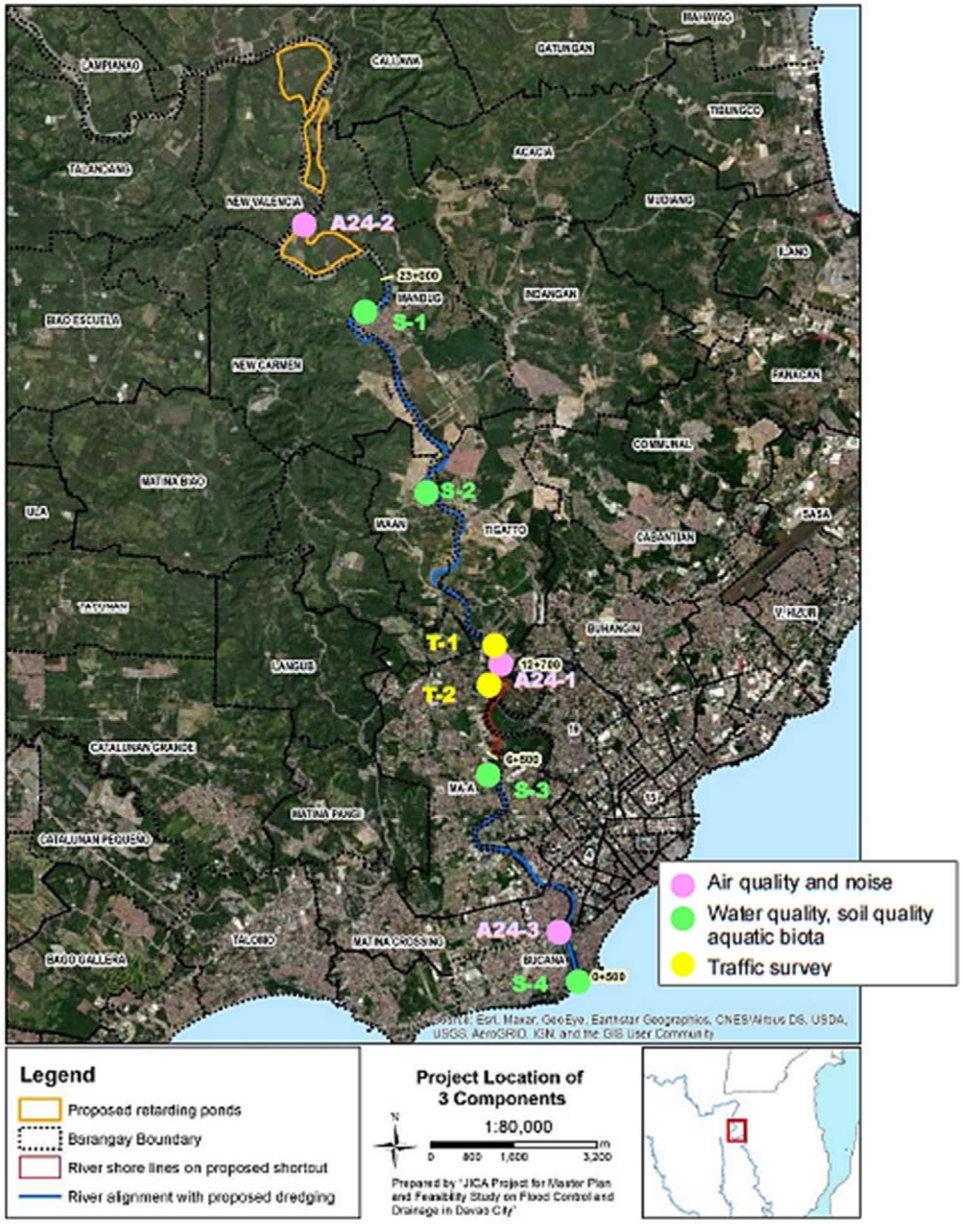
Items	Sampling Methodology/Analysis
PM10	High Volume Sampler – Gravimetric Method
PM2.5	High Volume Sampler – Gravimetric Method
Sulphur dioxide (SO_2)	Bubbler – Pararosaniline Method
Nitrogen dioxide (NO_2)	Bubbler – Griess Saltzman Reaction
Carbon oxide (CO)	Direct reading

Source: Project team

Table 4.6.4 Sampling Date and Locations

Location		Date
A24-1	Near Crocodile Park, Brgy. Ma-a	September 20 – 21, 2021
A24-2	Brgy. New Valencia、Sitio Luman Purok 6	September 22 – 23, 2021
A24-3	Bilusa, Bucana Brgy. 76-A	September 24 – 25, 2021

Source: Project team



Source: Project team

Figure 4.6.1 Location of Measurement of Air/ Water Quality, Noise/ Vibration and Traffic Survey

As shown in Table 4.6.5, all the data met the Philippine ambient air quality standards.

Table 4.6.5 Results of Air Quality Measurement

Location	Items				
	PM10 (ug/m^3)	PM2.5 (ug/m^3)	SO_2 (ug/m^3)	NO_2 (ug/m^3)	CO (ppm)
A24-1	<0.07	<0.07	3.35	0.18	<1.0
A24-2	<0.07	<0.07	3.24	0.19	<1.0
A24-3	<0.07	<0.07	4.72	0.16	<1.0
Standard criteria[1)]	150	35	180	150	9
Japan Standard[2)]	-	35ug/m^3 (daily average)	0.1ppm (172ug/m3)		10ppm
WB Guidelines[3)]	50	25	20	40 (annual average)	-

1) DENR NAAQGV. 24-hours average except CO, 8-hours average
2) Notification of the Environment Agency No. 25, 1970
3) Environmental, Health, and Safety General Guidelines, 2007
Source: Project team

It can be said that air quality condition in the Project area is relatively good. The major pollution source would be operation of construction equipment; significant impact is not expected.

(b) Water Quality

Water quality measurement was undertaken on September 29, 2021, based on Table 4.6.6 and Figure 4.6.1[2]. Classification by the EMB on the Project site is Class A in the RPs area, and Class B in other area.

Table 4.6.6 Items of Water Quality Measurement

Items	Measurement Method
Biochemical oxygen demand (BOD)	Titration
Chloride (Cl)	Colorimetric method
Dissolved oxygen (DO)	Titration
Fecal coliform	Most probable number
pH	Electrode method
Phosphate	Colorimetric method
Water Temperature	Termo meter
Total suspended solids (TSS)	Grabmetric method
Arsenic (As)	Atomic absorption
Cadmium (Cd)	Atomic absorption
Chromium, hexavalent (Cr^{6+})	Colorimetric method
Lead (Pb)	Atomic absorption
Mercury (Hg)	Vapor - Atomic absorption
Oil and grease (Oil & Grease)	Grabmetric method

Source: Project team

Results are indicated in Table 4.6.7

[2] Since no clear difference of rainfall level between dry season and rainy season; it was assumed not to cause significant change of river condition. Therefore, the water and aquatic biota survey was conducted one (1) time.

Table 4.6.7 Results of Water Quality Measurement

Parameter	unit	Water body classification						Japan stansard[2)]
		Class B			Class A			
		Bucana	Ma-a	Waan	Standard[1)]	Mandug	Standard[1)]	
BOD	mg/L	2	1	<1	5	<1	3	5
		2.9	1.5	1.5		1.5		
Chloride	mg/L	535	7.49	6.61	250	6.28	250	-
		1,047	8.0	7.8		7.4		
DO	mg/L	7.4	8.1	8.5	< 5	8.1	< 5	<5
		6.2	7.3	7.6		7.7		
Fecal coliform	MPN/100 mL	23	<1.8	<1.8	200	49	200	-
		426,853	28,793	16,340		15,635		
pH		7.2	7.6	7.6	6.5-8.5	7.8	6.5-8.5	6.5-8.5
		8.0	8.3	8.3		8.4		
Phosphate	mg/L	0.64	0.92	0.74	1.5	0.86	1.5	-
		0.80	1.68	1.29		1.33		
Water temperature	ºC	27.3	26.9	28.4	26-30	27.5	26-30	-
		28.4	27.9	28.1		28		
TSS	mg/L	70	221	84	65	211	50	50
		386	533	530		485		
Arsenic (As)	mg/L	0.006	0.005	0.005	0.01	0.007	0.01	0.01
Cadmium (Cd)	mg/L	<0.003	<0.003	<0.003	0.003	<0.003	0.003	0.003
		0.006	0.004	0.004		0.003		
Chrome hexavalent (Cr^{6+})	mg/L	<0.010	<0.010	0.018	0.01	0.019	0.01	
		No data		No data				
Lead (Pb)	mg/L	<0.01	<0.01	<0.01	0.01	<0.01	0.01	0.02
		<0.01	<0.01	<0.01		<0.01		
Mercury (Hg)	mg/L	<0.002	<0.002	<0.002	0.001	<0.002	0.002	0.0005
		0.0011	0.0016	0.0016		0.0021		
Oil and grease	mg/L	<1	<1	<1	1	2	1	-

1) Per DAO 2016-008, except for phosphate and fecal coliform; per DAO 2021-19, for phosphate and fecal coliform

2) Notification of the Environment Agency No. 59, 1971

NLT - Not less than

- WQMA Data (2012-2019), EMB-DENR

Source: Project team

BOD showed higher value in Bucana, near river mouth; but it met standard level. In general, the higher BOD value shows the downer stream nearer river mouth. Therefore, it was ordinal condition.

Concentration of chloride in Bucana was over two (2) times higher than water quality standard. It was caused by saltwater coming from the sea; that to say, natural situation.

All results of DO and fecal coliform passed the standard level. Occasionally the measurement by the EMB showed extreme contamination of fecal coliform, higher than tens of thousands of standard level; main pollution source must be from domestic water discharge.

Range of concertation of phosphate was between 0.6 - 0.9mg/L; these values were 20 – 30 times higher than standard limit. In general, pollution source of phosphate is chemical fertilizer, detergent, e.g.; however it is not sure how much those pollution sources raise concentration in that time.

TSS level at All locations exceeded the standard level. Even in Mandug, out of urbanization area, TSS showed high value; therefore, source of soil would be naturally in-flowed from the land, not by human activities.

Concentrations of heavy metals and oil and greases at all locations were passed the standard levels.

Possible raise of concentration by the Project will be caused from the construction activities for example, spillage from fuel oils, waste, and TSS by dredging/ excavated soil.

In addition, it was observed that untreated wastewater was directly discharged into the Davao River.

(c) River Sediment Condition

Sediment condition survey was conducted at the same locations and same date as water quality measurement. Soil was sampled from a depth of approximately 30cm from the surface. The results are summarized in Table 4.6.8. Since the Philippine has not declared sediment/ soil standards; Canadian standard and guideline of NOAA were referred.

Table 4.6.8 Results of Sediment Quality

Items	Mandug	Waan	Ma-a	Bucana	Canadian[3]	NOAA[4]
Arsenic (As) mg/kg	0.122	0.143	0.238	0.285	5.9	8.2
Cadmium (Cd) mgk/g	0.79	0.78	0.81	0.87	0.6	1.2
Chrome (Cr) mg/kg	78.69	90.32	83.10	98.81	37.3	81
Lead (Pb) mg/kg	9.94	8.47	9.68	10.56	35.0	8.0
Mercury (Hg) mg/kg	0.02	0.02	<0.02	0.02	0.17	0.15
Sulfur (S) mgk/g	41.51	29.23	74.80	376	-	-

Source: Project team

Concentration of Arsenic at all locations passed both standard values. Cadmium passed NOAA guideline; however slightly exceeded Canadian standard.

Concentration of Chrome passed at three (3) locations except Mandug compared with NOAA guideline; all locations, while, exceeded Canadian standard. Major pollution sources of Chrome are Nickel mining, chemical industries; but there are no such mining area or factories observed.

Lead met the Canadian standard (most relaxed level); but exceeded NOAA guideline (most stringent level).

Concentration of Mercury was below detected level; it concluded that mercury pollution by gold mining was not observed.

It is recommended to prior monitor possible contamination of toxic in the dredged/ excavated soil; on the other hand, it will be challenging how soil standards set for evaluation.

(d) Noise and Vibration

Noise/ vibration measurement was taken at the same locations as air quality measurement (only A24-2 for vibration). Noise measurement was taken four (4) times, that to say, morning, noon, evening and nighttime. The results of noise measurement are summarized in Table 4.6.9. Noise level at the N-3 in evening time exceeded the noise limitation over 8dB; however, it could not be significant level. Major noise source were animal calls, construction noise, community sound, etc.; those are ordinal sources.

[3] Canadian Environmental Quality Guidelines (2001). Canadian Sediment Quality Guidelines for the Protection of Aquatic life. Canadian Council of Ministers of the Environment.
[4] NOAA Sediment Quality Guidelines developed for Natioal Status and Trends Program.

Table 4.6.9 Results of Noise Measurement

Location	Time[1)]	Noise Level[2)] (dBA)	Standard Level[3)] NPCC Standard(dBA)	Japan standard[4)]	WB Guideline[s5)]	Source of Noise
N1	Morning	51	50	55	55	Animal calls
	Noon	54	55			Construction work
	Evening	51	50	45	45	Animal calls
	Night	49	45			Animal calls
N-2	Morning	51	50	55	55	Animal calls
	Noon	62	55			Animal calls, community sound
	Evening	53	50	45	45	Construction work
	Night	48	45			Traffic noise
N-3	Morning	56	50	55	55	Animal calls, community sound
	Noon	62	55			Animal calls
	Evening	58	50	45	45	Motor sound of boat, Karaoke
	Night	51	45			Animal calls

1) Morning: 5:00-9:00, daytime: 9:00-18:00, evening: 18:00-22:00, night: 22:00-5:00
2) Median of seven highest recorded noise levels
3) National Pollution Control Commission. (NPCC) memorandum circular no. 002, 1980
4) Notification of the Environment Agency, 1998. Daytime: 6:00-22:00, night: 22:00-6:00
5) Environmental, Health, and Safety General Guidelines, 2007. Daytime: 7:00-22:00, night: 22:00-7:00
Source: Project team

It is predicted that major source of noise by the Project is construction works; ordinal countermeasures, for instance maintenance of equipment, prohibit of nighttime work, prior notice of construction schedule to the communities, could be affordable.

The results of vibration survey are shown in Table 4.6.10. The survey was undertaken at the same location and date as the noise survey.

Table 4.6.10 The Results of Vibration Survey

Location	Peak Velocity		Guidelines[2)]
	Daytime[1)]	Night[1)]	
Residential area, Sitio Luman, Brdgy. New Valencia	7.5mm/s	0.4mm/s	17mms (daytime) 6mm/s (nighttime)

1) Daytime: 6:30 - 22:30, nighttime: 22:30 - 06:30
2) Table C1.1 Department of Environment and Conservation
Source: Project team

(e) Waste

Waste management is mainly undertaken by The City Environment and Natural Resources Office (CENRO); while policy making is controlled by The Davao City Solid Waste Management Board which is a direct office under the Mayor.

Most of the waste from Davao city is disposed at New Carmen sanitary waste dumping site located in Tugbok approximately 15km far form the downtown of the Davao City. It has been operated since 2010; service capacity will last in 8 – 10 years after.

Source: Project team]

Figure 4.6.2 New Carmen Sanitary Waste Dumping Site

On the otherhand, construction waste is usually disposed a vacant land near-by, or recycled. It has been observed to be illegally disposed in mountainous area. River dredged soil is disposed at a public space near-by.

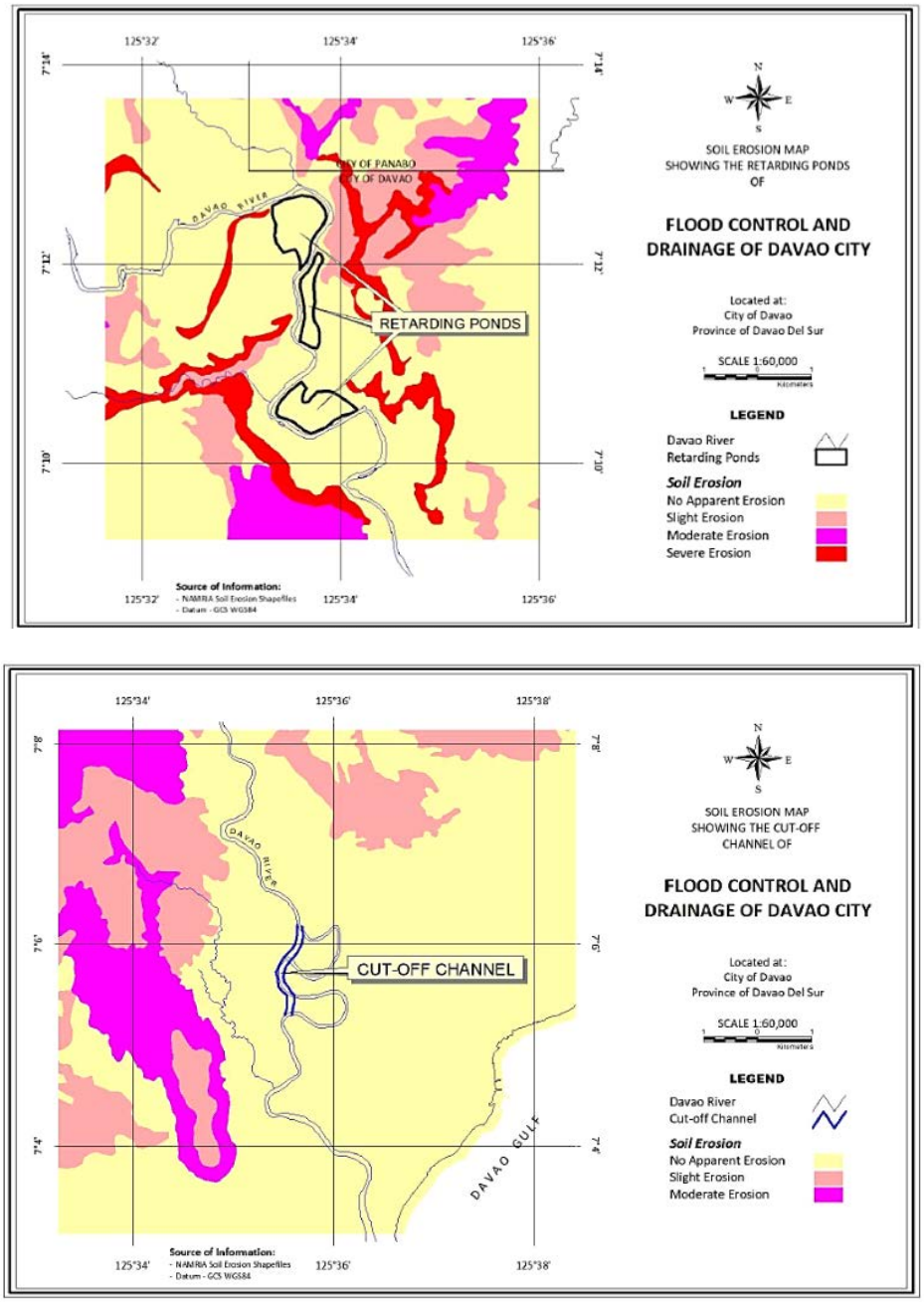
The observation survey indicated illegal dumping in the Davao River and the drainages connected.

2) Natural Environment

(a) Geography, Topography

Details of the results are described in the section [4.1.2 Additional Topographic and River Surveys for Structure Measures of the Priority Project Targeted for Feasibility Study for Riverine Flood in Davao River] and the section [4.1.3 Geotechnical Investigation for Structure Measures of the Priority Project Targeted for Feasibility Study for Riverine Flood in Davao River].

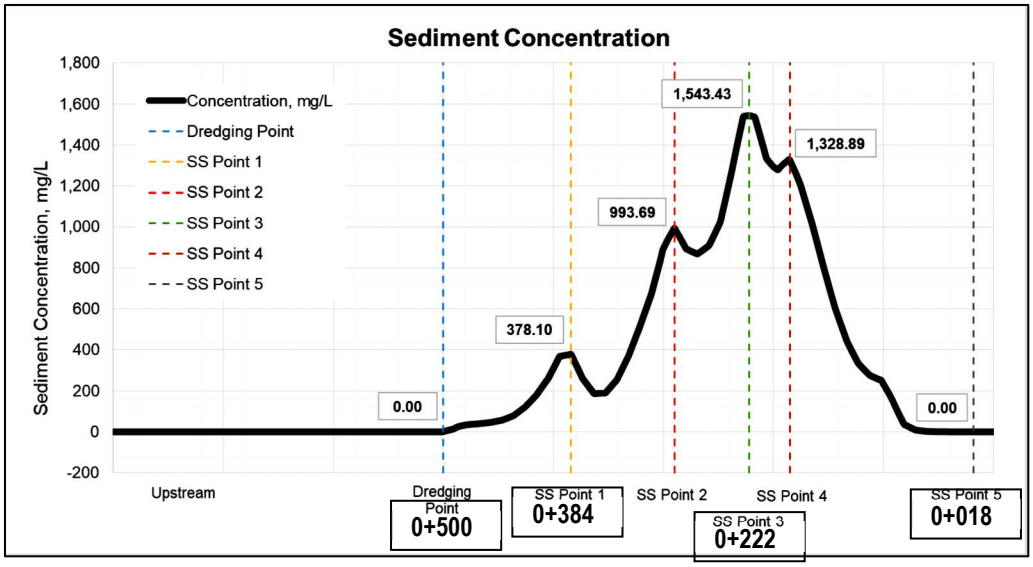
Because the location of retarding ponds and cut-off work are on the low and plain land; impacts to geographic and topographic conditions must not be significant. Erosion risk in the area will be low as described in Figure 4.6.3.



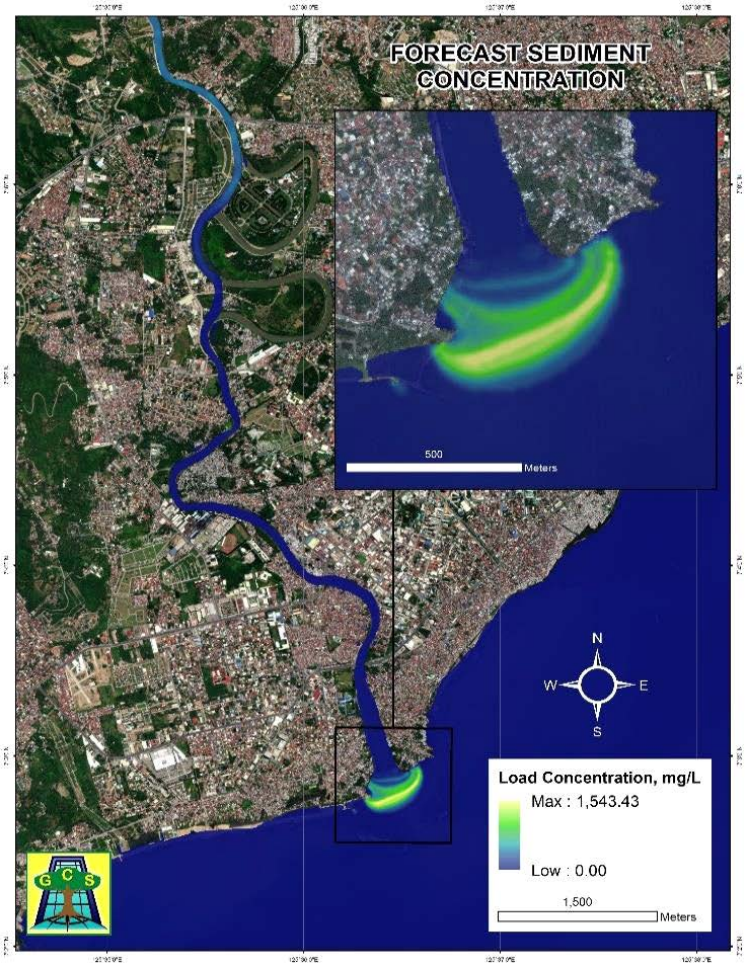
Source: NAMRIA

Figure 4.6.3 Risk of Erosion

Level of high turbid (TSS) water is forecasted possibly generated by the dredging work based on 2D HEC-RAS model. Level of high turbid water depends on scale of dredging work and river condition; the biggest impact case was simulated. Trend of concentration of the TSS from dredging point to downstream, and distribution pattern in the river mouth ware shown in Figure 4.6.4.



a) Trend of the concentration of the TSS



b) Distribution pattern of the TSS

Source: Project Team

Figure 4.6.4 Distribution pattern of the TSS

The highest concentration was shown 280m downstream; the High turbid water disappeared at the point of 0+018 station. No significant species, such as endangered aquatic biota observed at the Davao River mouth; and commercial fishing and recreation purposes are minor. Major fishing areas are located offshore; Fishermen move to other area depending on the weather and/or migration pattern of fish. It cannot be denied impact on recreation fishing and small-scale fishing in the river mouth; however, it could be mitigated by prior noticement of the construction schedule and public consultation with fishermen.

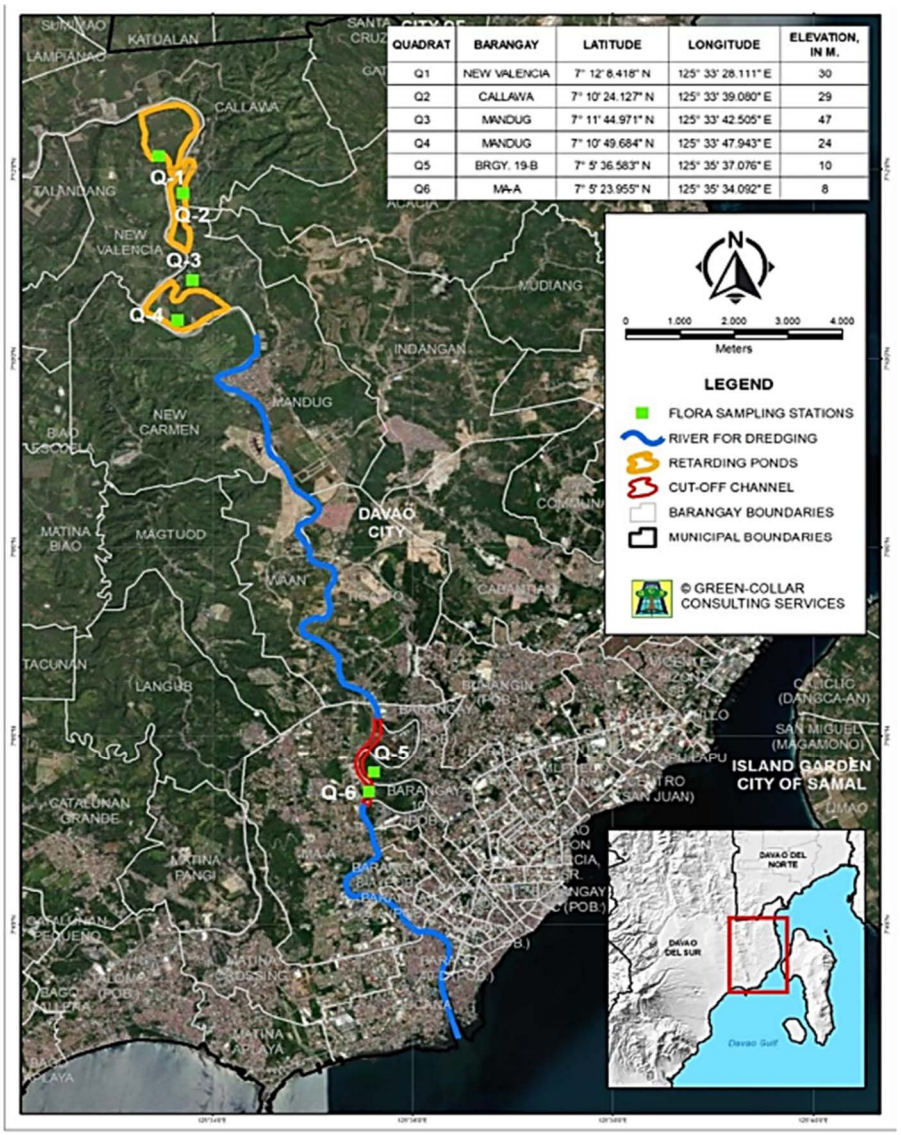
And water quality monitoring by the EMB occasionally record over 500mg/L of high TSS which might be caused by natural resources. It could be concluded that significant impact by the high TSS water could be limitted; however, it is possible to need control of generation of turbid water just in case.

(b) Protected Area, Ecosystem

Designated area of protected area, primary forest etc. is not observed near-by the Project area; the nearest protected area is Malagos Protected Land scape which is located around 15 km west of the retarding ponds as shown in Figure 2.2.4. The other important natural areas are Mt. Apo National Park and the protected forest in the northern Davao River; both are located far from the Project sites.

Dominant landuse at the retarding ponds area is agriculture in particular banana plantation. The area of cut-off work has been under urbanization, and occupied by banana plantation on the low are.

Investigation of the terrestrial flora and fauna was conducted at the six (6) locations (three (3) locations for fauna survey) as shown in Figure 4.6.5. Table 4.6.11 indicates location and method.



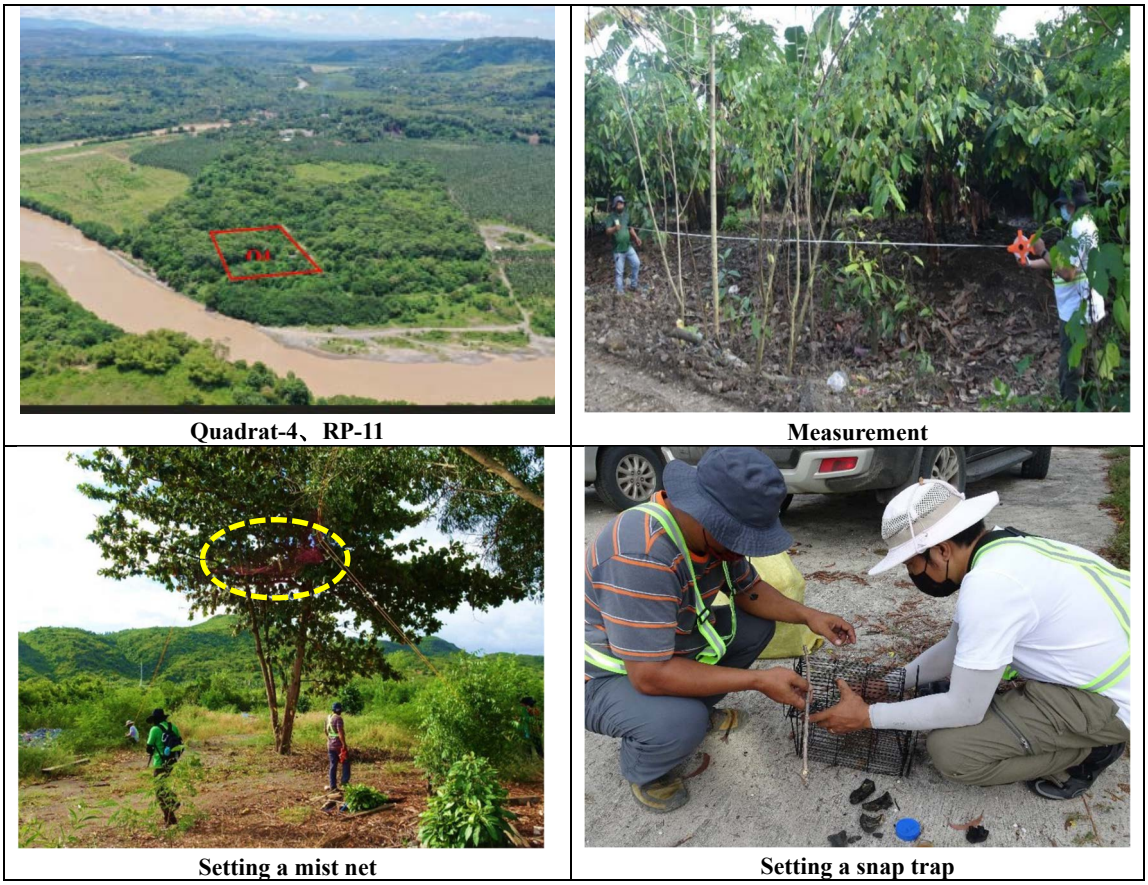
Source: Project Team

Figure 4.6.5 Sampling Location of Terrestrial Flora/ Fauna

Table 4.6.11 Sampling Location and Method of Terrestrial Flora/ Fauna Survey

Survey	Location	Methods
Terrestrial Flora	RP-8：Q-1（Brgy. New Carmen） RP-9：Q-2（Brgy. Caliawa） RP-11：Q-3、Q-4（Brgy. Mandug） COW：Q-5（Brgy. 19-B）、Q-6（Brgy. Ma-a）	Line Transect (2km)、 Quadrat (100m x 100m)
Terrestrial Fauna	RP-8：Q-1（Brgy. New Carmen） RP-11：Q-3（Brgy. Mandug） COW：Q-5（Brgy. 19-B）	Line transect (1 hr walking), mist nets、snap traps

Source: Project Team



Source: Project Team

Figure 4.6.6 Survey of terrestrial Flora/ Fauna

Flora

Most of the land for the retarding ponds is occupied by agricultural purposes; banana cassava, durian, mango, coconut, cacao coffee, etc. have been planted. Few endemic species were found. The land for the cut-off works is used as tourist zone (Crocodile Park) and banana plantation. Few green area or open space have been observed along the Davao River downer stream from this area.

The most observed flora was moracea with 73 species, and then euphorbiaceae and fabaceae with 13 species and 11 species respectively. Others were ferns, palms, etc. observed; total of 168 species of flora were observed.

16 species of the above are endemic flora as listed in Table 4.6.12. Those plantations will be demolished before construction.

Table 4.6.12 Philippine Endemic Flora

Common name		Scientific Name	Species	IUCN category[1)]	Location Observed[2)]
1	Mangapaho	*Mangifera monandra*	Anacardiaceae	NT	RP 9
2	Pugahan	*Caryota cumingi*	Arecaceae	DD	RP 9, Bet RP 9 & 11
3	Tree fern/Anotong	*Cyathea contaminans (Hook.)*	Cyatheaceae	LC	RP 9, Bet RP 9 & 11
4	Katmon	*Dillenia philippinensis*	Dilleniaceae	NT	RP 8, RP 9, COW
5	Hamindang	*Macaranga bicolor*	Euphorbiaceae	LC	RP 11, COW
6	Narra	*Pterocarpus indicus*	Fabaceae	EN	All stations
7	Barobo	*Diplodiscus paniculatus Turc*	Malvaceae	LC	RP 8, RP 11
8	Antipolo	*Artocarpus blancoi*	Moraceae	LC	RP 8, Bet RP 9 & 11, COW
9	Anubing	*Artocarpus cumingiana*	Moraceae	-	RP 8, RP 11
10	Kamansi/Rimas	*Artocarpus communis*	Moraceae	-	All stations
11	Is-is	*Ficus odorata*	Moraceae	LC	RP 8, Bet RP 9 & 11, COW
12	Niyog-niyogan	*Ficus pseudopalma*	Moraceae	-	All stations
13	Hambabalud	*Neonauclea formicaria*	Rubiaceae	LC	RP 8, Bet RP 9 & 11, COW
14	Kahoi Dalaga	*Mussaenda philippica Merr*	Rubiaceae	LC	RP 8, Bet RP 9 & 11, RP11, COW
15	Molave	*Vitex parviflora*	Verbenaceae	LC	RP 8
16	Tagbak	*Kolowratia elegans*	Zingiberaceae	-	RP9 and bet RP9 and 11

1) LC: least concern, NT: near threatened, DD: data deficient, EN: endangered
2) RP8, 9, 11: Retarding Ponds, COW: Cut-off Works
Source: Project Team

Total of 91 species of flora have been registered as Philippine rare flora according to DAO No. 2017-11: ''The National List of Threatened Philippine Plants and their Categories'. Seven (7) species of them were observed in the Project area as listed in Table 4.6.13. The most of those flora are planted by the communities; wild ones were not found.

Table 4.6.13 Rare Flora

No	Common Name	Scientific Name	Species	Conservation Status[1)]	IUCN Category	Location
1	Tree Fern/ Anotong	*Cyathea contaminans (Hook.)*	Cyatheaceae	Category B-Endangered	-	RP 8, RP 9
2	Molave	*Vitex parviflora*	Verbenaceae	Category B-Endangered	LC	RP 8
3	Dao	*Dracontomelon dao*	Anacardiaceae	Category C-Vulnerable	LC	RP 8
4	Mangapaho	*Mangifera monandra*	Anacardiaceae	Category C-Vulnerable	NT	RP 8
5	Manila Palm	*Adonidia merrillii*	Arecaceae	Category C-Vulnerable	-	Bet RP 9 and 11, RP 11
6	Narra	*Pterocarpus indicus*	Fabaceae	Category C-Vulnerable	EN	All stations
7	Anahaw	*Saribus rotundifolius*	Arecaceae	Category D-Other Threatened Species	-	RP8, bet RP 9 and 11

1) DAO No. 2017-11
Source: Project Team

Animal

Table 4.6.14 lists animals to be observed.

Table 4.6.14 Animals

Family	Scientific name	Common name	IUCN Category[1)]	Number of Animals			
				RP 8 s1	RP11 s2	COW s3	Total
Flying Animal							
Pteropodidae	*cynopterus brachyotis*	Lesser short-nosed fruit bat	LC	4	24	5	33
Pteropodidae	*Eonycteris robusta*	Philippine dawn bat	NT	0	6	3	9
Pteropodidae	*Ptenochirus jagori*	Greater musky fruit bat	LC	1	7	3	11
Pteropodidae	*Ptenochirus minor*	Lesser musky fruit bat	LC	2	5	3	10
Non-flying Animal							
Muridae	*Rattus tanezumi*	Tanezumi rat	LC	5	2	1	8
Total				12	44	15	71

1) LC – least concern, NT – near threatened

Source: Project Team

Five (5) species of fruit bats and one (1) species of muridae were observed. One (1) fruit bat of them, Eonycteris robusta, is registered as NT (near threatened) in IUCN category. The animals were the most abundant in RP-11, counted for 44 individuals. The bats were also found in the cut-off works area, counted for 14 individuals.

13 families, 18 species and total of 235 individuals of birds were observed in the Project area as shown in Table 4.6.15. The birds were also the most abundant in RP-11, half of individuals were observed.

Table 4.6.15 List of Birds

Family	Species	Scientific name	IUCN Category	Number of individuals			
				RP8 S1	RP11 S2	COW S3	Total
Accipitridae	Brahminy Kite	*Haliastur indus*	LC	0	1	1	2
Alcedinidae	White collared kingfisher	*Todiramphus chloris*	LC	3	5	4	12
Artamidae	White-breasted woodswallow	*Artamus leucorynchus*	LC	11	20	18	49
Columbidae	Asian Emerald Dove	*Chalcophaps indica*	LC	0	2	0	2
	White-eared Brown Dove	*Phapitreron leucotis*	LC	2	7	5	14
	Zebra dove	*Geopelia striata*	LC	1	5	2	8
	Spotted dove	*Spilopelia chinensis*	LC	0	4	3	7
Corvidae	Large-billed Crow	*Corvus macrorhynchos*	LC	1	3	2	6
	Slender-billed Crow	*Corvus enca*	LC	0	2	1	3
Hirundinidae	Barn swallow	*Hirundo rustica*	LC	0	17	5	22
Laniidae	Brown Shrike	*Lanius cristatus*	LC	3	7	5	15
Muscicapidae	Philippine magpie-robin	*Copsychus mindanensis*	LC	3	6	4	13
Nectariniidae	Olived backed sunbird	*Cinnyris jugularis*	LC	4	7	6	17
Oriolidae	Black naped oriole	*Oriolus chinensis*	LC	1	4	2	7
Pycnonotidae	Yellow-vented Bulbul	*Pycnonotus goiavier*	LC	2	5	3	10
	Philippine Bulbul	*Hypsipetes philippinus*	LC	1	1	1	3
Rhipiduridae	Philippine Pied-Fantail	*Rhipidura nigritorquis*	LC	3	7	5	15
Sturnidae	Asian Glossy Starling	*Aplonis panayensis*	LC	6	15	9	30
Total				41	118	76	235

Source: Project Team

The most observed birds were artamidae which occupied 20% of individuals. The Philippine Eagle, National bird of the Philippines was not obserbed in the project area.

As the other fauna, the following three (3) species of Amphibia were observed; one of them, Giant Philippine Frog, is categorized as NT in IUCN category.

Table 4.6.16 Amphibia

Family	Species	Scientific Name	IUCN Category	Number of Individuals to be observed			
				RP 8 S1	RP 11 S2	COW S3	Total
Bufonidae	Cane Toad	*Rhinella marina*	LC	5	6	7	18
Dicroglossidae	Giant Philippine frog	*Limnonectes magnus*	NT	2	5	8	15
Rhacophoridae	Common tree frog	*Polypedates leucomystax*	LC	1	2	4	7
Total				8	13	19	40

Source: Project Team

Pictures of typical fauna are below:

Philippine dawn bat

White-breasted woodswallow

Giant Philippine frog

Source: Project Team

Figure 4.6.7 Typical Fauna to be observed

Survey on aquatic biota (macroinvertebrate, plankton) was undertaken at the same location of those on water quality measurement. The results are listed in Table 4.6.17 and Table 4.6.18.

Table 4.6.17 Macroinvertebrate

Species	Scientific Name	IUCN Category	Number of individuals			
			Mandug	Waan	Ma-a	Bucana
Diogenidae	*Calcinus* sp.	--	0	0	0	4
Diogenidae	*Clibanarius* sp.	--	0	0	0	5
Ephemeridae	Unidentified mayfly species	--	1	0	0	0
Gerridae	*Limnogonus* sp.	--	4	0	0	0
Veliidae	*Rhagovelia philippina*	--	5	0	0	0

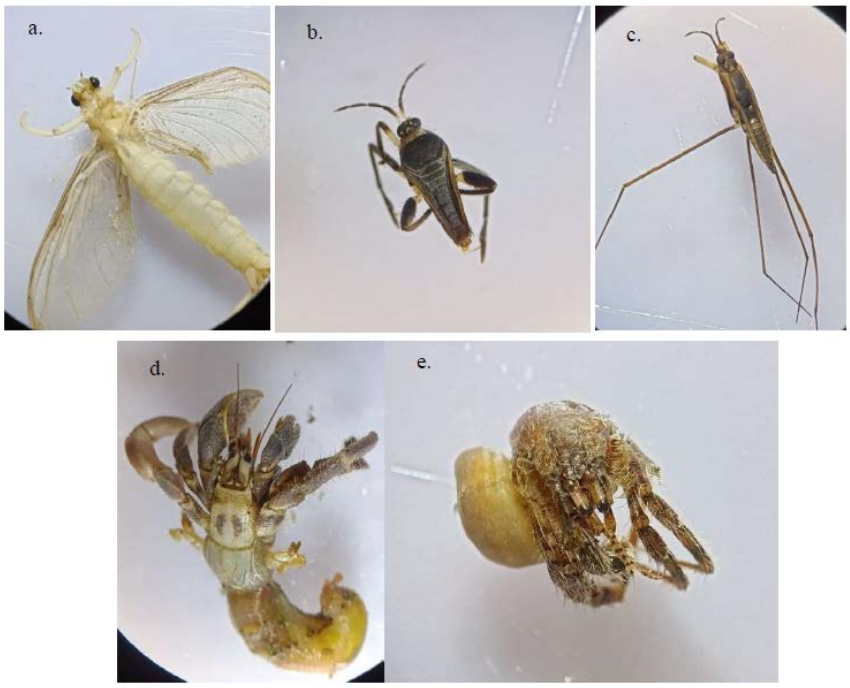
Source: Project Team

Table 4.6.18 Plankton

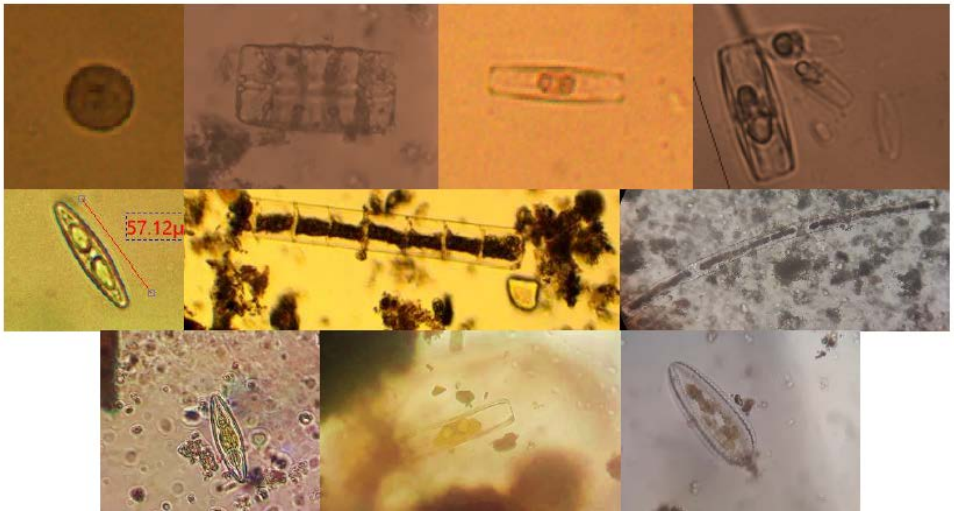
Species	Scientific Name	Number of Cells (cells/mL)			
		Mandug	Waan	Ma-a	Bucana
Bacillariophyta	*Cyclotella* sp.	10	5	5	0
	Diasdesmis sp.	0	0	42	0
	Diatoma sp1.	24	43	0	0
	Diatoma sp2.	122	0	0	0
	Diatoma vulgaris	23	15	0	0
	Meloseria sp.	76	0	0	0
	Meloseria virans	15	0	0	0
	Navicula sp.	12	3	10	42
	Pinnularia normanii	0	16	2	0
	Synura sp.	5	0	23	0
Cyanophyta	*Microcystis aeruginosa*	16	166	244	455
	Microcystis flos-aqaue	6	77	422	423
	Microcystis wesenbergii	2	89	131	422
Total		311	414	879	1342

Source: Project Team

Because of rain a day before of the survey, only five (5) species of macroinvertebrate were confirmed. Number of species of plankton which were confirmed was 13 species consist of bacillariophyta, cyanophyta; however, number of cells was relatively low.

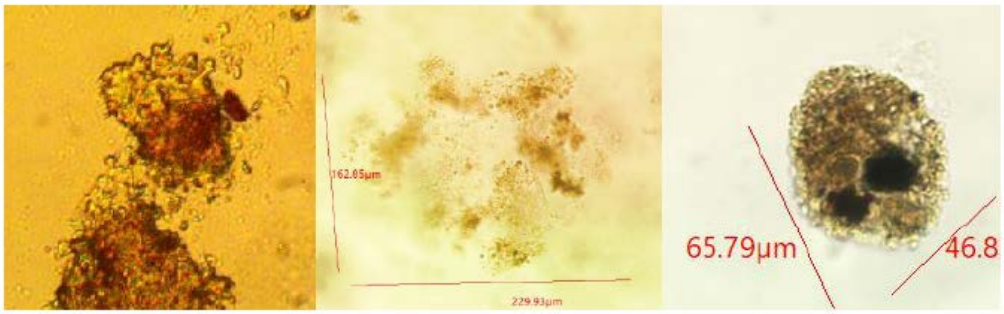


a. Unidentified mayfly species
b. Rhagovelia philippina
c. Limnogonus sp.
d. Clinabarius sp.
e. Calcinus sp.



(1) From right to left (top): *Cyclotella sp., Diasdesmis sp., Diatoma sp1., Diatoma sp2.*
(2) From right to left (middle): *D. vulgaris., Meloseria sp., M. virans.,*
(3) From right to left (bottom): *Navicula sp., Pinnularia normanii., Synura*
Source: Project Team

Figure 4.6.8 Aquatic Macroinvertebrate to be Confirmed



From right to left: *Microcystis aeruginosa., M. wesenbergii, M. flos aqaue*
Source: Project Team

Figure 4.6.9 Plankton to be Confirmed

Since the rain fell one day before the survey; nekton was not caught. The major nekton in the Project area is eel (Anguilla sp), carp, (Cyprinus sp.), tilapia (Oreochromis sp.), freshwater shrimp (Macrobrachium sp.), etc.

A few species of endemic and/or endangered fauna/ flora were confirmed; however, it could be said that ecosystem in the Project area is ordinary and popular which observed in/ around Davao City. Wise use of retarding ponds for restoration of ecosystem is recommendable. No coral reef is confirmed in the river mouth.

Major fish to be observed in the Davao River is listed as below:

Table 4.6.19 Main Fish observed in the Project Area

Name in the Project Area	English Name	Scientific Name	IUCNCategory[1)]
Karpa	Carp	*Cyprinus carpio carpio*	LC
Tilapia	Tilapia	*Oreochromis niloticus*	LC
Kasili	Asian eel	*Anguilla bicolor*	NT
Pantat	Walking catfish	*Clarias batrachus*	LC
Salmonete	Goatfish	*Upeneus moluccensis*	-
Talakitok	Barred queenfish	*Scomberoides tala*	LC
Bogaong	Silver perch	*Leiopotherapon plumbeus*	VU
Gisaw	mullet	*Mugil cephalus, Linn.*	LC
Aliling	Golden trevally	*Gnathanodon speciosus*	-
Padpad	Gangetic sleeper	*Odonteleotris macrodon*	LC
Sapsap	Slipmouth fish	*Leiognathus fasciatus*	-

1) LC: least concern, NT: near threatened, VU: vulnerable
Source: Project Team

The fish designated in the IUCN is Silver Perch (VU), Asian eel (NT) and Tilapia, well known as one of the farmed fish, (LC).

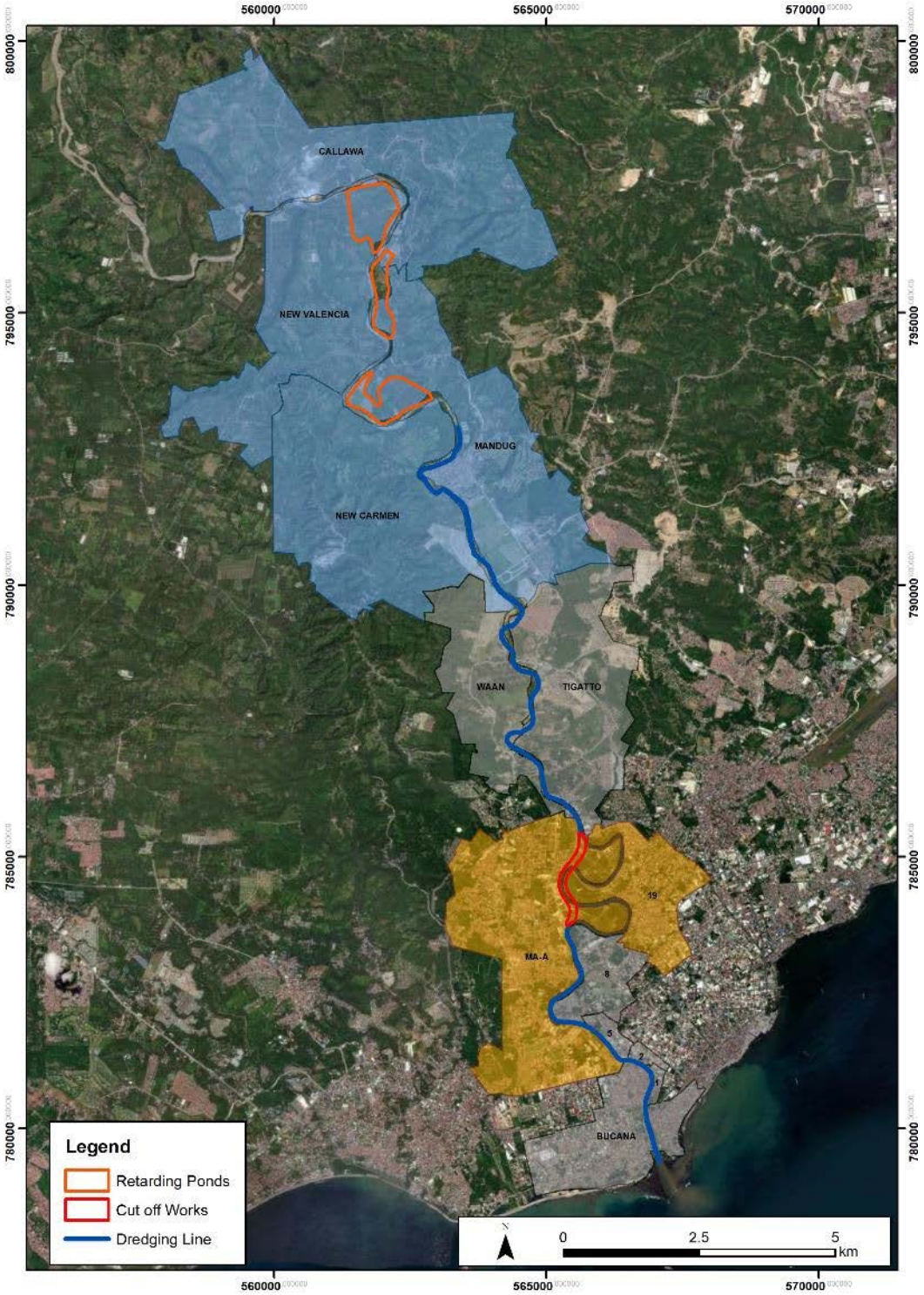
Silver Perch usually moves between river mouth and coast area; therefore, it can escape from the high turbid area caused by the dredging activity; Asian Eel mainly lives upper stream than the location of the planned retarding ponds. That is why, it is assumed that the Project site is out of sensitive habitats of this fish.

During the early 2000, the fishing was frequently taken. However, later as the water is becoming turbid, the fishing fishing production has decreased because of worsening turbidity. After the pandemic, no more fishing activity was done. Recreation fishing has been occasionally observed near the river mouth; mullet, sometimes silver perch are caught.

3) Social Environment

(a) Population

Total of 13 barangay are located in the Project area as shown in Figure 4.6.10; four (4) barangay (New Valencia, Callawa, Mandug and New Carmen) are in the area of retarding ponds; and two (2) barangay (Ma-a and 19-B) are located in the area of cut-off works.



Source: CPDO

Figure 4.6.10 **Barangay in the Project Area**

Population characters of each barangay are shown in Table 4.6.20.

Table 4.6.20 Population in Each Barangay

Barangay	Landuse Character	Population[1)]	Household Number[1)]	Area (ha)	Population Density (person/ha)
New Valencia	Rural	1,679	420	954.12	2
Callawa	Rural	3,553	888	1354.75	3
Mandug	Urban	13,594	3,399	969.19	14
New Carmen	Rural	2,626	657	1,107.90	2
Tigatto	Urban	36,387	9,097	761.31	48
Waan	Rural	3,925	981	436.97	9
Ma-a	Urban	59,803	14,951	999.38	60
Barangay 19-B	Urban	31,766	7,942	362.55	88
Barangay 8-A	Urban	11,075	2,769	179.80	62
Barangay 5-A	Urban	11,436	2,859	38.10	300
Barangay 2-A	Urban	3,589	897	16.38	219
Barangay 1-A	Urban	3,103	776	15.355	202
Barangay 76-A	Urban	83,964	20,991	410.51	205

1) PSA 2015 census
Source: CPDO

Average of population density of the four (4) barangays at the retarding ponds area and two (2) barangay at the cut-off works area are 5 pax/ha and 67 pax/ha respectively. Population density of the barangay in the downstream of the area of riverbed dredging is over 200 pax/ha.

(b) Landuse

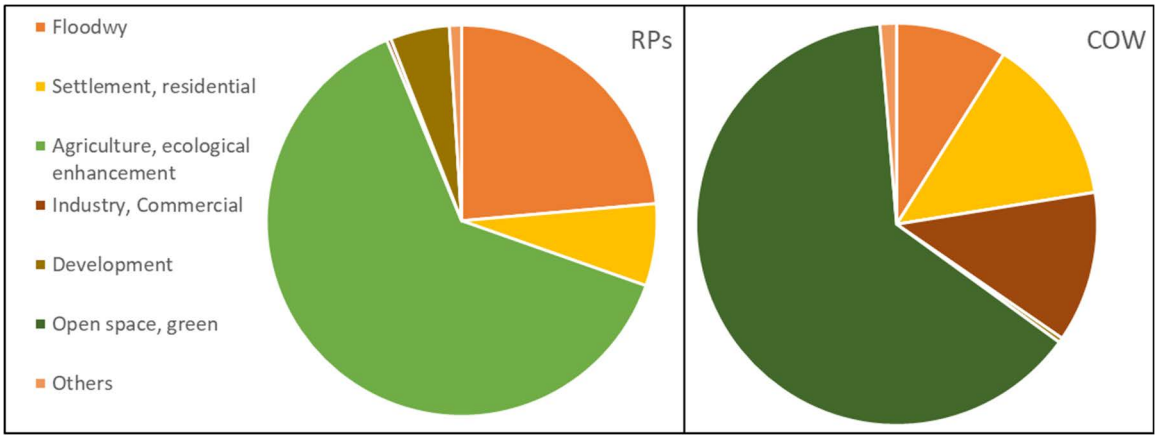
Table 4.6.21 summarizes current land use of six (6) barangay which face on the retarding ponds and cut-off works; and Figure 4.6.11 illustrates composition of landuse of retarding ponds and cut-off works area each.

Table 4.6.21 Current Landuse of each Barangay

Unit: ha

Barangay / Landuse	New Valencia	Callawa	Mandug	New Carmen	Ma-a	19-B
Floodwy	176.31	546.64	212.1	100.07	230.549	88.06
Settlement	74.43	17.15	140	66.02	367.622	113.63
Agriculture	703.38	790.96	411.39	872.84		
Industry, Commercial				15.42	277.536	154.79
Development			200.9	14.12	13.824	
Open space, green					2,268	0.1
Others			4.81	39.46	41.611	5.98

Source: CPDO



Source: CPDO

Figure 4.6.11 Current Landuse in the RPs and COW area

Retarding ponds area is located in the rural area; over 60% of the land is used as agriculture purposes. On the other hand, two (2) barangay which face to cut-off works area are occupied 60 % of green area (most of the green area is western part of barangay and located far from the Project area. Next residential zone and commercial zone occupy 13% and 12% of the land respectively.

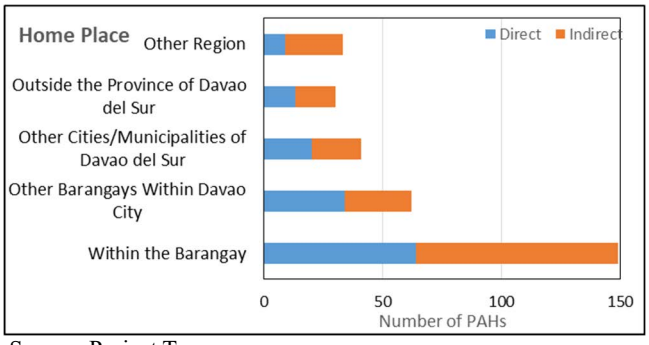
(c) Socio Economic Condition of the Project Affected Households (Interview Survey)

Interview survey was conducted with target of direct PAHs (with in approx. 1km from the Project site) and indirect PAHs in order to identify socio economic profile of the PAHs. Numbers of interviewees were 140 HHs for direct PAPs, 175 HHs for indirect PAHs, and then total of 315 HHs. 65% of responds was by women.

Home Place

As shown in Figure 4.6.12, half of PAPs have been born and grown up in the same place. 80% of PAPs come from South Davao Province. Average of duration of residing is around 25 years. In addition, approximately 17% of PAHs is single household; those are younger generation and recently migrated.

Ethnic profile shows around 65% of PAPs are Davaoeño, and next Boholano occupies approx. 6%. Ten (10) PAHs expressed their ethnicity as IPs; they are Kagan community who have resided south part of cut-off works area; their religious status is Muslim. 72% of PAPs interviewed are Roman Catholic.



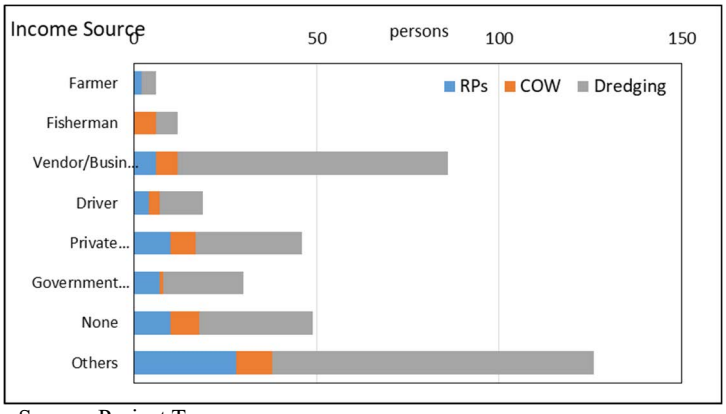
Source: Project Team

Figure 4.6.12 Home Place

Average number of family member is around 5 persons/HH; it was slightly bigger size than the data based on the census, approx. 3 persons/HH.

Income Source

Figure 4.6.13 describe major income sources for each project component. The biggest share was small shops such as vendors which occupies 23% of total PAPs; then private employees share 12% next. Fishermen have resided in the down stream; they go offshore for fishing.

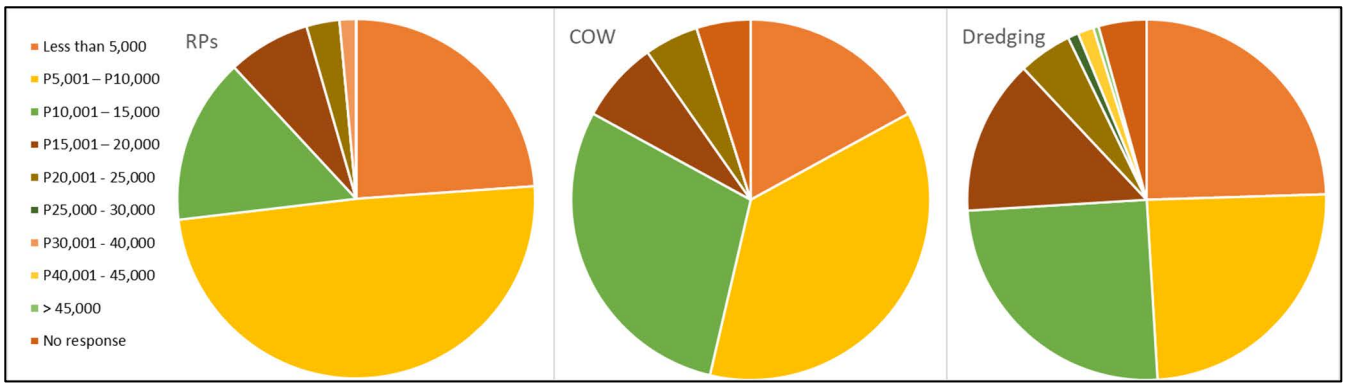


Source: Project Team

Figure 4.6.13 Income Source

70% of agricultural workers are employees; the landowners are residing in other places. Scale of agricultural land is less than 2ha; it occupies approx. 78% of farmers. And approx. 35% of farmers has the land less than 1h. Major production is banana, and coconuts in the retarding pond area. Income of approx. 30% of farmers is less than PHP 5,000 per month. It was observed to plant mango in the downstream area; those are not commercial level; consumed by local residences.

Figure 4.6.14 illustrates income level per each component. Income of the half of PAHs in the cut-off work and drainage (downstream) area and over 70% of that in the retarding area is less than PHP 10,000 per month; it is poor level. On the other hand, some PAHs in the downstream area have higher income level over PHP 40,000 per month.



Source: OCPD

Figure 4.6.14 Family Income Level of PAHs by Component

Houses

Approx. 80% of PAHs interviewed own their houses and rest is renting. Approx. 38% of houses have been built less than 10 years, while approx. 25% is over 30 years.

Major materials of houses are corrugated-iron (for roof, almost all) and cement (for wall, 48%). Near 100% of PAHs have sceptic tank. 60% of PAHs use piped water; the service has been increasing year by year. Around half of PAHs use wood or charcoal in the kitchen; this situation was found higher in rural area. Electricity service totally covers all the area.

Education, etc.

In general, Philippine families give high attention to children's education; only less than 2% of PAPs have not been given basic education due to financial problem. 55% of PAPs have been educated high school education; while less than20% of them have been got university/ college education.

Health services are sufficiently provided; while 30% of patients use self-treatment or traditional doctors;

this situation is popular in rural area.

51% of PAHs use City waste collection network; on the other hand, 7% of garbage in the rural area is treated by each household mostly by incineration. Recycle of compositing shares around 5%.

Information, Communication

Major sources of information are through TV, mobile phone, LGUs sharing 27%, 22% and 20% respectively. Around 40% of communities are involved in social groups; the most involved are women group and senior group with 34% and 30% respectively.

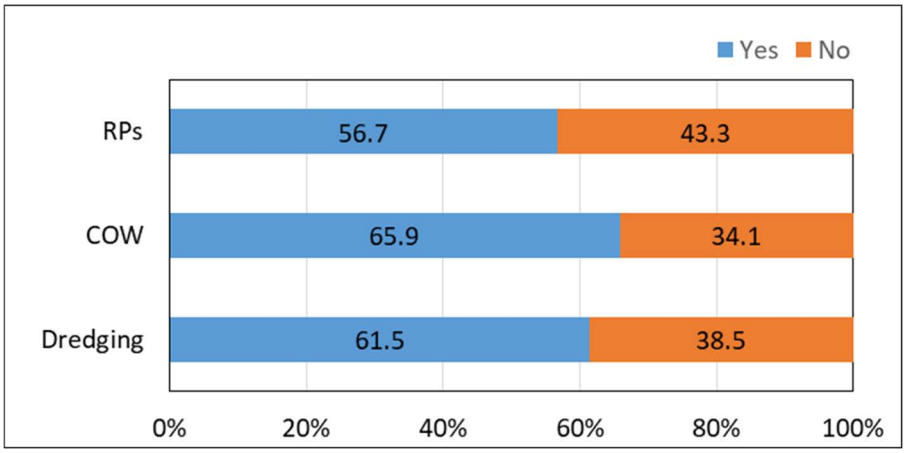
Local Issues

They have highlighted the following local issues;

- Floods (30)
- Landslide (13%)
- Employment (12%) and
- Education

(d) Perception on the Project

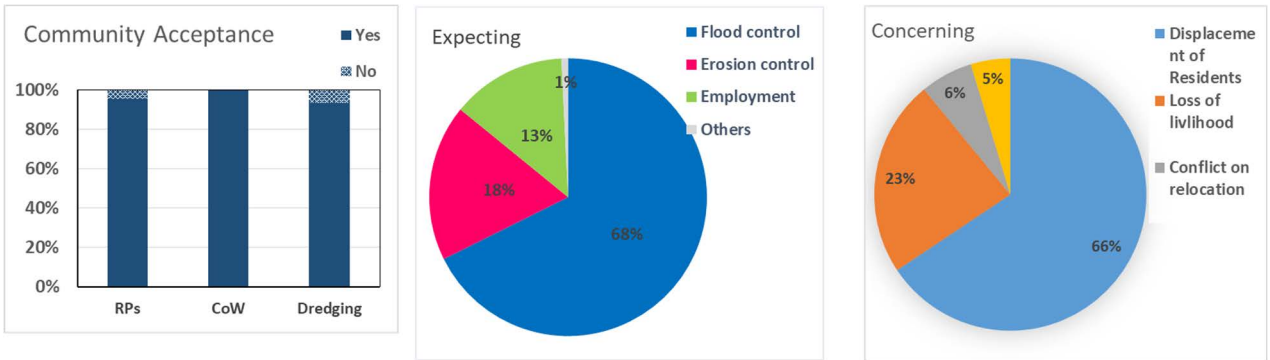
Over half of PAPs had known about flood control plan by the DPWH as shown in Figure 4.6.15. Mostly they were informed through barangay.



Source: Project Team

Figure 4.6.15 Perception about the Project Components

As shown in Figure 4.6.16, all PAPs generally have agreed with the Project. They have expected reduction of flood (68%), reduction of landslide (18%) and increase of job chance (13%).



Source: Project Team

Figure 4.6.16 Reasons of Acceptance and Non-acceptance

On the other hand, Half of PAPs in the cut-off work area expressed negative concerns about resettlement. They expressed demands to the LGUs for "sufficient compensation and support" and "Provision of relocation sit" those shared 98% of demands.

4) Indigenous People

The Project site is located out of the ancestral domains as shown in Figure 2.3.4.

On the other hand, it was found the Kagan who is the one of the Muslim groups residing in the Davao city. Originally, they had resided in mountainous area or costal area (Toril, e.g.); some of them had been transferring into the City area, for example Barangay Ma-a, Magsaysay etc.

The following table indicates an evaluation of Kagan in Ma-a whether or how much they are designated as IPs based on the World Bank Operation Manual, OP 4.10: [Indigenous Peoples].

Table 4.6.22 Evaluation Based on the World Bank Guideline OP 4.10

Condition		Evaluation
1	Self-identification as members of a distinct indigenous cultural group and recognition of this identity by others;	They have their own identity as Kagan and/or Muslim; and Citizens around their community know their identity. However, they do not express their tradition in their daily life; they appeal their tradition in some specific case such as Davao festival (Kadayawan). It was observed other groups such as cthoric, non-muslim, and also ordinal Philippine groups have resided together to have one community group.
2	Collective attachment to geographically distinct habitats or ancestral territories in the project area and to the natural resources in these habitats and territories	They do not have own ancestral domain land, and local natural resource. Their major income sources are manual labor and small business which share over 70% of PAHs.
3	Customary cultural, economic, social, or political institutions that are separate from those of the dominant society and culture; and	They have a community leader; but their life and social/ legal system rely on ordinal Philippine system. Less particular difference between Kagan and ordinal peoples.
4	An indigenous language, often different from the official language of the country or region.	They seem to have own language; however usually they use Visaya or Tagalog. Children access the same education as ordinal Philippine children.

Source: Project Team

The above evaluation could conclude that they are not a particular community with a daily lifestyle centered on traditional and unique culture which are isolated form the ordinal Philippine system. In general term of "Kagan" is the one of the sub-groups of the "Kalagan"; while Davao City has declared in the ordinance that they are "Kagan" not "Kalagan" in order to set them apart from other Kalagan group.

NCIP took a field-based investigation (FBI) with consultation as a Pre-FPIC (Pre- free prior and informed consent); and it was resulted that they are not IPs who have an ancestral domains land and been isolated from the ordinal Philippine tradition, custom, political/ legal system.

Upon this decision, Certificate of Non-Overlap (CNO) will be issued; and an IPAP will not be required.

However, it is fact that Kagan in Ma-a is relatively poor and categorized as ISFs, and they have strong community relation; special considerations, therefore, to keep the quality of their life are recommendable.

5) Gender Mainstreaming

As described in the section [2.3.1 Socio-economic Conditions, (7) Gender], Government of the Philippines, Davao City and DPWH have tackled on the improvement of Gender mainstreaming.

Based on the actions by the DPWH, Davao City and other related organizations through interview surveys and discussions, and through stakeholder meetings, it is summarized the expected contributions and points of concern from this project as below:

Benefit

- Local economy, transportation could be improved by mitigation of flood risk. It must lead local economy improvement, and then equal allocation of all benefit raised by the flood control to both male and female.
- In the same manner, improvement of local economy and life could enhance people, especially mother to think over education of their children. In addition, this situation could encourage enrichment education.
- Because of reduction of flood risk, and through support by government, NGOs, private sectors; people could pay more attention to improve quality of their life, to their awareness raising to environment.
- Basically, those benefits could be allocated to all project affected people regardless gender, age, handicapped, income level, etc.

Conflict

- Improper and/or shortage of compensation interrupts improvement of quality of their life.
- If some processes are skipped in the process of planning and implementation of the projects; sufficient flood control, proper allocation of the benefit would not be expected.
- If consistent policy in the planning, construction and operation stage is not properly given; sufficient effect and benefit by the project or balance allowance of the benefit may not be expected.

Those expectation, impacts and issues must affect to all people regardless gender, e.g. not only reduction of impact but also equal allocation of benefit shall be considered in the project. The followings are suggestions to pay attention to gender, handicapped, etc.:

1. Presence of criteria or prerequisites such as commitment of the leader, designated institution, agency or focal point, availability of skilled staff, availability of methods or technical approaches, availability of budget for the process, availability of an accountability mechanism, and involvement of the community.
2. Include women in the labor force and provide rightful income for them.
3. Ensure that the structures are user-friendly to children, women and vulnerable sectors.
4. Immediately provide income and employment opportunities to the affected families, in case of transfer. If possible, these opportunities are not far from where they used to live.
5. Monitoring of key sectoral concerns on gender equality, such as education, health, local economy, and environment and disaster management.

(7) Environmental Evaluation

The results of environmental evaluation explain in Table 4.6.23 to Table 4.6.25.

Table 4.6.23 Results of Environmental Evaluation (Riverbed Dredging)

Items	Scoping		Evaluation Results		Description of Evaluation Results
	Before/ During Construction	During Operation	Before/ During Construction	During Operation	
Air quality	✓		B-	N/A	Construction: Because most of the activities will be in the river; possible source of air pollution will be by construction equipment, dust during loading/ unloading, e.g., thus air pollution could be minor. Operation: No air pollution will be caused.
Water quality	✓		B-	N/A	Construction: Dredging work could cause turbid water, and then affect downstream. In addition, leachate from oil/ waste store might cause small pollution. Naturally concentration of TSS is high. The study resulted pollution of phosphate; however, the Project could not generate phosphate pollution. Operation: No water pollution will be caused.
Wastes	✓		A-	N/A	Construction: Plenty of dredged soil will be generated. Provision of disposal site must be one of the most significant issues. In case dredged soil contains toxic; treatment and disposal could be complicated. Operation: No waste will be caused.
Soil contamination	✓		B-	N/A	Construction: Contamination by waste, oil/ grease may be risk. Operation: The project will not generate soil contamination.
Noise and vibration	✓		B-	N/A	Construction: Because most of the activities will be in the river; noise/ vibration could be minor. Operation: No noise/ vibration pollution will be caused.
Subsidence			N/A	N/A	The project is not expected to cause land subsidence.
Odor			N/A	N/A	No odor is expected.
Protected areas			N/A	N/A	Any protected area is designated.
Ecosystem	✓		B-	N/A	Construction: Since project site has been used as agricultural land or vacant; less specific biota (endangered. Rare species under Red list, etc.) is not observed. However, it could not be denied affecting to ordinal ecosystem by turbid water generated by the dredging work. While common fishery resources have been observed near river mouth. Operation: No facilities nor activities which cause impact are anticipated.
Hydrology		✓	N/A	A+	Construction: Impacts will be negligible because the activity is inside of river area. Operation: Positive impact, reducing flood risk, is expected.
Geology/ Topography			N/A	N/A	Change of geology/ topography is not expected.
Involuntary resettlement			N/A	N/A	No resettlement is expected.
Poor/Vulnerable			N/A	N/A	Construction works will be inside of the river area.

Items	Scoping		Evaluation Results		Description of Evaluation Results
	Before/ During Construction	During Operation	Before/ During Construction	During Operation	
Indigenous Peoples/Minorities.			N/A	N/A	The project location is out of ancestral domains area; IPs group is not found.
Local economies			N/A	N/A	Construction works will be inside of the river area. Major fishing activities are taken offshore.
Water usage			N/A	N/A	River water is not used for water supply, fishing, and others.
Existing social infrastructures and services			N/A	N/A	Main activities are inside of river area.
Social institutions			N/A	N/A	Main activities are inside of river area.
Community severance			N/A	N/A	Main activities are inside of river area.
Cultural heritage			N/A	N/A	No such heritage is confirmed.
Local conflicts of interest			N/A	N/A	Main activities are inside of river area.
Utilization of land and local resources	✓	✓	B-	B-	Construction: Small scale sand mining has been taken in the river. On the other hand, provision of dredged materials to LGUs, communities, private, etc. is expected. Recerational fishing could be affected. Operation: affect to the sand mining activities.
Landscape			N/A	N/A	Main activities are inside of river area.
Gender	✓		D	N/A	No adverse impact on gender is expected by the Project, however, it shall be paid attention in the Project.
Children's rights	✓		D	N/A	No adverse impact on children's rights is expected by the Project, however, it shall be paid attention in the Project.
Infectious diseases			N/A	N/A	Construction: Since number of workers is not large, and long continues construction at the one place is not expected; Base camp will not be built. Thus, risk of infectious disease could be negligible. Operation: Such impact will not occur.
Labor conditions	✓		N/A	N/A	Construction: Secure working environment shall be considered. Operation: The project will not affect labor condition.
Accidents	✓	✓	B-	D	Accident during dredging, storage/ transportation of soil waste in both construction and maintenance stages.
Global warming			N/A	N/A	No action and facilities causing GHG.

✓means certain impacts is expected; need further investigation.
A+/－ : Significant positive/ negative impact is expected.
B+/－ : A certain positive/ negative impact is expected.
C : Level of impact is not clear, further investment is necessary.
D : Impact level is less or negligible.
N/A: No impacts were expected in the scoping, and the environmental study resulted "no impact".
Source: Project Team

Table 4.6.24 Results of Environmental Evaluation (Retarding Ponds)

Items	Scoping		Evaluation Results		Description of Evaluation Results
	Before/ During Construction	During Operation	Before/ During Construction	During Operation	
Air quality	✓		B-	N/A	Construction: Some adverse impacts are expected due to emissions of air pollutants by heavy machinery and vehicles and dust caused by excavation works and transportation construction materials, earth and sand, etc. However, the extent of impacts will be limited to the construction site and its proximity and only during construction period. Operation: Air pollution by the Project would be negligible.
Water quality	✓		B-	N/A	Construction: Dredging work could cause turbid water, and then affect downstream. In addition, leachate from oil/ waste store might cause small pollution. Naturally concentration of TSS is high. The study resulted pollution of phosphate; however, the Project could not generate phosphate pollution. Operation: No water pollution will be caused.
Wastes	✓		A-	N/A	Construction: Plenty of dredged soil will be generated. Provision of disposal site must be one of the most significant issues. In case dredged soil contains toxic; treatment and disposal could be complicated. Operation: No waste will be caused.
Soil contamination	✓		B-	N/A	Construction: Contamination by waste, oil/ grease may be risk. Operation: The project will not generate soil contamination.
Noise and vibration	✓		B-	N/A	Construction: Some adverse impacts are expected due to the operation of heavy machinery and vehicles and excavation works. However, since the construction site is in rural area; the impact could be minor. Operation: No noise/ vibration disturbance is expected.
Subsidence	✓		D	N/A	Construction: Risk of subsidence might be minor; and it could be prevented by ordinal measures. Operation: No activities or structures which accelerate subsidence are expected.
Odor			N/A	N/A	No odor is expected.
Protected areas			N/A	N/A	Any protected area is designated.
Ecosystem	✓		B-	N/A	Construction: some endangered fauna/ flora were confirmed (mostly LC in IUCN categorization). Narra is categorized as EN; it is planted by the communities, not wild. Ecosystem in the Project area is similar to that commonly observed in Davao City. It is, while, risk to affect to such ordinal ecosystem. Natural forest was not confirmed. Operation: New fauna/ flora habitats are expected if the RPs is not concreted.
Hydrology	✓	✓	B-	A+	Construction: Excavation work might affect drainage and underground condition. Operation: Positive impact, reducing flood risk, is expected.
Geology/ Topography	✓		D	N/A	Construction: The area is not on the geologically sensitive zone; however, engineering design must consider possible impact. Operation: The project will not affect geology/ topography.
Involuntary resettlement	✓		B-	N/A	Number of resettlements is only one (1) HHs (see 4.6.3 in detail)
Poor/Vulnerable	✓		B	N/A	Construction: Slum area or residential area of informal settlers are not found. Employee for agriculture would lose job chance. Operation: The project will not cause impact to residents.
Indigenous Peoples/Minorities.			N/A	N/A	The project location is out of ancestral domains area; IPs group is not found.
Local economies	✓		B-	N/A	Construction: Agricultural activity would be affected; while, agricultural workers are seasonally recruited so that impact could be limitted. Traffic disturbance caused by loading/

Items	Scoping		Evaluation Results		Description of Evaluation Results
	Before/ During Construction	During Operation	Before/ During Construction	During Operation	
					unloading of construction material/ waste would affect local economy along the mobilization route. Operation: The project will not cause impact to local economy.
Water usage			N/A	N/A	The project will not affect water use.
Existing social infrastructures and services	✓		B-	N/A	Construction: Excavation work will lead demolition of local roads, underground infrastructure. Loading/ unloading of equipment/ sol waste might cause traffic disturbance along the mobilization rout. Operation: The project will not cause impact to existing social infrastructure and service.
Social institutions	✓		D	N/A	No impacts on local decision making or social institutions are caused by the project, however considerations will be paid on public consultation methods while understanding their decision-making process and social institutions.
Community severance			N/A	N/A	No adverse impacts are expected.
Cultural heritage			N/A	N/A	No such heritage is confirmed.
Local conflicts of interest			N/A	N/A	Local conflict would be negligible.
Utilization of land and local resources	✓		B-	N/A	Construction: Farmland will be lost. Operation: The project will not cause impact to use of land.
Landscape			N/A	N/A	Beneficial landscape for tourism resource is not confirmed. Structural design shall consider harmonization with surroundings.
Gender	✓		B-	N/A	No adverse impact on gender is expected by the Project, however, it shall be paid attention in the Project.
Children's rights	✓		B-	N/A	No adverse impact on children's rights is expected by the Project, however, it shall be paid attention in the Project.
Infectious diseases	✓		B-	N/A	Construction: Increase of workers, and in case of base camp may cause risk. Operation: Mosquito bleeding at water remains after flood could cause increase of infectious disease risk.
Labour conditions	✓		B-	N/A	Construction: Secure working environment shall be considered. Operation: The project will not affect labor condition.
Accidents	✓	✓	B-	B-	Construction: Accident prevention at construction sites, as well as prevention of traffic accident at transportation of materials and equipment is needed. Operation: Accident during water stored
Global warming			N/A	N/A	No action and facilities causing GHG.

✓means certain impacts is expected; need further investigation.
A+/－ : Significant positive/ negative impact is expected.
B+/－ : A certain positive/ negative impact is expected.
C : Level of impact is not clear, further investment is necessary.
D : Impact level is less or negligible.
N/A: No impacts were expected in the scoping, and the environmental study resulted "no impact".
Source: Project Team

Table 4.6.25 Results of Environmental Evaluation (Cut-off Works)

Items	Scoping		Evaluation Results		Description of Evaluation Results
	Before/ During Construction	During Operation	Before/ During Construction	During Operation	
Air quality	✓		B-	N/A	Construction: Some adverse impacts are expected due to emissions of air pollutants by heavy machinery and vehicles and dust caused by excavation works and transportation construction materials, earth and sand, etc. However, the extent of impacts will be limited to the construction site and its proximity and only during construction period. Operation: Air pollution by the Project would be negligible.
Water quality	✓		A-	N/A	Construction: Dredging work could cause turbid water, and then affect downstream. In addition, leachate from oil/ waste store might cause small pollution. Naturally concentration of TSS is high. The study resulted pollution of phosphate; however, the Project could not generate phosphate pollution. Operation: No water pollution will be caused.
Wastes	✓		A-	N/A	Construction: Plenty of dredged soil will be generated. Provision of disposal site must be one of the most significant issues. In case dredged soil contains toxic; treatment and disposal could be complicated. Operation: No waste will be caused.
Soil contamination	✓		B-	N/A	Construction: Contamination by waste, oil/ grease may be risk. Operation: The project will not generate soil contamination.
Noise and vibration	✓		B-	N/A	Construction: Some adverse impacts are expected due to the operation of heavy machinery and vehicles and excavation works. No hospitals nor schools are found near new river area. Operation: No noise/ vibration disturbance is expected.
Subsidence	✓		D	N/A	Construction: Since main construction is excavation subsidence is not expected. Operation: No structures/ activities which lead subsidence will be installed.
Odor			N/A	N/A	No odor is expected.
Protected areas			N/A	N/A	Any protected area is designated.
Ecosystem	✓		B-	N/A	Construction: some endangered fauna/ flora were confirmed (mostly LC in IUCN categorization). Narra is one of the major flora; those are planted by the communities. Ecosystem in the Project area is similar to that commonly observed in Davao City. Operation: New fauna/ flora habitats are expected if the RPs is not concreted.
Hydrology	✓	✓	B-	A+	Construction: excavation work of new river area will cut drainage; therefore, its restoration is necessary. Operation: Positive impact, reducing flood risk, is expected.
Geology/ Topography	✓		D	N/A	Construction: The area is not on the geologically sensitive zone; however, engineering design must consider possible impact. Operation: The project will not affect geology/ topography.
Involuntary resettlement	✓		A-	N/A	Construction: Scale of resettlement counts for approx. 40 – 50 HHs (see Section 4.6.3 in detail). On-site relocation is proposed; While use of existing relocation site, land adjustment at the area of cut-off work (see section 3.17 in detail) would be another option. Continual coordination is recommended. Operation: No further resettlement is expected.
Poor/Vulnerable	✓		B-	N/A	Construction: Income level of Kagan Community is relatively low. Operation: The project will not cause impact to residents.
Indigenous Peoples/Minorities			N/A	N/A	Kagan has resided around the area of south-section of COW. They are one of IPs group in Davao City; however, since their territory is not ancestral domains; CNO (Certificate of Non-Overlap), which results the land is not designated ancestral domain land, are issued by the NCIP.
Local economies	✓		B-	N/A	Construction: Income restoring program for the PAHs especially Kagan will be necessary. Traffic disturbance caused by loading/

Items	Scoping		Evaluation Results		Description of Evaluation Results
	Before/ During Construction	During Operation	Before/ During Construction	During Operation	
					unloading of construction material/ waste would affect local economy along the mobilization route. Operation: New river channel could disturb traffic network.
Water usage			N/A	N/A	The project will not affect water use. Use of underground water is minor.
Existing social infrastructures and services	✓		B-	B-	Construction: Excavation work will lead demolition of local roads, underground infrastructure. Loading/ unloading of equipment/ sol waste might cause traffic disturbance along the mobilization rout. Operation: The project will not cause impact to existing social infrastructure and service.
Social institutions	✓		D	N/A	No impacts on local decision making or social institutions are caused by the project, however considerations will be paid on public consultation methods while understanding their decision-making process and social institutions.
Community severance	✓	✓	B-	D	Community split by new river area and especially relocation of Kagan communities shall be mitigated.
Cultural heritage			N/A	N/A	No such heritage is confirmed.
Local conflicts of interest	✓	✓	D	D	Operation: Some LGUs could be benefited from new land which leads economic enhancement and population increase, while others could be affected by loss of land.
Utilization of land and local resources	✓		B-	D	Construction: Change of land use may cause unbalance of benefit allocation. Operation: The project will not cause impact to use of land, etc.
Landscape	✓	✓	B-	B-	Since north-section of new river area faces at tourism spot (Crocodile Park); it is necessary to pay special attention to select constriction method and structural design to avoid interruption to those landscape.
Gender	✓		B-	N/A	No adverse impact on gender is expected by the Project, however, it shall be paid attention in the Project.
Children's rights	✓		B-	N/A	No adverse impact on children's rights is expected by the Project, however, it shall be paid attention in the Project.
Infectious diseases	✓	✓	B-	B-	Construction: Increase of workers, and in case of base camp may cause risk. Operation: Mosquito bleeding at water remains after flood could cause increase of infectious disease risk.
Labor conditions	✓		B-	N/A	Construction: Secure working environment shall be considered. Operation: The project will not affect labor condition.
Accidents	✓	✓	B-	B-	Construction: Accident prevention at construction sites, as well as prevention of traffic accident at transportation of materials and equipment is needed. Operation: Accident in the new river channel
Global warming			N/A	N/A	No action and facilities causing GHG.

✓means certain impacts is expected; need further investigation.
A+/－ : Significant positive/ negative impact is expected.
B+/－ : A certain positive/ negative impact is expected.
C : Level of impact is not clear, further investment is necessary.
D : Impact level is less or negligible.
N/A: No impacts were expected in the scoping, and the environmental study resulted "no impact".
Source: Project Team

(8) Proposed Environmental Managements and Cost

Proposed environmental managements for each component are summarized in Table 4.6.26 to Table 4.6.28. Mitigation cost will be generally a part of a contractor's construction cost; thus, it would be estimated in each implementation plan. As of now, it is estimated approximately PHP 160 million including wastewater treatment facility, operation cost of base camp, etc.

Table 4.6.26 Proposed Environmental Managements (Riverbed dredging)

Items	Mitigation Measures	Implementer	Supervisor
Construction			
Air quality	- Use least emission equipment to meet exhaust gas quality standards. - Regular maintenance and repair of equipment.	Contractor	DPWH、EMB
Water quality	- Store waste at designated area - Prevent leachate of toxic from waste, fuel oil etc. (ex. Cover with sheet, use a drum can, install side ditch to prevent leachate). - Schedule of dredging work, use silt curtain, e.g. - Install adequate toilet, drainage in the basecamp.	Contractor	DPWH、EMB
Waste	- Follow designated waste management by the Davao City. - Formulation and implementation of waste management plan. - Advance check of contamination of dredged/ excavated soil. - Encourage reuse/ recycle of waste.	Contractor	DPWH、Davao City
Noise and vibration	- Use least noise equipment. - Adequate maintenance and repair. - Adequate construction management. - Monitoring noise level.	Contractor	DPWH、EMB
Soil contamination	- Segragate storage of waste, toxic waste, oil, etc. - Prevention of leachate of toxic from waste and fuel oil by side ditch e.g., - Education to workers to follow working guideline.	Contractor	DPWH、Davao City
Ecosystem	- Investigate condition of aquatic flora/ fauna - Transfer benthos to the other area where dredging is completed if necessary	Contractor	DPWH, EMB、CENRO, Davao City
Utilization of land and local resources	- Prior information of the schedule to the sand mining workers, residents. - Encourage reuse of dredged soil - Support to sand mining activity.	Contractor, DPWH	DPWH, Davao City, Barangay
Labor conditions	- Pollution control. - Provision of PPE (personal protection equipment) - Awareness and education on labor environment and safety.	Contractor	DPWH, Davao City, Barangay
Accident	- Safety manual, training on accident - Install first-aid station, firefighting equipment. - Compliance traffic rule.	Contractor	DPWH, Davao City, Barangay
Operation			
Utilization of land and local resources	- Prior information of the schedule to the sand mining workers - Encourage reuse of dredged soil - Support to sand mining activity.	DPWH, Davao City	Davao City

Source: Project Team

Table 4.6.27 Proposed Environmental Managements (Retarding Ponds)

Items	Mitigation Measures	Implementer	Supervisor
Construction			
Air quality	- Use least emission equipment to meet exhaust gas quality standards. - Regular maintenance and repair of equipment. - Spread water during dry season. - Cover stored excavated soil with sheet to avoid dust spread.	Contractor	DPWH、EMB
Water quality	- Store waste at designated area - Prevent leachate of toxic from waste, fuel oil etc. (ex. Cover with sheet, use a drum can, install side ditch to prevent leachate). - Schedule of dredging work - Install adequate toilet, drainage in the basecamp.	Contractor	DPWH、EMB
Waste	- Cover with sheet or clos the lid to prevent spread. - Follow designated waste management by the Davao City. - Formulation and implementation of waste management plan. - Advance check of contamination of dredged/ excavated soil. - Secure adequate disposal site. - Encourage reuse/ recycle of waste.	Contractor	DPWH、Davao City
Noise and vibration	- Use least noise equipment. - Adequate maintenance and repair. - Traffic control and schedule to avoid nighttime near residential area. - Install sound barrier if necessary. - Adequate construction management. - Monitoring noise level.	Contractor	DPWH、EMB
Soil contamination	- Segragate storage of waste, toxic waste, oil, etc. - Prevention of leachate of toxic from waste and fuel oil by side ditch, e.g., - Education to workers to follow working guideline.	Contractor	DPWH、Davao City
Hydrology	- Install temporary drainage.	Contractor	DPWH、Davao City
Ecosystem	- Re-plantation based on the EMB guideline (Memorandum Circular N0. 2012 – 02, 50 trees per one (1) tree cut) - Transfer endemic/ endangered fauna (amphibia, e.g.) - Environmentally friendly design for restoring habitats.	Contractor	DPWH, EMB、Davao City
Resettlement	【See section 4.6.3】		
Poor/Vulnerable	- Secure accessibility to IEC. - Assistance to access social welfare and support. - Secure adequate compensation and support indicated in the RAP.	Contractor, DPWH	DPWH, Davao City, Barangay
Local economies	- Traffic control to prevent disturbance. - Prioritize local support to communities. - Encourage public consultation and consensus building. - Secure adequate compensation and support indicated in the RAP.	Contractor, DPWH	DPWH, Davao City, Barangay
Existing social infrastructures and services	- Relocation of electric line, streetlights, etc. - Traffic control	Contractor	DPWH, Davao City, Barangay
Utilization of land and local resources	- Prior information of the schedule to the sand mining workers, residents. - Encourage public consultation and consensus building. - Secure adequate compensation and support	Contractor, DPWH	DPWH, Davao City, Barangay

Items	Mitigation Measures	Implementer	Supervisor
	- Priority recruitment for women, widows. - Installment of female toilet, locker room. - Adequate labor condition (maternity leave, etc.).		
Children's rights	- Financial and social support for children of ISFs (Commute to school, counseling, etc.) - Prevent child labor. - Secure safety in school zone.	Contractor	DPWH, Davao City
Infectious diseases	- Management of construction site and basecamp (Sanitary toilet, proper waste storage, secure clean water, etc.). - Public awareness and education on infectious diseases.	Contractor	DPWH, Davao City
Labor conditions	- Pollution control. - Provision of PPE (personal protection equipment) - Awareness and education on labor environment and safety.	Contractor	DPWH, Davao City, Barangay
Accident	- Safety manual, training on accident - Install first-aid station, firefighting equipment. - Compliance traffic rule. - Water accident prevention (installment of gate, public education, etc.)	Contractor	DPWH, Davao City, Barangay
Operation			
Infectious diseases	- Control of remaining water area to prevent mosquito bleeding after flooding. - Public awareness and education on infectious diseases.	DPWH	Davao City, Barangay
Accidents	- Safety manual, IEC. - Formation of network with communities. - Water accident prevention (installment of gate, public education, etc.)	DPWH	Davao City, Barangay

Source: Project Team

Table 4.6.28 Proposed Environmental Managements (Cut-off Works)

Items	Mitigation Measures	Implementer	Supervisor
Construction			
Air quality	- Use least emission equipment to meet exhaust gas quality standards. - Regular maintenance and repair of equipment. - Spread water during dry season. - Cover stored excavated soil with sheet to avoid dust spread.	Contractor	DPWH、EMB
Water quality	- Store waste at designated area - Prevent leachate of toxic from waste, fuel oil etc. (ex. Cover with sheet, use a drum can, install side ditch to prevent leachate). - Schedule of dredging work - Install adequate toilet, drainage in the basecamp.	Contractor	DPWH、EMB
Waste	- Cover with sheet or clos the lid to prevent spread. - Follow designated waste management by the Davao City. - Formulation and implementation of waste management plan. - Advance check of contamination of dredged/ excavated soil. - Secure adequate disposal site. - Encourage reuse/ recycle of waste.	Contractor	DPWH、Davao City
Noise and vibration	- Use least noise equipment. - Adequate maintenance and repair. - Traffic control and schedule to avoid nighttime near residential area. - Install sound barrier if necessary. - Adequate construction management. - Monitoring noise level.	Contractor	DPWH、EMB
Soil contamination	- Segragate storage of waste, toxic waste, oil, etc. - Prevention of leachate of toxic from waste and fuel oil by side ditch, e.g. - Education to workers to follow working guideline.	Contractor	DPWH、Davao City
Hydrology	- Install temporary drainage. - Monitor groundwater level if necessary.	Contractor	DPWH、Davao City
Ecosystem	- Re-plantation based on the EMB guideline (Memorandum Circular N0. 2012 – 02, 50 trees per one (1) tree cut) - Move specific fauna to another habitat if necessary. - Environmentally friendly design of new canal - Encourge to use the improved river for ec-tourism.	Contractor	DPWH, EMB、Davao City
Resettlement	【See section 4.6.3】		
Poor/Vulnerable	- Secure accessibility to IEC. - Assistance to access social welfare and support. - Secure adequate compensation and support indicated in the RAP.	Contractor, DPWH	DPWH, Davao City, Barangay
Local economies	- Traffic control to prevent disturbance. - Prioritize local support to communities. - Encourage public consultation and consensus building. - Secure adequate compensation and support indicated in the RAP.	Contractor, DPWH	DPWH, Davao City, Barangay
Existing social infrastructures and services	- Prior noticement on relocation of electric line, streetlights, etc., and speedy completion. - Traffic control by detour, announcement of construction schedule.	Contractor	DPWH, Davao City, Barangay
Community severance	- Traffic control - Encourage public consultation and consensus building.	Contractor, DPWH	DPWH, Davao City, Barangay

Items	Mitigation Measures	Implementer	Supervisor
Utilization of land and local resources	- Adequate landuse control - Encourage public consultation and consensus building. - Secure adequate compensation and support indicated in the RAP. - Support to sand mining activity. - Improve accessibility to river area such as installment of footstep.	Contractor, DPWH	DPWH, Davao City, Barangay
Landscape	- Adequate design with harmonization with landscape.	Contractor, DPWH	DPWH, Davao City
Gender	- Encourage women to be involved in the public consultation. - Priority recruitment for women, widows. - Installment of female toilet, locker room. - Adequate labor condition (maternity leave, etc.).	Contractor	DPWH, Davao City
Children's rights	- Financial and social support for children of ISFs (Commute to school, counseling, etc.) - Prevent child labor. - Secure safety in school zone.	Contractor	DPWH, Davao City
Infectious diseases	- Management of construction site and basecamp (Sanitary toilet, proper waste storage, secure clean water, etc.). - Public awareness and education on infectious diseases.	Contractor	DPWH, Davao City, Barangay
Labor conditions	- Pollution control. - Provision of PPE (personal protection equipment) - Awareness and education on labor environment and safety.	Contractor	DPWH, Davao City, Barangay
Accident	- Safety manual, training on accident - Install first-aid station, firefighting equipment. - Compliance traffic rule. - Water accident prevention (installment of gate, public education, etc.)	Contractor	DPWH, Davao City, Barangay
Operation			
Existing social infrastructures and services	- Traffic control inc. bridges - Support for ferry services	DPWH	Davao City, Barangay
Community severance	- Traffic control against new river canal. - Public consultation.	DPWH	Davao City, Barangay
Landscape	- Adequate design with harmonization with landscape through consultation with academic, community, etc.	Contractor, DPWH	Davao City, Barangay
Infectious diseases	- Control of stagnation of river water, remaining water area, etc. to prevent mosquito bleeding after flooding. - Public awareness and education on infectious diseases.	DPWH	Davao City, Barangay
Accidents	- Safety manual, IEC. - Formation of network with communities. - Water accident prevention (installment of gate, public education, etc.)	DPWH	Davao City, Barangay

Source: Project Team

(9) Monitoring Plan

An environmental monitoring plan is summarized in Table 4.6.29 - Table 4.6.31. Since the cost for air/ water/ soil/ noise monitoring will depend on the number of sampling and construction site; the table indicates unit cost. The monitoring cost will be included in the project cost.

Table 4.6.29 Proposed Environmental Monitoring Plan (River Dredging)

Items	Methods	Location[1)]	Frequency	Cost (PHP)	Implementer	Supervisor
Construction						
Air quality	- Air quality measurement (CO, SO_2, NO_2, PM2.5, PM10) - Visual observation (dust)	Construction site	Two times a year Everyday	90,000 per sample	Contractor	DPWH, EMB
Water quality	- Water quality measurement (pH, DO, TSS, BOD, phosphorus, Coliform, oil & grease) - Visual observation (Turbid water)	Construction site (including the river mouth)	Two times a year Everyday	75,000 per sample	Contractor	DPWH, EMB
Waste	- Treatment/ disposal record, manifest - Visual observation	Construction site	Every month Everyday		Contractor	DPWH, Davao City
Soil contamination	- Test of dredged/ excavated soil (As, Cd, Cr, Pb, Hg) - Direct observation	Construction site	One time before construction at each site Weekly	50,000 per sample	Contractor	DPWH, Davao City
Noise and vibration	- Noise measurement - Hearing with communities	Construction site	Noise: quartely Vibration: Every year Weekly	Included in the air monitoring fee	Contractor	DPWH, EMB
Ecosystem	- Visual observation (aquatic biota only) - Hearing with communities, etc.	Construction site	Quartely		Contractor	DPWH、EMB
Utilization of land and local resources	- Hearing with san mining operators, residents - Monitoring of sand mining - Visual observation	Construction site	Quartely		Contractor	DPWH, Davao City, Barangay
Labor condition	- Patrol in the construction site - Hering with workers, e.g.,	Construction site	Monthly 2 times a year		Contractor	DPWH, Davao City, Barangay
Accidents	- Visual observation - Hearing and public consultation	Construction site	Every week 2 times a year		Contractor	DPWH, Davao City, Barangay
Operation						
Utilization of land and local resources	- Hearing with san mining operators - Monitoring of sand mining - Visual observation	Davao River	Every year during the maintenance dredging		DPWH, LGUs	DPWH, Davao City, Barangay

1) The construction site will be divided into several sections based on the constriction schedule.

Source: Project Team

Table 4.6.30 Proposed Environmental Monitoring Plan (Retarding Ponds)

Items	Methods	Location	Frequency	Cost (PHP)	Implementer	Supervisor
Construction						
Air quality	- Air quality measurement (CO, SO_2, NO_2, PM2.5, PM10) - Visual observation (dust)	Construction site	Two times a year Everyday	90,000 per sample	Contractor	DPWH, EMB
Water quality	- Water quality measurement (pH, DO, TSS, BOD, phosphorus, Coliform, oil & grease) - Visual observation (Turbid water)	Construction site	Two times a year Everyday	75,000 per sample	Contractor	DPWH, EMB
Waste	- Treatment/ disposal record, manifest - Visual observation	Construction site	Every month Everyday		Contractor	DPWH, Davao City
Soil contamination	- Test of dredged/ excavated soil (As, Cd, Cr, Pb, Hg) - Direct observation	Construction site	One time before construction at each site Weekly	50,000 per sample	Contractor	DPWH, Davao City
Noise and vibration	- Noise measurement - Hearing with communities	Construction site	Noise: quartely Vibration: Every year Weekly	Included in the air monitoring fee	Contractor	DPWH, EMB
Ecosystem	- Visual observation - Hearing with communities, etc. - Observation of condition as environmentally friendly spot or eco-torursm.	Construction site	Quartely		Contractor	DPWH、EMB
Hydrology	- Obsservation on drainage condition. - Hering with the residents - Records of floods	Construction site	During floods		DPWH	Davao City
Involuntary resettlement	See the section 4.6.3					
Poor/Vulnerable	- Hearing, public consultation - Record of social support - Record of income recovery program	Construction site	Every month		Contractor	DPWH, Davao City, Barangay
Local economies	- Traffic record - Record of social services - Record of use of local bresources. - Hearing and public consultation	Construction site	Every month		Contractor	DPWH, Davao City, Barangay

Items	Methods	Location	Frequency	Cost (PHP)	Implementer	Supervisor
Existing social infrastructures and services	- Visual monitoring - Traffic record. - Hering and public consultation	Construction site	Every month		Contractor	DPWH, Davao City, Barangay
Social institutions	- Hearing and public consultation	Construction site	Every month		Contractor	DPWH, Davao City, Barangay
Utilization of land and local resources	- Hearing with san mining operators - Monitoring of sand mining - Visual observation	Construction site	Every month		Contractor	DPWH, Davao City, Barangay
Gender Children's rights Infectious diseases	- Visual observation - Hearing and public consultationRecord of labor and health condition.	Construction site	Every week 2 times a year	50,000	Contractor	DPWH, Davao City, Barangay
Labor conditions Accidents	- Visual observation - Hearing and public consultation	Construction site	Every week 2 times a year		Contractor	DPWH, Davao City, Barangay
Operation						
Infectious diseases	- Hearing and public consultation - Health record.	Near Returding Ponds	Every year	50,000	DPWH, LGUs	DPWH, Davao City, Barangay
Accident	- Visual observation - Hearing and public consultation - Recirds of accidents	Near Returding Ponds	Every year		DPWH, LGUs	DPWH, Davao City, Barangay

Source: Project Team

Table 4.6.31 Proposed Environmental Monitoring Plan (Cut-off Works)

Items	Methods	Location[1)]	Frequency	Cost (PHP)	Implementer	Supervisor
Construction						
Air quality	- Air quality measurement (CO, SO_2, NO_2, PM2.5, PM10) - Visual observation (dust)	Construction site	Two times a year Everyday	90,000 per sample	Contractor	DPWH, EMB
Water quality	- Water quality measurement (pH, DO, TSS, BOD, phosphorus, Coliform, oil & grease) - Visual observation (Turbid water)	Construction site	Two times a year Everyday	75,000 per sample	Contractor	DPWH, EMB
Waste	- Treatment/ disposal record, manifest - Visual observation	Construction site	Every month Everyday		Contractor	DPWH, Davao City
Soil contamination	- Test of dredged/ excavated soil (As, Cd, Cr, Pb,	Construction site	One time before construction at each site	50,000 per sample	Contractor	DPWH, Davao City

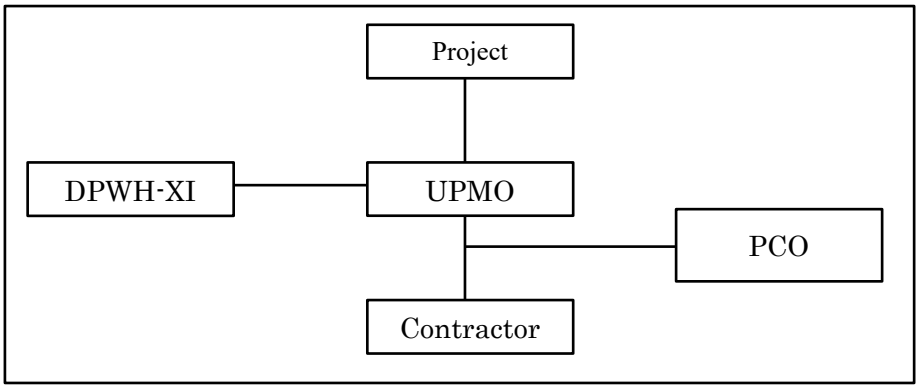
Items	Methods	Location[1)]	Frequency	Cost (PHP)	Implementer	Supervisor
	Hg) - Direct observation.		Weekly			
Noise and vibration	- Noise measurement - Hearing with communities	Construction site	Noise: quarterly Vibration Every year Weekly	Included in the air monitoring fee	Contractor	DPWH, EMB
Ecosystem	- Visual observation on the conditions of replanted trees - Hearing with communities, etc.	Construction site	Quartely continue one (1) year after replantation.		Contractor	DPWH、EMB
Hydrology	- Monitoring of underground water condition - Observation of drainage condition - Records of floods	Construction site	Before construction Quartely		Contractor	DPWH、Davao City
Involuntary resettlement	See the section 4.6.3					
Poor/Vulnerable	- Hearing, public consultation - Record of social support - Record of income recovery program	Construction site	Every month		Contractor	DPWH, Davao City, Barangay
Local economies	- Traffic record - Record of social services - Record of use of local bresources. - Hearing and public consultation	Construction site	Every month		Contractor	DPWH, Davao City, Barangay
Existing social infrastructures and services	- Visual monitoring - Traffic record. - Hering and public consultation	Construction site	Every month		Contractor	DPWH, Davao City, Barangay
Social institutions	- Hearing and public consultation	Construction site	Every month		Contractor	DPWH, Davao City, Barangay
Community severance	- Traffic record - Hearing and public consultation	Construction site	Every month		Contractor	DPWH, Davao City, Barangay
Utilization of land and local resources	- Hearing with san mining operators - Monitoring of sand mining - Visual observation	Construction site	Every month		Contractor	DPWH, Davao City
Landscape	- Consulttaion by academics for design and construction methos. - Cleaning the	At new river canal	Before/ after construction		Contractor	DPWH, Davao City

Items	Methods	Location[1)]	Frequency	Cost (PHP)	Implementer	Supervisor
	construction site to aboid degradation of landscape. - Public consultation with residents, users of river					
Gender Children's rights Infectious diseases	- Visual observation - Hearing and public consultation - Records of labor, health condition	Construction site	Monthly 2 times a year	50,000	Contractor	DPWH, Davao City, Barangay
Labor conditions Accidents	- Visual observation - Hearing and public consultation - Records of accidents	Construction site	Every week 2 times a year		Contractor	DPWH, Davao City, Barangay
Operation						
Existing social infrastructures and services	- Visual monitoring - Traffic record	At new river canal	Every year		DPWH, LGUs	DPWH, Davao City, Barangay
Community severance	- Traffic survey - Hearing with residents.	At new river canal	Yearly and two (2) tears after completion		DPWH	DPWH, Davao City, Barangay
Landscape	- Consultation with intellectual (before construction) - Public hearing.	At new river canal	Before constriction and beginning of operation.		Contractor	DPWH, Davao City
Infectious diseases	- Visual observation - Hearing and public consultation	At new river canal	Every year	50,000	DPWH, LGUs	DPWH, Davao City, Barangay
Accident	- Visual observation - Hearing and public consultation	At new river canal	Every year		DPWH, LGUs	DPWH, Davao City, Barangay

Source: Project Team

(10) Organization

The project proponent is DPWH-UPMO; DPWH-XI will cooperate. A pollution control officer PCO) shall be assigned based on EMB guideline, DAO 30-03. A contractor, in general, dispatches the PCO; his/her responsibility is direct reporting to the project proponent. Figure 4.6.17.



Source: Project Team

Figure 4.6.17 Project Implementation Organization

Responsibilities on each organization are as follows:

DPWH-UPMO

- Provide general direction and supervision for the successful completion of the project.
- Set guidelines for the project implementation.
- Set sanctions and penalty for the contractors for any violations of the contract.
- Ensure that the environmental management measures and programs are effectively implemented.
- Public window, responsible for grievance mechanism.

DPWH-XI

- Coordinate with UPMO in the implementation of the project.
- Assist the environmental officer in the implementation of environmental measures for the adverse impacts.
- Assist the environmental officers in the implementation of the environmental enhancement plan.
- Assist the UPMO in the coordination with the CLGU and BLGU.

PCO

- Monitoring and police compliance of contractors on their implementation of the provisions of ECC;
- Monitoring and evaluation of the effectiveness of the mitigating and enhancement measures;
- Planning and implementing modifications or additional measures needed to effectively protect the environment;
- Submit compliance report to EMB;
- Coordinating with concerned oversight agencies and other entities and organization including the local government units to ensure active participation in the implementation of ECC; and
- Ensure compliance to ECC conditions and reporting requirements of the DENR-EMB.

Contractor

- Implement the environmental programs, mitigating and enhancement measures as stipulated in the contract.
- Cooperate with the environmental officer, CLGU, BLGU.
- Report to the environmental officers any accident in the workplace.
- Undertake measures in dealing with accidents.
- Ensure compliance to ECC and contract.

Responsible for grievance mechanism will be organized under the PMO-DPWH; a public board, indicating contact person and address, will be set at the construction site. Local government, Davao City, barangay as well, will also contribute as a public window. The role-sharing between UPMO and Region XI will be cleared before implementation of the Project.

(11) Public Consultation Meetings

1) IEC Campaign

Public consultation meetings (hereinafter called "PCM") were undertaken based on the EIS guideline in order to explain the project, to exchange their opnions, perceptions. Those inputs were reflected to the project design and construction methods to minimize environmental and social impacts.

First IEC (Information, Education, and Communication) campaign was conducted with IEC material (explain project summary with Visaya language). The Study team visited with courtesy to each barangay to request cooperation on the EIS study; in addition, interview survey and group discussion with communities (including women, widows, etc.) were undertaken.

Candidate participants on the PCM were selected based on the results of interview survey, discussion with the EMB-XI; IEC Campaign was undertaken in 29th to 30th September 2019 in each barangay office.

Source: Project Team

Figure 4.6.18 IEC Campaign

2) Public Consultation Meetings

The PCMs were undertaken two (2) times at the beginning of the Study and at the reporting. Because COVID-19 pandemic, the PCMs were taken by hybrid, face-to-face and webinar. The meeting venue for the face-to-face was set at Mandug considered with internet condition.

The PCMs were organized by the EMB Region-XI; Project team and sub-consultant team assisted them. Candidate participants were selected through IEC campaign based on the "DAO 15, 2017: Guidelines on Public Participation"; it was confirmed attendances from women, low-income household, etc. The meetings were led by English, Tagalog and Visaya.

The meeting schedule and agenda were noticed 15 days before the meeting through EMB's WEB site and Facebook, public boards in each barangay office. All people regardless gender, age, etc., who are interested, could participate in the meetings either face-to-face or online. Invitation was sent social group such as women group, senior group. Public notice, agenda and presentation materials are in the Annex 7.

Summary of the PCMs is indicated in Table 4.6.32.

Table 4.6.32 Summary of PCMs

	Date	Venue	Participants	Topics
1	7th December, 2021	Barangay Mandug office with webinar	Barangay leaders/ representatives, LGU commissioners, communities, landowners, social groups, CPDO, DENR, etc. total of 101 attendances Total number of attendances is 95 persons with 46 male and 49 female)	Purposes of the PCM Summary of EIS system Project summary Discussion Conclusion, further schedule, etc.
2	28th June, 2022	Barangay Mandug office with webinar	Barangay leaders/ representatives, LGU commissioners, communities, landowners, social groups, CPDO, DENR, etc. total of 76 attendances Total number of attendances is 71 persons with 34 male and 37 female)	Purposes of the PCM Project summary Results of the EIS Study Discussion Conclusion, further schedule, etc.

Source: Project Team

The major questions and discussions are as below.

Table 4.6.33 Comments and Discussions

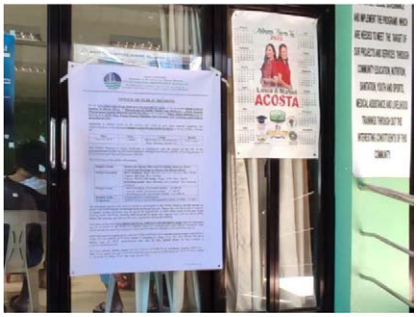
Comments	Responds
First PCM	
The shape of the River Front buffers the velocity of the water going to Ma-a. Once diverted, there will be a sudden flash of water to Ma-a and the riverside, causing people to drown.	- This project is similar to Monkayo. Cut-off works were done in Monkayo to solve the constriction of water flow. - Based on the simulation, water from upstream will be temporarily stored in the retarding ponds, thereby reducing the magnitude of the river flow going downstream.
Will a retarding pond be installed at barangay. Ma-a?	- There is no retarding pond in Ma-a, only cut-off works, and riverbed dredging. - Complementary projects will be implemented in the year 2045 onwards.
What is the schedule of the dredging project (if included in the master plan)? Is there a study on the maintenance schedule?	- The consultants will determine the schedule of dredging depending on the width and depth. What is essential is the maintenance of the flood control mechanisms. Non-structural measures were proposed by controlling erosion upstream and reducing sediment transport during floods. This is not only the concern of DPWH but also by other agencies. - JICA consultants are studying the dredging frequency, including excavation and other technical analyses.
How were the location of RPs, number and capacity evaluated and decided? Was flood volume at Ma-a was considered to estimate the capacity?	- The locations of the retarding ponds were determined by studying the characteristics of the Davao River
Was impact by Typhoon Vinta considered?	- Japan consultant used Typhoon Vinta incidence as the basis for the simulation. - In addition, the 100-year flood was used to calculate the design capacity of flood control systems.
Public hearing and information campaign by barangay is vital to raise community awareness and acceptance of the proposed project	- Public consultations were conducted even during the conceptualization of this plan. - DPWH will hold a series of public consultations in the future.

Comments	Responds
Old riverbeds will not be used as relocation sites, and these should be planted with trees and no structures. No relocation or community be allowed within the old riverbed.	- Noted.
Suggesting as; - Continue discussion with landowners especially who express negative concerns. - Continually discussion with each barangay - Periodical dredging	- Noted
Concerning about sand mining activities	- Noted
Were other prevention measures, ex) pump facilities (Singapore) examined? Possibility to install pump facilities in Davao City?	- Pump system is not recommendable. - One of the significant issues that decrease of wetland could accelerate floods. - Box culverts is useful for inland flood.
Resettlement caused by cut-off work must be concerned.	- The Project shall be designed to minimize the scale of resettlement.
Second PCM	
Are there any disadvantages of dredging that may collapse riverbanks?	- A 10-meter distance from the existing structure is part of the design. - The proponent will dredge only the center portion of the river, and it is like a canal.
In cut-off areas, Muslim communities will be affected. They got angry seeing JICA and DPWH personnel doing some field surveys and tagging activity. NCIP and the Office of the Mayor are now joining into this issue. Is it true that the width of the cut-off canal is 60 meters (it is mistaken)? We are not against the project; we are helping DPWH. We want to know the channel's size or width. We heard that 90 percent of the people living in the area are now supporting the project. Barangay Ma-a, in general, is happy about this project.	- This project has two options; the last option will only affect two barangays. A Field-Based Investigation (FBI) was conducted, and the results will be the basis for issuing a "certificate of non-overlapping" hopefully, they will give the CNO. They have already coordinated with the Office of the City Mayor. - The leaders have already agreed to talk with our RAP study team. We are just waiting for the schedule of Mayor Duterte, and he will be joining at the said meeting. We are still in the feasibility study stage. - The distance of the cut-off channel is 110 to 80 meters from the area. We are looking for other options with less affected people. This design might change during DED. - We understand the sentiments of these affected households. Together with our proponent, DPWH, we will ensure that these families will not be disregarded. - We are asking for the assistance and support of your council (BLGU of Ma-a) to convince the public to sit down with us and discuss their issues and concerns in a proper venue so that RAP will be finalized. - In addition, two bridges will be constructed to connect these communities
Will you be using gabion or retaining wall in the cut-off channel?	- Concrete revetment will be used instead of the gabion. It will be part of the DED.
Suggestion, DPWH should bring their legal representative during the meeting with the Muslim community at Brgy. Ma-a. The legal division can answer the issue of "just compensation."	- Noted
Our area (Mandug) has an elbowed river channel, is dredging possible? Is it also possible that dredged materials be used in refilling collapsed riverbanks? This plan will help our constituents who are residing in those areas.	- It is possible.
We heard that an old riverbed would be used as a resettlement area. How true is it? My suggestion is to consider it as forest area.	- That is just part of the feasibility study. The final plan will be seen in the DED. As of now, options and alternatives are considered and are to be evaluated by DPWH.
Can we fast-track the implementation of this flood control project?	- We need to follow the process of the government. We are still in the feasibility stage; after this is the detailed engineering

Comments	Responds
Let us help the proponent so that it will be implemented at the soonest time.	design. - NEDA pressures us to fast-track the FS, but specific procedures or studies require more time. After this, DED will take a year or 2 for the study. - It is up to Japan government if they will continue the project.

Source: Project Team

Second PCM



Public borad at barangay office

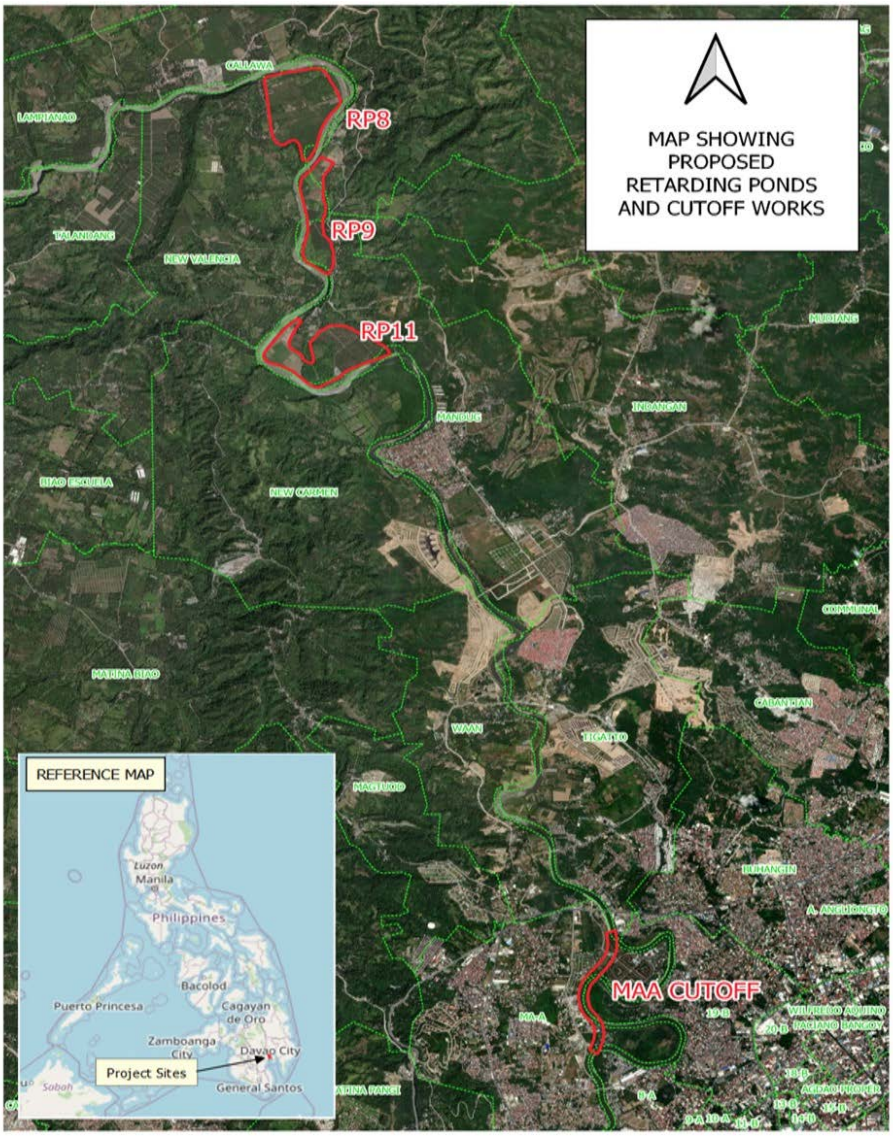
Source: Project Team

Figure 4.6.19 Second Public Consulttaion Meeting

4.6.3 Land Acquisition and Resettlement

(1) Necessity of Land Acquisition and Resettlement

The RAP Study covers the plan preparation of the resettlement of the affected ISFs in two of three project components of the Project for the Master Plan and Feasibility Study on Flood Control and Drainage in Davao City (Davao River); namely, the component on Retarding Ponds 8, 9 and 11, and the component on the Cut Off Works (See Figure 4.6.20). The component on Dredging is excluded from the RAP Study because there are no lands to be affected in this component.



Source: Project Team

Figure 4.6.20 Project Map showing Proposed Retarding Ponds and Cut-off Works Areas

The RAP study aims to meet requirements on Environmental and Social Considerations of the feasibility study of the Project for Master Plan and Feasibility Study on Flood Control and Drainage in Davao City (Davao River) and to prepare the Resettlement Action Plan for the priority projects. Specifically, the RAP Study aims to:

- Determine the scale of possible project affected persons (PAPs) and identify the assets (land, structures and improvements) they will lose due to the acquisition of infrastructure right-of-way (IROW) for the project;

- Determine the affected households (AHs) (including business entities) and/or project affected persons (PAPs) which are to be relocated out of the project area;
- Identify the social character of PAPs, the extent of impacts of the Project on their assets, livelihood, business and propose measures to mitigate these impacts;
- Assist the Department of Public Works and Highways (DPWH) undertake necessary procedures with Davao City including issuing the cut-off-date (COD);
- Identify the PAPs for entitlement of the compensation and other forms of support, and to control further migration, especially informal settling into the project site;
- Determine the compensation and entitlements to be given to PAPs for the acquisition of the assets to be affected by the IROW;
- Determine the budget estimate for compensation and entitlement, relocation, and resettlement, information dissemination, consultation, monitoring and other tasks for implementing the Land Acquisition Plan and Resettlement Action Plan (LAPRAP);
- Provide the timetable, manner of payment and institutional arrangement for implement;
- Assist the DPWH and JICA Study Team (JST) to hold public consultations for consensus building among the PAPs; and
- Ensure public participation in the implementation and monitoring of LAPRAP.

The RAP Study prepares the relocation plan to ensure that the affected households and Informal Settler Families (ISFs) residing inside the Right of Way to-be-acquired lands needed in the implementation of the Priority Projects, are appropriately relocated and their rights justly protected. Conversely, there shall be no involuntary relocation of ISFs and legal land and property owner in the Priority Projects without the appropriate provision of acceptable resettlement entitlements and assistance.

(2) Legal and Institutional Framework

The RAP must be prepared based on, and hence is inevitably closely linked with, relevant policies, laws, regulations, guidelines and other binding documents and commitments in and of the Philippines. In general, the RAP has been prepared with reference to:

- Relevant laws, regulations, guidelines and so on of the Government of the Republic of the Philippines (Republic Act No. 10752, DPWH Right-of-Way Acquisition Manual: DRAM, Land Acquisition, Resettlement, Rehabilitation, and Indigenous People's Policy: LARRIPP etc.)
- JICA Guidelines for Environmental and Social Considerations (April 2010)
- World Bank Operational Policies, OP 4.01 (January 1999) and Involuntary Resettlement Policy, OP 4.12 (December 2001)

(3) Scale of Land acquisition and Resettlement

There is a total of about **212.48** hectares of affected lands for acquisition and an estimated of **104** affected Informal Settler Family (ISF) in the project areas of the DCFCD Master Plan, specifically in RP 11 and Brgy. Ma-a. It is expected both physical and economic impacts for families necessary to be relocate. The affected lands and affected ISF is broken down in Table 4.6.34.

Table 4.6.34 Extent of Affected Lands and Affected Informal Settler Families

Components	Project Sites	Estimated Affected Land Area (ha)	Number of Affected Properties	Number of Affected ISFs
Retarding Ponds (RPs)	RP 8, New Valencia	76.60	26 land parcels with property documents	0
		1.53	2 land parcels with no reference documents of ownership	
	Sub-total in RP8	78.13	28	0
	RP 9, Callawa	28.61	21 land parcels with property documents	0

Components	Project Sites	Estimated Affected Land Area (ha)	Number of Affected Properties	Number of Affected ISFs
		11.71	3 land parcels with no reference documents of ownership	
	Sub-total in RP9	40.32	24	0
	RP 11, Mandug	66.03	27 land parcels with property documents	1
		5.26	4 land parcels with no reference documents of ownership	
	Sub-total in RP11	71.29	31	1
Cut Off Works (COW)	Brgy. Ma-a & Brgy. 19-B	22.74	22 land parcels with property documents	103
	Sub-total in COW	22.74	22	103
Total Area		**212.48**	**105**	**104**

Source: Project Team

Table 4.6.35 shows the number of crops and trees that would be affected by the project.

Table 4.6.35 Number of Permanent Crops and Trees Affected by the Project.

Project Components	Location	NUMBER						
		Cacao	Coconut	Fruit Trees	Lesser-used Trees	Premium Trees	Banana Local (hill)	Banana – Cavendish (hill)
RP8	New Valencia	292	1,223	1,185	216	400	11,468	-
RP9	Callawa	-	-	-	757	-	12,350	4,674
RP11	Mandug	-	-	-	936	-	38,501	-
COW	Ma-a & 19-B	-	20	24	-	-	3,985	-
Total		292	1243	1209	1909	400	66,304	4,674

Source: Project Team

Table 4.6.36 shows the structures and improvements that would be affected by the Project. The transmission towers in Barangay Callawa are owned by the National Grid Corporation of the Philippines (NGCP). The electric posts in Barangay Mandug are owned by the Davao Light & Power Company (DLPC).

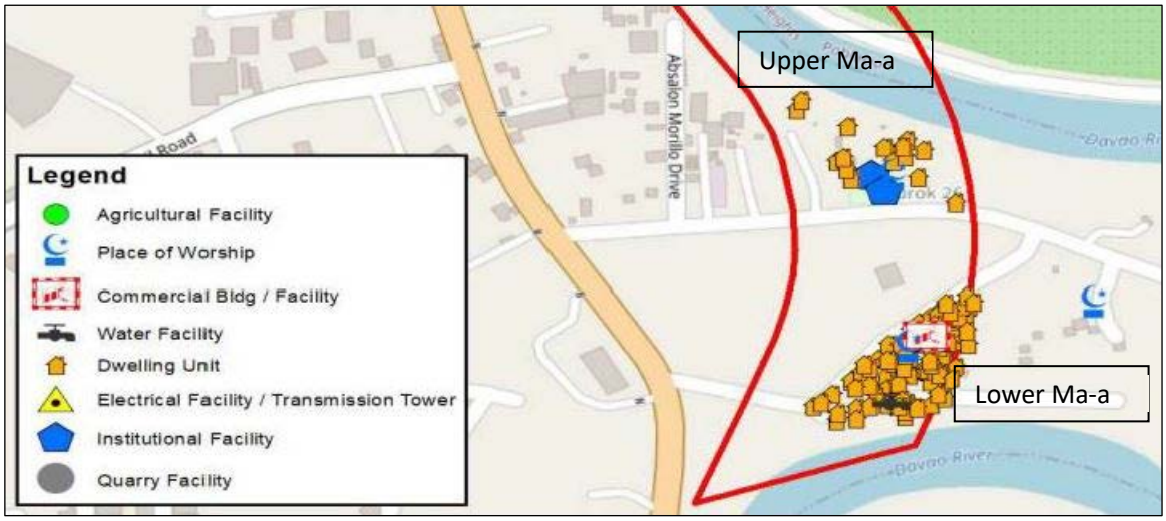
Table 4.6.36 Structures and Improvements that would be affected by the Project

Project Components	Location	Structures and Improvements								
		Electric Post	Quarry Facility	Agricultural Facility	Dwelling Units	Water Facility	Trans-mission Tower	Com-mercial	Institutional (Covered Court/ Madrasah)	Mosque
RP 8	New Valencia			1						
RP 9	Callawa		1	3			2			
RP 11	Mandug	11			4	1				
COW	Ma-a & 19-B			1	133	1		4	3	2
Total		11	1	5	137	2	2	4	3	2

Source: Project Team

(4) Socio Economic Characteristics of the project affected ISF

There are 104 ISFs qualified for relocation: 103 ISFs affected by the COW in Barangay Ma-a and 1ISF in Mandug affected by RP 11. Survey area in Ma-a is as following Map.



Source: Project Team

Figure 4.6.21 Socio Economic Survey area of Barangay Ma-a

Table 4.6.37 House and Structure

House Structure	Upper Ma-a		Lower Ma-a	
	Frequency	%	Frequency	%
Residential	31	100	72	100
Agricultural/Commercial	0	0	0	0

Source: Project Team

Table 4.6.38 Type of Residential Structure

Type	Upper Ma-a		Lower Ma-a	
	Frequency	%	Frequency	%
Single story residential unit;	25	80.6	34	47.2
Single two story;	6	19.4	30	41.7
Duplex, two story residential	0	0	2	2.8
No answer	0	0	6	8.3
Total	31	100	72	100

Source: Project Team

Table 4.6.39 Materials used for Dwelling Unit

Materials Used	Upper Ma-a		Lower Ma-a	
	F	%	F	%
Mixed but predominantly strong materials;	10	32.3	35	48.6
Mixed but predominantly light materials;	13	41.9	16	22.2
Salvaged/makeshift materials;	0	0	2	2.8
Strong materials (galvanized iron, tile, concrete, brick stone);	4	12.9	7	9.7
Light materials (cogon, nipa, anahaw, wood);	3	9.7	9	12.5
Others	1	3.2	2	2.8
No Answer	0	0	1	1.4
Total	31	100	72	100

Source: Project Team

Table 4.6.40 Household size and Number of HH per Dwelling Unit

HH Size	Upper Ma-a		Lower Ma-a	
	Frequency	%	Frequency	%
1-2	4	12.9	12	16.7
3-4	12	38.7	27	37.5
5-6	9	29	22	30.6
7-8	4	12.9	7	9.7
9-10	1	3.23	2	2.8
11-highest	1	3.23	1	1.4
No response	0	0	1	1.4
Total	31	100	72	100.0

Source: Project Team

Table 4.6.41 Ethnic Affiliation and Language used

Ethnic and Language Affiliation	Upper Ma-a		Lower Ma-a	
	Frequency	%	Frequency	%
Kagan/Kalagan	27	87.1	26	36.1
Cebuano/Bisaya	0	0	33	45.8
Mandaya	1	3.2	2	2.8
Maguindanao	1	3.2	2	2.8
Surigaonon	0	0	0	0.0
Others: Ilongo, Boholano, Tagalog	0	0	4	5.6
Maranao	1	3.2	5	6.9
Dabawenyo	1	3.2	0	0
Total	31	100	72	100

Source: Project Team

Table 4.6.42 Year of the stay in area

Length of Stay in Area (Years)	Upper Ma-a		Lower Ma-a	
	Frequency	%	Frequency	%
5 years or less	4	12.9	41	56.9
6 - 15 years	4	12.9	15	20.8
16 - 25 years	4	12.9	3	4.2
26 - 35 years	2	6.5	5	6.9
36 - 45 years	10	32.3	4	5.6
46 - 55 years	2	6.5	1	1.4
56 years and above	5	16.1	1	1.4
No Answer			2	2.8
Total	31	100	72	100
Mean: No. of Years of Stay	33 years		14 years	

Source: Project Team

Table 4.6.43 Sex of Household Head

Sex	Upper Ma-a		Lower Ma-a	
	Frequency	%	Frequency	%
Male	30	96.8	56	77.8
Female	1	3.2	16	22.2
Total	31	100	72	100.0

Source: Project Team

Table 4.6.44 Educational Attainment

Highest Educational Attainment	Upper Ma-a		Lower Ma-a	
	Frequency	%	Frequency	%
HS Undergraduate;	11	35.5	21	29.2
HS Graduate;	6	19.4	19	26.4
College Undergraduate;	5	16.1	5	6.9
Elementary Graduate;	5	16.1	9	12.5
Elementary Undergraduate;	4	12.9	13	18.1
College Graduate;	0	0	2	2.8
Vocational Graduate;	0	0	2	2.8
No response	0	0	1	1.4
Total	31	100.0	72	100

Source: Project Team

Table 4.6.45 Number of HH members who are working

Number of Working HH Members	Upper Ma-a		Lower Ma-a	
	Frequency	%	Frequency	%
1	14	45.2	41	56.9
2	14	45.2	28	38.9
4	1	3.2	2	2.8
5	2	6.5	1	1.4
Total	31	100.0	72	100.0

Source: Project Team

Table 4.6.46 Type of Occupation

Type of Occupation	Upper Ma-a		Lower Ma-a	
	Frequency	%	Frequency	%
Construction worker (welder, laborer, carpenter, etc.)	1	3.2	12	16.7
Driver	11	35.5	10	13.9
Own business	1	3.2	3	4.2
Private employee	4	12.9	3	4.2
Temporary laborer	3	9.7	3	4.2
Arabic teacher		0.0	1	1.4
Street Vendor	4	12.9	0	0
Government Employee	1	3.2	0	0
Canal Worker	1	3.2	0	0
Call Center	1	3.2	0	0
No answer		0.0	34	47.2
Not applicable (not working)	4	12.9	6	8.3
Total	31	100	72	100.0

Source: Project Team

Table 4.6.47 Household Income

Household Head Monthly Income	Upper Ma-a		Lower Ma-a	
	Frequency	%	Frequency	%
Php 5,000 & less	3	9.7	10	13.9
Php 5,001 – 10,000.00	13	41.9	19	26.4
Php 10,001 – 15,000.00	4	12.9	17	23.6
Php 15,001 – 20,000.00	3	9.7	10	13.9
Php 20,001 – 25,000.00	2	6.5	2	2.8
Php 25,001 – 30,000.00	2	6.5	8	11.1
Not applicable (no income)	4	12.9	6	8.3
Total	31	100.0	72	100
Mean/Average income	12,862.96		15,722.00	

Source: Project Team

Table 4.6.48 Primary Source of Water

Source of Water	Upper Ma-a		Lower Ma-a	
	Frequency	%	Frequency	%
Piped connection	27	87.1	51	70.8
Deep well			10	13.9
Water vendors (e.g., bottled water, container, peddlers	2	6.4	7	9.7
Unfinished				
Others (still being constructed)	2	6.5	2	2.8
No response			2	2.8
Total	31	100	72	100

Source: Project Team

Table 4.6.49 Type of Toilet Facility

Type of Toilet Facility	Upper Ma-a		Lower Ma-a	
	Frequency	%	Frequency	%
Water-sealed (flush or pour flush) connected to septic tank (inside the lot);	25	80.6	65	90.3
No toilet; open defecation			5	6.9
Water-sealed (flush or pour flush) connected to sewerage system (outside the lot);	1	3.2		
Shared toilet	4	12.9	1	1.4
No answer	1	3.2	1	1.4
Total	31	100	72	100

Source: Project Team

Table 4.6.50 Acceptability of the Flood Control Project

Acceptability of the Project	Upper Ma-a		Lower Ma-a	
	Frequency	%	Frequency	%
Yes	12	38.7	47	65.3
No	10	32.3	9	12.5
Not applicable (neither for nor against)	9	29.0	16	22.2
Total	31	100	72	100.0

Source: Project Team

Table 4.6.51 Reasons for being in favour of the Flood Control Project

Reasons	Upper Ma-a	Lower Ma-a
	Frequency	Frequency
For the good of many/welfare of everyone	6	16
Whatever is the decision of the leader	3	
What the government wants/law dictates		7
No choice		16
The project will help a lot of people	1	1
Yes, for the flood control but hopefully there is a proper compensation	1	1
Safety of the family/everyone	1	1
Not Applicable (neither for nor against)	19	25
No Answer		5
Total	31	72

Source: Project Team

Table 4.6.52 Reasons for not favouring of the Project

Reasons	Upper Ma-a	Lower Ma-a
	Frequency	Frequency
Have settled in the area already/have stabilized		6
Does not want to be relocated; has lived in area for a long time; Inheritance	5	1
Our income/livelihood is here; we don't want to lose it	1	1
Don't want to lose house and land	1	
Don't want to; no assurance of relocation	1	
Just moved in to this place		1
Undecided		1
Not Applicable (neither for nor against)	23	62
Total	31	72

Source: Project Team

Table 4.6.53 Household with children attending school

Number of Households with Children Attending School	Upper Ma-a		Lower Ma-a	
	Boys (Frequency)	Girls (Frequency)	Boys (Frequency)	Girls (Frequency)
1	7	11	19	25
2	5	3	19	11
3	1		2	3
4	1			
None	17	17	33	33
Total	31	31	72	72

Source: Project Team

Table 4.6.54 On whether HHs have members with disability

On Whether HHs have members with Person with Disabilities	Upper Ma-a		Lower Ma-a	
	Frequency	%	Frequency	%
Yes	3	9.7	2	2.8
No	28	90.3	70	97.2
Total	31	100.0	72	100.0

Source: Project Team

Table 4.6.55 Type of disability

Type of Disability	Upper Ma-a		Lower Ma-a	
	Frequency	%	Frequency	%
Physically challenged	2	6.5		
Acute arthritis	1	3.2		
Cerebral Palsy			1	1.4
Feet/limbs not developed since childhood			1	1.4
Not applicable (None)	28	90.3	70	97.2
Total	31	100.0	72	100

Source: Project Team

It is expected that a person will be affected his structure and farming in RP 11 area.

Table 4.6.56 Outline of the situation of affected person in RP11

Outline of character of affected person	
Civil Status:	No Answer
Age/Sex:	62 years old/Male (HH Head)
Birthplace:	Mandug, Davao City, Davao del Sur
Ethnic Affiliation/Main Language:	Bisaya
Highest Grade completed:	Elementary undergraduate
Total Number of persons living in the HH:	one (1)
Year first stayed in the community	2016

Whether HH have a member with disability	Yes (Cataract)
Dwelling Unit	
Type	Single residential unit
Materials Used	Light materials (cogon, nipa, anahaw)
Floor area	10 square meters
Total Affected Area	Land not owned
Age of Property/Age of built	5 years / 2016
Estimated cost of unit	PhP 8,000.00
Roofing materials/Cost	Metal roofing/About PhP 5,000.00
Flooring materials/Cost	Wood/About PhP2,000.000
Exterior materials/Cost	Outdoor kitchen: walls made of wood /About PhP2,000.00
Interior materials used/Cost	None/N/A
Total estimated cost of dwelling unit	About PhP17,000.00
Agriculture/Farming Loss	
Type of Asset	Banana
Quantity unit	300
Planted Area	500 square meters (but Land not owned)
Year planted	2016
Cost of Seedling	PhP 1,500.00

Source: Project Team

(5) Compensation Policy, Package and Procedure

(a) Eligibility for Compensation and Other Entitlement

Resettlement entitlement and compensation policies cover the (1) loss of land; (2) loss of use of land; (3) loss of houses and structures; and (4) loss of income and livelihood. The project's compensation policy and package were developed in consultation with the UPMO and ESSD and other concerned government entities such as DPWH-XI ROW Acquisition & Legal Division, and CPDO of Davao City. The views of other stakeholders and PAPs through both on-line and face-to-face consultations are also reflected in the development of the policy and packages. The compensation policy and packages are based on and guided by Republic Act (RA) 10752 and in accordance with the JICA Guidelines for Environmental and Social Considerations (2010).

Assessed based on the criteria and conditions described in the succeeding sections, all qualified affected people are eligible for compensation and for rehabilitation/ resettlement assistance irrespective of tenure status, social or economic standing, or any such factors. All PAPs will be entitled to compensation for their lost assets at replacement cost, and to restoration of income and businesses. They will be provided with rehabilitation measures sufficient to assist them to improve or at least maintain their pre-project living standards, income-earning capacity and production levels.

(b) Cut-off dates

Based on Department Order (DO) 152 series of 2017, the determination of Project-Affected Persons (PAPs) and affected improvements shall be based on the cut-off date (COD), which is the start of the census of PAPs and tagging for improvements. The COD of eligibility pertains to the date up to which the people would be considered eligible for receiving compensation and other forms of assistance for their losses or damages caused by the project. People are considered entitled to such support only if they were found occupying, living or using, in one way or another, the project-affected area at the time of declaration of the COD.

The Cut-Off Dates (COD) in Barangay Mandug is October 14, 2021; COD for Ma-a is July 7, 2022 and Barangay 19-B is October 20, 2021. There are no PAPs (ISFs) in New Valencia and Callawa.

(c) Entitlement Matrix

Entitlement Matrix of this project that is mentioned about type of loss and eligibilities for compensation is shown as in Table 4.6.57.

Table 4.6.57 Entitlement Matrix

RESETTLEMENT ENTITLEMENT & COMPENSATION POLICIES AND SPECIFIC APPLICATION IN PROJECT SITES							
	Type of Loss	Application	Category of AH/ISF	Entitlements	Clarification	Notes on Specific Application in Project Areas	Responsible Agencies
1. Loss of Land							
1a	Loss of Land	Agricultural, residential and commercial land	Legal owners and holders of land titles, including those covered by customary rights	• Cash compensation for land at full replacement cost or land swap of equal productive value. • For customary ownership, replacement land to sustain livelihood and way of life. Land registration, stamp duty and other fees to register land ownership or right to use will be reimbursed at cost • Provision of documentary stamp duties, land registration fees and other similar taxes, if applicable, for acquiring legal rights in case of replacement land (land for land swap) Includes option of compensation at same replacement cost for affected land that remain after acquisition if remaining land becomes unviable or unusable.	If land for land is offered, title will be conjugal. Applies to partial loss of land	Land for land swap has not surfaced during PCMs with landowners. Consultations with landowners have not come to a point where arrangements will be agreed on the remaining unaffected lands after deducting the portions needed only by the project in the Retarding Ponds (RPs) & Cut Off Works (COW)areas. **Note: All lands in all project sites (RPs & COW), partially & wholly affected, are still subject to parcellary surveys to be undertaken during the DED Phase It should also be noted with emphasis that there are untitled or Alienable & Disposable land areas within the project sites identified in this report which should be excluded for purchase but should be applied for state ownership by the DPWH/ROWA Legal Office.** There are also cases of narrow strips of land especially along the river which may become unviable or inaccessible for agriculture by the landowners. These strips of land can only be visually assessed whether still useful when the parcellary surveys are completed and property monuments are laid to visually appreciate the usefulness of the remaining land.	DPWH UPMO
1b	Loss of Land	Agricultural, residential and	Tenants and Leaseholders	• No compensation for loss of land to non-legal owners of land	Will not apply to non-paying and	There is no case of tenancy in RP 11. There may be cases of leaseholders, renters and doubled-up households (two	DPWH UPMO

RESETTLEMENT ENTITLEMENT & COMPENSATION POLICIES AND SPECIFIC APPLICATION IN PROJECT SITES							
	Type of Loss	Application	Category of AH/ISF	Entitlements	Clarification	Notes on Specific Application in Project Areas	Responsible Agencies
		commercial land			undocumented lease arrangements	or more families in one house) in the COW project site in Purok 27. Tenants, leaseholders are not entitled for compensation and relocation.	
1c	Loss of Land	Agricultural, residential and commercial land	Informal Settler Families or Illegal occupants who are without land titles or proof of claim/rights to land	• No compensation is provided for land loss for anyone without land titles or claims to ownership. On the other hands, support to relocation is planned (e.g. provision of space).	However, there is an ancestral domain claim but still unfiled with the National Commission for Indigenous People (NCIP)	A 1.6-hectare untitled land (candidate relocation site A) which is currently and partly occupied by the Kagans, located right beside the lower Cut Off Works area is most suitable for a near-site relocation. If secured by the DPWH and the City, the untitled land may well turn out to be a happy solution for a near-site relocation that may save the cost of land. Candidate relocation sites B and C are also near-site alternatives	DPWH UPMO
2. Loss of Use of Land							
2a	Loss of Crops and Fruit Trees	Agricultural land	All AHs/ISFs engaged in farming	• For rice/cash crop farming: Net annual income X 1year In addition, AHs/ISFs can harvest and retain income from standing crops. • For fruit trees, replacement cost of loss based on following formula: • Quantity Harvested per Year) X (Farm Gate-Price as Market Price) X (Number of years tree will bear fruit) + Cost of Seedling	Land Bank or DBP Appraiser l determines the amounts. Market Price is based on Farm-Gate Price	The lone household in RP 11 is occupying a land with consent to use from landowner which is used as lot occupied for residence and source of planted vegetable for consumptions.	DPWH UPMO
2b	Loss of Business	Commercial land and businesses	AHs/ISFs engaged in businesses.	• For businesses which need to be relocated to a new site, an amount equal to loss of projected net income for **2** months**.** • For businesses relocated on-site (move back or same area), an amount equal to loss of projected net income for one month. • For operating of illegal nature of businesses like gambling, prostitution, drugs and similar types, no compensation is paid.	Land Bank or DBP Appraiser will determine the amounts. Both registered and unregistered businesses are compensated.	The lone ISF in RAP 11 is not engaged in business. There are no ISFs in the COW area engaged in business enterprises beyond the livelihood level.	DPWH UPMO

RESETTLEMENT ENTITLEMENT & COMPENSATION POLICIES AND SPECIFIC APPLICATION IN PROJECT SITES							
	Type of Loss	Application	Category of AH/ISF	Entitlements	Clarification	Notes on Specific Application in Project Areas	Responsible Agencies
3. Loss of Houses and Structures							
3a	Loss of Houses and Structures	Residential, commercial structures and other assets	Owners of houses, and structures	• Cash compensation equivalent to replacement value of lost portion of the house/structure. • In case of loss of only a part of the house/structure and the remaining portion becomes not livable or useable, compensation will be paid for complete structure at same replacement cost.	Land Bank or DBP appraise to determine the replacement cost.		DPWH UPMO
3b	Loss of Houses and Structures	Residential, commercial structures and other assets	Tenants and Leaseholders	• In case house/structure is rented/leased, permanent improvements will be compensated at replacement cost and paid to renter/ leaseholder. Owner will not get compensation for the improvements but compensation to the renter will be deducted from the compensation payment to the house/structure owner. • Transfer/Disturbance Allowance equivalent to **1month** of rental or lease amount.	Land Bank or DBP appraise to determine the compensation cost.	Renters and leaseholders are not eligible for relocation assistance	DPWH UPMO
3c	Loss of Houses and Structures	Residential, commercial structures and other assets	Legitimate ISFs residing inside the project affected lands.	• Cash compensation equivalent to replacement value of the loss of structures.	Land Bank or DBP appraise to determine the replacement value.	In RP 11, 3 HHs interviewed became ineligible for relocation entitlement because they owned residences outside the RP 11 nearby area. ISF should not be in the alpha list of relocation and social housing beneficiaries of the city, other LGUs, NHA and the DPWH to avoid multiple benefit of assistance and root out professional squatters.	DPWH UPMO
3d	Loss of Houses and Structures Transportation Allowance	Transport allowance for household and personal goods	AHs/ISFs	• Fixed Lump Sum allowance per AH/ISF based on average cost of transportation to new relocation place, if off-site. • If relocation is on-site or near-site, there will be no transportation allowance.	Accredited bank appraisers determine the lump sum amount.	ISF in RP 11 is provided near-site relocation. Transportation allowance is unnecessary. The three candidate relocation sites for the ISFs in the COW area, is also near-site.	DPWH UPMO

RESETTLEMENT ENTITLEMENT & COMPENSATION POLICIES AND SPECIFIC APPLICATION IN PROJECT SITES							
	Type of Loss	Application	Category of AH/ISF	Entitlements	Clarification	Notes on Specific Application in Project Areas	Responsible Agencies
4. Loss of Income and Livelihood							
4a	Transition Period - Minimum Wage	Loss of Income	AHs/ISFs who lose income during the transition relocation transfer period	• Lump sum amount equivalent to **3 months** of income based on the official monthly minimum wage in the region established by the DOLE Region XI, thus: • Monthly DOLE Minimum Wage X Months (transitional period) X 3 months	Monthly Minimum Wage as established by DOLE (Department of Labor and Employment).	The sole ISF in RP 11 is a retiree receiving monthly pension from SSS (Social Security System) aside from eventually receiving the lump sum of minimum wage set by DOLE for the region. The near-site relocation of the ISFs in COW area will not displace them from their current sources of income and social services presently enjoyed. The relocation site must however be ready for occupancy and transfer way ahead the start of any actual excavation/construction activities in the COW area. This is of utmost importance in the DED stage when relocation establishment and project infrastructure implementation schedules are intimately intertwined and well-coordinated.	DPWH UPMO LGUs
4b	Loss of livelihood source due to physical relocation	Income Restoration	AHs/ISFs who lose their source of livelihood	• Provision of employment opportunities • Shaping the flood control facilities and premises to host and demonstrate livelihood opportunities that will allow robust community participation in planning and implementation of livelihood that will spawn job creation and generate main and augmentative income sources. 1. Fruit tree production and flowering trees as source of bee honey. Production. Trees are planted on top of the river revetments and dikes as natural shade for lake-like and riverine promenade and Community Park.	Planning the flood control to integrate other economic, cultural and eco-tourism job-creating functions may be started by the flood control host Barangays with the academe, NGOs, private sector and the City LGU. Planning is suggested to be parallel to the DED phase so that multi-sector mobilization is started early on.	• Planning the Retarding Ponds and COW beyond flood control functions, and serve to effectively host other economic activities incrementally developed such as: fruit and flowering tree planting lined up along the top of retarding pond dikes/river revetments; cash crop and vegetable gardening in devoted dried pond areas between flooding periods; livestock production to trim and control weed growth inside the ponds; fish-cage and pen culture in water-retained portions of the retarding ponds; provision of labor for pond and dike weeding, repair and maintenance; and flood control as community enterprise development venue and platform of incrementally nurtured eco-tourism: trekking and leisure guided tour around	DPWH UPMO LGUs

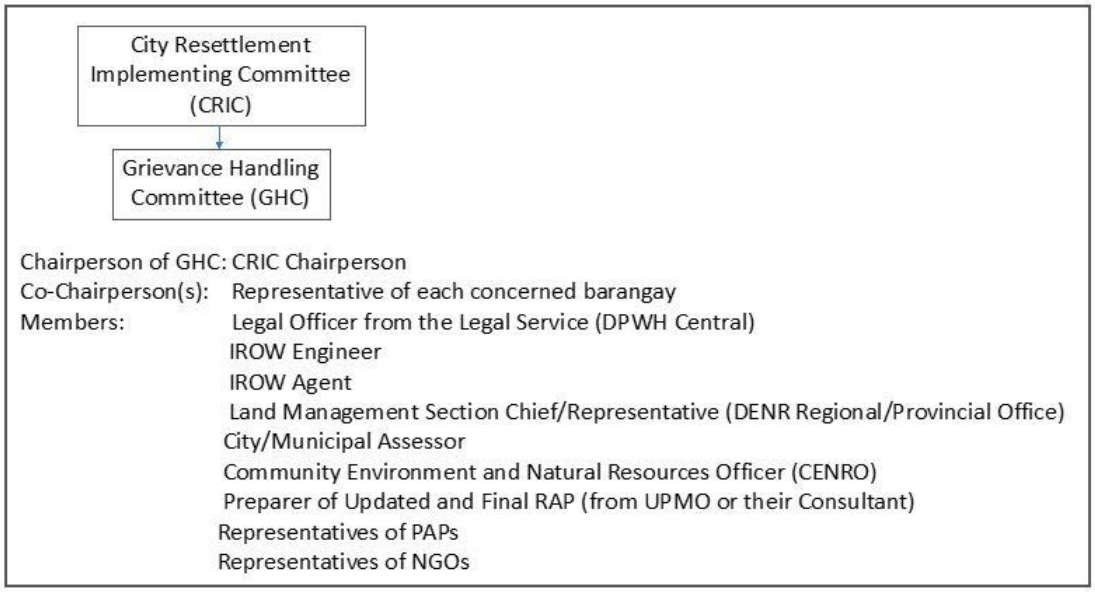
RESETTLEMENT ENTITLEMENT & COMPENSATION POLICIES AND SPECIFIC APPLICATION IN PROJECT SITES							
	Type of Loss	Application	Category of AH/ISF	Entitlements	Clarification	Notes on Specific Application in Project Areas	Responsible Agencies
				2. Incremental development of conservation hubs for: a) endemic eels, catfish and other riverine fish species; b) endemic and riverine birds and vegetation. 3. Open field facilities for inter-community, inter-Barangay sports events, cultural celebrations, and at the same time exposing guests to interest points and brief learning stops about flood control and disaster resiliency. 4. Eco-tourism destination for local tourists show-casing the 1 to 4 above The poorest and vulnerable AHs/ISFs, will be the priority at the earliest available and suitable employment opportunity. The above schemes will require coordination and serious planning among the DTI, TESDA, City LGU, DPWH, City Tourism, DENR. A local Task Force/Commission for the purpose shall be initiated by the City and DPWH.		the pond-based conservation of endemic vegetation, birds and fish species. • Retarding Pond 8 in New Valencia will attract visitors from left side of the Davao River. While Retarding Ponds 9 and 11, will attract visitors from the right side of the Davao River. • The COW area offers many possibilities for eco-tourism activities along both sides of the meandering river section as: a) walk and bike promenade, b) corridors for street food, plants, fruits and flowers, c) eco-tourism interest points, and d) short and long boat rides to and from Crocodile Park to the Coastal Road	

Source: Project Team

(6) Grievance Redressing Mechanism (GRM)

Grievance Redressing Mechanism is described the members and powers of the organization responsible for handling complaints and problems as well as the methods of grievance procedures during land acquisition and resettlement, and operation stage. The proponents (DPWH-UPMO) is responsible to address grievance related to the environmental issues.

Based on DPWH Land Acquisition, Resettlement and Rehabilitation Policy (LARRIP) and D.O. No. 152 series of 2017, a Grievance Handling Committee (GHC) shall be formed within the Resettlement Implementing Committee (CRIC- GHC) to facilitate the resolution of the PAP's grievances for both physically and non-physically displaced PAHs such as landowners without resettlement in prior to the project. Organizational chart related to the GRM is shown in following table.



Source: Project Team

Figure 4.6.22 Organizational Chart of RAP Implementation

The procedure will take effect once CRIC receives the grievance letter from PAPs. The policies based on LARRIP are as follows;

1. The PAPs will lodge their grievances by writing to the Resettlement Implementation Committee (RIC) for immediate resolution.

2. If the complaint is not satisfactorily resolved in 15 days or the PAP does not receive any response from the RIC, the PAP can forward the complaint to or file an appeal at the DPWH Regional Office (RO).

3. If the complaint is not satisfactorily resolved in 15 days or the PAP does not receive any response from the DPWH RO, the PAP can file a legal complaint in any appropriate Court of Law.

As prescribed in the LAPRAP Tracking Manual, a Grievance Action Form (GAF) shall be used during the detailed design stage to cover the various aspects of property acquisition based on validation of the RP. The GAF shall contain the following:

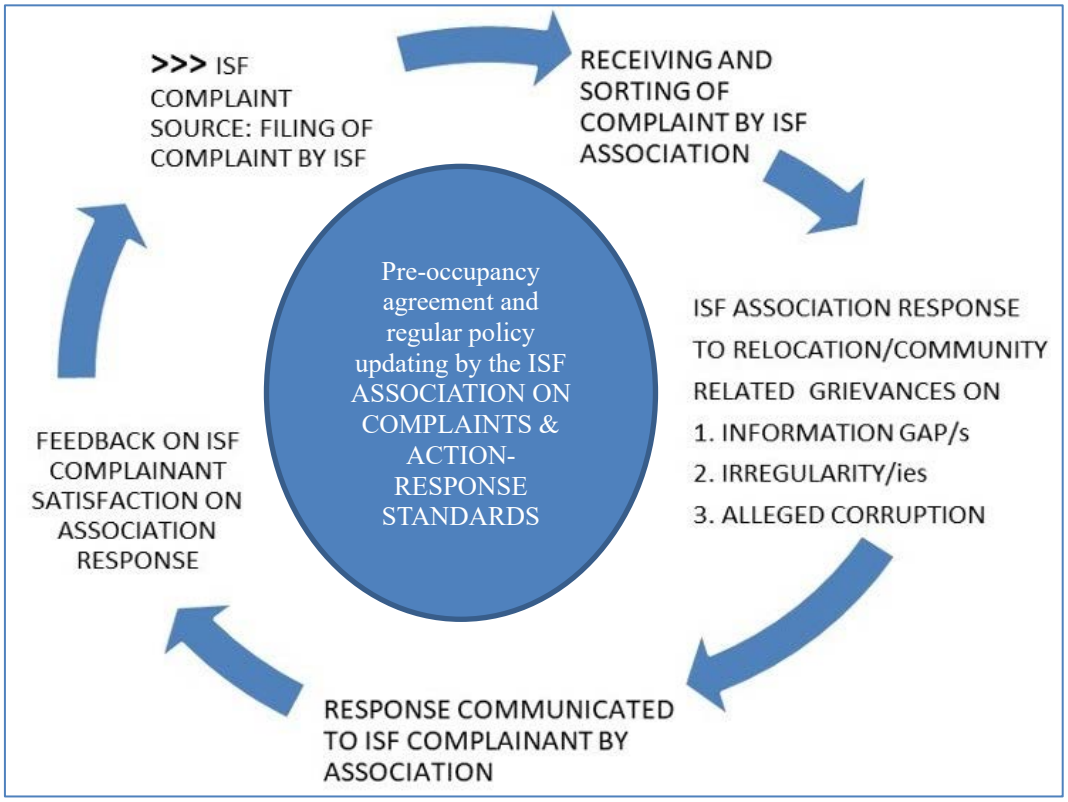
(i) Basic information on PAPs (Name, Address, Contact Number)
(ii) Date of last disclosure meeting;
(iii) Category of grievance filed (Legal, Technical/Engineering, Social, and Financial)
(iv) Type of action taken (Resolved at the CRIC level, or referred to higher authorities.

All GAFs shall be consolidated by the RIC chairperson and presented to the RIC for deliberation and appropriate action, on a weekly basis. Unresolved grievances at the RIC level shall be elevated to the respective District Engineering Offices for resolution of complaints. Recommendations of the District Engineer shall be elevated to the Regional ESSD for approval and final action. If there are still unresolved grievances, a case shall be filed in the proper courts.

PAPs shall be exempted from all administrative and legal fees incurred in pursuant to the grievance redress procedures.

All petty grievances are resolved within the association. Relocation facility management policies are best agreed by the ISFs before transferring to the relocation site and should be considered as a policy for final collective eligibility to trigger the ISF assignment of units and occupancy. This is the ground level theory and practice of community governance in the context of the relocation planning genuinely engaging the ISFs. On the matter of large criminal offenses, these shall be filed with the regular courts by the association with assistance from the City, DPWH, and HLURB. GRM operating framework being localized at the relocation community level is shown in Figure 4.6.23.

The GRM framework may be also reworked and adapted as the ISF association-level regular measure for community action-taking in improving current social and economic facilities of the relocation site. The CSOs may also be engaged in setting up the GRM and the community governance system of the relocated ISFs.

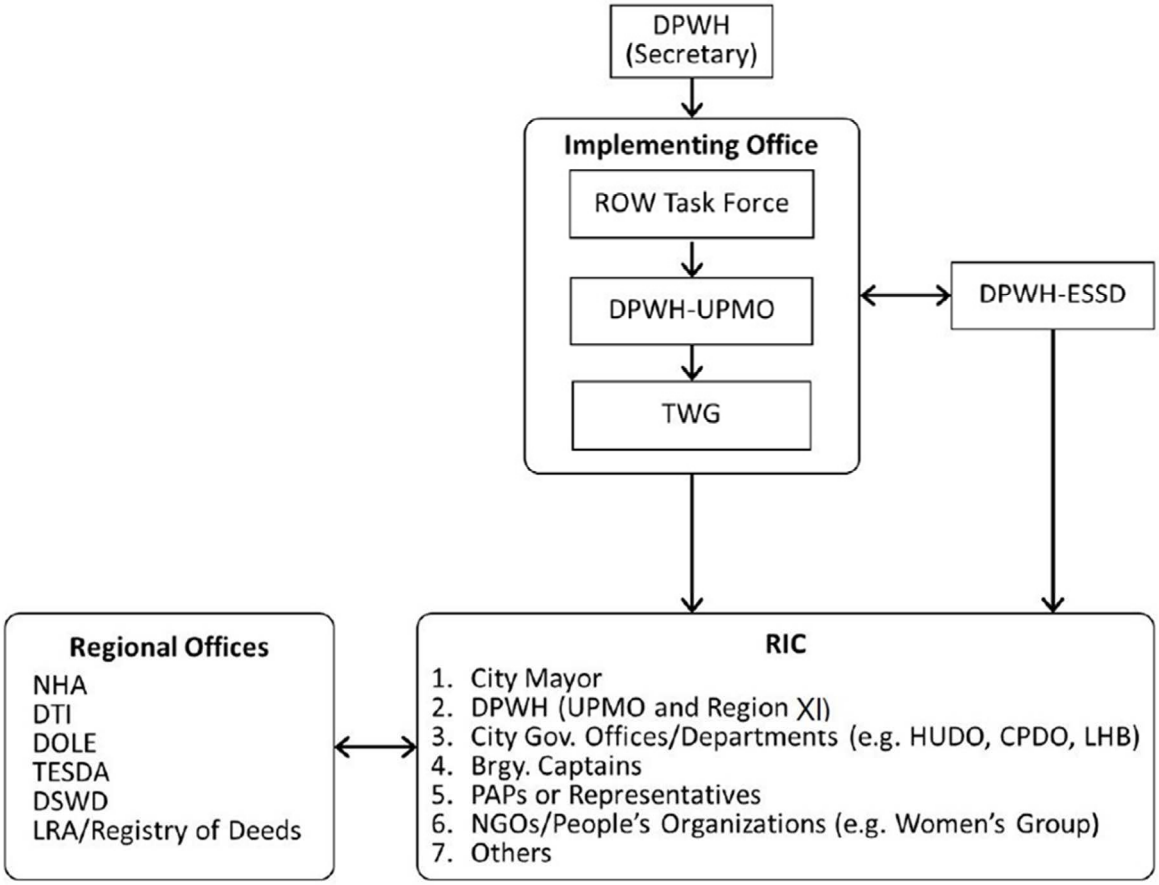


Source: Project Team

Figure 4.6.23 Grievance Redressing Mechanism

(7) Implementation System

The UPMO -FCMC, the project proponent, carries overall responsibility for the project. The managerial and supervisory body of DPWH is its UPMOFCMC. Under the UPMO-FCMC lies the ROW Task Force and the Technical Working Group (TWG) that are mandated to implement the RAP. At the local level, a Right-Of-Way/Resettlement Implementation Committee (RIC) will be set up in Davao City to assist DPWH in implementing the RAP before start project. Institutional Framework is shown in Figure 4.6.24;



Source: Project Team

Figure 4.6.24 Institutional Framework

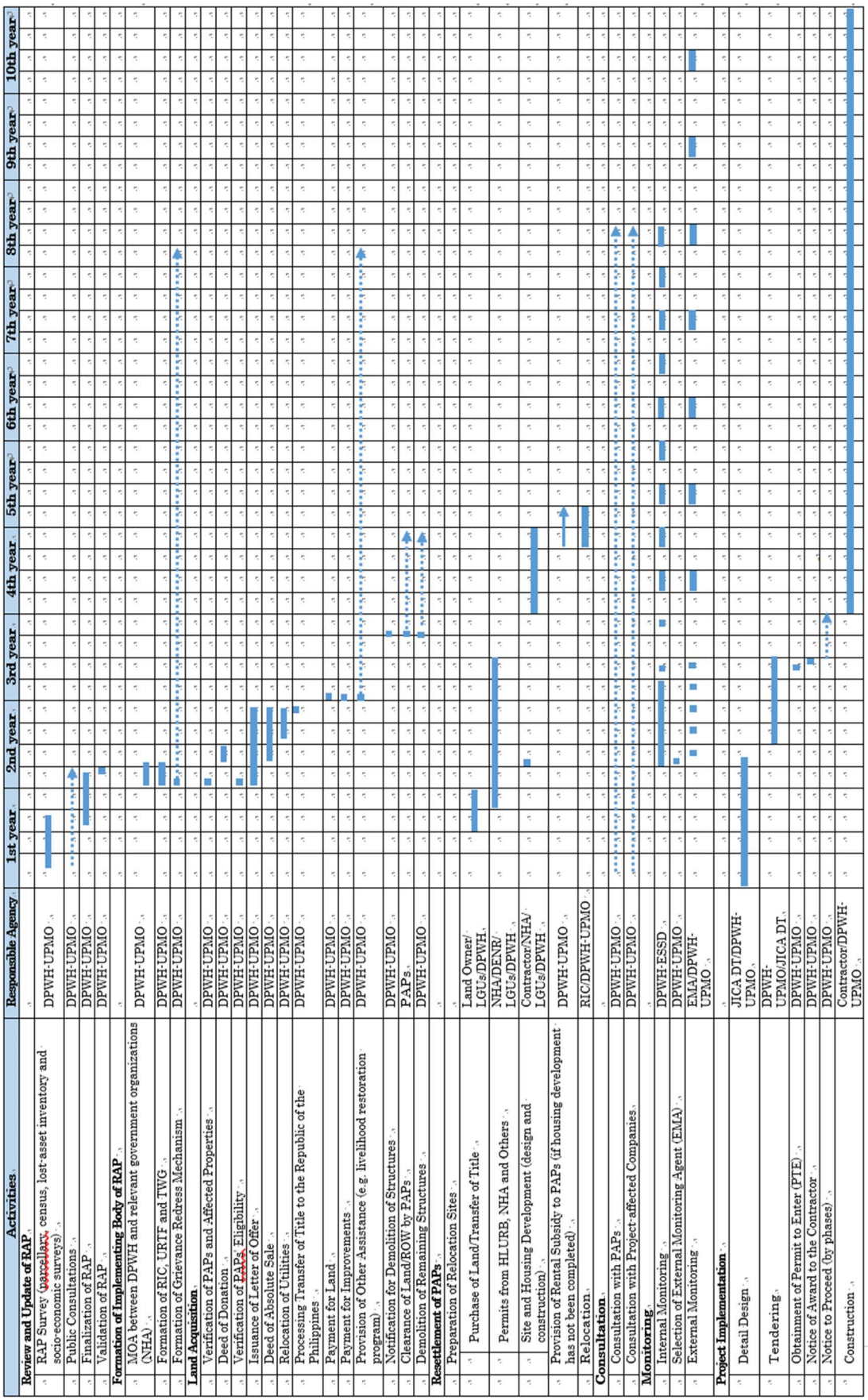
(8) Implementation Schedule

Main step and schedule to implement RAP is as following figures;

1. Review and Update of RAP	6. Grievance Redress System
2. Arrangements for Implementation of RAP	7. Monitoring of RAP Implementation
3. Compensation and Other Assistance	8. RAP for RP11
4. Relocation of PAPs	9. RAP for XX ISFs in COW area
5. Information Dissemination and Consultation	10. Synchronization of Implementation

Source: Project Team

Figure 4.6.25 RAP Implementation Schedule (Item)



Activities	Responsible Agency	1st year	2nd year	3rd year	4th year	5th year	6th year	7th year	8th year	9th year	10th year
Review and Update of RAP											
RAP Survey (parcellary, census, lost-asset inventory and socio-economic surveys)	DPWH-UPMO										
Public Consultations	DPWH-UPMO										
Finalization of RAP	DPWH-UPMO										
Validation of RAP	DPWH-UPMO										
Formation of Implementing Body of RAP											
MOA between DPWH and relevant government organizations (NHA)	DPWH-UPMO										
Formation of RIC, URTF and TWG	DPWH-UPMO										
Formation of Grievance Redress Mechanism	DPWH-UPMO										
Land Acquisition											
Verification of PAPs and Affected Properties	DPWH-UPMO										
Deed of Donation	DPWH-UPMO										
Verification of PAPs Eligibility	DPWH-UPMO										
Issuance of Letter of Offer	DPWH-UPMO										
Deed of Absolute Sale	DPWH-UPMO										
Relocation of Utilities	DPWH-UPMO										
Processing Transfer of Title to the Republic of the Philippines	DPWH-UPMO										
Payment for Land	DPWH-UPMO										
Payment for Improvements	DPWH-UPMO										
Provision of Other Assistance (e.g. livelihood restoration program)	DPWH-UPMO										
Notification for Demolition of Structures	DPWH-UPMO										
Clearance of Land/ROW by PAPs	PAPs										
Demolition of Remaining Structures	DPWH-UPMO										
Resettlement of PAPs											
Preparation of Relocation Sites											
Purchase of Land/Transfer of Title	Land Owner/ LGUs/DPWH										
Permits from HLURB, NHA and Others	NHA/DENR/ LGUs/DPWH										
Site and Housing Development (design and construction)	Contractor/NHA/ LGUs/DPWH										
Provision of Rental Subsidy to PAPs (if housing development has not been completed)	DPWH-UPMO										
Relocation	RIC/DPWH-UPMO										
Consultation											
Consultation with PAPs	DPWH-UPMO										
Consultation with Project-affected Companies	DPWH-UPMO										
Monitoring											
Internal Monitoring	DPWH-ESSD										
Selection of External Monitoring Agent (EMA)	DPWH-UPMO										
External Monitoring	EMA/DPWH-UPMO										
Project Implementation											
Detail Design	JICA DT/DPWH-UPMO										
Tendering	DPWH-UPMO/JICA DT										
Obtainment of Permit to Enter (PTE)	DPWH-UPMO										
Notice of Award to the Contractor	DPWH-UPMO										
Notice to Proceed (by phases)	DPWH-UPMO										
Construction	Contractor/DPWH-UPMO										

Source: Project Team

Figure 4.6.26 RAP Implementation Schedule

(9) Cost and Budget

(a) Compensation Cost for Land

There is a total of about **212.48 ha** of affected lands for acquisition as mention before. There are **9 untitled properties (18.5 ha)** identified across project site, without evidence of registration, tax declaration and payment. These 9 properties (18.5 ha) are not included for compensation.

Based on the Guidelines for the qualifications of PAPs, Entitlements and Compensations of D.O. 327, Series of 2003, "PAPs who will lose **more than 20% of their assets** because of the need to acquire right-of-way for the implementation of an infrastructure project or their remaining land or structure is no longer viable for continued use or occupancy. The PAPs who will lose those assets will be entitled to full payment of the fair market value of the entire land and the full replacement cost of the entire structure and other improvements affected.

PAPs who will lose **less than 20% of their assets** because of the ROW to be acquired for the project or if the remaining structure that is affected is still viable for continued use or occupancy. The PAPs who will lose those assets will be entitled to full payment for the fair market value of the land to be taken and the full replacement cost of the portions of the structures and other improvements affected". Therefore, total land that will be compensated are **275.05** ha and shown in Table 4.6.58

Table 4.6.58 Total Land area for Compensation

Project Components	Location	Marginally Affected		Severely Affected		Total Land Area for Compensation (ha)
		AH	Land Area for Compensation (ha)	AH	Land Area for Compensation (ha)	
RP8	New Valencia	1	0.10	25	112.95	113.05
RP9	Callawa	4	1.14	17	44.45	45.59
RP11	Mandug	3	1.96	24	76.62	78.58
COW	Maa & 19-B	9	9.13	13	28.70	37.83
Project Total		17	12.33	79	262.72	**275.05**

Source: Project Team

Table 4.6.59 shows the estimated cost for acquiring the land for the project by barangay based on the Current Market Value (CMV) and applying the guidelines for the qualification of PAPs and extent of impact (severity) of the project. The direct cost for acquiring the lands for the project is **PhP 8,985,935,000.00.** This is the net negotiated cost excluding Capital Gain Tax (CGT), VAT, notarial and operational expenses, documentary stamp tax, and transfer tax, among others, which is computed at 12 % of the direct cost of the land. The total cost of land acquisition with taxes is **PhP 10,064,247,200.00.**

Table 4.6.59 Cost for acquiring Land base of CMV

Project Component	Location	Total Land Area for Compensation (ha)	Land Classification	CMV (PhP/m^2)	Cost (PhP)
A	B	C	D	E	C*E*10,000
RP 8	New Valencia	113.05	Agricultural	2,000.00	2,261,000,000.00
RP 9	Callawa	45.59	Agricultural	2,000.00	911,800,000.00
RP 11	Mandug	78.58	Agricultural	3,000.00	2,357,400,000.00
COW	Ma-a & 19-B	22.93	Agricultural	3,600.00	825,480,000.00
		4.98	Residential	3,600.00	179,280,000.00
		1.96	Residential (High end)	24,800.00	486,080,000.00
		0.97	Commercial	20,250.00	196,425,000.00
		6.99	Commercial (COW-17)	25,300.00	1,768,470,000.00
Sub Total		**275.05**			**8,985,935,000.00**
CGT, VAT, Tax, others (12%)					**1,078,312,200.00**
TOTAL COST (PhP)					**10,064,247,200.00**

Source: Project Team

(b) Compensation Cost for Trees

Compensation cost for project affected household trees are shown in Table 4.6.60.

Table 4.6.60 Compensation Cost for project affected Trees

Type of Trees	Barangay				Total	Unit Cost (PhP)	Total Cost (PhP)
	New Valencia (RP8)	Callawa (RP9)	Mandug (RP11)	Ma-a (COW)			
Banana (Local)	11,468	12,350	38,501	3,985	66,304	280	18,565,120
Banana (Cavendish)		4,674			4,674	960	4,487,040
Cacao	292				292	320	93,440
Coconut	1,223			20	1243	2730	3,393,390
Fruit Trees (RP8)	1,185				1,185	3435	3,393,390
Fruit Trees (COW)				24*	24		90,450
Trees (Lesser Used)	216	757	936		1909	215	410,435
Trees (Premium)	400				400	7,950	3,180,000
TOTAL							**33,613,265.00**

Source: Project Team

(c) Compensation Cost for Structures

Compensation cost for project affected structures are shown in Table 4.6.61.

Table 4.6.61 Compensation Cost for dwelling unit

Location	Materials Used	No. of Units	Total Floor Area (m^2)	Computed Average Value per Floor Area (PhP/m^2)	Total Cost (PhP)
(a)	(b)	(c)	(d)	(e)	(f) = (d) x (e)
Mandug (RP 11)	**Light materials (cogon, nipa, anahaw, wood)**	**4**	**78.00**		
	Light/Salvage Materials	4	78.00	2,220.00	173,160.00
Ma-a (COW)	**Strong materials (galvanized iron, tile, concrete, brick stone);**	**11**	**834.44**		
	Concrete with Arch Finishes	8	584.45	6,750.00	3,945,010.00
	Concrete	3	250.00	4,500.00	1,125,000.00
	Light materials (cogon, nipa, anahaw, wood);	**19**	**871.02**		
	Semi-Concrete	1	50.00	3,700.00	185,000.00
	Light/Salvage Materials	18	821.02	2,220.00	1,822,664.00
	Mixed but predominantly strong materials;	**50**	**4,567.67**		
	Concrete with Arch Finishes	1	120.00	6,750.00	810,000.00
	Concrete	48	4,347.67	4,500.00	19,564,515.00
	Semi-Concrete	1	100.00	3,700.00	370,000.00
	Mixed but predominantly light materials;	**47**	**3,365.18**		
	Concrete	1	20.18	4,500.00	90,810.00
	Semi-Concrete	39	2,765.00	3,700.00	10,230,500.00
	Light/Salvage Materials	7	580.00	2,220.00	1,287,600.00
	Salvaged/makeshift materials;	**2**	**100.00**		
	Light/Salvage Materials	2	100.00	2,220.00	222,000.00
	Others (Unfinished)	**4**	**490.00**		
	Light/Salvage Materials	4	490.00	2,220.00	1,087,800.00
Total					**40,740,899.00**

Source: Project Team

Table 4.6.62 Compensation Cost for other Structures

Location	Structure Type	Count	Average of Unit Cost / m^2	Average of Cost per Structure	Total Cost (PhP)
New Valencia (RP8)	Agri-Related Facility	1	2,500	5,000	5,000
Callawa (RP9)	Agri-Related Facility	2	9,375	375,000	750,000
	Concrete Products Facility	1	15,000	1,500,000	1,500,000
Mandug (RP11)	Water Facility	1	10,000	3,000,000	3,000,000
Maa (COW)	Madrasah	2	17,500	1,000,000	2,000,000
	Mosque	2	17,500	1,000,000	2,000,000
	Covered Court	1	15,000	7,500,000	7,500,000
	Recreational Facility	1	17,500	2,500,000	2,500,000
	Concrete Products Facility	1	6,250	750,000	750,000
	Water Facility	1	5,000	20,000	20,000
	Agri-Related Facility	1	17,500	1,500,000	1,500,000
TOTAL					**21,525,000**

Source: Project Team

Table 4.6.63 Compensation Cost for Transmission Towers and Electric Posts

Location	Structure Type	Count	Total Cost (PhP)	Source of Valuation
Callawa (RP9)	Transmission Tower	2	**80,840,148.05**	National Grid Corporation of the Philippines (NGCP)
Mandug (RP11)	Electric Post	11	**660,000.00**	Davao Light & Power Company (DLPC)

Source: Project Team

(d) Cost for Development of Resettlement Site

Cost for development site (RP11, COW phase1 and 2) are shown in following tables.

Table 4.6.64 Construction/Procurement cost and land acquisition cost (RP11)

Work Item	Quantity	Unit	Unit Cost (Php)	Amount (Php)	Total (Php)
1. Construction Cost					175,678.57
2. Land Acquisition Cost: RP 11, lot in Sitio Lapuy	100.00	sqm	500.00	50,000.00	50,000.00
3. No site development cost of 100 sqm lot					
4. Survey Cost			150.00	15,000.00	15,000.00
5. Land Titling			100.00	10,000.00	10,000.00
Total					**250,678.67**

Source: Project Team

Table 4.6.65 Construction/Procurement cost and land acquisition cost (COW phase1)

ITEM NO.	DESCRIPTION	UNIT COST	UNIT	QTY	Amount (PhP)
A. SITE DEVELOPMENT COST					
1.00	PRELIMINARIES				**150,000.00**
2.00	EARTHWORKS				**1,662,600.00**
3.00	ROAD CONCRETING AND DRAINAGE SYSTEM				**745,337.10**
4.00	EXTERIOR WATER LINE SYSTEM				**184,000.00**
5.00	EXTERIOR ELECTRICAL WORKS				**645,300.00**
B. MEDIUM RISE BUILDINGS (MRBs)– Phase 1					
6.00	MEDIUM RISE BUILDINGS (MRB)				

ITEM NO.	DESCRIPTION	UNIT COST	UNIT	QTY	Amount (PhP)
6.10	MRB 1	32,956,000.00	LOT	1.00	32,956,000.00
6.20	MRB 2	32,956,000.00	LOT	1.00	32,956,000.00
6.30	MRB 3	32,956,000.00	LOT	1.00	32,956,000.00
SUBTOTAL for 3 MEDIUM RISE BUILDINGS (Item 6 only)					**98,868,000.00**
TOTAL OF SITE DEVELOPMENT & MRBs (Items 1-6 above)					**102,255,237.10**
7.10	OVERHEAD, CONTINGENCIES, MISCELLANEOUS - 15%				15,338,285.57
7.20	CONTRACTOR'S PROFIT -10%				10,225,523.71
7.30	VALUE ADDED TAX (VAT) - 5%				6,390,952.32
8.00	COST OF LAND				57,600,000.00
TOTAL ESTIMATED PROJECT COST FOR PHASE 1					**191,809,998.70**
					Area: 1.60 has
					At 3600/sqm

Source: Project Team

Table 4.6.66 Construction/Procurement cost and land acquisition cost (COW phase2)

ITEM NO.	DESCRIPTION	UNIT COST	UNIT	QTY	Amount (PhP)
A. SITE DEVELOPMENT (Items 1-6)					
1.00	PRELIMINARIES				**200,000.00**
2.00	EARTHWORKS				**100,000.00**
3.00	ROAD CONCRETING AND DRAINAGE SYSTEM				**3,927,490.80**
4.00	EXTERIOR WATER LINE SYSTEM				**184,000.00**
5.00	EXTERIOR ELECTRICAL WORKS				**1,080,600.00**
SUBTOTAL SITE DEVELOPMENT (Items 1-5)					
6.00	MEDIUM RISE BUILDING (MRB)				
6.10	MRB 1	32,956,000.00	LOT	1.00	32,956,000.00
6.20	MRB 2	32,956,000.00	LOT	1.00	32,956,000.00
6.30	MRB 3	32,956,000.00	LOT	1.00	32,956,000.00
SUBTOTAL - 3 MEDIUM RISE BUILDINGS					**98,868,000.00**
7.00	**AMENITIES**				
7.10	TWO-STOREY OFFICE BUILDING	23,000.00	SQM	120	2,760,000.00
7.20	PARKS & PLAYGROUNDS				0.00
7.30	PROMENADE AND LANDSCAPE				0.00
	SUBTOTAL - AMENITIES				**2,760,000.00**
ESTIMATED TOTAL COST OF ITEMS 1-7					**107,120,090.80**
	OVERHEAD, CONTINGENCIES, MISCELLANEOUS - 15%				16,068,013.62
	CONTRACTOR'S PROFIT -10%				10,712,009.08
	VALUE ADDED TAX (VAT) - 5%				6,695,005.68
TOTAL PROJECT COST FOR PHASE 2					**140,595,119.18**

Source: Project Team

(e) Cost for Development of Resettlement Site

Cost for resettlement and additional assistance to be provided to vulnerable groups are estimated to be **PhP 4,105,000.00**.

Table 4.6.67 Cost for Resettlement and Assistance to Vulnerable Group

Particulars	Unit Price	Number of PAPs	Total Cost (PhP)
Rehabilitation Assistance	PhP 15,000.00	104	1,560,000.00
Inconvenience Compensation	PhP 10,000.00	96	960,000.00
Transportation Assistance	PhP 5,000.00	104	520,000.00
Financial Assistance (Subsistence Allowance) PAPs who own land used for agricultural purposes that are severely affected only	PhP 15,000.00	71	1,065,000.00
		Total	**4,105,000.00**

Source: Project Team

(f) Cost for Monitoring

PhP 25,000,000.00 is allocated to cover the cost for both internal and external monitoring.

(g) Total Cost for RAP Implementation

The total cost for implementation of land acquisition and resettlement is estimated to be approximately **PhP 12,193,895,404.89**. This amount covers the costs for compensating affected lands, replacement costs for structures and improvements, cost for the development of the resettlement site, cost for implementing the livelihood restoration program, resettlement and assistance for vulnerable groups, and the cost for monitoring.

Table 4.6.68 Cost for Resettlement and Assistance to Vulnerable Group

No.	Items	Amount (PhP)	Remarks
1	Compensation Cost for Land	10,064,247,200.00	
2	Compensation Cost for Trees and Crops	33,613,265.00	
3	Compensation for HH Dwelling Units	40,740,899.00	
4	Compensation for Other Structures	21,525,000.00	
5	Compensation for DLPC Electric Posts	660,000.00	
5	Compensation for Transmission Tower	80,840,148.05	
6	Cost for Development of Resettlement Site in Mandug	250,678.67	
7	Cost for Development of Resettlement Site in Maa-Phase 1	191,809,998.70	
8	Cost for Development of Resettlement Site in Maa-Phase 2	140,595,119.18	
9	Cost for Resettlement and Assistance to Vulnerable Groups	4,105,000.00	
10	Cost for Monitoring	25,000,000.00	
	SUB-TOTAL	**10,603,387,308.60**	
11	Administrative & Contingency	1,590,508,096.29	15 %
TOTAL		**12,193,895,404.89**	

Source: Project Team

(10) Monitoring System and Monitoring Form

1) Purpose of Monitoring RAP Activities

The primary purposes of Monitoring and Evaluating of RAP activities are:

- ✓ To ensure that resettlement is carried out in accordance with the RAP;
- ✓ To check the progress made in the associated activities; and
- ✓ To identify any issues or problems that may arise during the course of RAP implementation at an early stage so that measures can be taken to address the problem without delay.

The activities subject to monitoring include:

- ✓ land acquisition,
- ✓ payment of compensation for lost assets,
- ✓ resettlement of the people affected by the project, and
- ✓ release of funds.

It is required under JICA Guidelines that the PAPs livelihoods are at least restored, if not improved, compared to pre-project levels. It is part of the goal of monitoring to confirm whether this condition has indeed been met.

2) Internal Monitoring

ESSD will conduct the evaluation and in-house monitoring of RAP implementation and will serve as the internal monitoring agent (IMA) supported by the consultants. The tasks assigned to the IMA are the following:

- ✓ Regularly supervise and monitor the implementation of RAP in coordination with the RIC. The findings will be documented in a quarterly report that is to be submitted to UPMOFCMC;
- ✓ Verify that the re-inventory baseline information of all PAPs has been carried out and that the valuation of assets lost or damaged, the provision of compensation and other entitlements, and relocation have been carried out in accordance with LARRIPP and RAP;
- ✓ Ensure that RAP is implemented as designed and planned;
- ✓ Verify that the funds for RAP implementation are provided by UPMO-FCMC in a timely manner and in the amount sufficient for the purpose; and
- ✓ Record all grievances and their resolution and ensure that complaints are dealt with promptly.

3) External Monitoring and Evaluation

The UPMO-FCMC of DPWH will commission an external monitoring agent (EMA) to undertake independent monitoring and evaluation. The rationale of using third parties to assess the status and performance of a project, its compliance status, or emerging issues through a specialized party is to provide an unbiased perspective on the issue and status of the project, and to make recommendations for improvement. The tasks of the EMA are to:

- ✓ Verify the results of internal monitoring;
- ✓ Verify that the compensation process has been carried out in an open and transparent manner with sufficient communication and consultations with the PAPs;
- ✓ Review how the affected assets were evaluated and compensation amount determined;
- ✓ Assess the efficiency, effectiveness, impact and sustainability of activities associated with resettlement and RAP implementation;

- ✓ Assess if resettlement objectives have been met, specifically if livelihoods and living standards have been restored or improved;
- ✓ Review the way in which complaints and grievances had been handled; and
- ✓ Suggest modifications in the implementation procedures of RAP, if necessary, to better achieve the principles and objectives of the resettlement policy

4) Framework of Monitoring Activities

Framework of Monitoring Activities are shown as following table;

Table 4.6.69 Framework of Monitoring Activities

Monitoring Activity	Description	Frequency/Schedule	Monitoring Agent Responsible
Preparation of Inception Report and Compliance Monitoring Report	To determine the scope of the monitoring activities to be carried out	One month after receipt of Notice to Proceed for the engagement of IMA/EMA	IMA, EMA
Monitoring and Evaluation during RAP Implementation	Monitoring of RAP implementation activities	Monthly (for IMA) and Quarterly (for EMA) until end of RAP implementation	IMA, EMA
Interim Evaluation	Interim evaluation of the implementation of RAP to verify if the social and economic conditions of the PAPs have been restored after delivery of compensation and other assistance *If PAPs are found worse off in terms of standard of living and livelihood, DPWH in coordination with concerned institutions shall provide assistance such as livelihood and skills training.	Three months after completion of compensation payments to and resettlement of PAPs	EMA
Monitoring and Evaluation during Construction	To follow up if the social and economic conditions of the PAPs after project implementation have improved or are been restored *If PAPs are found worse off in terms of standard of living and livelihood, DPWH in coordination with concerned institutions shall provide assistance such as livelihood and skills training.	Every six months (for IMA) and every 12 months (for EMA) until one year after completion of construction	IMA, EMA
Final Evaluation	To confirm if social and economic conditions of the PAPs after project implementation have improved or are at least been restored	One and two years after completion of the project	IMA, EMA

Source: Project Team

(11) Public Consultations

Public Consultations (PC) are crucial for any proposed projects as these provide venues for disclosure and generate feedback relevant for consideration of project designs and other components. These consultations also create a bridge between project proponents and affected communities to do dialogue and settle concerns in a more amicable manner.

The organized consultations for the project presented the following:

1) Objectives of the Orientation/Consultation
2) Presentation of JICA-RAP Study covering a) Master Plan and Feasibility of the Flood Control and Drainage Project in Davao City, b) RAP Objectives and Components, and c) RAP Processes
3) Open Forum - Clarifications about Project and Discussion of Issues/Concerns
4) Roles of the Barangay

Three layers of consultations were done for project dissemination and feedback. Each layer focused on specific stakeholders. Announcement conducting the PCM have been done around 1 month before of PC through Barangay Chief or administration. Barangay administration informed residents including vulnerable people about PCM. Method of meeting adopted both face to face and online. Usually Visaya (local) language were using during PCM. And During the RAP consultations, a project information brochure was distributed to all participants.

1) Coordination and Consultation Meetings with BLGUs, MLGUs, CSOs, and Line Agencies
2) First Round Public Consultation Meetings (PCMs) with PAPs (including ISFs)
3) Second Round Consultation Meetings (PCMs) with PAPs (including ISFs)

Table 4.6.70, Table 4.6.71, Table 4.6.72 and Table 4.6.73 are outline of Consultation Meetings and Presentation.

Table 4.6.70 Consultation Meeting with LGUs, CSOs and Line Agencies

Areas Covered	Date and Venue	LGU/Sector Concerned	Number of Participants	
			LGUs/LGAs, CSOs	RAP Team & Partners**
Brgy. New Valencia and Brgy.Talandang*	October 12, 2021 New Valencia Barangay Hall	Barangay Captain, councilors, concerned purok leaders and staff	8 Male 5 Female 3	9 Male 6 Female 3
Brgy. Callawa	October 13, 2021 Barangay Hall	Barangay Captain, councilors and staff	6 (M4, F2)	10 (M6, F4)
Brgy. Mandug	October 13, 2021 Barangay Hall	Barangay Captain, councilors and concerned purok leader	6 (M4, F2)	11 (M8, F3)
Brgy. Ma-a	October 19, 2021 Barangay Hall	Barangay Captain, councilors, concerned purok leader and staff	7 (M6, F1)	15 (M11, F4)
Brgy. 19-B	October 19, 2021 Barangay Hall	Barangay councilors and staff	5 (M2, F3)	15 (M12, F3)
Davao City	October 26, 2021 via Zoom (online)	Local government units and agencies	10 (M7, F3)	12 (M8, F4)
Davao City	October 26, 2021 via Zoom (online)	Civil society/non-government organizations, Academe	8 (M5, F3)	11 (M9, F2)
Brgy. New Carmen	November 9, 2021 Barangay Hall	Barangay Captain, councilors, purok leaders and staff	15 (M8, F7)	13 (M9, F4)
Brgy. 8-A	November 11, 2021 Barangay Hall	Barangay Captain, councilor, purok leaders and staff	17 (M6, F11)	9 (M4, F5)

* Barangay officials from Talandang were invited upon the initiative of the officials of Brgy. New Valencia. This is because direct supervision over the residents and property owners in the RAP proposed site is under Brgy. Talandang though political jurisdiction is under Brgy. New Valencia.
** RAP Partners include Project Team, DPWH -District Office, City Planning and Development Office-Housing Division and RAP Study Team
Source: Project Team

Table 4.6.71 1st Round Consultation Meetings with PAPs

Areas Covered	Date and Venue	LGU/Sector Concerned	Number of Participants	
			Landowners/Affected households	RAP Team & Partners
Brgy. 19-B	October 22, 2021 Barangay Hall	Affected Landowners and barangay officials	4 (M2, F2)	16 (M11, F5)
Purok 27, Brgy. Ma-a	October 25, 2021 Purok Gymnasium	Affected Households (community leaders and members)	did not want to sign in attendance sheet	12 (M9, F3)
Brgy. Talandang and New Valencia	November 9, 2021 Barangay Hall	Land/Property Owners*, renters and Barangay officials	17 (M9, F8)	15 (M11, F4)
Brgy. Callawa	November 10, 2021 Barangay Hall	Land/Property Owners	5 (M1, F4)	15 (M7, F8)
Brgy. Mandug	November 10, 2021 Barangay Gymnasium	Land/Property Owners, sand and gravel operators, and affected households from Sitio Lapuy	13 (M10, F3)	20 (M12, F8)
Brgy. Ma-a	November 11, 2021 Barangay Hall	Barangay Captain and Deputy Mayor for Kagan with Assistant	3 (M3, F0)	11 (M3, F8)
Brgy. Maa	November 16, 2021 Barangay Hall	Purok 27 Community Leaders/Affected households, barangay official and Deputy Mayor for Kagan	4 (M4, F0)	7 (M3, F4)

* Land and property owners include both private individuals and representatives of privately owned companies
Source: Project Team

Table 4.6.72 RAP study/Survey Results Presentation

Areas Covered	Date and Venue	LGU/Sector Concerned	Number of Participants	
			Affected individuals/ Potential partners	RAP Team & Partners
Sitio Lapuy, Brgy. Mandug	December 9, 2021, LABEARBCO Building, Sitio Lapuy, Mandug	Affected households	6* (M2, F4)	7 (M6, F1)
Davao City	December 15, 2021, via Zoom (online)	Local government units and agencies, CSOs/NGOs	19 (M12, F7)	15 (M7, F8)

*Two are representatives of households who only live temporarily inside RP 11 hence, not included in the survey. One participant works with LABEARBCO but not directly affected by project.
Source: Project Team

Table 4.6.73 2nd Round Consultation Meetings with PAPs

Areas Covered	Date and Venue	LGU/Sector Concerned	Number of Participants	
			Landowners/Affected households	RAP Team & Partners
New Valencia	18 July 2022, Barangay Hall, Barangay Talandang	Affected Landowners	11 (M7, F4)	8 (M5, F3)
Callawa	19 July 2022 AM 2/F Conference Room, Planning and Design Division, DPWH RXI Office, Davao City	Affected Landowners	14 (M6, F8)	11 (M8, F3)
Mandug	19 July 2022 PM 2/F Conference Room, Barangay Hall, Brgy, Mandug	Affected Landowners	10 (M7, F3)	3 (M1, F2)
Upper Ma-a, Purok 27, Ma-a	17 August 2022, Ma-a Barangay Hall, Davao City	Affected Heirs of Padaman (Ma-a)	33 (M16, F17)	10 (M6, F4)
Lower Ma-a in Purok 27, Ma-a	17 August 2022, Ma-a Barangay Hall, Davao City	Affected House Owners and Renters	64 (M33, F31)	10 (M6, F4)
Ma-a	24 August 2022, Barangay Hall, Barangay Ma-a	Affected Landowners	2 (M2, F0)	3 (M1, F2)

Source: Project Team

➢ **Summary of issues**

Summary of the major issues and concerns raised and suggestions during each round of the consultations are presented in Table 4.6.74. Major issues and concerns raised relate to:

- more detailed information about project components (specific boundaries, size, depth, project start and duration, etc.), particularly the cut-off works which has been perceived as creating more impacts, not only in terms of displacement but even environmentally;
- compensation specifically basis of appraisal, eligibility and payment schedule;
- relocation process and sites;
- alternative income and support;
- effect on existing quarry operations; and
- Negotiation processes.

A major comment has been the delays in compensation payments related to previous DPWH projects creating some apprehensions among property owners. Suggestions point to:

- more visual and technical presentation of the project components;
- review and revision of cut-off works design to prevent large displacement and impacts on other properties;
- provision of regular platform for inclusive participation of various stakeholders (PAPs and non-PAPs) in project development;
- consideration of other protection revetments such as gabion improvement;
- potential hiring and prioritization of affected barangay members in construction work during project implementation;
- consideration allowing quarry operators to do dredging works during project implementation;
- improvement of DPWH payment scheme and processes; and
- Resolution of long-standing barangay boundary disputes by City Council.

Table 4.6.74 A Part of the results of Public Consultations

Participant	Issues and Concerns/Comments	Responses	Suggestions
Project Information/Details			
New Valencia	What is exact area that will be affected in the barangay? Who is project contractor?	Most affected under Purok Saging (Bonggan) in New Valencia/ Talandang. No project contractor at the moment; JICA providing technical assistance.	It would be good for affected areas to see the structural design, for clear visualization.
New Carmen, Ma-a, CSOs CDRRMO	What is the volume capacity of the retarding pond? Width of river for widening? Mentioned inefficiency of multiple flood control measures of DPWH. In relation to RPs, these can be 'overwhelmed' and water will return to the river and cause overflow. Focus should be on the people in the impact areas and bring them to a safe location.	DPWH representative responded that the details will be provided once the Master Plan is completed. As of the moment, everything is under assessment and only proposals. Once these are approved, the team will come back to present the proposed design with all the necessary details. For river widening, this will be 30 meters both sides.	CDRRMO - Focus on relocation to safer areas of vulnerable communities to flooding.
DENR RXI, CDRRMO	Concern on cut-off works - The water flow will increase and create a destructive effect on the lower portion of the river. It will also cost a lot of money; no matter the solution, the river will be	DPWH DEO: River shortening will increase water velocity by 20%, speeding up water flow from river to the sea plus consider river widening on both sides. Both the cut-off and RPs are efficient based	DENR RXI - Recommended to do inventory of trees that might be cut down due to the project - resettlement action is not just resettlement of humans. Also, other erosion

Participant	Issues and Concerns/Comments	Responses	Suggestions
Project Information/Details			
	'overwhelmed.' Funds must be allocated for relocation of people near these areas. Areas near the river bed should not have private land titles and no subdivisions near these areas as these are prone to flooding.	on Japan's experience. These are just plans and needs further study but confident that flooding in the city will be mitigated with the implementation of the Master Plan. As to erosion control, there is no specified countermeasure yet.	control measures be considered with river widening plus look into subdivisions nearby.
CSOs	Request to have a copy of the project Master Plan to understand the project better	DPWH RXI representative noted there is an initial master plan and it can be shared to the public.	Write to DPWH Regional Director to request for a copy of initial Master Plan.
Affected Property and Compensation			
Ma-a, Callawa, Mandug	Brgy. Captain shared bad experience with previous DPWH project, making it difficult for some constituents to believe in offer of just compensation. Sometimes government is only good in persuading people but does not deliver on promise. In past experience, affected individuals were only compensated P5000 for damages, and some have not received compensation. Why is compensation payment taking so long? Those affected have complained about this as compensation was not provided for more than a year or so.	DPWH District Engineer assured that there will be just compensation. He shared the preliminary plan for the relocation site and facilities and emphasized this is a JICA-supported project. Based on his Japan experience, he presented that just compensation provided was very generous, using the market value of the property affected for the government project. *NOTE: No DPWH representative present during initial consultation in Callawa.*	Write and file a complaint to the DPWH Regional Office regarding delayed compensation. We should correct this practice of delayed payment so that the project will run smoothly, with no disruptions.
New Valencia	Most lands to be affected are privately owned and titled; no households or informal settlers.	In case there are no titles, DPWH will verify these with the Bureau of Lands. DPWH will finalize once they have the [legal] instruments that can identify the affected areas.	-
Ma-a	Which will come first - payment for land or structure? Government should pay for land first so we can look for an area where to transfer. Fair market value should be easy if the institutions and their personnel will do their job.	Structure will be compensated first as it does not entail legal documents and other documentation. For land, it will be a tedious process. The Development Bank of the Philippines will provide the standard for computing the fair market value. Payments for lands and structures are different.	Payment for land and structure should be done together. How can people transfer and look for property if they do not have the money?
Ma-a	In case of those renting the house, are they included to receive compensation? Or in the case of those who owns the house but is renting the land only, will they be compensated?	No, only the owner of the house/structure will be compensated. If they own the house (not the land), they can be compensated or can opt for resettlement.	-
Relocation			
DENR RXI	What will happen to those who will not qualify for resettlement?	CPDO-Housing: At the city level, they can be referred to apply for the Community Mortgage Program and apply for loans from the Social Housing Finance Corp. through their associations.	Suggested this program should be added to the action plan as a proactive measure

Source: Project team

4.7 Project Implementation

4.7.1 Project Organization

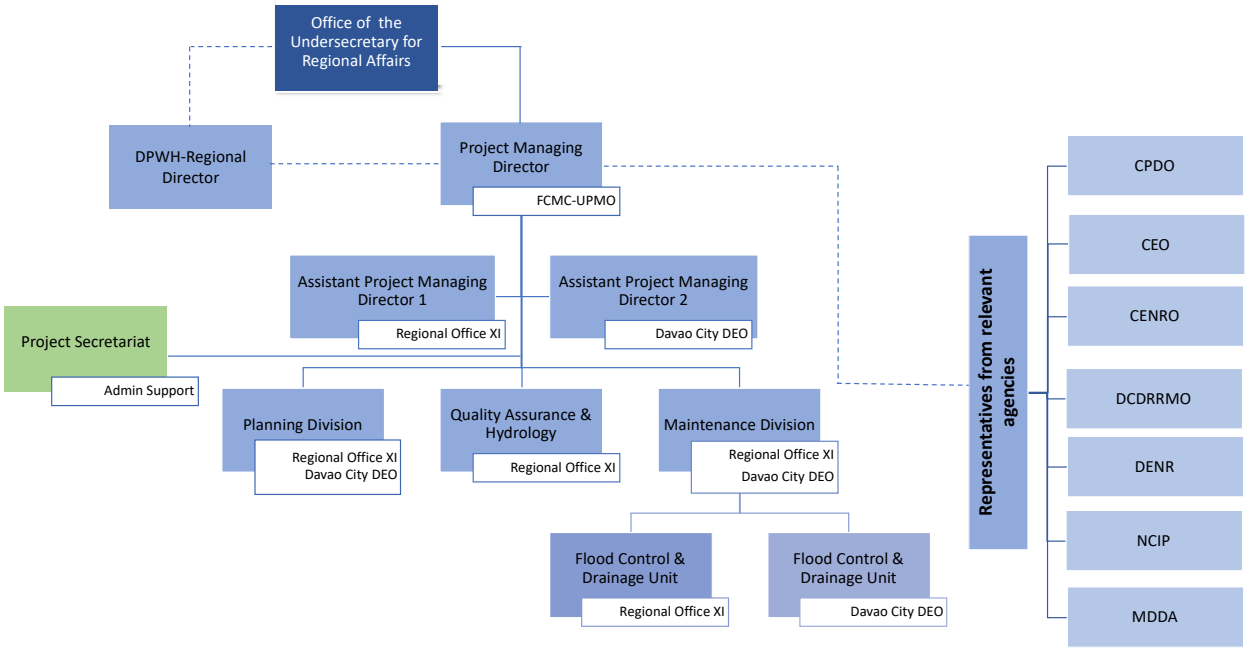
(1) Organizational Framework for Structural Measures

In order to facilitate smooth implementation of projects covered in the feasibility study, the following organizational framework is recommended to be considered:

1) During Detailed Engineering Design and Construction

The Flood Control Management Cluster-Unified Project Management Office (FCMC-UPMO) of DPWH is expected to assume a major role and shall take the lead in the overall implementation of the projects. They will be administratively and technically supported by the DPWH Regional Office and the Davao City District Engineering Offices (DC DEO).

In order to facilitate an effective and efficient project implementation, a Davao River Project Management Office (DRPMO) will be established. The DRPMO is an adhoc office with a specialized organizational structure created to handle the overall responsibility, supervision and management of the project during detailed engineering design and during construction period. The DRPMO is expected to be under the supervision of the Office of Undersecretary for Regional Affairs-Unified Project Management Office, and will be headed by a Project Managing Director, two Assistant Project Managing Directors and three (3) technical representatives from the Planning Division, Quality Assurance and Hydrology and the Maintenance Division. A Project Secretariat will be created provide administrative and finance support to the DRPMO. Figure 4.7.1 illustrates the adhoc organizational structure during detailed engineering design and during construction period.



Source: Project Team

Figure 4.7.1 Adhoc Organizational Structure during Detailed Engineering Design and Construction Period

Furthermore, the DRPMO is expected to serve as the focal point and counterpart structure to the project to handle coordination, communication and monitoring as well as to ensure a timely implementation of activities during detailed engineering design and during construction period. The following are among the expected roles and functions of the proposed DRPMO:

- To facilitate the overall coordination in the conduct of detailed engineering design and during construction period (retarding ponds, cut-off works and dredging) in the Davao River;
- To coordinate and collaborate with relevant agencies and significant stakeholders in order to effect a smooth, effective and efficient implementation of activities during detailed engineering design and construction period;
- To ensure that all activities outlined are properly and smoothly carried out by the Project Consultants;
- To serve as the counterpart structure to the Project Consultants to facilitate smooth implementation and to make sure that technologies are effectively transferred and/or acquire during the implementation of the detailed engineering design and construction period.

Moreover, at least seven (7) agencies are identified to play a crucial role in the project implementation for coordination purposes namely; City Planning and Development Office (CPDO), City Engineers` Office (CEO), City Environment and Natural Resources (DENR), Davao City Disaster Risk Reduction and Management Office (DCDRRMO), and two other regional agencies such as the Department of Environment and Natural Resources (DENR) and the National Commission on Indigenous Peoples (NCIP). For purposes of policy support, information sharing shall be conducted with the newly created Metropolitan Davao Development Authority (MDDA) since one of its function includes flood control management. Furthermore, coordination and collaboration will also be done with the Davao City Task Force on Drainage and Right of Way and the Davao River Basin Management Board.

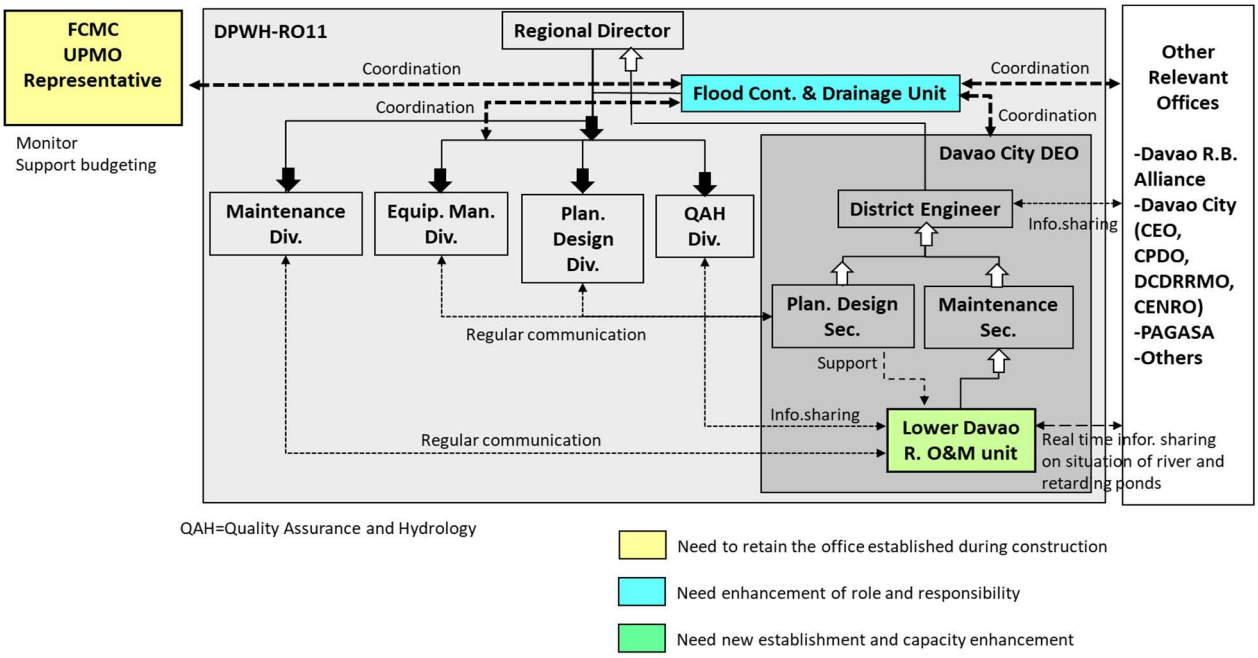
The roles and functions of these institutions and agencies are crucial not only in facilitating the required clearances and permits but also in providing technical inputs, advises on critical areas that may have an impact on the overall implementation of the project.

2) During Operation and Maintenance

The Davao City District Engineering Office (DC DEO) is proposed to be the primary body responsible in the operation and maintenance of retarding ponds, cut-off works and dredging in Davao River with the technical support from the FCMC-UPMO.

Moreover, in order to facilitate continuity and sustainability of the technology acquired during the detailed engineering design and during construction period, it is proposed that the Davao River Management Office (DRPMO) which was established during the detailed engineering design and during construction period shall be institutionalized and a Davao River Operation & Maintenance Unit (DROMU) shall be created as a permanent unit which is responsible for the implementation of operation and maintenance of flood control works in the Lower Davao River under the Maintenance Section of Davao City DEO.

Figure 4.7.2 shows a draft skeletal structure during O&M.



Source: Project Team

Figure 4.7.2 Proposed Organizational Structure during Operation & Maintenance

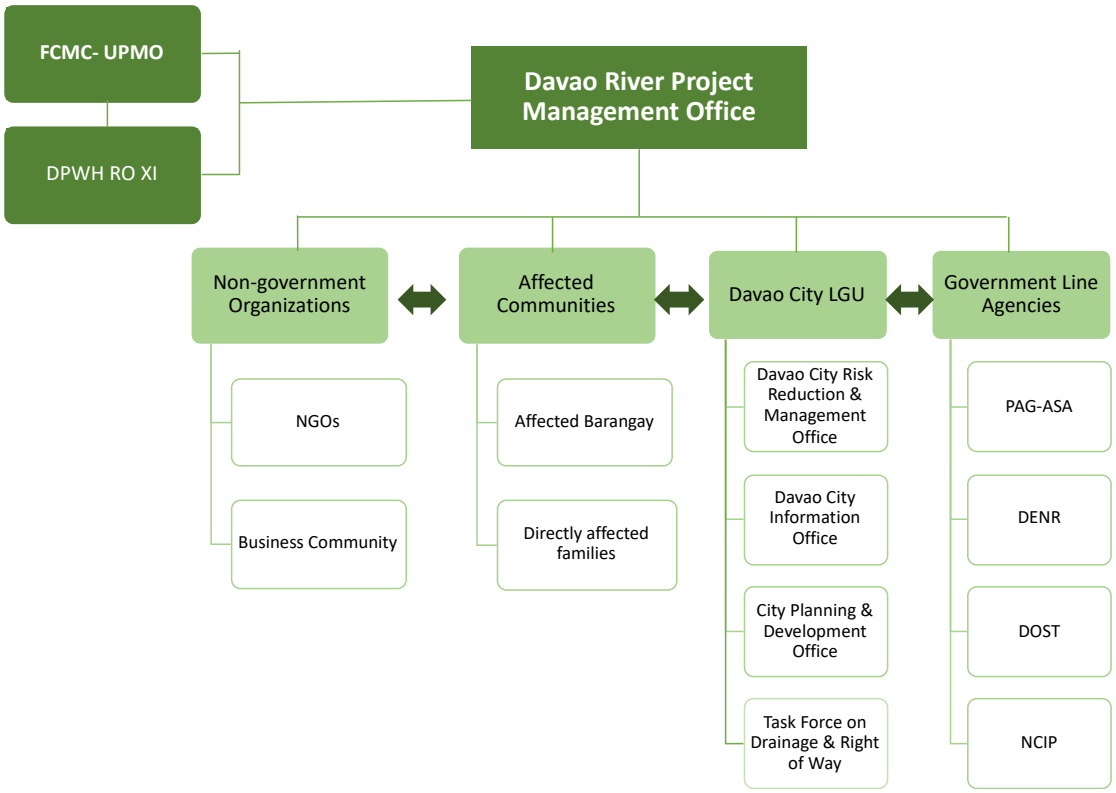
(2) Organizational Framework for Non-Structural Measures

1) During Detailed Engineering Design and Construction

The non-structural measures plays a crucial role during the overall implementation of the projects covered under the feasibility study. The following non-structural measures shall be implemented as discussed in Section 4.2.

- Installation of additional water level gauges in strategic locations within the Davao River
- Setting up warning water level corresponding to the latest river and social conditions within Davao River
- Preparation and distribution of IEC materials and conduct public relation activities regarding the proposed structural measures in Davao River
- Updating of flood hazard maps for riverine, inland and coastal structural measures
- Recommend and updating of land use control surrounding the proposed projects
- Conduct various capacity building activities to support activities during detailed engineering design and during construction period

Responsible organization for each activity is mentioned in Section 4.2. Moreover, during the detailed engineering design and construction period, the proposed Davao River Project Management Office (DRPMO) is expected to lead in carrying out the abovementioned activities in partnership with other key agencies including, but not limited to the Local Government Unit of Davao City, line government agencies, non-government organizations and the project affected communities. Figure 4.7.3 shows the skeletal diagram in coordinating the implementation of non-structural measures during detailed engineering design and construction period.

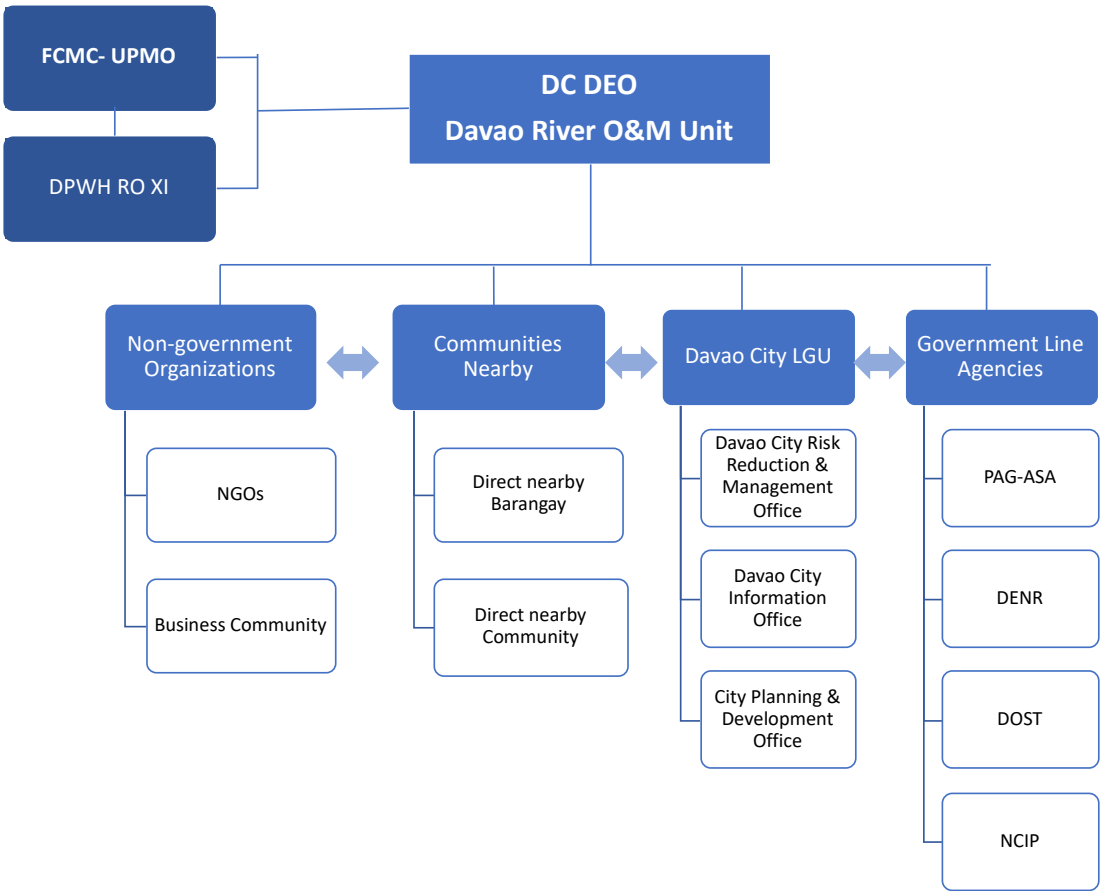


Source: Project Team

Figure 4.7.3 Proposed Organizational Structure for Non-structural Measures during Detailed Engineering Design and Construction Period

2) During Operation and Maintenance

During operation and maintenance, non-structural measure activities are expected to continue and will take in form of various public relations works particularly related to flood warning and evacuation arrangements. Consultations and information dissemination as well as awareness campaign on significant concerns as to the overall operation and management of the facilities shall also be conducted periodically. In this manner, relevant stakeholders are adequately informed about operation and maintenance works of the facilities. Figure 4.7.4 provides the proposed organizational mechanism during operation & maintenance.



Source: Project Team

Figure 4.7.4 Proposed Organizational Structure for Non-structural Measures during O&M

4.7.2 Procurement Method

The construction work for this project includes large-scale earthwork and dredging work to be performed within a limited period of time, as well as embankments that require meticulous quality control. Therefore, based on the circumstances, the project will be implemented through international and domestic bidding. The contract packages will be divided into the following three packages to provide opportunities for participation to Philippine domestic contractors.

Package 1: Dredging
Package 2: Cut-off
Package 3: Retarding Pond

For detailed design and construction supervision, consulting services will be provided by a coordinated group of international and domestic engineering consultancy firms.

4.7.3 Implementation Schedule

The construction work will be divided into three packages. The implementation schedule is shown in Table 4.7.1. After the detailed design, bidding for construction work will begin in the second year, with a target completion date of all the construction works of tenth year. Resettlement and land acquisition are planned to be started in the second year, in conjunction with the detailed design and construction work.

Table 4.7.1 Schedule of the F/S Project

	Item	Months	Year									
			1	2	3	4	5	6	7	8	9	10
1	Detailed Design	18										
2	Land Acquisition	36										
3	PQ and Tendering	12										
4	Construction Works	84										
4-1	Contract Package No.1 Dredging	72										
4-2	Contract Package No.2 Cut-off	48										
4-3	Contract Package No.3 Retarding Pond	84										

Source: Project Team

4.7.4 Funding / Finance

The details for the cost estimation for F/S project is described in Section 4.4. Domestic and foreign currencies are estimated respectively by the method described in 4.4.3 Cost Estimation (1) Conditions and Assumptions for Estimation 4) Currency. The total funds required to implement the project amount to 9,246 million (Local Currency Portion, pesos equivalent), and 12,349 million (Foreign Currency Portion, pesos equivalent). The total amount is 21,595 million (pesos equivalent). Table 4.7.2 shows the amount of funds required, and Table 4.7.3 shows the financial plan during the project implementation period.

Table 4.7.2 Required Amount of Fund for F/S Project

Item				LC	FC	Total
				(Unit: Million Philippines Pesos)		
1	Project Management Cost			282	418	700
			Subtotal	282	418	700
2	Preparation Cost					
	2-1	Land Acquisition Cost		889	0	889
	2-2	Compensation Cost		8	0	8
	2-3	Removal Cost		2	0	2
	2-4	Environmental Impact Assessment Cost		0	0	0
			Subtotal	899	0	899
3	Construction & Procurement Cost			5,619	9,359	14,978
			Dredging	419	698	0
			Cut-off	639	1,064	0
			Retarding Pond	4,561	7,597	0
			Subtotal	5,619	9,359	14,978
4	Consultant Service Cost					
	4-1	Consultant Service Costfor Civil Work				
		4-1-1	Detail Design Cost	562	936	1,498
		4-1-2	Construction Management Cost	449	749	1,198
	4-2	Consultant Service Cost for Building		0	0	0
	4-3	Consultant Service Cost for Equipment		0	0	0
			Subtotal	1,011	1,685	2,696
5	Contingency Cost					
	5-1	Price Contingency		1,104	335	1,439
	5-2	Physical Contingency		332	552	884
			Subtotal	1,435	888	2,323
6	Technical Training Cost			0	0	0
			Subtotal	0	0	0
7	Operation and Maintenance Cost					
			(1) Dredging (Implementation)	61	122	183
			(2) Dredging (Consultation)	11	22	33
			(3) Cut-off & Retarding Pond	26	43	69
			Subtotal	98	187	285
Total (Excluding OM Cost)				9,246	12,349	21,595

Source: Project Team

Table 4.7.3 Financial Plan for F/S Project

Item		Unit	Q	Ratio		Cost Million PhP			Duration (Year)	Year									
				All	Construction	LC	FC	Total		1	2	3	4	5	6	7	8	9	10
1	Project Management	LS	1	3.2%		282	418	700	10	70	70	70	70	70	70	70	70	70	70
2	Preparation, Resettlement	LS	1	4.2%		899	0	899	3		899								
3	Construction & Procurement	LS	1	69.4%	100%	5,619	9,359	14,978											
3-1	Dredging	LS	1	5.2%	7.5%	419	698	1,118	6				186	186	186	186	186	186	
3-2	Cut-off	LS	1	7.9%	11.4%	639	1,064	1,703	3				568	568	568				
3-3	Retarding Pond	LS	1	56.3%	81.2%	4,561	7,597	12,157	7				1,737	1,737	1,737	1,737	1,737	1,737	1,737
4	Consulting Service	LS	1	12.5%		1,011	1,685	2,696	10	270	270	270	270	270	270	270	270	270	270
5-1	Price Contingency	LS	1	6.7%		1,104	335	1,439	10	144	144	144	144	144	144	144	144	144	144
5-2	Physical Contingency	LS	1	4.1%		332	552	884	10	88	88	88	88	88	88	88	88	88	88
6	Technical Training Cost	LS	1	0.0%		0	0	0	10	0	0	0	0	0	0	0	0	0	0
7	Operation and Maintenance Cost	LS	1			98	187	285	per year										
Total (Excluding OMC)				100%				21,595		572	1,471	572	3,062	3,062	3,062	2,495	2,495	2,495	2,309

Source: Project Team

4.7.5 Consulting Services

DPWH will implement the project, but a consultant will be hired to prepare the detailed design, pre-qualification (PQ), and bid documents. The consultant will also assist and support the bidding and contracting process in the pre-construction phase and supervise the construction.

(1) Consulting Service

1) Prepare detailed design, construction cost estimates, pre-qualification (PQ) and bid documents

2) PQ and bidding process assistance for selecting construction contractors, and construction supervision

(2) Scope of the Specific Consulting Service

The specific scope of consulting services is as follows:

1) Preparation of detailed design, construction cost estimation, pre-qualification (PQ) and bid documents

a) Review of existing plans and designs
b) Gathering and further analysis of relevant information and data
c) Surveying and field investigation, and Hydraulic model test
d) Preparation of Definitive Design
e) Structural analysis and calculations
f) Execution of detailed design including preparation of design drawings
g) Construction planning and detailed construction cost estimation
h) Resettlement Action Plan (RAP) review and update according to the detailed design
i) Update Environmental Impact Statement (EIS); including Environmental Management Plan (EMP) and Monitoring Plan (EMoP)
j) Additional environmental studies to obtain ECC for the soil disposal site
k) Prequalification and preparation of bidding documents

2) PQ and bidding process assistance for selecting construction contractors, and construction supervision

a) Bidding and contracting assistance for construction
- Assistance and support for pre-qualification
- Attendance at pre-bid meetings and site briefings for bidders
- Assist in evaluation of bid documents, including bid opening and preparation of evaluation reports

b) Supervision of construction work

c) Technical support for maintenance and management operations, including preparation of manuals

d) Environmental management and monitoring
- Environmental monitoring, evaluation and management during the construction period (including preparation of monitoring program and establishment of environmental monitoring and management system)

e) Resettlement Action Plan Implementation Monitoring

f) Technology transfer

(3) Duration of the Consulting Service

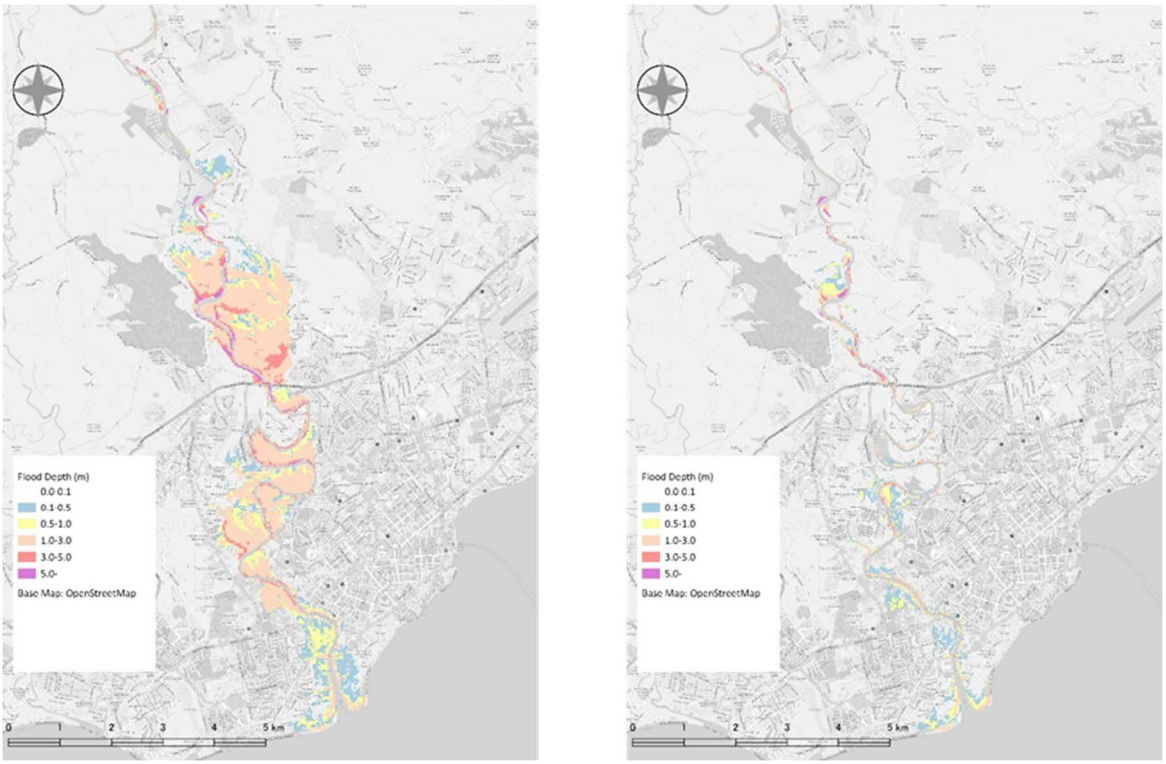
Engineering services (detailed design) shall be for a period of 18 months. Consulting services (construction supervision) shall be provided for 84 months (7 years, not including the construction defect period).

4.7.6 Effect of the Project and Performance Indicator

In this section, the project performance indicators to conduct the ex-post evaluation to be conducted three years or more after the F/S completion are considered and proposed.

(1) Effect of the Project

The purpose of the F/S is to reduce the damage, especially in the downstream urban area of Davao City caused by the overflow of Davao River during a 10-year return period flood. Figure 4.7.5 shows how the inundation area is anticipated to be reduced with the implementation of the F/S projects.



Source: Project Team

Figure 4.7.5 Simulated inundation area during a 10-year return period flood (Actual situation on the left and after the F/S implementation on the right)

(2) Project Performance Indicator: Operation Indicator

As operation indicators to quantitatively assess the adequacy of the operation and maintenance after the implementation of the F/S, the measurement of annual maximal water level at Waan Bridge (reference point of the flood control plan) and retarding ponds is proposed.

Water level observation is actually conducted at Waan Bridge (Tigatto Station). Several tributaries with a catchment area smaller than 10 square kilometer confluent Davao River in the downstream of Waan Bridge. However, the discharge peak of these tributaries occur earlier than Davao River during floods. Therefore, based on the hydraulic analysis results, it is assumed that the influence of these tributaries to the downstream will be minimal and that the maximal discharge of the downstream will be almost the same as the one measured at Waan Bridge.

Therefore, the monitoring of the annual maximal water or during flood event (and conversion from water level to discharge) enables the evaluation of the effects (or water level decrease) due to the river channel improvement and construction of retarding ponds. In addition, through the monitoring of water level, the appropriateness and continuity of operation and maintenance (including periodic maintenance dredging) can be checked.

Regarding the three retarding ponds, non-structural measures including the installation ow water level gauges are proposed. The monitoring of the water level at the retarding ponds sites enables the evaluation of the operation and maintenance of these large-scale facilities by checking the water inflow condition, duration and frequency of operation during floods.

Therefore, annual maximal water level at Waan Bridge and at the retarding ponds sites is recommended to be used as operation indicator.

Table 4.7.4 Proposed Operation Indicator

	Operation Indicator				Reference
	Annual Maximal Water Level at Waan Bridge(water level to be monitored)	Annual Maximal Water Level at the Retarding Ponds Sites (gauges to be installed and water level to be monitored)			Maximal Water Level at Waan bridge during past flood events (to be collected from past records)
		RP08	RP09	RP11	
Year 1					Dec.22, 2017 (Vinta) : 11.5m
Year 2					….
…					
Year N					

Source: Project Team

(3) Project Performance Indicator: Effect Indicator

With the implementation of the F/S, damage caused by Davao River during a 10-year return period flood will almost be eliminated in the urban areas of the City. As one methodology to measure the project effect, the comparison between the targeted value of inundated area with the project implementation and the simulated value of flood area under actual situation is proposed.

Table 4.7.5 shows the simulated flood area under actual situation (without project) obtained by the hydraulic and hydrologic analysis, in the right column. However, the inundation caused by inland or rainwater flooding is not included. Therefore, in order to properly assess the effect of the F/S which is targeting the flooding caused by the overflow of Davao River, the floods records containing the details on the location and cause of inundation (possibility of inland inundation) will be crucial.

In conclusion, as effect indicator, the floods records on inundated areas, location of inundated areas and inundation cause (river overflow or rainwater/inland inundation) during real flood events is proposed.

Table 4.7.5 Proposed Effect Indicator

	Effect Indicators				Reference
	Targeted inundated areas during a 10-year flood event	Flood Records (from real situation)			Simulated flood area under actual situation
		Inundated areas (ha)	Location of Inundated sites	Cause of inundation	
Year 1					W=1/10 : 920 ha
Year 2					W=1/5 : 690 ha
…					W=1/3 : 500 ha
Year N					W=1/2 : 220 ha

Note: the simulated area was computed by adding the flood simulation model meshes in which the flood depth is higher than 10 centimeters.

Source: Project Team

4.8 Recommendation

Based on the overall results and outputs of the study, the recommendations related to the priority projects targeted in the F/S are described below.

(1) Early implementation of priority projects

Floods with inundation damage are occurring frequently in the target area, such as the flood in November 2021 (estimated to be about 5-10 year scale flood from the inundation situation). Priority projects are expected to have early effects, therefore, those early implementation is desirable to contribute to the reduction of flood damage.

(2) Effective use of excavated soil during construction and soil by maintenance dredging after construction

A large amount of excavation and dredging soil will be generated in any of the projects targeted in this F/S. In addition, even after the construction is completed and the facility is completed, soil will be generated due to the removal of sediment after flooding or regular maintenance dredging. This treatment of soil is a major issue for the projects.

On the other hand, commercial extracted sand and gravel business has been actively carried out along the Davao River. Also, at the stakeholder meetings held during the project, residents requested the use of this excavated soil, as well as a large-scale filling has been carried out in the development of residential areas along the Davao River. Based on these circumstances, it is highly possible that these generated soils will be used effectively.

It is essential to confirm the soil contamination before using it, but it is desirable to cooperate with the surrounding residents, organizations, and Davao City to make effective use of the generated soils.

(3) Detailed examination of the disposal site and implementation of environmental survey

Regarding the large amount of excavation and dredging soil generated during the implementation of this F/S projects, candidate sites for disposal sites were proposed in this Project, but no concrete decision has been reached.

In this Project, a series of discussions have been carried out so far like 1) explanation to DPWH and Davao City about the assumed amount of excavation and dredging soil and necessity of the disposal sites, 2) explanation and discussion on options for disposal sites and utilization of the soils, 3) investigation and discussion on the availability of candidate landfill sites along the coast, and 4) discussion on the availability of candidate sites for new disposal sites proposed by Project Team. Through these discussions, DPWH and Davao City fully understand the importance of securing disposal sites for the realization of the projects.

However, since the implementation of the project and its timing have not been concretely decided at this time, further detailed examination for disposal sites, such as possibility of utilization for other public projects and consultation with private companies and local residents regarding the use of the soil.

As for future prospects, it is conceivable that the treatment and reuse plan for the large amount of the soil and the selection and securing of the disposal sites will be the conditions for project implementation. Therefore, in the next phase, which is expected to be conducted toward the implementation of the projects, it is necessary to carry out detailed examination and coordination regarding the treatment and reuse plan for the excavation and dredging soil and the selection and securing of the disposal sites.

In addition to above, the followings shall be paid attentions in the environmental and social considerations:

- It is possible to select a possible disposal site in the middle – upper stream of the Davao River. In this case, candidate site shall be selected to avoid from not only naturally sensitive area but also ancestral domains lands.

- Involuntary resettlement shall be avoided as much as possible. If it is difficult to avoid it; sufficient compensation and social support shall be given to the PAPs.
- It is recommended to effectively reuse excavated/ dredged soil to reduce the necessary size of disposal site. And provision of soil to the sand mining operators, who will be stopped operation during construction phase, must be one of the mitigation measures to recover their income, etc.
- Continual public consultation for above considerations and implementation of environmental/ RAP study must be effective tools to encourage communication with the stakeholders and consensus building.

(4) Establishment and maintenance of operation and maintenance framework including procurement of necessary equipment

Appropriate maintenance is essential to maintain the effectiveness of measures and facilities. It is expected that the operation and maintenance framework proposed in this Project will be established, and that the framework will function and be maintained appropriately, such as securing equipment and budget for maintenance dredging.

(5) Implementation of hydraulic model test for retarding ponds

Various specifications of the retarding ponds (overflow dike height, overflow dike width, etc.) were set in this F/S, but these are determined based on the results of simulations by an analytical hydraulic model constructed using topographic data available in this Project.

Since it is difficult to completely reproduce a complicated flow in the simulation using the hydraulic model, it is crucial before implementing the projects that detailed topographic surveys such as river longitudinal and cross sectional surveys in the section of installation of retarding ponds including upstream and downstream of the retarding ponds, and ground height survey around retarding ponds as well as necessary surveys like riverbed material survey and geotechnical investigation will be conducted, and a hydraulic model test will be carried out by modeling topography, rivers and facilities using the survey results in the next phase such as detailed engineering design stage, in order to revise and finalize various specifications of the retarding ponds.

(6) Upgrading of height of overflow dike of retarding ponds

In the construction stage of F/S projects, the overflow dikes in the retarding ponds will be constructed at the height set based on the flow capacity (about 800 m^3/s) of the lower Davao River after the dredging project, which is one of the priority projects.

After the implementation of the river widening works, which is a mid/long-term measures, the overflow dikes need to be upgraded, that is, height of overflow dikes needs to be raised based on the enhancement of the downstream flow capacity (planned at 1700 m^3/s) to exert an appropriate effect in the event of large-scale floods.

It should be noted that the maintenance (upgrading) will be carried out in stages according to the development status of the river channel of lower Davao River.

(7) Utilization of retarding ponds in normal times

The retarding ponds are inundated/submerged for a few days during and after floods, but it is not inundated in normal times and can be used in various ways. The total area of the three retarding ponds of priority projects, is about 1.5 km^2 in terms of the area of the bottom of the retarding ponds.

It is desirable to make effective use of the retarding ponds in normal times such as sports facilities, natural parks, renting out for small-scale agricultural areas and so on, in collaboration with local residents and related organizations, taking account of the conditions of inundating/submerging in the event of floods.

(8) Handling of the present river after implementation of the cut-off works

Rainwater drainage from areas along the Davao river flows into the Davao River not only during floods but also during normal times. If the present river channel (meandering part) will be reclaimed after the cut-off works project, it is necessary to plan and install facilities (drainage channels connecting to the Davao river, regulating reservoirs, etc.), which properly treat the rainwater drainage flowing into the present river channel from the surrounding area during normal and flood times.

(9) Coordination with other projects (Davao Expressway) closely related to the F/S projects

In the Davao River, there are many on-going and planned road projects such as the bypass road currently being implemented and the Davao Expressway where F/S completed, even in the target area of the F/S projects. Of these, the alignment of the Davao Expressway is planned to cross the Davao River multiple times.

Since most of the sections of the Expressway are elevated except for some sections, there is no problem in relation to the HWL during floods, but in the cut-off works planning section targeted for this F/S, the planned alignment of the Expressway intersects the cut-off works section on the south side. It is necessary to coordinate/adjust the alignment of the road or the position and type of the piers.

Davao Expressway is under the jurisdiction of DPWH UPMO RMC. Appropriate coordination must be made within DPWH UPMO to implement the projects.

(10) Enhancement of disaster management activities by utilizing flood hazard map and IEC materials referencing Japanese actual examples

In Davao City, although flood hazard maps were prepared, several organizations create the maps with different methods and accuracy, and, there is no sufficient explanation from preparing agency when distributing the map. Therefore, the maps are not linked to effective disaster management activities.

In this Project, the first draft of IEC materials was created to improve residents' awareness of flood risks, and it was proposed that they will be distributed and utilized at the training institute to be established in Davao, although actual way of utilizing them would be discussed and determined by DPWH and Davao CDRRMO.

In Japan, various ideas have been devised regarding the utilization and publicity of hazard maps and IEC materials, like 1) explanation of how to use the hazard maps and meaning of items written on the maps at various city events, 2) creating hazard maps focusing on the living area of residents through discussion on information necessary for evacuation with residents and local government officials, 3) holding on-site lectures and study sessions for residents by local government officials and river administrators, 4) conducting evacuation drills using the hazard maps, 5) using the maps and materials for disaster management education at schools, 6) introducing the maps and materials in the mass media (radio), 7) publicizing the maps and materials through public relations magazines, and 8) displaying information on the hazard map, such as water levels in the event of a disaster, on utility poles and billboards throughout the town to raise awareness among local residents.

Referencing these actual examples in Japan, it is expected that hazard maps and IEC materials prepared in this Project will be appropriately updated and utilized paying attention to the following points of 1) when distributing materials, to explain carefully the contents of the materials and how to use them, and 2) to provide a wide range of opportunities for distributing and introducing the materials.

Chapter 5 Pre-Feasibility Study for Future Priority Project

5.1 Future Priority Project and Preliminary Design of Structural Measures Targeted for Pre-Feasibility Study for Riverine Flood in Davao River

5.1.1 Future Priority Project of Structural Measures Targeted for Pre-Feasibility Study for Riverine Flood in Davao River

(1) Overview of Priority Project (Structural Measure) Target for Pre-Feasibility Study

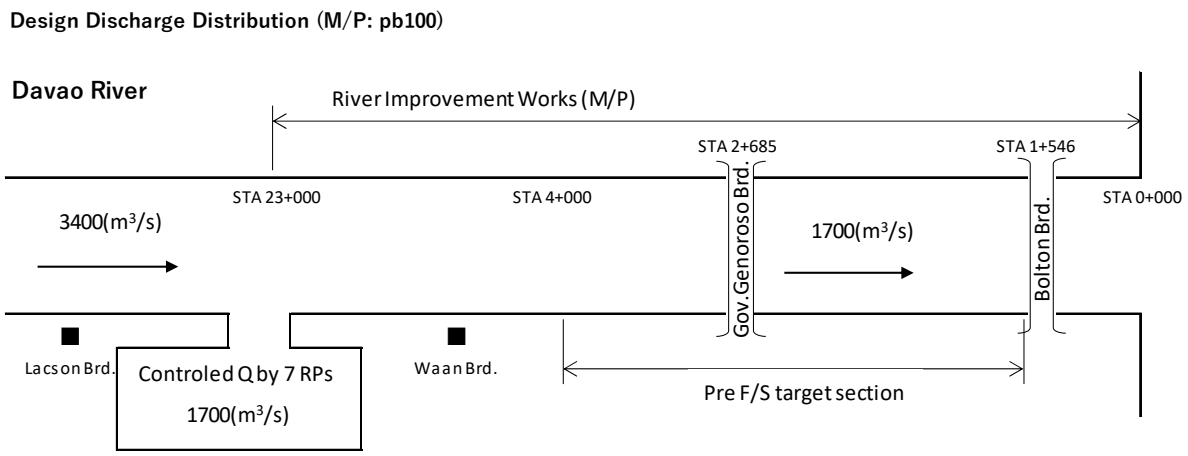
The priority project targeted for Pre-F/S will be undertaken after completion of the priority projects targeted for F/S described in Chapter 4, therefore, the project is based on the premise that flood control safety level of 10 year scale flood or less is already secured.

In this Pre-F/S, the downstream section with 2.5km distance from the Bolton bridge to Sta. 4+000 was selected as a pilot section for the river widening works, which is one of the mid-long term measures for the Davao River, and the study at pre F/S level was conducted for the pilot section. The purpose of the study is to grasp in advance the issues that will arise when implementing future widening works and to consider countermeasures against the issues, and then, to contribute to the smooth implementation of future project.

Table 5.1.1 Priority Project Targeted for Pre-Feasibility Study and Structural Measures in M/P

Item	Target Portion	Remarks
River Improvement	Riverbed Dredging Works STA 0+500 – STA 23+000 (L=18.0km)	Priority Project for F/S
	Cut-off Works STA 6+500 – STA 12+700 (L=1.3 ㎞)	Priority Project for F/S
	River widening Works STA 0+500 – STA 23+000 (L=18.0km) (Target Area of Riverine Flood Control)	Priority Project for Pre-F/S at the portion of STA 1+561 – STA 4+000 (L≒2.4km)
Retarding Ponds	7 retarding ponds installation at upper portion of the Davao River	Priority Project for F/S at the portion of RP 08, RP 09, and RP 11

Source: Project Team

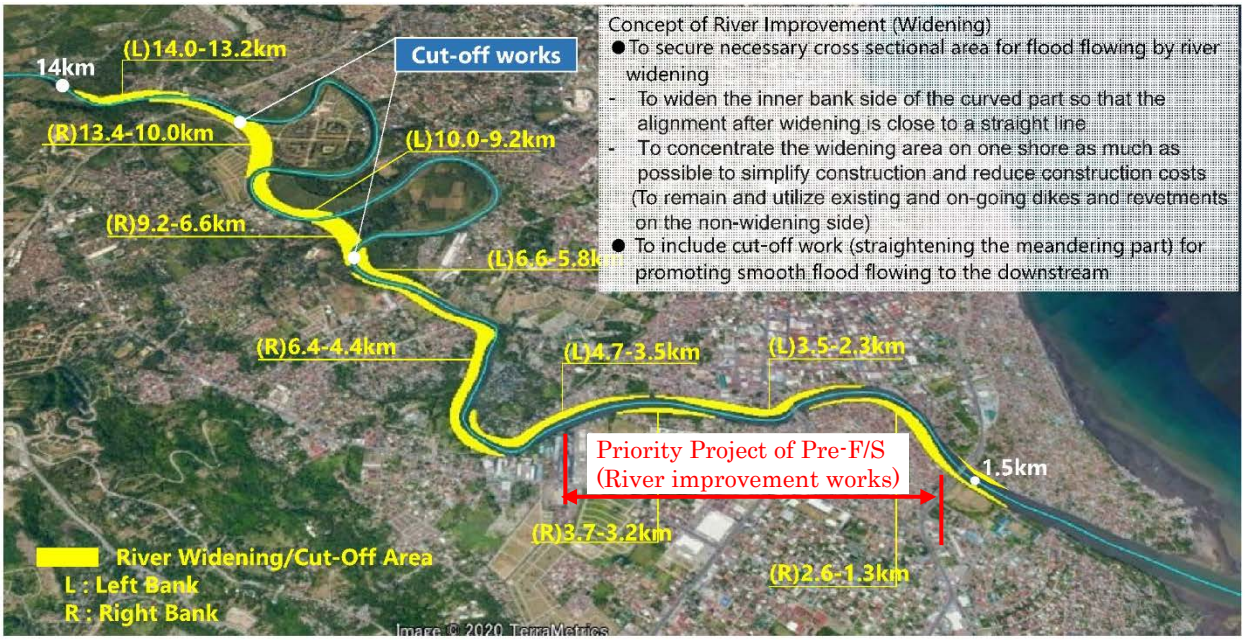


Source: Project Team

Figure 5.1.1 Design Flood Discharge Distribution of Davao River (100-yr scale floods)

(2) Target Area of Priority Project (Structural Measure) Target for Pre-Feasibility Study

As shown in Figure 5.1.2, the target area of the priority project for Pre-F/S is the reach from immediately upstream of the Bolton Bridge (STA 1+561) to STA 4+000 since the downstream of the Bolton Bridge has been undertaken the river improvement works by DEO and RO in addition to that reach has sufficient flow capacity against the design flood discharge of 1,700 m^3/s.



Source: Project Team

Figure 5.1.2 Conceptual Drawing of Priority Project for Pre-F/S

5.1.2 Additional Topographic and River Surveys for Structure Measures of the Future Priority Project Targeted for Pre-Feasibility Study for Riverine Flood in Davao River

(1) Outline of Additional Topographic and River Survey

For the facilities (river widening) subject to Pre-F/S of the Davao River, topographical surveys and river surveys were conducted on the Downstream of the Davao River. The survey works was subcontracted to a local survey firm and carried out during the period from April 2021 to August 2021. The work items and quantity are as Table 5.1.2.

Table 5.1.2 Work Item and Work Quantity (Additional Topographic and River Survey)

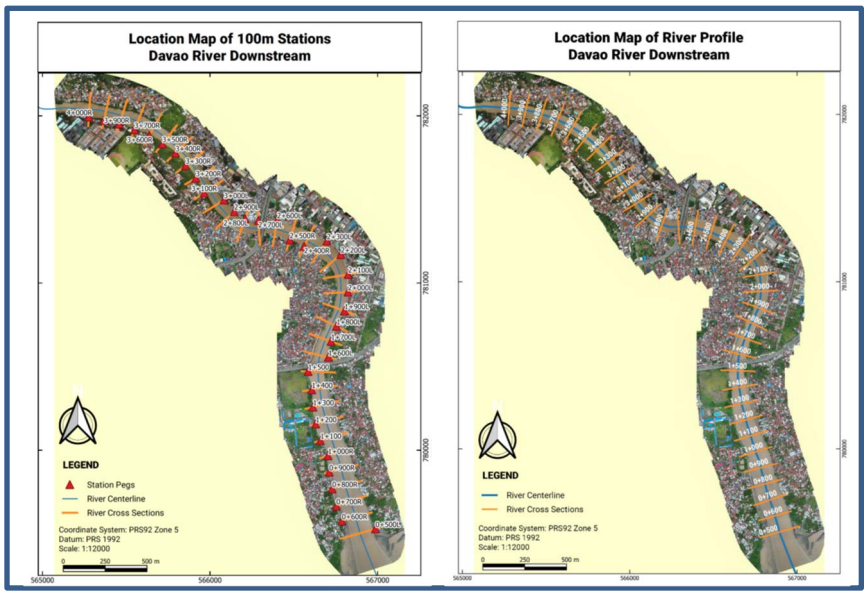
Work Item	Quantity
1. River and Topographic Survey of PRE-F/S Targeted Structure (Downstream of the Davao River)	
1.1 River Longitudinal Survey (Station No. 0+500 – 4+000)	3.5km
1.2 River Cross Sectional (C/S)Survey (Interval of C/S : 100m pitch, Width : 200m)	36 sections
1.3 Ortho-photo Mapping by UAV(including GCP survey:10points)	70 ha

Source: Project Team

(2) Topographic and River Survey on Downstream of the Davao River

The topographic and river survey on the Downstream of the Davao River (Station No. 0+500 – 4+000) consists the setting up of river cross section points, river longitudinal survey, river cross sectional survey

and ortho-photo mapping were conducted. Information on survey location maps, surveying methods and output covering on the Downstream of the Davao River are as follows.



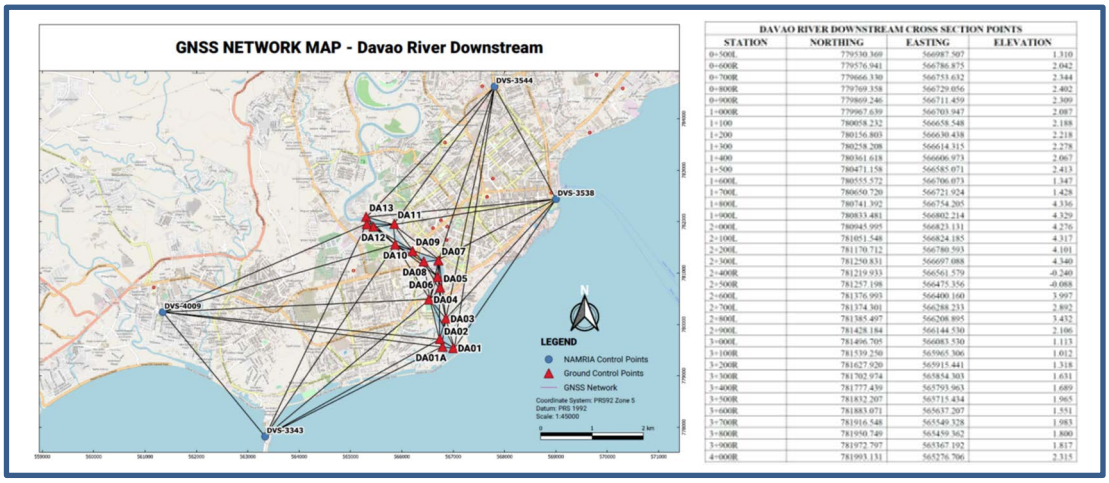
Source：Project Team

Figure 5.1.3 Location Map of Downstream of the Davao River (River Cross section Points, Longitudinal & Cross Sectional Survey and Otho-photo Mapping)

1) Setting up of River Cross Section Points

36 river cross section points were set up at 100 m pitches along the Downstream of the Davao River (Station No. 0+500 – 4+000). Setting up of the river cross section points were carried out by GCP survey from NAMRIA GCPs and Benchmarks, and it obtained the geo-coordinates and elevation of the river C/S points. Accuracy coordinates and elevation for setting up of river crossing are as follows.

- Accuracy of coordinates： 1/8,000 (From NAMRIA GCP and closed loop by GNSS travers)
- Accuracy of elevation： 40mm$\sqrt{}$km （From NAMRIA Benchmarks, Levelled twice）



Source：Project Team

Figure 5.1.4 Location Map of River Cross Section Points and its data on Downstream of the Davao River

2) River Longitudinal Survey

River longitudinal survey were carried out to obtain the coordinates and elevation of the river canter line of the Downstream of the Davao River (Station No. 0+500 – 4+000). The location map of the river longitudinal survey is as shown in Figure 5.1.3. Accuracy of the survey from a river cross section points is as follows.

- Accuracy of coordinates : ±3 cm /Riparian area, ±5 cm/Water area
- Accuracy of elevation : ±3 cm /Riparian area, ±5 cm/Water area

3) River Cross Sectional Survey

The River Cross Sectional Survey was carried out to obtain geo-coordinate and elevation of the river cross section of the Downstream of the Davao River (36 sections, width: 200 m). The location map of the river cross section is as shown in Figure 5.1.3. Accuracy of the survey from river cross section points is as follows.

- Accuracy of coordinates : ±3 cm /Riparian area, ±5 cm/Water area
- Accuracy of elevation : ±3 cm /Riparian area, ±5 cm/Water area

Bolton and Gov. Generoso Bridges Abutment Survey was also carried out by River Cross Sectional Survey method.

4) Ortho-photo Mapping by UAV

Ortho-photo mapping by UAV were carry out covering the Downstream of Davao River (Station No. 0+500 – 4+000). Ground resolution of aerial photos by UAV measurement was 10 cm and coverage area was 70ha. Ortho-photos were prepared using coordinates and elevation data of additional GCP Survey.

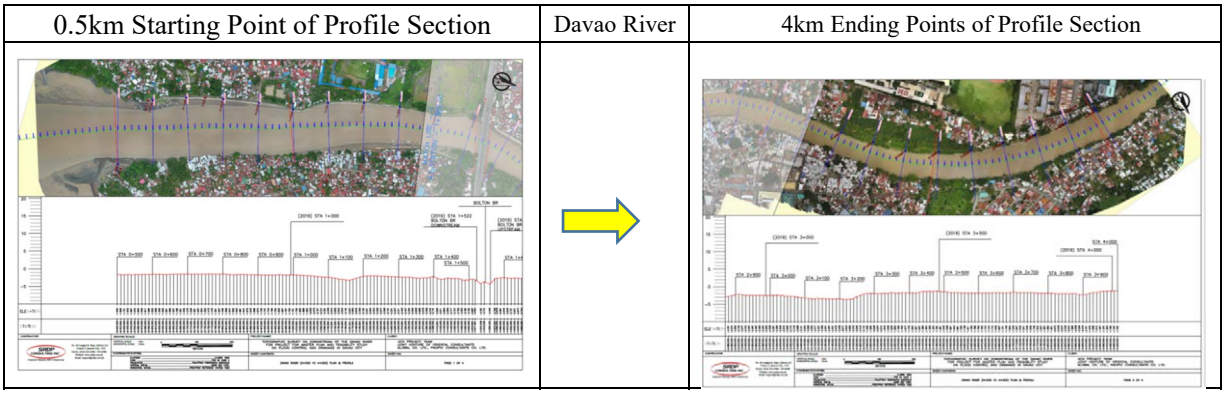
5) Output

Output is as follows:

Table 5.1.3 List of Output and Quantity (Downstream of the Davao River)

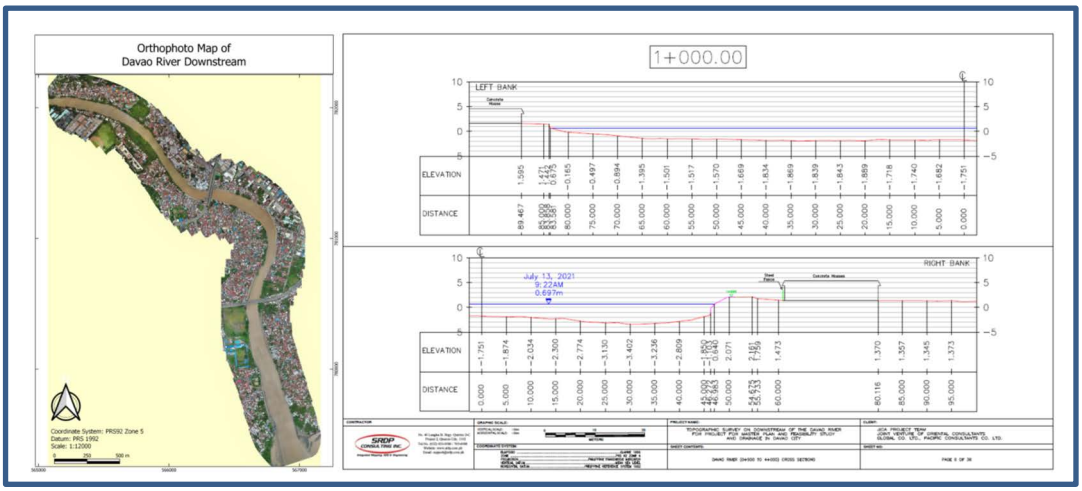
Output	Quantity (Hard & Soft Copy)	
1. River and Topographic Survey of PRE-F/S Targeted Structure (Downstream of the Davao River)	**A4 size**	**A3 size**
1.1 Survey Mark Description of 100m Station No. Pegs	2sets	-
1.2 River Longitudinal Survey Data	1set	-
1.3 River Profile Section Data	2set	1set
1.4 River Cross Sectional Survey Data	2sets	-
1.5 River Cross Section Data	2set	1set
1.6 Ortho-photo Mapping by UAV and GPS Data	1set	-
1.7 Ortho-photo Map Data	2set	1set
1.8 Survey Report	2sets	-

Source : Project Team



Source：Project Team

Figure 5.1.5　River Longitudinal Sections (Downstream of the Davao River)



Source：Project Team

Figure 5.1.6　River Cross Sections and Ortho-photo ((Downstream of the Davao River)

Source：Project Team

Figure 5.1.7　Bridges Abutment Survey Chart (Downstream of Davao River)

6)　Check Survey for DEO Benchmark data

The coordinates and elevation check survey was executed between at DEM BM established along the Downstream of Davao River and NAMRIA BM and Ground Control Point (GCP) established Downstream of Davao river and its surrounding area on May 9, 2021.

Source：Project Team

Figure 5.1.8 Field Photo of DEO BM N.03 and DEO Plans

The coordinates and elevation check survey was carried out by RTK Survey at DEM BM No.03 of downstream of Bolton Bridge .From the check survey results, between coordinates and elevation of DEM BM No.03 and NAMRIA coordinates and elevation has confirmed the following different values.

Table 5.1.4 Results of the Check Survey

DEO BM	DEO Plans Data (PTM coordinates and elevation)			Observation Data from NAMRIA BM and GCP (PTM coordinates and elevation)			Different values		
	Northing	Easting	Elevation	Northing	Easting	Elevation	Northing	Easting	Elevation
BM No.03 (1+515)	780439.344	566591.448	70.430	780438.220	566591.792	1.962	1.124	0.344	68.469
BM No.03.1 (1+515)	780439.344	566591.448	70.430	780438.206	566591.789	1.962	1.138	0.341	68.469

Source：Project Team

5.1.3 Geotechnical Investigation for Structure Measures of the Future Priority Project Targeted for Pre-Feasibility Study for Riverine Flood in Davao River

(1) Outline of Geotechnical Investigation

A geological investigation (BH-9: 1 site) was carried out in the central part of the river channel widening section for the preliminary design of the Pre-F/S priority project (structural measures).

The main purpose of the geological investigation was to confirm the stratigraphy of the underlying ground for the study of the revetment at the channel widening section, in particular to confirm the presence or absence of the soft ground. As the elevation of the existing borehole was unknown, we made sure to take the elevation of the new borehole. The location map and coordinates of the geotechnical survey locations are shown below.

Source: Project Team

Figure 5.1.9 Geotechnical Survey Location Map for Priority Project for Pre-F/S (BH-09)

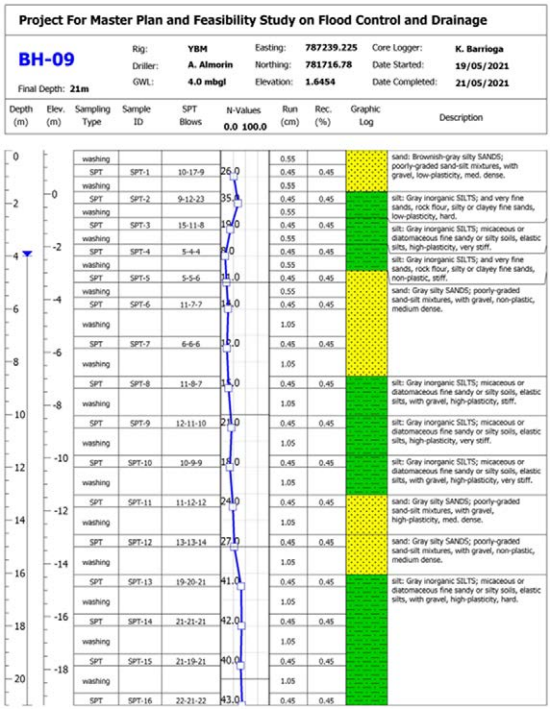
Table 5.1.5 List of Geotechnical Survey Location for Priority Project for Pre-F/S (BH-09)

No.	Coordinate Location		Description with type of structure assumed
	N	E	
BH-9	7° 4'8.12"N	125°35'49.24"E	Channel Widening (revetment / embankment)

Source: Project Team

(2) Geotechnical Investigation on River Widening Section

In the channel widening section, BH-11 was drilled near the middle of the section. The foundation soil consists of alternating layers of sand and clay with a thickness of 2-5 m. For the clayey layer, the average N-value is more than 10 at depths of 1.5-4.5 m and more than 20 at deeper depths, indicating that there was no soft ground at investigated location.



BH-09 (river widening)

Source: Project Team

Figure 5.1.10 Geotechnical Survey Result (BH-09)

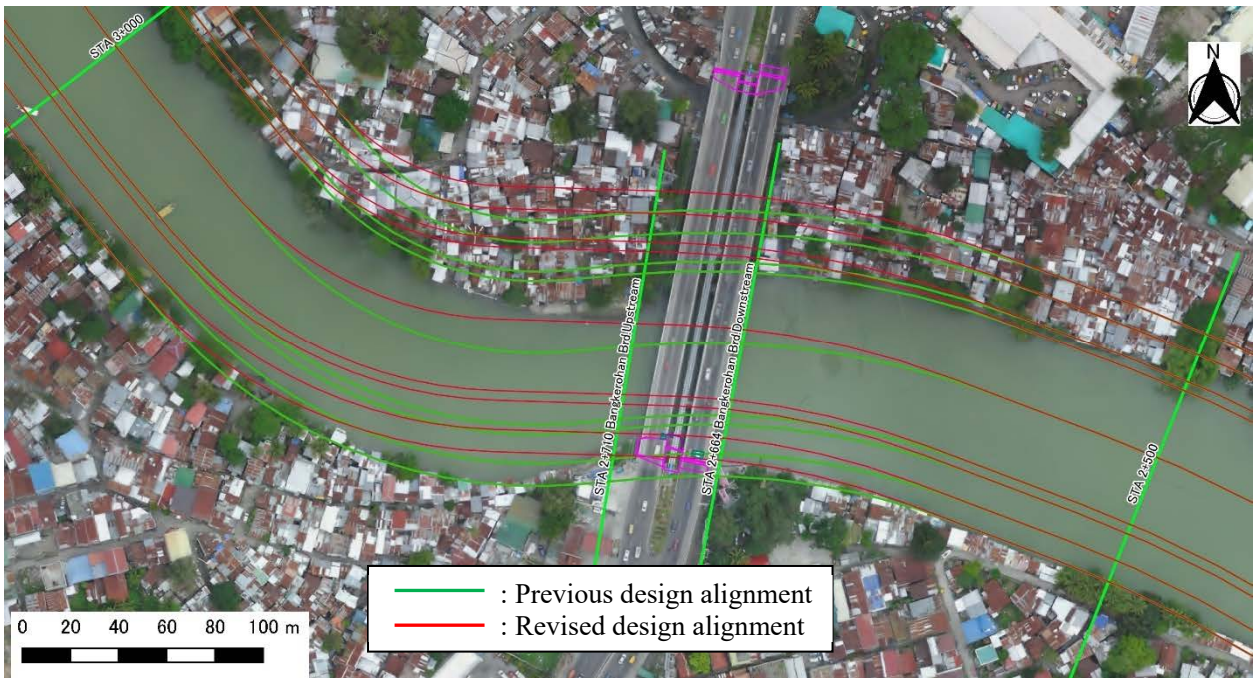
5.1.4 Hydraulic Study and Setting of Design Conditions for Future Priority Project of Structural Measures Targeted for Pre-Feasibility Study

(1) Design River Shape

The design river shape is considered based on the river shape that is considered corresponding to the design flood scale (100-yr scale flood) in Chapter 4 Feasibility Study.

1) Plan View Designing

The design river alignment has been set in Chapter 4 Feasibility Study with respect to the existing channel alignment, while considering the number of houses to be relocated due to river widening work, effective use of existing revetments, construction period and cost, and with widening by single-bank side construction in mind. The location of abutments of Gov. Generoso Bridges (STA 2+664 (downstream side) and STA 2+710 (upstream side)) were identified in conjunction with additional surveying in Pre-F/S. As a result, it was found that the design river channel conflicts with the right bank abutment and that the left bank abutment is located far from the current left bank. Therefore, the design river alignment was adjusted so that the design river channel would fit within the width of the existing bridge.

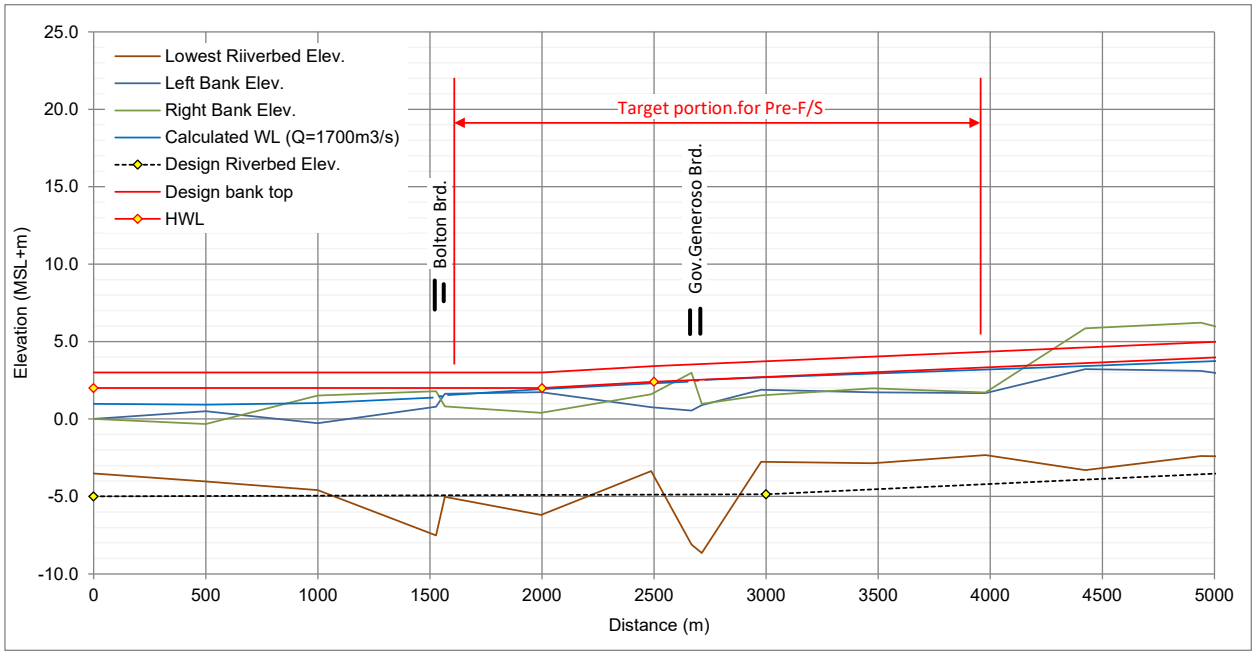


Source: Project Team

Figure 5.1.11 Design River Alignment Portion Arranged in Pre-F/S

2) Longitudinal Profile Designing

The design riverbed elevation and gradient have been set as generally the same as the existing river channel in Chapter 4 Feasibility Study, with no large-scale alteration of the riverbed gradient or excavation of the riverbed, in order to ensure stable riverbed elevation and biological habitat. Figure 5.1.12 shows the design longitudinal profile of target reach for Pre-F/S. Here, a storm surge protection levee (MSL+3.00m) will be constructed up to STA 2+000.

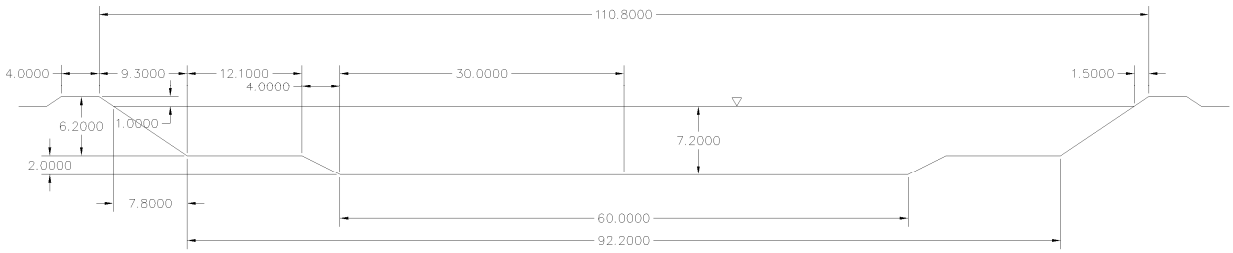


Source: Project Team

Figure 5.1.12 Design River Profile of Target Reach for Pre-F/S

3) Typical Design Cross-section

The typical design cross-sectional has been set by no-uniform flow calculations as a cross-section that can flow the design flood discharge based on the design longitudinal profile in Chapter 4 Feasibility Study. Since the target reach for Pre-F/S includes a portion subject to the backwater effect of the tide level, the water level with design flood discharge is calculated by non-uniform flow calculation for the river channel to which the typical cross-section shown in Figure 5.1.13 is applied, and the validity of the design high water level would be confirmed.

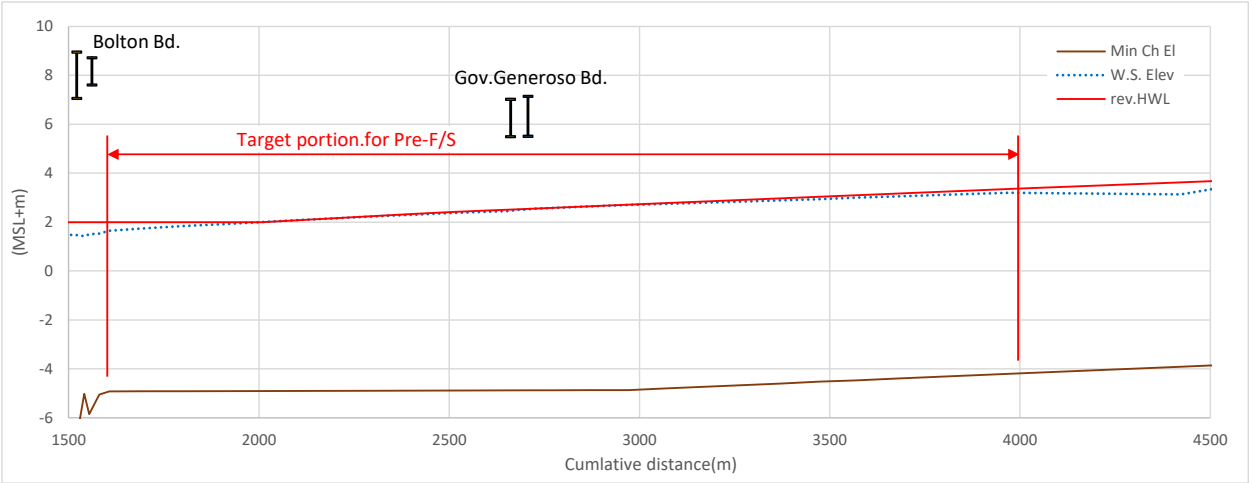


Source: Project Team

Figure 5.1.13 Typical Design Cross-section of Target Reach for Pre-F/S

(2) River Widening

The water level at the condition of design flood discharge of 1,700m3/s was calculated using 1D non-uniform flow calculations for the design rive shape set in the section above. For the downstream end boundary condition, the mean high tide level (MHHW) (MSL+0.981m) was applied, taking into account that the project for Pre-F/S is a middle to long-term project in the M/P, and that future increases of tide level due to climate change. As a result of the calculations, as shown in Figure 5.1.14 and Table 5.1.6, the water level at the condition of design flood discharge was less than HWL in the target reach for Pre-F/S, and it was confirmed that the design river shape considered in the previous section has no hydraulic problems.



Source: Project Team

Figure 5.1.14 River Water Level Profile with Design River Shape of Target Reach for Pre-F/S

Table 5.1.6 Calculated Water Level with Design River Shape of Target Reach for Pre-F/S

Reach	River Sta	Profile	Q Total	Min Ch El	rev.HWL	W.S. Elev	HWL-W.S.
			(m3/s)	(m)	(MSL+m)	(MSL+m)	(m)
main(5)	4000	100yr	1700	-4.2	**3.354**	3.2	0.154
main(5)	3900	100yr	1700	-4.27	3.290	3.15	0.140
main(5)	3800	100yr	1700	-4.33	3.226	3.1	0.126
main(5)	3700	100yr	1700	-4.4	3.162	3.05	0.112
main(5)	3600	100yr	1700	-4.47	3.098	3	0.098
main(5)	3500	100yr	1700	-4.53	3.034	2.94	0.094
main(5)	3400	100yr	1700	-4.6	2.970	2.89	0.080
main(5)	3300	100yr	1700	-4.67	2.906	2.84	0.066
main(5)	3200	100yr	1700	-4.73	2.842	2.79	0.052
main(5)	3100	100yr	1700	-4.8	2.778	2.74	0.038
main(5)	3000	100yr	1700	-4.87	2.714	2.7	0.014
main(5)	2900	100yr	1700	-4.87	2.650	2.64	0.010
main(5)	2800	100yr	1700	-4.88	2.586	2.58	0.006
main(5)	2725	100yr	1700	-4.88	2.558	2.55	0.008
main(5)	2695	100yr	1700	-4.88	2.539	2.51	0.029
main(5)	2680	100yr	1700	-4.88	2.529	2.5	0.029
main(5)	2648	100yr	1700	-4.88	2.509	2.45	0.059
main(5)	2600	100yr	1700	-4.88	2.481	2.43	0.051
main(5)	2500	100yr	1700	-4.89	**2.417**	2.37	0.047
main(5)	2400	100yr	1700	-4.89	2.333	2.3	0.033
main(5)	2300	100yr	1700	-4.9	2.250	2.23	0.020
main(5)	2200	100yr	1700	-4.9	2.167	2.16	0.007
main(5)	2100	100yr	1700	-4.91	2.083	2.08	0.003
main(5)	2000	100yr	1700	-4.91	**2.000**	2	0.000
main(5)	1900	100yr	1700	-4.92	2.000	1.92	0.080
main(5)	1800	100yr	1700	-4.92	2.000	1.84	0.160
main(5)	1700	100yr	1700	-4.92	2.000	1.75	0.250
main(5)	1600	100yr	1700	-4.93	2.000	1.65	0.350
main(5)	1574	100yr	1700	-5.06	2.000	1.53	0.470
main(5)	1548	100yr	1700	-5.86	2.000	1.5	0.500

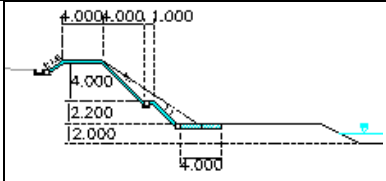
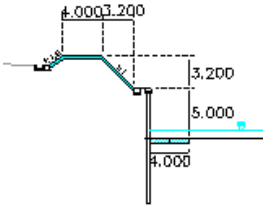
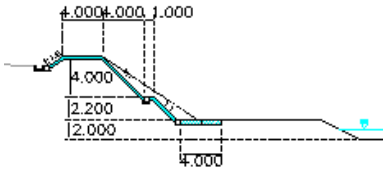
Source: Project Team

5.1.5 Comparison of Alternatives for Future Priority Project of Structural Measures Targeted for Pre-Feasibility Study

(1) River Widening

Regarding the river widening, land acquisition is the key to smooth implementation of the project. Therefore, the width of the channel is preferable to be smaller, but on the other hand, in order to secure the enough channel capacity to be safely flowing the design flood discharge, sheet pile revetments, etc., which may result in increased construction costs, need to be installed. Consequently, the required right-of-way (ROW) and cross-sectional structure are selected as items for setting alternatives for comparison. The alternatives are shown in Table 5.1.7. Regarding the handling of the 30-meter Easement, discussions were held with related agencies including C/P such as DPWH UPMO and Davao City, and it was concluded that "Development of the 30-meter Easement is still in the concept stage and there are no concrete plans at this time, so the project should be considered within the design river channel width and ROW". For reference, however, a proposal to secure the 30m Easement from the design riverbank is also shown in Table 5.1.7.

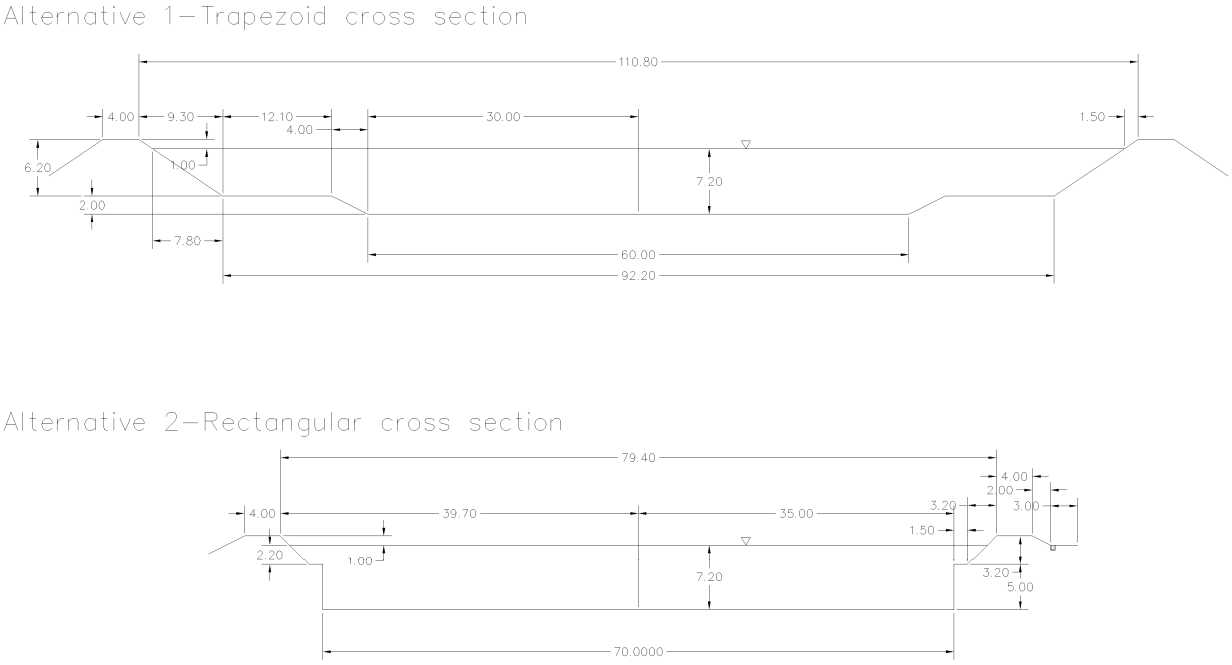
Table 5.1.7 Alternatives of River Widening

Alterna-tives	Alt.1	Alt.2	Reference
Contents	- Inverted trapezoidal double cross-section - Channel width: 111m+ROW	- Rectangular cross-section with straight wall - Channel width: 80m+ROW	- Inverted trapezoidal double cross-section - Channel width: 111m+30m Easement
Revetment structure			

Source: Project Team

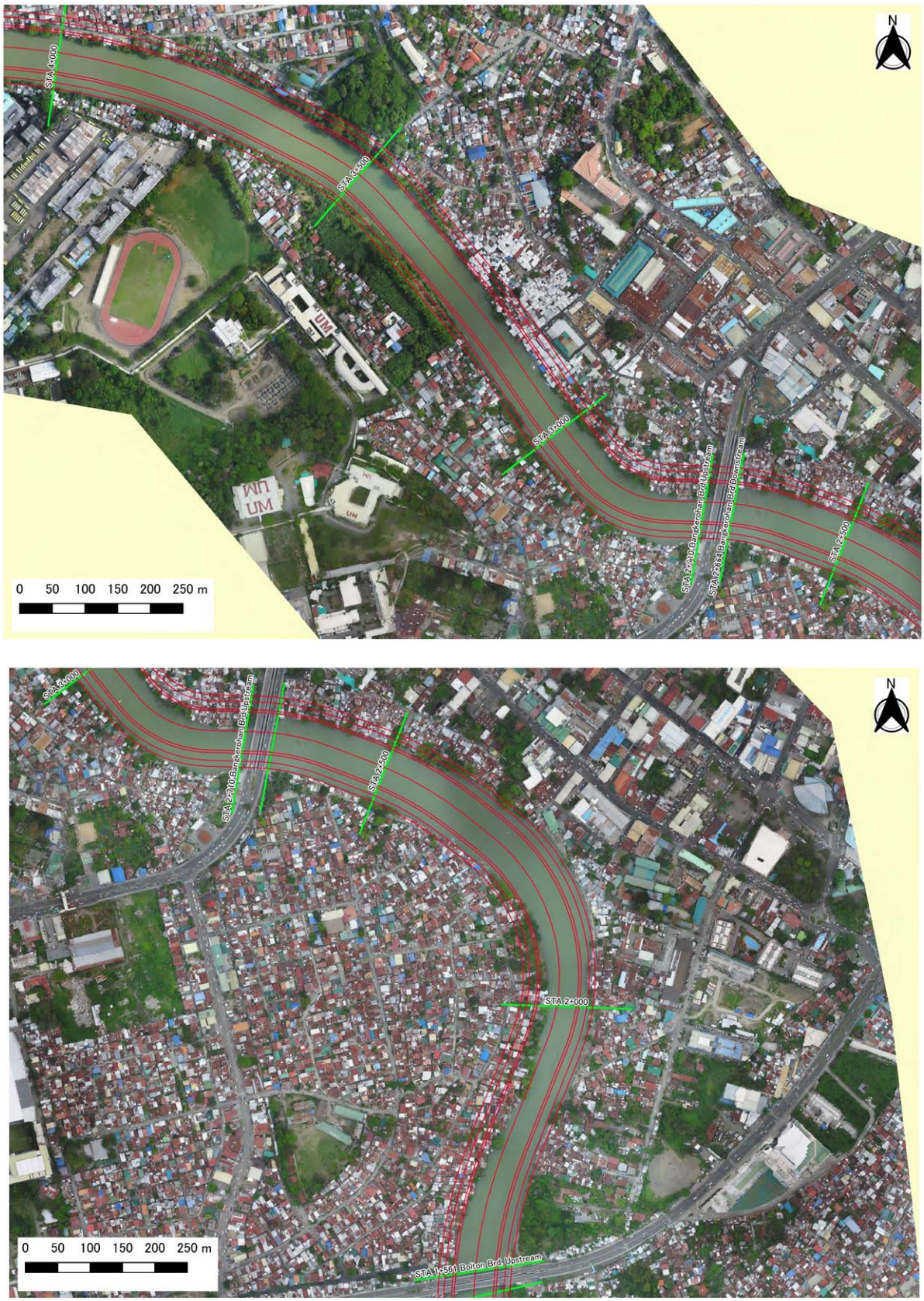
The revetment structure of Alt.1 is a concrete revetment with a slope of 1:1.0 with a catwalk, based on the typical cross-section shown in Section 5.1.4(1), to ensure the stability of the slope, and to prevent bank erosion with the flow velocity under the condition of design flood discharge. Alt.2 is a rectangular cross-section with sheet pile revetment to minimize the required width of the designed river channel. In order to ensure the structural stability of the revetment, a sheet pile revetment height from the riverbed would be less than 5m, and a 1:1.0 concrete revetment is applied for the portion beyond 5m. As a result, the typical design cross-section width for Alt.2 is approximately 80m. As described in 5.1.4(2), the target reach for Pre-F/S shall be considered to the backwater effect of the tide level, so it is confirmed that the water level calculated by the non-uniform flow calculation is less than HWL for Alt.2 as well.

For the design alignment of Alt.1, the design channel alignment studied in F/S is applied, while for Alt.2, the design channel alignment is adjusted to reduce the number of affected houses as the width of the design channel is reduced. The design plan drawings for each alternative are shown in Figure 5.1.16 and Figure 5.1.17, respectively.



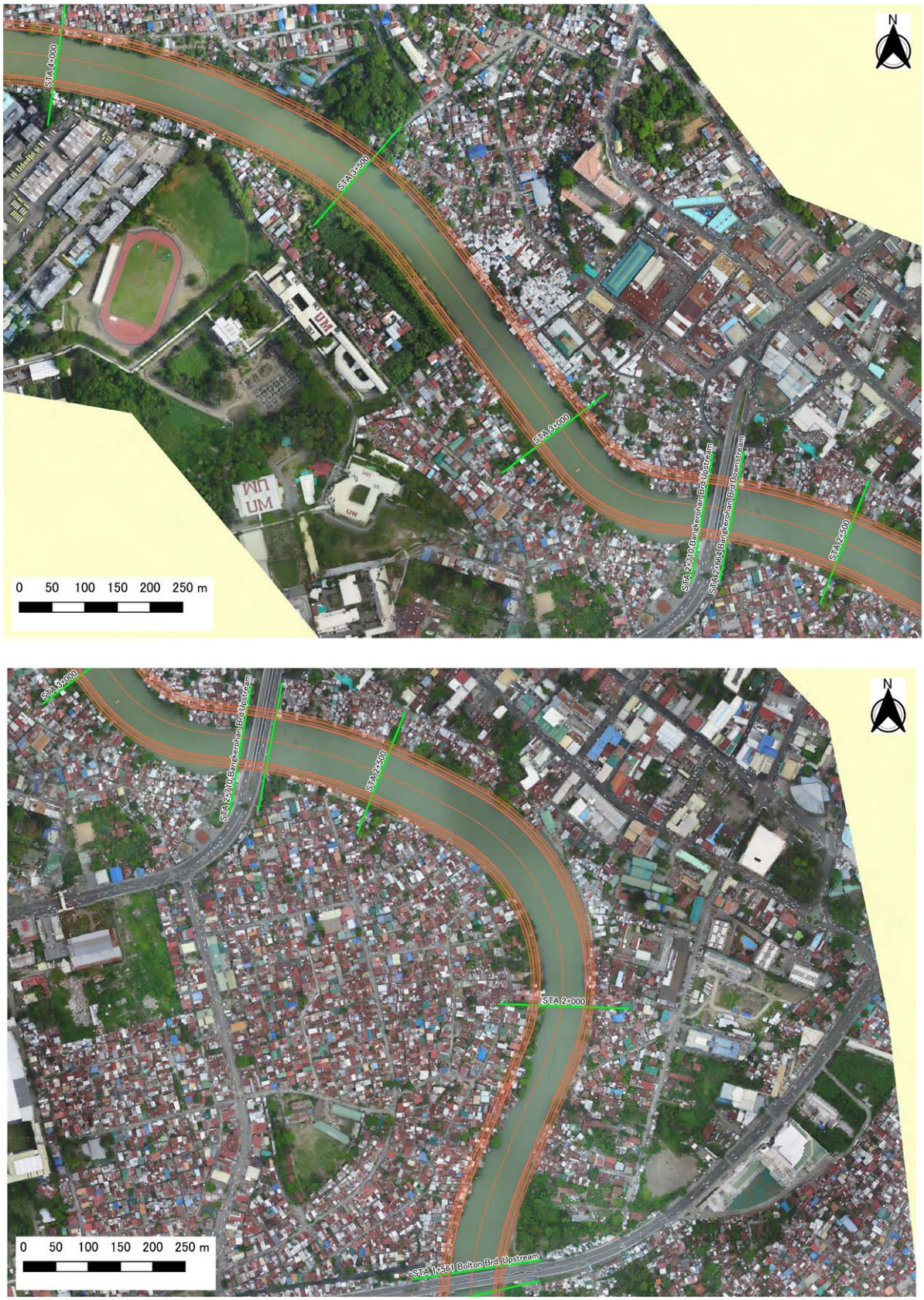
Source: Project Team

Figure 5.1.15 Typical Cross-section of Alternatives of River Widening



Source: Project Team

Figure 5.1.16 Design Alignment of Alternatives of River Widening (Alt.1)



Source: Project Team

Figure 5.1.17 Design Alignment of Alternatives of River Widening (Alt.2)

The result of comparison of river widening alternatives is shown in Table 5.1.8.

Table 5.1.8 Comparison of Alternatives for River Widening

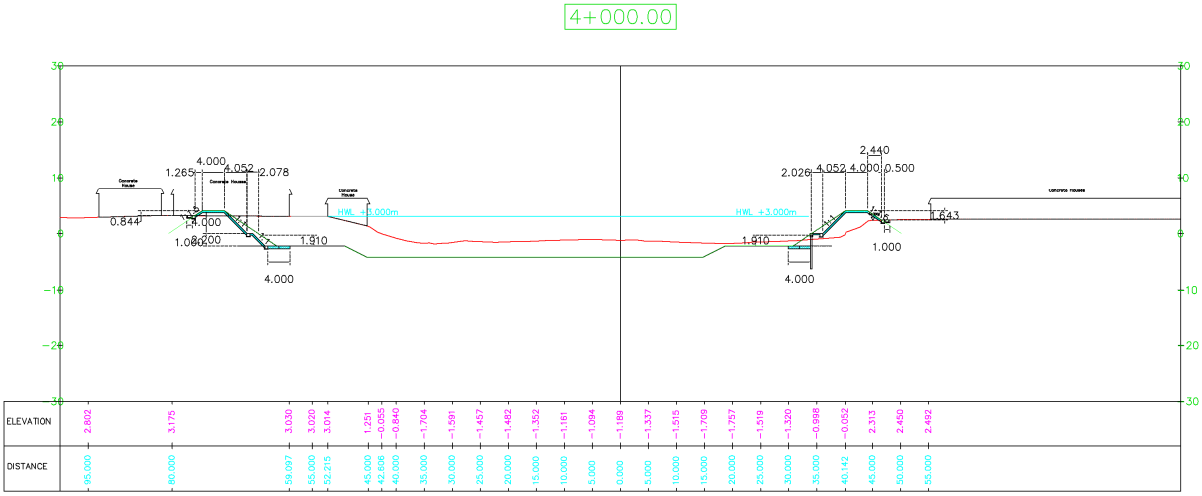
Alternatives	Alt.1: Inverted trapezoidal double cross-section (channel width: 111m+ROW)	Alt.2: Rectangular cross-section with straight wall (channel width: 80m+ROW)	Reference: Inverted trapezoidal double cross-section (channel width: 111m+30m Easement)
A. Flood protection level (expected damage reduction)	Flow capacity 1700m^3/s (Design flood discharge in M/P (100-yr scale floods)		
B. Economic effectiveness	Direct cost for works: 0.50 Billion PhP Land acquisition/compensation cost: 0.35 Billion PhP Total: 0.85 Billion PhP	Direct cost for works: 1.40 Billion PhP Land acquisition/compensation cost: 0.14 Billion PhP Total: 1.54 Billion PhP	Direct cost for works: 0.50 Billion PhP Land acquisition/compensation cost: 0.73 Billion PhP Total: 1.23 Billion PhP
C. Feasibility from in regards with social restriction	Affected houses: 1,150 (incl. 990 IFS)	Affected houses: 480 (incl. 440 IFS)	Affected houses: 2,240 (incl. 1,850 IFS)
D. Feasibility from the technical viewpoint to construct countermeasures	Phased construction is available.	Phased construction is available.	Phased construction is available.
E. Sustainability	- Maintenance dredging volume is minimum	- Maintenance dredging volume increase twice of Alt.1 - Difficulty and cost for rehabilitation/repairing would be higher since structure of straight wall portion will be sheet pile	- Maintenance dredging volume is minimum
F. Flexibility	- It is relatively easy to deal with the need to revise the cross-section (increase the flow area) in the future.	- The straight wall portion will be a sheet pile structure, and it is difficult to respond to the need to revise the cross-section (increase the flow area) in the future.	- It is relatively easy to deal with the need to revise the cross-section (increase the flow area) in the future.
G. Social and natural environment impact	- Compared to Alt.2, the land acquisition area would be larger. Impact to the local society (variation of land use, reconstruct of existing infrastructures, especially road) would be occur. - Compared to Alt.2, access to the river is easier and more hydrophilic.	- Compared to Alt.1, the scale of land acquisition and impact to local society would be mitigated. - Compromising access to the river and the landscape due to the high straight wall.	- The scale of land acquisition and impact to local society is maximum. - Compared to Alt.2, access to the river is easier and more hydrophilic.
	- There is a possibility of air and water pollution due to construction, whereas it can be reduced by general measures. - Project site is an urban area with almost no forests or green areas. Vulnerable ecosystems are not assumed, whereas general measures for conservation of urban ecosystems (control of generation and diffusion of turbid water, green areas in river channels, design considering natural riverbeds, etc.) are recommended.		
Other	—	—	—
Evaluation Result	**The number of relocations is about twice that of Alt.2, but the direct construction cost is 1/3 of Alt.2, the volume of maintenance dredging can be minimized, and there is greater future flexibility.** **◎ (Recommended)**	**The number of relocations is less than half that of Option 2, but the direct construction cost is about three times that of Option 2.** **Although future flexibility is low and maintenance costs including maintenance dredging are expected to be high, it can be an alternative when land acquisition is extremely difficult.** **△**	

Source: Project Team

5.1.6 Preliminary Design of Structure Measures of the Future Priority Project Targeted for Pre-Feasibility Study for Riverine Flood in Davao River

(1) Preliminary Design of Structural Measures (Pilot Section of River Widening Works)

The revetment structure was studied for the cross section of the river channel widening works. An example of a 4.0k cross-section is shown below as a standard cross-section including left and right banks. The planned crest height is 2.5m higher than the current ground level at most, while some sections have "excavate channel" where the crest height is lower than the existing ground.



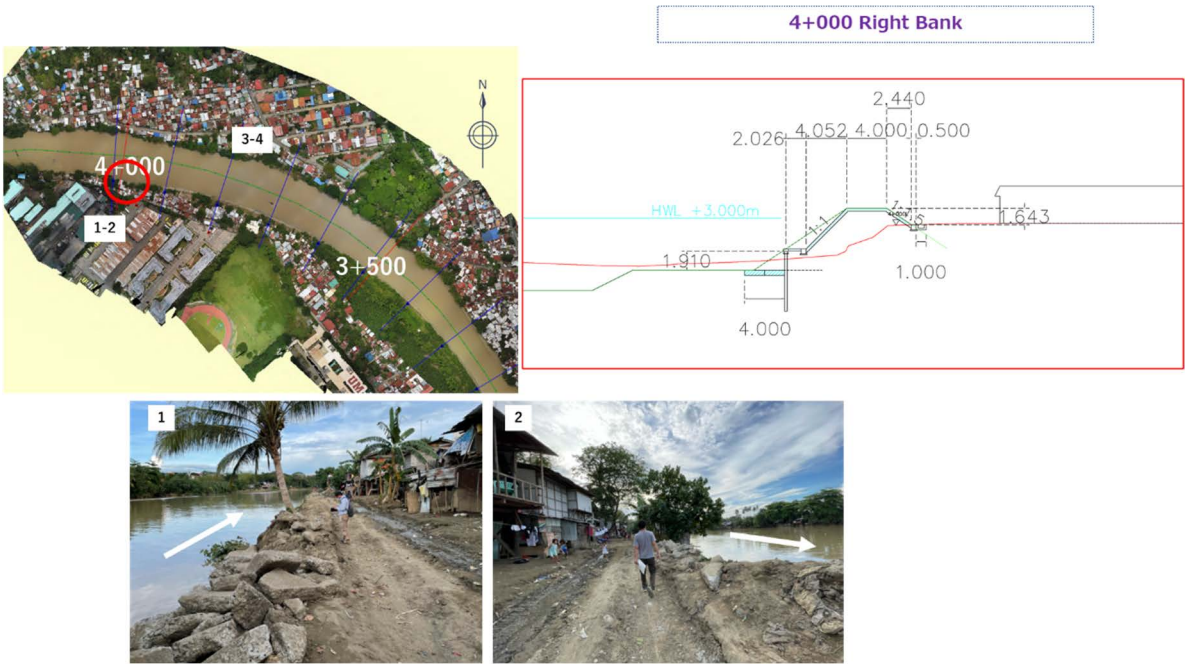
Source: Project Team

Figure 5.1.18 River widening works: standard revetment section (4.0k)

Concrete revetment structure (without steel sheet piles) will be the standard structure, but depending on the relationship between the planned river cross-section and existing ground level/existing dike alignment and the planned cross-section, different types of structure are proposed, such as the installation of steel sheet piles as foundation or the use of the existing dike. The typical structural types are shown below.

1) 4.0k Right Bank

At 4.0k right bank, the planned dike alignment runs above the current river channel, and it is difficult to construct revetment foundations by coffering, so the revetment foundations are steel sheet pile type.



Source: Project Team

Figure 5.1.19 Structural type at river channel widening section (steel sheet pile section)

2) 4.0k Left Bank

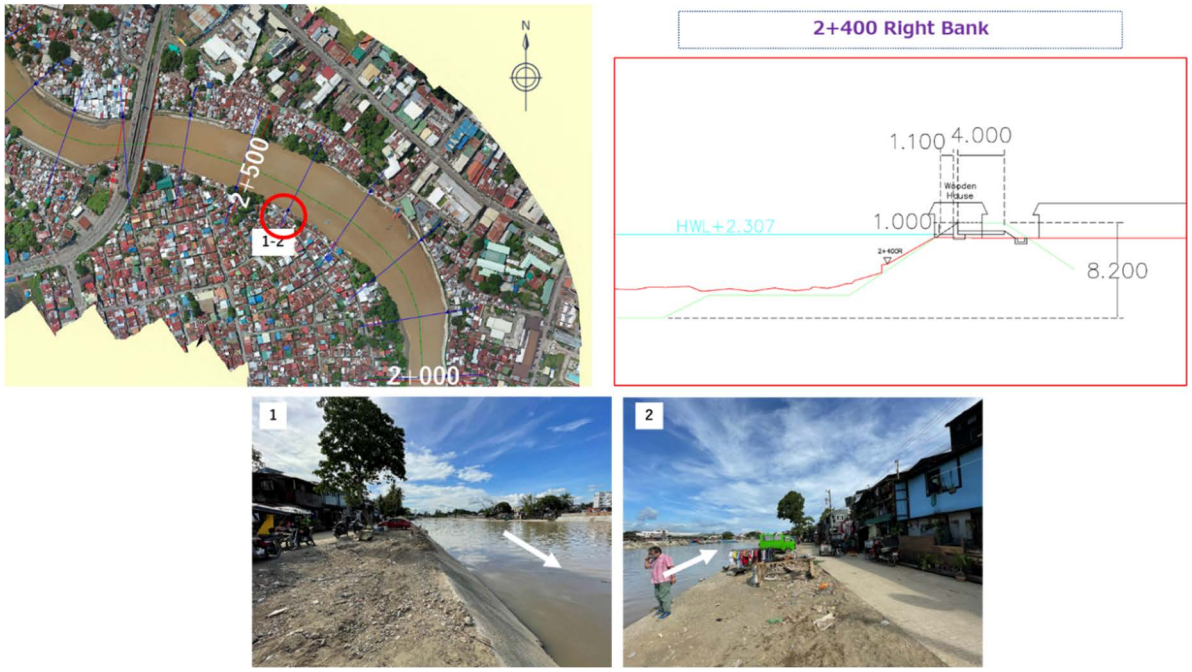
The 4.0k left bank is the standard section of the river channel widening and the planed dike alignment is inside the current dike alignment. Only concrete revetments and foot protections are to be installed.

Source: Project Team

Figure 5.1.20 Structural type at river channel widening section (revetment only section)

3) 2.4k Right Bank

The 2.4k right bank is an "excavated section" where the ground level is higher than HWL. The current dike alignment and the planned dike alignment are almost identical, and the difference between the current crest height and the planned crest height is less than the freeboard height (1m). The lacking freeboard height will therefore be accommodated by installing a parapet.

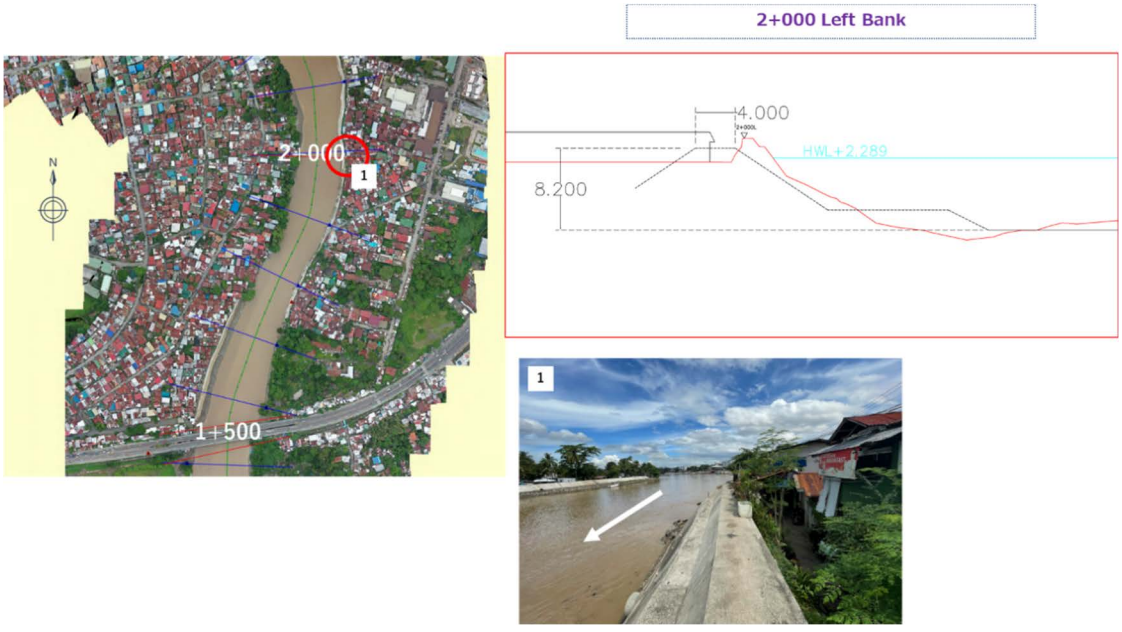


Source: Project Team

Figure 5.1.21 Structural type at river channel widening section (parapet section)

4) 2.0k Left Bank

At 2.0k left bank, the existing and planned dike alignments are almost in line with each other and the existing dike is of sufficient height. Therefore, the existing dike shall be utilized as it is.

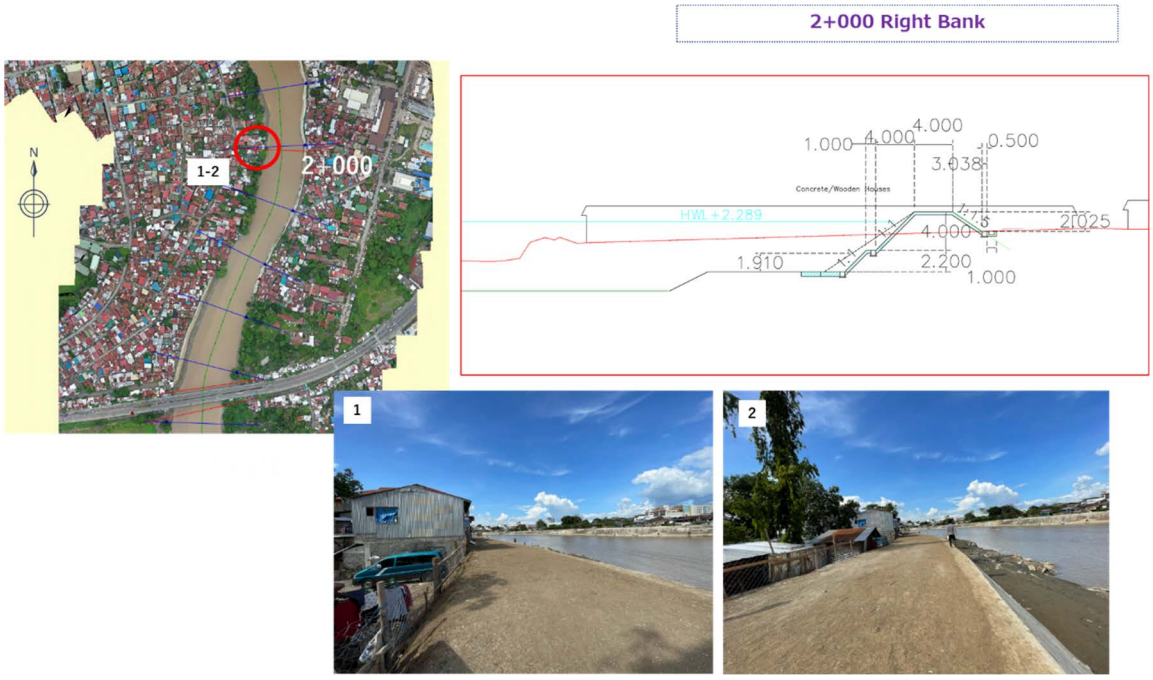


Source: Project Team

Figure 5.1.22 Structural type at river channel widening section (existing revetment section)

5) 2.0k Right Bank

The 2.0k right bank is also the standard section of the river channel widening and the planed dike alignment is inside the current dike alignment. Only concrete revetments and foot protections are to be installed.

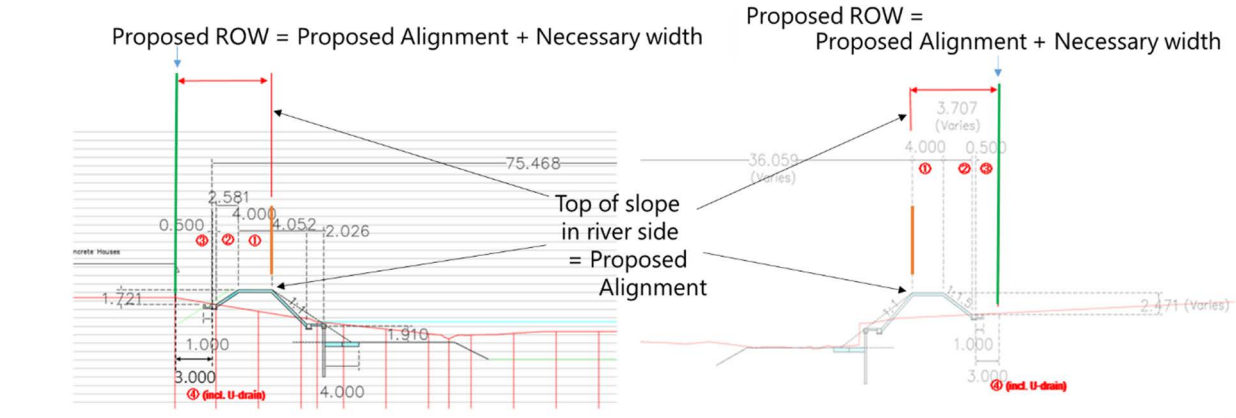


Source: Project Team

Figure 5.1.23 Structural type at river channel widening section (revetment only section)

(2) Investigation of ROW and Affected Buildings for Pilot Section of River Widening Works

Right of way (ROW) for Pilot Section of River Widening Works was investigated. As shown in Figure 5.1.24, necessary width that consists of crown width, slope, base concrete and width for construction was checked for each surveyed cross section with 100m interval in longitudinal direction. Then those checking points are connected to set ROW alignment as shown in Figure 5.1.25.



Left Bank

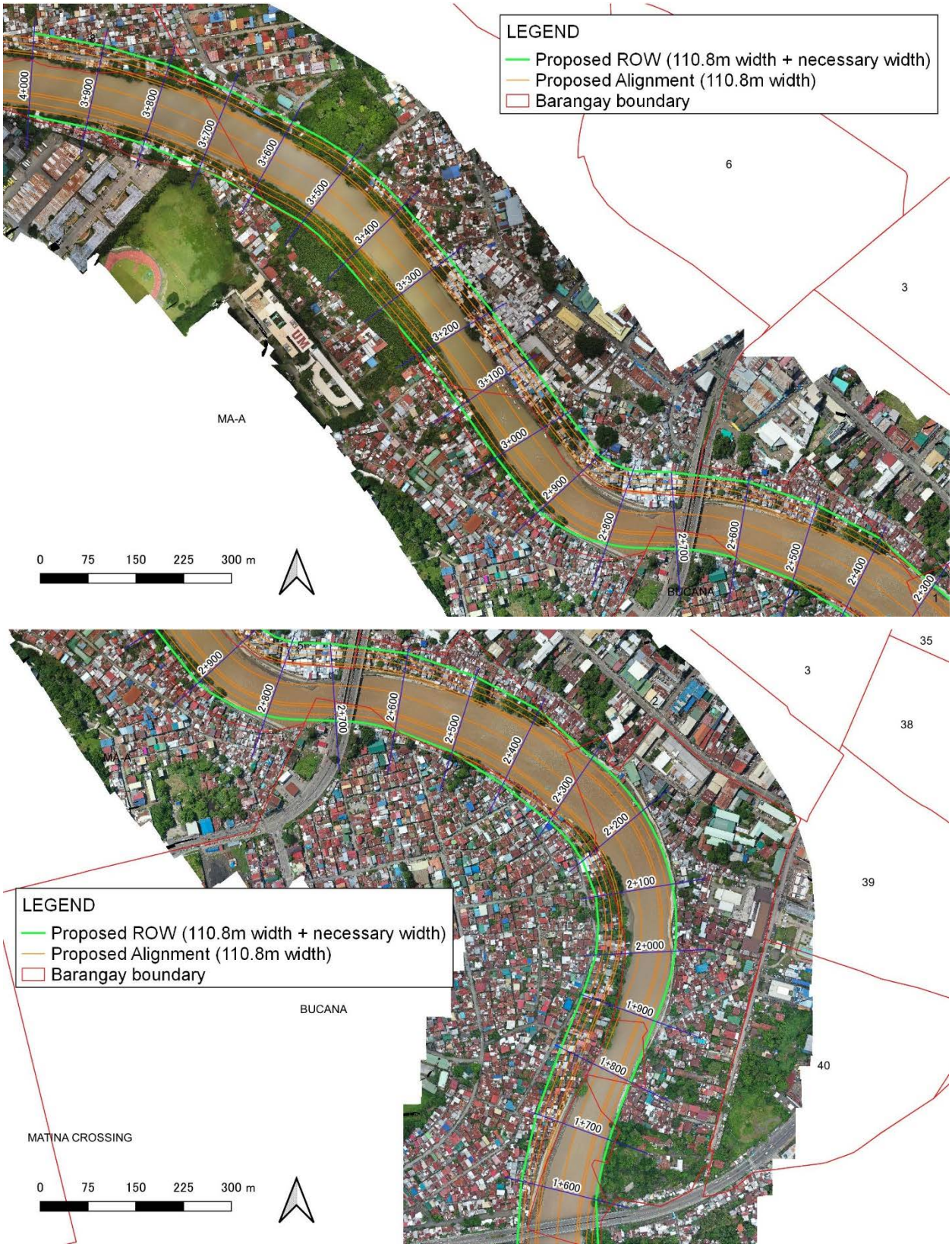
km	① Crown width (m)	② Slope (m)	③ Base Concrete (m)	④ for construction incl. U-drain (m)	Difference (Dike Elev. - Ground Elev.)	= ①+②+③+④ Necessary Width (m)	Note
4000	4.00	1.27	0.50	3.00	0.84	8.77	
3900	4.00	1.27	0.50	3.00	0.84	8.77	
3800	4.00	1.13	0.50	3.00	0.75	8.63	
3700	4.00	0.66	0.50	3.00	0.45	8.16	
3600	4.00	0.00	0.50	3.00	0.00	7.50	enough ground elev.

Right Bank

km	① Crown width (m)	② Slope (m)	③ Base (m)	④ for construction incl. U-	Difference (Dike Elev. - Ground Elev.)	= ①+②+③+④ Necessary Width (m)	Note
4000	4.00	2.44	0.50	3.00	1.64	9.94	
3900	4.00	3.31	0.50	3.00	2.20	10.81	
3800	4.00	2.83	0.50	3.00	1.90	10.33	
3700	4.00	2.70	0.50	3.00	1.80	10.20	
3600	4.00	2.87	0.50	3.00	1.93	10.37	

Source: Project Team

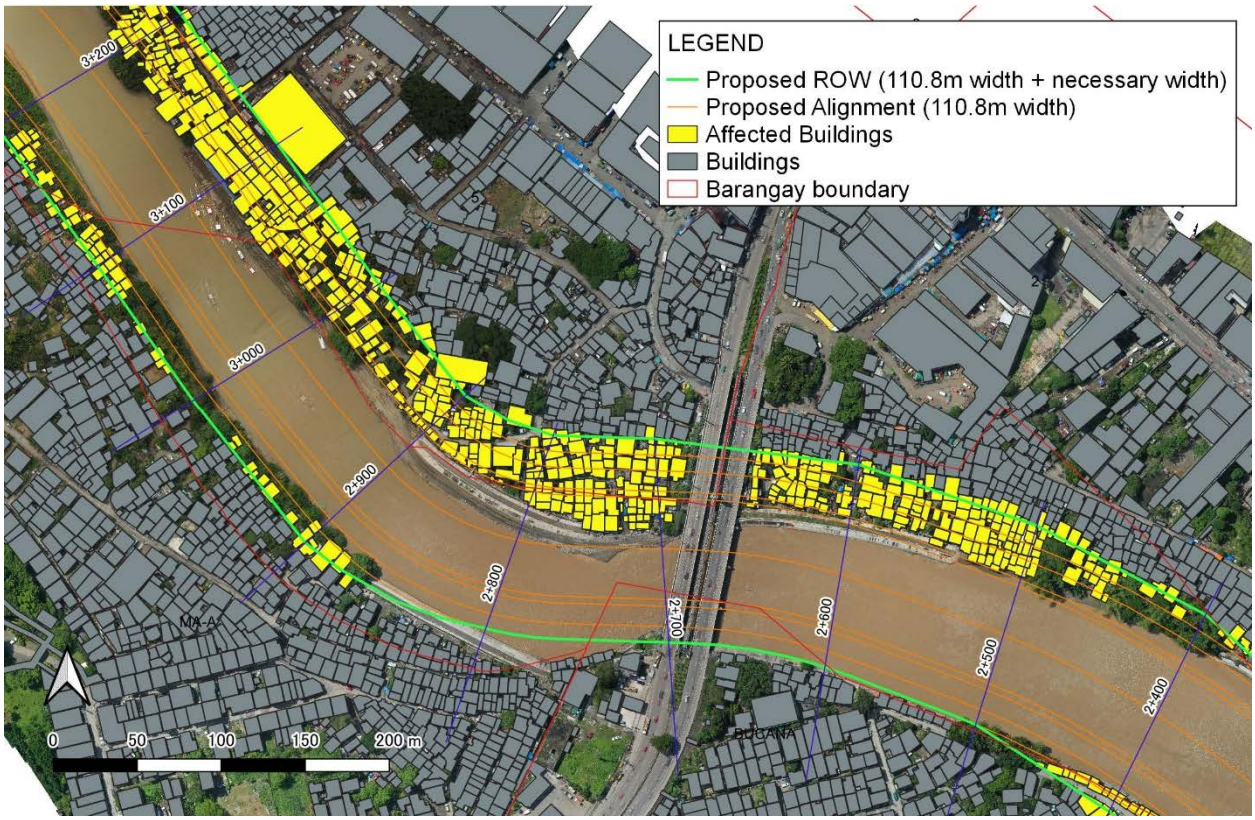
Figure 5.1.24 Setting of ROW



Source: Project Team

Figure 5.1.25 ROW for Pilot Section (from Bolton bridge to Station 4+000) of River Widening Works

Figure 5.1.26 shows an example of map for studying buildings in and on ROW. The buildings and affected households in and on ROW are analyzed and mentioned in Section 5.4.2 (2) 4) and Section 5.4.3.



Source: Project Team

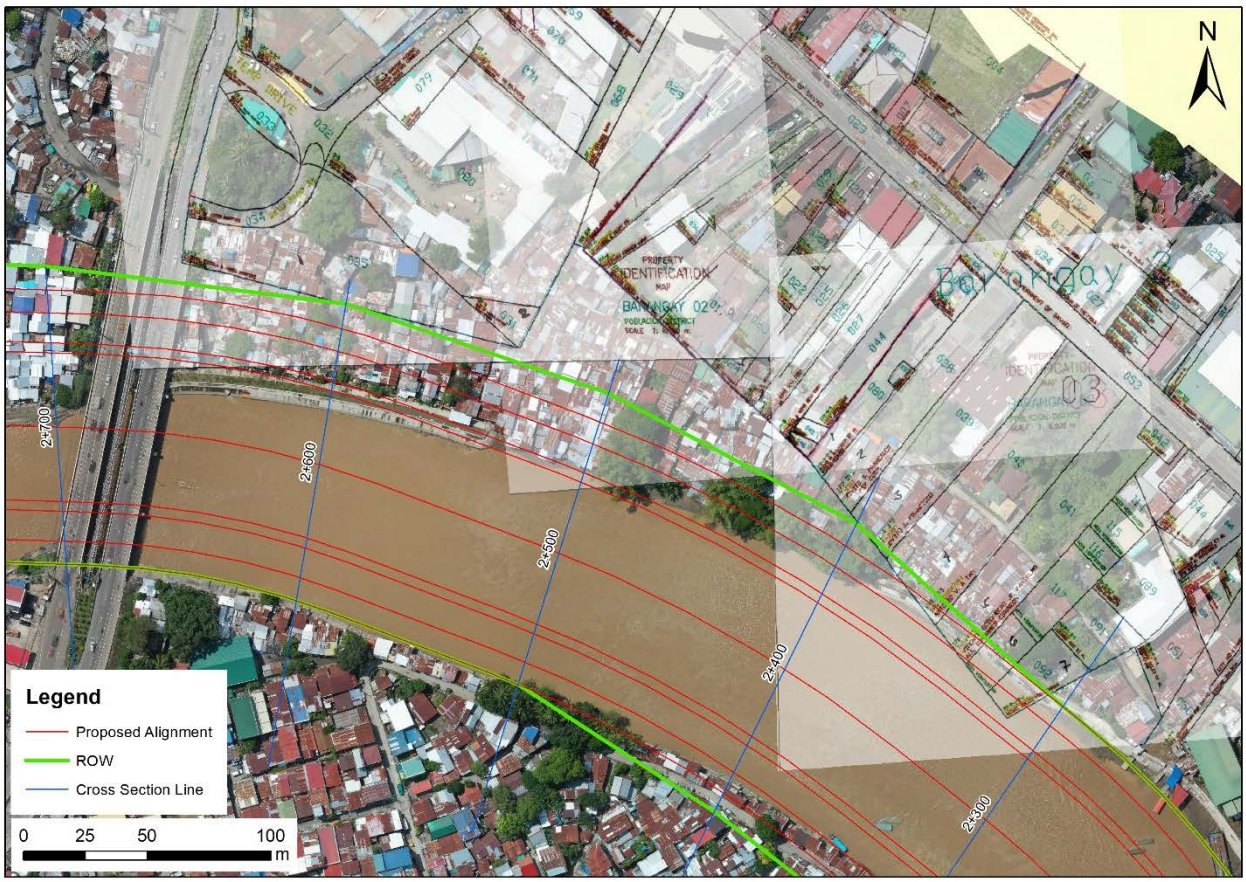
Figure 5.1.26 An Example Map of Study on Buildings in and on ROW

In addition, as a preliminary parcellary survey, tax maps and technical description were collected from CAO (City Assessor's Office) in Davao City and analyzed. Figure 5.1.27 shows examples of some collected tax maps in the left bank from around station 2+300 to 2+700, which were georeferenced and put on GIS. Lot boundary were digitized from the collected Tax Maps. Figure 5.1.28 shows digitized lot boundary around ROW in the pilot section with about 2.5 km from Bolton bridge to Station 4+000. Also, Figure 5.1.29 shows status of land in ROW such as with/without title or area included/not included in collected Tax Maps. From the analysis, it was found that:

- The Tax Map, currently available in the City, only covers partially the proposed ROW.
- In the ROW area where already populated by structures/improvement but without Tax Map may have titles and subdivided or still governmental lands. To confirm this, the collection of TCT and/or OCT as well as the technical description is necessary.

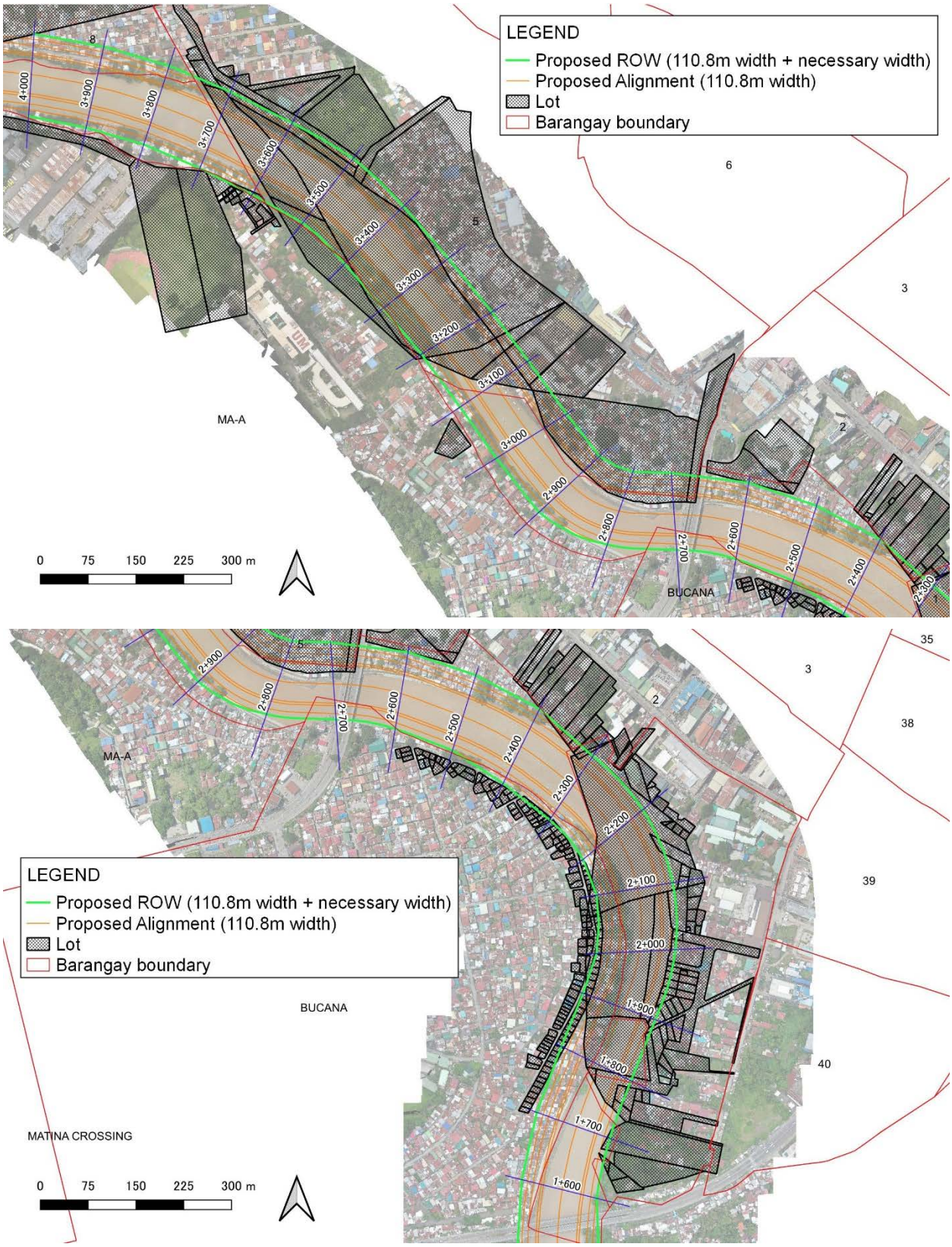
In the Detailed Design Stage, the following is necessary.

- From DENR Region 11, to collect the approved land plans and technical description for the proposed ROW to confirm the latest status of the subdivision in each lot
- From Land Survey Department Region 11, to collect TCT and/or OCT
- From City Assessor Office of Davao City, to collect Tax Declaration
- To prepare the Parcellary Survey Plan based on the above supporting documents.
- To validate the eligibility of each affected lot for the compensation by the government.



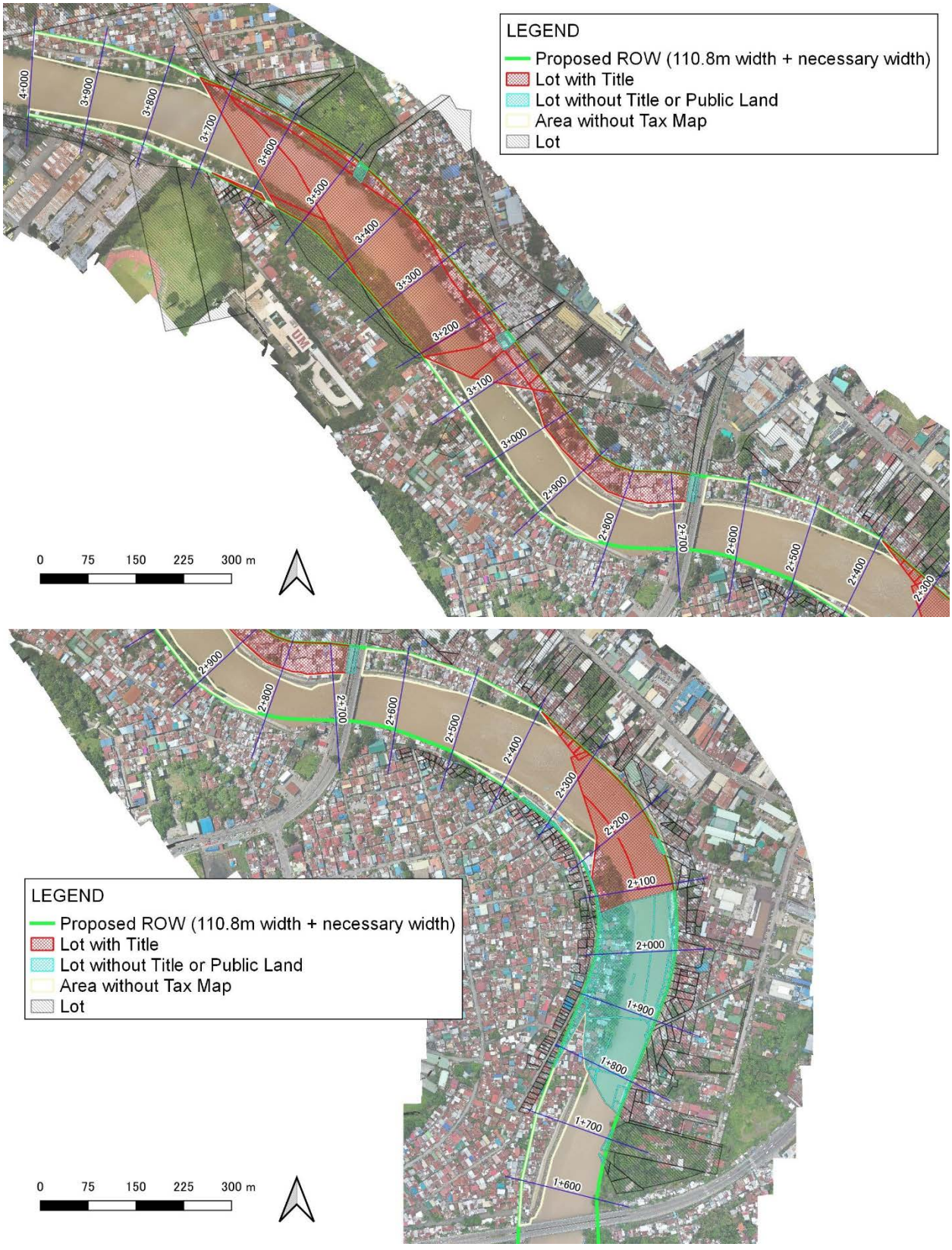
Source: Project Team

Figure 5.1.27 Examples of Collected Tax Map (Left bank from Station 2+300 to 2+700)



Source: Project Team

Figure 5.1.28 Condition of Lot Boundary in and around ROW in Pilot Section from Bolton bridge to Station 4+000



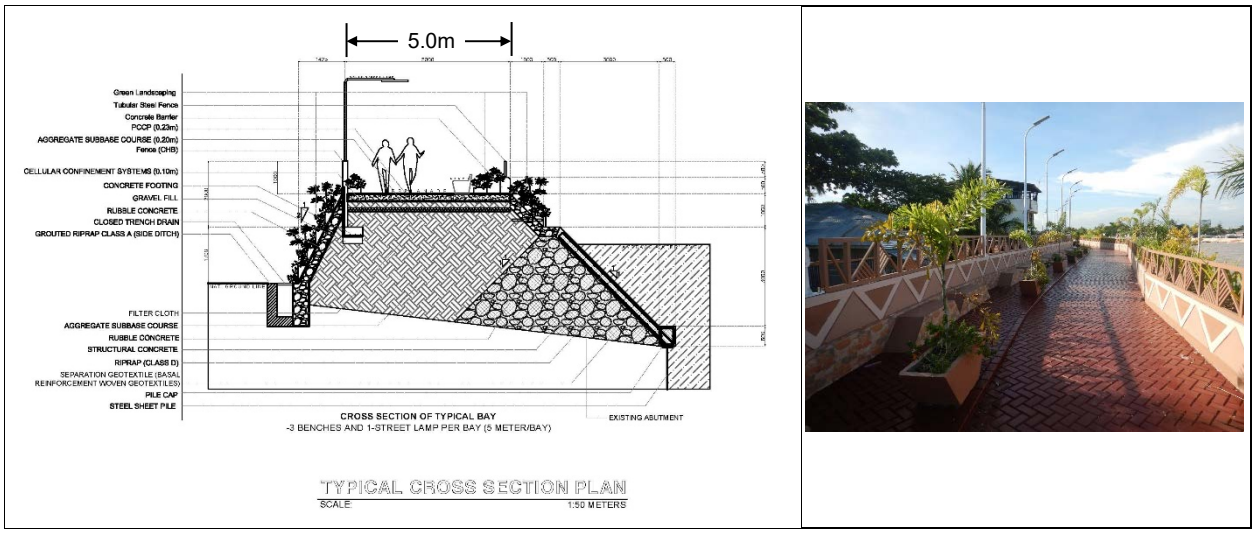
Source: Project Team

Figure 5.1.29 Status of Land in ROW (with/without Title or Area without Tax Map)

(3) Additional Examination on Cross-Sectional Structures

Additional examination is conducted on the cross-sectional structure of the river widening works.

Davao City is currently implementing a project to develop dike and revetments, as well as a promenade for the river mouth and downstream sections of the Davao River. Figure 5.1.30 shows the typical cross section plan of dike, revetment and promenade in the river mouth of the Davao River and an example of developed promenade.



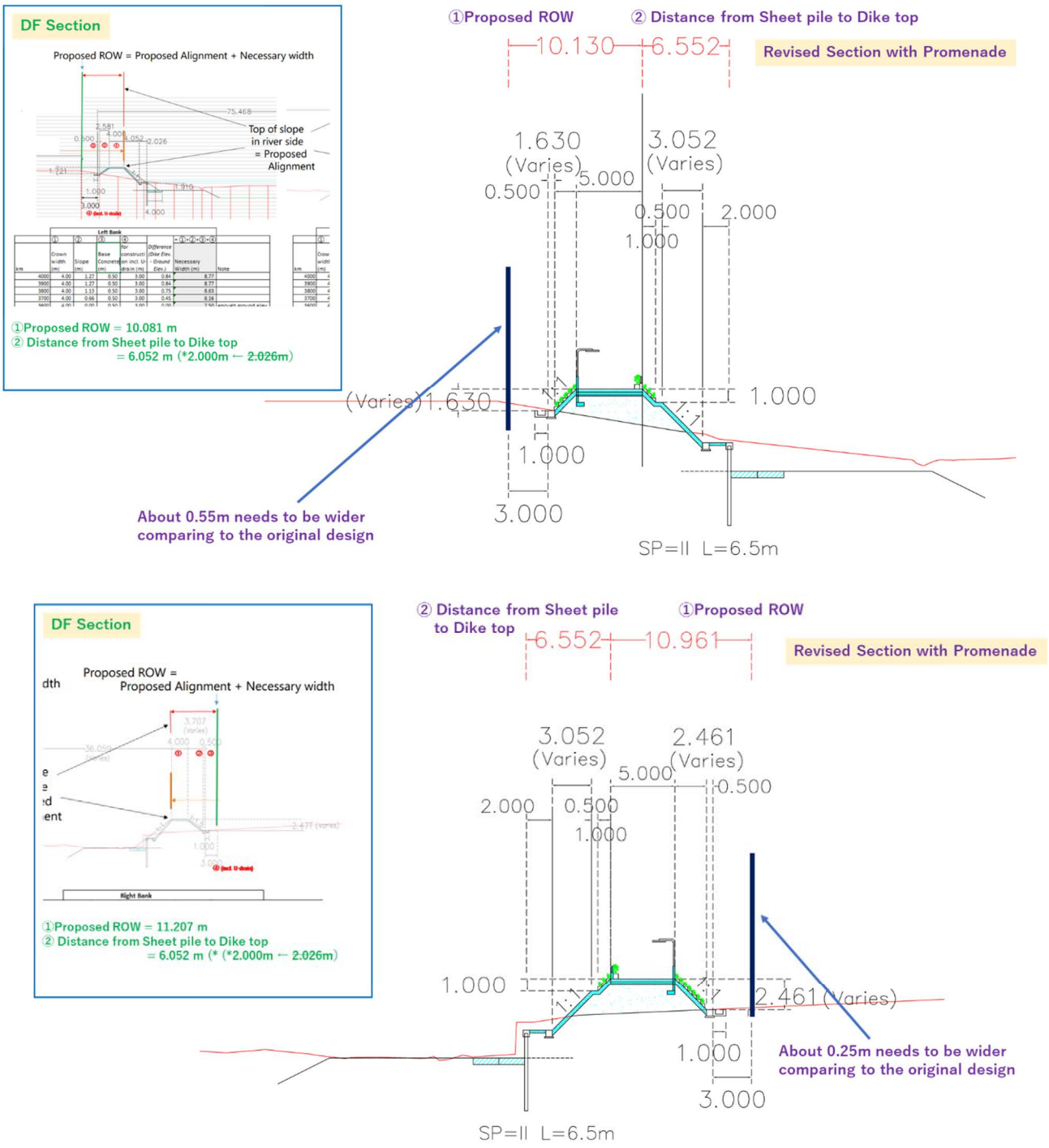
Source: DPWH DCDEO

Source: Project Team

Figure 5.1.30 Typical Cross Section Plan of Dike, Revetment and Promenade in the River Mouth of the Davao River (Left) and an Example of Developed Promenade (Right)

The structure of the river widening works for target section in this Pre-F/S has already been studied in the above (1), whereas it was examined that if the similar structure as the promenade currently developed in the Davao River is to be applied in the target section, whether the structure could be implemented within the ROW proposed in the above (2) or not.

Figure 5.1.30 shows the examination results for two cross sections. For each cross section, the upper left figure shows the cross section and required land width set in (1), and the right figure shows the cross section and required land width when the promenade is applied.



Source: Project Team

Figure 5.1.31 Comparison between ROW of Initial Design and ROW of Design with Promenade

As a result of the above examination using two cross sections as examples, the required land width to incorporate the promenade will be 0.25m to 0.55m larger than the original design, but this can be adjusted from the 3m set as the construction width (reducing the width by 0.25m to 0.55m from the 3m width for construction), and it can be judged possible to incorporate a promenade within the ROW proposed in (2).

In addition, the project cost estimated in this Project (detailed in Section 5.2) does not include the cost of outdoor lights, fences, etc. for the promenade. These construction costs are roughly estimated at approximately 200 million pesos. If the promenade development will be judged to be applied and included in the project for the widening works in future, more detailed studies and cost calculations need to conducted in the next stage such as detailed design stage and it is necessary to include it in the project cost.

5.2 Construction Plan and Cost Estimate

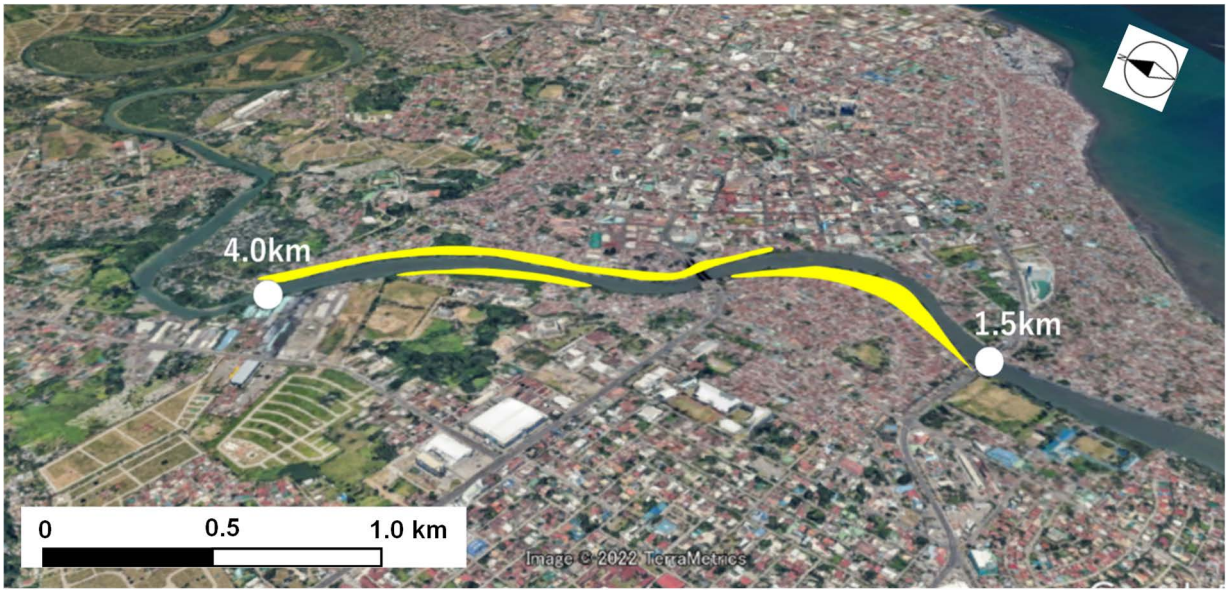
5.2.1 General

This chapter describes the construction plan and cost estimation after clarifying the construction procedures based on the local conditions for the River Widening project (1.5-4 km and 2.5 km from the river mouth) to be studied on a pilot basis before the full-scale F/S (F/S for the River Widening project (1.5-14 km)) is conducted as a pre-F/S. In the construction plan and cost estimation, the process and construction method should be studied in consideration of necessary construction conditions such as access to the construction site and the method of bringing in materials and equipment. In addition, the applicability and appropriateness of the conditions for the use of Japanese technology (STEP: Special Terms for Economic Partnership) shall be investigated.

5.2.2 Construction Plan and Schedule

(1) Scope of Work

For the major works in this project, i.e., channel excavation, shortcut, and Retarding Pond, the scope of work is shown in Figure 5.2.1, the major works are shown in Table 5.2.1, and the major construction quantities are shown in Table 5.2.2, respectively.



Source: Project Team

Figure 5.2.1 Location of the Project

Table 5.2.1 Summary of the Project

Item	Descriptions
River Widening	Scope：1.5km～4.0km from River Mouth (Length =2.5 km)
	Width of the River：80m
	Excavation Volume：321,000m^3, (Open Cut：112,000m^3, Dredging：209,000m^3)

Source: Project Team

Table 5.2.2 Quantity of the Project

Item		Unit	Quantity
River Widening			
1-1	Channel Excavation (Excavation-Loading-Transportation)	m3	112,000
1-2	Dredging-soils (using Backhoe on Barge)	m3	209,000
1-3	Channel Excavation (Loading and Transportation)	m3	146,000
1-2	Embankment (for Dike)	m3	46,000
1-3	Embankment (at Disposal area)	m3	212,000
1-4	Concrete Revetment (Reinforced Concrete t=50cm)	m3	23,535
1-5	Gabion (t=50cm) - Foot Protection	m3	10,000
1-6	Concrete Block - Slope Toe Protection	m3	3,750
1-7	Steel Sheet Piles , Furnished	m	16,250
1-8	Steel Sheet Piles, for temporary works, without materials	m	16,250

Source: Project Team

(2) Basic Conditions of Construction Plan

The conditions related to construction planning are the same as those described in Section 4.4 for weather conditions, days available for construction, labor hours, construction roads, and construction generated soil receiving sites.

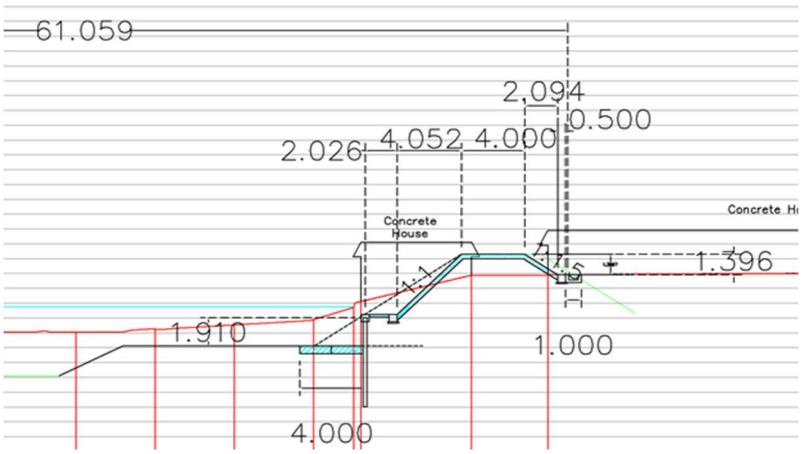
(3) Labor, Equipment and Material for Construction

Labor, equipment, and materials All labor is available in Davao City and surrounding cities; same as described in Section 4.4.

(4) Construction Method

1) General

The channel widening is at 1.5 km to 4.0 km from the mouth of the river. The standard cross section (2+300) is shown in Figure 5.2.2 and the quantity of earthwork including dredging is shown in Table 5.2.3, respectively.



Source: Project Team

Figure 5.2.2 Typical Cross-section for River Widening

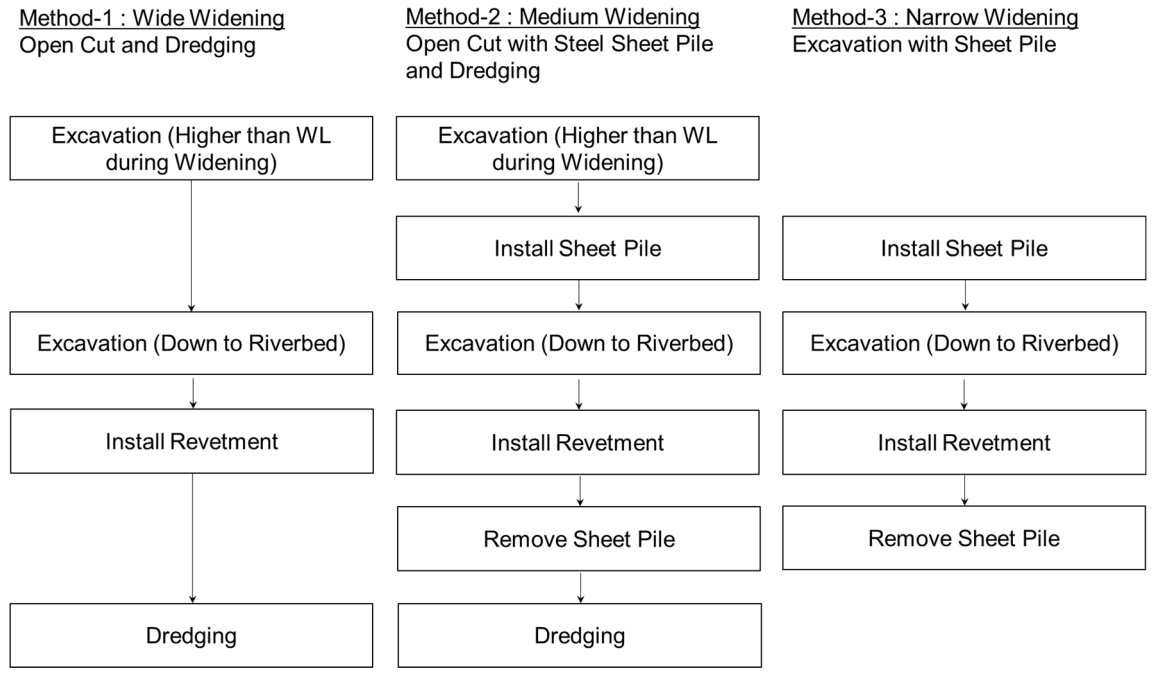
Table 5.2.3 Quantity of Earthwork Including Dredging

Station	Structures	Dredging Area from barge (m2)	Cut Area from ground (m2)	Dredging Volume (m3)	Cut Volume (m3)	Filling Area (m2)	Filling Volume (m3)
STA 1+561	Bolton Brd. U	0	0	0	0	0	0
STA 2+000		151	41	33,242	9,062	8	1,760
STA 2+500		44	7	48,964	12,037	7	3,827
STA 2+664	Gov.Generoso Brd. D	90	51	11,024	4,746	9	1,351
STA 2+710	Gov.Generoso Brd. U	150	103	5,520	3,547	8	398
STA 3+000		82	69	33,617	24,919	43	7,479
STA 3+500		82	39	40,921	26,861	12	13,988
STA 4+000		59	86	35,252	31,125	55	16,757
Total				209,000	112,000		46,000

Source: Project Team

2) Construction Flow Chart

Figure 5.2.3 shows the construction flow of the river channel widening. The construction procedure for the revetment work will be carried out according to the method shown in the master plan (Figure 3.11.5 River Channel Widening Work). Excavation is to be carried out in dry conditions, and if necessary, temporary closure using steel sheet piles, etc., is to be used to complete the excavation of the portion necessary to construct the revetment. The excavated sediment remaining on the river side will be dredged to excavate the river channel after the temporary sealing is removed. After excavation of the revetment area is completed, revetment mats and concrete revetment will be constructed.



Source: Project Team

Figure 5.2.3 Implementation Flow Chart of River Widening

(5) Efficiency of Construction Equipment

1) Dredged and Excavated Soil Transportation

The River Widening will involve excavation of 321,000 m^3 in 3 years period. Assuming that there are 243 workable days per year, implementation rate per day will be approximately 440 m^3. When 0.8 m^3 backhoe is used, as the capacity will be approximately 500 m^3 per day, one set will be required. One set of excavating and dredging equipment will be required for both open excavation and dredging.

Dump trucks (12 yd^3) will be used to transport the dredged sediment. The amount of work depends on the hauling distance. The number of dump trucks required is about 12 for a hauling distance of 20 km (36.2 m^3/day) and about 7 for 10 km (63.0 m^3/day).

A 21-ton bulldozer will be used to level the soil at the dumping site, with a work rate of 127 m^3 per hour (cycle time of 1.08 minutes at a leveling distance of 20 m), or 890 m^3 per day. The number of sets required is 1 set.

2) Summary of the Efficiency of Construction Equipment

Table 5.2.4 shows the equipment combinations and work efficiencies for the major types of work in the pre-F/S covered projects.

Table 5.2.4 Equipment Combinations and Work Efficiencies for the Major Works

Work Item	Equipment	Productivity			Remarks
		per hr	per day		
Excavation	Bulldozer (140 HT)	50	350	m3	
Loading	Backhoe (0.8 m3)	71	500	m3	
Transportation	Dump Truck (12Yd3)	9 ～ 5.2	63 ～ 36	m3	10km～20km
Spreading	Motorized Road Grader, 140hp	50	350	m3	
	Bulldozer (140 HT)				
Embankment	Vibratory 10mt SD100DC	50	350	m3	
Dredging-soils (using Backhoe on Barge)	Backhoe (0.8m3～)	16 ～ -	112 ～ 630	m3	Dredging
	Deck Barge (600mt DWT～)				
	Scow, 10 m3～				
	Tugboat, 500hp～				
	Payloader (1.5m3)- at Temporary yard				
	Crawler Crane (36-40m)190hp with Bucket				Unloading from
Steel Sheet Piles (Slope Protection)	Crawler Crane (36-40mt)	10	70	m	
	Vibro Hammer (201 hp)				

Source: Project Team

(6) Package of Contract

The construction contractor procurement shall be conducted through international or domestic tenders. The contracted construction area shall be one package. It should be noted that the river widening project is expected to be an International Competitive Bidding process, considering the difficulty of construction and the scale of the work.

Package 1: River widening

(7) Proposed Construction Schedule

Construction schedule is shown in Table 5.2.5.

Table 5.2.5 Construction Schedule

	Unit	Unit	Quantity	Workable days pre Year	Year	Progress per Day	Year 1	2	3	4	5	6	7	8	9	10
1 River Widening																
1-2 Preparation, Resettlement																
1-3 Construction																
1-3-0	Tendering, etc.	LS	1		1.0											
1-3-1	Channel Excavation (Excavation-Loading-Transportation)	m3	112,000	243	2.0	230										
1-3-2	Dredging-soils (using Backhoe on Barge)	m3	209,000	243	2.0	430										
1-3-3	Channel Excavation (Loading and Transportation)	m3	146,000	243	2.0	300										
1-3-4	Embankment (for Dike)	m3	46,000	251	2.0	92										
1-3-5	Embankment (at Disposal area)	m3	212,000	251	2.0	422										
1-3-6	Concrete Revetment (Reinforced Concrete t=50cm)	m3	23,535	251	2.0	47										
1-3-7	Gabion (t=50cm) - Foot Protection	m3	10,000	251	2.0	20										
1-3-7	Concrete Block - Slope Toe Protection	m3	3,750	251	2.0	7										
1-3-8	Steel Sheet Piles , Furnished	m	16,250	251	2.0	32										
1-3-9	Steel Sheet Piles, for temporary works, without materials	m	16,250	251	2.0	32										
1-4 Design, Construction Management		LS	1		2.0											

Source: Project Team

5.2.3 Cost Estimation

The project cost estimation method was the same as described in Section 4.4.3.

5.2.4 Project Cost

(1) Project Cost estimated based on the Methodology set in the Section 4.4.3

The estimated project costs are shown in Table 5.2.6. Table 5.2.7 shows the preparation costs and Table 5.2.8 shows the construction and procurement costs. Project costs were calculated using the method described in Section 4.4, and the total project costs for the project as a pre-F/S target are shown at the bottom of the table. Operation and maintenance costs are the costs required annually after construction is completed. Except for preparation costs, the other costs were calculated as a percentage of construction and procurement costs. Construction and procurement costs were calculated by each work, and the total amount is shown at the bottom of the table.

Table 5.2.6 Project Cost for Pre-F/S Project

No.	Item	LC	FC	Total	Description
		(Unit: Million Philippines Pesos)			
1	Project Management Cost	17	21	38	3.5% of the amount of Construction & Procurement Cost, Consulting Service Cost and Contingency Cost.
	Subtotal	17	21	38	
2	Preparation Cost	0	0	0	
2-1	Land Acquisition Cost	231	0	231	Same as Master Plan
2-2	Compensation Cost	167	0	167	Relocating buildings located on the site to implement the measures.
2-3	Removal Cost	33	0	33	20% of the cost required for building transfer
2-4	Environmental Impact Assessment Cost	0	0	0	Included in Common Temporary Facility Cost
	Subtotal	431	0	431	
3	Construction & Procurement Cost	344	474	818	See Construction & Procurement Cost
	Subtotal	344	474	818	
4	Consultant Service Cost	0	0	0	
4-1	Consultant Service Costfor Civil Work	0	0	0	
4-1-1	Detail Design Cost	34	47	82	10 % of Construction & Procurement Cost
4-1-2	Construction Management Cost	28	38	65	8 % of Construction & Procurement Cost
4-2	Consultant Service Cost for Building	0	0	0	
4-3	Consultant Service Cost for Equipment	0	0	0	
	Subtotal	62	85	147	
5	Contingency Cost	0	0	0	
5-1	Price Contingency	68	17	85	The price increase cost was assumed to be 16.6% and 3.0% of the total construction and procurement cost and design and supervision cost, respectively, in domestic and foreign currency (compounded over 6 years, respectively, as an average).
5-2	Physical Contingency	20	28	48	5% of the total Construction & Procurement and Consultant Service Cost.
	Subtotal	88	45	133	
6	Technical Training Cost	0	0	0	
	Subtotal	0	0	0	
7	Operation and Maintenance Cost	2	2	4	
	Subtotal	2	2	4	
	Total (Excluding OM Cost)	943	625	1,568	

Source: Project Team

Table 5.2.7 Preparation Cost for Pre-F/S Project

Item	Unit Price	Quantity	LC	FC	Total	LC with VAT	FC with VAT	Total with VAT
	(PhP)	(m2)	(PhP)	(PhP)	(PhP)	(PhP)	(PhP)	(PhP)
2 Preparation Cost								
2-1 Land Acquisition Cost								
2-1-1 River Widening	2,150	95,913	206,212,950	0	206,212,950			
2-1-2 Disposal	0	0	0	0	0			
Sub Total	0	0	206,212,950	0	206,212,950	230,958,504	0	230,958,504
2-2 Compensation Cost								
2-1-1 River Widening	130,000	1,147	149,110,000	0	149,110,000			
2-1-4 Disposal	0	0	0	0	0			
Sub Total			149,110,000	0	149,110,000	167,003,200	0	167,003,200
2-3 Removal Cost			29,822,000	0	29,822,000	33,400,640	0	33,400,640
2-4 EIA Cost			0	0				
Total			385,144,950	0	385,144,950	431,362,344	0	431,362,344

Source: Project Team

Table 5.2.8 Construction Cost for Pre-F/S Project

Item		Unit	Quantity	Unit Rate		Amount		Total
				LC(PhP)	FC(PhP)	LC(PhP)	FC(PhP)	PhP
1 River Widening								
1-1	Channel Excavation (Excavation-Loading-Transportation)	m3	112,000	116	262	12,997,651	29,319,193	42,316,844
1-2	Dredging-soils (using Backhoe on Barge)	m3	209,000	155	282	32,429,793	58,975,468	91,405,262
1-3	Channel Excavation (Loading and Transportation)	m3	146,000	96	219	13,994,498	31,996,400	45,990,898
1-4	Embankment (for Dike)	m3	46,000	33	65	1,497,739	2,997,600	4,495,339
1-5	Embankment (at Disposal area)	m3	212,000	11	20	2,277,256	4,168,048	6,445,305
1-6	Concrete Revetment (Reinforced Concrete t=50cm)	m3	23,535	3,893	3,795	91,619,336	89,325,779	180,945,115
1-7	Gabion (t=50cm) - Foot Protection	m3	10,000	2,778	0	27,776,495	0	27,776,495
1-8	Concrete Block - Slope Toe Protection	m3	3,750	3,893	3,795	14,598,365	14,232,916	28,831,280
1-9	Steel Sheet Piles , Furnished	0	16,250	330	2,851	5,368,681	46,332,182	51,700,863
1-10	Steel Sheet Piles, for temporary works, without materials	0	16,250	353	585	5,740,006	9,510,225	15,250,230
	Additional Cost of Dredging (10% of Major Direct Cost)					20,829,982	28,685,781	49,515,763
	Sub Total					229,129,801	315,543,592	544,673,394
Direct Construction Cost						229,129,801	315,543,592	544,673,394
Common Temporary Facility Cost								
Accumulated Portion (4% of Direct Construction Cost)						4,582,596	6,310,872	10,893,468
Rate Portion (4% of Direct Construction Cost)						9,165,192	12,621,744	21,786,936
Total of Common Temporary Facility Cost						13,747,788	18,932,616	32,680,404
Net Construction Cost (Direct Construction Cost + Common Temporary Facility Cost)						242,877,590	334,476,208	577,353,797
Site Management Cost (15% of Net Construction Cost)						36,431,638	50,171,431	86,603,070
Indirect Construction Cost (Common Temporary Facility Cost + Site Management Cost)						50,179,427	69,104,047	119,283,473
Construction (Prime) Cost (Direct Construction Cost + Indirect Construction Cost)						279,309,228	384,647,639	663,956,867
General Management Cost. etc. (10% of Construction (Prime) Cost)						27,930,923	38,464,764	66,395,687
Construction Cost for Civil Work (Construction (Prime Cost) + General Management Cost)						307,240,151	423,112,403	730,352,553
Construction Cost for Building Work						0	0	0
Construction Cost						307,240,151	423,112,403	730,352,553
Procurement Cost						0	0	0
Construction & Procurement Cost without VAT						307,240,151	423,112,403	0
VAT (12%)						36,868,818	50,773,488	87,642,306
Construction & Procurement Cost with VAT						344,108,969	473,885,891	817,994,860

Source: Project Team

(2) Project Cost applying another land unit price

For the Pre-F/S project, the project cost was estimated in the above (1) under the conditions specified in Section 4.4.3. On the other hand, there was a comment from the relevant division (DPWH ESSD) that it would be desirable to calculate the land acquisition cost in the project cost using another land unit price (current market value or double BIR Zonal Value). Although the land acquisition cost and compensation cost should be studied and examined in detail at the detailed design stage, as reference value for future implementation, the preparation cost was calculated applying the another land unit price (13,800Php/m^2, which is double of the zonal value (6,900Php/m^2) of the Pre-F/S target section in DO No. 032-2021 of Department of Finance), and then the project cost was estimated. Table 5.2.9 shows the estimated project cost.

Table 5.2.9 Project Cost for Pre-F/S Project (when another land unit price is applied)

No.	Item	LC	FC	Total	Description
		(Unit: Million Philippines Pesos)			
1	Project Management Cost	17	21	38	3.5% of the amount of Construction & Procurement Cost, Consulting Service Cost and Contingency Cost.
	Subtotal	17	21	38	
2	Preparation Cost	0	0	0	
2-1	Land Acquisition Cost	1,482	0	1,482	Same as Master Plan
2-2	Compensation Cost	167	0	167	Relocating buildings located on the site to implement the measures.
2-3	Removal Cost	33	0	33	20% of the cost required for building transfer
2-4	Environmental Impact Assessment Cost	0	0	0	Included in Common Temporary Facility Cost
	Subtotal	1,683	0	1,683	
3	Construction & Procurement Cost	344	474	818	See Construction & Procurement Cost
	Subtotal	344	474	818	
4	Consultant Service Cost	0	0	0	
4-1	Consultant Service Costfor Civil Work	0	0	0	
4-1-1	Detail Design Cost	34	47	82	10 % of Construction & Procurement Cost
4-1-2	Construction Management Cost	28	38	65	8 % of Construction & Procurement Cost
4-2	Consultant Service Cost for Building	0	0	0	
4-3	Consultant Service Cost for Equipment	0	0	0	
	Subtotal	62	85	147	
5	Contingency Cost	0	0	0	
5-1	Price Contingency	68	17	85	The price increase cost was assumed to be 16.6% and 3.0% of the total construction and procurement cost and design and supervision cost, respectively, in domestic and foreign currency (compounded over 6 years, respectively, as an average).
5-2	Physical Contingency	20	28	48	5% of the total Construction & Procurement and Consultant Service Cost.
	Subtotal	88	45	133	
6	Technical Training Cost	0	0	0	
	Subtotal	0	0	0	
7	Operation and Maintenance Cost	2	2	4	
	Subtotal	2	2	4	
	Total (Excluding OM Cost)	2,194	625	2,819	

Source: Project Team

In this Project, two types of project costs were calculated as mentioned above and the economic evaluation was also conducted for two types of project costs (see Section 5.3.4). In the next stage following this Project, it is necessary to carry out necessary surveys, examinations, and discussions for determining the land unit price to be applied, reflect it in the project cost, and improve the accuracy of the project cost.

5.2.5 Project Implementation Schedule

The project implementation schedule is shown in Table 5.2.10.

After the detailed design, bidding for construction work will begin in the third year, with a target completion date of six years later. Resettlement and land acquisition are planned to be carried out in the second and third years, in conjunction with the detailed design and construction work.

Table 5.2.10 Project Implementation Schedule for Pre-F/S Project

	Item	Months	Year										
			0	1	2	3	4	5	6	7	8	9	10
1	Preparation, Loan Agreement etc.	6											
2	Procurement of Consultant (for D/D, C/S)	12											
3	Detailed Design	12											
4	Preparation of PQ and Tender Document	6											
5	PQ and Tendering	12											
6	Construction Works	36											
7-1	Contract Package No.1 River Widening	36											

Source: Project Team

5.3 Project Evaluation

5.3.1 Project Implementation Schedule

The Section 5.5 details the Project Implementation for the priority projects targeted by the Pre-F/S for the Davao River.

The implementation of the Pre-F/S will be carried out through international and local bidding in accordance with specific guidelines taking into account the scale of the project. The contract package was assumed to be included in one package for the river widening in order to provide opportunity to Philippines domestic contractor to participate.

Table 5.3.1 Implementation Plan of the pre-F/S Projects

	Item	Months	Year										
			0	1	2	3	4	5	6	7	8	9	10
1	Preparation, Loan Agreement etc.	6											
2	Procurement of Consultant (for D/D, C/S)	12											
3	Detailed Design	12											
4	Preparation of PQ and Tender Document	6											
5	PQ and Tendering	12											
6	Construction Works	36											
7-1	Contract Package No.1 River Widening	36											

Source: Project Team

5.3.2 Consulting Engineering Services

Consulting services for detailed design and construction supervision will be provided by a group of international and local engineering consultants.

5.3.3 Project Benefit

The project benefit of the pre-F/S was computed by using the same methodology as the F/S described in Chapter 4. Since the river widening proposed by the pre-FS is premised on the implementation of the F/S consisting of riverbed dredging, cut-off channel and retarding ponds, the project benefits of the pre-F/S are reflecting the benefits gained with the implementation of the F/S.

(1) Benefit Computation

Table 5.3.2 shows the damage cost if no project is implemented (without case) and Table 5.3.3 the damage cost if pre-F/S projects are implemented (with case).

Table 5.3.2 Damage Cost if "no project is implemented (without case)"

	W=1/2	W=1/3	W=1/5	W=1/10	W=1/25	W=1/50	W=1/100
Direct Damage	**5.596**	**6.995**	**12.435**	**21.308**	**33.405**	**42.548**	**50.989**
Agriculture	0.842	1.053	1.914	3.370	5.398	6.232	6.789
Commerce	0.119	0.148	0.192	0.503	1.158	1.755	2.378
Industry	0.128	0.160	0.495	1.019	1.831	2.500	3.159
Institution	0.598	0.747	1.257	1.928	2.935	3.824	4.717
Residences	2.580	3.225	5.629	9.464	14.243	18.134	21.493
Mix Use Facilities	0.038	0.047	0.078	0.107	0.131	0.285	0.686
Infrastructure	1.291	1.614	2.870	4.917	7.709	9.819	11.767
Indirect Damage	**1.679**	**2.098**	**3.730**	**6.392**	**10.022**	**12.765**	**15.297**
Total Damage	**7.275**	**9.093**	**16.165**	**27.700**	**43.427**	**55.313**	**66.285**

Source: Project Team

Table 5.3.3 Damage Cost if "Pre-F/S projects are implemented (with case)"

		W=1/2	W=1/3	W=1/5	W=1/10	W=1/25	W=1/50	W=1/100
Direct Damage		1.184	1.209	1.249	1.520	12.042	19.064	24.796
	Agriculture	0.074	0.083	0.100	0.279	2.415	4.222	5.344
	Commerce	0.052	0.053	0.054	0.055	0.223	0.349	0.435
	Industry	0.016	0.017	0.019	0.021	0.554	0.967	1.333
	Institution	0.019	0.020	0.021	0.022	0.369	0.696	1.076
	Residences	0.404	0.409	0.414	0.434	4.181	6.316	8.141
	Mix Use Facilities	0.345	0.348	0.353	0.358	1.521	2.114	2.745
	Infrastructure	0.273	0.279	0.288	0.351	2.779	4.399	5.722
Indirect Damage		**0.355**	**0.363**	**0.375**	**0.456**	**3.613**	**5.719**	**7.439**
Total Damage		**1.540**	**1.571**	**1.624**	**1.976**	**15.654**	**24.783**	**32.234**

Source: Project Team

(2) Expected annual average damage reduction

Based on the results of the Flood Simulation of Davao River, the expected annual average damage reduction is computed as shown in Table 5.3.4.

Table 5.3.4 Expected annual average damage reduction if F/S projects are implemented

	Annual average exceedance probability	Amount of Damage (Billion PhP)			Average Damage per reach	Probabilities per reach	Annual Average Damage Reduction	Aggregated annual average damage = Expected annual average damage reduction
		Without Project (1)	With Project (2)	Damage Reduction (1)-(2)				
W=1/1	1.000	0.000		0.000				
W=1/2	0.500	7.275	1.540	5.735	2.867	0.500	1.434	1.434
W=1/3	0.333	9.093	1.571	7.522	6.628	0.167	1.105	2.538
W=1/5	0.200	16.165	1.624	14.541	11.032	0.133	1.471	4.009
W=1/10	0.100	27.700	1.976	25.724	20.133	0.100	2.013	6.023
W=1/25	0.040	43.427	15.654	27.772	26.748	0.060	1.605	7.627
W=1/50	0.020	55.313	24.783	30.530	29.151	0.020	0.583	8.211
W=1/100	0.010	66.285	32.234	34.051	32.290	0.010	0.323	8.533

Source: Project Team

5.3.4 Economic Evaluation

(1) Economic Cost

Table 5.3.5 shows the economic cost converted from the financial cost and Table 5.3.6 the investment schedule in economic cost.

Table 5.3.5 Financial Cost and Economic Cost

Financial Cost

	LC	FC	Total (Billion PhP)
1 Project Management	0.300	0.439	0.738
2 Preparation, Resettlement	1.330	0.000	1.330
3 Constrution & Procurement	5.963	9.833	15.796
Dredging	0.419	0.698	1.118
Cut-off	0.639	1.064	1.703
Retarding Pond	4.561	7.597	12.157
Widening	0.344	0.474	0.818
4 Consulting Service	1.073	1.770	2.843
5 Contingency	1.523	0.933	2.456
6 Technical Training Cost	0.000	0.000	0.000
TOTAL	**10.189**	**12.974**	**23.163**

Economic Cost

	LC	FC	Total (Billion PhP)
1 Project Management	0.291	0.439	0.729
2 Preparation, Resettlement	0.758	0.000	0.758
3 Constrution & Procurement	4.711	9.833	14.543
Dredging	0.331	0.698	1.030
Cut-off	0.505	1.064	1.568
Retarding Pond	3.603	7.597	11.200
Widening	0.272	0.474	0.746
4 Consulting Service	1.277	1.770	3.047
5 Contingency	1.555	0.933	2.488
6 Technical Training Cost	0.000	0.000	0.000
TOTAL	**8.592**	**12.974**	**21.566**

Source: Project Team

Table 5.3.6 Investment schedule (Economic Cost)

	PM	PR	CP	CS	Cont	TTC	Economic Investment per Year (in Billion PhP)	Percentage (Yearly / Total Investment)
	Project Management	Preparation, Resettlement	Constrution & Procurement	Consulting Service	Contingency	Technical Training Cost		
Year 1	0.069	0.171	0.000	0.288	0.235	0	0.763	3.54%
Year 2	0.069	0.171	0.000	0.288	0.235	0	0.763	3.54%
Year 3	0.069	0.171	0.000	0.288	0.235	0	0.763	3.54%
Year 4	0.069	0.000	2.294	0.288	0.235	0	2.886	13.38%
Year 5	0.069	0.000	2.294	0.288	0.235	0	2.886	13.38%
Year 6	0.069	0.000	2.294	0.288	0.235	0	2.886	13.38%
Year 7	0.069	0.000	1.772	0.288	0.235	0	2.364	10.96%
Year 8	0.069	0.000	1.772	0.288	0.235	0	2.364	10.96%
Year 9	0.069	0.000	1.772	0.288	0.235	0	2.364	10.96%
Year 10	0.069	0.000	1.600	0.288	0.235	0	2.192	10.16%
Year 11	0.007	0.082	0.000	0.028	0.022	0	0.139	0.65%
Year 12	0.007	0.082	0.000	0.028	0.022	0	0.139	0.65%
Year 13	0.007	0.082	0.000	0.028	0.022	0	0.139	0.65%
Year 14	0.007	0.000	0.249	0.028	0.022	0	0.306	1.42%
Year 15	0.007	0.000	0.249	0.028	0.022	0	0.306	1.42%
Year 16	0.007	0.000	0.249	0.028	0.022	0	0.306	1.42%
Total	**0.729**	**0.758**	**14.543**	**3.047**	**2.488**	**0.000**	**21.566**	**100.00%**

Source: Project Team

(2) Results of Economic Evaluation

Table 5.3.7 shows the cost and benefits cash flow of the proposed pre-F/S for Davao River, when the SDR is 10% and Table 5.3.8 when SDR is 15%. The evaluation period considered is equivalent to the "anticipated implementation period + 50 years after the completion of the project".

When the SDR is 10%, the Economic Internal Rate of Return (EIRR) is 16.43 %, Economic Net Present Values (ENPV) is PhP 13.76 Billion and Cost-Benefit Ratio (CBR) is 2.175.

When the SDR is 15%, ENPV is PhP 1.52 Billion and CBR is 1.244.

Therefore, the proposed is evaluated as economically adequate in both cases.

For reference, when the SDR is 20%, EIRR remains unchanged at 16.43 %, ENPV is PhP -2.15 Billion and CBR is 0.779.

Table 5.3.7 Cost and benefits Cash Flow of the proposed Pre-F/S for Davao River (SDR=10%)

Year		No. of Year after completion	Project Cost	O/M Cost	Total	Accumulated Cost	Annual Cost after discount	Annual Benefit	Annual Benefit after discount	Net Benefit
2022	0		0.763		0.763	0.763				-0.763
2023	1		0.763		0.763	1.526	0.694		0.000	-0.763
2024	2		0.763		0.763	2.289	0.630		0.000	-0.763
2025	3		2.886		2.886	5.175	2.169		0.000	-2.886
2026	4		2.886		2.886	8.062	1.972		0.000	-2.886
2027	5		2.886		2.886	10.948	1.792		0.000	-2.886
2028	6		2.364		2.364	13.312	1.334		0.000	-2.364
2029	7		2.364		2.364	15.675	1.213		0.000	-2.364
2030	8		2.364		2.364	18.039	1.103		0.000	-2.364
2031	9		2.192		2.192	20.231	0.930		0.000	-2.192
2032	10		0.139		0.139	20.370	0.054	5.917	2.281	5.778
2033	11		0.139	0.337	0.476	20.509	0.167	5.917	2.074	5.441
2034	12		0.139	0.337	0.476	20.649	0.152	5.917	1.885	5.441
2035	13		0.306	0.339	0.644	20.954	0.187	5.917	1.714	5.273
2036	14		0.306	0.340	0.646	21.260	0.170	5.917	1.558	5.271
2037	15	*1*	0.306	0.341	0.647	21.566	0.155	7.627	1.826	6.981
2038	16	*2*	0.000	0.341	0.341	21.566	0.074	7.627	1.660	7.286
2039	17	*3*	0.000	0.341	0.341	21.566	0.067	7.627	1.509	7.286
2040	18	*4*	0.000	0.341	0.341	21.566	0.061	7.627	1.372	7.286
2041	19	*5*	0.000	0.341	0.341	21.566	0.056	7.627	1.247	7.286
2042	20	*6*	0.000	0.341	0.341	21.566	0.051	7.627	1.134	7.286
2043	21	*7*	0.000	0.341	0.341	21.566	0.046	7.627	1.031	7.286
2044	22	*8*	0.000	0.341	0.341	21.566	0.042	7.627	0.937	7.286
2045	23	*9*	0.000	0.341	0.341	21.566	0.038	7.627	0.852	7.286
2046	24	*10*	0.000	0.341	0.341	21.566	0.035	7.627	0.774	7.286
2047	25	*11*	0.000	0.341	0.341	21.566	0.031	7.627	0.704	7.286
2048	26	*12*	0.000	0.341	0.341	21.566	0.029	7.627	0.640	7.286
2049	27	*13*	0.000	0.341	0.341	21.566	0.026	7.627	0.582	7.286
2050	28	*14*	0.000	0.341	0.341	21.566	0.024	7.627	0.529	7.286
2051	29	*15*	0.000	0.341	0.341	21.566	0.022	7.627	0.481	7.286
2052	30	*16*	0.000	0.341	0.341	21.566	0.020	7.627	0.437	7.286
2053	31	*17*	0.000	0.341	0.341	21.566	0.018	7.627	0.397	7.286
2054	32	*18*	0.000	0.341	0.341	21.566	0.016	7.627	0.361	7.286
2055	33	*19*	0.000	0.341	0.341	21.566	0.015	7.627	0.328	7.286
2056	34	*20*	0.000	0.341	0.341	21.566	0.013	7.627	0.299	7.286
2057	35	*21*	0.000	0.341	0.341	21.566	0.012	7.627	0.271	7.286
2058	36	*22*	0.000	0.341	0.341	21.566	0.011	7.627	0.247	7.286
2059	37	*23*	0.000	0.341	0.341	21.566	0.010	7.627	0.224	7.286
2060	38	*24*	0.000	0.341	0.341	21.566	0.009	7.627	0.204	7.286
2061	39	*25*	0.000	0.341	0.341	21.566	0.008	7.627	0.185	7.286
2062	40	*26*	0.000	0.341	0.341	21.566	0.008	7.627	0.169	7.286
2063	41	*27*	0.000	0.341	0.341	21.566	0.007	7.627	0.153	7.286
2064	42	*28*	0.000	0.341	0.341	21.566	0.006	7.627	0.139	7.286
2065	43	*29*	0.000	0.341	0.341	21.566	0.006	7.627	0.127	7.286
2066	44	*30*	0.000	0.341	0.341	21.566	0.005	7.627	0.115	7.286
2067	45	*31*	0.000	0.341	0.341	21.566	0.005	7.627	0.105	7.286
2068	46	*32*	0.000	0.341	0.341	21.566	0.004	7.627	0.095	7.286
2069	47	*33*	0.000	0.341	0.341	21.566	0.004	7.627	0.086	7.286
2070	48	*34*	0.000	0.341	0.341	21.566	0.004	7.627	0.079	7.286
2071	49	*35*	0.000	0.341	0.341	21.566	0.003	7.627	0.071	7.286
2072	50	*36*	0.000	0.341	0.341	21.566	0.003	7.627	0.065	7.286
2073	51	*37*	0.000	0.341	0.341	21.566	0.003	7.627	0.059	7.286
2074	52	*38*	0.000	0.341	0.341	21.566	0.002	7.627	0.054	7.286
2075	53	*39*	0.000	0.341	0.341	21.566	0.002	7.627	0.049	7.286
2076	54	*40*	0.000	0.341	0.341	21.566	0.002	7.627	0.044	7.286
2077	55	*41*	0.000	0.341	0.341	21.566	0.002	7.627	0.040	7.286
2078	56	*42*	0.000	0.341	0.341	21.566	0.002	7.627	0.037	7.286
2079	57	*43*	0.000	0.341	0.341	21.566	0.001	7.627	0.033	7.286
2080	58	*44*	0.000	0.341	0.341	21.566	0.001	7.627	0.030	7.286
2081	59	*45*	0.000	0.341	0.341	21.566	0.001	7.627	0.028	7.286
2082	60	*46*	0.000	0.341	0.341	21.566	0.001	7.627	0.025	7.286
2083	61	*47*	0.000	0.341	0.341	21.566	0.001	7.627	0.023	7.286
2084	62	*48*	0.000	0.341	0.341	21.566	0.001	7.627	0.021	7.286
2085	63	*49*	0.000	0.341	0.341	21.566	0.001	7.627	0.019	7.286
2086	64	*50*	0.000	0.341	0.341	21.566	0.001	7.627	0.017	7.286
Total (in Billion			**21.566**	**18.406**	**39.972**		**13.529**	**410.960**	**29.427**	
							EIRR			**16.43%**
							Social Discount Rate			**10%**
							NPV			**13.76**
							B/C			**2.175**

Source: Project Team

Table 5.3.8 Cost and benefits Cash Flow of the proposed Pre-F/S for Davao River (SDR=15%)

Year		No. of Year after completion	Project Cost	O/M Cost	Total	Accumulated Cost	Annual Cost after discount	Annual Benefit	Annual Benefit after discount	Net Benefit
2022	0		0.763		0.763	0.763				-0.763
2023	1		0.763		0.763	1.526	0.663		0.000	-0.763
2024	2		0.763		0.763	2.289	0.577		0.000	-0.763
2025	3		2.886		2.886	5.175	1.898		0.000	-2.886
2026	4		2.886		2.886	8.062	1.650		0.000	-2.886
2027	5		2.886		2.886	10.948	1.435		0.000	-2.886
2028	6		2.364		2.364	13.312	1.022		0.000	-2.364
2029	7		2.364		2.364	15.675	0.889		0.000	-2.364
2030	8		2.364		2.364	18.039	0.773		0.000	-2.364
2031	9		2.192		2.192	20.231	0.623		0.000	-2.192
2032	10		0.139		0.139	20.370	0.034	5.917	1.463	5.778
2033	11		0.139	0.337	0.476	20.509	0.102	5.917	1.272	5.441
2034	12		0.139	0.337	0.476	20.649	0.089	5.917	1.106	5.441
2035	13		0.306	0.339	0.644	20.954	0.105	5.917	0.962	5.273
2036	14		0.306	0.340	0.646	21.260	0.091	5.917	0.836	5.271
2037	15	*1*	0.306	0.341	0.647	21.566	0.079	7.627	0.937	6.981
2038	16	*2*	0.000	0.341	0.341	21.566	0.036	7.627	0.815	7.286
2039	17	*3*	0.000	0.341	0.341	21.566	0.032	7.627	0.709	7.286
2040	18	*4*	0.000	0.341	0.341	21.566	0.028	7.627	0.616	7.286
2041	19	*5*	0.000	0.341	0.341	21.566	0.024	7.627	0.536	7.286
2042	20	*6*	0.000	0.341	0.341	21.566	0.021	7.627	0.466	7.286
2043	21	*7*	0.000	0.341	0.341	21.566	0.018	7.627	0.405	7.286
2044	22	*8*	0.000	0.341	0.341	21.566	0.016	7.627	0.352	7.286
2045	23	*9*	0.000	0.341	0.341	21.566	0.014	7.627	0.306	7.286
2046	24	*10*	0.000	0.341	0.341	21.566	0.012	7.627	0.266	7.286
2047	25	*11*	0.000	0.341	0.341	21.566	0.010	7.627	0.232	7.286
2048	26	*12*	0.000	0.341	0.341	21.566	0.009	7.627	0.201	7.286
2049	27	*13*	0.000	0.341	0.341	21.566	0.008	7.627	0.175	7.286
2050	28	*14*	0.000	0.341	0.341	21.566	0.007	7.627	0.152	7.286
2051	29	*15*	0.000	0.341	0.341	21.566	0.006	7.627	0.132	7.286
2052	30	*16*	0.000	0.341	0.341	21.566	0.005	7.627	0.115	7.286
2053	31	*17*	0.000	0.341	0.341	21.566	0.004	7.627	0.100	7.286
2054	32	*18*	0.000	0.341	0.341	21.566	0.004	7.627	0.087	7.286
2055	33	*19*	0.000	0.341	0.341	21.566	0.003	7.627	0.076	7.286
2056	34	*20*	0.000	0.341	0.341	21.566	0.003	7.627	0.066	7.286
2057	35	*21*	0.000	0.341	0.341	21.566	0.003	7.627	0.057	7.286
2058	36	*22*	0.000	0.341	0.341	21.566	0.002	7.627	0.050	7.286
2059	37	*23*	0.000	0.341	0.341	21.566	0.002	7.627	0.043	7.286
2060	38	*24*	0.000	0.341	0.341	21.566	0.002	7.627	0.038	7.286
2061	39	*25*	0.000	0.341	0.341	21.566	0.001	7.627	0.033	7.286
2062	40	*26*	0.000	0.341	0.341	21.566	0.001	7.627	0.028	7.286
2063	41	*27*	0.000	0.341	0.341	21.566	0.001	7.627	0.025	7.286
2064	42	*28*	0.000	0.341	0.341	21.566	0.001	7.627	0.022	7.286
2065	43	*29*	0.000	0.341	0.341	21.566	0.001	7.627	0.019	7.286
2066	44	*30*	0.000	0.341	0.341	21.566	0.001	7.627	0.016	7.286
2067	45	*31*	0.000	0.341	0.341	21.566	0.001	7.627	0.014	7.286
2068	46	*32*	0.000	0.341	0.341	21.566	0.001	7.627	0.012	7.286
2069	47	*33*	0.000	0.341	0.341	21.566	0.000	7.627	0.011	7.286
2070	48	*34*	0.000	0.341	0.341	21.566	0.000	7.627	0.009	7.286
2071	49	*35*	0.000	0.341	0.341	21.566	0.000	7.627	0.008	7.286
2072	50	*36*	0.000	0.341	0.341	21.566	0.000	7.627	0.007	7.286
2073	51	*37*	0.000	0.341	0.341	21.566	0.000	7.627	0.006	7.286
2074	52	*38*	0.000	0.341	0.341	21.566	0.000	7.627	0.005	7.286
2075	53	*39*	0.000	0.341	0.341	21.566	0.000	7.627	0.005	7.286
2076	54	*40*	0.000	0.341	0.341	21.566	0.000	7.627	0.004	7.286
2077	55	*41*	0.000	0.341	0.341	21.566	0.000	7.627	0.003	7.286
2078	56	*42*	0.000	0.341	0.341	21.566	0.000	7.627	0.003	7.286
2079	57	*43*	0.000	0.341	0.341	21.566	0.000	7.627	0.003	7.286
2080	58	*44*	0.000	0.341	0.341	21.566	0.000	7.627	0.002	7.286
2081	59	*45*	0.000	0.341	0.341	21.566	0.000	7.627	0.002	7.286
2082	60	*46*	0.000	0.341	0.341	21.566	0.000	7.627	0.002	7.286
2083	61	*47*	0.000	0.341	0.341	21.566	0.000	7.627	0.002	7.286
2084	62	*48*	0.000	0.341	0.341	21.566	0.000	7.627	0.001	7.286
2085	63	*49*	0.000	0.341	0.341	21.566	0.000	7.627	0.001	7.286
2086	54	*50*	0.000	0.341	0.341	21.566	0.000	7.627	0.004	7.286
Total (in Billion			**21.566**	**18.406**	**39.972**		**10.310**	**410.960**	**12.821**	
							EIRR			**16.43%**
							Social Discount Rate			**15%**
							NPV			**1.52**
							B/C			**1.244**

Source: Project Team

(3) Sensitivity Analysis

To check the economic adequacy in case of project cost increase and benefit decrease, a sensitivity analysis was conducted. In all cases, the economic internal rate of return (EIRR) exceeds the current social discount rate of 10%. Therefore, it can be concluded that the project can be evaluated as adequate from the viewpoint of investment efficiency.

Table 5.3.9 Results of Sensitivity Analysis

		EIRR (%)
Case 0	Base Case	16.43
Case 1	Project Cost: increase of 10%	15.53
Case 2	Project Cost: increase of 20%	14.72
Case 3	Benefit: Decrease of 10%	15.88
Case 4	Benefit: Decrease of 20%	15.28
Case 5	Project Cost: increase of 10% and Benefit: Decrease of 10%	14.97
Case 6	Project Cost: increase of 20% and Benefit: Decrease of 20%	13.56

Source: Project Team

For reference, the break-even point analysis shows the EIRR of 10.0% when project cost increases by 114.0% under the condition that there is no change in benefit as well as when benefit decreases by 76.0% under the condition that there is no change in project cost.

(4) Economic Evaluation for the Project Cost applying another land unit price

An economic evaluation is carried out on the project cost estimated by applying another land unit price, which was estimated as the reference value in Section 5.2.4(2). In this evaluation, the project cost of the premised F/S project is the project cost estimated by applying the RAP survey results (the project cost estimated in Section 4.4.5(2)).

When the SDR is 10%, the Economic Internal Rate of Return (EIRR) is 11.75 %, Economic Net Present Values (ENPV) is PhP 5.67 Billion and Cost-Benefit Ratio (CBR) is 1.496. Therefore, it is evaluated as economically adequate.

For reference, when the SDR is 15%, EIRR remains unchanged at 11.75 %, ENPV is PhP -5.49 Billion and CBR is 0.820. When the SDR is 20%, EIRR remains unchanged at 11.75 %, ENPV is PhP -8.38 Billion and CBR is 0.494.

In addition, for reference, the break-even point analysis shows the EIRR of 10.0% when project cost increases by 28.2% under the condition that there is no change in benefit as well as when benefit decreases by 31.3% under the condition that there is no change in project cost.

5.3.5 Environmental Evaluation

(1) Compliance of Environmental Compliance Certificate

The Pre-feasibility study does not aim to comply with ECC license. The river widening is possible to be designated as “environmental enhancement”; if so, the ECC will not be required. However since huge volume of excavated soil will be generated, and the project is located in the area where socially and economically important; environmental and social impact could be significant. Therefore careful examination and coordination with EMB are important in the next stage, F/S stage, e.g.

(2) Preliminary Scoping

Draft scoping is prepared based the results of the environmental and social consideration study; and then described in the Section [5.4.2 Environmental Impact]. The TOR for further environmental study was drafted.

(3) Basic Policy on Environmental Mitigation

The following basic policies are made based on the results of basic study in the MP stage, EIS and RAP studies in the F/S stage and quick study written in the Section [5.4 Environmental and Social Considerations].

- The project area is located along the Davao River downstream; naturally sensitive area (protected forest, mangrove, etc.) is not found. Stakeholder meetings resulted necessity of accessibility to the river and recreation use. Therefore, it is recommendable to introduce environmentally friendly structural design and construction method to improve quality of environment and recreation purposes.
- The project will lead huge scale of involuntary resettlement, interruption of local economy, community life, etc. Sufficient compensation and social support must be given to the PAPs.
- Mitigation of air/ water pollution shall be incorporated with construction method.
- Effective and continual public consultation with LGUs and communities must be given.

5.3.6 Socioeconomic Evaluation

(1) Estimated Level of Resettlement by the Project

Total number of households to be relocated by the project is estimated approximately 1,100 HHs or 3,300 persons (see Section “5.4.3 Social Impact”). In addition considerable scale of infrastructures must be relocated or demolished.

(2) Preventive Relocation by the Priority Projects

The most of the households to be relocated have resided near the Davao River where it is high risk area and not suitable for dwellings. Therefore resettlement under the Priority project must encourage preventive relocation to protect their life and assets.

(3) Protection of the Human Life

The preventive relocation by the Priority projects could encourage mitigation of damage to human life by relocation to out of high flood risk area.

(4) Protection of the Assets

The preventive relocation by the Priority projects could encourage mitigation of damage to private assets and public infrastructures so as to enhance sustainable socio-economic activities.

(5) Social Evaluation

For above reasons, resettlement to be proposed is not only to secure necessary space for the project site but also to mitigate flood risk; and then project design was formulated with minimizing scale of resettlement, consensus with project affected households.

5.3.7 Technical Evaluation

Section 5.2 details the construction plan for the priority projects of the Pre-F/S. As a result of a detailed examination, the technical feasibility, safety, reliability and appropriateness of the proposed structures were confirmed.

The Pre-F/S proposed the partial river widening from 1.5 kilo post until 4.0 kilo post in order to optimize the effects of the F/S.

The procedure to widen the river is the same as the one proposed by the Master Plan.

If required, temporary cofferdam will be built with steel sheet piles and other materials to keep the site under dry condition in order to implement excavation and revetment works. The excavated soil will be dredged after the remove of the cofferdam. Erosion control mats and concrete revetment will be installed from the places where the excavation works are completed.

5.3.8 Overall Evaluation of the Project

The detailed alternatives comparison analysis of the structural measures composing the Pre-F/S is explained in Section 5.1.5. Since the Pre-F/S assumes the implementation of the F/S, the overall evaluation of the Pre-F/S is combined with the evaluation results of the F/S consisting of river dredging, retarding ponds and cut-off channel.

(1) Results of the alternatives comparison analysis for the river widening

Regarding the river widening, different standard cross-sections and bank revetment structures of the river channel were compared. As a result, the Alternative 1 (compound inverted trapezoid cross section with a width of 111 meters in addition to the ROW) was adopted from the viewpoint of economy, sustainability with a minimal maintenance dredging, flexibility in the future to increase the flood capacity and environmental impact.

(2) Comprehensive evaluation of the Pre-F/S

Table 5.3.10 summarizes the comprehensive evaluation results of the Pre-F/S projects. In the table, the " Pre-F/S: River widening Alternative 1: compound inverted trapezoid cross section with a width of 111 meters in addition to the ROW" is the priority project which was selected in the Section 5.1.5. In addition, the " Entire F/S (River dredging, retarding ponds, cut-off channel)" is the results of the overall evaluation of the F/S conducted in Section 4.5.9.

The feasibility of each project was confirmed from the points of view of economic feasibility, socio-economic suitability, and environmental and technical safety and soundness.

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Table 5.3.10 Comprehensive Evaluation Results of the Pre-F/S for the Davao River

Project / Evaluation Axis	**Pre-F/S including the three projects composing the F/S**	***Pre-F/S: River widening Alternative 1: compound inverted trapezoid cross section with a width of 111 meters in addition to the ROW***	***Entire F/S (River dredging, retarding ponds, cut-off channel)***
a. Flood Protection Level (Expected damage reduction)	Target Flood: 25-year return period flood	*Target Flood capacity: 1,700 cubic meters per second (Corresponding to the 100-year return period flood targeted by the Master Plan)*	*Target Flood: 10-year return period flood*
b. Economic Effectiveness	Total cost: PhP 23.163 Billion EIRR:16.43% NPV:13.76 B/C:2.177 *SDR=10%	*Direct construction cost: PhP 0.50 Billion* *Cost for households relocation and land acquisition: PhP 0.35 Billion*	*Total cost: PhP 21.595 Billion* *EIRR:15.32%* *NPV:10.00* *B/C:1.896* **SDR=10%*
c. Feasibility in regards with social and legal restrictions	Including the proposed dump site, the project will not be located in the natural conservation area. The coordination with concerned Communities will be required.	—	*The proposed locations for the project implementation and dump sites are not included in the natural conservation area. Kagan Community is located within the area where the project is planned to be implemented and will need to be relocated. Therefore the continuation of information sharing on the project and dialogue with the Community will be needed..*
d. Feasibility from the technical viewpoint to construct countermeasures:	Phased construction is possible.	*Phased construction is possible.*	*Phased construction is possible.*
e. Sustainability	Sustainable. However, maintenance dredging is required.	*Sustainable. In addition, the volume of maintenance dredging to ensure the expected flood capacity (by avoiding the raise of riverbed) is estimated to be minimal.*	*Sustainable. However, maintenance dredging is required.*
f. Flexibility	Future revision is possible.	*The revision of the cross section (such as increase of the flood capacity) will be relatively easy if the needs occur in the future.*	*Future revision is possible.*
g. Social and natural environment impacts	Households relocated:1,254	*Households relocated:1,150* *(Including 990 informal households)*	*Households relocated: 104*

Project / Evaluation Axis	**Pre-F/S including the three projects composing the F/S**	***Pre-F/S: River widening Alternative 1: compound inverted trapezoid cross section with a width of 111 meters in addition to the ROW***	***Entire F/S (River dredging, retarding ponds, cut-off channel)***
	Relocation and land acquisition will be needed especially in the areas affected by the construction of the cut-off channel and river widening. In addition, social impacts may occur. Even though some environmental impact may occur, the retarding ponds may be used as new places for nature restoration in the future.	*The amount of relocated households and land acquisition will be large. In addition, some changes in land use and impact to actual infrastructures such as road network is anticipated.*	*Relocation and land acquisition will be needed especially in the areas affected by the construction of the cut-off channel.* *The inhabit of Designated Endangered Species (animals and plants) was not confirmed in the target area. However, to minimize the impact to the natural environment during the project implementation, water and air pollution measures will be promoted.* *After the completion of the F/S, the retarding ponds may be used as new places for nature restoration.*
Evaluation Result	The Projects composing the F/S are appropriate from the viewpoint of economic efficiency, technical feasibility, sustainability and flexibility. On the other hand, the project may generate social impacts such as the relocation of the Kagan Community. Regarding this point, the impacts can be reduced by sharing the information on the project and continuing the dialogue with the Community. In addition, regarding the impacts on the natural environment (such as noise, water quality, etc.) during the construction, they can be reduced by devising construction methods. Therefore, it was evaluated that the project as a whole is appropriate.		

Source: Project Team

5.4 Environmental and Social Considerations

5.4.1 Categorization

Category “A” under the JICA-GL

Reason: The project site would cause adverse impacts which are described in the Guidelines for Environmental and Social Considerations (April 2010).

5.4.2 Environmental Impact Evaluation

Initial level of environmental impact evaluation was undertaken for the proposed project indicated in the section [5.1.1 Priority Project of Structural Measures Targeted for Pre-Feasibility Study for Riverine Flood in Davao River]. The alternative analysis was summarized in the section [5.1.5 Preliminary Design of Structure Measures of the Priority Project Targeted for Pre-Feasibility Study for Riverine Flood in Davao River].

(1) Method

The evaluation was conducted based on the basic study [Chapter 2], environmental and social consideration study in the F/S [4.6 Environmental and Social Considerations], data collection and site reconnaissance; and then formulated scoping.

(2) Environmental Aspect

1) Summary

Current environmental and social aspect are summarized as below:

Numbers in the map indicate the location of pictures in Figure 5.4.2.
Source: Project Team

Figure 5.4.1 Study area of River Widening

		
1. Temporary boat station	2. ISFs near Bolton Bridge	3. Stairs to riverbank
		
4. Ferryboat station	5. Occupy on the dyke by community	6. Public market
		
7. Loading station at the public market	8. Private dwelling nearby river	9. Church in the site

Source: Project Team

Figure 5.4.2 Pictures in the Study Area

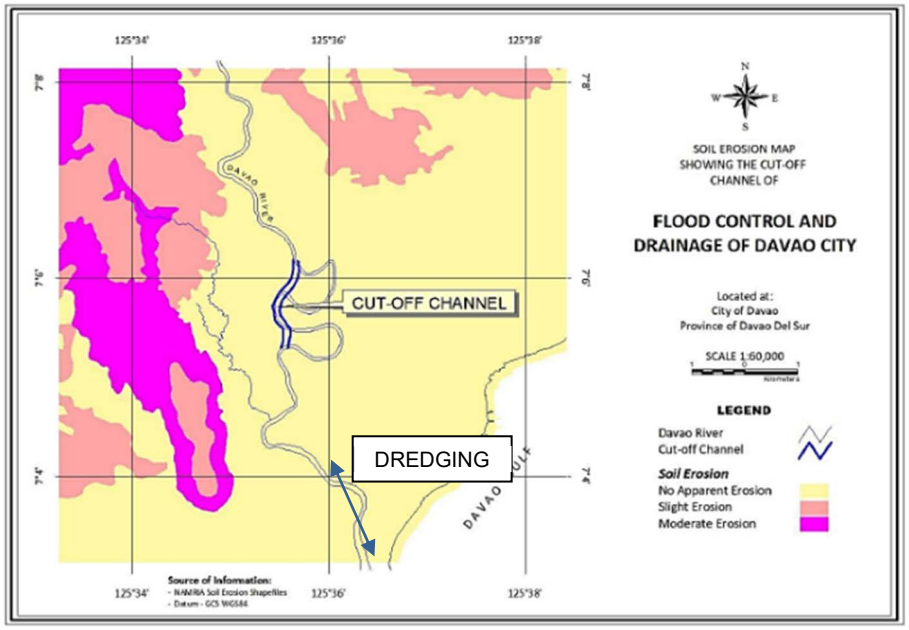
The project site is located urbanization area of the Davao City; little artificial forest exists. Aquatic biota figures ordinal aspect which is seen any place in the city area; less endangered, commercial fish are observed. Impact to ecosystem could be minor.

On the other hand, since urbanization has rapidly proceeded, and economic growth and population has increased; impact to socio economy in particular land procurement and resettlement must be significant. Many ISFs has resided along the Davao River (see section [5.4.3 Social Impact]); and their income level is lower; therefore, their relocation and income recover must be key factors to implement the project.

Currently DPWH-RO XI has taken action to construct a dyke; land clearance and demolition have been progressed.

2) Natural Environment

The Project site is located in the downstream of the Davao City in low and plain land; therefore, topographic limitation will be small. As indicated in the figure below, erosion risk could be minor.



Source：NAMRIA

Figure 5.4.3 Erosion Risk

3) Urban Environment

Air quality condition in the downstream area, in particular Brgy. Bucana, showed good condition to meet air quality standard according to the FS. Though noise level slightly exceeded the noise standard; it could be acceptable level.

Water quality condition of Chloride, Inorganic phosphorus and TSS exceeded the limitation according to the results of FS. Increase of chloride was caused by sea water. High TSS level has been generally observed in the Davao River and the Matina/ Talomo River; the source of soil might be inflow from mountainous area. One of the source of phosphorus is chemical fertilizer; but it is not sure.

4) Social Environment

The river widening project will occupy total of approximately 8.5ha of land, changing from land to water area. As shown in Table 5.4.1 and Figure 5.4.4, nearly 90% of the land is residential zone; and roads occupy around 6 %. Occupation of the land by the project will lead loss and demolition of private/ public buildings, infrastructures; its impact must be significant.

Table 5.4.1 Landuse in the Project Site

Category	Area (ha)	%
Open Space	0.50	5.8
Residential Area	7.57	88.5
Public Area	< 0.01	< 0.1
Roads	0.48	5.6
Total	8.55	-

Source: CPDO

Source: CPDO

Figure 5.4.4 Landuse in the Project Area

Especially relocation of ISFs must be one of the most significant issue. Since river widening will continue in mid- and long-term stage; development of relocation site indicated in the section [3.17 Examination of Measures to Promote Implementation of Master Plan] is key factor to smoothly implement the project.

A church was confirmed in the project area, which is to be relocated (Picture No. 9 in Figure 5.4.2).

(3) Scoping

Draft scoping made in the MP (in 2019) was updated based on the above survey.

Table 5.4.2 Scoping (River Widening)

Environmental Item	Evaluation		Explanation of Evaluation
	Before/ During Construction	Explanation of Evaluation	
Air quality	✓		Construction: Some adverse impacts are expected due to emissions of air pollutants by heavy machinery and vehicles and dust caused by excavation works and transportation construction materials, earth and sand, etc. However, the extent of impacts will be limited to the construction site and its proximity and only during construction period. Operation: Air pollution by the Project would be negligible.
Water quality	✓		Construction: Some adverse impacts caused by, such as, turbidity by excavation works, leachate from waste and fuels, domestic wastewater from construction workers, Operation: Water pollution by the Project would be negligible.
Wastes	✓		Construction: Plenty of excavated soil will be generated. In case excavated soil contains toxic; treatment and disposal could be complicated. Operation: No waste is expected.
Soil contamination	✓		Construction: Contamination by waste, oil/ grease may be risk Operation: The project will not generate soil contamination.
Noise and vibration	✓		Construction: Some adverse impacts are expected due to the operation of heavy machinery and vehicles and excavation works. Operation: No noise/ vibration disturbance is expected.
Subsidence			Construction: Major construction is excavation; therefore, subsidence is not expected. Operation: No subsidence is expected.
Odor			No odor is expected.
Protected areas			Any protected area is designated.
Ecosystem	✓		Construction: Since project site has been urbanized for residential, commercial purposes, small artificial forests (vacant land) have been dotted; impacts on specific biota (endangered. Rare species under Red list, etc.) will be minor. On the other hand, mitigation to ordinarly ecosystem shall be implemented. Operation: The project will not affect above urban ecosystem.
Hydrology	✓	✓	Construction: Possible interruption of drainage or underground water are anticipated in case residents use a shallow well. Operation: Positive impact, reducing flood risk, is expected.
Geology/ Topography			Construction: Major construction is excavation; therefore, impact to geological topographical condition is not expected. Operation: The project will not affect geology/ topography.
Involuntary resettlement	✓		Construction: Possible relocation volume is estimated approx. 1,100 units[1)]. Operation: No resettlement will be caused.
Poor/Vulnerable	✓		Construction: Considerable number of ISFs have resided; their resettlement may interrupt their income. Income recover program and/or social support is necessary. Operation: No activities cause degradation of their life.
Indigenous Peoples/Minorities.			The project location is out of ancestral domains land.
Existing social infrastructures and services	✓		Construction: Excavation work will lead demolition of local roads, underground infrastructure. Loading/ unloading of equipment/ sol waste might cause traffic disturbance along the mobilization rout. Operation: The project will not cause impact to existing social infrastructure and service.

Environmental Item	Evaluation		Explanation of Evaluation
	Before/ During Construction	Explanation of Evaluation	
Water usage			The project will not affect water use.
Existing social infrastructures and services	✓		Construction: Excavation work will lead demolition of local roads, underground infrastructure. Loading/ unloading of equipment/ sol waste might cause traffic disturbance along the mobilization rout. One church must be relocated. Operation: The project will not cause impact to existing social infrastructure and service.
Social institutions	✓		Loss of land by river widening, traffic disturbance during constryction phase could affect to local economy and activities by social insitutuion, therefore, considerations will be paid on public consultation methods while understanding their decision-making process and social institutions.
Community severance	✓	✓	Construction/ operation: Shut of road along the river, loss of land might cause interruption of local economy; gap of impact level may cause community split.
Cultural heritage			No such heritage is confirmed.
Local conflicts of interest	✓	✓	Community split, imbalance of allocation of benefit or impact may cause conflict among communities.
Utilization of land and local resources	✓		Construction: Loss of land could lead change of land use. Sand quarrying activities were rarely observed in the downstream. Sand mining in the downstream has not been observed. Operation: No activities which affect to land use nor local resources.
Landscape		✓	Since: structures are not tall; impact to landscape must be minor. It could be relieved by good design to harmonize town view.
Gender	✓		No adverse impact on gender is expected by the Project, however, it will be evaluated based on present conditions during the study. Example: Construction: Equal employment opportunities, provision of break rooms (including toilets)
Children's rights	✓		During Construction /During Operation: No adverse impact on children's rights is expected by the Project, however, it will be evaluated based on present conditions during the study. Example Construction: Avoidance of Child labour, safety of school zone along the mobilization route
Infectious diseases	✓	✓	Construction: Since the project location is near urban area; basecamp will not be built; hence risk of infectious disease could be negligible. Monitoring of existing of puddle of water by patrol and/or hearing with barangay or communities is recommended. Operation: Since water area would expand by the widening; spawning mosquitoes in the puddle of water could be possible.
Labour conditions	✓		Construction: Secure working environment shall be considered (provide PPE, adequate resting time, education through SOPs, etc.). Operation: The project will not affect labor condition.
Accidents	✓	✓	Construction: Accident prevention at construction sites, as well as prevention of traffic accident at transportation of materials and equipment is needed. Operation: Water accident.
Global warming			No action and facilities causing GHG.

✓means certain impacts is expected; need further investigation.
1) DPWH with the Davao City has decided to cover necessary width for widening plus ROW as project area; reset of easement will be continually examined.

(4) Study Items and Methodology for the Environmental and Social Considerations

Study Items and Methodology for the Environmental and Social Considerations (EIS Study) are summarized in Table 5.4.3.

Table 5.4.3 Method of EIS Study

Items	Evaluation Items	Method of Environmental and Social Consideration Study
Alternatives	Construction methods, rover arraignment	- Examination on minimizing resettlement and maximizing project benefit - Examination on environmental mitigation
Air quality	- Measure of air quality level, and evaluate based on the standard criteria. - Investigate traffic condition for selection of construction site, methods and schedule. - Location of sensitive zone such as schools, hospitals.	- Collection and analysis of legal framework, monitoring data, similar experiences, etc. - Air quality measurement at the project area - Site reconnaissance, hearing survey for traffic condition - Examination on construction method, schedule
Water quality	- Measure of air quality level, and evaluate based on the standard criteria. - Usage of river water	- Collection and analysis of legal framework, monitoring data, similar experiences, etc. - Water quality measurement at the project area
Waste	- Estimation of dredged soil - Contamination in the dredged soil - Disposal method of the construction waste	- Examination of treatment/ disposal method of waste, discharged water, etc. - Measurement of contamination in the soil - Examination of possible recycle/ reuse of dredged soil - Hearing with relevant organizations, communities, etc.
Soil contamination	- Storage site of dredged/ excavated soil, oil, and prevention method of leakage of toxic	- Examination of prevention
Noise and vibration	- Measure of noise/ vibration level, and evaluate based on the standard criteria. - Investigate traffic condition for selection of construction site, methods and schedule. - Location of sensitive zone such as schools, hospitals.	- Collection and analysis of legal framework, monitoring data, similar experiences, etc. - Noise/ vibration measurement at the project area - Site reconnaissance, hearing survey for traffic condition - Examination on construction method, schedule
Geology/ Topography	- Geological and topographical conditions - Construction methods	- Geological and topographical surveys - Case study - Hearing
Ecosystem	- Condition of wildlife habitat - Scale of tree cut	- Data collection and analysis - Hearing with relevant organizations, academics, communities, etc. - Site reconnaissance
Hydrology	- River condition - Construction method - Underground water condition - Project effect	- Data collection and analysis - Case study - Hearing, site reconnaissance - Inundation forecast
Involuntary resettlement	- Scale of affected land and resettlement - Socio-economic condition of the PAHs - Gap analysis between Philippine legal framework and JICA Guideline - Method of cut-off date - Existing and/or planned relocation site - Role sharing among DPWH, Davao City and barangay	- RAP study (census, socio-economic study, loss of asset survey, public consultation, etc.) - Examination of compensation policy, gap of policy to the ISFs who has migrated before or after 1992 - Examination of existing and/or planned relocation site

Items	Evaluation Items	Method of Environmental and Social Consideration Study
		- Confirmation of construction schedule and resettlement schedule
Poor/Vulnerable	- Scale of impact to the poor and vulnerable	- Data collection and analysis - Hearing with relevant bodies, communities, etc. - Stakeholder meetings
Local economies	- Local economic condition	- Data collection and analysis - Hearing with relevant bodies, communities, etc. - Stakeholder meetings
Existing social infrastructures and services	- Condition of social infrastructures - Condition of electric line, drainage, etc.	- Data collection and analysis - Hearing with relevant bodies, communities, etc. - Stakeholder meetings
Social institutions	- Activities by NGOs, community groups, etc.	- Data collection and analysis - Hearing with relevant bodies, communities, etc. - Stakeholder meetings
Community severance	- Landuse - Road network, traffic condition	- Data collection and analysis - Hearing with relevant bodies, communities, etc. - Stakeholder meetings
Local conflicts of interest	- Use of land to be occupied by the Project - Impact during construction phase	- Data collection and analysis - Hearing with relevant bodies, communities, etc. - Stakeholder meetings
Utilization of land and local resources	- Current landuse of the land where to be lost. - Local resources (sand mining, boat transportation, etc.)	- Data collection and analysis - Hearing with relevant bodies, communities, etc. - Stakeholder meetings
Utilization of land and local resources	- Tourism resources - Parks, street plant - Design of structures to be installed (dyke. e.g.)	- Data collection and analysis - Hearing with relevant bodies, communities, etc. - Stakeholder meetings - Perception about structure design
Gender	- Condition on gender issues/ mainstreaming	- Data collection and analysis - Hearing with relevant bodies, communities, etc. - Stakeholder meetings
Children's right	- Right of children - School condition	- Data collection and analysis - Case study - Hearing with relevant bodies, communities, etc. - Stakeholder meetings
Infectious diseases	- Condition of diseases - Medical condition - Generation status of diseases - Relevant organizations	- Data collection and analysis - Case study - Hearing with relevant bodies, communities, etc. - Stakeholder meetings
Labour conditions	- Construction method - Health and safety management	- Data collection and analysis - Case study
Accidents	- Traffic accident during construction phase - Water accident in the operation phase	- Data collection and analysis - Case study - Hearing with relevant bodies, communities, etc. - Stakeholder meetings

Source: Project Team

5.4.3 Social Impact

Basically, the project site has been developed; approximately 90% of the land is used as residential zone according Table 5.4.1. The site reconnaissance resulted that the project site is key area for residential and commercial activities, and many community roads have passed along or nearby the Davao River. From this results, it could be concluded that river widening could affect not only direct impact in terms of loss of land but also indirect impact to local economy and road network.

Davao City conducted a census survey in 1992 in order to identify volume of ISFs; and to examine possible compensation. Total volume of ISFs was estimated around 1,000 units according the IM4Davao Study (2017).

Even though the City declared not to compensate to the ISFs who migrated after 1992; in fact, Volume of ISFs along the Davao River has increased. The City undertook an interview survey to update condition of dwelling based on ICBMs (Intelligent Community Based Monitoring System). The survey estimated number of ISFs 1,117 HHs (3,334 persons) as shown in Table 5.4.4. Number of buildings/ dwellings were also estimated by Orthophoto survey under FS; estimated number counted 1,080 units which is same label as the ICBMs.

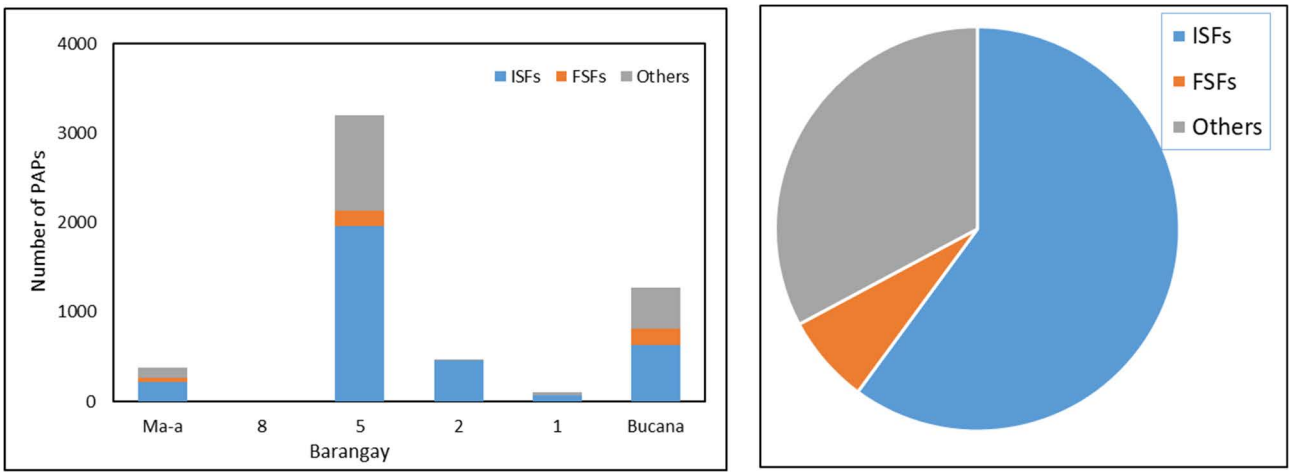
Significant increase of volume of ISFs was not shown; one of the reason may be because construction of dyke by the DPWH-RO XI which has been implemented since 1019 has accelerated relocation of ISFs.

Table 5.4.4 Number of PAHs/ PAPs by Barangay

Barangay		ISFs	FSFs	Others	Total
Ma-a	PAHs	60	12	35	107
	PAPs	217	46	114	377
8	PAHs	0	0	0	0
	PAPs	0	0	0	0
5	PAHs	682	52	359	1,093
	PAPs	1,960	168	1,069	31,97
2	PAHs	130	1	2	133
	PAPs	459	0	3	462
1	PAHs	20	0	8	28
	PAPs	72	0	26	98
Bucana	PAHs	225	67	206	498
	PAPs	626	191	459	1,276
Total	PAHs	1,117	132	610	1,859
	PAPs	3,334	405	1671	5,410
Reference[1)]					
Total no. of building		1,080	170	-	1,250

PAHs: Project Affected Households, PAPs: Project Affected Persons
ISFs: Informal Settler Families
FSFs: Formal Settler Families (owner, lender, mortgage occupancy but out of the Government properties)
1) Orthophoto survey, 2021
Source: ICBMs, Project Team

Figure 5.4.5 shows share of ISFs in the PAHs/ PAPs. The share occupies over 60% of resettlement volume; especially only 3HHs out of 462HHs are formally residing.



Source: ICBMs

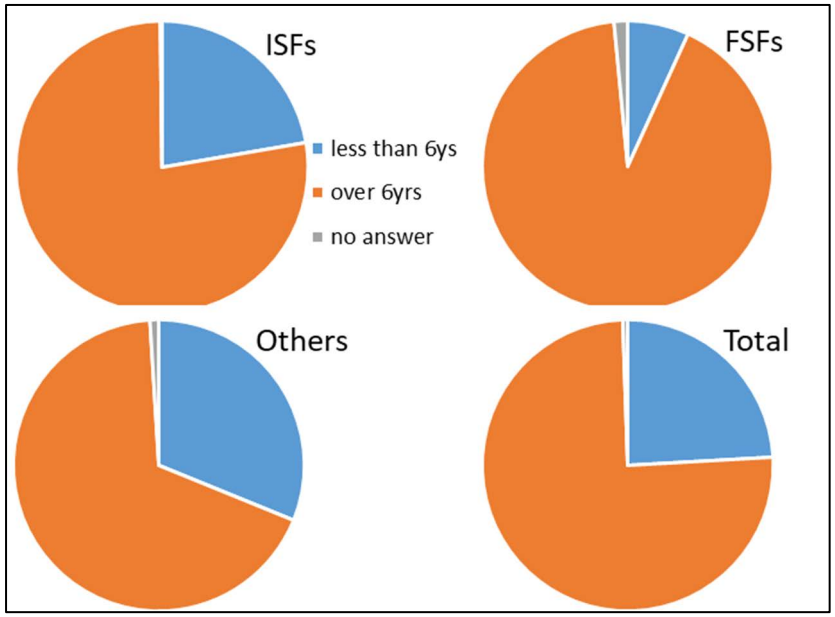
Figure 5.4.5 Share of ISFs in the PAPs

As indicated in Table 5.4.5 and Figure 5.4.6, share of PAPs in ISFs, who have been residing less than 6 years, occupies approximately 22%; its share was more than triple of those in FSFs (share approx. 7%). Principally ISFs who has migrated after 1992 have no eligible for compensation; however careful consensus building and sufficient support for informal PAHs must be key challenge for smooth implementation of the Project.

Table 5.4.5 Number of PAHs by Barangay and Duration of Residing

Barangay		ISFs	FSFs	Others	Total
Ma-a	Less than 6yrs	7	0	11	18
	Over 6yrs	53	12	24	89
	No answer	0	0	0	0
8	Less than 6yrs	0	0	0	0
	Over 6yrs	0	0	0	0
	No answer	0	0	0	0
5	Less than 6yrs	195	7	116	318
	Over 6yrs	485	45	238	768
	No answer	2	0	5	7
2	Less than 6yrs	29	0	1	30
	Over 6yrs	101	0	1	102
	No answer	0	1	0	1
1	Less than 6yrs	3	0	0	3
	Over 6yrs	17	0	8	25
	No answer	0	0	0	0
Bucana	Less than 6yrs	15	2	62	79
	Over 6yrs	210	64	143	417
	No answer	0	1	1	2
Total	Less than 6yrs	249	9	190	448
	Over 6yrs	866	121	414	1,401
	No answer	2	2	6	10

ISFs: Informal Settler Families
FSFs: Formal Settler Families (owner, lender, mortgage occupancy but out of the Government properties)
Source: ICBMs



Source: ICBMs

Figure 5.4.6 Share of PAPs by Duration of Residing

5.4.4 Recommendation

The followings are recommendation from the environmental and social viewpoints in order to smoothly implement the river widening project:

1. Excavation work generates plenty volume of soil. It is recommended to encourage reuse of excavated soil for urban/ housing/ infrastructure development, land adjustment etc. aside from development of soil disposal areas.
2. Environmentally friendly flood control, such as slope and unpaved dyke, plantation on the embankment, etc. must be promoted to create new attractive water area.
3. Balance of safety and accessibility to riverbank for recreation purposes, improvement of landscape must be considered.
4. Over 1,000 HHs of ISFs will be relocated in this project; river widening will continue up to 14km from the river mouth; therefore, huge volume of resettlement will totally happen. Development of sufficient relocation site is key challenge; Relocation site development proposed in the section [3.17 Examination of Measures to Promote implementation of Master Plan] shall be progressed.
5. Davao City conducted a census survey when setting up the Easement in 1992 and issued a regulation that ISFs that entered before 1992 would be compensated, but households that entered after 1992 would not. However, the influx has continued since 1992, and by 2021 there is more than 1,000 households. Differences in compensation for resettled households may raise concerns about serious social unrest and resistance to the project. Social support measures for them are necessary for supporting relocation and recover of livelihoods after relocation. Considering the above, it is required to conduct the RAP study and fulfill it at the time of implementation.
6. Sine downstream of the Davao River is located in the area of important economy and transpiration network; construction plan and schedule shall pay special attention to avoid degradation of economy and disturbance of traffic.
7. Public consultation, consensus building and IEC activities shall be provided in order to avoid social conflict and fear.

5.5 Framework of Implementation of Widening Works

In this Pre-F/S, the downstream section with 2.5km distance from the Bolton bridge to Sta. 4+000 was selected as a pilot section for the river widening works, which is one of the mid-long-term measures for the Davao River, and the study at pre F/S level was conducted for the pilot section. The purpose of the study is to grasp in advance the issues that will arise when implementing future widening works and to consider countermeasures against the issues, and then, to contribute to the smooth implementation of future project.

Below, the results of the pilot section study on the project organization, procurement method and so on are described. In this regard, however, when actually implementing the project of widening works, referring to the results of the examination for this pilot section, the F/S should be conducted for the entire section of the widening works (from river mouth to Sta. 14+000 (14km upstream from the river mouth)) and the plan for the entire section should be formulated.

(1) Project Organization

1) During Detailed Engineering Design and Construction

The Flood Control Management Cluster-Unified Project Management Office (FCMC-UPMO) of DPWH is expected to assume a major role and shall take the lead in the overall implementation of the projects. They will be administratively and technically supported by the DPWH Regional Office and the Davao City District Engineering Offices (DC DEO).

In order to facilitate an effective and efficient project implementation, it is recommended that a Davao River Project Management Office (DRPMO) will be established.

2) During Operation and Maintenance

The Davao City District Engineering Office (DC DEO) is proposed to be the primary body responsible in the operation and maintenance with the technical support from the FCMC-UPMO. It is also proposed that the Davao River Management Office (DRPMO) shall be institutionalized and a Davao River Operation & Maintenance Unit (DROMU) shall be created as a permanent unit which is responsible for the implementation of operation and maintenance of flood control works in the Lower Davao River under the Maintenance Section of Davao City DEO.

(2) Procurement Method

The construction of this project will be conducted through international and domestic bidding in accordance with the size of the project and other factors. The contract package will be one of the following packages to provide opportunities for participation to Philippine domestic contractors.

Package 1: River Channel Widening

Consulting services for detailed design and construction supervision will be provided by a coordinated group of international and domestic engineering consultancy firms.

(3) Implementation Schedule

Project Implementation schedule is shown in Table 5.5.1. After the detailed design, bidding for construction work will begin in the third year, with a target completion date of six years. Resettlement and land acquisition are planned to be carried out in the second and third years, in conjunction with the detailed design and construction work.

Table 5.5.1 Project Implementation Schedule for Pre-F/S Project

	Item	Months	Year										
			0	1	2	3	4	5	6	7	8	9	10
1	Preparation, Loan Agreement etc.	6											
2	Procurement of Consultant (for D/D, C/S)	12											
3	Detailed Design	12											
4	Preparation of PQ and Tender Document	6											
5	PQ and Tendering	12											
6	Construction Works	36											
7-1	Contract Package No.1 River Widening	36											

Source: Project Team

(4) Funding / Finance

The cost estimation for pre-F/S project was calculated as described in Section 4.4. The construction plan and the basis for cost estimation are described in Section 5.2. The total funds required to implement the project amount to 943 million (Local Currency Portion, pesos equivalent), and 625 million (Foreign Currency Portion, pesos equivalent). The total amount is 1,568 million (pesos equivalent). Table 5.5.2 shows the amount of funds required, and Table 5.5.3 shows the financial plan during the project implementation period. Maintenance costs are the costs required annually after construction is completed. All costs other than preparation costs were calculated as a percentage of construction and procurement costs. In addition, construction and procurement costs were calculated by each work, and the total amount is shown at the bottom of the table.

Table 5.5.2 Required Amount of Fund for Pre-F/S Project

Item				LC	FC	Total
				(Unit: Million Philippines Pesos)		
1	Project Management Cost			17	21	38
			Subtotal	17	21	38
2	Preparation Cost					
	2-1	Land Acquisition Cost		231	0	231
	2-2	Compensation Cost		167	0	167
	2-3	Removal Cost		33	0	33
	2-4	Environmental Impact Assessment Cost		0	0	0
			Subtotal	431	0	431
3	Construction & Procurement Cost			344	474	818
			Subtotal	344	474	818
4	Consultant Service Cost					
	4-1	Consultant Service Costfor Civil Work		0	0	0
		4-1-1	Detail Design Cost	34	47	82
		4-1-2	Construction Management Cost	28	38	65
	4-2	Consultant Service Cost for Building		0	0	0
	4-3	Consultant Service Cost for Equipment		0	0	0
			Subtotal	62	85	147
5	Contingency Cost					
	5-1	Price Contingency		68	17	85
	5-2	Physical Contingency		20	28	48
			Subtotal	88	45	133
6	Technical Training Cost			0	0	0
			Subtotal	0	0	0
7	Operation and Maintenance Cost			2	2	4
			Subtotal	2	2	4
Total (Excluding OM Cost)				943	625	1,568

Source: Project Team

Table 5.5.3 Financial Plan for Pre-F/S Project

Item		Unit	Q	Ratio		Cost Million PhP			Duration (Year)	Year									
				All	Construction	LC	FC	Total		1	2	3	4	5	6	7	8	9	10
1	Project Management	LS	1	2.5%		17	21	38	6	6	6	6	6	6	6				
2	Preparation, Resettlement	LS	1	27.5%		431	0	431	3	144	144	144							
3	Construction	LS	1	52.2%	100%	344	474	818											
3-1	River Widening	LS	1	52.2%	100%	344	474	818	3				273	273	273				
4	Consulting Service	LS	1	9.4%		62	85	147	6	25	25	25	25	25	25				
5	Contingency	LS	1	8.5%		88	45	133	6	22	22	22	22	22	22				
6	Technical Training Cost	LS	1	0.0%		0	0	0	6	0	0	0	0	0	0				
7	Operation and Maintenance Cost	LS	1			2	2	4	per year							4	4	4	4
Total (Excluding OMC)				100.0%				1,568		197	197	197	326	326	326				

Source: Project Team

(5) Consulting Services

DPWH will implement the project, but a consultant will be hired to prepare the detailed design, pre-qualification (PQ), and bid documents. The consultant will also assist and support the bidding and contracting process in the pre-construction phase and supervise the construction.

1) Consulting Service

i) Prepare detailed design, construction cost estimates, pre-qualification (PQ) and bid documents

ii) PQ and bidding process assistance for selecting construction contractors, and construction supervision

2) Duration of the Consulting Service

Engineering services (detailed design) shall be for a period of 12 months. Consulting services (construction supervision) shall be provided for 36 months (3 years, not including the construction defect period).

5.6 Recommendation

Based on the overall results and outputs of the study, the recommendations related to the project targeted in the Pre-F/S are described below.

(1) Implementation of F/S for entire section

As described in Section 5.5, in this Pre-F/S, only the downstream section with 2.5km distance from the Bolton bridge to Sta. 4+000 was examined as a pilot section for the river widening works. When actually implementing the project of widening works, referring to the results of the examination for this pilot section, the F/S should be conducted for the entire section of the widening works (from river mouth to Sta. 14+000 (14km upstream from the river mouth)) and the plan for the entire section should be formulated.

(2) Points for implementing widening works

Widening works project that improve the flow capacity of river channels should be implemented sequentially from the most downstream side of the project implementation section so as not to adversely affect the downstream side of the construction section. In case of the section targeted by this Pre-F/S, construction should be proceeded from the most downstream Bolton Bridge to the upstream in sequence. Therefore, the relocation needs to be implemented with priority from the downstream area.

In addition, the project is desirable to be carried out consistently with a unified concept. The project should be implemented by DPWH (DPMO), which is also the implementing body of the short-term measures targeted by F/S.

(3) Handling of 30m Easement

After discussions with the Davao city, it was decided to plan the project by setting a ROW within a range of approximately 10m from the riverbank (top of the slope of revetment in river side) as a necessary range for the widening works.

As a background, it has been confirmed with the Davao city that the development within 30m Easement along the riverbank (CLUP plans to develop 10m as a promenade and 20m outside as a road) is at the concept level at present and there is no concrete plan, hence, this Project can make a plan without consideration of 30m Easement.

On the other hand, it is considered that the Davao city will proceed with the development of the Easement range in the future, therefore, it is desirable that cooperation with the Davao city will continue in the future stages and the plan by the of Davao city will be incorporated into the flood control M/P as appropriate based on the progress of the plan.

(4) Promotion of Relocation

Looking at the 2.5km pilot section targeted by this Pre-F/S, about 1,100 buildings needs to be relocated. Prompt implementation of the relocation is essential for the implementation of the widening works. It is recommended to proceed with the development of the relocation site, which was considered as a measure to promote the implementation of M/P, and to lead to the smooth implementation of the widening works.

In addition, when land acquisition and resettlement will be extremely restrictive for the implementation of the project, the rectangular cross section shown in the comparison of alternatives as Alt.2 can be considered to be applied or partially applied to minimize the range of land acquisition and the number of resettlements.

Davao City has declared in the city ordinance that ISFs, who had migrated in the easement after 1992, are not eligible for compensation for resettlement. It is, however, recommended the DPWH to take actions (consensus building with the PAPs, social assistances, provision of relocation site, etc. proposed in the section 5.4.4).

＜Part　II : Capacity Enhancement＞

Chapter 1 Capacity Enhancement

1.1 Approach

1.1.1 Current Issues on Flood Control and Drainage

The following are issues in the field of flood control in the Philippines that the Project Team has identified as potential obstacles to the implementation of this Project.

(1) Necessity of enhancement of DPWH's capacity to formulate plans

According to the Department Order No. 33, series of 2017 of DPWH, it was stipulated that "In order to accelerate the conduct of master plan and feasibility studies which shall serve as the basis for priority flood control and drainage studies, the UPMO-Flood Control Management Cluster (UPMO-FCMC) and the Regional Offices (ROs)/District Engineering Offices (DEOs) shall pursue the conduct of these studies, in coordination with the Planning Service." and "UPMO-FCMC has a responsibility for Major River Basins and Principal River Basins traversing two or more ROs." However, presently, FCMC is mainly engaged in designing and implementing construction using a donor-assisted project-employed consultant, and it does not have time to work on planning itself. In addition, local consultants which can handle flood control M/P are also limited.

Since the necessity of planning on flood control is increasing, it is deemed to be urgently required to enhance DPWH HQs' capacities, especially FCMC's capacities, to formulate M/P as well as to supervise consulting work for preparation of flood control M/P from the perspective of future expansion.

(2) Insufficient coordination among relevant organizations concerning planning and implementation

A flood control project is not limited only to the river structure plan, but water related works such as "river basin management (in charge of DENR and LGU)", "urban and land development (in charge of LGU and Department of Agriculture)", "Urban drainage (in charge of DPWH and LGU)", "basic data management / provision (in charge of PAGASA, NAMRIA, etc.)".

The coordination among these government agencies is an important factor in formulating an appropriate plan that can avoid significant problems at the time of implementation. It is necessary to promote and secure collaboration among organizations in order to formulate an executable plan and smooth project implementation.

(3) Inadequate management of basic data necessary for the formulation and renewal of plans, and maintenance of project

In common cases after the implementation of projects in the Philippines, the facilities implemented are not properly maintained and managed, which often makes the effect of a project lower. This is because 1) the data on countermeasures taken (river structure asset inventory) are not well maintained in many cases, 2) the exact location of the facilities/countermeasures and those in-service periods become unclear, and specifications cannot be determined at the time of repairing and/or replacement of those facilities/countermeasures due to deficient data. The inadequate data management also becomes a major obstacle when newly formulating the plan or updating the plan. Measures such as "development of databases on basic information on facilities" and "strengthening coordination among relevant organizations to share and utilize the database" are necessary.

1.1.2 Approach for Capacity Enhancement in the Project

Based on the current issues mentioned in 1.1.1, activities in this Project are carried out with the following basic approaches on capacity enhancement in mind:

1) "Foster the capacity to formulate an integrated flood control M/P by personnel in DPWH by acquiring the knowledge and skills necessary for supervising subletting work"

2) "Strengthen the organization, in order to secure the sustainability of the measures by implementing the M/P formulated in this project and the selected priority projects and by properly operating and maintaining the projects".

The activities shown in the Table 1.1.1 are planned to achieve the targets. It is also planned that the activities shoot for “M/P formulation of one river (Matina River) by C/Ps themselves within this project period".

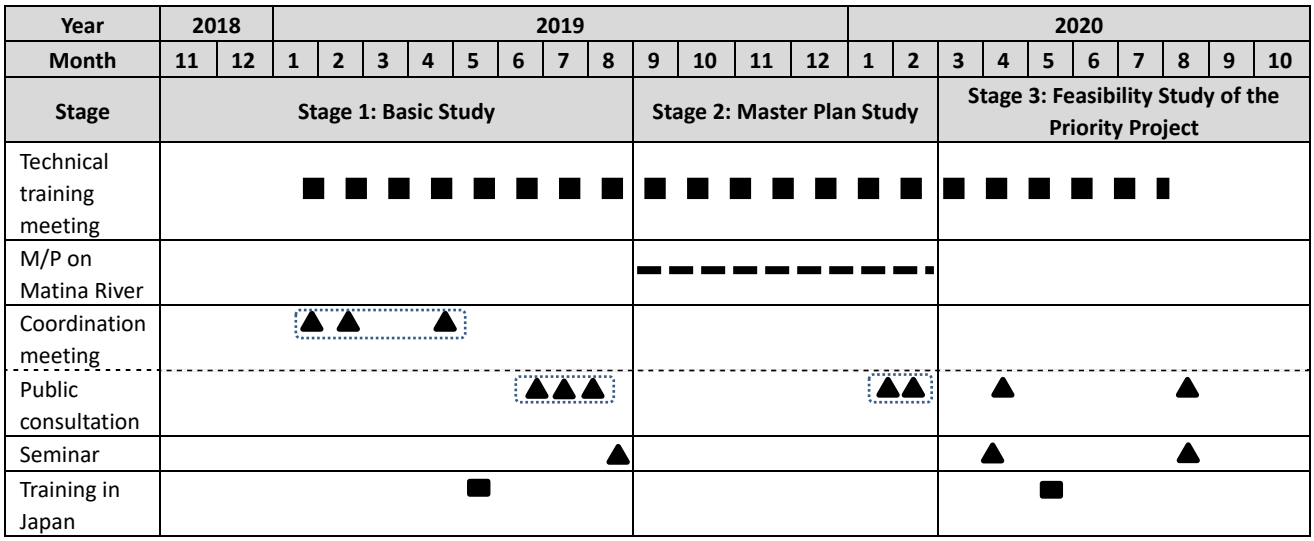
Table 1.1.1 Methodology for Capacity Enhancement

Item / Target / Place	Method	Content
Capacity Enhancement on M/P formulation and management Target C/Ps of DPWH-FCMC, PS Sub-target Other C/Ps Place Manila	C/Ps meeting and technical training meeting	「**C/Ps meeting**」 It will be held regularly when the project team stays Confirm and share the progress and issues of the project. Confirm and share the work situation of each project team member and C/Ps, and activity contents of the relevant period and future schedule.
		「**Technical training meeting**」 It will be held together with the C/Ps meeting when the project team stays At the Stage 1, the C/Ps will deepen understanding by lectures, practical training, and discussions on the M/P process and important tasks (setting of river area, design level, etc.) in each stage. At the Stage 2, the C/Ps will obtain the information on planning situation from each member of the project team, and discuss key issues on the plan such as target design level setting, contents of structural measures and consensus building with stakeholders. At the Stage 3, the C/Ps will discuss challenges focusing on F/S of the Davao River, mainly on environmental impact assessment, resident resettlement action plan and maintenance and management system.
	M/P formulation on Matina River	In order to deeply understand the methodology for formulation of an integrated flood control master plan, it is regarded as quite effective to experience all the process of the formulation of the plan through actual activities to prepare the plan by themselves. Therefore, C/Ps themselves will formulate M/P for the Matina River which is one of three target basins during the period of Stage 2, utilizing their knowledge, experiences and learning through the contents of the technical training meeting at Stage 1 as well. The project team ensures the adequate support for this activity.
	On the Job Training (OJT)	As OJT, collection, arrangement and analysis of data and information will be conducted together with C/Ps.
	Seminar	Approximately three seminars will be held (Manila and/or Davao) during the Project. The seminars will include the introduction of Japanese experience which may contribute to address the water-related disasters in the Philippines and the findings obtained through the project activities and discussion which is facilitated by C/Ps.
	C/Ps training in Japan	To promote further understanding of Japanese cases on flood control, advanced technologies and knowledge as well as those backgrounds, C/Ps training in Japan, in which C/Ps can directly observe and experience, will be conducted. The content of the training would emphasize the following points. • Examples of flood control projects in Japan (survey, planning, design, construction) and river management (maintenance and disaster response, etc.) • Disaster prevention and flood control projects in urban river basins and industrial clusters in Japan • Disaster prevention measures integrated with land use (urban planning, land use regulation, etc.) • Efforts to manage information on rivers

Item / Target / Place	Method	Content
Strengthening of capacity on organization aspect for project implementation Target C/Ps and stakeholders Place Davao	Coordination meeting	The coordination meetings aim to widely recognize and share issues related to floods in the target areas among stakeholders, to facilitate understanding of M/P, smooth implementation of flood control measures and appropriate maintenance and management activities. The meeting will be held in Davao City, and coordinated by C/Ps of DPWH RO-XI and C/Ps of Davao City. Participants are stakeholders. Manila's C/Ps will also expect to participate for understanding the local conditions and the local awareness, related organizations and local residents so as to contribute to appropriate M/P formulation activities in Manila. The meetings will be held three times in Stage 1. The meetings are designed to link with the public consultation for SEA in Stage 2.
	OJT	The site survey in the target area will be conducted together with C/Ps and the project team members. In addition, the inventory of data collected during the survey will be conducted together with C/Ps, and database to organize the data will be prepared. Training on how to utilize the database will also be provided.
	Seminar	Same as mentioned above
	C/Ps training in Japan	Same as mentioned above

Source: Project Team

The planned schedule of the activities related to capacity enhancement during this Project is shown in the Figure 1.1.1. Details of technical training meeting, coordination meeting, seminar and training in Japan are described in Chapter 1.2.



Source: Project Team

Figure 1.1.1 Planned Schedule for Activities Related to Capacity Enhancement

1.2 Activities

1.2.1 C/P Meeting and Technical Training Meeting

At all Stages of Stage 1, Stage 2 and Stage 3, the C/P meetings were always held simultaneously with the technical training meetings. Regarding the counterpart members targeted for C/P meetings and technical training meetings, DPWH was requested to select members from the beginning of the Project in November 2018, and 7 members of the DPWH HQ were notified in January 2019. After that, in March 2019, a total of 13 counterpart members including 2 additional members from the DPWH HQ and members from DPWH RO and DEO and Davao City were notified, and full-scale activities have started. The Table 1.2.1 shows the counterpart members.

Table 1.2.1 Counterpart Members

No.	Name	Office	Position
1	Jeric John U. Nuguid	DPWH UPMO-FCMC	Engineer II
2	Alex T. Almojuela	DPWH BOC	Engineer III
3	Crissa Rica V. Espiritu	DPWH BOD	Engineer III
4	Renz Russel D. Tolosa	DPWH Planning Service- PPD	Engineer II
5	Ara Charise Salcedo	DPWH Planning Service- ESSD	Environmental Management Specialist II
6	Ershad S. Ibba (to March, 2021) Lea Yvette Aguilar (from Sep., 2021 to March 2022) Reggie Marie S. Gabales (from March to May, 2022) Michiko Marie B. Quiachon (from June, 2022)	DPWH Planning Service- ESSD	Sociologist II Engineer II Sr. Environmental Management Specialist II Sr. Environmental Management Specialist II
7	Harold Uyap	DPWH UPMO-FCMC-FCMO	Engineer III
8	Lorenz Atajar	DPWH UPMO-FCMC-FCMO	Engineer II
9	Allan V. Dela Peña	DPWH-RO XI	Engineer IV
10	Alain John R. Sotto	DPWH-RO XI	Engineer III
11	Newton L. Apao	DPWH-Davao City DEO	Engineer II
12	Richard Elorde	Davao City Engineering Office	Engineer II
13	Samuel A. Singco (until Dec., 2021) Gina R. Santos (from Dec., 2021) & Clyde Eric Verga (from June, 2022) (additional member)	Davao City Planning and Development Office	Engineer III Planning Officer IV Planning Officer IV

Source: Project Team

(1) Stage 1

The technical training meetings were held at the same timing as the C/P meetings as mentioned above, and basically held in Manila except the field survey in the Matina River basin conducted in the Davao area as the 5th technical training meeting for two nights and three days, and the meetings held on April 30 and July 22, 2019 in Davao. At Stage 1, the technical training meetings aimed at deepening the understanding the process of M/P's formulation and important issues in formulation of M/P in the form of lectures from each expert and discussions. The contents of the technical training meetings at Stage 1 are shown in the Table 1.2.2.

Table 1.2.2 Theme of Technical Training Meeting in Stage 1

No.	Date & Place	Theme
1	January 25, 2019 Manila	− Introduction of the Project activity − Information sharing on flood control and drainage in Davao city − confirmation for future schedule of the Project activity − Initial assessment of background and capacity of C/P
2	February 7, 2019 Manila	− Planning process (whole and flood measures) − Planning process (inland flood measures) − Characterization of target area
3	February 27, 2019 Manila	− Study on design level (hydrological analysis and evaluation, hydraulic and hydrological analysis modeling, analysis and evaluation of past floods) − Results of Coordination Meetings in Davao − Initial discussion on organization / institution
4	March 22, 2019 Manila	− Methodology of setting of design hydrological amount such as probable basin average rainfall corresponding to design level − Examination and setting of river area, examination of design level − Assessment of Organization Status
5	April 2-4. 2019	− Field reconnaissance in Matina River Basin
6	April 12, 2019 Manila	− Planning process (storm surge measures) − Findings/Results in drainage inventory and flood survey − Setting of planning framework such as design level
A1	April 30, 2019 Davao	− Preparation of Design hyetograph for drainage planning / Introduction of Drainage network simulation model
A2	May 2, 2019 Manila	− Preparation of Design hyetograph for drainage planning / Introduction of Drainage network simulation model
7	June 14, 2019 Manila	− Setting of planning framework such as design level − Examination of alternative measures − Results of Topographic survey − Knowledge/Experiences learned through Training in Japan
8	July 5, 2019 Manila	− Setting Target Level for Coastal Disasters − Facility design for flood control − Cost estimation, construction planning, operation and management planning − Planning of non-structural measures
9	July 22, 2019 Davao	− Selection of the optimum flood measures based on SEA concept, examination of resettlement action plan − Project evaluation for setting optimal flood measures and selection of priority projects from the optimal flood measures
A3	July 23, 2019 Davao	− Presentation of all results up to the middle of July / Discuss issues and direction of improvement based on the simulation model

Source: Project Team

(2) Stage 2

In Stage 2, technical training meetings were held for sharing the status of M/P development and discussing major issues. In Stage 1, the concepts and methods of examining important issues on the planning process were learned through mainly by lectures. In Stage 2, the practical planning capacity for flood control was enhanced through discussing and examining specific issues in the target area as actual planning activities. The contents of the technical training meetings at Stage 2 are shown in the Table 1.2.3.

Table 1.2.3 Theme of Technical Training Meeting in Stage 2

No.	Date & Place	Theme
10	September 4, 2019 Manila	− Formulation of framework plan and master plan on riverine flood, inland flood and coastal flood
11	October 18, 2019 Manila	− Progress/Results of hydrological and hydraulic Analysis (Rainfall Statistical Analysis, Rainfall-Runoff Analysis, Inundation Analysis, Determination of Design Discharge) − Progress of Environmental and Social Impact Assessment (Environmental Sensitivity Map)
B1	October 23, 2019 Davao	Meeting with DPWH, Davao city and NEDA XI − Discussion on infrastructure development plans to be taken in to the Master Plan − Available area for retarding basins as one of alternative measures in Davao river
12	October 30, 2019 Manila	− Determination of Design Discharge − Formulation of the plan for Coastal Flood − Design of Structure Measures for Coastal Flood
13	November 19, 2019 Manila	− Formulation of the plan for Riverine Flood − Examination of alternative measures for Riverine Flood
B2	December 3, 2019 Davao	Workshop with related organizations in Davao − Planning on Non-structural measures − Discussion on Institutional and Ordinance Framework
14	December 12, 2019 Manila	− Discussion on framework plan and master plan for riverine floods in Matina, Talomo and Davao rivers, inland flood and coastal flood
15	January 16, 2020 Manila	− Discussion on framework plan and master plan for riverine floods in Davao, Matina and Talomo rivers, inland flood and non-structural measures

Source: Project Team

Technical training meetings were mainly held in Manila, but not only Manila C/Ps also Davao C/Ps frequently participated in the meetings and actively discussed each other. According to additional request from C/Ps, the meetings on April 30 and May 2, 2019 were held in order to introduce the drainage network simulation model in details. In addition to the C/P, the other DPWH RO and DEO officers attended the May 2 meeting in Davao. The participation rate of C/Ps in the meetings was generally high, although the participation from Davao City was limited. The meetings also became a place to share information about project activities with DPWH since one of DPWH UPMO-FCMC project manager and TWG member attended almost every meeting, also TWG chairperson and DPWH DEO director sometimes attended. Figure 1.2.1 shows a photo of the technical training meetings.

1st technical training meeting on January 29, 2019

4th technical training meeting on March 22, 2019

Source: Project Team

Figure 1.2.1 Technical training meetings

(3) Stage 3

In Stage 3, technical training meetings were held for sharing the status of F/S study and discussing major issues. The technical training meetings in Stage 3 were started from August 2021 as a monthly meeting that were held on the last Friday of every month in principle. The meetings were carried out by online meeting style since JICA Project Team could not enter the Philippines until March 2022 due to the influence of COVID-19. In the meetings, it was shared and discussed that the process for project implementation such as setting hydraulic conditions for structural design, preliminary design of structural measures, procurement/construction plan, environmental impact assessment and resettlement action plan as well as various issues and problems that occurred in the process. In Stage 3, capacity for the project implementation process was enhanced through activities to solve/try to solve problems in collaboration with C/P and JICA Project Team.

Table 1.2.4 Topic of Technical Training Meeting in Stage 3

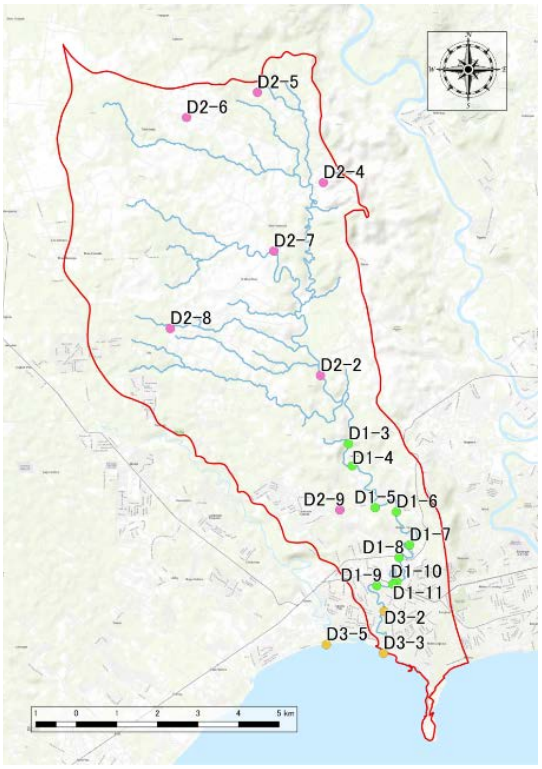
No.	Date	Topic
16	August 19, 2021	− Expected Activities in F/S Stage - Target Projects - − Activities from end of 2020 until now (August, 2021) − Arrangement of how to proceed with the Project activities hereafter
17	September 24, 2021	− Outputs of Topographic Surveys − Status of environmental and social consideration studies (Status of Environmental Study and Resettlement Study by sub-letting) − Analysis of Retarding Ponds (Analysis Process and Progress) − Examination of Soil Disposal Site (Soil volume calculation result at coastal reclamation candidate sites, etc.) − Examination of Cut-off Works and Development of Proposed Relocation Site
18	October 29, 2021	− Status of environmental and social consideration studies (status of Environmental study and Resettlement study by sub-letting) − Progress of analysis of retarding ponds with introduction of examples of retarding ponds − Examination of soil disposal site (possible sites in mountainous areas) − Cut off works and development of proposed relocation site − Progress of study on non-structural measures
19	November 26, 2021	− Status of environmental and social consideration studies (status of Environmental study and Resettlement study by sub-letting) − Progress of preliminary design of dredging − Progress of analysis and preliminary design of retarding ponds − Preliminary analysis of impact against floods by target structural measures for F/S − Progress of examination of cut off works and development of proposed relocation site
20	December 17, 2021	− Status of environmental and social consideration studies

No.	Date	Topic
		(status of Environmental study and Resettlement study by sub-letting) − Further preliminary analysis of impact against floods by target structural measures for F/S
21	January 28, 2022	− Status of environmental and social consideration studies (status of Environmental study and Resettlement study by sub-letting) − Progress of preliminary design of target structural measures for F/S - Design of Retarding Pond -
22	February 24, 2022	− Status of environmental and social consideration studies (status of Environmental study and Resettlement study by sub-letting) − Revised/Updated CLUP 2019-2028 in Davao City
23	March 25, 2022	− Status of environmental and social consideration studies (status of Environmental study and Resettlement study by sub-letting) − Progress of preliminary design of target facilities for F/S and Pre-F/S
24	April 22, 2022	− Status of environmental and social consideration studies (status of Environmental study and Resettlement study by sub-letting) − Study on Operation & Maintenance − Study on Non-Structural Measures
25	May 27, 2022	− Status of environmental and social consideration studies (status of Environmental study and Resettlement study by sub-letting) − ROW lines for Pre F/S
26	July 1, 2022	− Status of environmental and social consideration studies (status of Environmental study and Resettlement study by sub-letting) − Outputs of F/S Activities ・ Hydraulic conditions for structural design ・ Structural Measures ・ Road/Bridge design of cut-off area ・ Construction Planning & Cost Estimation ・ Project Evaluation − Development Concept for Proposed Urbanization Site

Source: Project Team

1.2.2 M/P Formulation on Matina River

Specific activities for this item were carried out in the Stage 2 of M/P formulation stage. In the Stage 1, as preparation activities, explanation and discussion on the M/P formulation process and important issues in the formulation process were conducted in the technical training meetings described in 1.2.1. Also, as an item of the technical training meetings, field surveys of the Matina River basin were carried out for two nights and three days in the 5th technical training meeting. Most of the C/Ps, except for a few, participated in the field survey from the upstream to the downstream of Matina River basin, and interviews with the residents were also carried out to deepen the local understanding. By conducting the field survey with all C/Ps, discussions can be held with a common specific image when considering M/P formulation in the Stage 2. Figure 1.2.2 shows the location and photos of the site survey in the Matina River basin.



Location of site survey

Source: Project Team

Figure 1.2.2 Location and photo of site survey in Matina river basin

In Stage 2, specific activities were carried out to formulate the M/P for the Matina River. Specifically, first, the C/Ps learned the specific process through information sharing and discussion in the examination of the M/P on the Davao River, which was conducted mainly by the project team, then, the C/Ps tried to formulate the M/P for the Matina River with reference to the study process for the Davao River. As for hydrological analysis and runoff flood analysis on the Matina River, practical technical training was held in each of Manila and Davao to strengthen the capacity of the C/Ps as shown in Table 1.2.5. Figure 1.2.3 shows a photo of the practical technical training. At the practical technical training held in Davao, the related officers other than the C/Ps also participated, indicating the high level of interest in this training.

Table 1.2.5 Theme of Practical Technical Training in Stage 2

No.	Date & Place	Theme
1	October 22, 2019 Manila	− Hydrological data collection & modification − Statistical analysis (probable evaluation)
2	October 30, 2019 Manila	− Modeling with HEC-HMS(SCS model)
3	November 7, 2019 Manila	− Modeling with HEC-RAS (1D flow model & 2D inundation model)
4	November 19, 2019 Manila	− Discharge allocation study − Hydraulic analysis for examining alternatives of flood control measures
5	December 5-6,2019 Davao	− Integrating the above four themes

Source: Project Team


Source: Project Team

Figure 1.2.3 Practical technical training for hydrological analysis and runoff flood analysis (Left: held in Manila, Right: held in Davao)

Since the F/S study on the priority project(s) for the Davao river will be conducted in Stage 3, the capacity building activities for the Matina river were completed in Stage 2.

1.2.3 Coordination Meeting

The coordination meetings were held with the following objectives:

- To widely recognize and share issues related to flood/drainage/tidal flood and coastal erosion in Davao among stakeholders, and
  to facilitate understanding of M/P and smooth implementation of flood control measures as well as appropriate maintenance and management activities of the measures.
- To utilize discussed results in the meeting for 1) understanding the actual conditions and the awareness of related organizations and residents, and 2) formulating appropriate Master plan.

For the meetings, target barangays were selected for each theme, and barangay captains from the selected barangays and relevant organizations were invited. The meetings were held in Davao City. Selection of barangays and related organizations and preparation and coordination of meetings were conducted cooperating with experts, DPWH HQ, DPWH RO and DEO and Davao City. The outline of each coordination meeting is shown in the Table 1.2.6.

Table 1.2.6 Theme of Coordination Meeting

Date	Theme	Participants		
		Number of People	Number of Barangay	Number of Relative Organization
January 29, 2019	Flood from the rivers of Davao River, Talomo River and Matina River	46	24	11
February 20, 2019	Inland flood in Davao urban area	89	48	13
April 24, 2019	Tidal flood and coastal erosion	81	46	12

Source: Project Team

In the total of 3 coordinating meetings, 70 to 90% of the invited barangays positively participated.

The participated representatives from each barangay were divided into several groups, then the current situation, problems and expected countermeasures on flooding were discussed within the group. Through presentation by each group representative, the participants were able to share their opinions on the flood situation and expected countermeasures in each area. Figure 1.2.4 shows a photo of the coordination meeting.

Source: Project Team

Figure 1.2.4 Coordination meeting on April 24, 2019

The coordination meetings are designed to link with public consultation at SEA, aiming to integrate flood control and environmental conservation. Public consultation meetings for SEA were held in July 2019 at the end of Stage 1 and in January 2020 in Stage 2.

There was participation from the DPWH headquarters in all the three coordination meetings. Although some of the C/Ps in Manila had no chances to participate for the coordination meetings, most of the C/Ps in Manila could participate in the following public consultation meetings in Davao and they could grasp the conditions and the awareness of related organizations and residents in Davao. The outline of the public consultation meetings is as described in section 3.14 of Part I.

The coordination meetings as a part of capacity enhancement activities ended with the above-mentioned three meetings in Stage 1, whereas public consultation meetings were continuously held in the Stage 2 and 3, following the coordination meetings.

1.2.4 Seminar

The seminar was planned to be held about three times throughout the project period at the timing of the report compilation, but it was held only once due to the influence of COVID-19. The program of the seminar included progress and results of the Project, introduction of technical cases in Japan contributing to the solution of flood issues in the Philippines, introduction of knowledge obtained through the Project activities by C/P, discussion and exchange of opinions.

The first seminar was held at the timing of the preparation of the progress report as shown in the Table 1.2.7 and Figure 1.2.5.

Table 1.2.7 Contents of 1st Seminar

Objective	➢ To share progress of Project activities with the related organizations ➢ To transfer of various technologies relating to methodology of formulation of integrated flood control M/P
Date and Time	September 3, 2019 14:00-17:00
Venue	Hotel H2O (Manila)
Participants	72 (DPWH HQs, Regional and District office, Davao city, the related organizations)
Contents	➢ Progress of Project activities (Results of Basic Study and Planning of Master Plan Study) ➢ Introduction of Flood Control Projects in the Philippines ➢ Knowledge sharing on Integrated Flood Management in Japan ➢ Experience of Counterpart Training in Japan

Source: Project Team

Source: Project Team

Figure 1.2.5 First Seminar

In the Q&A session after each presentation in the first seminar, active participation was seen including many questions on the content of the presentation regarding the details of rainwater storage facilities in Japan and related laws and regulations, how to manage waste as part of flood control, how to deal with climate change, the contents of inland flood control in this project, etc.

1.2.5 C/Ps Training in Japan

The training in Japan aims to promote understanding through direct inspections and experiences of actual situation and the background of flood control planning and measures in Japan that cannot be taught through the technical training meetings and OJT, and to utilize those acquired knowledge and experiences for project activities and future activities on flood control. In this Project, training in Japan is scheduled to be conducted twice. The first training conducted in 2019 focuses on planning on measures against riverine flood. The second training was planned to be carried out in 2020 focusing on design, construction and maintenance related to inland flood and coastal measures, but it was canceled due to the influence of COVID-19.

The outline of the 1st training in Japan is shown below.

(1) Training Period

May 19, 2019 - June 1, 2019 (14 days)

(2) Number of Participants

7 persons

Table 1.2.8 List of Participants

No.	Name	Office	Position
1	Jeric John U. Nuguid	DPWH UPMO-FCMC	Engineer II
2	Crissa Rica V. Espiritu	DPWH BOD	Engineer III
3	Renz Russel D. Tolosa	DPWH Planning Service- PPD	Engineer II
4	Lorenz Atajar	DPWH UPMO-FCMC-FCMO	Engineer II
5	Alain John R. Sotto	DPWH-RO XI	Engineer III
6	Newton L. Apao	DPWH-Davao City DEO	Engineer II
7	Samuel A. Singco	Davao City Planning Office	Engineer III

(3) Contents of Training

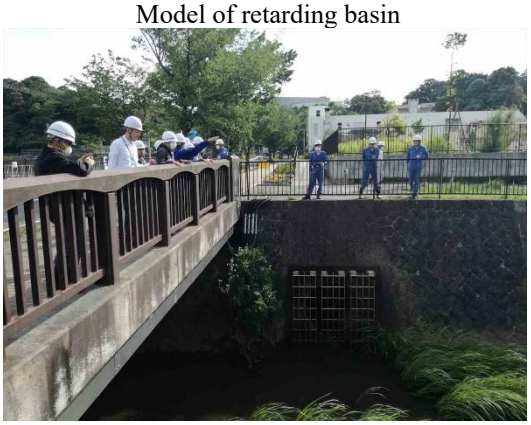
To learn about the framework of the Integrated Flood Management Plan (River Development Plan) in Japan, the process of formulating the plan and the measures taken as a result of the plan.

(4) Places Visited

- Ministry of Land, Infrastructure, Transport and Tourism (MLIT), Water and Disaster Management Bureau
- MLIT, Kanto Regional Development Bureau, Arakawa Upstream River Office,
- MLIT, Kanto Regional Development Bureau, Arakawa Downstream River Office,
- MLIT, Kanto Regional Development Bureau, Keihin River Office
- MLIT, National Institute for Land and Infrastructure Management, River Department
- Public works research institute (PWRI), International center for water hazard and risk management (ICHARM)
- Kanagawa Prefecture, Bureau of Land Development
- Osaka Prefecture, Neyagawa river office
- Tokyo Metropolis, Department of construction
- Yokohama City, Department of river management
- Yokohama City, Department of Sewage System Planning
- Fujisawa City, Department of disaster management & Department of planning architecture
- Kobe city, Department of Disaster Management
- Foundation of River & basin Integrated Communications (FRICS)
- JICA HQs


Model of retarding basin


Emergency operation center


Outlet of retarding basin


Underground reservoir


Sedimentation basin for underground diversion channel


Lecture at Tokyo Metropolis

Figure 1.2.6 1st C/P training in Japan

(5) Outcomes of Training

Through a series of lectures and site visits in Japan, the following items could be learned as effort of integrated flood control measure.

- River improvement measures such as retarding basin, underground diversion channel, and each river improvement
- Storage and infiltration measures in the basin such as regulating pond/reservoir, permeable pavement, and green space conservation
- Land use control in the basins such as development regulations in vulnerable areas, super levees

According to the comments from one of the trainees, he thought that there were limits to flood control in the Davao river basin, but his image of the countermeasure could be materialized through this training.

As for application of retarding basins and underground diversion channels to Davao, the trainees were able to deepen their understanding through question-and-answer sessions on how to pay attention to landowners.

After the training, the results of this training were shared with other C/Ps and DPWH officers who did not participate in the training, and discussions were held on how to utilize them for flood control in the Davao river basin, in the C/P meeting and technical training meeting held on June 14, 2019 and the DPWH-UPMO internal regular meeting held on July 15, 2019.

Regarding the three target rivers including the Davao River, 11 major issues described in Section 2.7.10 of Part I have been clarified. Among them, regarding (1) “Improvement of Present Situation of Implementation of Flood Control Measures with Different Design Levels”, implementation of countermeasures based on the “Fundamental river management policy” and “River improvement plan” in Japan, which was lectured in the training in Japan, will contribute. Also, as for (10) “Better Operation and Maintenance Activities”, although the second training in Japan, which was planned focusing on operation and maintenance as one of the main topics, could not be implemented due to the influence of COVID-19, even in the 1st training in Japan, it is considered that the understanding of the importance of operation and maintenance has progressed through 1) repetitive explanations that proper maintenance is essential for the planned and constructed facilities to continue to fulfill the prescribed function, and 2) seeing and hearing actual examples of maintenance activities such as inspection and cleaning after operation in retarding basins, underground diversion channel and so on.

It is expected that activities aimed at resolving the major issues will be implemented by utilizing what was learned in the training in Japan.

1.3 Outputs and Evaluation

In this Project, project activities have been done with the following basic approaches on capacity enhancement in mind:

1) "Foster the capacity to formulate an integrated flood control M/P by personnel in DPWH by acquiring the knowledge and skills necessary for supervising subletting work"
2) "Strengthen the organization, in order to secure the sustainability of the measures by implementing the M/P formulated in this project and the selected priority projects and by properly operating and maintaining the projects".

Concretely, as mentioned in Section 1.2, capacity enhancement activities have been carried out through C/P Meeting and Technical Training Meeting, seminar, C/Ps Training in Japan and coordination meetings as well as on-the-job training (OJT), such as discussing project issues with related parties including C/P, and conducting field surveys together to confirm local conditions and issues, especially during field activities in Davao.

In addition, there were various opportunities during Project to present/explain and discuss the content and activity status of the Project at many conferences and meetings, such as the Business Webinar by NEDA XI and Consulate General of Japan, IDC XI quarter regular meeting, public consultation meetings for environmental and social consideration and so on, C/P members often made presentations and responded to questions and answers at those meetings.

As for formulating M/P in Matina River, due to time constraints, while discussing the main issues with C/P, most of the plan was prepared by the project team, but as for the basic approach 1) "Foster the capacity to formulate an integrated flood control M/P”, it can be evaluated to have been strengthened to a certain extent, mainly through thematic training and discussions at technical training meetings and discussions at OJT.

Regarding the basic approach of 2), proper understanding of the Project is indispensable for presentations and discussions at many official meetings, and appropriate understanding of the content of the measures, the necessity of the measures and their effects will lead to the operation and

maintenance of the measures during and after the construction. In this respect, it can be evaluated that some results have been achieved in 2) as well.

On the other hand, it is considered that there is a limit to the capacity enhancement that can be done by development-study-type technical cooperation of which main purpose is to formulate M/P and conduct F/S, and implementation of a technical cooperation project whose main purpose is to strengthen the capacity is needed in order to further strengthen the capacity.

Chapter 2 Recommendation

Based on the activities related to capacity enhancement in this Project, the followings are recommended:

(1) Implement flexible activities according to the needs of the implementing agency and secure a scheme for that

In this project, while formulating M/P and implementing F/S, capacity enhancement activities were also carried out. C/P member of this Project actively participated in technical training meetings, field surveys, discussions and consultations on issues despite their own respective duties. On the other hand, it seems that there are large time constraints in their respective duties, and it may be difficult to carry out specific examination work related to this Project and to secure time for it. In addition, as a project team member (JICA team member), there was a time limit for preparing for training and preparing materials while conducting various studies and works related to the formulation of the plan.

In the future, when conducting a project aiming at practical and effective capacity enhancement while formulating M/P and implementing F/S, it is considered effective to formulate a project considering the following:

＜Project Team Side＞

- A generous project schedule

  To secure a project schedule and assignment period with sufficient time for collaborative work with C / P and capacity enhancement, in addition to time for each work of the part in charge related to M/P and F/S examination.

- Continued on-site stay

  Opportunities for jointly responding, discussing, examining issues that arise on the C/P side are extremely valuable and practical chances for capacity enhancement.
  In order to respond without missing such an opportunity, to secure a scheme that the team can stay in the site continuously and respond appropriately.

- Flexible team member composition

  Even if sufficient prior consultation is conducted, it may happen that it will be necessary to deal with new related fields after the start of a project, beyond the issues and needs that can be assumed at the time of project formation and start.
  To make a flexible member composition that can respond to unexpected issues, or secure a scheme that makes it easy to change or add members.

＜C/P Side＞

- Creating an environment where C/P can engage in collaborative work

  It is considered that there is a limit to capacity enhancement in the form of lectures and short-term intensive training, and responding to specific issues and long-term collaborative work are effective in strengthening practical capacity.
  To secure an environment where C / P can engage in collaborative work as much as possible.

(2) Implementation of technical cooperation projects of which main purpose is to enhance capacity

It is considered that there is a certain limit to the capacity enhancement that can be carried out by development-study-type technical cooperation of which main purpose is to formulate M/P and implement F/S. In order to effectively enhance capacity, it will be efficient to implement a collaborative technical cooperation project of which main purpose is capacity enhancement.

When implementing a project, it is desirable to consider training in a third country if there are successful examples from countries/regions with similar disaster scales, budgets, and organizational structures. As one of candidates for a third country training for a project targeting the Philippines, Indonesia can be

considered because of d similarity as an island country and its organizational structure related to flood management activity.

Annex

Annex 1

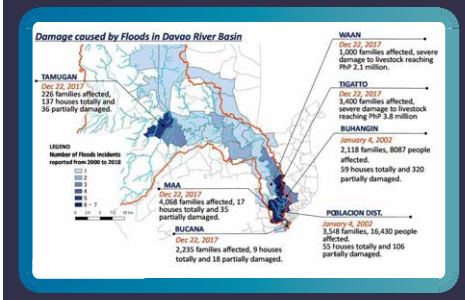
Outputs of Non Structural Measures (IEC materials and Flood hazard map)

IEC material
(Public awareness on flood control measures)

WHO ARE THE MOST AFFECTED POPULATION?

The **largest flood** in recent years in the Davao River Basin was caused by Typhoon Vinta in **December 2017**. It affected **21,768 families** which corresponds to two-thirds of the total number of affected families (30,503).**

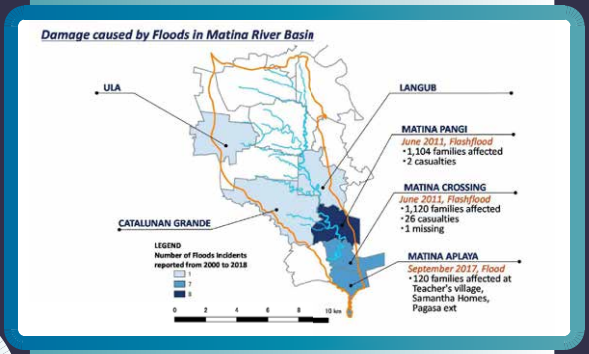
Reported flooding incidents are concentrated in the **lower part of the Davao River Basin where the urbanized area is located.** Specifically, the areas that experienced inundation include the barangays of: **Ma-a, Tigatto, Brgy. 2; and Brgy. 5.****



The January 2002 flood caused damage to more than **10,000 families** in the most downstream barangay of the Talomo River Basin and affected **5, 794 families** in Davao River Basin.**

Did you know?

78% of the 182 barangays comprising Davao City are highly susceptible to floods These barangays experience flood heights of **more than one (1) meter, which take place in over three (3) days.***

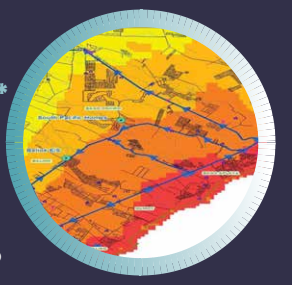


Floods can potentially affect 1,625,154 persons, who occupy parcels of residential areas that total to **8,600.07 hectares** in Davao City.*

The **most destructive flood** in the **Matina River Basin** was the flashflood that happened in **June 2011** causing the **death of 26 people** in Matina Crossing and 2 in Matina Pangi due to drowning. The flood **affected 2,307 families** in Matina River Basin and **497 families** in Davao River Basin (Ma-a Barangay).**

IF IT REMAINS UNADDRESSED, WHAT WILL BE THE FLOODING SITUATION IN X YEARS?

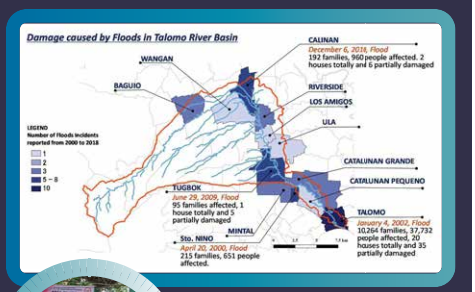
Typhoon Vinta 2017 Flooding**



Estimated monetary damage to Davao City reached PhP 204 million:

- **79 M for agriculture**
- **9 M for animal/livestock/ poultry**
- **116 M for infrastructure**

The highest water level during Typhoon Vinta recorded by DPWH was about 5.0 m from ground level at Jade Valley area.**

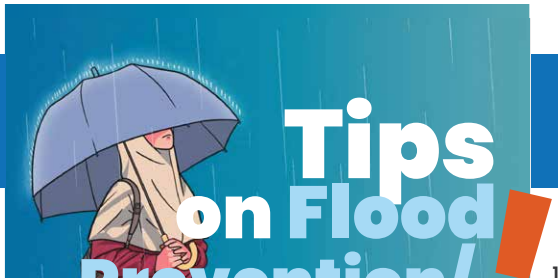


Sources:
*Davao City DRRM Plan 2020-2025

**JICA, Oriental Consultants Global Co., Ltd, and Pacific Consultants Co. Ltd. (2021). Project for Master Plan and Feasibility Study on Flood Control and Drainage in Davao City Interim Report.

Photo Credits: Davao City DRRM Office

Tips on Flood Prevention/ Preparedness!



FOR HOUSEHOLDS

Before

1. Keep your surroundings clean. **Do not throw garbage in waterways** such as rivers, estuaries, canals and drainages.
2. **Practice proper segregation and recycling** of household wastes.
3. **Harvest crops** that can be yielded already and **secure domesticated animals and pets** in a safe place. For fisherfolks, place boats in safe areas.

During

1. Stay indoor and stay informed: **Monitor weather updates** through radio, television and warnings given by local authorities.
2. Undertake **pre-emptive evacuation**
3. **Shut down power lines** at home and ensure that your house is **safely locked** prior to evacuation.
4. **Unplug your appliances** to prevent electrical shock when the power comes back on.
5. **Call 911** if in need of emergency response-related assistance and services.
6. **Observe** physical distancing and other **health protocols** (e.g., wearing of face mask, washing of hands) in the evacuation centers.
7. **Remain on higher grounds** while waiting for rescue

- **Don'ts:**
  - **Do not attempt to cross streams** when water is already above the knee.
  - **Do not attempt to swim or boat** your way through swollen rivers.
  - **Avoid walking through flood waters**, especially if you have open wounds on your lower extremities, to prevent contracting leptospirosis, and other related diseases.

After

1. Leave the evacuation area only **when local authorities say it safe** to return home
2. Upon return home, **be cautious of possible dangers** such as electrical and gas explosion or dangerous animals like snakes.
3. Throw away rainwater in cans, pots and tires to **prevent breeding of mosquitoes.**

- **Don'ts:**
  - Do not drink tap water **unless you are sure that it is safe** — boil water to be safe.
  - **Don't use any gas or electrical appliance submerged in floodwater** until a professional has checked them for safety.

1. Know your Barangay's flood susceptibility.
2. Know the flood-prone & landslide-prone areas near you.

3. Make sure that everyone in your household is informed about **flood warning systems/signals, safe evacuation routes, and evacuation centers** in your Barangay.
4. Are you aware of your emergency alert signals in Davao City?

SIGNAL	MEANING	ACTION
Electronic Siren & Manual Bell		
Wavering tone for 3 mins Continuous dings for 3 mins	Imminent possible disaster such as Tsunami, Storm Surge, Strong Wind, or Flooding	Orderly evacuate to your designated Safe Evacuation Area and listen to Radio Stations/ Alert Text Blast for Instructions
Steady tone for 3 mins 2 repeating dings for 3 mins	All danger, drill or exercise is CLEAR	Return to normal activities or if evacuated, safely return to your houses
Steady tone for 30 secs	Testing Sound	Testing every Tuesday at 12 noon

5. Develop a **family preparedness plan** containing information such as where to convene in case you get separated, and emergency contact details.
6. Secure important documents (including digital version), household items, and belongings in waterproof and/or elevated spaces.
7. Prepare a **72-hour Emergency Grab Kit** for each of your household member.

FOR COMMUNITIES

Before

1. Regularly **clean drainage and waterways to prevent clogging.**

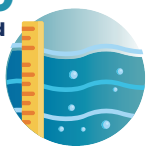
2. **Strictly follow** environmental and disaster risk reduction and management-related laws implemented by the city government (e.g., Ecological Solid Waste Management, Watershed Code, Storage and Use of Rainwater, Pre-emptive Evacuation).

3. **Participate in reforestation activities** such as tree planting in mountains and swamplands.

4. **Participate in flood preparedness planning, actions, and drills** in the barangay.

During

1. **Constantly monitor flood markers** and disseminate the status of water level in the river/s surrounding your community.



2. **Prioritize the evacuation of vulnerable groups** such as children, pregnant women, older persons, and persons with disabilities.

After

1. **Clear roads and other lifelines** in the community from debris and other obstructions.

2. **Report fallen trees and electric posts** to authorities.

Know the contact and services to reach in case of emergency.

For emergency response services:
Central 911

For Public Safety And Security Concerns:
Task Force Davao
0917 131 4333
0999 227 1111
(082) 224 0911

Davao City Police
0917 131 5333
0919 070 2222
(082) 285 0911

For Complaints, Reports, And Suggestions:
Davao City Reports
0917 1312333
0919 072 2222

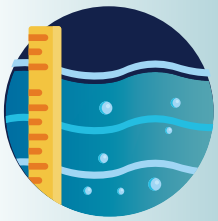
Sources

- Mines and Geosciences Bureau (MGB) IEC
- Inquirer.Net infographic
- Office of Civil Defense (OCD) Infographic
- Davao City Disaster Risk Reduction and Management Plan 2020-2025
- Davao City Disaster Risk Reduction and Management Office (http://drrmo.davaocity.gov.ph/)
- Interim Report of Project for Master Plan and Feasibility Study on Flood Control and Drainage in Davao City

DIFFERENT CAUSES OF FLOODING

Heavy, continuous rains that last for days or ceases only briefly

Overtopping of dikes and levees

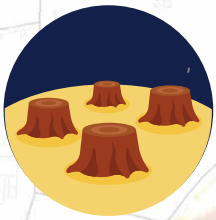


Insufficient carrying capacities of the river system due to factors such as heavy siltation

Changes in tide

Improper garbage disposal and waste management

Deforestation



Source: PAGASA and MGB

What is flooding?

- The rising of water level until it overflows its natural or artificial confines and submerge the surrounding area.

Source: Office of Civil Defense

- A flood happens when large amounts of water, usually from rainfall, accumulates faster than it can evaporate, disperse or get discharged.

Source: Philippine Atmospheric, Geophysical and Astronomical Services Administration

Why is it so dangerous?

- Flooding can cause deaths due to drowning, destruction of properties, structures and livelihoods.
- It can also lead to the rise in epidemics, environmental degradation, and cause barriers to continuous delivery of services such as electricity and telecommunications.

Source: Mines and Geosciences Bureau

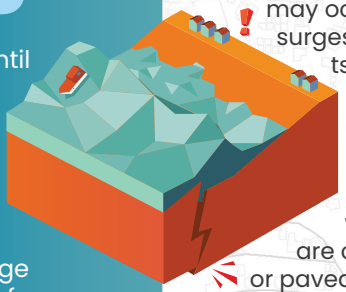
TYPES OF FLOODING

The types of floods are determined by factors such as location (place of occurrence) and duration.

Floods based on location are:

River Flooding
occurs when a large amount of rainfall causes a river to overflow. This type of flooding may last a few hours or many days depending on the intensity and amount of rainfall and carrying capacity of the river.

Coastal Flooding
may occur due to storm surges, high tide and tsunamis (waves produced by earthquakes at sea).

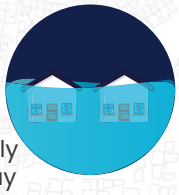


Urban Flooding
occurs in locations where most areas are covered by buildings or paved. During heavy rains, water cannot infiltrate into the grounds and accumulates on the surface. Urban flooding is also caused by the limited capacity of drainage systems to accommodate heavy rains.

Floods based on duration are:

Flood waves
is a result of a heavy rainfall over a relatively small drainage area. Flash floods carry highly destructive food waves and are most common in mountainous areas or in steep places that have streams flowing through narrow canyons. It happens quickly and with little warning.

Sheet flooding



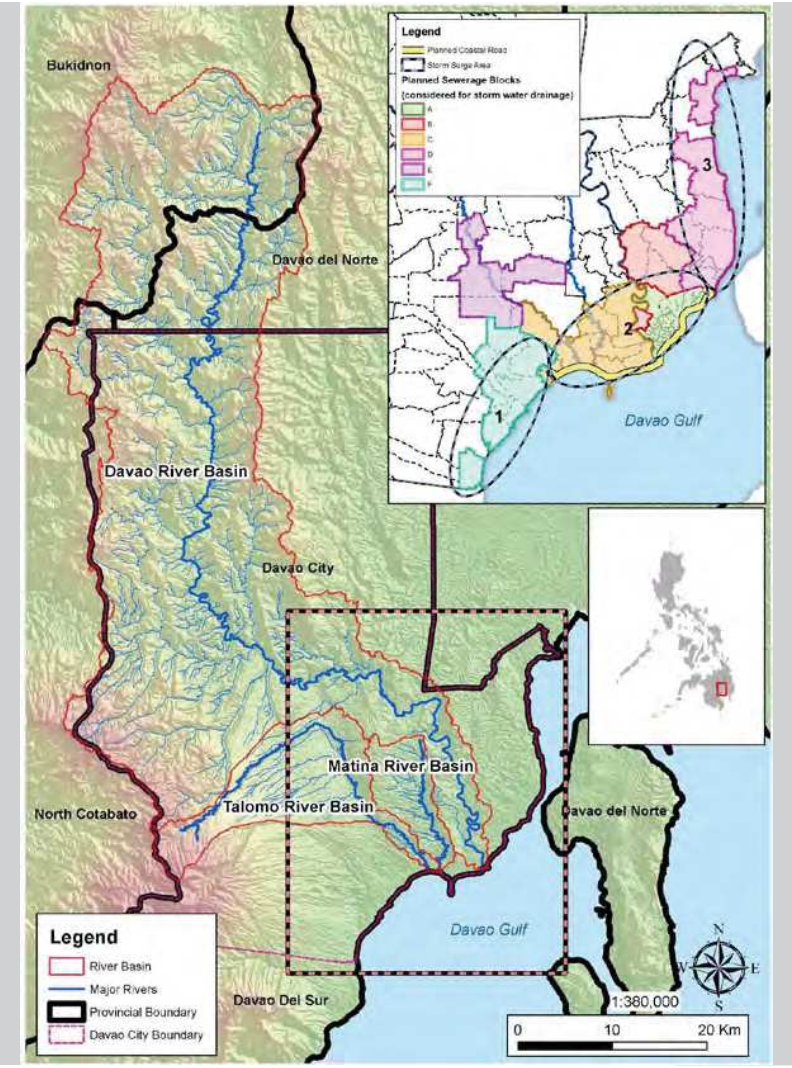
is caused by shallow water flowing over a wide area and is very common in flood plains that are normally flat. Sheet flooding may also result when water in a river channel with insufficient carrying capacity overtops its banks, inundating the adjacent areas.

Source: PAGASA

IEC material
(Pamphlet introducing the flood control Master Plan)

PROJECT FOR THE MASTER PLAN & FEASIBILITY STUDY ON FLOOD CONTROL AND DRAINAGE IN DAVAO CITY

The project aims to mitigate damage and losses from flood in Davao City by implementing flood control measures through the development of a Master Plan for Davao, Matina and Talomo River Basins and conduct of a Feasibility Study on urgent and/or priority project(s).



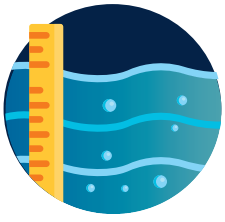
Total Target Area:
2, 200 sq/km
consisting of Davao City urbanized area, Davao River Basin, Matina River Basin, and Talomo River Basin

Duration:
2023 to 2032
short-term
2033 to 2045
mid-/long-term

The implementing agencies are the ***Department of Public Works and Highways (DPWH)***, UPMO-FCMC, regional office and district engineering office, and the ***City Government of Davao.***

COMPONENTS

The project has structural and non-structural components contributing to:

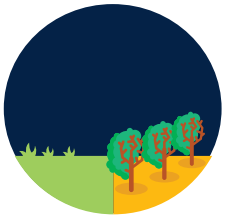


Riverine Flood Control

to reduce severe damage and loss due to inundation by riverine flood

Storm Water Drainage Improvement

to reduce severe damage and loss due to inundation by storm water and secure proper urban function as regional center



Coastal Disaster Countermeasures

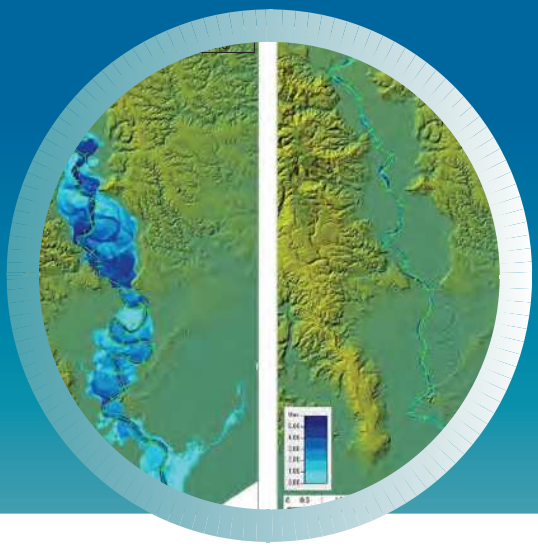
to reduce the damage caused by coastal inundation and ensure appropriate use of coastal areas according to land use

Structural Measures

Flood in 3 rivers (Riverine flood)	Flood in the city (Inland flood)	Coastal conservation and storm surge (Coastal flood)
	2023	
Dredging Davao River Talomo River	**Installation of Retarding Basin** Drainage Areas: Agdao, Jerome, Mamay Creek, Sasa Creek, Emars, Shanghai, Maa1, Maa2 Maa1 Drainage Area Maa2 Drainage Area	**Back Levee (Dike: Narrow / Wide)** Central area
Cutoff Work Davao River Matina River Talomo River	**Improvement of:** **Lower Channel -** Agdao, Jerome **Upper Creek -**Mamay Creek **Channel -** Sasa Creek, Shanghai, Maa1, Maa2	
Retarding Ponds Davao River (3) Matina River (12) Talomo River (3)	**Installation of Bypass Channel** Sasa Creek, Emars, Shanghai	
	2032	
River Widening Davao River Matina River Talomo River	**Channel Improvement** Roxas Drainage Area	
Retarding Ponds Davao River (5)	**Installation of Retarding Basin** Drainage Areas: Agdao, Jerome, Mamay Creek, Sasa Creek, Maa1, Maa2	**Dike** North area (Wide) South area (Narrow)
Flood Wall at river mouth Matina River Talomo River	**Installation of Bypass Channel** Roxas, Mamay Creek	
	Installation of Underground Diversion Channel Maa2	
	2045	

SHORT-TERM

MID-/LONG-TERM



RIVERINE FLOOD CONTROL MASTER PLAN IN DAVAO RIVER (STRUCTURAL MEASURES)

	SHORT-TERM MEASURES	MID-LONG TERM MEASURES
Implementation Period (Target Year)	**2023-2032** (2032)	**2033-2045** (2045)
Design Level	**5-10 year scale flood**	**100 year scale flood**
Design Discharge	**1,500m3/s**	**3,400m3/s**
Target Area	From river mouth to 23km	From river mouth to 23km
Measures	**Dredging** (from river mouth to 23km **Cut-off works** **Installation of retarding ponds**	**River widening** (from Bolton bridge to 14km) **Installation of retarding ponds**
Project Cost	**Php 10.54 billion**	**Php 33.90 billion** (including short-term measures)
Economic Evaluation (EIRR)	**18.54%**	**15.83%** (including short-term measures)
Economic Evaluation (ENPV) (Discount rate: 10%)	**Php 18.40 billion**	**Php 17.31 billion** (including short-term measures)
Economic Evaluation (B/C) (Discount rate: 10%)	**2.042**	**1.516** (including short-term measures)

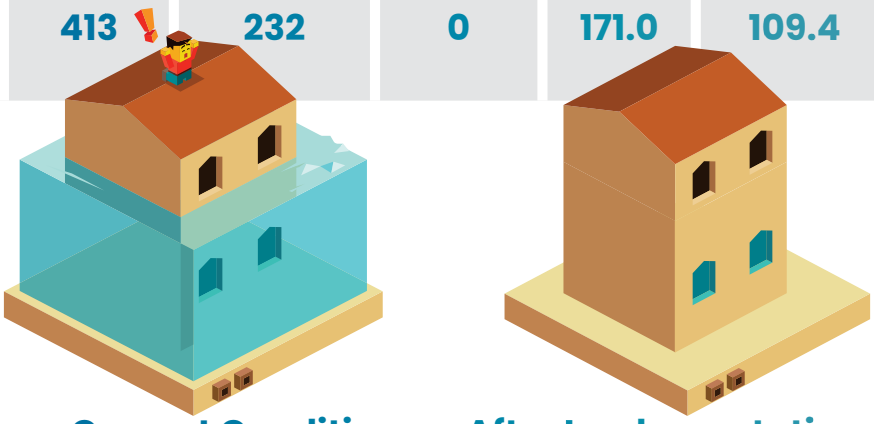
BENEFITS

After the short-term and mid-long term measures are implemented, area to be protected in the Davao River can expect to become basically safe for 100 year scale flood considering climate change impact

TOTAL COST

PhP 33.90 billion short-term and mid-long-term combined

FLOODSCALE	INUNDATION AREA (ha) >0.10m inundation depth			NUMBER OF INUNDATED BUILDINGS (1= 100 buildings) >0.10m inundation depth)		
	PRESENT CONDITION	AFTER SHORT-TERM MEASURES	AFTER MID-LONG TERM MEASURES	PRESENT CONDITION	AFTER SHORT-TERM MEASURES	AFTER MID-LONG TERM MEASURES
100 year	624	571	0	260.6	253.3	0
50 year	573	508	0	246.0	228.1	0
25 year	500	418	0	211.5	186.3	0
10 year	413	232	0	171.0	109.4	0



Current Condition vs. After Implementation

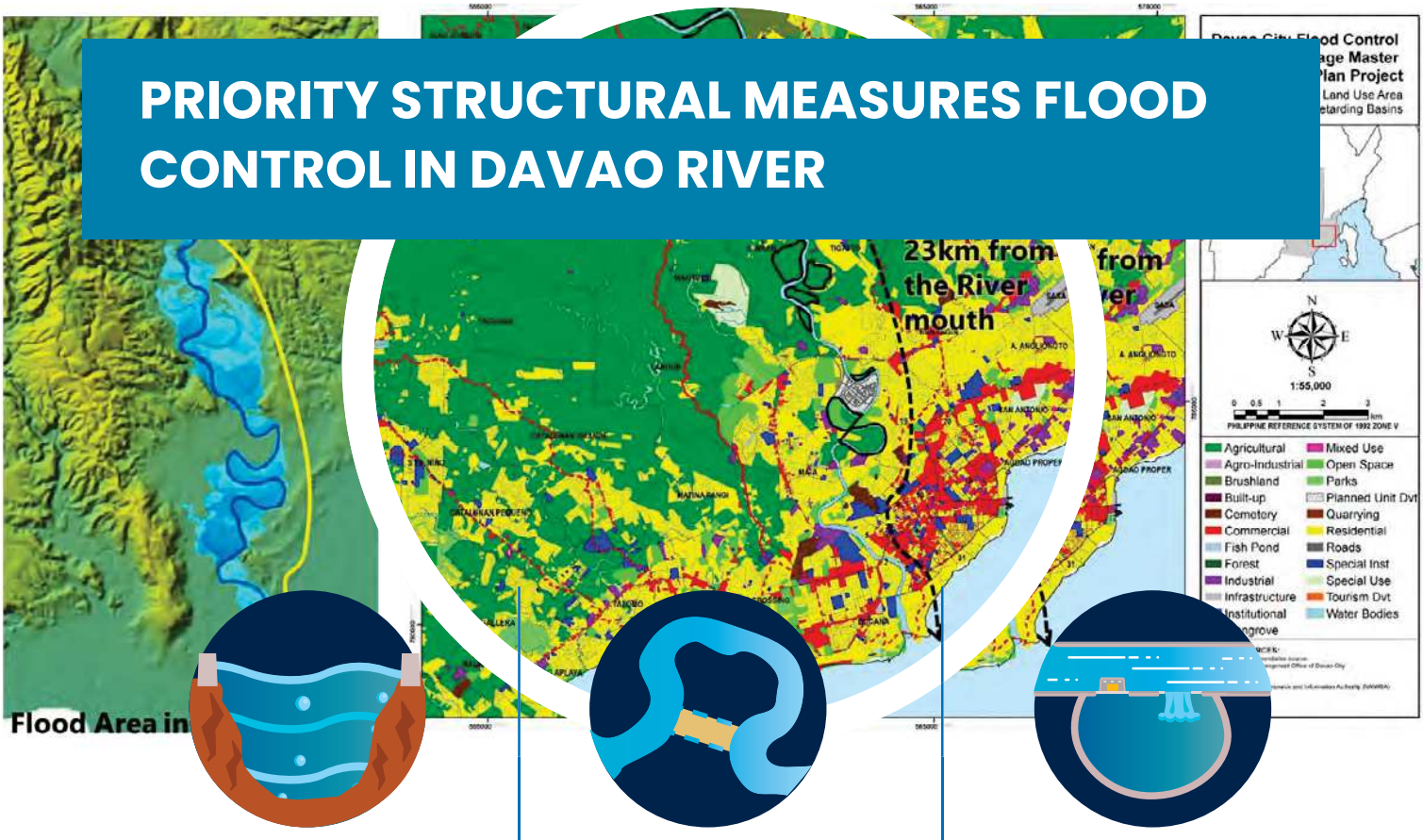
Non-Structural Measures

2023

- Flood forecasting & warning
- Forest & mangrove conservation
- Cleaning maintenance of drainage channels, river, & coastal area
- Evacuation planning
- Land use control
- Awareness activities
- Runoff control through onsite storage and permeable pavement system

2045

PRIORITY STRUCTURAL MEASURES FLOOD CONTROL IN DAVAO RIVER



River Dredging

will remove sediments and debris from the bottom of the Davao River in order to restore its original depth, and improve its flow capacity, thereby reducing the risk of flooding.

Cut-off work

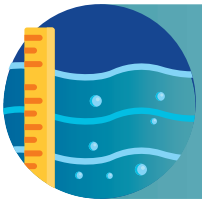
will promote the discharge of flood water, and further the present river channel (meandering part).

Retarding Ponds

excavated area/s to enable storage of water for a limited period of time will be installed along critical areas in the Davao River to protect against flooding and downstream erosion.

NON-STRUCTURAL MEASURES

The non-structural measures in the masterplan will cover Davao City including the Davao River, the Talomo River and the Matina River, targeting riverine flood, inland flood, and storm surge.



Additional installation of water level gauges

Installing water level gauges will help facilitate better dissemination of early warning to the communities.

Setting a warning water level in the Davao river corresponding to the latest river and social conditions.

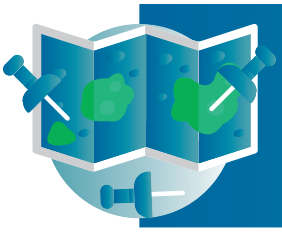
The review of warning water level of water level gauges installed in bridges will be done to avoid missed or overlooked warnings.

Preparation of IEC materials on the proposed structural measures and non-structural measures

Materials such as brochures will be prepared to disseminate the content of the master plan on flood control and properly inform the target stakeholders about it.

Formulation and update of flood hazard map for riverine, inland, and coastal with evacuation information

The updated maps will include estimation of inundation for riverine, inland, and coastal floods and will take into account worst-case scenario. It will also identify important infrastructural facilities (e.g., evacuation centers, hospitals, disaster response agencies, etc.) located in the inundation area.



Land use control along the proposed structural measures

The enforcement of land use regulations is necessary for the implementation of structural measures such as retarding basins and river widening.

Capacity enhancement project on riverine flood, rainwater drainage and coastal management in Davao

The implementation of a technical cooperation project for DPWH and City Engineering Office is a priority measure to address the limitations in the capacity of executing organizations.

DID YOU KNOW THAT...

Photo Credits: Davao City DRRM Office

- **78% of the 182** barangays comprising Davao City are highly susceptible to floods These barangays experience flood heights of **more than one (1) meter, which take place in over three (3) days.** [1]

- **Floods can potentially affect 1,625,154 persons**, who occupy parcels of residential areas that total to **8,600.07 hectares in Davao City.** [2]

- The **largest flood in recent years** in the Davao River Basin was caused by **Typhoon Vinta in December 2017**. It affected **21,768 families** which corresponds to **two-thirds of the total number of affected families** (30,503). Reported flooding incidents are concentrated in the **lower part of the Davao River Basin where the urbanized area is located**. Specifically, the areas that experienced inundation include the barangays of Ma-a, Tigatto, BRGY 2 and BRGY 5.[3]

- Based on the data of the CDRRMO, the **total monetary damage to Davao City resulting from the flood was estimated at about PhP 204 million: PhP 79 million for agricultural losses; PhP 9 million for animals/ livestock/poultry damages; and PhP 116 million pesos for infrastructure damage.** [4]

- The **highest water level** during Typhoon Vinta recorded by DPWH was about **5.0 m from ground level** at Jade Valley area.[5]

- The **most destructive flood in the Matina River Basin** was the flashflood that happened in **June 2011** causing the **death of 26 people in Matina Crossing** and **2 in Matina Pangi due to drowning.** The flood affected **2,307 families in Matina River Basin** and **497 families in Davao River Basin** (Ma-a Barangay).[6]

- The **January 2002 flood c**aused damage to more than **10,000 families** in the most downstream barangay of the **Talomo River Basin.** [7]

1 Davao City DRRM Plan 2020-2025

2 Ibid.

3 JICA, Oriental Consultants Global Co., Ltd, and Pacific Consultants Co. Ltd. (2021). Project for Master Plan and Feasibility Study on Flood Control and Drainage in Davao City Interim Report.

4 Ibid.

5 IIbid.

6 Ibid.

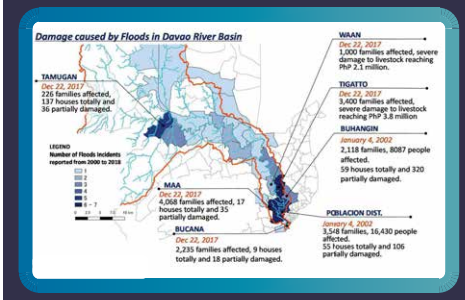
7 Ibid.

IEC material: Visayan version (Public awareness on flood control measures)

KINSA ANG LABING APEKTADO NGA POPULASYON?

Vinta ang nahimong hinungdan sa nahitabong **pinakadakong baha** sa Davao River basin. Nahitabo kini niadtong Disyembre tuig 2017. Naapektuhan sa maong baha ang **21,768 ka pamilya** 2/3 nga bahin sa kinatibuk-ang ihap sa naapektuhang pamilya (30,503).**

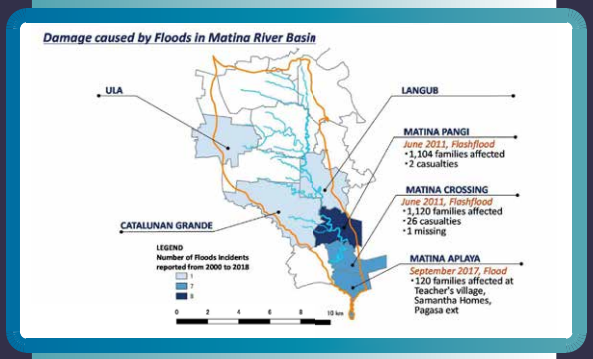
Ang mga gitaho nga pagbaha anaa sa **ubos nga bahin sa Davao River Basin, diin nahimutang ang urbanisadong bahin sa dakbayan** ilabi na ang **Brgy. Ma-a, Tigatto, Brgy. 2 ug Brgy 5.****



Ang baha niadtong **Enero 2022** naghatag og kadaut sa sobra **10,000 ka pamilya** nga lumulupyo sa mga barangay nga nahimutang sa ubos nga bahin sa Talomo River Basin. **

Nasayod ka ba?

78% sa 182 ka barangay nga naglangkob sa syudad sa Davao kay bahaonon. Ang maong mga barangay makasinati og baha nga moabot og **usa ka metro ang kataason** ug molungtad sa sulod sa kapin kon kulang tulo ka adlaw.*



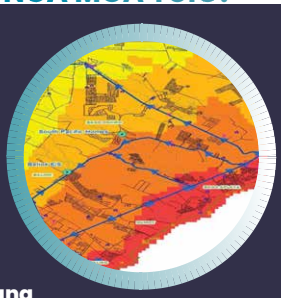
Mokabat sa 1,625,154 ka mga tao nga nahimutang sa mga parcels sa residential areas nga ang kinatibuk-ang sukod moabot sa **8,600.07 hectares** ang posibleng maapektuhan sa pagbaha dinhi sa dakbayan.*

Ang **pinaka nakadaut nga baha** sa **Matina River Basin** mao ang flashflood nga nahitabo niadtong **June 2011.** Nahimo kining hinungdan sa **kamatayon sa 26 ka tao** sa Matina Crossing ug duha ka tao sa Matina Pangi tungod sa pagka-anod nila. Naapektuhan sa maong pagbaha ang **2,307 ka pamilya** nga anaa nagpuyo sa Matina river basin ug **497 ka pamilya** nga nahimutang sa Davao River Basin (Barangay Ma-a).**

Sa milabay nga katuigan ang

KUNG MAGPADAYON KINI NGA DILI MASULBAD, UNSA ANG SITWASYON SA BAHA SA UMAABOT NGA MGA TUIG?

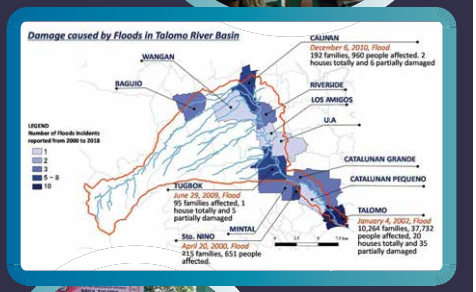
Baha atol sa bagyong Vinta tuig 2017**



Gibana-banaang mokabat sa 204 milyon ang kantidad sa nahimong danyos sa baha dinhi sa syudad:

- **79 M sa agrikultura**
- **9 M sa mga nagbuhi og mga hayop**
- **116 M sa imprastraktura**

5.0 m gikan sa lebel sa yuta sa Jade Valley, mao kini ang natala sa DPWH nga pinakataas nga lebel sa tubig atol sa bagyong Vinta.**



Sources:
*Davao City DRRM Plan 2020-2025

**JICA, Oriental Consultants Global Co., Ltd, and Pacific Consultants Co. Ltd. (2021). Project for Master Plan and Feasibility Study on Flood Control and Drainage in Davao City Interim Report.

Photo Credits: Davao City DRRM Office

Pamaagi sa paglikay/ pagpangandam sa baha

ALANG SA PANIMALAY

Sa wala pa ang baha

1. Limpyohi permi ang palibot. **Ayaw ilabay ang mga basura** sa mga agianan sa tubig sama sa suba, estero, kanal ug mga drainage.
2. **Himuang pamatasan ang hustong paglain-lain ug pagrecycle** sa mga basura sa panimalay.
3. **Anihon ang mga abot sa tanum** nga ana-a na sa hustong gulang ug sigurohon usab ang **seguridad sa mga binuhing hayop.** Ibutang sila sa mga luwas nga lugar. Alang sa mananagat ibutang ang mga bangka sa luwas nga lugar.

Samtang nagabaha

1. Pagpuyo sa sulod ug pagpabiling nahibalo sa mga panghitabo. Pagmonitor sa lakat sa panahon pinaagi sa pagpaminaw sa radyo, telebisyon ug uban pang mga pagpasidaan nga ihatag sa local nga awtoridad.
2. Pagpahigayon og **pre-emptive evacuation**.
3. **Palunga ang mga linya sa kuryente** sa inyong panimalay ug **siguruha nga nakalock** kini una mobakwit.
4. **Tanggala ang mga nakasaksak** na mga appliances aron malikayan ang electrical shock pagmabalik na ang kuryente.
5. **Tawag sa 911** kon nanginahanglan og tabang o serbisyo nga dunay kalambigitan sa pagresponde sa emerhensiya.
6. **Sunda ang physical distancing ug ubang health protokol** (sama sa pagsuot og facemask, paghugas sa kamot) kung anaa na sa evacuation centers.
7. **Magpundo sa tag-as nga lugar** samtang naghulat nga marespondehan.

- **Ayaw buhata:**
  - **Ayaw suwayi pagtabok sa baha** kon ang lebel sa tubig molampas sa imong tuhod ang katas-on.
  - **Ayaw suwayi og langoy o sakay og bangka** kon motabok sa dakong tubig sa kasapaan.
  - **Likayi ang paglakaw-lakaw sa tubig baha** samot na kung aduna kay samad sa tiilan nga bahin aron malikayan ang leptospirosis ug uban pang susama nga mga sakit.

Pagkahuman sa baha

1. Biya lamang sa evacuation area **kon moingon ang lokal nga awtoridad** nga luwas na nga mouli sa tagsa-tagsa ka panimalay.
2. **Magbinantayon sa mga posibleng peligro** pag-uli sa tagsa-tagsa ka panimalay sama na lamang sa pagbuto sa kuryente o gas explosion ug mga delikadong mananap sama sa bitin.
3. Iyabo ang mga tubig ulan nga nasalod sa mga lata, kaldero ug mga ligid aron **dili mapangitlogan sa mga lamok.**

- **Ayaw buhata:**
  - **Ayaw inom og tubig gikan sa gripo.** Pabukali kini aron **masigurong luwas kini imnon.**
  - **Ayaw usa gamita ang mga nangabasa nga butang sa balay nga nagagamit og gas o kuryente** hangtud wala pa kini masusi sa usa ka propesyonal aron masigurong luwas pa kini gamiton.

1. Angay kang masayod kung bahaonon ang inyong barangay.
2. Sayri usab ang mga duol nga mga lugar nga bahaonon ug dali nga modahili ang yuta.

3. Siguraduha nga ang tanang miyembro sa inyong pamuyo nakahibalo sa sistema o signal nga nagapasidaan sa pagbaha, luwas nga agianan paduloong sa bakwitanan, ug mga evacuation centers sulod sa barangay. Nasayod ka ba sa mga emergency alert signal sa syudad?

SIGNAL	PASABOT	BUHATON
Electronic Siren & Manual Bell		
Nagabalud-balud nga tonada sulod sa 3 ka minuto Padayon nga bagting sulod sa 3 ka minuto	Adunay posibleng umaabot nga katalagman sama sa tsunami, storm surge, kusog nga hangin ug pagbaha.	Bakwit nga malinawon sa mga gitudlong luwas nga evacuation area ug paminaw sa mga radio station/ alert text blast alang sa instruksyon.
Makanunayong tonada sulod sa 3 ka minuto Duha ka nagsunod nga bagting sulod sa 3 ka minuto	Humana ang tanang peligro, pagbansay o kalihukan.	Makabalik na sa normal nga mga kalihukan. Luwas na usab nga mouli sa tagsa-tagsa ka panimalay ang mga gipabakwit.
Makanunayong tonada sulod sa 30 segundo.	Gisulayan ang pagpatingog	Testing matag adlawng Martes alas 12 sa udto

4. Paghimo og plano sa pagpangandam sa pamilya. Naglangkod sa maong plano ang impormasyon sama sa lugar kung diin magtapok kung magkatibulaag ang miyembro sa pamilya, ug emergency contact details.
5. Ibutang ang mga importante nga dokumento (lakip ang digital nga bersyon niini), mga gamit sa balay ug uban pang kabtangan sa dili mabasa nga sudlanan o ibalhin sa tag-as nga spasyo.
6. Pag-andam og 72-hour Emergency Grab Kit alang sa matag miyembro sa pamilya.

ALANG SA KOMUNIDAD

Sa wala pa ang baha

1. Kanunay nga limpyohan ang drainage ug uban pang agianan sa tubig aron malikayan nga mabarado kini.

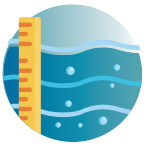
2. **Hugot nga sundon** ang mga balaod nga adunay kalambigitan sa kinaiyahan ug disaster risk reduction and management (sama sa Ecological solid waste management, Watershed Code, Storage and Use of Rainwater, Pre-emptive evacuation)

3. **Salmot sa mga kalihukan alang sa REFORESTATION** sama sa pagpananum og mga kahoy sa kabukiran ug kalamakan.

4. **Apil sa mga pagplano sa pagpangandam sa baha, aksyon ug pagbansay-bansay** sa barangay.

Samtang nagabaha

1. **Kanunay nga bantayan** ang mga marka sa baha ug ipakaylap ang kahimtang sa lebel sa tubig sa suba nga nagpalibot sa imong komunidad.



2. **Unaha pagpabakwit ang mga bulnerable nga grupo** sama sa mga bata, buntis, tiguwang ug adunay mga kakulian sa panlawas.

Pagkahuman sa baha

1. **Hawani ang kadalanan ug lain pang agianan** sa komunidad gikan sa mga tinumpag, basura ug uban pang mga nakababag dinhi.

2. **Ipahibalo sa mga awtoridad** ang mga nangatumba nga kahoy ug poste sa kuryente.

Kinahanglan kahibalo ka sa mga numerong angay makontak kung adunay emerhensya.

Alang sa pagresponde sa mga emerhensiya:
Central 911

Alang sa seguridad sa publiko:
Task Force Davao
0917 131 4333
0999 227 1111
(082) 224 0911

Davao City Police
0917 131 5333
0919 070 2222
(082) 285 0911

Alang sa mga reklamo, report ug mga sugyot:
Davao City Reports
0917 1312333
0919 072 2222

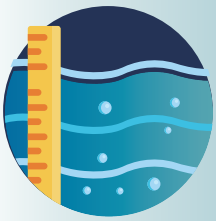
Sources

- Mines and Geosciences Bureau (MGB) IEC
- Inquirer.Net infographic
- Office of Civil Defense (OCD) infographic
- Davao City Disaster Risk Reduction and Management Plan 2020-2025
- Davao City Disaster Risk Reduction and Management Office (http://drrmo.davaocity.gov.ph/)
- Interim Report of Project for Master Plan and Feasibility Study on Flood Control and Drainage in Davao City

HINUNGDAN SA BAHA

Kusog nga ulan nga mohunong lamang kadali apan molungtad og pila ka adlaw

Overtapping sa mga dikes ug leeves

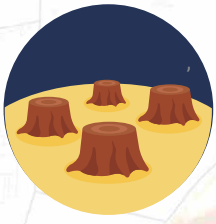


Kulang ang kapasidad sa kasapaan nga modala sa dakong dulhog sa tubig tungod sa mga binanlas nga mga materyales nga nagpamabaw niini

Kausaban sa taub sa kadagatan

Dili hustong paglabay ug pagdumala sa mga basura

Pagpamutol og mga kahoy

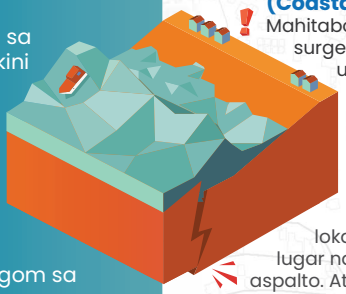


Source: PAGASA and MGB

Unsa ang baha?

- Mao kini ang pagtaas sa lebel sa tubig hangtud nga molapaw kini sa natural ug artipisyal nga mga utlanan niini nga mao ang hinungdan sa paglubog sa mga kasigbit niini nga lugar.

Source: Office of Civil Defense



- Ang mas paspas nga pagkatigom sa tubig (kasagaran tungod sa kusog nga ulan) kaysa sa pag-agas, pag-alisngaw o pagkatibulaag niini mao ang hinungdan nganung mahitabo ang pagbaha.

Source: Philippine Atmospheric, Geophysical and Astronomical Services Administration

Nganung delikado kini?

- Ang pagbaha mamahimong hinungdan sa kamatayon tungod sa pagkalumos, pagkaguba sa mga kabtangan, istraktura ug panginabuhian.
- Mamahimo usab kining hinungdan sa pagdaghan sa mga sakit, pagkadaut sa kinaiyahan ug pagbabag sa mga serbisyo sama sa elektrisidad ug komunikasyon.

Source: Mines and Geosciences Bureau

MGA KLASE SA PAGBAHA

Mailhan ang mga matang sa baha pinaagi sa nagkadaiyang butang sama sa lokasyon o lugar nga gibaha) ug sa gidugayon sa maong baha.

BAHA BASE SA LOKASYON:

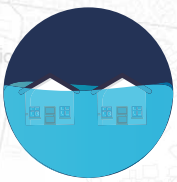
Baha sa Kasapaan (River Flooding)
Mahitabo kini kon ang kusog nga ulan mao ang hinungdan sa pag lapaw sa tubig sa kasapaan. Ang maong matang sa baha molungtad lamang sulod sa pila ka oras o adlaw depende sa kakusgon, sa kadaghanon sa tubig ulan ug sa kapasidad sa maong sapa.

Baha sa baybayon (Coastal Flooding)
Mahitabo kini tungod sa mga storm surges, pagtaub sa baybayon ug tsunamis. Mahitabo ang tsunami kon adunay linog nga nasinati sa kadagatan.

Pagbaha sa siyudad (Urban Flooding)
Mahitabo kini sa mga lokasyon diin kadaghanan sa lugar natabunan na sa bilding o aspalto. Atol sa kusog nga ulan dili na motuhop sa yuta ang tubig ug maipon kini sa ibabaw nga bahin. Hinungdan usab sa pagbaha sa kasyudaran ang limitado nga kapasidad sa drainage system, mga kanal, nga modawat sa tubig nga gikan sa kusog nga ulan.

MATANG SA BAHA BASE SA GIDUGAYON:

Flash flooding
Resulta kini sa kusog nga ulan sa mga lugar nga adunay gagmay nga gawsanan sa tubig. Grabe ang kadaut nga mahatag sa flashflood. Mahitabo kini kasagaran sa mga bukiron nga lugar nga adunay mga sapa apan gagmay ang agianan sa tubig. Kalit kining mahitabo. Maong gamay lamang ang mamahimong pagpasidaan.



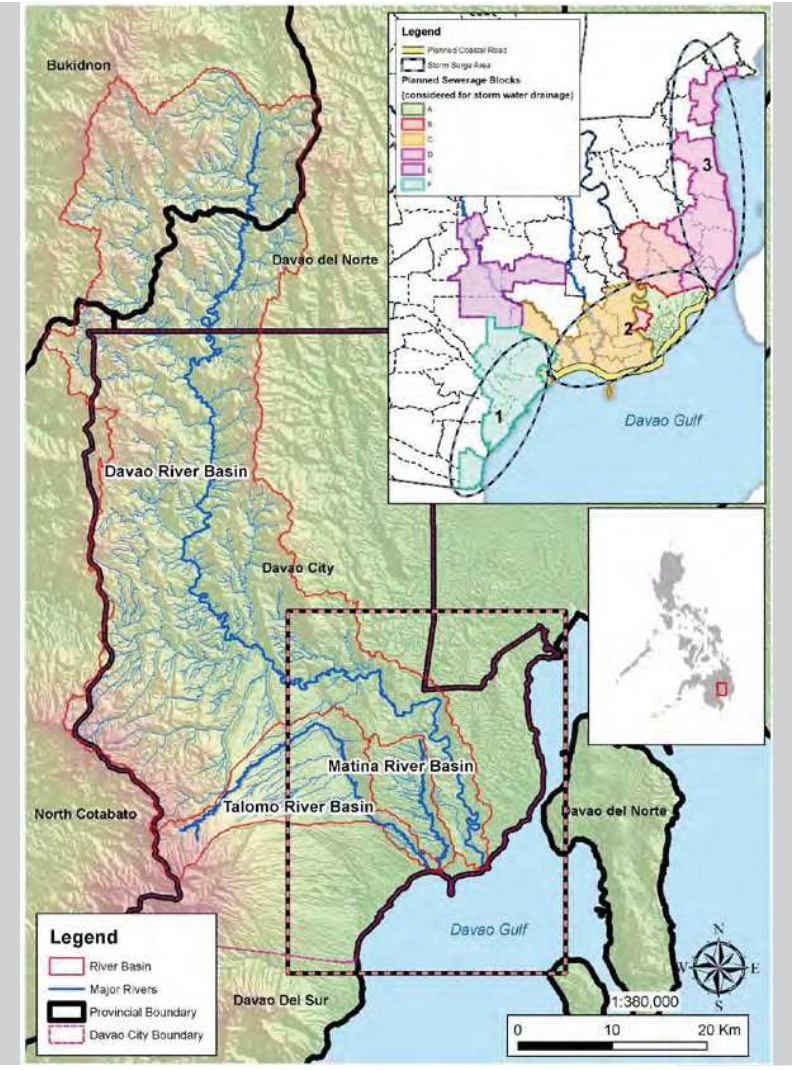
Sheet flooding
Resulta kini sa pagbanaw sa mabaw nga tubig nga midagayday sa lapad nga lugar. Mamahimo usab nga hinungdan sa sheet flooding ang pagbanaw sa tubig sa kasapaan tungod sa dili igo ang kapasidad niini, hinungdan nga mobaha ang mga kasigbit niini nga lugar.

Source: PAGASA

IEC material: Visayan version (Pamphlet introducing the flood control Master Plan)

PROJECT FOR THE MASTER PLAN & FEASIBILITY STUDY ON FLOOD CONTROL AND DRAINAGE IN DAVAO CITY

Tumong sa maong proyekto nga magpatuman og mga lakang sa pagpugong sa baha aron mapakunhod ang kadaut ug danyos tungod niini nga nasinati sa dakbayan, kini pinaagi sa pagbuhat og Master Plan alang sa Davao, Matina ug Talomo River Basins ug pagpahigayon og Feasibility Study sa mga kinahanglan dalion ug/o prayoridad nga



Ang kinatibuk-ang lugar:
2, 200 sq/km
km gilangkuban sa urbanisadong lugar sa dakbayan, Davao River Basin, Matina River Basin ug Talomo River Basin.

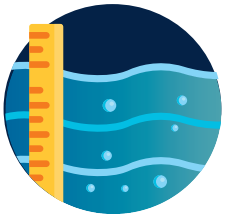
Gidugayon:
2023 to 2032
Hamubo nga Panahon

2033 to 2045
Katunga-/Taas nga Panahon

Ang nagpatuman nga mga ahensya mao ang ***Department of Public Works and Highways (DPWH)*** UPMO-FCMC, regional offive ug district engineering office, ug ang ***City Government of Davao.***

COMPONENTS

Mga kabahin:

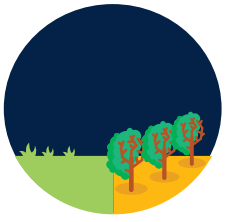


Riverine Flood Control

aron mapakunhod ang grabeng kadaot ug kapildihan tungod sa pagbaha sa suba. d

Storm Water Drainage Improvement

aron mapakunhod ang grabeng kadaot ug kapildihan tungod sa baha gumikan sa bagyo ug pagsiguro nga mapadayon ang gimbuhaton sa syudad isip sentro sa rehiyon.



Coastal Disaster Countermeasures

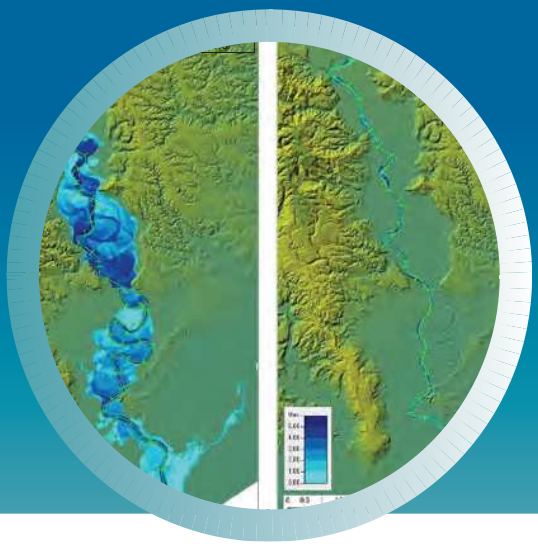
aron mapakunhod ang kadaut tungod sa baha sa mga baybayon ug sigurohon nga husto ang paggamit sa coastal area sumala sa angay niining gamit.

Straktural nga pamaagi

Baha sa 3 ka sapa (Riverine flood)	Baha sa syudad (Inland flood)	Coastal Conservation ug Storm Surge (Coastal flood)
Pagkalot Davao River Talomo River	**Pag-instalar og Retarding Basin** Drainage Areas: Agdao, Jerome, Mamay Creek, Sasa Creek, Emars, Shanghai, Maa1, Maa2 Maa1 Drainage Area Maa2 Drainage Area	**2023** **Back Levee (Dike: Pig-ot / Lapad)** Central area
Cutoff Work Davao River Matina River Talomo River	**Pagpalambo sa:** **Lower Channel -** Agdao, Jerome **Upper Creek -**Mamay Creek **Channel -** Sasa Creek, Shanghai, Maa1, Maa2	
Retarding Ponds Davao River (3) Matina River (12) Talomo River (3)	**Installation of Bypass Channel** Sasa Creek, Emars, Shanghai	
Pagpalapad sa sapa Davao River Matina River Talomo River	**Pagpalambo sa agianan** Roxas Drainage Area	**2032**
Retarding Ponds Davao River (5)	**Pag-instalar og River Basin** Drainage Areas: Agdao, Jerome, Mamay Creek, Sasa Creek, Maa1, Maa2	**Dike** Norte nga bahin (Lapad) Habagatanang bahin area (Narrow)
Bungbong sa baha Matina River Talomo River	**Pag-instalar og Bypass channel** Roxas, Mamay Creek	
	Pag-installar og Under-gounds Diversion Channel Maa2	**2045**

HAMUBO NGA PANAHON

KATUNGA/TAAS NGA PANAHON



RIVERINE FLOOD CONTROL MASTER PLAN IN DAVAO RIVER (STRAKTURAL NGA PAMAAGI)

	PAMAAGI SA HAMUBO NGA PANAHON	PAMAAGI SA KATUNGA/TAAS NGA PANAHON
Panahon sa pagpahigayon (Target ng Tuig)	2023-2032 (2032)	2033-2045 (2045)
Lebel sa Desinyo	5-10 year scale flood	100 year scale flood
Design Discharge	1,500m3/s	3,400m3/s
Gilangkubang bahin	Gikan sa baba sa sapa hangtud 23 km	Gikan sa baba sa sapa hangtud 23 km
Pamaagi	Dredging (Gikan sa baba sa sapa hangtud 23 km) Cut-off works Pag-installar og retarding ponds	River widening (Gikan sa Bolton Bridge hangtud 14km) Pag-installar og retarding ponds
Kantidad sa proyekto	Php 10.54 billion	Php 33.90 billion (apil na ang pamaaging ipahigayon sa hamubong panahon)
Economic Evaluation (EIRR)	18.54%	15.83% (apil na ang pamaaging ipahigayon sa hamubong panahon)
Economic Evaluation (ENPV) (Discount rate: 10%)	Php 18.40 billion	Php 17.31 billion (apil na ang pamaaging ipahigayon sa hamubong panahon)
Economic Evaluation (B/C) (Discount rate: 10%)	2.042	1.516 (apil na ang pamaaging ipahigayon sa hamubong panahon)

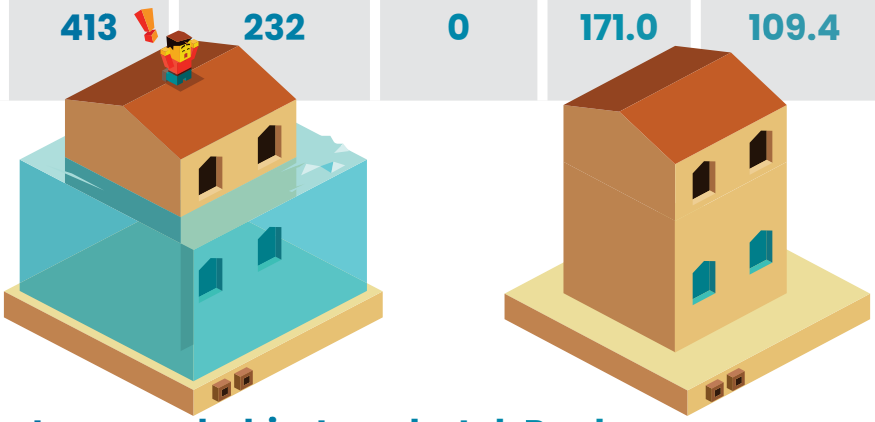
BENIPISYO

Paghuman sa pagpatuman sa short-term ug mid-long term nga mga pamaagi, ang mga bahin nga milangkob sa Davao river magdahum nga mas mahimong luwas sulod sa "100-year scale flood" bisan pa man sa epekto sa pagkausab sa atong Klima.

KINATIBUK-ANG KANTIDAD

PhP 33.90 billion Itipo ang hamubo nga panahon ug katunga-/ taas nga panahon

FLOODSCALE	MABAHAANG BAHIN (ha) >0.10m gilawmon sa baha			IHAP SA MGA MABAHAANG BILDING (1= 100 buildings) >0.10m gilawmon sa baha		
	KASAMTANGANG KAHIMTANG	HUMAN SA MGA PAMAAGING MAIPATUMAN SULOD SA MOBONG TERMINO	HUMAN SA MGA PAMAAGING MAIPATUMAN SULOD SA KATUNGA-TAAS NGA TERMINO	KASAMTANGANG KAHIMTANG	HUMAN SA MGA PAMAAGING MAIPATUMAN SULOD SA MOBONG TERMINO	HUMAN SA MGA PAMAAGING MAIPATUMAN SULOD SA KATUNGA-TAAS NGA TERMINO
100 year	624	571	0	260.6	253.3	0
50 year	573	508	0	246.0	228.1	0
25 year	500	418	0	211.5	186.3	0
10 year	413	232	0	171.0	109.4	0



Kasamtangang kahimtang batok Paghuman sa pagpatuman

Dili Straktural nga mga pamaagi

2023

- Pagtagna ug pagpasidaan sa baha
- Pagtipig sa kalasangan ug mga bakhaw.
- Pagmintinar sa paglimpyo sa mga drainage channel, kasapaan ug baybayon
- Pagplano sa pagbakwit
- Kontrol sa paggamit sa yuta
- Pagpahigayon og kalihukan alang sa pagpahibalo
- Pagkontrol sa tubig pinaagi sa onsite storage ug permeable pavement system.

2045

MGA PRAYORIDAD NGA STRAKTURAL NGA PAMAAGI SA PAGPUGONG SA BAHA SA DAVAO RIVER

River Dredging

Motanggal kini sa mga linugdang ug mga debris gikan sa ilawom sa Davao river aron mabalik ang tinuod nga kalawom niini, ug aron mapalambo ang kapasidad sa dagan sa tubig, subay niana mapaubos ang risgo sa baha.

Cut-off work

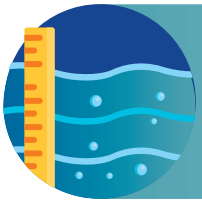
mopasiugda sa pagpagawas sa tubig baha ug dugang pa sa kasamtangan agianan sa sapa. (likuon nga mga bahin) .

Retarding Ponds

pagkubkob sa lugar aron mahimo pundohanan sa tubig sulod sa limitadog panahon ang iinstalar sa mga kritikal nga bahin sa Davao river aron maprotktahan batok sa baha ug erosion sa ubos.

DILI STRAKTURAL NGA PAMAAGI

Ang dili straktural nga pamaagi sa masterplan maglangkob sa dakbayan sa Davao apil ang Davao River, Talomo River ug Matina River iguon niini ang riverine flooding, inland flooding ug storm surge.



Pag-instalar og dugang water level gauges

Ang pag-instalar og water level gauges maoy mopadali sa pagpakaylap sa sayong paghatag og pahimangno sa komunidad.

Pagpahimutang og pahimangno sa lebel sa tubig sa Davao River katugbang sa pinakaulahing kahimtang sa sapa ug sa katilingban

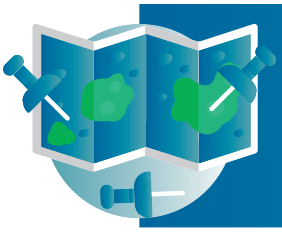
Pagabuhaton ang pagsusi sa Pasidaan sa lebel sa tubig sa mga water level gauges nga nakainstalar sa mga tulay aron malikayan nga masipyat sa mga pasidaan.

Pagbuhat og mga materyales sa pagpahibalo sa mga gisugyot nga stratural ug dili-straktural nga pamaagi

Magbuhat og mga materyales sama sa brosyur aron maipakaylap ang sulod sa master plan sa pagpugong sa baha aron hustong maipahibalo ang mga stakeholders mahitungod niini.

Pagbuhat ug pag-update sa flood hazard map alang sa kasapaan, kayutaan ug mga bayabayon inubanan sa mga impormasyon mahitungod sa pagbakwit

Apil sa pagbansay sa mga mapa ang pagbana-bana sa baha sa kasapaan, kayutaan ug mga baybayon, ikonsiderar niini ang labing pait nga mga kahimtang: Ilhon usab niini ang mga importanteng imprastraktura (sama sa mga evacuation centers, mga hospital, mga ahensya nga nagaresponde sa emerhensiya) nga nahimutang sa bahaonon nga lugar.



Pagkontrol sa Gamit sa yuta nga nahisubay sa gisugyot nga straktural nga mga pamaagi

Kinahanglang ang pagpatuman sa mga regulasyon sa paggamit sa yuta alang sa pagpahigayon sa straktural nga mga pamaagi sama sa mga retarding basin ug pagpalapad sa sapa.

Pagpausbaw sa kapasidad sa mga proyekto alang sa baha sa kasapaan, drainage alang sa tubig ulan ug pagdumala sa baybayon sa dakbayan

Pagpahigayon og proyekto alang sa pakighiusa nga teknikal alang sa DPWH, CEO us aka prayoridad nga pamaagi aron mabansay ang limitasyon sa kapasidad sa mga organisasyon nga magpatuman sa proyekto.

KAHIBALO KA BA NGA...

Photo Credits: Davao City DRRM Office

- **78% of the 182** ka barangay nga naglangkob sa syudad sa Davao kay bahaonon. Ang maong mga barangay makasinati og baha nga **moabot og usa ka metro ang kataason ug molungtad sa sulod sa kapin kon kulang tulo ka adlaw.**[1]

- **Mokabat sa 1,625,154 ka tao** nga nahimutang sa mga parcela sa residential areas nga mokabat sa **8,600.07 hectares dinhi sa dakbayan ang posibleng maapektuhan sa pagbaha.**[2]

- Sa milabay nga katuigan ang **Bagyong Vinta** ang nahimong hinungdan sa **nahitabong pinakadakong baha sa Davao River Basin**. Nahitabo kini niadtong Disyembre tuig 2017. Naapektuhan sa maong baha ang **21,768 ka pamilya**, **2/3 nga bahin sa kinatibuk-ang ihap sa naapektuhang pamilya** (30,503). Ang mga gitaho nga pagbaha anaa sa **ubos nga bahin sa Davao River Basin,** diin nahimutang ang urbanisadong bahin sa dakbayan. Apil sa mga barangay nga nakasinati sa pagbaha ang barangay Ma-a, Tigatto, Brgy 2 ug Brgy 5. [3]

- Base sa datus sa CDRRMO, gibabanaang **mikabat sa Php 204 milyon ang kinatibuk-ang danyos sa baha dinhi sa dakbayan: Php 79 M ang nalugi sa agrikultura; Php 9M sa mga binuhing kahayupan; Php 116 M ang kantidad sa nadaut nga imprastraktura.**[4]

- **5.0 m gikan sa lebel sa yuta** sa Jade Valley, mao kini ang natala sa DPWH nga **pinakataas nga lebel sa tubig** atol sa bagyong Vinta.[5]

- Ang **pinaka nakadaut nga baha sa Matina River Basin** mao ang flashflood nga nahitabo niadtong **June 2011.** Nahimo kining hinungdan sa **kamatayon sa 26 ka tao sa Matina Crossing** ug **duha ka tao sa Matina Pangi tungod sa pagka-anod.** Naapektuhan sa maong pagbaha ang **2,307 ka pamilya nga lumulupyo sa Matina river** basin ug 497 **ka pamilya nga nahimutang sa Davao River Basin** (Barangay Ma-a).[6]

- Ang **baha niadtong Enero 2022** naghatag og kadaut sa sobra **10,000 ka pamilya** nga lumulupyo sa mga barangay nga nahimutang sa ubos nga bahin sa **Talomo River Basin.**[7]

1 Davao City DRRM Plan 2020-2025

2 Ibid.

3 JICA, Oriental Consultants Global Co., Ltd, and Pacific Consultants Co. Ltd. (2021). Project for Master Plan and Feasibility Study on Flood Control and Drainage in Davao City Interim Report.

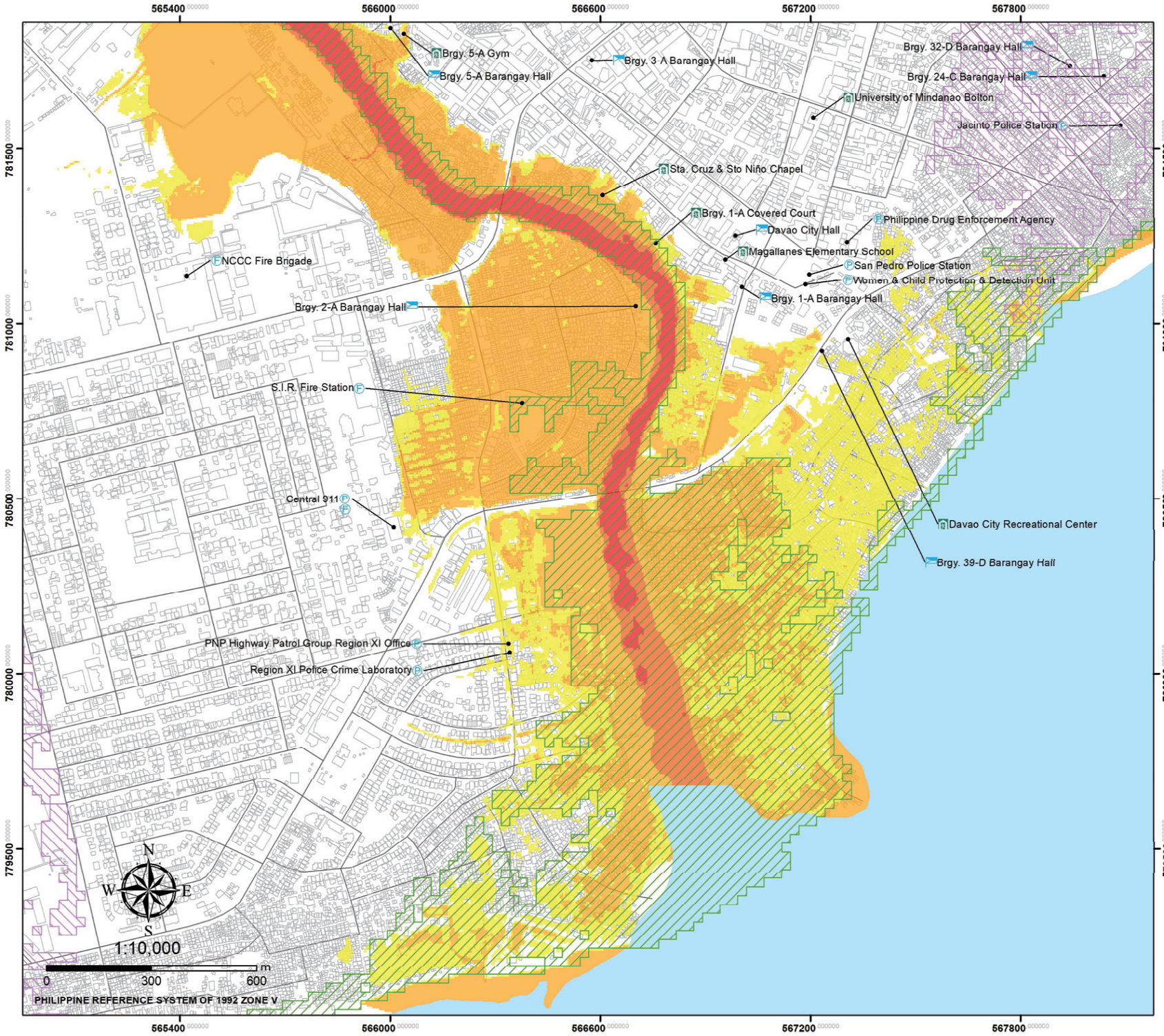
4 Ibid.

5 IIbid.

6 Ibid.

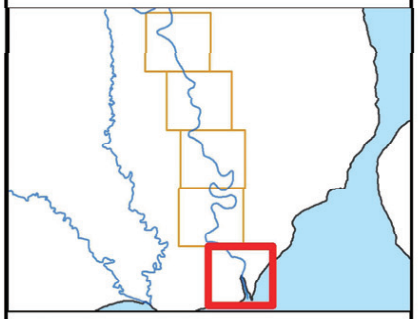
7 Ibid.

Flood hazard map integrating riverine flood, inland flood, storm surge and evacuation information



Riverine Flood Hazard Map (Davao River)

This hazard map shows inundation depth in case of riverine flood in Davao river based on Design Flood Discharge 3,400 m3/s for 100-year flood with climate change impact.



Legend

- Evacuation Center
- Town Hall
- Police Station
- Fire Station
- Inundation area due to 25-year inland flood
- Inundation area due to 100-year storm surge

Flood Risk (by depth)

- Low (0 - 0.5m)
- Medium (0.5 - 3m)
- High (3 - 5m)
- Very High (> 5m)

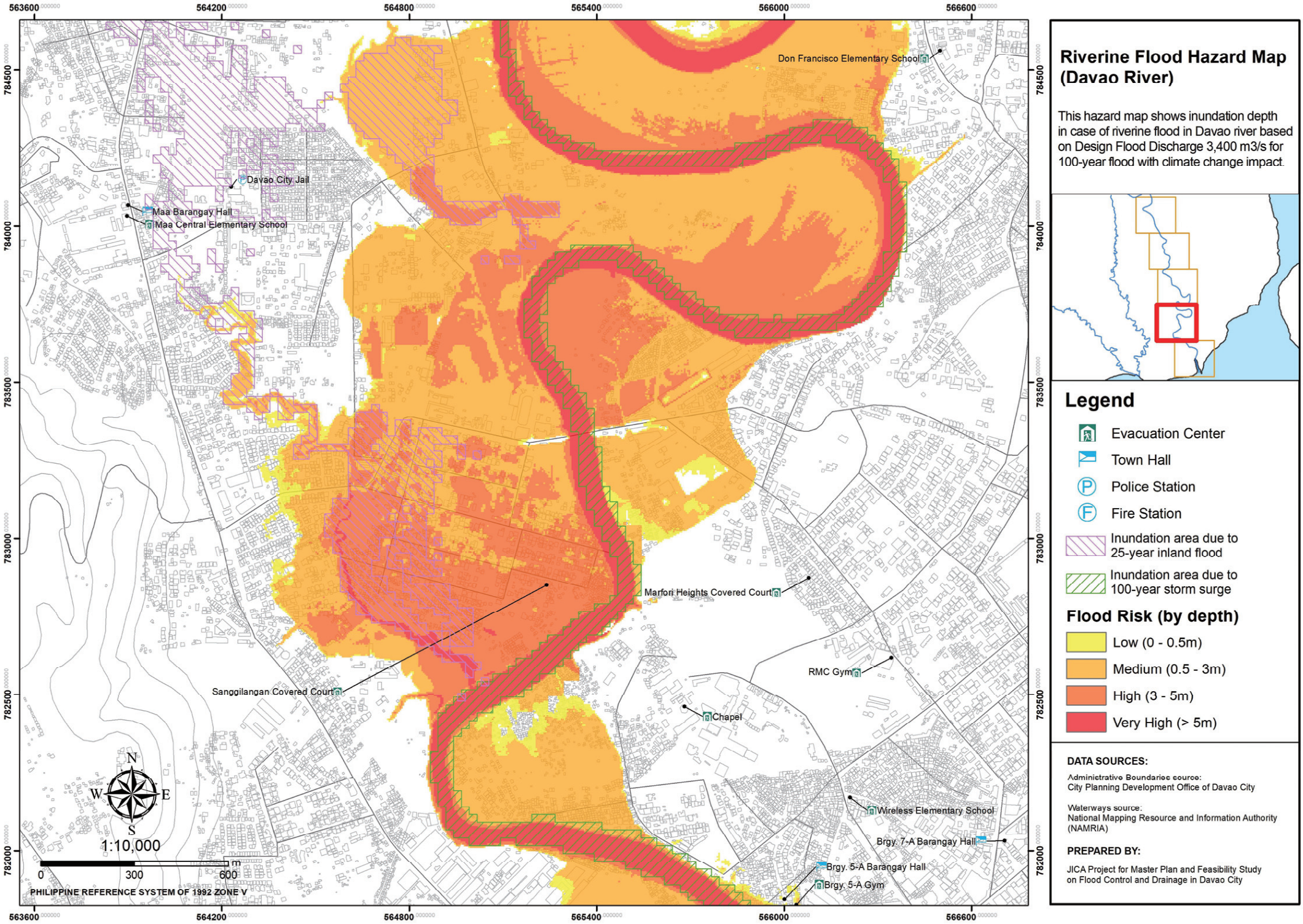
DATA SOURCES:

Administrative Boundaries source:
City Planning Development Office of Davao City

Waterways source:
National Mapping Resource and Information Authority (NAMRIA)

PREPARED BY:

JICA Project for Master Plan and Feasibility Study on Flood Control and Drainage in Davao City



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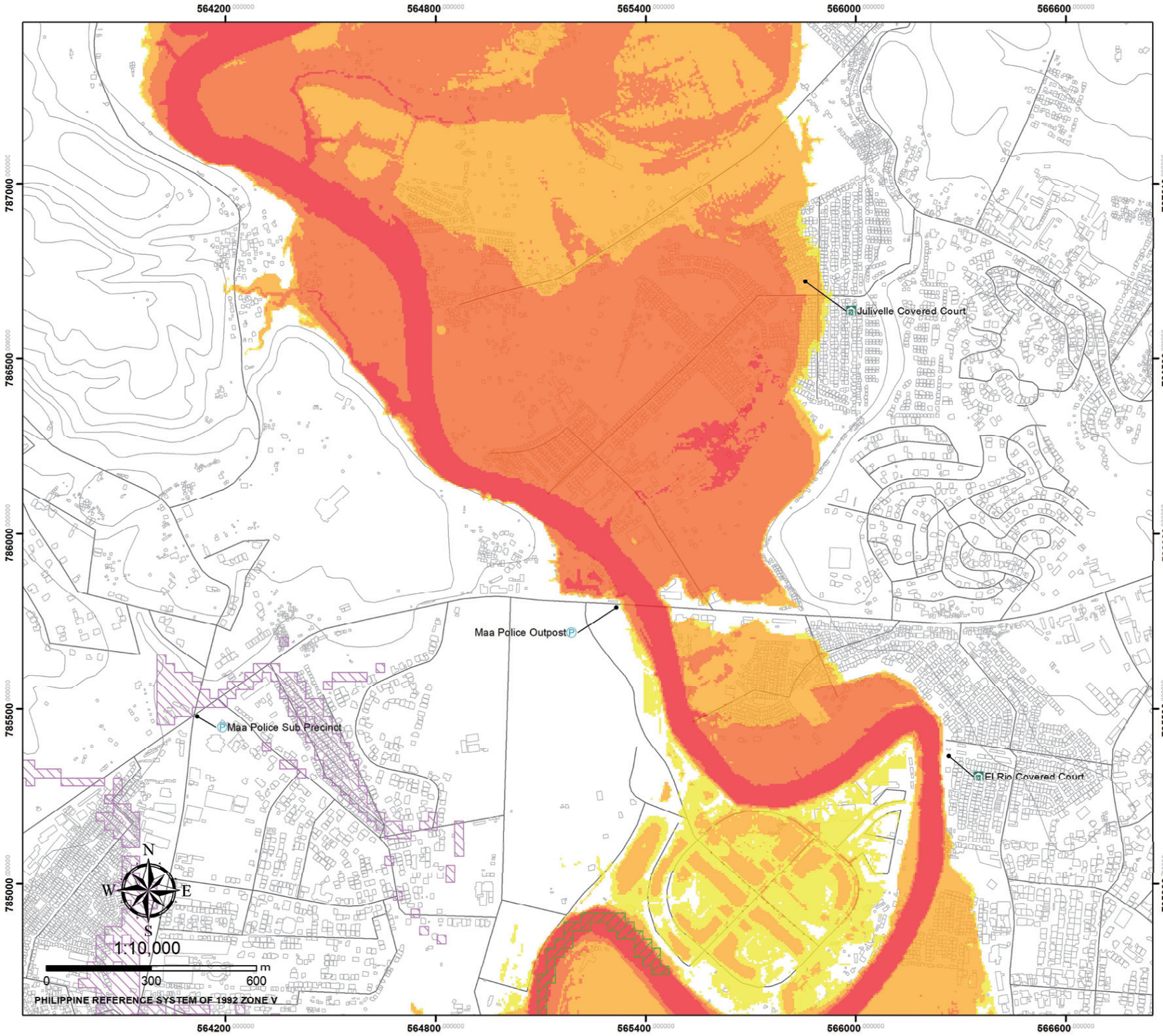

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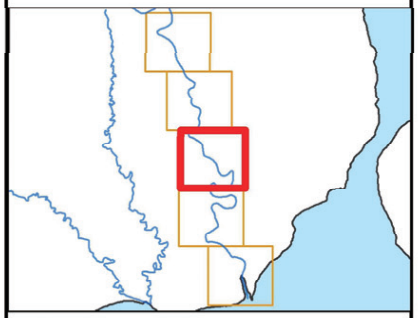

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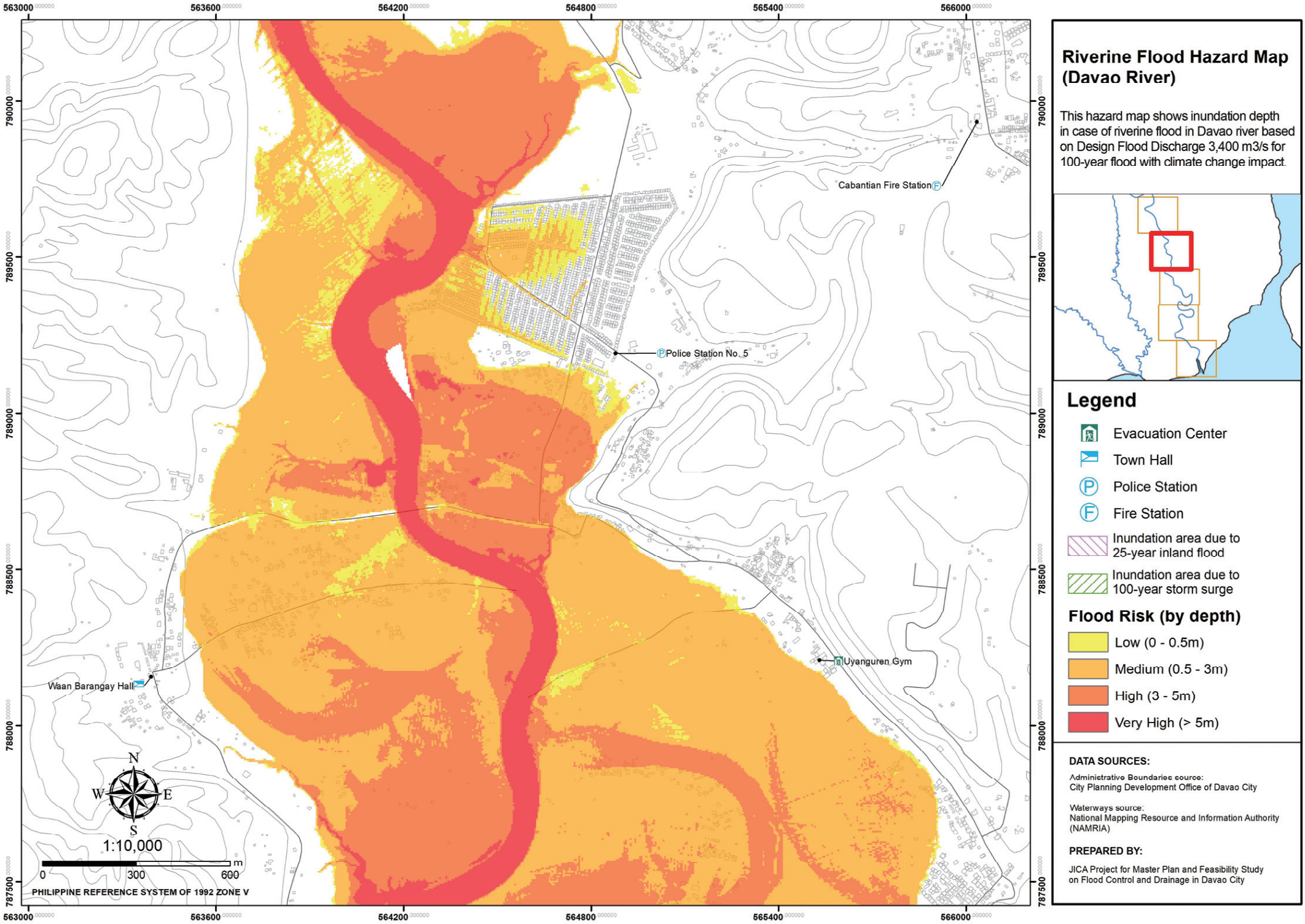

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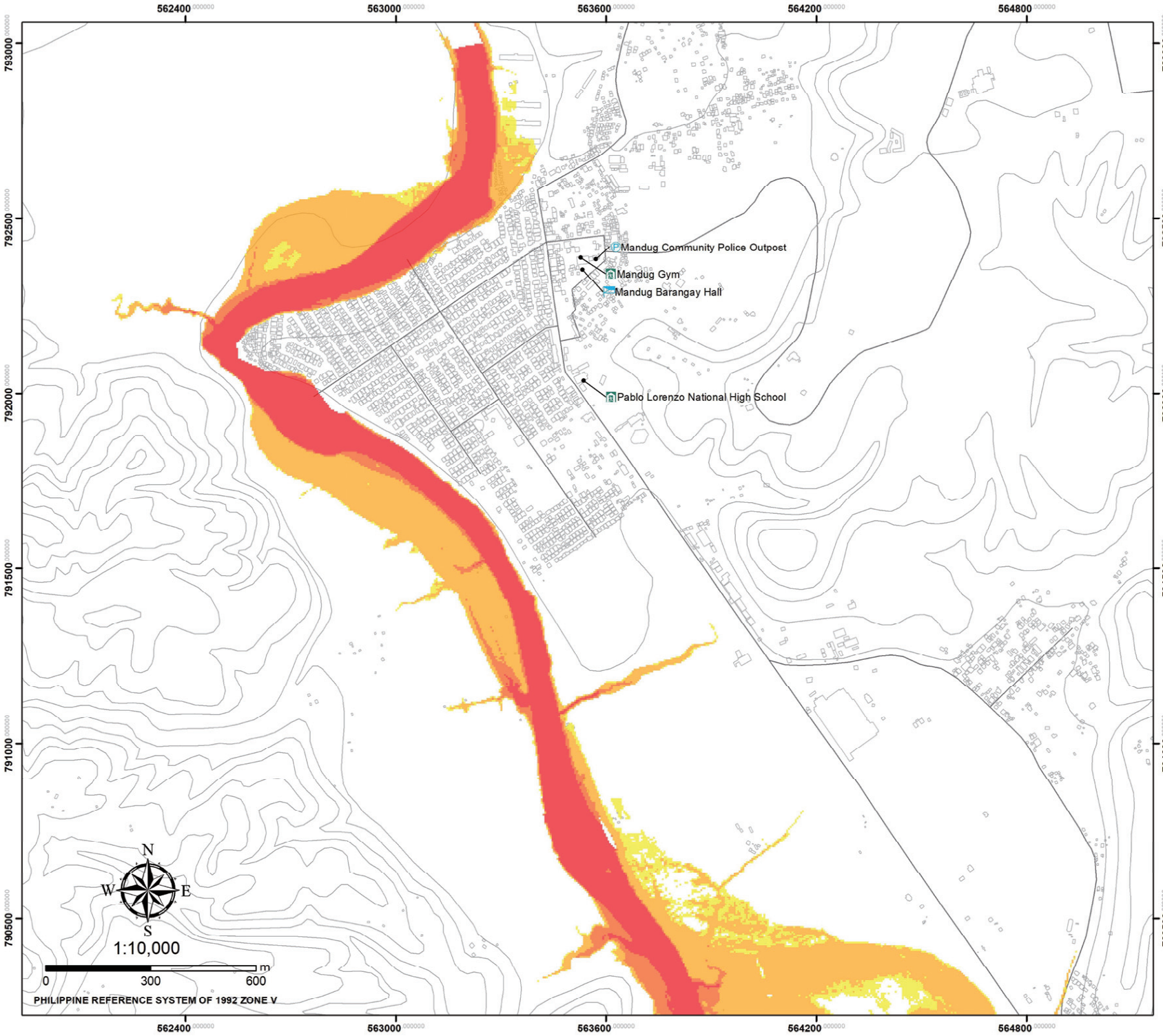

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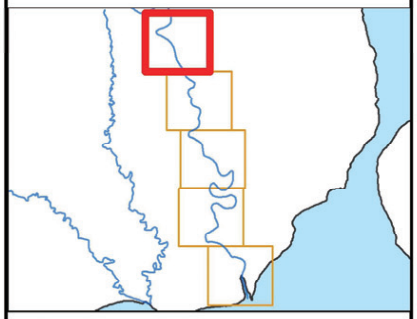

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