

**Republic of the Philippines**  
**Department of Public Works and Highways (DPWH)**

**Preparatory Survey**  
**for**  
**Central Mindanao**  
**High Standard Highway Project**  
**(Cagayan de Oro-Malaybalay section)**

**Final Report**  
**(Advanced Version)**

**June 2024**

**Japan International Cooperation Agency (JICA)**

**CTI Engineering International Co., Ltd.**  
**Dia Nippon Engineering Consultants Co., Ltd.**  
**Oriental Consultants Global Co., Ltd.**  
**Nippon Koei Co., Ltd.**

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**Exchange Rate**

May 2024

1PhP = 2.6961JPY

1USD = 57.7619PhP

1USD = 155.7344JPY

Central Bank of the Philippines

## **EXECUTIVE SUMMARY**

### **1. INTRODUCTION**

The Project aims to strengthen the connectivity between the two cities and to revitalize the economy in the surrounding areas by developing highway sections with high level of technical standards. The High Standard Highway Network Master Plan Development Project (Phase 2) being implemented by JICA has identified this Project as one of the highest priority projects that should be developed in the short term. The objectives of the Project are also in line with the Philippine Development Plan (2023-2028), which states that 'Building a sustainable, resilient and modern infrastructure systems will enable the Philippine economic transformation.'

To objectives of the Survey are to:

- Conduct a feasibility study to figure out the effectiveness of the Project as a Loan Project.
- Prepare documents and references necessary for ODA loan examination.
- Examine the applicability of Japanese technology in accordance with the provisions of Special Terms for Economic Partnership (STEP) for Section 1, Cagayan de Oro city only.
- Summarize and provide information about project components including engineering survey results, preliminary design, cost estimate, schedule, project implementation plan, organization, operation and maintenance system, and environmental and social considerations.

The Survey reviews the results of previous survey studies related to the Project and collects information necessary to develop the project components – objective, outline, cost, schedule, project implementation plan, application of Japanese technology, organization and system, operation and maintenance system, environmental and social considerations for the identified projects. Based on the survey results and gathered information, the Project will be examined by JICA and appraised if it is suitable as a Yen Loan Project.

Approximately 65 km long section from Cagayan de Oro to Malaybalay is targeted by this Survey. The Survey area covers the region marked in the location map in the beginning of the report. The Survey commenced in September 2020 and completed in June 2024.

### **2. NATIONAL AND REGIONAL DEVELOPMENT PLAN**

The Central Mindanao High Standard Highway Project (CDO-Malaybalay Section) was studied based on the various national, regional, and local development plans such as the National Development Plans – Philippine Development Plans (PDPs) 2017-2022 and 2023-2028, Mindanao Development Plans, Regional Development Plan and the different local development plans of Cagayan de Oro City, Tagoloan, Manolo Fortich, and Malaybalay City.

### **3. SOCIO-ECONOMIC CONDITION OF THE PROJECT AREA: REGION X – NORTHERN MINDANAO**

Region X (Northern Mindanao) is situated in the southern part of the Philippines and the northern part of Mindanao Island. The region has a total land area of 20,458.51 sq. km<sup>1</sup>. The majority of which are classified as forestlands comprising about 54% of the land area and the remaining 46% are alienable

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<sup>1</sup> 2015 Census of Population. Population, Land Area, and Population Density. Page xiv.

and disposable lands.<sup>2</sup> The region is composed of 5 major provinces, 2 highly urbanized cities, 7 component cities, 84 municipalities and 2,022 barangays.

The topography in the region is composed of a combination of flatlands, rolling hills, and mountainous terrains. The area is predominantly composed of cool highlands (52.8%) with elevations ranging from 500 to 2,000 meters above sea level. Around 12% of the total land area are warm lowlands with an elevation of lower than 100 meters above sea level, while the remaining 35.2% of the total land area are warm uplands with elevations ranging from 100 to 500 meters above sea level.

Northern Mindanao's population of 4,689,302 in 2015 comprised 19.4% of the total population of Mindanao and 4.6% of the country's total population. The region's population increased by about 391,979 from the year 2010 to 2015. The region's annual population growth rate (APGR) for the past four (4) census periods revealed a fluctuating yet declining trend from 2.23% in 1990-2000 to 1.68% in 2010-2015.

In 2019, the economy of the Region 10 grew by 5.9%<sup>3</sup>, a slower rate compared to the previous year. The service sector still had the biggest growth at 8.9% which accounted for 55.4% of the total economy, followed by the industry sector at 3.8% growth with 24.3% share, and lastly AHFF at 1.5% growth with 20.3% share.

#### **4. EXISTING AND PLANNED ROADS AND INFRASTRUCTURES**

Major existing plans for roads, major ports and airports are as follows;

##### <Road Development Plans>

- Proposed Central Mindanao Highway (CDO-Malaybalay Section) (This project)
- Sayre Highway
- Alae-PHIVIDEC Bypass Road (under construction)
- Butuan City-Cagayan de Oro City-Iligan City Road
- Manolo-Fortich- Libona-CDO Bypass/Alternate Road (road improvement)
- Cagayan de Oro Coastal Road
- Mindanao Connectivity Potential Project (MCP)
- Proposed Villanueva-Cagayan de Oro City-Opol Expressway

##### <Port Development Plans>

- Cagayan de Oro Port
- Mindanao Container Terminal (MCT)

##### <Airport Development Plans>

- Laguindingan Airport

#### **5. TRAFFIC STUDY AND FUTURE TRAFFIC DEMAND**

Sayre Highway is the only trunk road from Cagayan de Oro to Malaybalay City. Three kinds of traffic surveys were carried out to understand the travel characteristics within the study area – Traffic Count Survey, Travel Speed Survey, and Logistic Company Interview Survey. Results are as follows:

- The traffic volume along Sayre Highway from Cagayan de Oro to Manolo Fortich is approximately 9,000-10,000 vehicles/day. Along the Manolo Fortich to Malaybalay section, the traffic volume is approximately 6,000-6,500 vehicles/day.
- The traffic volume trend is observed to be different along the Cagayan de Oro to Manolo Fortich section, as compared to the section between Manolo Fortich and Malaybalay.

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<sup>2</sup> 2018 Northern Mindanao Socio-Economic Profile. *Based on 2011 Census.*

<sup>3</sup> Based on the constant 2018 prices.

- The survey also found out that a significant number of trucks pass through Sayre Highway. Trucks comprised approximately 40% of the traffic volume. Large trucks accounted for 25~30% of the traffic volume.
- Along zigzag road and urban sections, the travel speed decrease to approximately 15-20 km/h.
- Sayre Highway is being utilized for travel from Cagayan de Oro to Malaybalay, as well as for long trips from Cagayan de Oro to Davao (over 200 km in distance).
- Agricultural products account for approximately 40% of transported goods along Sayre Highway.
- Trucks with commodity weight of over 20 tons were also observed on Sayre Highway, so the overloaded trucks on the CMH should be controlled by DPWH and DOTC to protect pavements.

The target year for future traffic assignment is 2040, which is the same with the target year set in the High Standard Highway Masterplan - Phase 2.

Method of Traffic Assignment:

- Road Network: 2040 road network all proposed road in HSH Master Plan
- OD matrix: 2040, 4 types of vehicles (Car, Jeepney, Bus, Truck)
- Link Condition of CMH: 4-lane, toll road

Similarly, future traffic assignment is conducted under two scenarios:

- Scenario 1: Malaybalay City - Davao HSH section is completed
- Scenario 2: Malaybalay - Davao National Road is improved to 4-lanes

Estimated Traffic Volumes are as shown in Table 1 and 2:

**Table 1: Future Traffic Volume for Scenario 1 in 2040**

	Section 1	Section 2	Section 3	Section 4	Section 5	Average*
	CDO-Mambatangan	Mambatangan-Manolo Fortch	Manolo Fortch- Impasugong	Impasugong-Dalwangan	Dalwangan-Malaybaray	
CMH	21,700	19,400	18,300	16,000	16,100	18,300
Existing Road	5,500	7,700	4,200	4,900	4,300	5,400
Total	27,200	27,100	22,500	20,900	20,400	23,800

\*Note: Weighted average of traffic volume from Sections 1 to 5

Existing Road: Sayre Highway

Source: JICA Study Team

**Table 2: Future Traffic Volume for Scenario 2 in 2040**

	Section 1	Section 2	Section 3	Section 4	Section 5	Average*
	CDO-Mambatangan	Mambatangan-Manolo Fortch	Manolo Fortch- Impasugong	Impasugong-Dalwangan	Dalwangan-Malaybaray	
CMH	20,900	18,800	17,500	15,100	12,000	16,900
Existing Road	5,500	7,500	4,100	5,000	7,600	6,000
Total	26,400	26,300	21,600	20,100	19,600	22,900

\*Note: Weighted average of traffic volume from Sections 1 to 5

Existing Road: Sayre Highway

Source: JICA Study Team

## 6. NECESSITY OF THE PROJECT

To promote the development of an important transportation axis which shall eventually improve

transportation access between north-central and southern Mindanao is the objective of this project. Specifically, the project is to study the feasibility of the construction of a new road section from Cagayan de Oro City to Malaybalay City, Bukidnon. This is a part of the 300-km high standard road connecting Cagayan de Oro City and Davao City.

The necessity of the project is based from the following perspectives:

- For the realization of development plans,
- For the improvement of quality of life of the residents,
- For the improvement of regional development potentials,
- For solving current road traffic problems on an existing national road.

## **7. ALIGNMENT SELECTION**

The Project (Central Mindanao High Standard Highway Project) is identified as one of the high priority projects and should be developed and realized in the short term. According to HSH-MP2, for High Standard Highway Class-1, requires the design speed of 80 km/h or more, the vertical gradient of 5% or less. Further, the radius of curvature should be more than 252 m. These are among the basic requirements to be applied to the Project.

To select the most appropriate route, the following conditions are essentially considered;

- Bridge type and location should be determined considering cost-effectiveness.
- Bridge length necessary for crossing V-shaped deep valley should be set in a way of being cost-effectiveness and structural stability.
- Structural components like high soil embankment and deep cutting section requiring large-scale earth work should be reduced as much as possible, considering from the viewpoint of cost-effectiveness and adverse environmental impact minimization.
- As a general rule, environmental protection and indigenous peoples' residential areas should be preserved with priority; and an alignment should avoid to pass through the areas covered by Certificate of Ancestral Domain Titles (CADTs) and Key Biodiversity Areas (KBAs).
- The number of houses to be relocated should be minimized.
- Urban areas accommodating public facilities, like schools and religious structures should be protected and not be interfered with the alignment, as much as possible.
- Accessibility and connection to the Cagayan de Oro Container Terminal should be consistently considered.

In selecting the alignment, the interchange locations were first considered based on the following criteria.

- The interchange should be located near the center of the city/municipality (Tagoloan; Manolo Fortrich; Impasug-ong; Sumilao; and City of Malaybalay).
- The interchanges in mountainous areas should be placed at an average intervals of 10-15 km as per Japan standard (No standard for interchange intervals in the Philippines).

After the identification of the location of the interchanges, the alignment was divided into five (5) sections - each Section starting and ending at the interchange location.

There are three (3) alignments studied by the JICA team. The evaluation criteria are established for the quantitative and qualitative assessment for the alignment selection. Table 3 summarized the evaluation results.

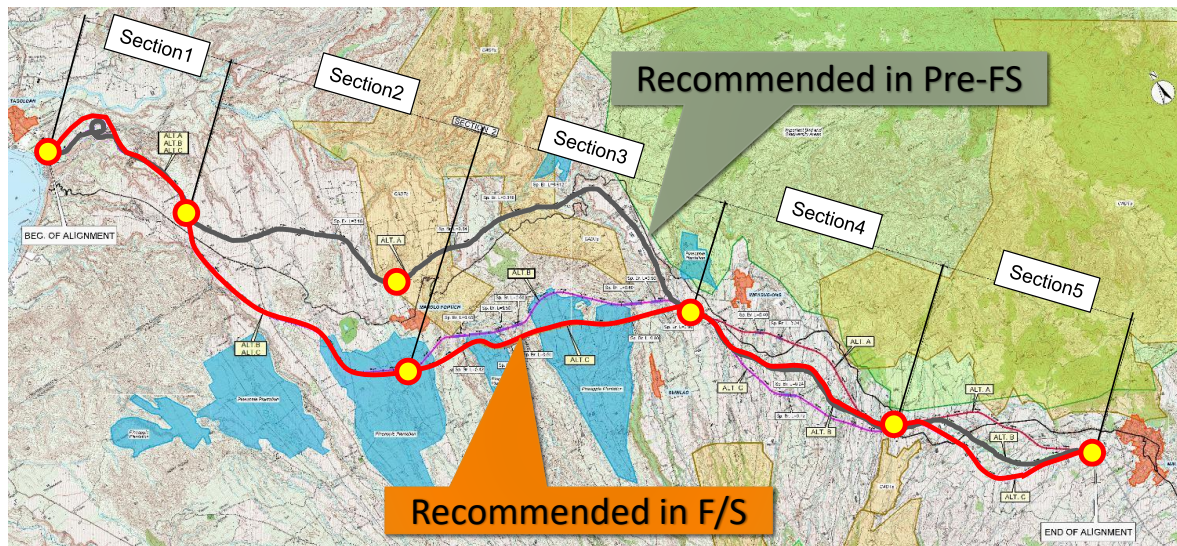
**Table 3: Summary of Alignment Study Result**

Criteria	Score	Section-1			Section-2 and 3		
		S1-ALT.A	S1-ALT.B	S1-ALT.C	S2 3-ALT.A	S2 3-ALT.B	S2 3-ALT.C
Road	10.0	<b>5.0</b>	5.5	3.0	<b>8.5</b>	8.0	See Section 7.6.3
Traffic	10.0	<b>10.0</b>	10.0	10.0	<b>10.0</b>	9.8	
PTJ Cost	35.0	<b>35.0</b>	30.1	22.4	<b>30.9</b>	30.9	
Environmental	15.0	<b>8.5</b>	8.5	8.5	<b>10.2</b>	8.2	
Social	20.0	<b>16.0</b>	16.0	14.0	<b>9.5</b>	10.5	
Constructability	10.0	<b>5.0</b>	5.0	2.0	<b>0.0</b>	0.0	
<b>Total</b>	100.0	<b>79.5</b>	75.1	59.9	<b>69.1</b>	67.4	
Recommendation		<b>O</b>			<b>O</b>		

Criteria	Score	Section-4			Section-5		
		S4-ALT.A	S4-ALT.B	S4-ALT.C	S5-ALT.A	S5-ALT.B	S5-ALT.C
Road	10.0	<b>9.0</b>	9.0	8.5	<b>8.5</b>	8.5	9.0
Traffic	10.0	<b>10.0</b>	10.0	10.0	<b>9.6</b>	9.9	10.0
PTJ Cost	35.0	<b>35.0</b>	30.7	26.8	<b>35.0</b>	32.0	27.7
Environmental	15.0	<b>13.1</b>	9.0	13.3	<b>13.2</b>	14.5	12.7
Social	20.0	<b>12.0</b>	15.5	14.0	<b>16.5</b>	15.5	15.0
Constructability	10.0	<b>5.0</b>	5.0	2.0	<b>7.0</b>	5.0	3.0
<b>Total</b>	100.0	<b>84.1</b>	79.2	74.6	<b>89.8</b>	85.4	77.4
Recommendation		<b>O</b>			<b>O</b>		

Source: JICA Study Team

The selected route under this F/S has a total length of 64.7 km.



Source: JICA Study Team

**Figure 2: Recommended Alignment**

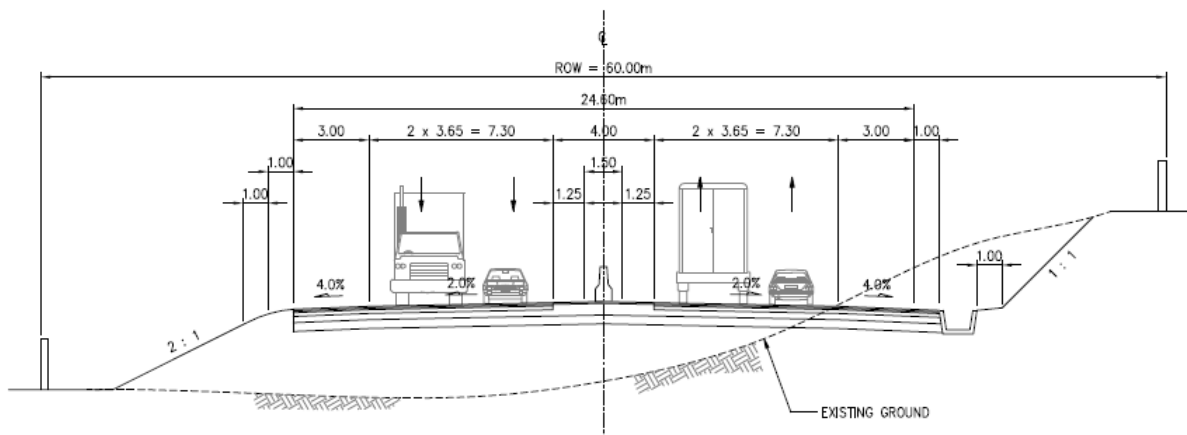
## 8. PRELIMINARY DESIGN

The design concept is to provide a high-standard highway that allows safe and efficient movement of traffic as HSH. The following standards were mainly used as references for the design of the Central Mindanao High Standard Highway:

- Design Guidelines, Criteria & Standards, Volume 4, Highway Design, 2015, DPWH
- A Policy on Geometric Design of Highways and Streets, AASHTO 2018, 7th Edition
- Japan Road Association, Road Structure Ordinance, 2019

Design criteria

Design Speed : 80 km/hour  
 No. of Lanes : 4  
 Lane Width : 3.65 m  
 Shoulder Width : 3.65 m  
     - Outer Shoulder: 3.00 m  
     - Inner Shoulder: 1.25 m  
 Median Strip Width : 4.0 m



**Figure 1: Cross-sectional Configuration (4 Lanes) Main HSH**

For the preliminary bridge design, results are as shown in Table 4.

**Table 4: Results of Basic Design of Bridges (Main Line)**

Road Section Bridge Type	Number of Bridge, Bridge Length (Nos, [m])					Total Number of Bridges	Total Bridge Length (m)
	Section 1	Section 2	Section 3	Section 4	Section 5		
PSCG – AASHTO Girder	3 [970]	6 [1,665]	5 [815]	11 [2,340]	13 [2,795]	38	8,585
PC Box Girder				1 [246]		1	246
Steel Box Girder			1 [184]			1	184
CSB*1			2 [1,000]			2	1,000
Arch Bridge			1 [195]			1	195
Suspension Bridge			2 [1,834]			2	1,834
CSWB*2	2 [798]					2	798
<b>Total</b>	<b>5</b> <b>[1,768]</b>	<b>6</b> <b>[1,665]</b>	<b>11</b> <b>[4,028]</b>	<b>12</b> <b>[2,586]</b>	<b>13</b> <b>[2,795]</b>	<b>47</b>	<b>12,842</b>

\*1 : Cable Stayed Bridge

\*2 : Corrugated Steel-Web Girder

Source JICA Study Team

## 9. PROJECT COST ESTIMATE

The Project cost is composed of (1) Civil Work Cost (2) Engineering Service Cost, (3) Right-of-Way Acquisition Cost, (4) Administration Cost, and (5) Operation and Maintenance Cost.

**Table 5: Summary of Project Cost (Section1 to 5)**

Unit: Million Peso  
Price Level: 2022

Items		Section-1	Section-2	Section-3	Section-4	Section-5	Total
		(ODA Sec.)					
Civil Work (Base Cost)							
Engineering Service (Base Cost)							
ROW Acquisition Cost (Base Cost)							
Physical Contingency	Civil Work (10%)						
	Engineering Service (5%)						
	ROW Acquisition (10%)						
Administrative Cost (3.5% of Civil Work Cost)							
<b>Total</b>							

Source: JICA Study Team

## 10. ECONOMIC EVALUATION

Following three (3) economic evaluation indicators are calculated;

- Net Present Value (NPV)
- Benefit/Cost Ratio (CB; B/C)
- Economic Internal Rate of Return (EIRR)

Economic evaluation results based on Scenarios 1 and 2 are shown in Table 6 to 7;

**Table 6: Result of Economic Analysis for Scenario 1**

Toll/No-toll	Cases	Economic Value		
		EIRR	B/C	ENPV (Million PhP)
Tolled Road	Section 1 (4-lane)			
	Sections 2, 3, 4, 5 (4-lane)			
	Whole Section (4-lane)			
Non-tolled Road	Section 1 (4-lane)			
	Sections 2, 3, 4, 5 (4-lane)			
	Whole Section (4-lane)			

\*Social discount rate is 10.0%

Source: JICA Survey Team

**Table 7: Result of Economic Analysis for Scenario 2**

Toll/No-toll	Cases	Economic Value		
		EIRR	B/C	ENPV (Million PhP)
Tolled Road	Section 1 (4-lane)			
	Sections 2, 3, 4, 5 (4-lane)			
	Whole Section (4-lane)			
Non-tolled Road	Section 1 (4-lane)			
	Sections 2, 3, 4, 5 (4-lane)			
	Whole Section (4-lane)			

\*Social discount rate is 10.0%

Source: JICA Survey Team

## 11. ENVIRONMENTAL IMPACT ASSESSMENT

The EIA study involves the characterization of the environmental baseline conditions, identification and assessment of impacts, recommendation of mitigation and enhancement measures, and preparation of an environmental management plan (EMP) and environmental monitoring plan (EMoP).

The project proponent shall prepare and submit the EIS report to the Environmental Management Bureau (EMB) Office for review and approval. After review by the EMB Office, Environmental Compliance Certificate (ECC), Certificate of Non-Coverage (CNC) or Denial Letter will be issued. In the process of PEISS, public participation is required at the stages of scoping, EIA study, review/evaluation and monitoring.

The PEISS covers activities that have significant adverse impact to the environmental quality. Presidential Proclamation No. 2146 defines activities that are either Environmentally Critical Projects (ECPs) or located in Environmentally Critical Areas (ECAs) as within the scope of the PEISS.

**Table 8: Scoping Result of CMH**

No	Item	Selection Status	
		Pre-construction Stage /Construction Stage	Operation Stage
1	Air Quality	✓	✓
2	Water Quality	✓	
3	Waste	✓	
4	Soil Contamination	✓	
5	Noise and Vibration	✓	✓
6	Ground Subsidence		
7	Offensive Odor	✓	
8	Bottom Sediment	✓	
9	Protected Area		
10	Ecosystem	✓	✓
11	Hydrology	✓	✓
12	Topography and Geology	✓	✓
13	Land Acquisition and Resettlement	✓	
14	Poverty	✓	✓
15	Ethnic Minority and Indigenous People	✓	✓

No	Item	Selection Status	
		Pre-construction Stage /Construction Stage	Operation Stage
16	Local Economy such as Employment and Livelihood	✓	✓
17	Land Use and Usage of Local Resources	✓	✓
18	Water Usage	✓	
19	Existing Social Infrastructure and Services	✓	
20	Social Institutions such as Socially-related Capital and Decision-making Organizations	✓	✓
21	Misdistribution of Benefit and Damage		
22	Local Conflicts of Interest	✓	✓
23	Cultural Heritage		
24	Landscape	✓	✓
25	Gender	✓	✓
26	Children's Rights	✓	✓
27	Infectious Diseases such as HIV/AIDS	✓	✓
28	Labor Environment including Safety	✓	
29	Accident	✓	✓
30	Transboundary Impact and Climate Change	✓	✓

## 12. LAND ACQUISITION AND INVOLUNTARY RESETTLEMENT

Land acquisition required and the number of people/structures affected are shown in Table 9.

**Table 9: Land Acquisition/No. of Affected People**

No. of Barangays Traversed	27
Lands to be Acquired	3,943,800 m <sup>2</sup>
No. of Parcel of Land	352
Agricultural land to be Acquired	2,571,526 m <sup>2</sup>
No. of Structure Affected	298
Residential Structure	99
Residential/Commercial Structure	1
Commercial Structure	3
Institutional Structure	4
Community Structure	52
Other Structure	139
No. of Project Affected People	484
Project Affected Households	96

This is the project to construct 65 km of new road. Although the alignment with less social impact was selected through exploring alternatives, land acquisition and involuntary resettlement are inevitable.

### **13. GENDER AND DEVELOPMENT**

With the enactment of Republic Act 9710 or the Magna Carta of Women, the Department of Public Works and Highways (DPWH) has formulated the Gender and Development (GAD) Toolkit for Making Road Infrastructure Projects Gender Responsive in the effort to mainstream gender responsiveness in road infrastructure projects (DO48/2011). According to the GAD Toolkit, a Gender Assessment Report needs to be prepared during the feasibility study of a road project.

The GAD's scope of works for the Central Mindanao High Standard Project are: (1) Review of the existing GAD Plan prepared by DPWH, (2) Preparation of Draft GAD Plan for the Project, and (3) Gender Meetings.

### **14. INDIGENOUS PEOPLES PLAN**

The primary objective of the IPP is to ensure that the project activities will avoid adverse effects on indigenous communities and provide benefits in a culturally appropriate, gender-sensitive, and intergenerational inclusive way. The project will employ culturally appropriate and gender-sensitive consultation processes when engaging tribal leaders, indigenous communities, and IP representatives. The IPP specifies safeguard provisions to be monitored during project implementation to ensure that benefits are equally distributed. It also provides necessary guidance to guarantee culturally appropriate program implementation.

The Central Mindanao High Standard Highway Construction Project (CMHSHCP) traverses 27 barangays of four (4) municipalities and two (2) cities in the Provinces of Misamis Oriental and Bukidnon in Region 10 (Northern Mindanao). Among those administrative units, 2 Municipalities (7 barangays) are located within the area of the Mount Palaopao, Upper Mangima-Upper Kulaman Ancestral Domain (MPUMUKAD) which has not certified as a CADT.

The Mt. Palaopao Upper Mangima Tribal Communities (MPUMATRIC) is an Indigenous Peoples (IP) organization that assists the Higaonon-Talaandig Indigenous Cultural Communities in applying for the Certificate of Ancestral Domain Title (CADT) for MPUMUKAD. Organized on October 8, 2003, after a Mt. Palaopao Stakeholders Conference, it is an Indigenous Peoples Organization of the Talaandig - Higaonon communities of Municipalities of Manolo Fortich and Sumilao, Province of Bukidnon.

There are 22 confirmed Indigenous Peoples Project-Affected Families (IP PAFs) occupying land within the Right-of-Way (ROW) are categorized as follows: 15 Higaonon, 6 Talaandig, and 1 Bukidnon-Tagoloanon household, with each family having an average size of 5 members. All vulnerable IP PAFs are eligible for compensation and inclusion in the livelihood restoration program, which is part of either the Resettlement Action Plan (RAP) or the Indigenous Peoples Plan (IPP).

Of these 22 IP PAFs, 13 are slated for inclusion in the Indigenous Peoples Plan because they reside within the claimed ancestral domain. The RAP covers the remaining nine (9) IP PAFs, as they are identified as migrant IPs, and the National Commission on Indigenous Peoples (NCIP) has issued a Certificate of Non-Overlap for the areas where they live.

### **15. PROJECT IMPLEMENTATION PLAN**

Section 1 will be implemented by JICA ODA loan and Section 2 to 5 will be implemented by other doner's fund. Regarding Section 1, since the JICA loan will be implemented in two steps: Detailed Design and Construction/Construction Supervision, the procurement of consultants is also divided into two parts: Detailed Design and Tender Assistance /Construction Supervision.

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## 16. PROJECT EVALUATION

In order to enable project monitoring and evaluation on the basis of consistent indicators, operation and effect indications are introduced for ODA loan projects. Operation and effect indicators are basically equivalent to the outcome indicators and performance indicators used by the World Bank.

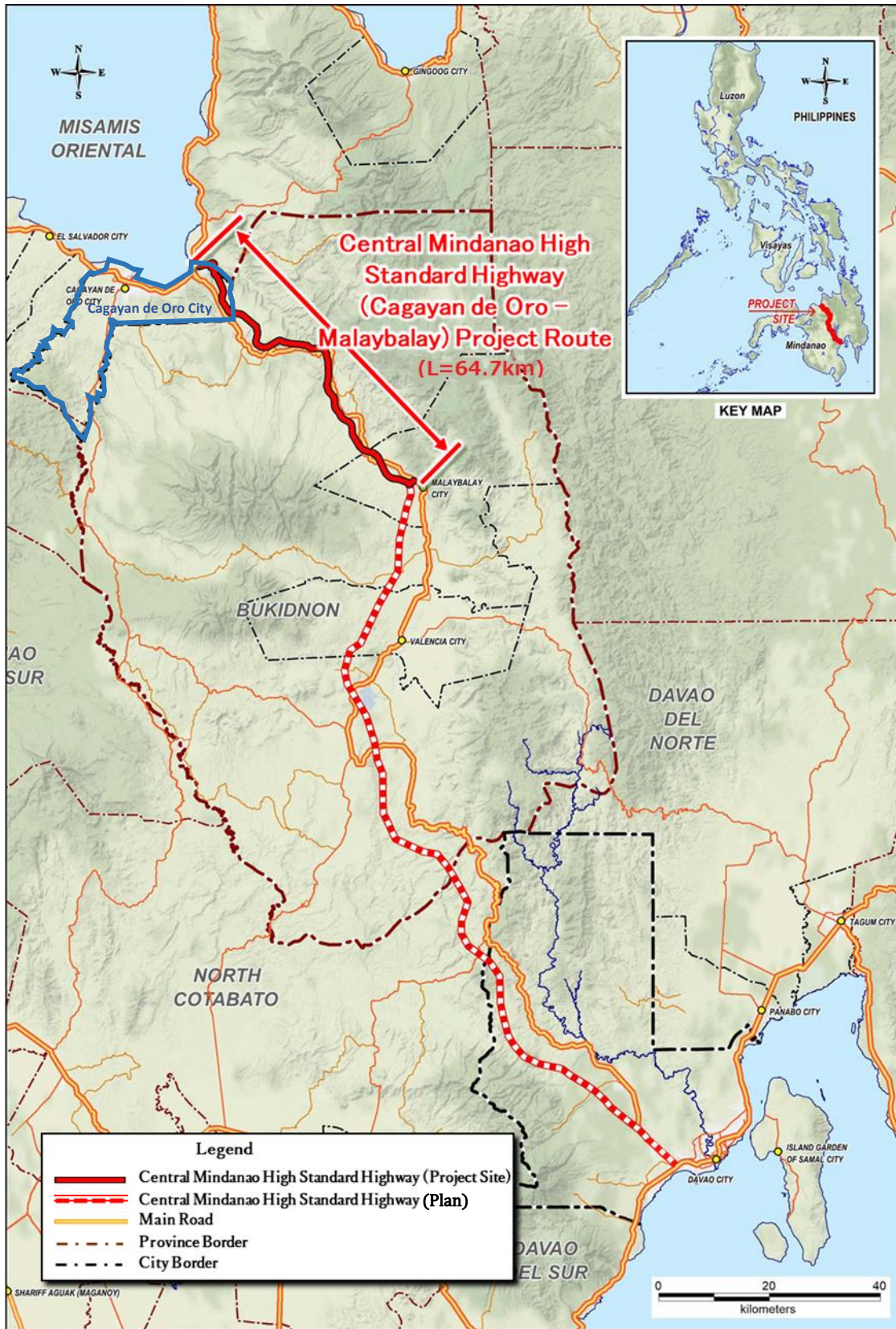
In view of project objectives and expected effects, the following indicators were selected. The design values are calculated upon Scenario 2 mentioned in Section 5.

**Table 10: Summary of Operation and Effect Indicators**

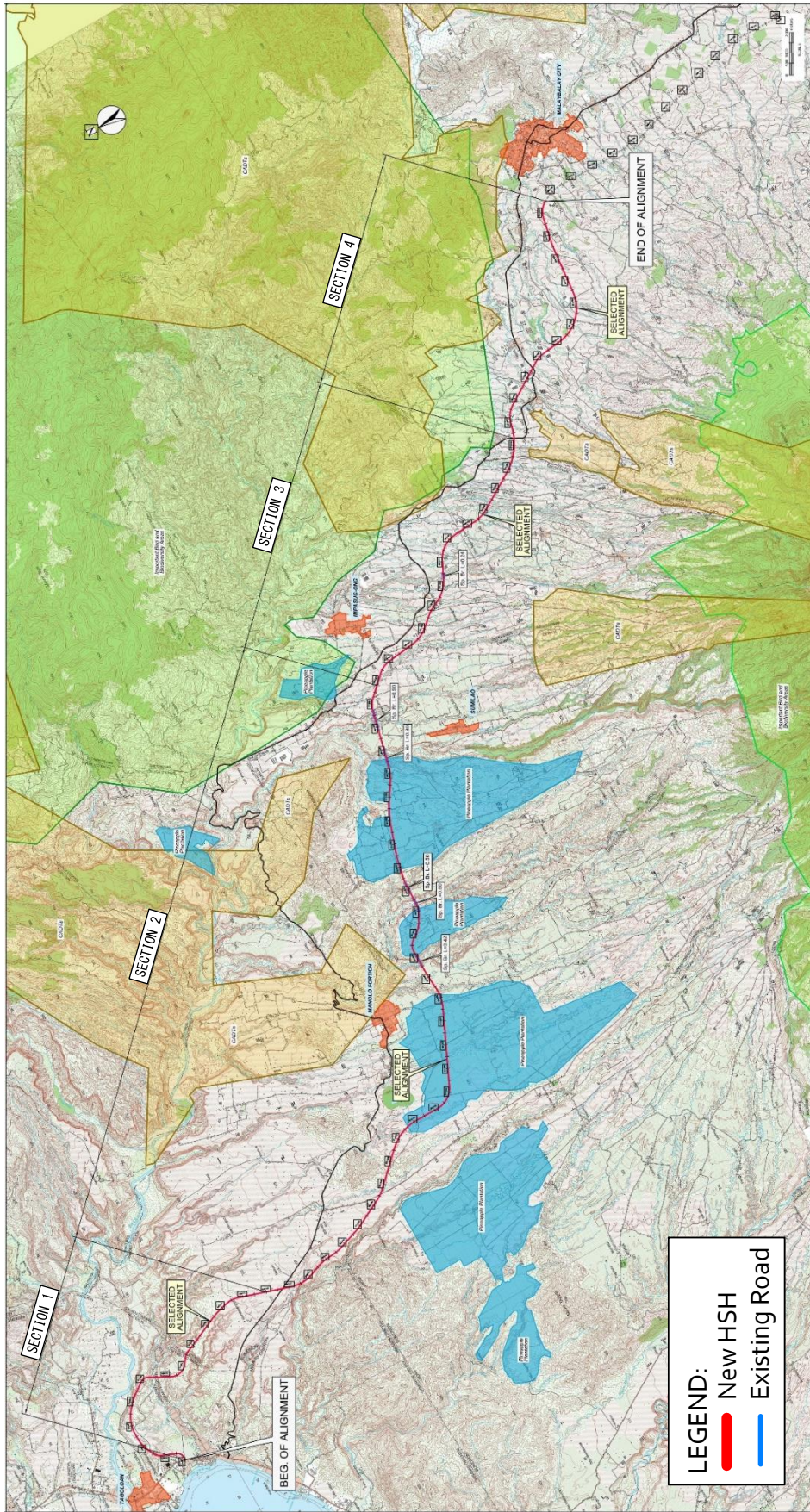
Indicator	Index	Baseline (Existing Road) (as of 2021)	Design Value (as of 2036)		Design Value (as of 2040) (CMH)
			CMH	Existing Road + CMH	
Operation Indicators	Average Traffic Volume of CMH (Veh/day)	9,584	14,800	19,600	16,900
	Volume of Passengers (person / day)	30,827	852,500	113,300	97,000
	Volume of Cargo (ton / day)	21,513	39,400	41,900	42,200
	Toll Revenue (Million Peso/ year)	-	2,591	-	2,850
Effect Indicators	Traveling time CDO- Malaybalay (minutes)	Approx. 90	51	-	51
	Travel Time Cost Saving (Million Peso/Year)	-	10,982	-	12,576
	Vehicle Operating Cost Saving (Million Peso/Year)	-	8,423	-	9,662
	Reduction of Greenhouse Gas Emission (Thousand ton/Year)	-	333	-	379

Source: JICA Study Team





Location Map



Proposed Alignment

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## **Acronyms and Abbreviations**

AADT	: Annual Average Daily Traffic
AAQMP	: Ambient Air Quality Monitoring Plan
AASHTO	: American Association of State Highway and Transportation Officials
AATV	: Annual Average Traffic Volume
AC	: Asphalt Concrete
ACEL	: The Association of Construction Equipment Lessors, Inc.
AD	: Ancestral Domains
ADB	: Asian Development Bank
ADR	: Alternative Dispute Resolution
ADSDPP	: Ancestral Domain Sustainable Development and Protection
ADT	: Average Daily Traffic
AFF	: Agriculture, Forestry, and Fisheries
AH	: Affected Household
AHFF	: Agriculture, Hunting, Forestry and Fishing Sector
APGR	: Annual Population Growth Rate
ARFF	: Aircraft rescue and firefighting
ASEAN	: Association of Southeast Asian Nations
ATC	: Air traffic control
B/C	: Benefit/Cost Ratio
BARMM	: Bangsamoro Autonomous Region in Muslim Mindanao
BCDA	: Bases Conversion Development Authority
BCIR	: Butuan–Cagayan de Oro–Iligan Road
BCP	: Biodiversity Conservation Plan
BIMP-EAGA	: Brunei Darussalam-Indonesia-Malaysia-Philippines East ASEAN Growth Area
BMR	: Biodiversity Management Bureau
BOC	: Bureau of Construction
BOD	: Bureau of Design
BOT	: Build-Operate-Transfer
BQS	: Bureau of Quality and Safety
BRS	: Bureau of Research and Standards
BSDS	: Bridge Seismic Design Specifications
BSP	: Bangko Sentral ng Pilipinas
BTO	: Build-Transfer-Operate
BUTEL	: Bukidnon Telephone
BZP	: Buffer Zone Plan
CAA	: Clean Air Act
CAAP	: Civil Aviation Authority of the Philippines
CADC	: Certificate of Ancestral Domain Claim
CADT	: Certificate of Ancestral Domain Title
CALAX	: Cavite-Laguna Expressway
CAR	: Cordillera Administrative Region
CARL	: Comprehensive Agrarian Reform Law
CAVITEX	: Manila-Cavite Toll Expressway
CBR	: Cost Benefit Ratio
CCA	: Climate Change Adaptation
CDF	: Controlled Dump Facility
CDO	: Cagayan De Oro

CENRO	: Community Environment and Natural Resources Office
CFMP	: Chance Find Management Plan
CFS	: Container Freight Station
CGT	: Capital Gain Tax
CLLEX	: Central Luzon Link Expressway
CLUP	: Comprehensive Land Use Plan
CMH	: Central Mindanao Highway
CMMTC	: Citra Metro Manila Tollways Corp
CMR	: Compliance Monitoring Report
CMVR	: Compliance Monitoring and Validation Report
CNC	: Certificate of Non-Coverage
CO	: Central Office
CO	: Carbon Monoxide
CO <sub>2</sub>	: Carbon Dioxide
COD	: Chemical Oxygen Demand
COVID-19	: Coronavirus disease 2019
CP	: Certificate of Precondition
CR	: Critically Endangered
CS	: Construction stage
CVRP	: Construction Vegetation Removal Plan
CVTPP	: Construction Vegetation and Tree Planting Program
CWMP	: Construction Waste Management Plan
D/D	: Detailed Design
DAO	: DENR Administrative Order
DD	: Data Deficient
DED	: Detailed Engineering Design
DENR	: Department of Environment and Natural Resources
DF/R	: Draft Final Report
DGCS	: Design Guidelines, Criteria and Standards
DO	: Dissolved Oxygen
DO	: Department Order
DOF	: Department of Finance
DOH	: Department of Health
DOLE	: Department of Labor and Employment
DOST	: Department of Science and Technology
DOTr	: Department of Transportation
DPWH	: Department of Public Works and Highways
DRAM	: DPWH ROW Acquisition Manual
DRR	: Disaster Risk Reduction
DRRM	: Disaster Risk Reduction and Management
DST	: Documentary Stamp Tax
DSWD	: Department of Social Welfare and Development
DTM	: Digital Terrain Model
E/IMP	: Environmental/Impact Management Plan
ECAs	: Environmentally Critical Areas
ECC	: Environmental Clearance Certificate
ECP	: Environmentally Critical Project
EDC	: Energy Development Corporation
EGGA	: Engineering, Geological, and Geohazard Assessment

EIA	: Environmental Impact Assessment
EIRR	: Economic Internal Rate of Return
EIS	: Environmental Impact Statement
EMB	: Environmental Management Bureau
EMoP	: Environmental Monitoring Plan
EMP	: Environmental Management Plan
EMVMP	: Equipment and Motor Vehicle Maintenance Plan
EN	: Endangered Species
ENIPAS	: Expanded National Integrated Protected Areas System
EO	: Executive Order
ESAL	: Equivalent Single Axle Loading
ESSD	: Environmental and Social Safeguards Division
EU	: Environmental Unit
F/R	: Final Report
F/S	: Feasibility Study
FGDs	: Focus Group Discussions
FHWA	: Federal Highway Administration, USA
FLEMMS	: Functional Literacy, Education and Mass Media Survey
FPIC	: Free, Prior and Informed Consent
GAA	: General Appropriation Act
GAD	: Gender and Development
GDP	: Gross Domestic Product
GFI	: Government Financial Institutions
GHG	: Green House Gas
GII	: Global Innovation Index
GIS	: Geographic Information System
GNI	: Gross National Income
GNSS	: Global Navigation Satellite System
GOCC	: Government-Owned and Controlled Corporation
GOP	: Government of the Philippines
GPS	: Global Positioning System
GRDP	: Gross Regional Domestic Product
GVA	: Gross Value Added
HDI	: Human Development Index
HEC	: Hydraulic Engineering Circular
HEC-HMS	: Hydrologic Engineering Center's Hydrologic Modeling System
HEC-RAS	: Hydrology Engineering Center- River Analysis System
HGDG	: Harmonized Gender and Development Guidelines
HIV/AIDS	: human immunodeficiency virus/ acquired immunodeficiency syndrome
HLURB	: Housing and Land Use Regulatory Board
HOVs	: High Occupancy Vehicles
HSH	: High Standard Highway
HSH MP2	: High Standard Highway Master Plan Phase 2
HUCs	: Highly Urbanized Cities
HWL	: High Water Level
IATF	: Inter-Agency Task Force
IBA	: Important Bird Area
IBAT	: Integrated Biodiversity Assessment Tool
IBBA	: Important Bird and Biodiversity Area

IC	: Interchange
IC/R	: Inception Report
ICC	: Investment Coordinating Committee
ICCs/IPs	: Indigenous Cultural Communities/Indigenous Peoples
ICT	: Information, Communication and Technology
IEC	: Information, education and communication
IEE	: Initial Environmental Examination
IEER	: Initial Environmental Examination Report
IPAP	: Indigenous People Action Plan
IPAs	: Independent Property Appraisers
IPP	: Indigenous Peoples Plan
IPRA	: Indigenous Peoples Right Act
IPs	: indigenous peoples
IPS	: Initial Perception Survey
IRI	: International Roughness Index
IROW	: Infrastructure Right of Way
IRR	: Implementing Rules and Regulations
ISMP	: Informal Settler Monitoring Plan
IT/R	: Interim Report
IUCN	: International Union for Conservation of Nature
JICA	: Japan International Cooperation Agency
JICA-GL	: JICA Guidelines for Environmental and Social Consideration
JRA	: Japan Road Association
KBA	: Key Biodiversity Area
KIIs	: Key Informant Interviews
LARAP	: Land Acquisition and Resettlement Action Plan
LARRIPP	: Land Acquisition, Resettlement, Rehabilitation and Indigenous Peoples Policy
LEF	: Load Equivalent Factor
LEP	: Local Employment Plan
LGUs	: Local Government Units
LiDAR	: Light Detection and Ranging
LOS	: Level of Service
LRFD	: Load and Resistance Factor Design
MATES	: Manila Toll Expressway Systems
MBAS	: Methylene Blue Active Substances
MC	: Motorcycle
MCT	: Mindanao Container Terminal
MCX	: Muntinlupa- Cavite Expressway
MEFL	: Maximum Experienced Flood Level
MGB	: Mines and Geosciences Bureau
MILF	: Moro-Islamic Liberation Front
MinDC	: Mindanao Development Corridors
MNTC	: Manila North Tollways Corporation
MOA	: Memorandum of Agreement
MOU	: Memorandum of Understanding
MP	: Master Plan
MRF	: Material Recovery Facilities
MSME	: Micro, Small and Medium Enterprise
MVUC	: Motor Vehicle User's Charge

NAAQG	: National Ambient Air Quality Guidelines
NAAQGV	: National Ambient Air Quality Guidelines Values
NAMRIA	: National Mapping And Resource Information Authority
NATAx	: NAIA Expressway
NCIP	: National Commission on Indigenous Peoples
NCM	: Normal Cubic Meter
NCR	: National Capital Region
ND	: None Detected
NEDA	: National Economic and Development Authority
NGCP	: National Grid Corporation of the Philippines
NGO	: Non-Governmental Organization
NGP	: National Greening Program
NHA	: National Housing Authority
NIPAS	: National Integrated Protected Areas System
NLEX	: North Luzon Expressway
NM/NL	: Natural Monuments/ Natural Landmark
NMP	: Noise Monitoring Plan
NP	: Natural Park
NPCC	: National Pollution Control Commission
NPR	: National Primary Road
NPV	: Net Present Value
NSR	: National Secondary Road
NSS	: National Spatial Strategy
NT	: Near Threatened Species
NTP	: National Transport Policy
NTR	: National Tertiary Road
NWQG	: No Water Quality Guidelines
O&M	: Operation and Maintenance
OD	: Origin-Destination
ODA	: Official Development Assistance
ODS	: Ozone depleting substances
OS	: Operation stage
OTS	: Other Threatened Species
OWMP	: Operation Waste Management Plan
PA	: Parking Area
PAFs	: Project Affected Families
PAGASA	: Philippine Atmospheric, Geophysical and Astronomical Services Administration
PAMB	: Protected Area Management Board
PAP	: Project Affected Person
PASA	: Protected Area Suitability Assessment
PBCPP	: Philippine Biodiversity Conservation Prioritization Process
PCB	: Polychlorinated Biphenyl
PCC	: Portland Cement Concrete
PCCP	: Portland Cement Concrete Pavement
PCO	: Pollution Control Officer
PCS	: Pre-construction stage
PCU	: Passenger Car Unit
PD	: Presidential Decree
PDFP	: Peace and Development Framework Plan

PDP	: Philippine Development Plan
PEA	: Philippine Estate Authority
PEIS	: Programmatic Environmental Impact Statement
PEISS	: Philippine Environmental Impact Statement System
PENRO	: Provincial Environment and Natural Resources Office
PFA	: Priority Focus Area
PHIVIDEC	: Philippine Veterans Investment Development Corporation
PHP	: Philippine Pesos
PIA	: PHIVIDEC Industrial Authority
PIDC	: Private Infra Dev Corporation
PL/S	: Protected Landscape and Seascape
PMC	: Project Management Committee
PMT	: Project Management Team
PNCC	: Philippine National Construction Corporation
PNP	: National Police
POPs	: Persistent Organic Pollutants
PPA	: Philippine Port Authority
PPGD	: Philippine Plan for Gender-responsive Development
PPK	: Post Processing Kinematic System
PPP	: Public Private Partnership
PPPS	: Public Private Partnership Service
PRSS	: Passive Rotational Spherical Shell
PS	: Planning Service
PSA	: Philippine Statistics Authority
PT&T	: Philippine Telephone and Telegraph
PTB	: Passenger Terminal Building
PWD	: households with member who has disability
R&D	: Research and Development
R.A.	: Republic Act
RAP	: Resettlement Action Plan
RCA	: Residual Containment Area
RCBC	: Reinforced Concrete Box Culvert
RCDG	: Reinforced Concrete Deck Girder Bridge
RCPC	: Reinforced Concrete Pipe Culvert
RDP	: Regional Development Plan
REXPRIP	: Region X Priority Infrastructure Project
RHO	: Regional Hearing Office
RIC	: Resettlement Implementation Committee
RMC	: Roads Management Cluster
ROW	: Right-of-Way
RPFP	: Regional Physical Framework Plan
RROW	: Road Right-of-Way
RS	: Resource Reserve
RSET	: Regional Social & Economic Trends
RTK	: Real Time Kinematic System
SAFDZ	: Strategic Agriculture and Fisheries Development Zones
SCTEX	: Subic-Clark- Tarlac Expressway
SDA	: Strategic development area
SEMP	: Soil Erosion Management Plan

SIDC	: STAR Infrastructure Development Corp
SLEX	: South Luzon Expressway
SLTC	: South Luzon Tollway Corporation
SMR	: Self-Monitoring Report
SNR	: Strict Nature Reserve
SOMCO	: Skyway Operations and Maintenance Corp
SSS	: Social Security System
STAR	: Southern Tagalog Arterial Road
STC	: STAR Tollway Corp
STDs	: Sexually Transmitted Diseases
STEP	: Special Terms for Economic Partnership
SWM	: Solid Waste Management
TBC	: Trimble Business Center
TBD	: To be determined
TESDA	: Technical Education and Skills Development Authority
TEUs	: Twenty-foot Equivalent Units
TMC	: Tollways Management Corporation
TMP	: Traffic Management Plan
TPLEX	: Tarlac- Pangasinan-La Union Expressway
TRB	: Toll Regulatory Board
TSMP	: Tree Survival and Monitoring Plan
TSS	: Total suspended solids
TTBP	: Tree Transfer and Balling Plan
TTC	: Travel Time Cost
TWG	: Technical Working Group
UAV	: Unmanned Aerial Vehicle
UPMO	: Unified Project Management Office
UPMO RMC1	: Unified Project Management Office - Roads Management Cluster 1
USD	: United States Dollar
VAT	: Value Added Tax
VAWC	: Violence Against Women and Children
VMS	: Variable Message Signboard
VOC	: Vehicle Operating Cost
VTDI	: Vertex Tollway Dev't. Inc
VTPPO	: Vegetation and Tree Planting Program during Operations
VU	: Vulnerable Species
WB	: World Bank
WCP	: Water Conservation Plan
WEEE	: waste electrical and electronic equipment
WFP	: Work and Financial Plan
WIM	: Weigh in Motion
WMP	: Wildlife Monitoring Plan
WQG	: Water Quality Guideline
WS	: Wildlife Sanctuary

## **CHAPTER 1 INTRODUCTION**

### **1.1 Background of the Survey**

Mindanao is an island in the southern part of the Republic of the Philippines with an area of about 102,000 km<sup>2</sup> and a population of about 26 million (2020 Philippine population statistics).

The island has for decades lagged compared to the rest of the Philippines in terms of economic and infrastructure development, because of the long-standing conflict between anti-government groups and government troops in the southwest. Thus, the poverty rate is 27.7%, higher than the 18.1% of national average in 2021. After a comprehensive peace agreement between the Philippine Government and the Moro-Islamic Liberation Front (MILF) was made in 2014, the Bangsamoro Transitional Autonomous (BTA) Government was established in March 2019. With the steady progress of the peace process through the establishment of BTA, economic development, particularly in the agricultural and mineral industries, is expected throughout Mindanao Island. The project is also expected to contribute to the economic development.

According to the Philippine Development Plan (2017-2022), the national government identified Cagayan de Oro City (population of approximately 728,000 in 2020) and Davao City (population of approximately 1.78 million in 2020) as Metropolitan Centers in Mindanao Island. For the Metropolitan Center, the plan aims to improve the connectivity between cities in urban and rural areas, movement of people and commodities, and access to services and employment. These are expected to ultimately contribute to the economic growth of the country. The Philippine Development Plan 2023-2028 also emphasises that “Enhanced Connectivity” is important for digital connectivity as well as physical connectivity to improve infrastructure and transport and reduce the cost of transport.

The road sector is responsible for about 90% of the country's passenger transportation and about 50% of freight transportation, which is essential for economic growth. However, there remains many problems on the existing roads connecting cities and the surrounding areas. In particular, the existing road between Cagayan de Oro City and Malaybalay City (population of about 190,000 in 2020) has continuous sharp-curved and zigzag sections, causing frequent road crashes. Low speed movement in such road sections interrupts the transportation of agricultural products and other goods.

The Central Mindanao High Standard Highway section between Cagayan de Oro (CDO) City and Malaybalay City (referred to as the Project) is included in the Central Mindanao High Standard Highway planned in the High Standard Highway Master Plan Phase 2. This project is planned as a high priority section to be developed in the short term in the Master Plan. The other section connecting Malaybalay City and Davao City is planned as a section to be developed in the medium term.

The Project aims to strengthen the connectivity between the two cities and to revitalize the economy in the surrounding areas by developing sections with high level of technical difficulty. The High Standard Highway Network Master Plan Development Project (Phase 2) being implemented by JICA has identified this Project as one of the highest priority projects that should be developed in the short term. The objectives of the Project are also in line with the Philippine Development Plan (2023-2028), which states that ‘Building a sustainable, resilient and modern infrastructure systems will enable the Philippine economic transformation’.

The Survey reviews the results of previous surveys related to the Project and collects information necessary to develop the project components – objective, outline, cost, schedule, project implementation plan, application of Japanese technology, organization and system, operation and maintenance system,

environmental and social considerations. Based on the survey results and gathered information, the Project will be examined and appraised if it is suitable as a Yen Loan Project.

## **1.2 Objective of the Survey**

The objectives of the Survey are to:

- Conduct a feasibility study to figure out the effectiveness of the Project as a Loan Project.
- Prepare documents and references necessary for ODA loan examination.
- Examine the applicability of Japanese technology in accordance with the provisions of Special Terms for Economic Partnership (STEP) for Section 1, Cagayan de Oro city only.
- Summarize and provide information about project components including engineering survey results, preliminary design, cost estimate, schedule, project implementation plan, organization, operation and maintenance system, and environmental and social considerations.

## **1.3 Work Scope of the Survey**

To achieve the above objectives, the Survey will cover the following:

- 1) Information collection on background and necessity of the Project
- 2) Investigation on current situation of the project site
- 3) Selection of optimum alignment
- 4) Engineering surveys
- 5) Traffic survey and traffic demand forecast
- 6) Preliminary design
- 7) Project implementation schedule
- 8) Project implementation plan
- 9) Application of Japanese technology
- 10) Project cost estimate
- 11) Procurement plan
- 12) Project implementation organization
- 13) Operation and maintenance organization
- 14) Identification of responsibility of the government of the Philippines
- 15) Environmental impact assessment
- 16) Resettlement action plan
- 17) Gender assessment development
- 18) Indigenous Peoples Plan
- 19) Project evaluation
- 20) Information collection and analysis for climate change mitigation measure

#### **1.4 Survey Area**

The Project will promote traffic access improvement in the northern and southern parts of Mindanao Island as a part of the Central Mindanao High Standard Highway. The whole highway will be about 300 km long between Cagayan de Oro City and Davao City. Specifically, approximately 65 km long section from Cagayan de Oro to Malaybalay will be targeted by this Survey. The Survey area covers the region marked in the location map in the beginning of the report.

#### **1.5 Schedule Survey**

The Survey commenced in September 2020 and was completed in June 2024 as shown in Table 1.5-2.

The following meetings with DPWH are shown in Table 1.5-1. The JICA Study Team explained to both undersecretaries and requested for their concurrence on the optimum alignment, before proceeding with the conduct of the surveys.

**Table 1.5-1 Major Meeting with DPWH**

<b>Agenda</b>	<b>Date</b>	<b>Major Attendance</b>
Kick-off Meeting	October 26, 2020	6 participants from DPWH UPMO including Usec. Sadain and Director Castillo, 6 participants from JICA, and 14 participants from the study team
Inception Report consultation	November 5, 2020	17 participants from DPWH Planning and PPP Service including Usec. Cabral and Director Llanes, 1 participant from Embassy of Japan, 8 participants from JICA, and 13 participants from the study team
Formulation of route plan	February 3, 2021	11 participants from DPWH Planning Service, 2 participants from DPWH UPMO, 1 participant from DPWH BOD, 1 participant from DPWH BOC, 1 participant from DPWH Regional Office (R10), including Director Llanes and Director Castillo, 10 participants from JICA, and 11 participants from the study team
Formulation and approval of route plan	February 19, 2021	3 participants from DPWH UPMO, including Usec. Sadain 1 participant from Embassy of Japan, 10 participants from JICA, and 9 participants from study teams
Formulation and approval of route plan	February 23, 2021	15 participants from DPWH Planning and PPP service, 3 participants from DPWH Regional Operations in Mindanao, 2 participants from DPWH BQS, 1 participant from DPWH UPMO, 2 participants from DPWH Regional Office (R10) including Usec. Cabral, Usec. Pipo and Director Llanes, 5 participants from PPP Center, 5 participants from JICA, 5 participants from the study team
Presentation for Interim Report	August 19, 2021	19 participants from DPWH Planning Service headed by Dir. Llanes, 3 participants from DPWH UPMO, 1 participant from DPWH BOC, 1 participant from DPWH BQS, 1 participant from PPPS, 1 participant from DENR, 1 participant from DOTr, 2 participants from PPP Center, 3 participants from JICA Tokyo, 3 participants from JICA Manila, 1 DPWH JICA Expert and 11 participants from the study team
Presentation for Interim Report	August 25, 2021	4 participants from DPWH UPMO, including Usec. Sadain 1 participant from Embassy of Japan, 3 participants from JICA Tokyo, 3 participants from JICA Manila, 1 DPWH JICA Expert, and 9 participants from the study team
Presentation of Project Status to UPMO	December 7, 2021	4 participants from DPWH UPMO RMC1, 1 participant from DPWH UPMO RMC2, 1 participant from Usec. Sadain's office, 1 participant from ADB, 4 participants from JICA Tokyo, 4 participants from JICA Manila, 1 DPWH JICA Expert, and 6 participants from the study team
Presentation of Progress Report	September 28, 2022	5 participants from DPWH UPMO, including Usec. Sadain 4 participants from JICA Tokyo, 4 participants from JICA Manila, 1 DPWH JICA Expert, and 9 participants from the study team

**Table 1.5-2 Survey Schedule**

Item	2020			2021			2022			2023			2024									
	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6
2.2.1 Preparation and Discussion on Inception Report																						
2.2.2 Information Collection on Background and Necessity of the Project																						
2.2.3 Confirmation on Current State of the Project Site																						
2.2.4 Selection of Optimum Alignment																						
2.2.5 Engineering Survey (Climate, Disaster, Hydraulic Geometries, Geotechnical)																						
2.2.6 Traffic Survey and Traffic Demand Forecast																						
2.2.7 Preliminary Design																						
2.2.8 Construction Implementation Schedule																						
2.2.9 Construction Implementation Plan																						
2.2.10 Application of Japanese Technologies																						
2.2.11 Project Cost Estimate																						
2.2.12 Procurement Plan																						
2.2.13 Project Implementation Organization																						
2.2.14 Operation and Maintenance Organization																						
2.2.15 Confirmation on Responsibility of the Government of the Philippines																						
2.2.16 Environmental Impact Assessment (EIA report)																						
2.2.17 Land Acquisition and Resettlement Action Plan (RAP)																						
2.2.18 Gender Assessment Development Plan																						
2.2.19 Project Evaluation																						
2.2.20 Information Collection and Analysis for Climate Change Mitigation Measures																						
2.2.21 Presentation to Japanese Company																						
2.2.23 Draft Indigenous Peoples Development Plans (IPP)																						
2.2.22 Preparation and Discussion on Reports																						
Report Submission																						

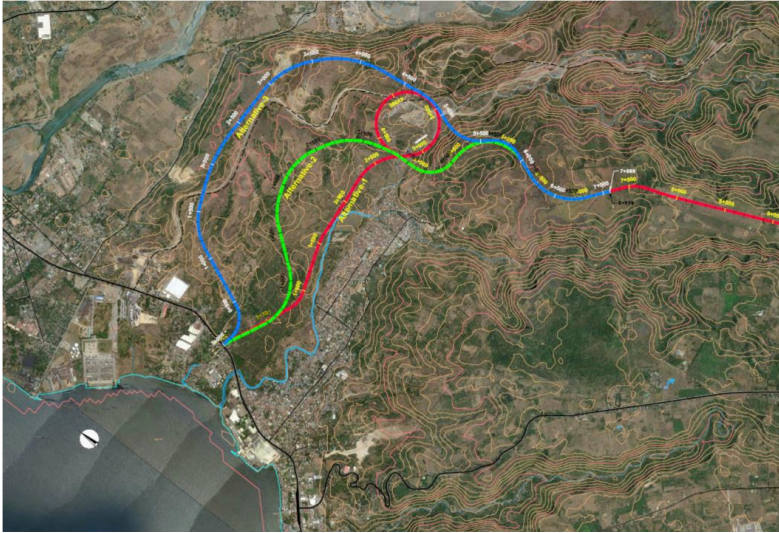
Legend : ■ Study in the Philippines    □ Study in Japan    IC/R: Inception Report, IT/R: Interim Report, DF/R: Draft Final Report, F/R: Final Report

Note: the schedule is based on the assumption that study team can go to the project site in September 2021. There is a possibility that the schedule may be delayed due to the influence of travel restrictions by Covid19.

## 1.6 Identified Issues in the Pre-F/S

The Central Mindanao High Standard Highway (CMH) (CDO-Malaybalay section) was selected as one of four projects for pre-feasibility study in the High Standard Highway Network Master Plan Development Project (Phase 2) (hereafter HSH-MP2) in 2021. Pre-F/S was conducted in 2021 in the HSH-MP2. The outline of Pre-F/S and identified issues in the HSH-MP2 are summarized in Table 1.6-1.

**Table 1.6-1 Summary of Identified Issues in the Pre-F/S and F/S Output**

Items	Identified Issues in the Pre-F/S (HSH-MP2)	Output of this project						
1.Alignment Study	<p>In the Pre-F/S, the applicable alignment was studied based on the available free satellite map and topographic data. The proposed alignment was selected based on lowest construction cost and least negative social and environmental impact. It is necessary to carefully select the optimum alignment by comparing the alternatives based on a more accurate field survey data during the F/S stage.</p> <p>In section 1, the present road network such as the Sayre Highway and the Alae-PHIVIDEC Bypass Road feature many hairpin curves and steep slope sections; as such, the design speed is 20km/h. The zigzag section of Sayre Highway has a very low travel speed, and the occurrence of road crashes is high. As the connection between the two Metropolitan Centers (CDO City and Davao City) is essential, a high standard highway for this corridor is of the highest priority amongst the projects. As a result of the alternative study of the beginning 2km section and evaluation items were construction costs, road alignment, environmental impact and workability, either Alternative-1 or Alternative-3 is recommended. Alternative-3 was slightly cheaper than Alternative-1, but Alternative-1 was easier to construct than Alternative-3, so overall there was no significant difference between Alternative-1 and Alternative-3. So it is necessary to conduct a detailed comparative study between the two alignments during the F/S stage to select the best alignment through discussion with the DPWH and other stakeholders.</p>  <table border="1"> <tr> <td>Alternative-1</td> <td>Red line</td> </tr> <tr> <td>Alternative-2</td> <td>Green line</td> </tr> <tr> <td>Alternative-3</td> <td>Blue line</td> </tr> </table> <p><b>Pre-F/S Alternative Study in Section-1</b></p>	Alternative-1	Red line	Alternative-2	Green line	Alternative-3	Blue line	<p>Alternative study was conducted for whole section in consideration of these issues and selected the optimum route (See Chapter 7)</p>
Alternative-1	Red line							
Alternative-2	Green line							
Alternative-3	Blue line							

Items	Identified Issues in the Pre-F/S (HSH-MP2)	Output of this project	
	<p>In the Pre-F/S, the technical difficulty was also an evaluation criterion for the purpose of technology transfer in the Philippines, but in the F/S, the following items shall be considered for the comparative alignment study:</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="text-align: center;">Cost, Route Alignment, Bridge Type, Construction Period and Others</td> </tr> </table>	Cost, Route Alignment, Bridge Type, Construction Period and Others	
Cost, Route Alignment, Bridge Type, Construction Period and Others			
2. Phasing Development	<p>In year 2040, the future traffic volume of CMH will be 18,000 vehicles per day. Thus, a four-lane HSH will be necessary. Based on the preliminary economic analysis, the EIRR in case of 4-lane toll road is 18.6%; and in case of a 2-lane non-toll road, the EIRR is 22.0%. In both cases, the 10% NEDA requirement is met. Based on the EIRR, it is desirable to construct a 2-lane road during the initial stage. This will be studied further during the F/S stage.</p> <p>It is necessary to study the staging plan, such as initial 2-lane construction; sections 1 and 2 only if the highway construction budget is limited. It is also necessary to thoroughly study the applicability of toll collection. Likewise, there is a need to study the operation and maintenance structure of the project during the F/S stage.</p>	Based on the necessity of 4-lane road timing study, it is recommended as 4-lane construction from the beginning stage (See <i>Chapter 15</i> )	
3. EIA and RAP (1) General Issues	<p>Alternative discussions shall be done further to avoid protected areas, areas inhabited by indigenous peoples, and KBA/IBA (sensitive areas from development impact based on JICA's Guidelines for Environmental and Social Considerations) as much as possible.</p> <ul style="list-style-type: none"> <li>• Confirmation of construction methodology and necessary machinery and vehicles</li> <li>• Confirmation of soil borrow pit, quarry, waste dumping site, etc.</li> <li>• Necessary budget for mitigation and monitoring</li> <li>• Confirmation of specific role and responsibility for mitigation, monitoring, and resettlement implementation</li> <li>• Stakeholder Meetings and Public Consultations as F/S level</li> </ul>	Regarding alternative alignment was studied in <i>Chapter 7</i>  Others are described in <i>Chapter 12</i>	
(2) Natural Environment	<p>CMH will pass through the vicinity of Mount Tago Range (KBA/IBA) and some newly proposed protected areas. The proposed alignment will not directly traverse these areas, but the actual boundary of IBA and Protected Area, and the status of the proposed protected area should be confirmed with DENR during the F/S stage.</p> <p>Field surveys for fauna and flora at appropriate locations in appropriate seasons (e.g., dry and wet season) shall be conducted to identify the important points (nest, feeding area, breeding area) for fauna and survey the potential impact of the project to the environment.</p> <p>The impact on the ecosystem due to the cutting of trees in the project area shall be studied.</p>	See <i>Chapter 12</i>	

Items	Identified Issues in the Pre-F/S (HSH-MP2)	Output of this project
(3) Social Environment	<p>CMH will pass through the vicinity of several Certificate of Ancestral Domain Titles (CADTs). In addition, the one (1) CADT application in Bukidnon is currently in process. The proposed alignment will not hit these areas at this moment, but the actual boundary of CADTs and status of CADT application should be confirmed with NCIP during F/S stage. Once the potential impact on the IPs is estimated, the impact and necessary mitigation measures shall be studied during F/S through communication with NCIP in consideration of on-site ancestral domain condition.</p> <ul style="list-style-type: none"> <li>• RAP-related surveys including Census, Socio-Economic Survey, Inventory of Loss, Replacement Cost Survey, etc.</li> <li>• Confirmation of status of vulnerable people including poor people and illegal residents around the project area</li> <li>• Confirmation of status of ethnic minority and/or indigenous people</li> <li>• Confirmation of public/social facilities around the project sites</li> </ul>	<p>See <i>Chapter 13</i>.</p> <p>The confirmation that the alignment will not pass through the CADT areas is currently under verification by the NCIP during preliminary design.</p>

## CHAPTER 2 NATIONAL AND REGIONAL DEVELOPMENT PLAN

### 2.1 National Development Plan

#### 2.1.1 Long-term Vision for the Philippines

*AmBisyon Natin 2040* is a collective long-term vision and aspiration of the Filipino people for the country that describes the future life and state of the nation in 2040. The 25-year vision started in 2015 and yearns for nationwide development planning across different administrations. This long-term vision is a result of focus group discussions participated by more than 300 people and a nationwide survey answered by approximately 10,000 people that was undertaken by National Economic and Development Authority (NEDA) in 2016.<sup>1</sup>

The two major interconnected goals of *AmBisyon Natin 2040* for the life of the Filipino people are:

1. By 2040, Filipinos enjoy a strongly rooted, comfortable, and secure life which literally translates to "*Matatag, Maginhawa, at Panatag na buhay*";
2. By 2040, the Philippines is a predominantly middle-class society where people live long, healthy, smart, and innovative; a country with a high-trust society, thriving in cultural diversity and resilient communities.

#### (1) *Matatag, Maginhawa, at Panatag na Buhay (Stable, Convenient at Assured life)*

By 2040, the Philippines is expected to have a stable and comfortable lifestyle where families live together, have sufficient daily needs, secured, and prepared for their future. The country is expected to have a trustworthy government that protects and serves the people fairly and equally, free of corruption, and provides safety all over the country. Figure 2.1-1 summarizes the goals under *Matatag, Maginhawa, at Panatag na buhay*.



Source: NEDA, 2016. *AmBisyon Natin 2040*. P.2

**Figure 2.1-1 The life of Filipinos in 2040**

#### (2) *Philippines as Prosperous Middle-class Society*

By 2040, most Filipinos are expected to be in the middle class where hunger and lack of jobs and opportunities are to be eliminated. To achieve this goal, economic sustainability within 25 years until 2040 will play a significant role. A family needs to earn a monthly family income of at least PHP120,000 in 2015 price for a household of four persons living in National Capital Region (NCR).<sup>2</sup> In other words, the per capita income should grow more than three-fold by 2040 and the Philippines will join the high-income country group by reaching the per capita GDP of nearly USD 10,000.<sup>3</sup>

<sup>1</sup> NEDA 2016. *AmBisyon Natin 2040*

<sup>2</sup> NEDA. PDP 2017-2022

<sup>3</sup> World Bank. 2018. *Growth and Productivity in the Philippines: Winning the Future*.

To realize the vision, the Government of the Philippines (GOP) has identified four specific objectives and eight priority sectors, as follows:

Objectives:

1. Investment in human capital so that Filipinos are equipped to learn and adapt to new technology and the changing profile of society;
2. Investment in high-quality infrastructures to make the cost of moving people, goods, and services competitive;
3. Sound urban development that takes advantage of scale and agglomeration economies to make the cities more competitive and livable; and
4. Adequate and inclusive finance to enable households to build up savings and to provide capital for micro, small, and medium enterprises (MSMEs) and households considering the desire of many to run their own businesses.

Priority Sectors:

- Housing and urban development – construction, manufacturing, and utilities
- Manufacturing – food, housing, transport, and others
- Connectivity – roads, bridges, ports, transport systems, ICT
- Educational Services – formal education and re-tooling services
- Tourism and Allied Services – resorts, sports and recreational services, cultural shows, heritage sites, etc.
- Agriculture – food and crop production, industrial and commercial production, biotechnology and engineering
- Health and Wellness Services – primary to tertiary care, pharmaceuticals, wellness, sports and fitness facilities
- Financial Services – consumer and enterprise financing, mobilization of insurance savings

### **(3) Contribution of the Project to the National Vision**

NEDA envisions a comfortable (*maginhawa*) life for all Filipinos by 2040. The Central Mindanao High Standard Highway contributes to the realization of this goal by providing enhanced transport facilities and a more convenient means of mobility in Mindanao.

Likewise, connectivity through adequate road infrastructure and transport systems was identified by NEDA as one of the priority pillars for development. In line with the *AmBisyon Natin 2040*, the CMH aims to increase Mindanao's competitiveness in terms of moving people, goods, and services. By connecting leading with lagging areas, the CMH provides equitable access to institutions which are generally situated in highly urbanized cities such as Cagayan de Oro City and Davao City.

#### **2.1.2 The Philippine Development Plan (PDP) 2017-2022**

The “plan with a vision” known as the Philippine Development Plan (PDP) 2017-2022 is a six-year term plan guided by *AmBisyon Natin 2040*. The main objective is to realize the long-term vision of *AmBisyon Natin 2040* by “laying down the foundation for inclusive growth, to build a high trust resilient society, and a globally competitive knowledge economy.” In the first three years of implementation, the PDP introduced critical reforms that ensure the sustainable economic growth and development to improve the quality of life of the Filipinos and enables them to achieve their *Ambisyon*. However, COVID-19 global pandemic happened during the midterm of its implementation that will be expecting to have ineffaceable effect on the socioeconomic development of the country.<sup>4</sup> To conform to the new normal, the updated PDP adjusted the targets for the remaining period.

Adjusted Targets of PDP:

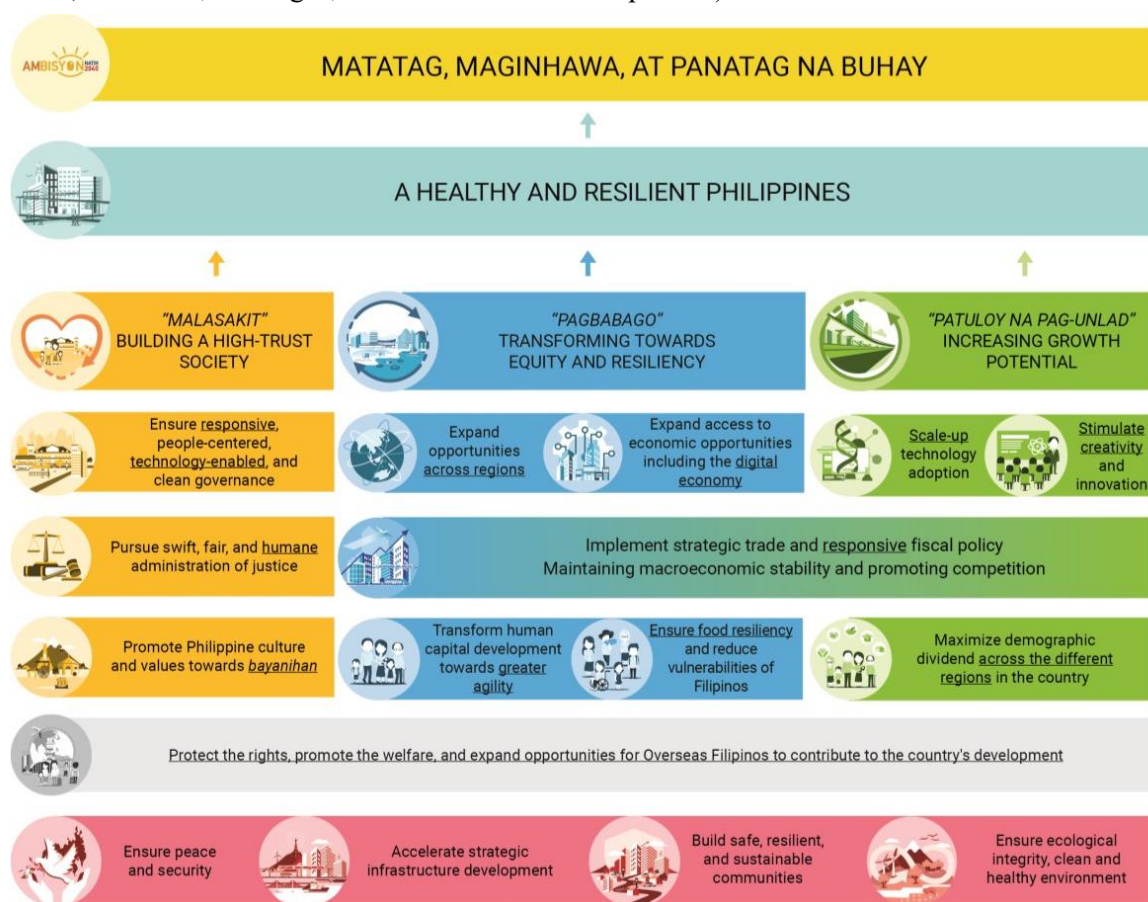
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<sup>4</sup> Updated Philippine Development Plan 2017-2022.

1. **Economic growth** – slightly lower economic growth than initial target where the revised target for Gross Domestic Product (GDP) is 6.5 to 7.5% by 2022 and while the Gross National Income (GNI) per capita is expected to be 6.0% by 2022.
2. **Poverty incidence** – lower poverty incidence of 14% by 2022 is still achievable. Revised target for subsistence poverty is 5% by 2022 same with food inflation to be sustained at 2-4% in 2021 to 2022.
3. **Human development** – increasing trend of human development index (HDI) is expected to continue until 2022.
4. **Unemployment** – revised targets of unemployment is ranging from 7 to 9% in 2021 to 2022 due to pandemic and significant increase in labor force from the first batch of K-12 graduates in college. However, this will lead to increase of unemployment rate for the youth to 22.5% by 2022. Moreover, underemployment target for those outside the National Capital Region (NCR) is 15.5 to 17.5% in 2022.
5. **Innovative society** – improving global innovation index (GII) of the country will continue and is expected to increase by 2022. The target is to be among the top one-third or in 40<sup>th</sup> to 42<sup>nd</sup> rank.

### (1) Strategic Framework

The strategic framework of PDP 2017-2022 (Figure 2.1-2) has been updated to adapt on the changes brought by the COVID-19 global pandemic under the new normal. The framework has been adjusted to align with the requirements for recovery to be able to have a healthy and resilient Philippines to attain a strongly rooted, comfortable, and secure life. To achieve the abovementioned goals, the strategies are sectioned under three major pillars of “Malasakit”, “Pagbabago”, and “Patuloy na pag-unlad”(“Concern”, “Change”, and “Continuous development”).<sup>5</sup>



Source: Updated Philippine Development Plan 2017-2022

**Figure 2.1-2 Strategic Framework of PDP 2017-2022**

<sup>5</sup> Updated Philippine Development Plan 2017-2022 Page 4-4

## **(2) National Spatial Strategy**

The main objective of the National Spatial Strategy (NSS) incorporated in the PDP 2017-2022 is to allow every single Filipino people to settle wherever they want and at the same time enjoy comfortable and secure lives. To meet the requirements of the new normal, this strategy is updated to continuously establish the direction of the country's physical growth by "improving connectivity and providing equal access to quality social services across regions." Other objectives of this strategy include the decongestion of NCR and directing the growth of urban centers throughout the country require serious understanding and cooperation of each government entity to guarantee that efforts will not go in vain.<sup>6</sup>

Due to the health hazards brought by COVID-19 pandemic, the necessity to improve the living standards and to ensure safe mobility and connectivity is must. Hence, NSS framework is beneficial in addressing the risks and in achieving the main objective of the strategy.

### **NSS Framework: Major strategies and objectives:<sup>7</sup>**

1. Regional agglomeration
  - a. To apply the integrated approach to urban planning (e.g., Decongestion of NCR).
  - b. To provide sustainable development and better access to opportunities in rural areas.
  - c. To make cities livable and efficient in high density urban areas in terms of population and enterprise.
  - d. To improve social services and expedite investment in transportation and infrastructures.
  - e. To promote "smart city" principle in developed urban areas.
  - f. To improve social service delivery of local government units (LGUs).
  - g. To give into consideration food accessibility and vulnerability during pandemic.
2. Connectivity
  - a. To increase efficiency in production zones and market centers.
  - b. To provide missing links between local and national road networks.
  - c. To use the National Transport Policy (NTP) as instrument to guide the implementation of transport system masterplan for the rational development of transport system network.
  - d. To develop efficient logistic system in ensuring undisruptive delivery of goods across regions especially in times of crises.
  - e. To increase investment in construction of ICT infrastructures to maintain public and private services in times of digital transformation caused by COVID-19 pandemic.
3. Reducing vulnerability
  - a. To consider projections and threats for disaster risk reduction.
  - b. To build the capacity to mitigate hazards, disease outbreaks, and pandemics.

## **(3) Contribution of the Project to the Philippine Development Plan**

The Philippine Development Plan acknowledges that despite recent improvement and expansion of the road network, it is still inadequate compared to the rapidly growing demand. With road-based transport infrastructure at the center of trade and logistics in the country, the PDP envisions that the coverage of high standard highway operations will eventually stretch across Visayas and Mindanao<sup>8</sup>. Once constructed, the Central Mindanao High Standard Highway will be among the pioneer HSH in Mindanao. The CMH is expected to "improve connectivity and access to social services across regions," in line with the objectives of the National Spatial Strategy.

The PDP likewise envisions increased access to economic opportunities in the agricultural sector<sup>9</sup>. A traffic survey conducted by the JICA Study Team revealed that more than half (52%) of the trucks in the Sayre Highway (existing national road) carry agricultural products. With the presence of large

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<sup>6</sup> Updated Philippine Development Plan 2017-2022. Pages 3-1, 3-10

<sup>7</sup> Updated Philippine Development Plan 2017-2022. Page 3-1 to 3-2

<sup>8</sup> Philippine Development Plan 2017-2022. Page 19-20

<sup>9</sup> Philippine Development Plan (2017-2022), Chapter 8.

plantations along the Cagayan de Oro-Malaybalay corridor, the CMH has the capacity to develop the untapped potential of agribusiness industries within the area.

In addition, the PDP identified poor road network quality and inadequate road safety features among the main issues in the country's transport sector. Currently, zigzag sections and steep slopes prevent the smooth transport of large vehicles along the Sayre Highway. According to the traffic survey conducted by the JICA Study Team, a combined 55% of vehicles along the existing thoroughfare are composed of trucks and buses. The establishment of a high standard highway in this corridor would give vehicles a safer option to transport people and goods and increase the country's competitiveness, in line with the vision of the PDP.

### **2.1.3 The Philippine Development Plan (PDP) 2023-2028**

The Philippine Development Plan (PDP) 2023-2028 serves as a blueprint for development in the Philippines. The country's general development blueprint for the next six years. It exemplifies policies, tactics, initiatives, and legislative priorities of the government in support of President Ferdinand R. Marcos, Jr.'s Socioeconomic Agenda. The Plan is aimed at achieving the country's long-term vision, the *AmBisyon Natin 2040*, in which all Filipinos are expected to be deeply established, comfortable, and secure lives.

The PDP was formulated in collaboration with national government agencies, local government units, the private sectors, stakeholder groups, civil society, and development partner through a "whole-of-government and whole-of-society approach".

#### **Expand and Upgrade Infrastructure**

Building a sustainable, resilient and modern infrastructure systems will enable the Philippine economic transformation. With the long-term vision as an anchor, the Philippine government will steer the nation toward a future where movement of people and goods is safely and efficiently facilitated by adequate and accessible transportation.

#### **(1) Assessment, Challenges and Strategies on Connectivity**

##### **Assessment**

During the administration of Former President Rodrigo R. Duterte, the Annual Public Infrastructure spending ranged from 4.2% to 5.8% of Gross Domestic Product (GDP) (2017-2021), nearly double to average annual spending over the previous decades. However, infrastructure facilities and services remain inadequate in terms of accessibility, quality, safety and affordability.

- 1) Mobility of majority of Filipinos is hampered by inadequate transportation facilities.
- 2) The Philippine rail system's capacity is inadequate to meet the ridership post-pandemic.
- 3) Transport facilities deemed inaccessible and unsafe, especially for vulnerable groups.
- 4) Shortage of road-based public transportation persists in many urban areas.
- 5) Use of active transportation is still not popular.
- 6) Road traffic fatalities are increasing in the Philippines.
- 7) While progress has been made in maritime transportation, issues on infrastructure quality remains.
- 8) Little progress has been made to improve airport infrastructure.
- 9) Civil works and utilities installation along roads are not coordinated.
- 10) There are no operational cargo and/or freight rail services in the country.
- 11) Port and ancillary facilities are insufficient and underdeveloped.
- 12) Automated logistics are not yet integrated.
- 13) Movement of information through digital infrastructure steadily improved but still not enough.

## **Challenges**

The major challenges include financing of investments, coordination of plans and programs across agencies and across levels of government and ensuring asset preservation and resiliency. Hereunder are the challenges;

- 1) The implementation of the National Transport Policy is difficult without a National Master Plan and sufficient data.
- 2) Public high capacity transportation is unable to meet current and future demand.
- 3) Active transport will remain nonviable for commuters without adequate infrastructure and support facilities.
- 4) Pursuing or expanding the current PUV Service Contracting Program requires appropriate balancing between enhancing service standards and fiscal sustainability.
- 5) Air traffic congestion is likely to persist if not worsen, without the needed investments in developing, upgrading and improving airports.
- 6) Achieving universally accessible and gender-responsive transport facility designs needs a shift in construction priorities and practices, and in carrying out coordination and advocacy.
- 7) Ensuring travel safety on road transport corridors while aiming to increase travel speeds poses a challenge.
- 8) Low-quality infrastructure, inconsistent regulations, and inefficient operations leads to high logistics cost.
- 9) Transport corridors supporting airports and ports will continue to impede movement of goods if not upgraded.
- 10) The disparity in access to and high costs of digital services in the country indicate inadequate investments in digital infrastructure.

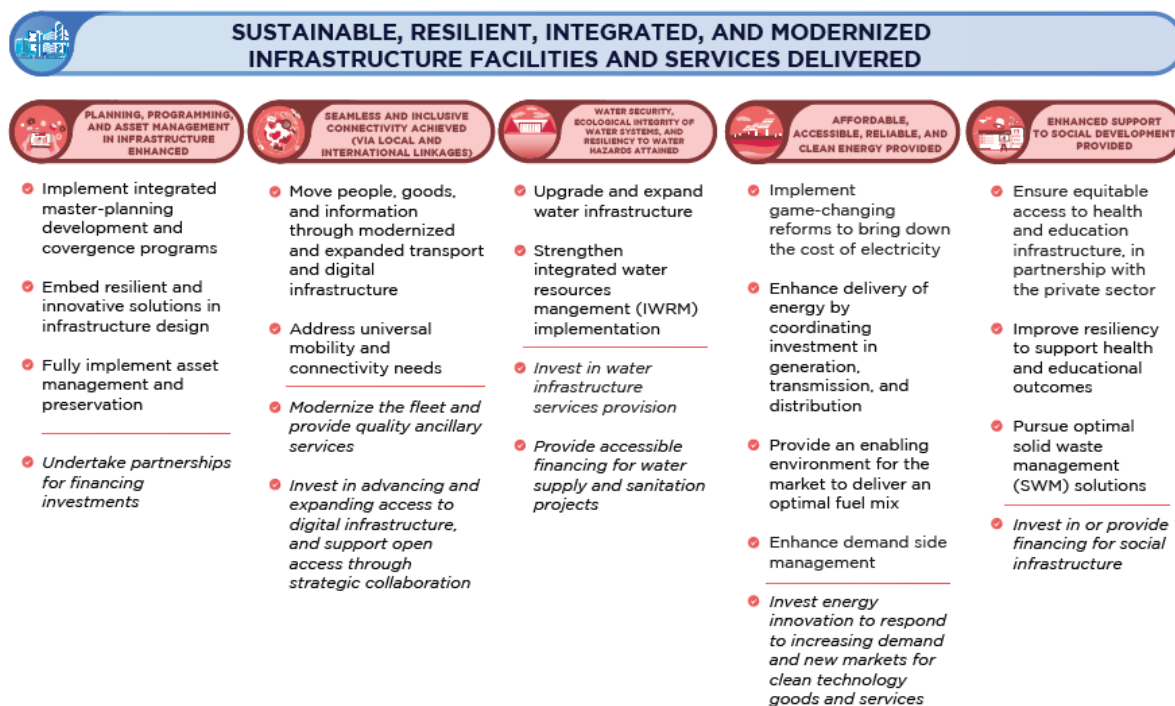
## **Strategy**

An expected outcome for connectivity is to achieve a seamless and inclusive connectivity via local and international linkages. Active participation of the Private Sector is seen vital to be able to move people, goods and information through modernized and expanded transport and digital infrastructure.

- 1) A National Transportation Plan will be formulated and adopted.
- 2) Intermodal transport facilities will be constructed and upgraded to achieve seamless connectivity.
- 3) Active transport networks will be developed.
- 4) Applicable transportation system (i.e., railways, road-based, and ferry) will be developed in Metropolitan areas.
- 5) Reforms in the provision of public transport services will be strengthened.
- 6) The nautical highway will be improved.
- 7) Existing airports will be improved, and new ones will be strategically developed to address future demands.
- 8) Cargo and freight rail infrastructure to connect strategic infrastructure such as ports will be developed and expanded.
- 9) Cold chain logistics and management facilities will be developed.
- 10) The implementation of the ULP and Transport Accreditation, Permit and Pass for Ports (TAPPP) will be made seamless and integrated.
- 11) Transport safety and security will be ensured.
- 12) Digital infrastructure will be modernized and expanded.
- 13) Gender mainstreaming, inclusion, and accessibility will be main consideration in all stages of transport project implementation.
- 14) Universal digital connectivity needs will be addressed.

## (2) Strategy Framework

“Build Better More” is the overarching objective for the infrastructure sector over the medium term, to enable economic transformation for a prosperous, inclusive, and resilient society. Geared toward the delivery of sustainable, resilient integrated, and modern infrastructure system, the strategic framework comprises the cross-cutting strategies and specific strategies corresponding to each of the infrastructure subsectors: connectivity (physical and digital), water resources energy, and social infrastructure.



Source: Philippine Development Plan 2023-2028

**Figure 2.1-3 Strategy Framework to Expand and Upgrade Infrastructure**

## (3) Legislative Agenda

Priority Bills of the 19<sup>th</sup> Congress during the Plan period to expand and upgrade infrastructure related to Connectivity involving DPWH are presented in the table below:

**Table 2.1-1 Legislative Agenda to Expand and Upgrade Infrastructure**

LEGISLATIVE AGENDA	RATIONALE/DESCRIPTION	RESPONSIBLE AGENCY
<b>General Infrastructure Policy</b>		
Public-Private Partnership (PPP) Act	This amends the Build-Operate-Transfer (BOT) Law to enhance the principal framework governing PPPs in the Philippines by fostering a more competitive and enabling environment for PPPs, addressing the ambiguities in the existing law, and addressing the bottlenecks and challenges affecting the PPP program.	Public-Private Partnership Center (PPPC), National Economic and Development Authority (NEDA)
Amendment of RA No. 10752 (The Right-of-Way Act (ROWA))	This will address difficulties in complying with the law's strict requirements (such as valuation, compensation and expropriation problems) and further expedite the implementation of infrastructure projects; to provide clearer, fairer, and simpler terms for ROW acquisition for both property owners and the government.	Department of Public Works and Highways (DPWH)
<b>Physical Connectivity</b>		
National Transport Policy Act	This aims to help achieve a safe, secure, efficient, competitive, dependable, integrated, environmentally sustainable, and people-oriented Philippine transportation system by setting forth policies that will serve as boundary conditions to guide all entities involved in the transportation sector in the exercise of their functions, including the creation of metropolitan transit authorities, and clarifying the roles and responsibilities of national and local governments.	Department of Transportation (DOTr), Department of Public Works and Highways (DPWH)

Source: Philippine Development Plan 2023-2028

#### (4) Results Matrix

The indicators and targets to expand connectivity infrastructure in relation to DPWH as implementing agency is shown below.

**Table 2.1-2 Indicator and Target**

INDICATOR	BASELINE (YEAR)	TARGETS							MEANS OF VERIFICATION	RESPONSIBLE AGENCY/ INTER-AGENCY BODY
		2023	2024	2025	2026	2027	2028	EOP		
Intermediate Goal: DELIVER SUSTAINABLE, RESILIENT, INTEGRATED, AND MODERNIZED INFRASTRUCTURE FACILITIES AND SERVICES Chapter Outcome: Connectivity, Water Resources, Energy, and Social Infrastructure Improved										
Public infrastructure spending increased (% share in gross domestic product [GDP]) *	5.9 (Q1-Q3 2022)	5.2	5.1	5.0	5.0	5.4	6.0	6.0	Actual spending	All concerned implementing agencies, Development Budget Coordination Committee (DBCC)/ Department of Budget and Management (DBM)
<b>Physical Connectivity</b>										
Travel time (decreased) via land per key corridor (hours)	3.285 (2019)  2.38 (2021)	3.272	3.258	3.246	3.233	3.220	3.207	3.207	Agency reports	Metro Manila Development Authority, Department of Public Works and Highways (DPWH)

Source: Philippine Development Plan 2023-2028

## 2.2 Mindanao Development Plan

### 2.2.1 Mindanao 2020 Peace and Development Framework Plan (PDFP) 2011-2030

Mindanao 2020 or the Peace and Development Framework Plan 2011-2030 is a 20-year long-term plan that serves as basis for more detailed plans and budget allocations throughout its duration. The main goal of the long-term vision is to have a better future for Mindanao and its people (*Mindanawons*). It is designed through collective efforts and participations of several sectors and individuals that involves different forums, workshops, focus group discussions, interviews, surveys, and consultations. Moreover, it envisions to provide a holistic and multidimensional framework that emphasizes Mindanao history, culture, and social development. However, the long-term plan emphasizes that it is not a detailed blueprint but a guide to set general directions and define broad strategies to identify key concrete initiatives that will put *Mindanawons'* aspirations and necessities in coherent form.<sup>10</sup>

#### Guiding Principles of PDFP 2011-2030 Formulation<sup>11</sup>

1. Holistic and integrative planning to address various dimensions of human welfare.
2. Environment and natural resources as foundation of peace and development.
3. Consideration of dynamic changes in local and global context, both national and international settings.
4. People as primary determining factor to address problems and issues in communities by using appropriate actions and interventions.

<sup>10</sup> Mindanao 2020 Peace and Development Framework Plan (2011-2030). Page 12

<sup>11</sup> Mindanao 2020 Peace and Development Framework Plan (2011-2030). Page 13

5. Promotion of pluralism and cultural diversity in the whole region.
6. Good governance to address poverty, injustice, and unfair treatment, as well as to promote sustainable development in the community.
7. Involvement of women and youth in the success of peace and development interventions.
8. Positive and corroborative action to rectify traditional injustices and restore damages due to conflicts.
9. Sensitivity to different dimensions of conflict across regions.
10. Secured wide ownership through process of participatory plan formulation and gain support towards its successful implementation.

### **Overall Objectives<sup>12</sup>**

1. Define and long-lasting peace in the region.
2. Overall well-being of *Mindanawons* – good health, sufficient education, social connectedness and solidarity.
3. Consolidated, dynamic, and sustainable economy.
4. Participatory and cultural-sensitive governance and political framework.
5. Active international economic, cultural, and political linkages.

### **Overall Targets by 2030<sup>13</sup>**

1. Peace and order, and widely accepted cultural pluralism.
2. Lower income poverty rate of 15% of total Mindanao population.
3. Improved average life expectancy of 72 years, 100% enrollment rate with 90-95% completion rates in elementary and high school.
4. Stable forest cover of at least 40% of the land area.
5. Growing economy with GDP growth range averaging from 8 to 10%.
6. Up-to-date comprehensive plans (development plans and land use plans) for all LGUs at the same time climate change resilient.
7. Presence of working alliances and collaborations among municipalities.
8. Paved national and provincial roads in good condition, and linkages of different transportation system in several provinces.
9. Distinctive ambiance of Mindanao landscapes and architectures.

### **Enabling Conditions and Corresponding Challenges<sup>14</sup>**

1. Infrastructures/ Infrastructure development
  - a. Lack of comprehensible plans in integrated roads, bridges, logistics, and water resource management
  - b. Insufficient government financial support for development and maintenance
  - c. Lack of investment from private sectors due to weak policy of the implementation of projects under public-private partnerships
  - d. Vandalism of services and threat in peace and order
  - e. Serious power shortage. By 2030, the minimum requirement will be 1500MW.
  - f. Large percentage of unpaved roads up to 34.8% in national roads and 95% in barangay roads. Paved roads on the other hand which are in poor condition is about 39.2%
2. Knowledge support
  - a. Scarcity of basic research and weak application and transfer of advance technology.
  - b. Lack of financial support in human resource development.
  - c. Inadequate and unresponsive research agendas
  - d. Inability to produce enough scientists.

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<sup>12</sup> Mindanao 2020 Peace and Development Framework Plan (2011-2030). Page 31

<sup>13</sup> Mindanao 2020 Peace and Development Framework Plan (2011-2030). Page 35

<sup>14</sup> Mindanao 2020 Peace and Development Framework Plan (2011-2030). Pages 28-29

### **Realizing Mindanao 2020<sup>15</sup>**

The requisite for the realization of the vision is to address the challenges and conditions of Mindanao's development mentioned above. Goals and strategies related to infrastructure development, science and technology, research and development, and financing of projects are presented below.

#### **Goals:**

1. To build a reliable, efficient, and climate-resilient infrastructures in the form of:
  - a. Integrated intermodal transport and logistics network
  - b. High standard highways
  - c. Strategically located and climate-resilient ports
  - d. Airports and transport stationsthat will allow faster mobility; reduction of logistics costs; and promotion of productivity and competitiveness to everyone.
2. To have a dependable power system that will optimize the use of renewable energy, minimize environmental and ecological impacts, and ensure reliable transmission of power supply to most remote barangays.
3. To provide widely accessible water supply systems and eco-friendly sewerage and sanitation systems.
4. To invest in a state-of-the-art ICT infrastructure that will provide reliable, fast, and affordable connectivity for the people and for economic growth.
5. To build infrastructures for health, education, agriculture, tourism, and disaster risk and reduction management.
6. To have a strong and well-equipped science & technology that addressed peculiar challenges through relevant research and development.
7. To acquire sufficient financial resources from local and external fund sources that will promote self-reliance in sourcing of funds for the development and support of projects.

#### **Strategies and initiatives:**

##### *Infrastructures and Logistics*

1. Simultaneous formulation of Mindanao-wide long term infrastructure development plan and infrastructure subsector development plan.
2. Establishment of effective monitoring and evaluation system to reward and sanction performing and underperforming entities.
3. Educating the public of the infrastructure policies and programs to promote transparency and understand the significance and nature of the projects.

##### *Science & Technology and Research & Development*

1. Building a strong scientific and R&D community and culture.
2. Establishment of Mindanao Research and Development Center.
3. Establishment of Knowledge Mindanao Network to link various research institutions in different levels.
4. Enhancing technological support for Mindanao-based industries for human resource and economic development.

##### *Financing*

1. Improvement of local revenue generation and expenditure management of every LGU to strengthen the fiscal decentralization, responsibility, and accountability.
2. Addressing bottlenecks and utilizing ODA funds for medium-term projects.
3. Providing LGUs flexibility on fund management and allocation for local projects and programs.
4. Establishment of monitoring and evaluation mechanism to efficiently utilize funds and to prevent corruption.

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<sup>15</sup> Mindanao 2020 Peace and Development Framework Plan (2011-2030). Pages 44-48

5. Building LGUs capacities to manage offices considering balance and optimization of the people, profit, and the planet.

### **2.2.2 Mindanao Development Corridors (MinDC)**

According to the Mindanao Development Authority, MinDC is a spatial development strategy that aims to increase the competitiveness of Mindanao industries by providing integrated common service facilities in that way agriculture, tourism, and manufacturing sectors can generate more income and at the same time provides massive employment opportunities for the locals.<sup>16</sup>

#### **Objectives**

1. To improve the contribution of Mindanao to the Gross Domestic Product (GDP) of the Philippines and strengthen the enabling business environment in the island to maintain trade relations with economic unions such as BIMF-EAGA and ASEAN;
2. To provide infrastructures and improve connectivity so that identified industries such as rubber, coconut, coffee etc. will scale up their development;
3. To create business opportunities to farmers and fisher-folks leading to sustainable livelihood and increased income;
4. To provide capacity building for government workers as well as for business development providers and beneficiaries representing the conflict-affected areas; and
5. To strengthen good governance in all levels of the government to have an efficient and transparent public service.

#### **Development Corridors**

1. Northern Mindanao Development Corridor
  - a. host of heavy and large industries
  - b. Gateway to domestic markets in Visayas and Luzon
2. Western Mindanao Development Corridor
  - a. Top producer of fishery based products
  - b. Known for rubber, mango, and coconut production
  - c. Strategic area for international trading with neighboring countries (Malaysia, Indonesia, and Brunei)
3. South-Central Mindanao Development Corridor
  - a. Food basket, Agri-business, and industry
  - b. Center of logistics related activities
  - c. Known for its biodiversity and eco-tourism

#### **Development Clusters**

1. Business and industrial
2. Mariculture and Trade
3. Biodiversity and Eco-tourism
4. Food basket
5. Food, Agri-business, and Logistics

#### **Priority Programs and Projects**

1. Development of Surigao Airport
2. Northern Mindanao High Standard Highway
3. 1<sup>st</sup> segment of Mindanao Railway System
4. Development, Operations, and Maintenance of Laguindingan Airport

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<sup>16</sup> Mindanao Development Corridors (MinDC). <https://minda.gov.ph/project-management-and-coordination/mindanao-development-corridors-mindc>

5. Panguil Bay bridge
6. Development of Ozamiz Airport
7. Pagadian Airport
8. Zamboanga del Sur Coastal Road
9. Sioco – R.T. Lim Road
10. Zamboanga West Coastal Road
11. Zamboanga City Ecozone
12. New Zamboanga International Airport
13. Sulu Circumferential Road
14. Development of Tawi-tawi Road Network
15. Sanga-sanga Airport in Tawi-tawi
16. Development Malassa Airport in Tawi-tawi
17. Mapun Airport in Tawi-tawi
18. Sapah Airport in Tawi-tawi
19. Expansion of Davao International Airport
20. Development of Anflo Industrial Estate in Panabo, Davao del Norte
21. Davao International Container Terminal, Inc.
22. Davao Port Modernization
23. Development of Awang Airport
24. Development of Polloc Port
25. General Santos Airport Complex

### **Contribution of the Project to the Mindanao Development Plan**

Mindanao envisions that by 2020, “an integrated inter-modal transport and logistics network, with high standard highways and strategically-located ports and airports” would be in place. The establishment of the Central Mindanao High Standard Highway would aid in this realization by “allowing faster movement of people, goods and services, reducing logistics costs, and promoting productivity and competitiveness.”

Mindanao aims to position itself as a “logistics hub,” in preparation for the economic re-integration with member states of the BIMP-EAGA. With forward-looking investments for the development of airports and seaports in Cagayan de Oro and Davao already in the pipeline, the CMH would play a significant role in logistics in Mindanao. Once realized, the travel time between the two metropolitan centers would potentially be reduced from 6.5 to 3.5 hours, thus increasing the trade competitiveness within the region.

## **2.3 Regional Development Plan (Region X)**

### **2.3.1 Development Framework**

Anchoring to the long-term vision of *AmBisyon Natin 2040*, Northern Mindanao Region envisages to be “the gateway and leading industrial core and trade center in Southern Philippines, with dynamic men and women enjoying equal opportunities in sustainability, harnessing its agricultural and natural resources in building a decent, harmonies and safe environment.” This vision expresses the desire for the region to become a transshipment hub and industrial center as well as a major provider of high-value agricultural and fishery products. Figure 2.3-1 presents the development plan framework of Northern Mindanao. The framework identifies and emphasizes the priority focus areas (PFAs) with advantages which includes high value agricultural crops; livestock, poultry and fishery, fresh and processed foods; metal and engineering; tourism; and other emerging sectors. The macroeconomic targets are presented in Table 2.3-1.

The identified development issues include: low productivity, insufficient enterprises, formulation of value chain and industry cluster, market linkage, and Metropolitan Food Cluster/agri-based product cluster approach, in the AFF sector; high cost of doing business, limited access to production networks, insufficient infrastructure, and market access among others, in the industry and service sectors; and

poor connectivity in rural, production and left-behind area, traffic congestion, vulnerability to hazards, and improvement of airport capacity and port facilities in the transportation sector.

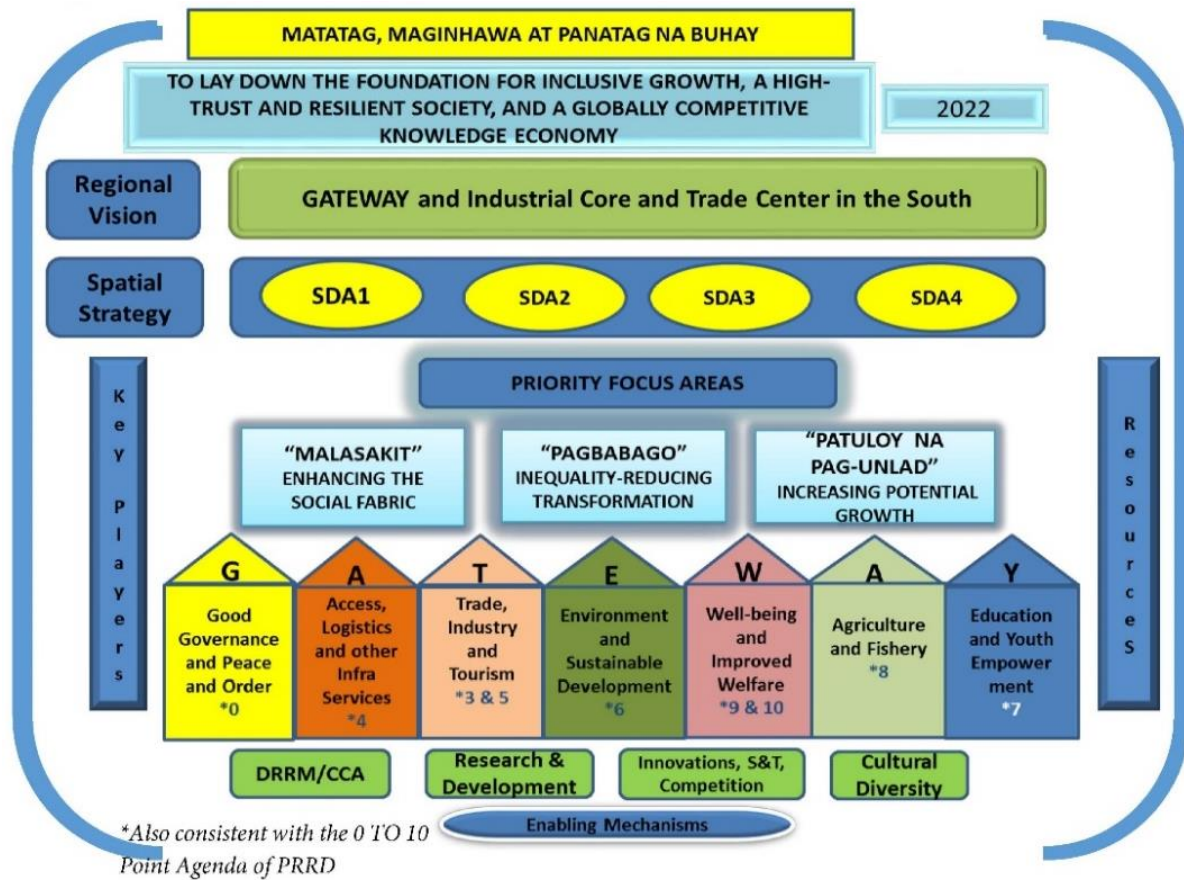


Figure 2.3-1 Northern Mindanao Development Plan Framework

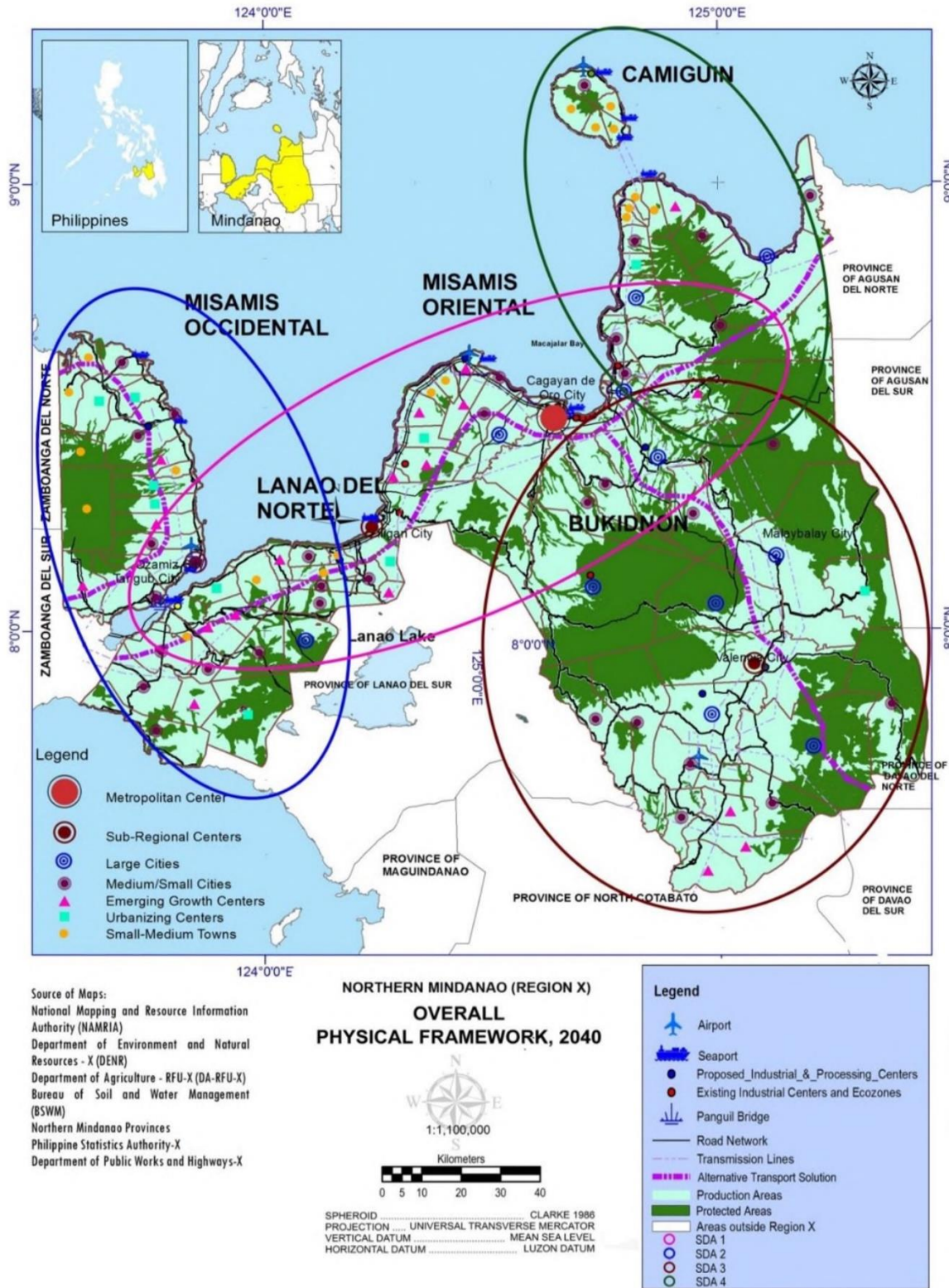
Table 2.3-1 Selected Macroeconomic Targets of Northern Mindanao 2017-2022

Indicator		Baseline	Average	Targets	
		Year	Value	2017	2022
GRDP and GVA Annual Growth Rate (%)	GRDP	2010-2015	6.3	5.1 - 6.7	6.1 - 8.2
	AHFF	2010-2015	3.7	4.0 - 5.5	4.5 - 7.0
	Industry	2010-2015	7.6	6.0 - 7.5	6.0 - 8.0
	Services	2010-2015	6.9	5.0 - 6.7	7.0 - 9.0
Underemployment Rate (%)		2015	24.9	24	<20
Poverty Incidence among Families (%)		2015	30.3	25 - 27 (2019)	22 - 24

Source: NEDA. Northern Mindanao Regional Development Plan 2017-2022.

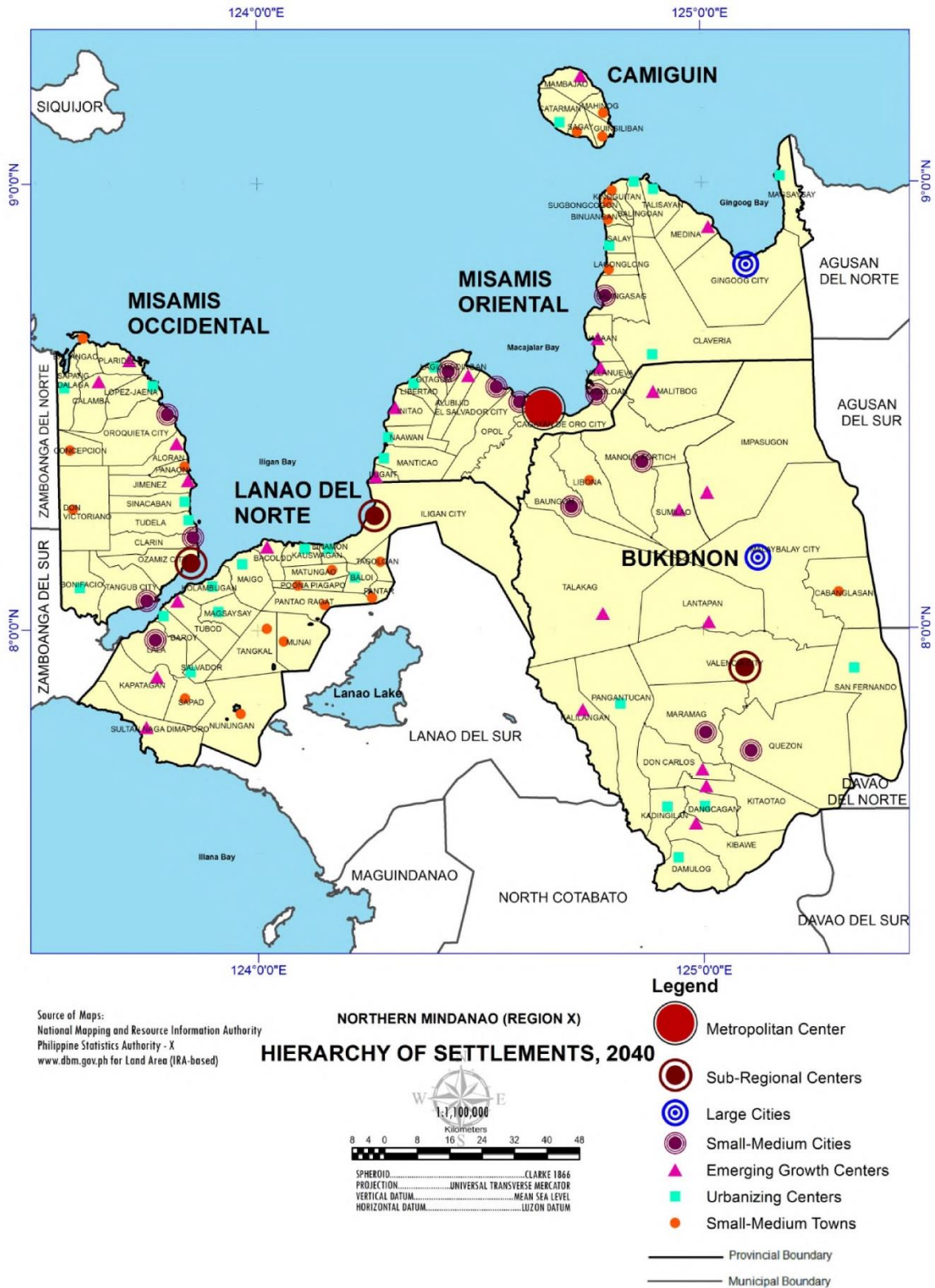
### 2.3.2 Regional Spatial Strategy

The Regional Spatial Strategy for Northern Mindanao is expressed in the Climate and Disaster Risk-Sensitive Regional Physical Framework Plan 2013-2040. Guided by the vision, the RFPF has proposed the physical framework, hierarchy of settlements, infrastructure framework, and vulnerability reeducation strategies, as shown from Figure 2.3-2 to Figure 2.3-5.



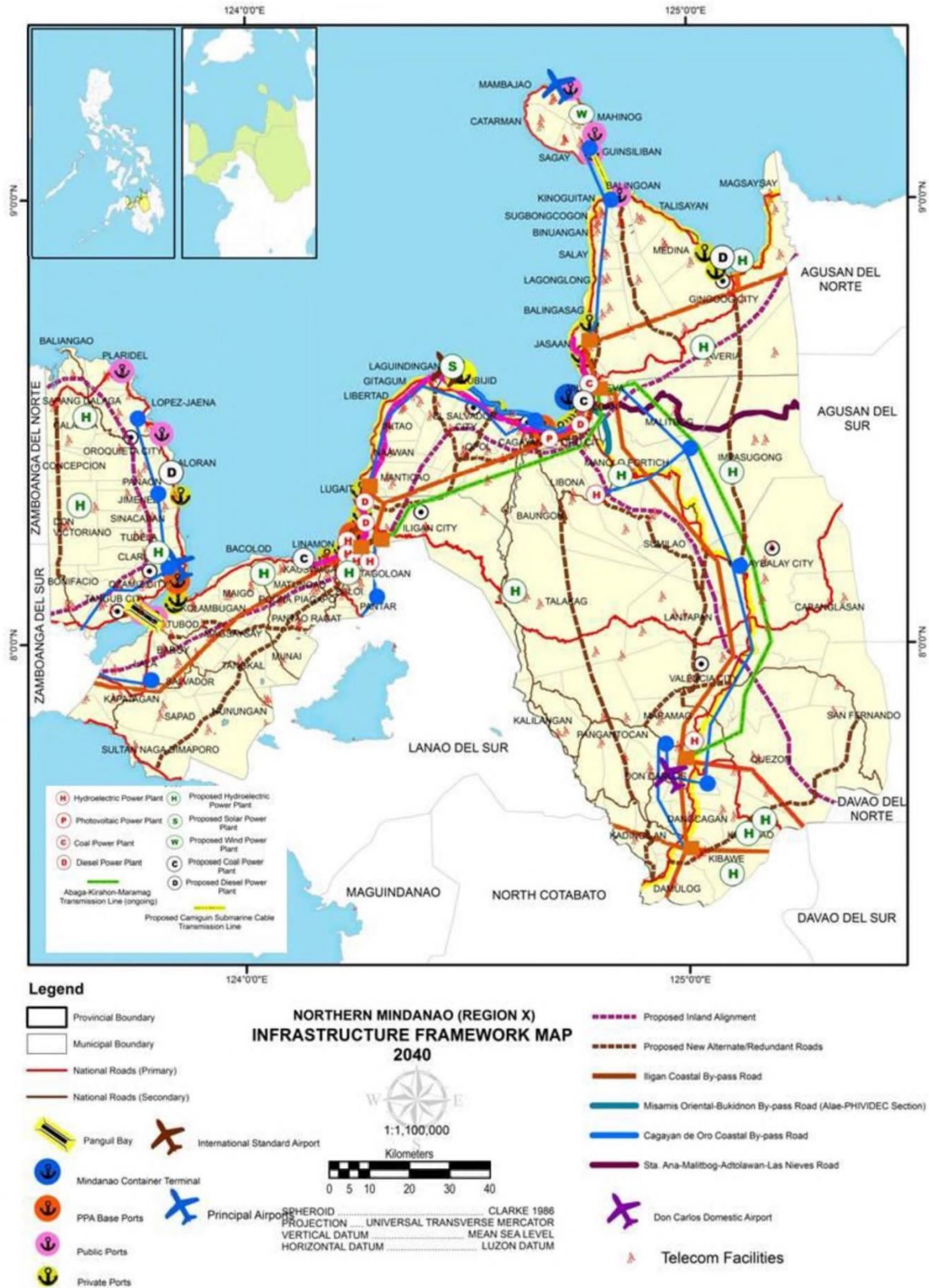
Source: NEDA. Northern Mindanao Regional Development Plan 2017-2022. Page 22.)

**Figure 2.3-2 Physical Framework 2040**



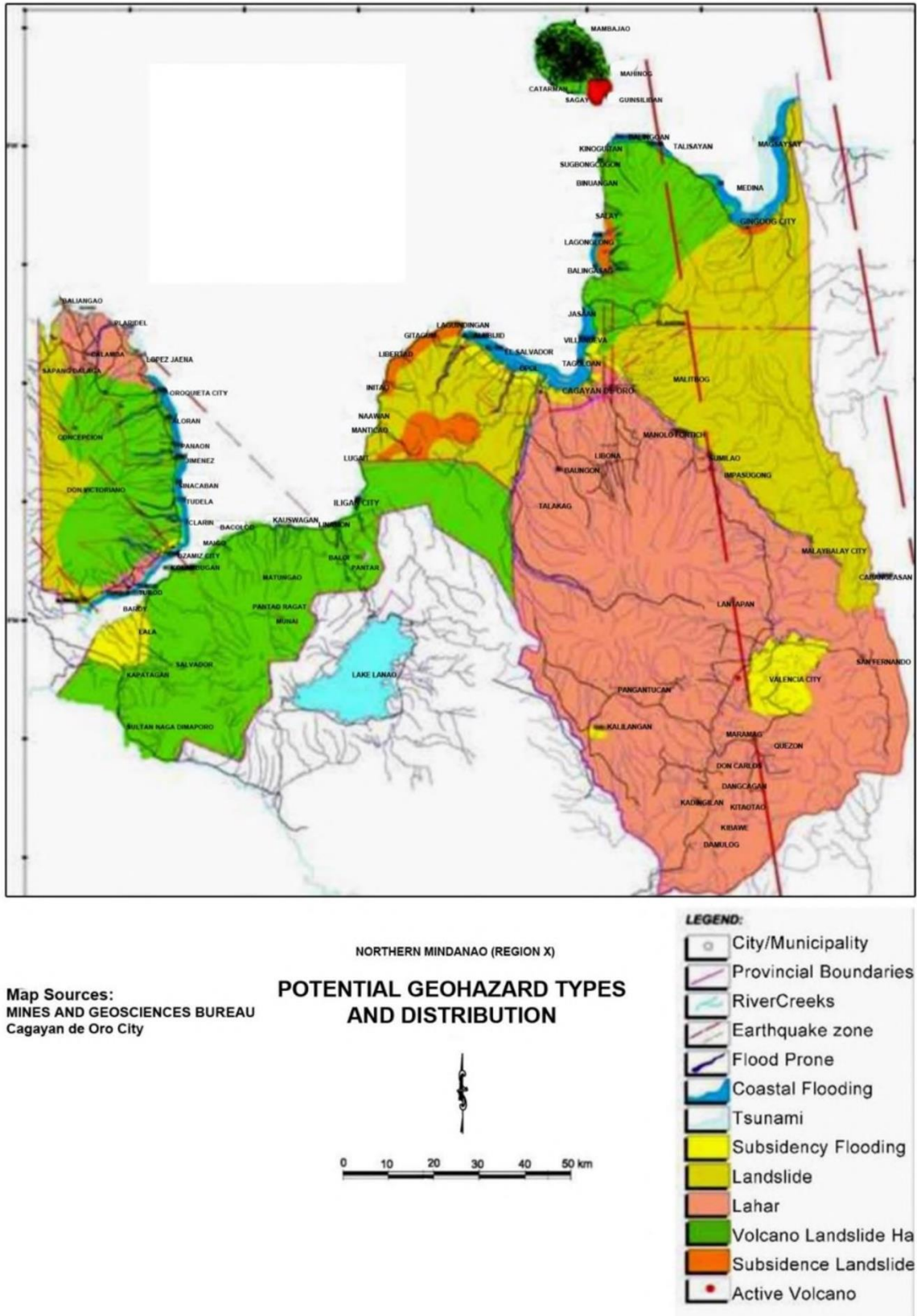
Source: NEDA. Northern Mindanao Regional Development Plan 2017-2022. Page 39.

**Figure 2.3-3 Hierarchy of Settlements 2040**



Source: NEDA. Northern Mindanao Regional Development Plan 2017-2022. Page 376.

**Figure 2.3-4 Infrastructure Framework Map**



Source: NEDA. Northern Mindanao Regional Development Plan 2017-2022. Page 24.

**Figure 2.3-5 Potential Geohazard Types and Distribution**

### **Contribution of the Project to the Regional Development Plan (Northern Mindanao)**

Northern Mindanao aims to utilize its geographical links to serve as a “transshipment hub and industrial center” and the primary gateway to Southern Philippines. The Regional Development Plan considers adequate and efficient logistics system and infrastructure support as the “backbone of the region’s development.”<sup>17</sup> According to the RDP, “transport networks linking production areas into processing and market centers and urban settlements shall be prioritized.”

The Central Mindanao High Standard Highway would be key to the attainment of this vision by “enhancing access and capacity for the movement of people, goods, services and information.” A high standard highway would increase logistics competitiveness, especially with trucking and shipping costs comprising 85% of total logistics costs<sup>18</sup> in Northern Mindanao.

Region X also aims to improve the resilience of the transport sector, as part of the Disaster Risk Reduction (DRR) and Climate Change Adaptation (CCA) strategies. Over the past years, alternate roads and bridges have been constructed within the region. The Central Mindanao Highway, as a high standard highway, would be designed to take natural disasters (e.g., landslides) into consideration. Should the existing national highway be damaged due to natural calamities, the CMH could offer road redundancy in Central Mindanao.

## **2.4 Local Development Plan**

### **2.4.1 Cagayan de Oro City**

The city envisions itself to be a city that managed through good governance, to have empowered citizens that thrives in a highly competitive economy, and to enjoy sustainable environment that nurtures diversity and multicultural heritage towards a progressive and resilient future.

The city government of Cagayan de Oro collaborated with different agencies such as Housing and Land Use Regulatory Board (HLURB) and National Economic Development Authority (NEDA) to prepare the Comprehensive Land Use Plan 2013-2022. These agencies gave assistance to guide the city to its future physical development, goals, objectives, and strategies required for the year 2022.<sup>19</sup>

#### **(1) Development Policy**

The city is facing development challenges in areas of urban planning, urban economy and finance, DRRM and CCA, urban mobility, urban energy, and governance and land management. Furthermore, poverty and vulnerability, informality, and emergence of slums are gradually becoming the key social and underdevelopment issues in the city. To address these challenges and issues, the local government unit of the city made efforts in developing policies, objectives, and strategies. They categorized those goals into two: (1) major development; and (2) preferred development.

Under Major development goals and objectives are the following:

- a. Upliftment of socio-economic condition by empowering citizens for a safe, healthy, and secured community integrating the principles of DRR-CCA.
- b. A strong, efficient, and responsive governance.
- c. Sustainable development for the protection and utilization of natural resources for inclusive growth.

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<sup>17</sup> Regional Development Plan 2017-2022, Chapter 2

<sup>18</sup> Confederation of Philippine Exporters 10. (2010). Shipping cost and competitiveness in Northern Mindanao “A Closer view of Northern Mindanao’s State of Competitiveness.” Cagayan de Oro City, cited by the Regional Development Plan 2017-2022, Chapter 2

<sup>19</sup> CLUP-CDO 2013-2022 Volume 1

- d. Investment to Enabling city.

Under the Preferred development thrust are as follows:

- a. Implementation of Major spatial development strategies.
- b. Development of urban centers.

Some of the strategies in different relevant areas are shown below:

- a. Social – employment and livelihood, housing and resettlement, sports and recreation, disaster risk reduction and mitigation, and establishment of city social welfare services complex.
- b. Economic – expansion of urban greening areas, establishment of high-density commercial district in new growth areas, promotion of agricultural technology, provision of alternative livelihood programs.
- c. Infrastructure – establishment of quality infra support, formulation of comprehensive drainage master plan, encouragement of using solar energy as alternative source of energy, establishments of bypass roads.
- d. Land use and environment – promotion of urban gardening, adoption of river basin approach in planning, implementation of DRR management plan, regulate mining activities, implementation of warning system developed by DOST, strict implementation of environment related act or law.

## **(2) Spatial Development**

The city's 12 major spatial development strategies are shown below. These served as the guide in developing spatial structure plan of the City.

- a. Entice development through the provision of basic and excellent facilities in identified growth areas.
- b. Conservation and protection of natural heritage sites.
- c. Incorporate provisions of pedestrian on proposed road right-of-way.
- d. Identify and legally declare built heritage sites.
- e. Intensify and sustaining urban greening.
- f. Establishment of new sanitary landfill.
- g. Enforce the setback requirements along public roads for yield points or loading-unloading bay.
- h. Intensify greening and fruit tree growing in sloping areas.
- i. Creation of light-medium industrial areas.
- j. Mangrove reforestation.
- k. Provision of structural mitigation measures for hazard prone areas.
- l. Provision of housing for settlers in blighted areas.

Figure 2.4-1 shows the spatial development structure plan of rural and urban area of Cagayan de Oro City based on the development strategies. It identifies areas for development, conservation and protection, heritage sites, light to medium industry, reforestation, and urban greening.

Figure 2.4-2 presents the transport network and circulation pattern in Cagayan de Oro City highlighting the five different development areas. These growth nodes are discussed and summarized in Table 2.4-1.

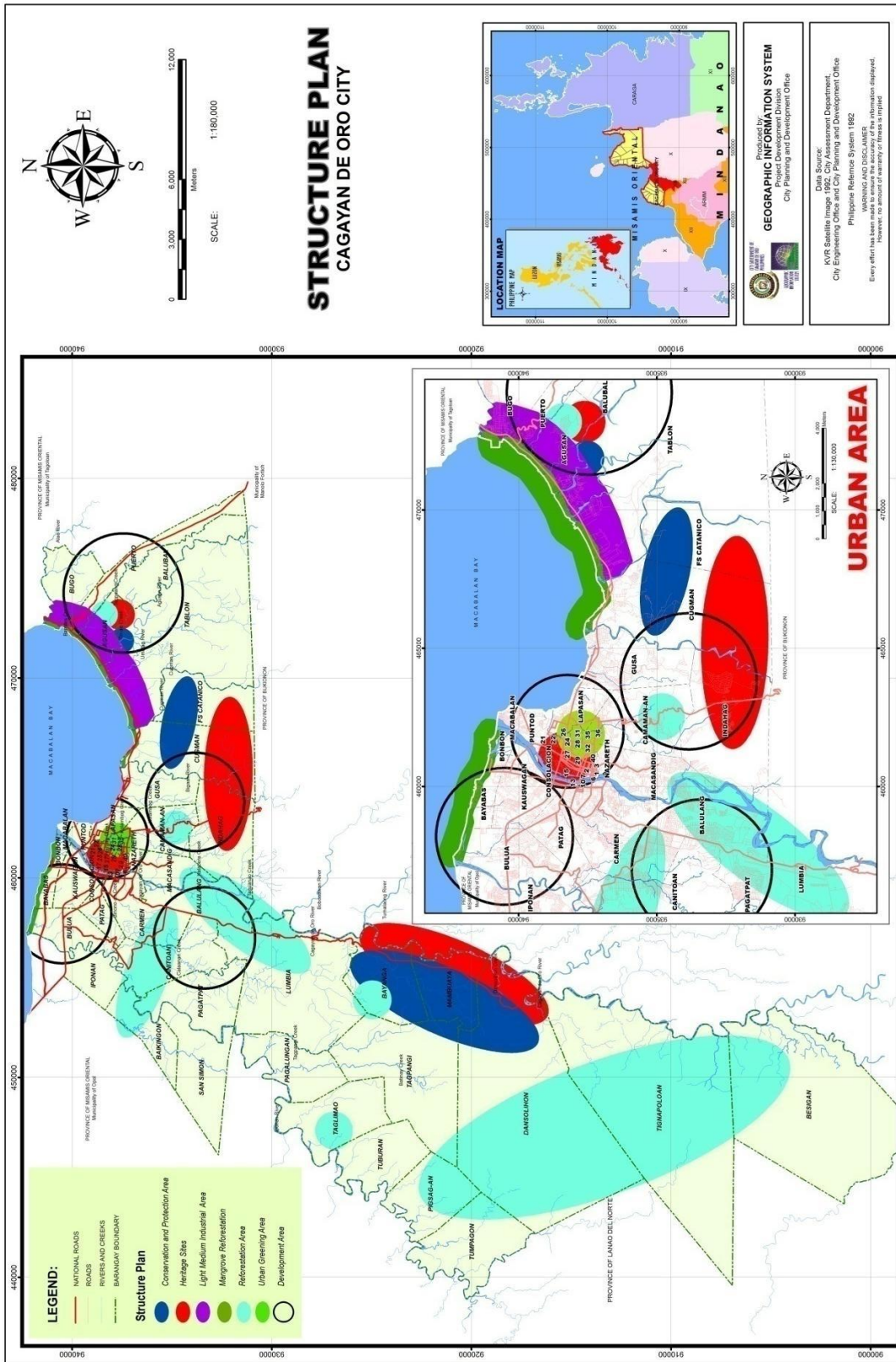
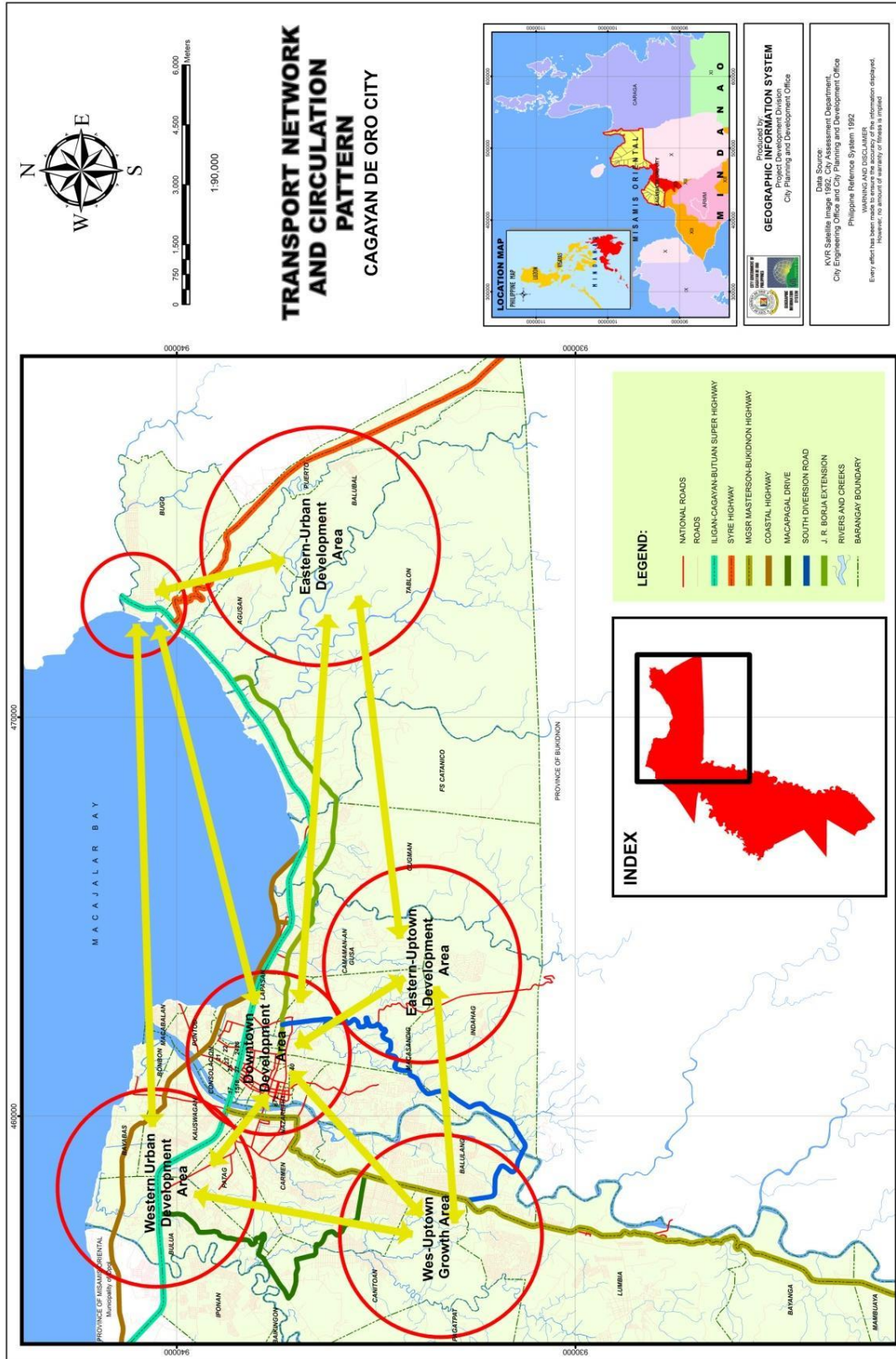


Figure 2.4-1 Map of the Structure Plan of Cagayan de Oro City  
 Source: CDO CLUP 2013-2022, Page 95.



Source: CDO CLUP 2013-2022, Page 104.  
 Figure 2.4-2 Transport and Circulation Pattern Map of Cagayan de Oro City

**Table 2.4-1 Summary of Cagayan de Oro City Urban Development Areas**

Urban Expansion Area/ Growth Node	Description/Function	Area Covered
Western urban development area	<ul style="list-style-type: none"> <li>Entry and exit points to Laguindingan Airport</li> <li>Major convergence points for people, goods and products</li> </ul>	Barangay Bulua, Patag, Kauswagan, Bonbon, and Bayabas
West-uptown development area	<ul style="list-style-type: none"> <li>Medium to high-density, mixed-use pedestrian friendly center with high-end, low density type of development for residential and commercial uses</li> <li>Decongest present major urban city</li> <li>Provide more opportunities for socio-economic activities.</li> </ul>	Barangay Carmen, Canitoan, Lumbia, and Pagatpat
East-uptown development area	<ul style="list-style-type: none"> <li>Same function as West-uptown development area</li> <li>Linked to other major urban centers</li> </ul>	Barangay Gusa, Indahag, Macasandig, and Camaman-an
Eastern urban development area	<ul style="list-style-type: none"> <li>Agro-industrial area</li> <li>Industrial and residential area</li> <li>High-end subdivision area</li> <li>Agro-tourism area</li> </ul>	Barangay Puerto, Bugo, Agusan, Balubal, Tablon, Palalan
Downtown development area	<ul style="list-style-type: none"> <li>High-density commercial district</li> </ul>	Poblacion, Barangay Carmen, Lapasan, Puntod, and Macabalan

Source: CDO CLUP 2013-2022

### (3) Land Use Plan

To guide the physical development and steer economic development in the area, Cagayan de Oro City prepared two kinds of land use plans – the general and urban land use plans. The general land use is categorized into agricultural, forest, tourism, urban use, and including roads, rivers and creeks. Furthermore, urban land use is categorized into agro-industrial, commercial, industrial, institutional, open space, residential, and marshland. These are summarized in Table 2.4-2 and Table 2.4-3 and can be visualized in Figure 2.4-3 and Figure 2.4-4.

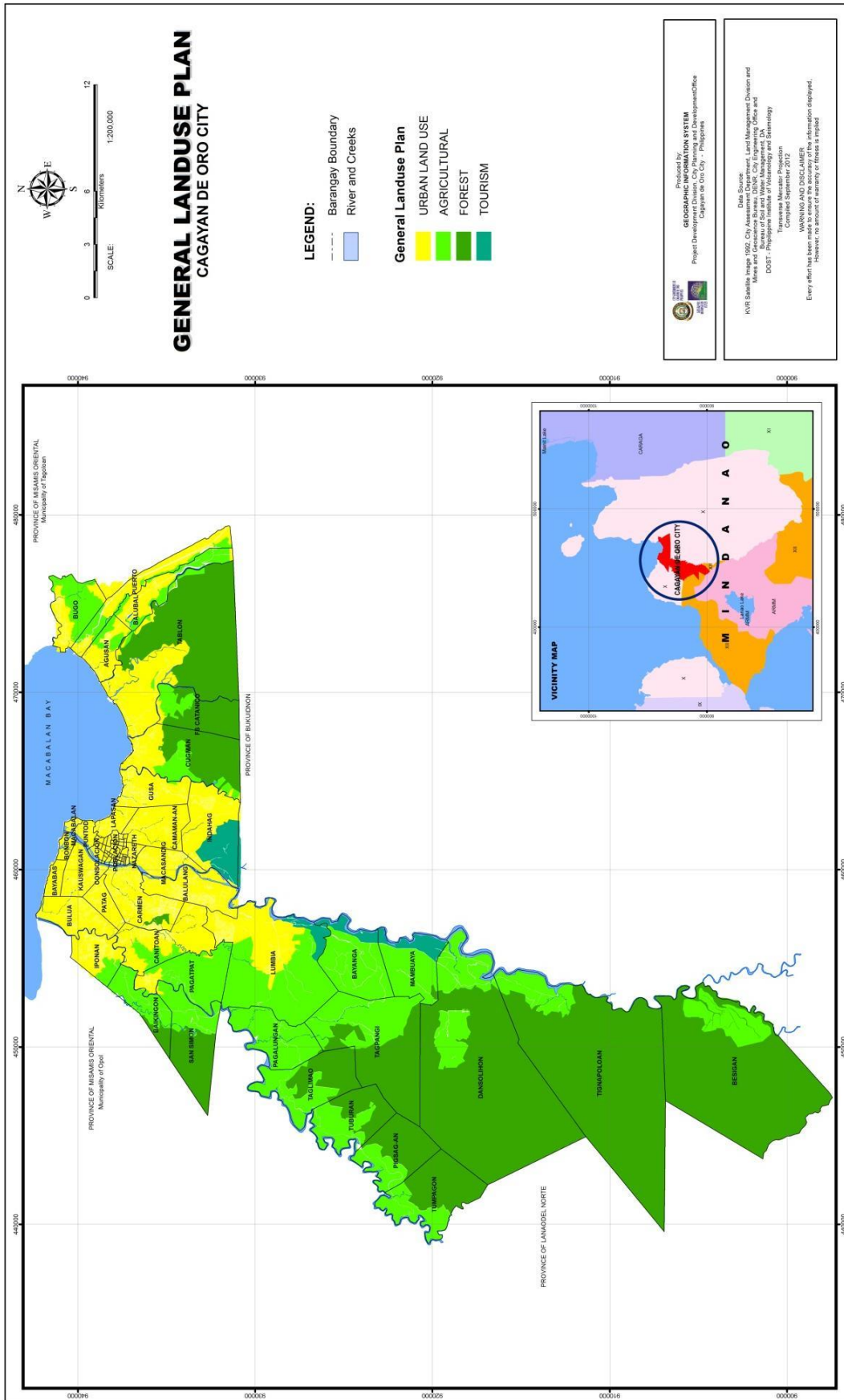
Majority of the city’s land area comprising 47.93% are forest lands, followed by agricultural lands with 25.5%, then about 20.96% are for urban use. The smaller portion of the city is intended for tourism with only 2.02%, which is smaller than 3.58% of the roads, rivers, and creeks combined (Table 2.4-2).

Urban lands are mostly intended for residential use with 75.75% of its land area. The remaining quarter of the urban land area is divided in the other six land uses where the smallest portion of about 0.66% is for the marshland (Table 2.4-3)

**Table 2.4-2 Proposed General Land and Water Uses (2013-2022)**

Land Use	Area (ha.)	% of Total Area
Agricultural	14,759.63	25.51
Forest	27,730.32	47.93
Tourism	1,167.34	2.02
Urban	12,123.47	20.96
Roads, rivers, and creeks	2,070.24	3.58
<b>Total</b>	<b>57,851.00</b>	<b>100</b>

Source: CDO CLUP 2013-2022



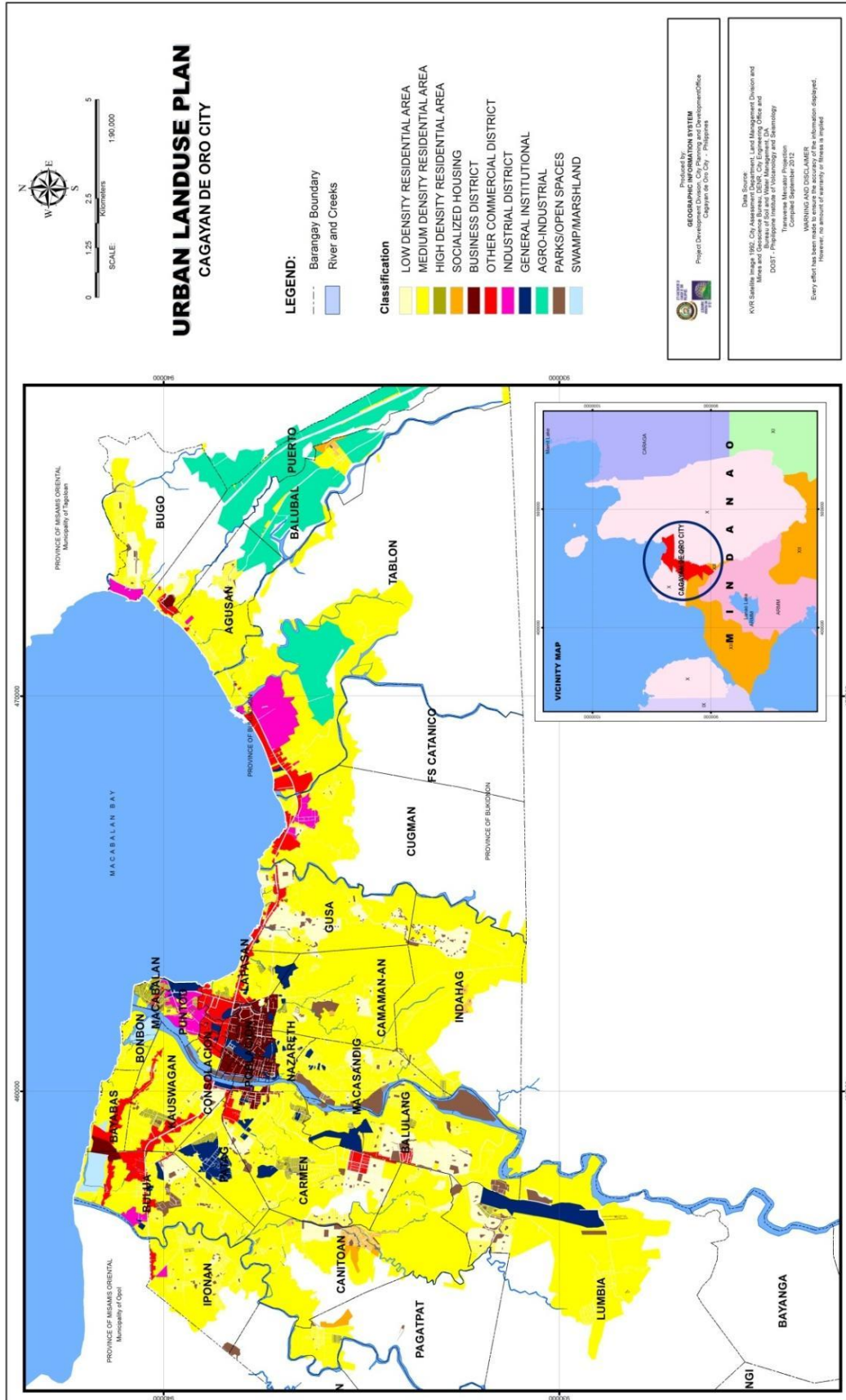
Source: CDO CLUP 2013-2022. Page 98

**Figure 2.4-3 Map of General Land Use Plan of Cagayan de Oro City**

**Table 2.4-3 Proposed Urban Land and Water Uses (2013-2022)**

<b>Land Use</b>	<b>Area (ha.)</b>	<b>% of Total Area</b>
Agro-Industrial	1,189.11	9.81
Commercial	688.96	5.68
Industrial	284.81	3.07
Institutional	372.53	2.35
Open Space/Vacant Land	325	2.68
Residential	9,183.19	75.75
Swamp/Marshland	79.87	0.66
<b>Total</b>	<b>12,123.47</b>	<b>100</b>

*Source: CDO CLUP 2013-2022*



Source: CDO CLUP 2013-2022. Page 103  
 Figure 2.4-4 Map of Urban Land Use Plan of Cagayan de Oro City

## **2.4.2 Tagoloan**

Tagoloan envisions itself as the center of industrial tourism with God-centered, healthy, and resilient citizens living in balanced and climate adaptive environment, guided by proactive and committed leaders that promote transparency.

### **(1) Development Policy**

“The Local Government Unit of Tagoloan, Misamis Oriental shall pursue a holistic and sustainable development through the principles of good governance, people empowerment, competitiveness, public and private sector partnership with the guidance of the Divine Providence.” To fulfill its mission, the local government of Tagoloan developed strategies, goals, and thrust, that will help lessen and eradicate problem and issues through programs and projects in social and economic sectors, infrastructure, and local governance.

The engines of growth summarized below are the preferred development strategy of Tagoloan that will allow to maximize and earn revenue for the citizens at the same time open more opportunities in both rural and urban areas:

- a. Industrial tourism
- b. Sustainable business enterprise

The major objectives of the preferred development thrust of the municipality are the following:

- a. Establishment of industrial and tourism sites to develop resilient communities
- b. Establishment of green belt and pocket parks
- c. Identification of commercial and industrial development area in PHIVIDEC
- d. Establishment of standard circumferential or radial road network system
- e. To provide buffers using fast growing trees in areas with body of water and around borders of industries
- f. Protection of coastal and aquamarine resources
- g. Development of a sustainable business district
- h. Establishment of an integrated municipal drainage system.
- i. Development of industry in General Industrial Zone outside PHIVIDEC.
- j. Adopt crop development zoning.
- k. Development of eco-tourism park.
- l. Development of compact settlements in residential areas.
- m. Establishment of watershed management plan.

### **(2) Spatial Development**

The structure plan map of Tagoloan is presented in Figure 2.4-5. Areas are categorized into four (4) growth areas: major residential, major commercial, major industrial, and major agricultural areas.



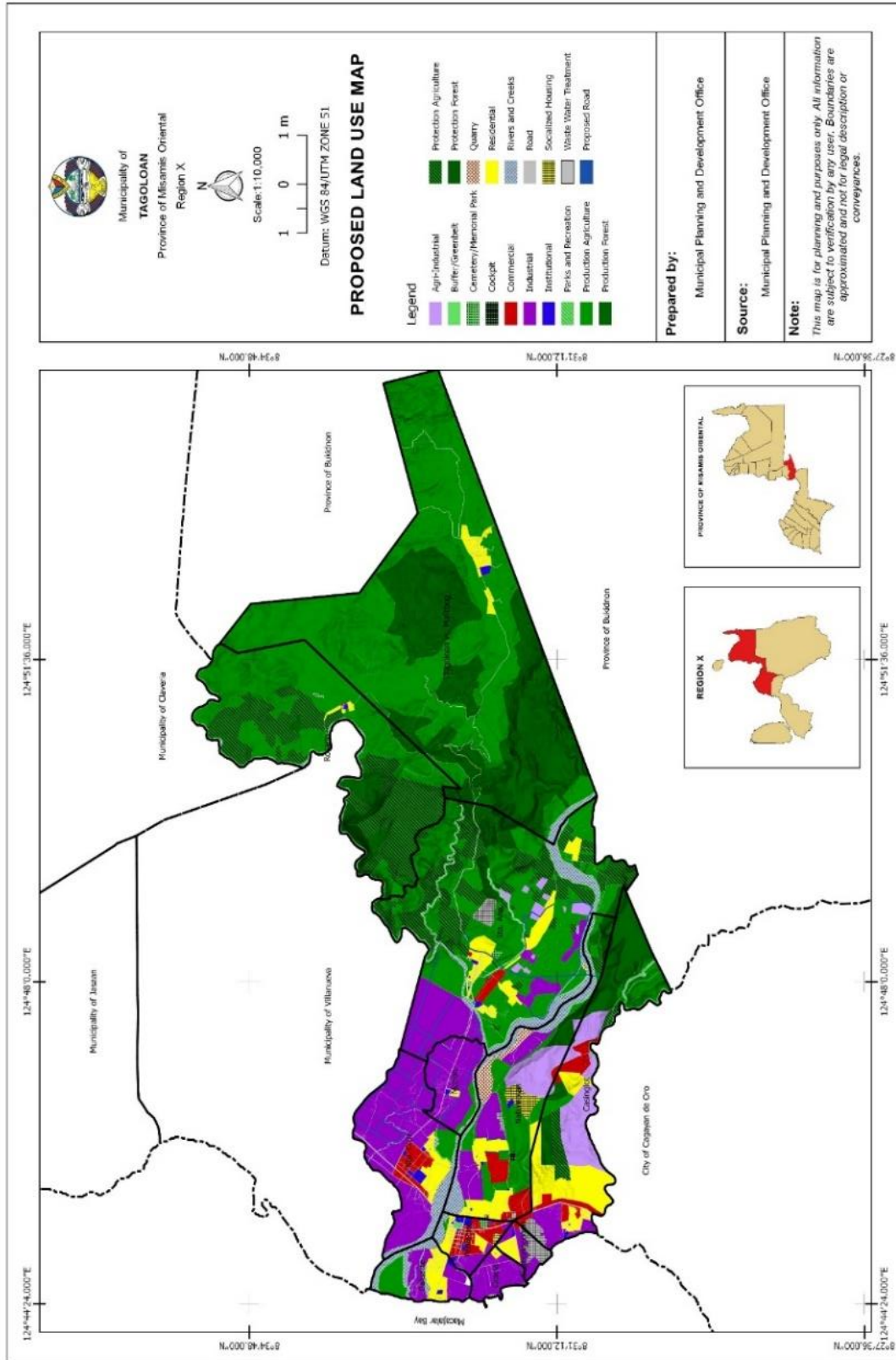
**(3) Land Use Plan**

The municipality of Tagoloan is known as the industrial center in Norther Mindanao hence, the largest portion of the land area is allocated for industrial areas. An increase of about 10.63 % from the existing allocation is due to the increase in number of industrial structures in nine barangays except Rosario. Built up areas composed of residential, institutional, commercial, and open spaces come second with an increase of 8.54 %. Agricultural lands experienced a 19.59 % decrease in total land area and were converted to settlements specially inside of PIA to pave way for the massive industrialization of the town. The changes in the land use increase areas for growth to accommodate increasing trend in urbanization and legal existence. The proposed land use plan identifies areas suitable for urban settlements, forest, and agricultural area as shown in Table 2.4-4 and presented in Figure 2.4-6.

**Table 2.4-4 Proposed Land Use Plan of Tagoloan CY 2017-2027**

Land Use	Existing		Proposed		% Increase/ (Decrease)
	Area (ha.)	% of the Total Area	Area (ha.)	% of the Total Area	
Built-up areas (Residential, Institutional, Commercial, Open Spaces)	247.33	2.90	976.44	11.44	8.54
Industrial Areas	150.54	1.76	1,057.40	12.39	10.63
Agricultural Areas					
Production	5,001.54	58.59	3,328.73	39.00	(19.59)
Protection	936.95	10.98	868.43	10.17	0.81
Forest					
Production	1,447.30	16.96	1,323.25	15.50	(1.46)
Protection	83.05	0.97	161.28	1.89	0.92
Agro-Industrial Areas	177.83	2.08	242.43	2.84	0.76
Utilities	99.40	1.17	182.92	2.14	0.97
Quarry	36.89	0.43	39.95	0.47	0.04
Rivers and Creeks	354.96	4.16	354.96	4.16	-
<b>Total Land Area</b>	<b>8,535.79</b>	<b>100.00</b>	<b>8,535.79</b>	<b>100.00</b>	
Foreshore and Coastal Water	2,722.13	100.00	2,722.13	100.00	-
<b>Total Water Area</b>	<b>2,722.13</b>	<b>100.00</b>	<b>2,722.13</b>	<b>100.00</b>	

Source: Tagoloan CLUP Vol. 1 2017-2027



Source: Tagoloan CLUP Vol. 1 2017-2027. Page 181  
**Figure 2.4-6 Proposed Land Use Map of Tagoloan City (2017-2027)**

### 2.4.3 Manolo Fortich

The vision of the municipality of Manolo Fortich is to be a premier and agri-ecotourist destination in the region with resilient and responsible people towards the environment and led by officials that are dynamic and proactive to the challenges of progress.

#### (1) Development Policy

The goals of the local government of the town categorized in 4 sectors are listed below:

- a. Social – to have empowered citizens that can adapt and respond to modernization and climate change.
- b. Economic – to achieve a vibrant and sustainable agri-eco tourist industry.
- c. Infrastructure – take advantage of advancement in technology and environment-friendly utilities for convenient access to goods and services.
- d. Environment – to have a well-defined ecological friendly land and water uses.

The objectives with corresponding strategies and policies for the development of the town is shown in Table 2.4-5.

**Table 2.4-5 Objectives, Strategies, and Policies of Manolo Fortich**

Objectives	Strategies		Policies
	Adaptation	Mitigation	
Provide settlements that are disaster resilient	<ul style="list-style-type: none"> <li>• Formulation of plans with integration of greenhouse gases reduction.</li> <li>• Identification of feasible areas for settlement.</li> <li>• Integration of greenbelts and buffers in the design of urban settlements</li> </ul>	<ul style="list-style-type: none"> <li>• Delineation of moderate-high risk areas to low density activities.</li> <li>• Complete circulation system in settlements</li> <li>• Drainage system in road network plan and easement along waterways</li> </ul>	<ul style="list-style-type: none"> <li>• Zoning ordinance</li> <li>• Sanctions for non-compliance</li> <li>• Strong permitting system prior to grant of Business permit</li> </ul>
Development of potential agri-eco-based tourism sites	<ul style="list-style-type: none"> <li>• Complementary commercial activities</li> </ul>	<ul style="list-style-type: none"> <li>• Municipal tourism plan making</li> </ul>	<ul style="list-style-type: none"> <li>• Implantation of approved Municipal tourism plan</li> </ul>
Improvement of drainage system	<ul style="list-style-type: none"> <li>• Drainage plan formulation</li> </ul>	<ul style="list-style-type: none"> <li>• Drainage plan implementation</li> </ul>	<ul style="list-style-type: none"> <li>• Strict implementation of National Building Code</li> </ul>
Reduction of soil erosion	<ul style="list-style-type: none"> <li>• Hinterland barangays as SALT cluster</li> </ul>	<ul style="list-style-type: none"> <li>• Planting of suitable crops</li> </ul>	<ul style="list-style-type: none"> <li>• Establishment of Organic Agricultural Local Technical Committee</li> </ul>
Prohibit settlements in river floodways and regulate development	<ul style="list-style-type: none"> <li>• Integration ofn greenbelts and pocket parks</li> </ul>	<ul style="list-style-type: none"> <li>• Strick implementation of easement in rivers and creeks</li> </ul>	<ul style="list-style-type: none"> <li>• Strict implementation of existing laws and regulations</li> </ul>
Prohibit construction and expansion of new building in areas that are susceptible to floods and landslides	<ul style="list-style-type: none"> <li>• Provide tree park or buffer strips</li> </ul>	<ul style="list-style-type: none"> <li>• Relocation of settlements to safe area</li> </ul>	<ul style="list-style-type: none"> <li>• Subdivision laws for non-agricultural lands</li> <li>• Urban development and housing act</li> </ul>
In 2022, to increase forest cover by 50%	<ul style="list-style-type: none"> <li>• Tree planting</li> </ul>	<ul style="list-style-type: none"> <li>• 2 hectares of 3 parks in urbanizing barangay and 5 hectares for rural barangay</li> </ul>	<ul style="list-style-type: none"> <li>• Ordinance that requiring all miners to plant a tree per cubic meter of materials extracted</li> </ul>

Objectives	Strategies		Policies
	Adaptation	Mitigation	
Preservation and maintenance of prime agricultural lands	<ul style="list-style-type: none"> <li>• CARL &amp; SAFDZ</li> <li>• Agri-commodities of compact farms</li> <li>• Promote organic and sustainable farming technologies</li> </ul>	<ul style="list-style-type: none"> <li>• Establishment of Monitor team</li> <li>• Flood resistance crops</li> </ul>	<ul style="list-style-type: none"> <li>• Establishment of mechanism for sanctions and rewards for non-compliance and complying land owners respectively</li> </ul>
Protection of bodies of water using buffers along creeks and rivers	<ul style="list-style-type: none"> <li>• Periodic monitoring of poultries and piggeries near rivers and creeks</li> </ul>	<ul style="list-style-type: none"> <li>• Establishment of environment friendly zones</li> <li>• Establishment of tree parks in barangays and riparian rehabilitation</li> </ul>	<ul style="list-style-type: none"> <li>• Implementation of zoning ordinance</li> <li>• MOA between LGU of Bukidnon and Manolo Fortich</li> </ul>
Resolution of boundary conflicts with neighboring municipalities	<ul style="list-style-type: none"> <li>• Coordination with DENR re legal municipal boundary</li> </ul>	<ul style="list-style-type: none"> <li>• Meeting with the 3 affected municipalities and its council</li> </ul>	<ul style="list-style-type: none"> <li>• Ordinance to resolve boundary conflicts with other Municipalities in the province</li> </ul>
Upgrade devastated areas if feasible or resettle if otherwise	<ul style="list-style-type: none"> <li>• Provide infrastructure utilities</li> <li>• Provide tree park or buffer strips</li> </ul>	<ul style="list-style-type: none"> <li>• Regulation of informal settlers in public and private lands</li> <li>• Preparation of Local Shelter Plan through Local Housing Board</li> </ul>	<ul style="list-style-type: none"> <li>• Strictly enforce Subdivision law</li> <li>• Implementation of Urban Housing and Development Act</li> </ul>

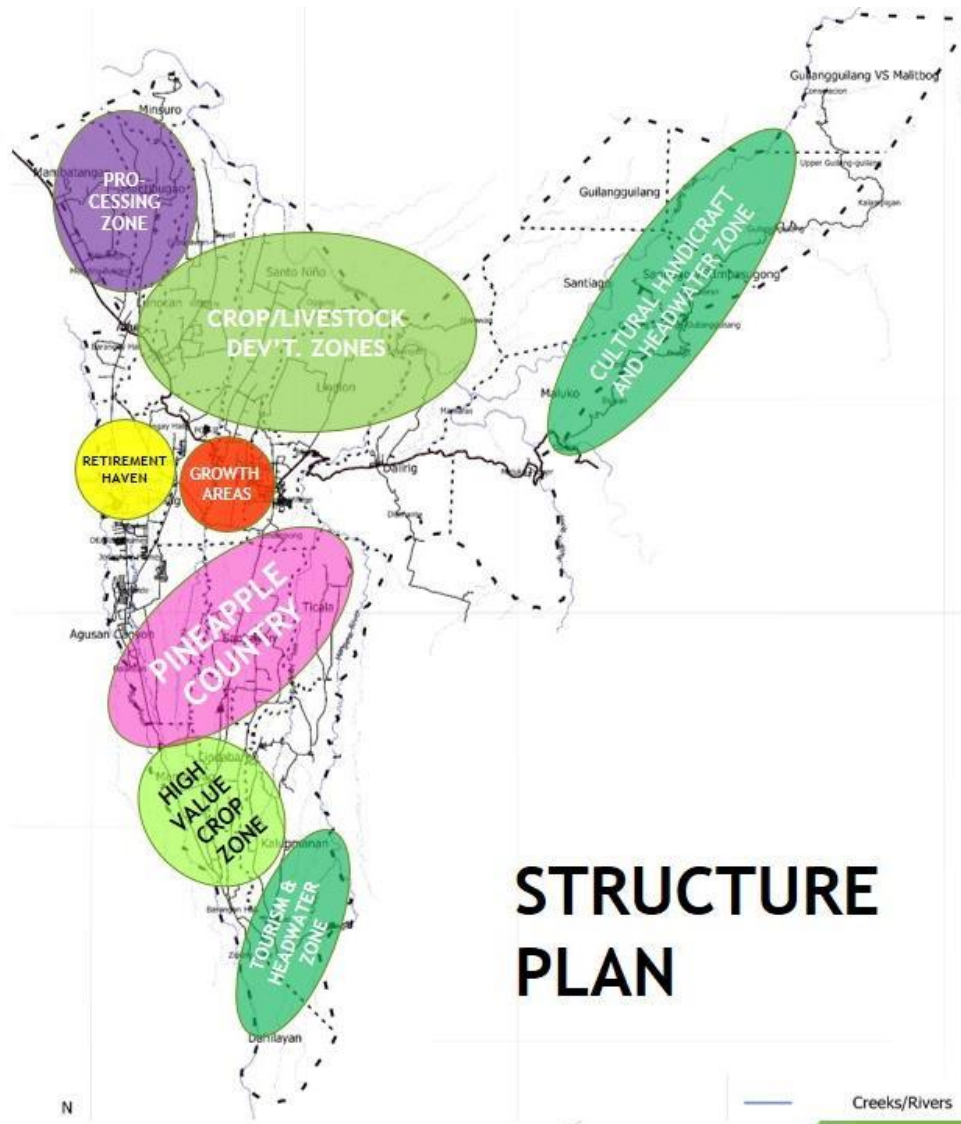
Source: Manolo Fortich CLUP Vol. 1 2013-2022

## (2) Spatial Development

To support the development direction of the town, two structure plans were formulated that highlights the sectoral development of the town.

- a. Agric-ecological tourism – cultural and handicraft zone, adventure and tourism zone, pineapple country, central business district, headwater preservation zone, high value vegetation zone.
- b. Urban-rural complementation – growth areas development, crops livestock development, processing zone, head water preservation zone.

After the evaluation of the impacts in socio-economic and physical aspects, the municipality arrived in a preferred structure plan that will promote the municipality’s vision integrating the two structure plans as Sustainable urban-rural complementation which is an expansion of the two structure concepts. It focuses on the potentials, vulnerability, and risk of barangays to disasters by assigning them individual major roles for balanced development, climate change adaptation, and disaster risk reduction. Figure 2.4-7 shows the structure plan of the municipality.



Source: Manolo Fortich CLUP Vol. 1 2013-2022. Page 77

**Figure 2.4-7 Structure Plan of Manolo Fortich**

**(3) Land Use Plan**

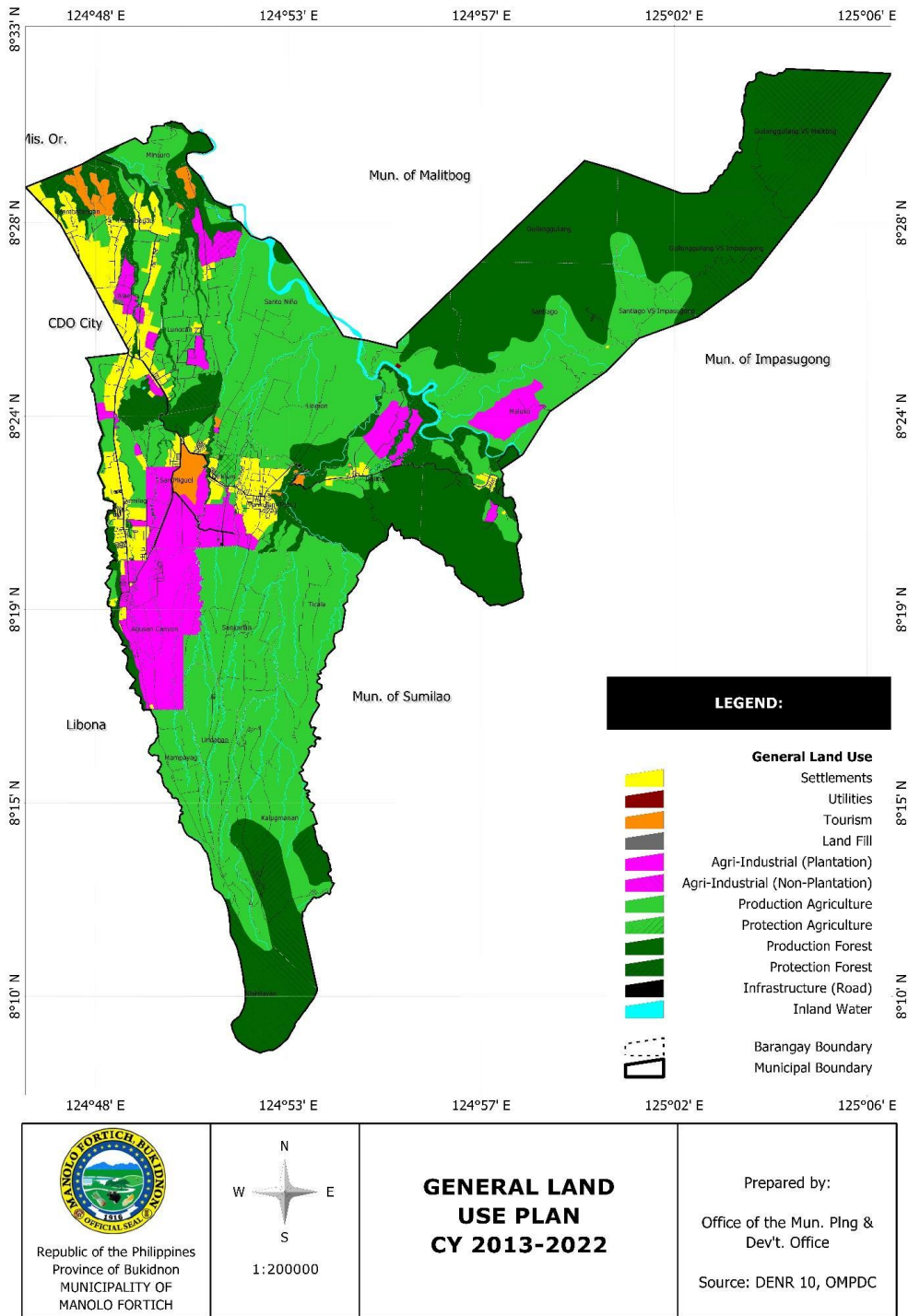
The proposed land use plan of the municipality focuses on the following objectives and changes from the existing plan. Table 2.4-6 shows the existing and proposed land uses of Manolo Fortich.

- a. Preservation and conservation of fragile areas
- b. Concentration on production areas to increase adaptation of the municipality to climate change and increase mitigation of risks.
- c. Based on existing laws and locational viability that results to reallocation of some portion of agricultural areas to settlement area and production or protection areas, agri-industrial to agricultural production areas.
- d. Quarry to be part of forest production area.
- e. Forest production area to be decrease and increase protection area for adaptation to climate change.

**Table 2.4-6 Comparative General Land Uses of Manolo Fortich (2013-2022)**

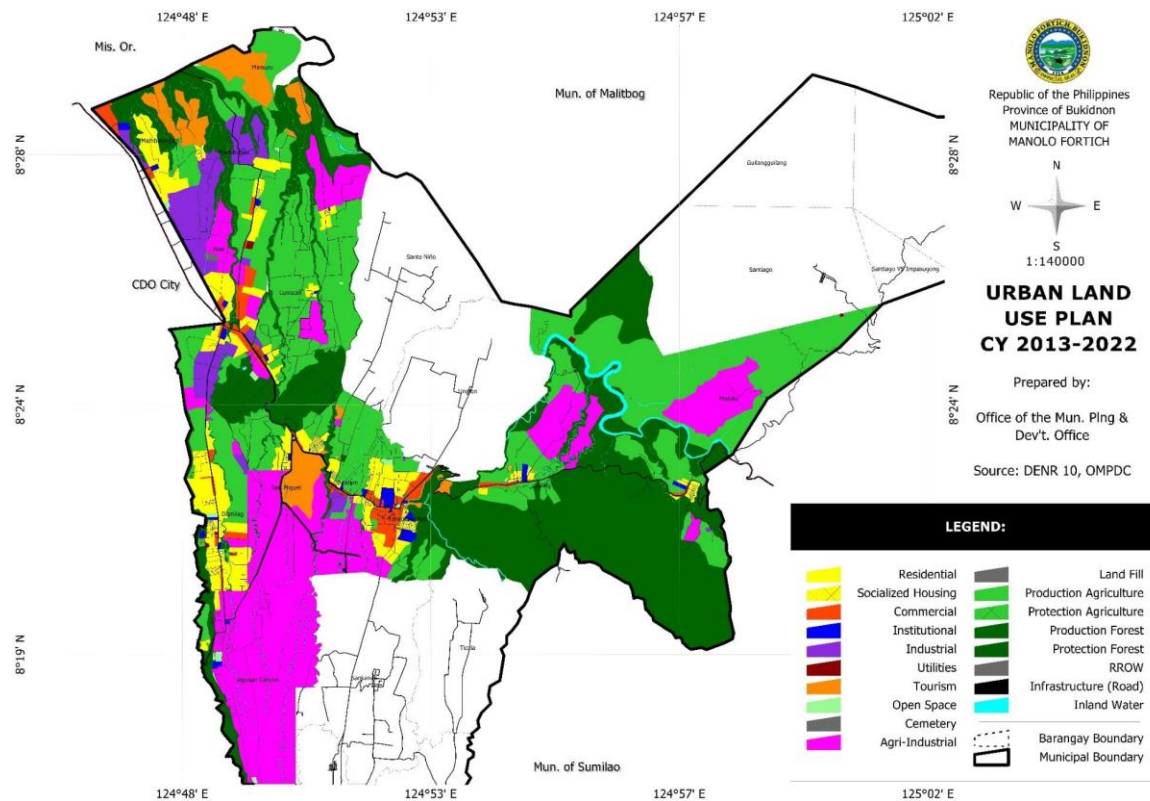
Land Use	Existing (2012)		Proposed (2013-2022)		% Increase/ (Decrease)
	Area (ha.)	% of the Total Area	Area (ha.)	% of the Total Area	
Settlements					
Urban	420.92	0.88	1416.83	2.96	2.08
Urbanizing	521	1.09	1292.37	2.70	1.61
Rural	309.08	0.65	309.08	0.65	0.00
Agricultural					
Production	22,796.11	47.62	20,398.72	42.61	(5.01)
Protection	92.38	0.19	118.4	0.25	0.05
Agri-industrial					
Plantation crops	5,061.43	10.57	4312.55	9.01	(1.56)
Other agri-processing	189.64	0.40	628.57	1.31	0.92
Forest					
Production	11,581.33	24.19	10,877.06	22.72	(1.47)
Protection	5,159.88	10.78	6532.65	13.65	2.83
Quarry	79.27	0.17			(0.17)
Special Uses (Road and Landfill)	492.70	1.03	684.78	1.43	0.40
Tourism	157.70	0.33	329.71	0.69	0.36
Inland water	1,006.76	2.10	967.49	2.02	(0.08)
<b>Total</b>	<b>47,868.21</b>	<b>100.00</b>	<b>47,868.21</b>	<b>100.00</b>	

Source: Manolo Fortich CLUP Vol. 1 2013-2022



Source: Manolo Fortich CLUP Vol. 1 2013-2022. Page 87

**Figure 2.4-8 Manolo Fortich General Land Use Plan CY 2013-2022**



Source: Manolo Fortich CLUP Vol. 1 2013-2022. Page 88

Figure 2.4-9 Manolo Fortich Urban Land Use Plan CY 2013-2022

#### 2.4.4 Malaybalay

Malaybalay City envisions itself as the prime center of agriculture industry in Northern Mindanao having God-centered, productive, self-reliant, and contented citizens living in harmony in an ecologically balanced environment led by transparent, accountable, and dynamic leaders.

##### (1) Development Policy

The goals of the city for each sector and subsectors are:

- a. Social – God-centered, productive, self-reliant, and contented citizen.
  - Health – provide accessible and affordable quality health services to cater people’s needs.
  - Education – to support schools to give their students to have excellent quality education and equip them with skills to compete globally.
  - Housing – to strengthen the local housing program.
  - Social welfare – to improve the quality of life through proactive, responsive, and sustainable social welfare services that will also promote social justice.
  - Protective service – to ensure public safety and internal security.
  - Sports and recreation – to promote wholesome sports and recreational activities.
- b. Economic – maximize productivity, production, and marketing capabilities.
  - Agriculture – to increase the crop production and productivity for food security.
  - Trade and commerce – to provide equitable opportunity and conducive business environment to attract investors and commercial establishments.
  - Agri-industry – to have a balanced agri-industrial economy.
  - Eco-tourism – to become a premier eco-cultural tourist destination in Mindanao.

- Forestry and environment – to have a sustainable management of forest resources.
- c. Local governance – accountable, transparent, competent, responsive, participative, and dynamic
  - Local organization – to have a competent human resources and active civil society participation in the formulation and implementation of policies, programs, and services as well as monitoring of those.
  - Local finance – to enhance and facilitate sustainable revenue generation.
- d. Infrastructure – development of facilities and utilities that promotes green infrastructures to support the social and economic needs.
  - Power – improvement of rural electrification projects; and to support power companies to fast-track line expansion and rehabilitation.
  - Water – to provide potable, affordable, and sufficient water supply.
  - Transportation – to enhance accessibility and movement.
  - Information and communication technology – to build efficient communication facilities.
  - Solid waste management – to have an effective and efficient ecological solid waste management.

The development thrusts of Malaybalay city are enumerated below. These principles served as guide in the whole planning and conceptualization of the city's Comprehensive Land Use Plan (CLUP).

- a. To allocate lands for future development.
- b. To keep the citizens and properties safe and reduce risk is to guide development away from hazardous areas.
- c. To protect and preserve green areas and environmentally critical areas.
- d. To protect agricultural lands and ensure the sustainable use of its resources.
- e. To ensure that housing meets the needs of the whole community.
- f. To provide alternative transportation routes.
- g. To facilitate delivery of services.
- h. To ensure that the economic growth of the city is attained but not on the expense of the environment.

## **(2) Spatial Development**

The structural plan embodies the preferred future growth and development of the city. The following are the structures of CLUP:

- a. Nodal development
- b. Corridor or Road-building development
- c. Urban greening
- d. Eco-tourism
- e. Commercial business district
- f. Institutional center
- g. Grain center
- h. Settlement expansion

(3) Land Use Plan

Table 2.4-7 Existing and Proposed Land Uses of Malaybalay City

Land Use	Existing		Proposed (2016-2025)		% Increase/ (Decrease)
	Area (ha.)	% of the Total Area	Area (ha.)	% of the Total Area	
<b>ALIENABLE AND DISPOSABLE</b>	<b>34,575.97</b>	31.938	<b>34,575.97</b>	31.938	0.000
<b>SETTLEMENTS</b>	<b>2,039.22</b>	1.884	<b>3,218.83</b>	2.973	1.090
<i>Residential (General)</i>	1,202.73	1.111	1,497.91	1.384	0.273
<i>Residential (Socialized)</i>	45.79	0.042	57.5	0.053	0.011
<i>Commercial</i>	62.56	0.058	292.87	0.271	0.213
<i>Institutional</i>	260.98	0.241	293.06	0.271	0.030
<i>Industrial</i>	67.62	0.062	114.94	0.106	0.044
<i>Special Institution</i>	-		5.68	0.005	0.005
<i>Parks/Playgrounds</i>	19.37	0.018	24.39	0.023	0.005
<i>Cemetery</i>	21.3	0.020	25.44	0.023	0.004
<i>Utilities</i>	5.75	0.005	4.38	0.004	(0.001)
<i>Eco-Tourism</i>	6.38	0.006	15.59	0.014	0.009
<i>Vacant Lots</i>	38.86	0.036		0.000	(0.036)
<i>Slaughterhouse</i>	0.29	0.000	0.27	0.000	0.000
<i>Roads</i>	305.08	0.282	467.65	0.432	0.150
<i>Controlled Dumpsite</i>	2.53	0.002	2.02	0.002	0.000
<i>Proposed Sanitary Landfill</i>	-		51.97	0.048	0.048
<i>Proposed Roads</i>	-		365.16	0.337	0.337
<i>Proposed General Settlements</i>	-		1,497.91	1.384	1.384
<b>AGRICULTURAL</b>	<b>32,536.75</b>	30.055	<b>31,357.14</b>	28.965	(1.090)
<b>Protection Lands</b>	<b>289.59</b>	0.267	<b>2,027.73</b>	1.873	1.606
<i>Riverbank Allowances</i>	-		1,729.14	1.597	1.597
<i>Rivers</i>	289.59	0.267	298.59	0.276	0.008
<i>*Restricted Development Zone</i>	-		<b>2,353.80</b>	2.174	2.174
<b>Production Lands</b>	<b>32,238.16</b>	29.779	<b>29,329.42</b>	27.092	(2.687)
<i>Light Industries (Processing Plants)</i>	-		1,001.24	0.925	0.925
<i>Agricultural Lands (Protection)</i>	3,616.83	3.341	4,154.71	3.838	0.497
<i>Agricultural Lands (Production)</i>	20,070.94	18.540	17,699.40	16.349	(2.191)
<i>Agri-Industrial (Livestock/Poultry)</i>	386.19	0.357	316.53	0.292	(0.064)
<i>Agro-Industrial (Plantation Crops)</i>	8,164.20	7.541	6,157.54	5.688	(1.854)
<b>FORESTLAND/TIMBERLAND</b>	<b>73,682.03</b>	68.062	<b>73,682.03</b>	68.062	0.000
<b>PROTECTION FOREST</b>	<b>46,529.95</b>	42.981	<b>46,529.95</b>	42.981	0.000
<i>Settlements</i>	101.59	0.094	91.36	0.084	(0.009)
<i>Agri-Industrial (Livestock/Poultry)</i>	31.02	0.029	27.76	0.026	(0.003)
<i>Agricultural Lands (Protection)</i>	217.31	0.201	176.75	0.163	(0.037)
<i>Forest Lands (Protection)</i>	23,029.42	21.273	22,255.43	20.558	(0.715)
<i>Forest Lands (Production)</i>	11,321.85	10.458	10,225.57	9.446	(1.013)
<i>MKRN</i>	11,511.32	10.633	11,511.32	10.633	0.000
<i>Roads</i>	39.49	0.036	39.49	0.036	0.000
<i>Rivers</i>	277.94	0.257	277.94	0.257	0.000
<i>Riverbank Allowances</i>		0.000	1,924.33	1.778	1.778
<b>PRODUCTION FOREST</b>	<b>27,152.07</b>	25.081	<b>27,152.07</b>	25.081	0.000
<i>Settlements</i>	288.41	0.266	335.18	0.310	0.043
<i>Proposed Sanitary Landfill</i>		0.000	8.5	0.008	0.008
<i>Agri-Industrial (Livestock/Poultry)</i>	44.66	0.041	43.15	0.040	(0.001)
<i>Agricultural Lands (Protection)</i>	2,748.83	2.539	2,679.88	2.475	(0.064)
<i>Forest Lands (Production)</i>	23,821.53	22.004	23,048.30	21.290	(0.714)
<i>Roads</i>	90.4	0.084	90.4	0.084	0.000
<i>Rivers</i>	158.24		158.24	0.146	0.146
<i>Riverbank Allowances</i>	-		788.43	0.728	0.728
<i>*Restricted Development Zone</i>			<b>3,493.72</b>	3.227	3.227
<b>GRAND TOTAL</b>	<b>108,258.00</b>		<b>108,258.00</b>		

Source: Malaybalay CLUP Vol 1 2016-2025



## **CHAPTER 3**

### **SOCIO-ECONOMIC CONDITION OF THE PROJECT AREA: REGION X- NORTHERN MINDANAO**

#### **3.1 Physical Profile**

##### **3.1.1 Geographic location, Land Area, Administrative Boundaries, and Accessibility**

Region X (Northern Mindanao) is situated in the southern part of the Philippines and the northern part of Mindanao island. It is located within 7°15'N to 9°15'N and 123°30'E to 125°30'E and is bounded by Bohol Sea in the north; the province of Agusan del Norte and Agusan del Sur in the east; the province of Davao del Norte, Davao City, and North Cotabato in the south; by Lanao del Sur in the southwest; and by Zamboanga del Norte and Zamboanga del Sur in the west. The region has a total land area of 20,458.51 sq. km<sup>1</sup> comprising around 6.8% of the country's total land area. The majority of which are classified as forestlands comprising about 54% of the land area and the remaining 46% are alienable and disposable lands.<sup>2</sup>

Figure 3.1-1 presents the administrative divisions of Northern Mindanao. It shows the provincial and municipal boundaries of the five major provinces in the region as well as the other provinces in neighboring regions.

The region is composed of:

- Five (5) major provinces – Bukidnon, Camiguin, Lanao del Norte, Misamis Occidental and Misamis Oriental
- Two (2) highly urbanized cities – Cagayan de Oro (part of Misamis Oriental province) and Iligan (part of Lanao del Norte)
- Seven (7) component cities – El Salvador, Gingoog, Malaybalay, Oroquieta, Ozamiz, Tangub and Valencia
- 84 municipalities
- 2,022 barangays

The region is divided into 14 congressional districts:

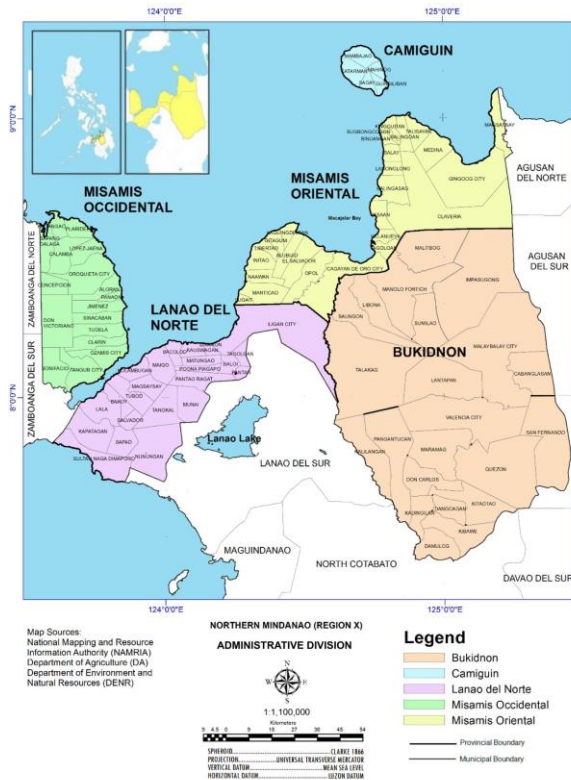
- Four (4) in Bukidnon province
- Two (2) in Lanao del Norte
- Two (2) in Misamis Oriental
- Two (2) in Misamis Occidental
- Two (2) in Cagayan de Oro City
- Lone districts in Camiguin and Iligan City.

Region X is connected to all regions in Mindanao island through networks of roads. Hence, road improvements shall be made to improve the transport of people, goods, and services within the island. Its proximity to major cities like Manila, Cebu, and Davao gives a strategic advantage when it comes to local trade and logistics services. Furthermore, the deep harbor of the region gives the best jump-off point for sea-based international trading with ASEAN and BIMP-EAGA nations.

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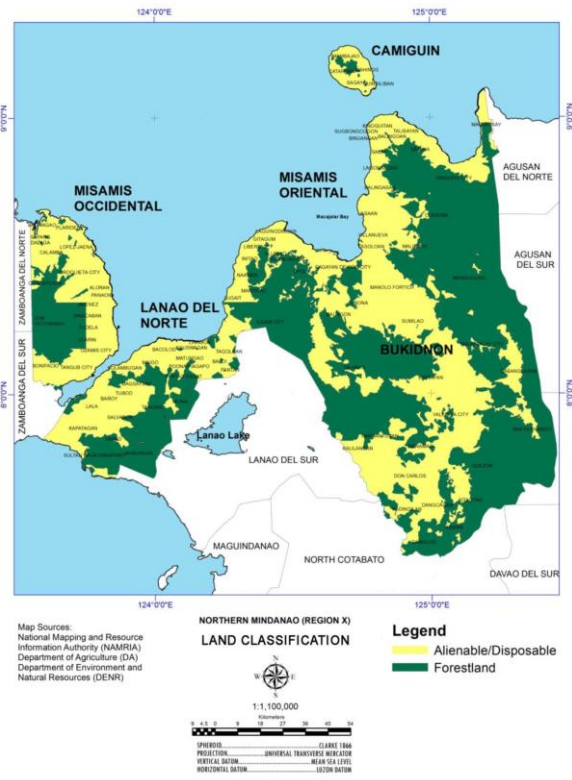
<sup>1</sup> 2015 Census of Population. Population, Land Area, and Population Density. Page xiv.

<sup>2</sup> 2018 Northern Mindanao Socio-Economic Profile. *Based on 2011 Census.*



Source: Northern Mindanao (Region X) Climate and Disaster Risk-Sensitive Regional Physical Framework Plan 2013-2040 (2015 update).

**Figure 3.1-1 Map of Northern Mindanao Administrative Boundaries**



Source: Northern Mindanao (Region X) Climate and Disaster Risk-Sensitive Regional Physical Framework Plan 2013-2040 (2015 update). Page 28

**Figure 3.1-2 Land Classification Map of Northern Mindanao**

### 3.1.2 Climate, Slope and Topography, and Geology

According to the PAGASA’s Climate Map of the Philippines (1951-2010), the prevailing types of climate in the region are Type III (with no very pronounced maximum rain period, with a dry season either from December to February or from March to May) and Type IV (rainfall is evenly distributed throughout the year). However, based on the study conducted by PAGASA in 2011 regarding climate trends and projections, there are areas in the region that are highly vulnerable to climate change<sup>3</sup>. Hence, patterns of rainfall, temperature, and extreme weather events may change in the succeeding years.

The topography in the region is composed of a combination of flatlands, rolling hills, and mountainous terrains. The area is predominantly composed of cool highlands (52.8%) with elevations ranging from 500 to 2,000 meters above sea level. Around 12% of the total land area are warm lowlands with an elevation of lower than 100 meters above sea level, while the remaining 35.2% of the total land area are warm uplands with elevations ranging from 100 to 500 meters above sea level. The elevation map of Region X is shown in Figure 3.1-3.

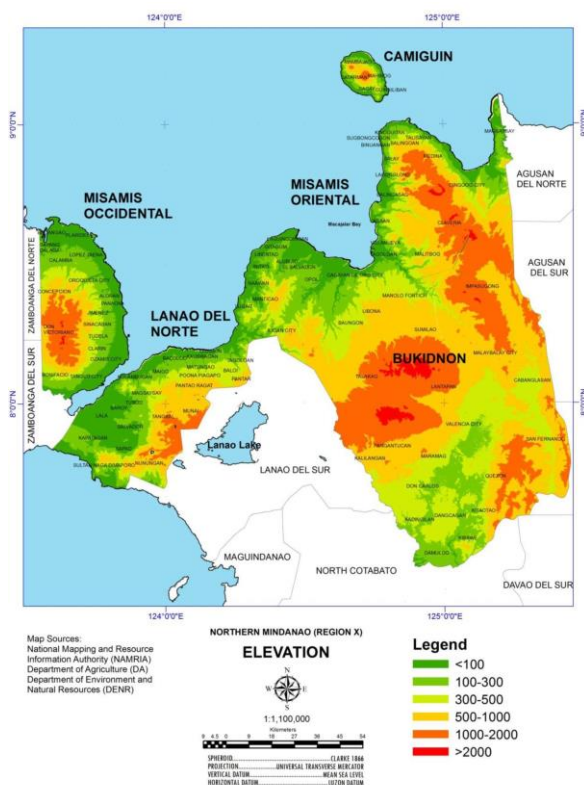
Table 3.1-1 shows the distribution of the varying slopes present in the region. The majority of the total land area in the region has more than 50% slope with very steep and mountainous areas which are considered very difficult and uneconomical. The slope profile of Region X is shown in Figure 3.1-4.

<sup>3</sup> Northern Mindanao (Region X) Climate and Disaster Risk-Sensitive Regional Physical Framework Plan 2013-2040 (2015 update). Page 38.

**Table 3.1-1 Slope Distribution in Northern Mindanao Region**

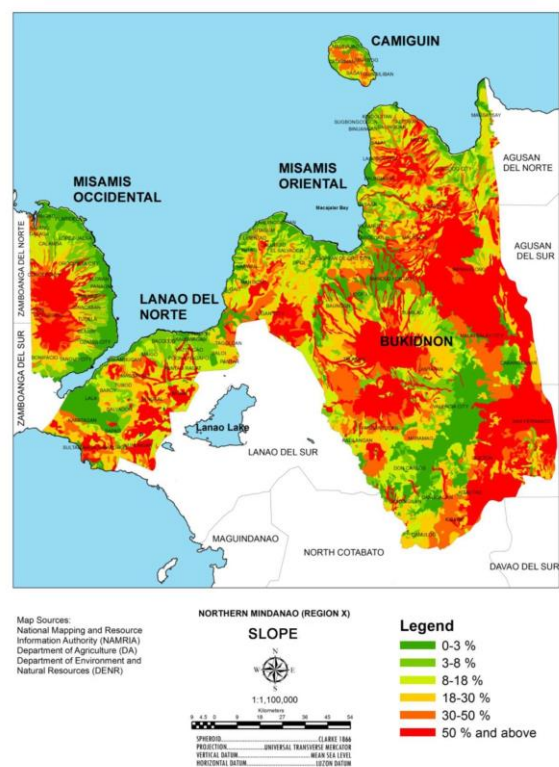
Slope	% of the Land area	Description and Uses
0-8 %	22%	<ul style="list-style-type: none"> <li>• Generally flat and irrigable</li> <li>• Highly suitable for agricultural uses</li> </ul>
8-18%	>12%	<ul style="list-style-type: none"> <li>• Gently sloping to rolling lands</li> <li>• For agricultural development</li> </ul>
18-30%	16%	<ul style="list-style-type: none"> <li>• Hilly to mountainous areas</li> <li>• Marginal lands for crops that need tillage</li> </ul>
30-50%	15%	<ul style="list-style-type: none"> <li>• Rough, hilly, dissected mountainous terrain</li> <li>• Reserved for forest trees to attain balance</li> </ul>
>50%	35%	<ul style="list-style-type: none"> <li>• Very steep and extremely mountainous areas</li> <li>• Difficult for tree extraction and uneconomical</li> </ul>

Source: Northern Mindanao (Region X) Climate and Disaster Risk-Sensitive Regional Physical Framework Plan 2013-2040 (2015 update). Page 27



Source: Northern Mindanao (Region X) Climate and Disaster Risk-Sensitive Regional Physical Framework Plan 2013-2040 (2015 update). Page 29

**Figure 3.1-3 Elevation Map of Northern Mindanao**



Source: Northern Mindanao (Region X) Climate and Disaster Risk-Sensitive Regional Physical Framework Plan 2013-2040 (2015 update). Page 30

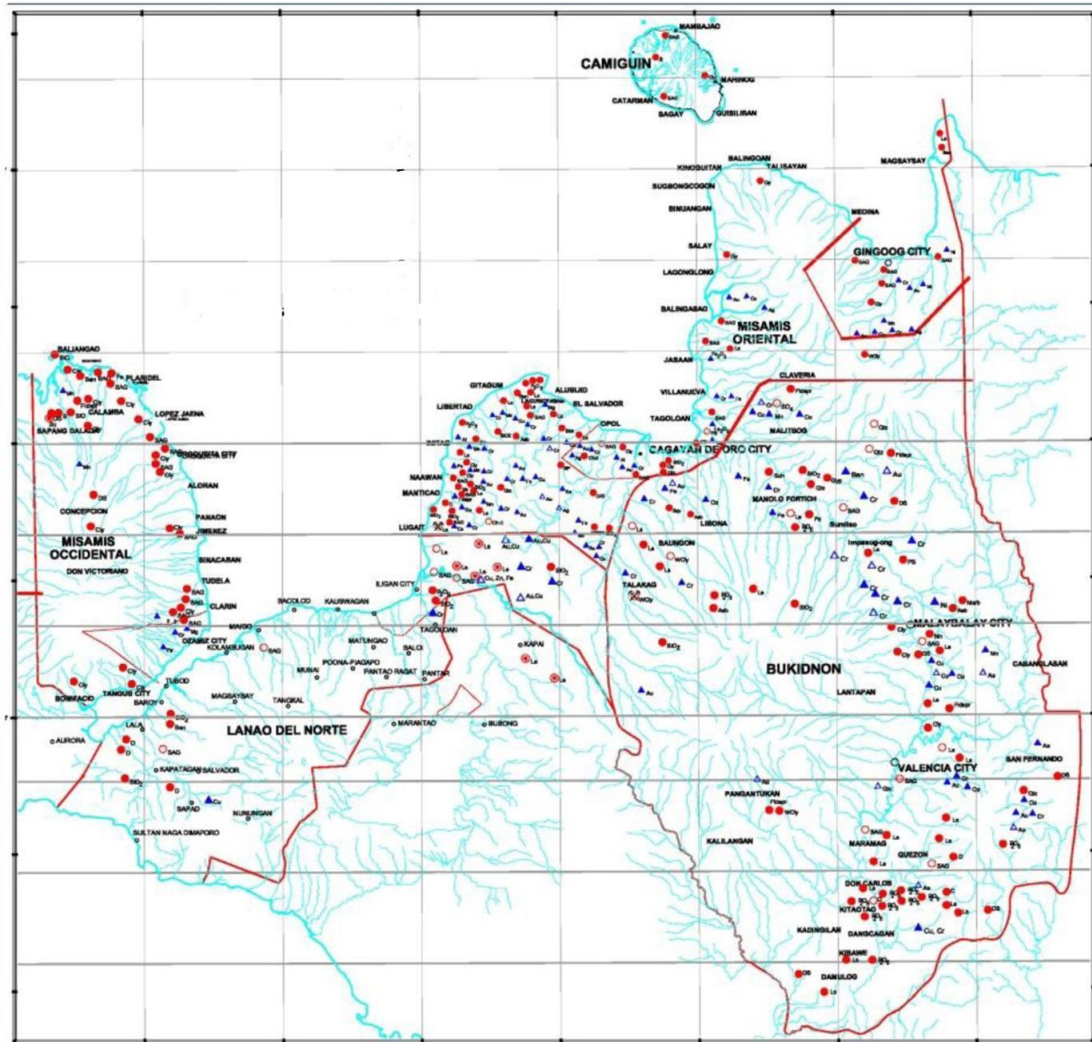
**Figure 3.1-4 Slope Map of Northern Mindanao**

Northern Mindanao’s geology is mostly composed of mountain ranges and of volcanic origin which makes it very abundant in mineral deposits. It includes the northeastern tip of Zamboanga Cordillera, the Lanao-Bukidnon Highland, the West Central Cordillera, and the Camiguin-Balatukan Range<sup>4</sup>. Most of the mineral resources found in the region are non-metallic minerals composed of limestone, guano and phosphate rocks, bentonite, clay, dolomite, feldspar, silica, sulfur, diatomite, coal, and that are used for structural and building materials. About 4.071 billion metric tons<sup>5</sup> of non-metallic mineral deposits

<sup>4</sup> Northern Mindanao (Region X) Climate and Disaster Risk-Sensitive Regional Physical Framework Plan 2013-2040 (2015 update). Page 36

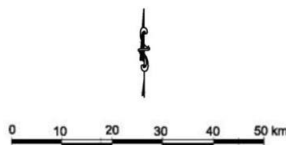
<sup>5</sup> Northern Mindanao (Region X) Climate and Disaster Risk-Sensitive Regional Physical Framework Plan 2013-2040 (2015 update). Page 36

can be found in different areas of Bukidnon, Camiguin, and Misamis Oriental. Furthermore, metallic minerals such as gold, silver, iron, alloys, and copper are also present in the region deposited in provinces of Misamis Oriental and Bukidnon. Figure 3.1-5 shows the distribution of non-metallic and metallic mineral deposits across the region.



Map Sources:  
 Department of Environment  
 and Natural Resources - X  
 MINES AND GEOSCIENCES BUREAU - X  
 GEOSCIENCES DIVISION  
 Cagayan de Oro City

NORTHERN MINDANAO (REGION X)  
**MINERAL DISTRIBUTION**



**LEGEND:**

<b>METAL ORES</b>	<b>NON-METALLIC MINERAL AND ROCKS</b>
Ag ..... Silver	Asb ..... Asbestos
Al ..... Aluminum	Ben ..... Bentonite
Au ..... Gold	C ..... Coal
Cr ..... Chromite	Ch, J ..... Chert / Jasper
Cu ..... Copper	Cly ..... Clay
Fe ..... Iron	D ..... Diatomaceous Earth
Mg ..... Magnesite	D/G ..... Diorite / Gabbro
Mn ..... Manganese	Ds ..... Dimension Stone
Ni ..... Nickel	Fkdspr ..... Feldspar
Fe <sub>3</sub> O <sub>4</sub> ..... Magnetite Sand	Gyp ..... Gypsum
<b>METALLIC MINERALS</b>	La ..... Limestone
△ ..... Active Small Scale	Marb ..... Marble
▲ ..... Prospect	PS ..... Phyllite Schist
<b>NON METALLIC MINERALS</b>	P <sub>2</sub> O <sub>5</sub> ..... Phosphate and Guano
⊗ ..... Large Scale Mining	Qtz ..... Quartz
○ ..... Active Small Scale	S ..... Sulfur
● ..... Prospect	SAG ..... Sand and Gravel
● ..... Explored	Sc ..... Schoria
	Sh ..... Shale
	SiO <sub>2</sub> ..... Silica
	SO <sub>2</sub> ..... Massive Sulphides
	SP ..... Serpentinized Peridotite
	Srp ..... Serpentine
	WCly ..... White Clay

Source: Northern Mindanao (Region X) Climate and Disaster Risk-Sensitive Regional Physical Framework Plan 2013-2040 (2015 update). Page 37

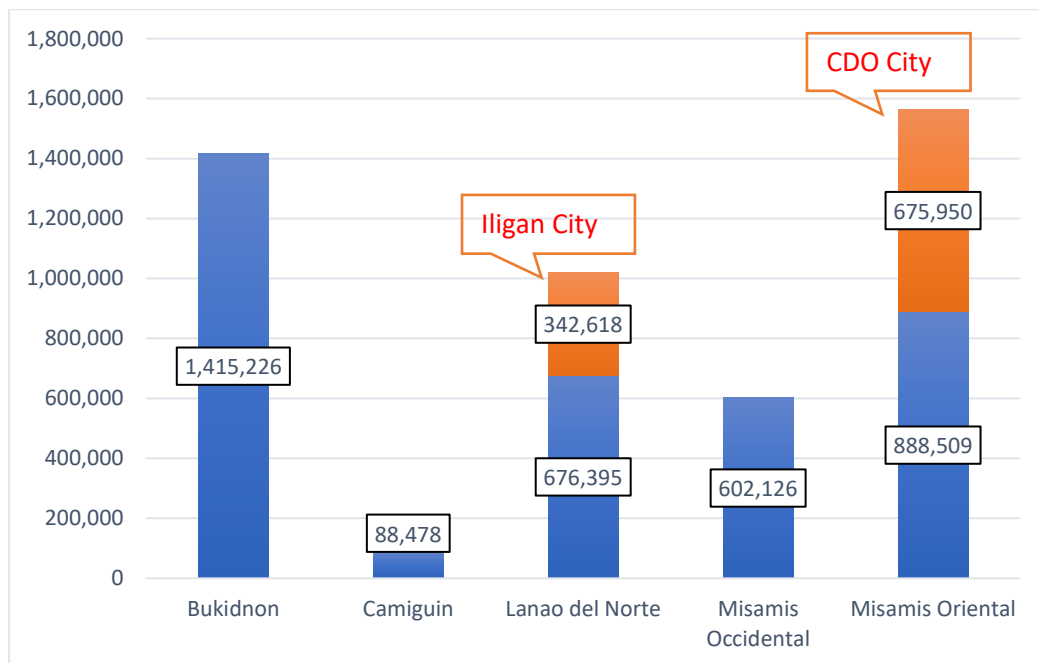
**Figure 3.1-5 Mineral Distribution in Northern Mindanao Region**

### 3.2 Demographic Trend

Northern Mindanao’s population of 4,689,302 in 2015 comprised 19.4% of the total population of Mindanao and 4.6% of the country’s total population. Table 3.2-1 shows the comparison of the total population of the said areas in the recent census years (2010 and 2015). The region’s population increased by about 391,979 from the year 2010 to 2015. Figure 3.2-1 shows the graphical representation of the region’s population per province in 2015. Misamis Oriental recorded the highest population in the region which comprised around 33.4% of the region’s total population, followed by Bukidnon (30.2%), then by Lanao del Norte (21.7%) and Misamis Occidental (12.8%). Camiguin (1.9%) posted the lowest population count in the region in 2015.

**Table 3.2-1 Comparison of the Total Population According to the 2010 and 2015 Census**

Area	2010 Census	2015 Census	Delta (+)
Philippines	92,337,852	100,981,437	8,643,585
Mindanao	21,968,174	24,135,775	2,167,601
Region X	4,297,323	4,689,302	391,979



**Figure 3.2-1 Total Population of Region X Provinces (2015 Census)**

Table 3.2-2 shows the total population by Provinces, Highly Urbanized Cities (HUCs), and Component cities of the Northern Mindanao region. Throughout the six (6) census years from 1995 to 2015 conducted by the Philippine Statistics Authority (PSA), the increasing trend in population was very evident in the whole region. Among the five (5) major provinces of the region, Bukidnon posted the highest increase in population from the year 1990 to 2015 with an increase from 687,912 in 2007 to 964,551 in 2010.

**Table 3.2-2 Total Population of Northern Mindanao Region for the Past Six Census Years**

Region/Province/City	Total Population					
	1990	1995	2000	2007	2010	2015
<b>Region X</b>	<b>2,811,646</b>	<b>3,197,059</b>	<b>3,505,708</b>	<b>3,952,437</b>	<b>4,297,323</b>	<b>4,689,302</b>
<b>Provinces</b>						
Bukidnon*	490,598	541,592	608,590	687,912	964,551	1,047,608
Camiguin	64,247	68,039	74,232	81,293	83,807	88,478
Lanao del Norte**	387,524	440,783	473,062	538,283	607,917	676,395
Misamis Occidental***	237,436	255,005	266,765	286,550	307,278	326,530
Misamis Oriental****	416,150	468,521	527,309	594,733	651,100	713,657
<b>HUCs</b>						
Iligan City	226,568	273,004	285,061	308,046	322,821	342,618
Cagayan de Oro City	339,598	428,314	461,877	553,966	602,088	675,950
<b>Component cities</b>						
El Salvador	26,721	31,500	34,650	41,905	44,848	50,204
Gingog	82,582	87,530	102,379	112,247	117,908	124,648
Malaybalay	94,722	112,277	123,672	144,065	153,085	174,625
Oroquieta	52,500	56,012	59,843	65,349	68,945	70,757
Ozamiz	91,503	101,944	110,420	123,137	131,527	141,828
Tangub	42,926	46,004	49,695	56,644	59,892	63,011
Valencia	116,110	128,623	147,924	162,745	181,556	192,993

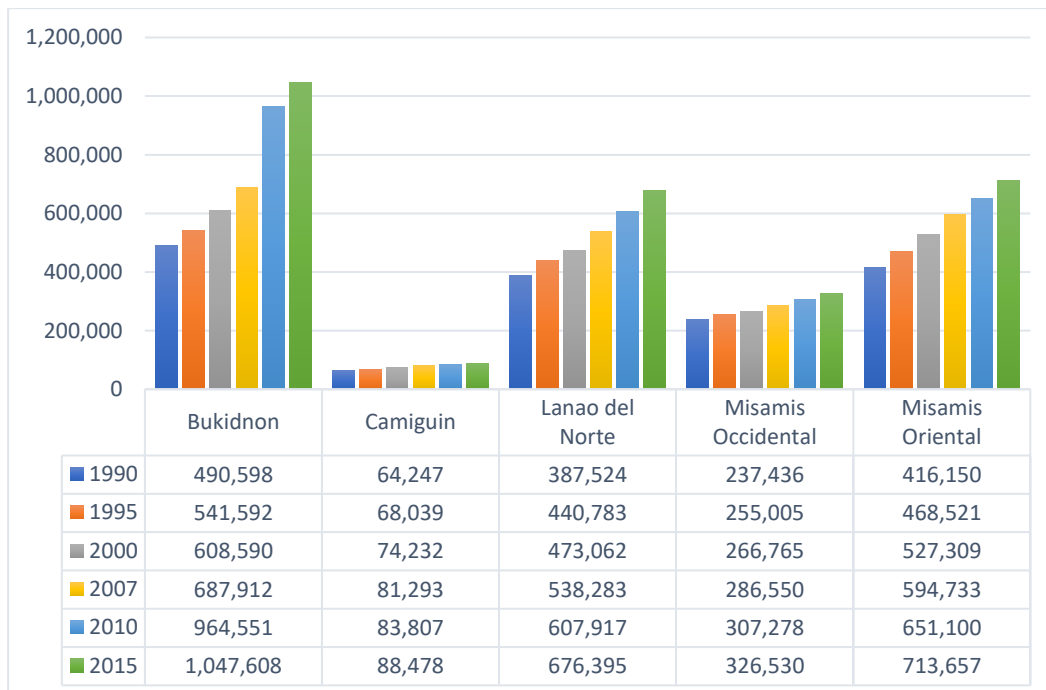
\*Excluding Malaybalay and Valencia City

\*\*Excluding Iligan City

\*\*\*Excluding Oroquieta, Ozami, and Tangub

\*\*\*\*Excluding Cagayan de Oro City, El Salvador, and Gingog

Source: PSA-X



**Figure 3.2-2 Total Population of Region X Major Provinces (CY 1990-2015)**

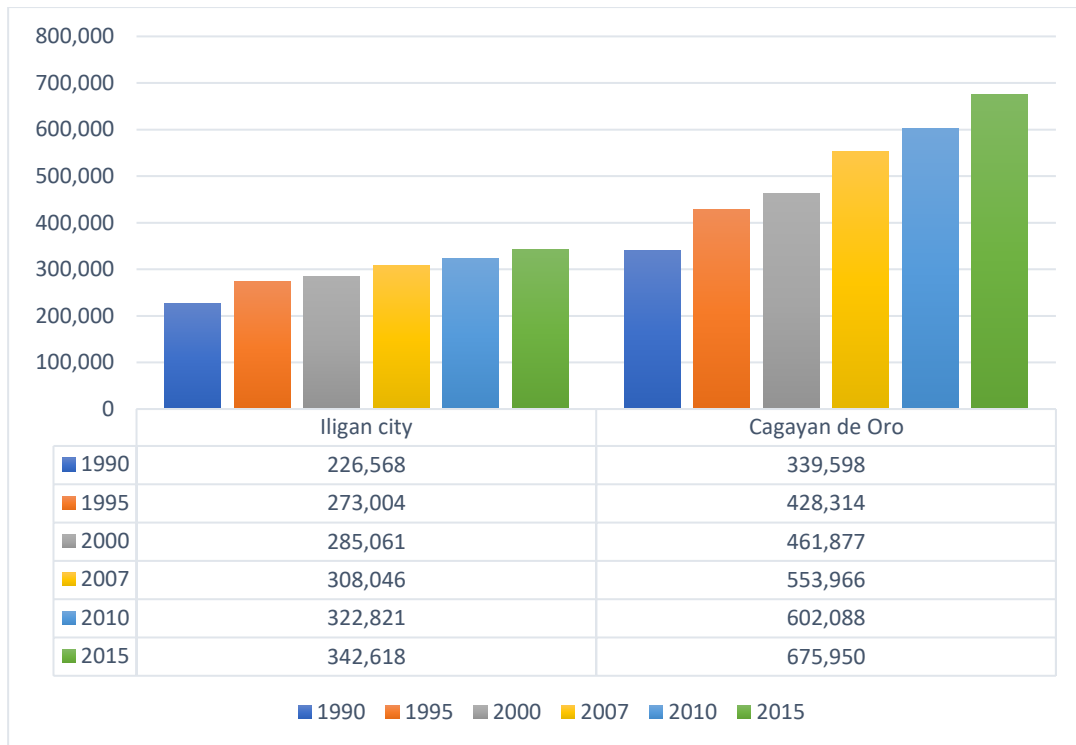


Figure 3.2-3 Total Population of Region X HUC's (CY 1990-2015)

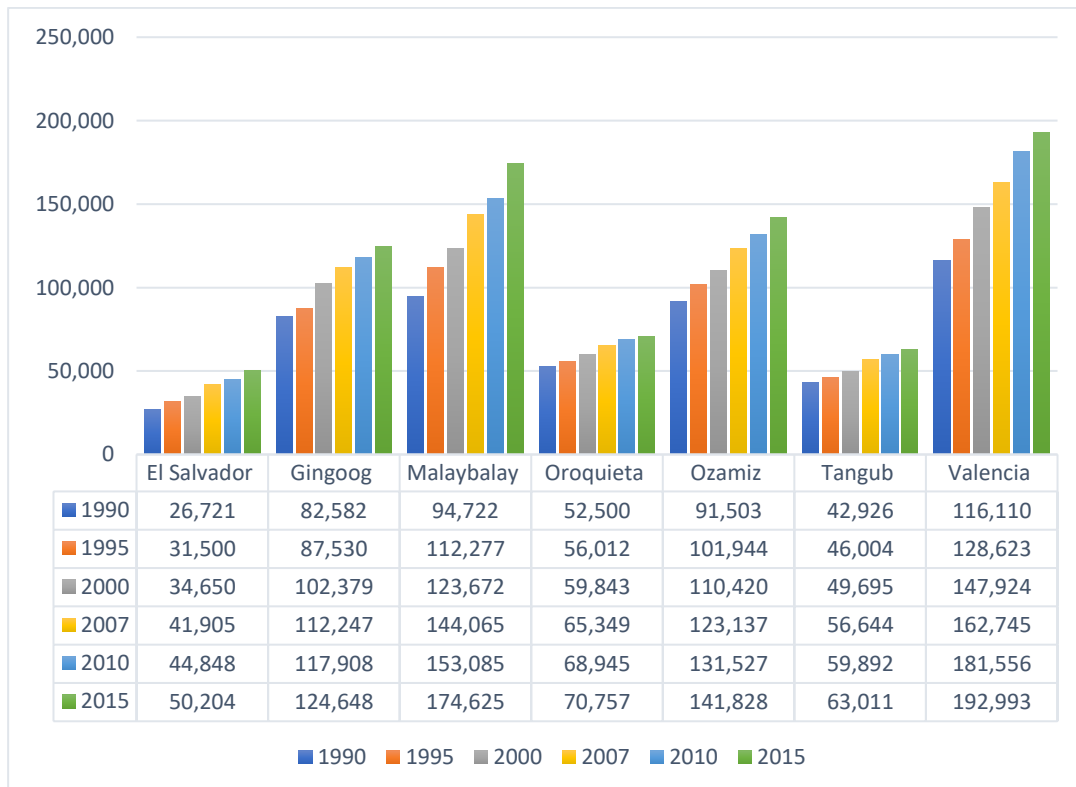


Figure 3.2-4 Total Population of Region X Component Cities (CY 1990-2015)

The region's annual population growth rate (APGR) for the past four (4) census periods as shown in Table 3.2-3 and Figure 3.2-5 revealed a fluctuating yet declining trend from 2.23% in 1990-2000 to 1.68% in 2010-2015. Bukidnon recorded the highest APGR of 3.97 in 2000-2010, significantly higher than the region's APGR of 2.06 in the same period. However, it declined in the following period (1.64) which is slightly lower than the region's APGR. On the other hand, Lanao del Norte and Cagayan de Oro City recorded APGR above the regional average in 2000-2010 and 2010-2015.

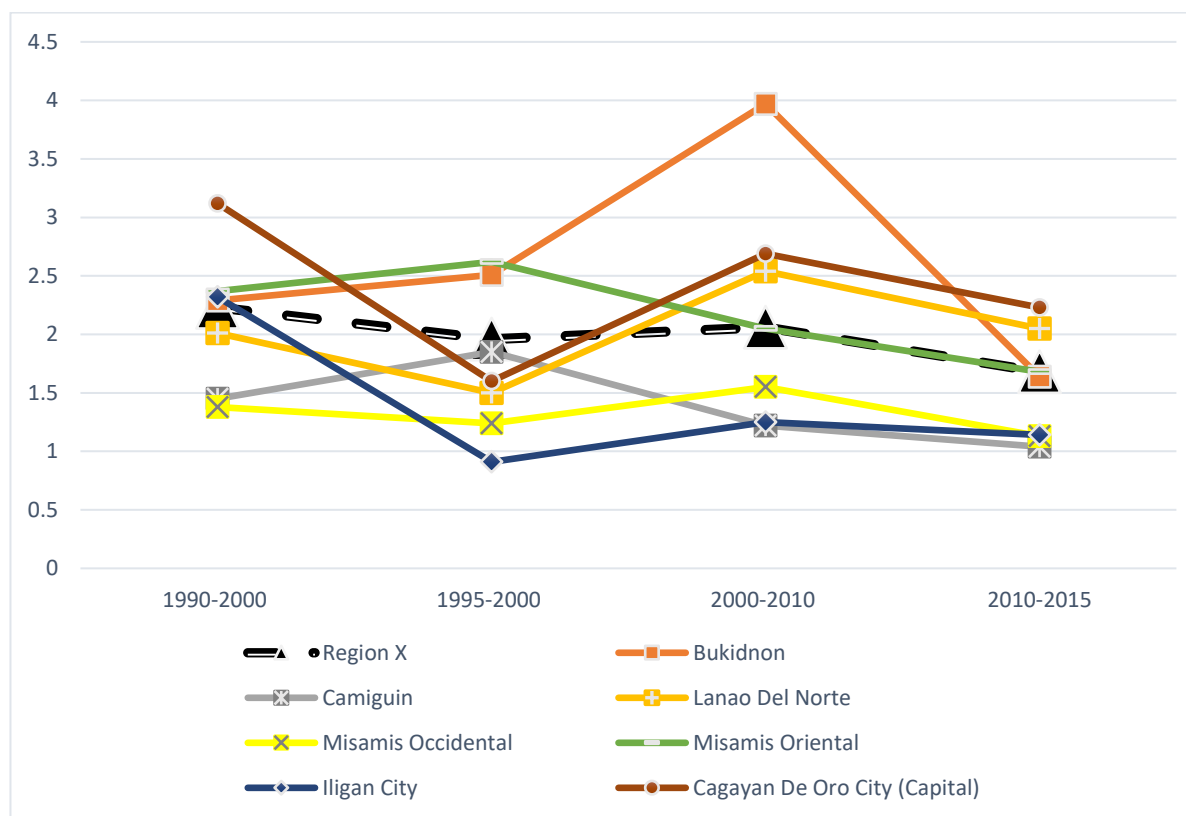
**Table 3.2-3 Annual Population Growth Rate in Region X from 1990 to 2015.**

Region/Province/City	Annual Population Growth Rate			
	1990-2000	1995-2000	2000-2010	2010-2015
<b>Region X</b>	<b>2.23</b>	<b>1.96</b>	<b>2.06</b>	<b>1.68</b>
Bukidnon	2.29	2.51	3.97	1.64
Camiguin	1.45	1.85	1.22	1.04
Lanao Del Norte*	2.01	1.5	2.54	2.05
Iligan City	2.32	0.91	1.25	1.14
Misamis Occidental	1.38	1.24	1.55	1.13
Misamis Oriental**	2.37	2.62	2.05	1.68
Cagayan De Oro City (Capital)	3.12	1.6	2.69	2.23

\*Excluding Iligan City

\*\*Excluding Cagayan de Oro City

Source: PSA-X



**Figure 3.2-5 Annual Population Growth Rate of Region X Major Provinces and Cities (CY 1990-2015)**

Northern Mindanao’s household population by sex is presented in Table 3.2-4. There were slightly more males than females (both 2010 and 2015) in the region, at 51% and 49% share of the total household population, respectively. The figure indicates that there is an even distribution of both sexes in the region. Furthermore, there is no significant increase in the percentage of both sexes from census year 2010 to 2015.

**Table 3.2-4 Household Population by Sex in Region X provinces and HUCs  
(Census Years 2010 & 2015)**

Region/Province/City	Male		Female	
	2010	2015	2010	2015
<b>Region X</b>	<b>2,183,786</b>	<b>2,376,968</b>	<b>2,100,808</b>	<b>2,286,140</b>
Bukidnon	672,204	730,063	622,673	676,701
Camiguin	42,643	44,902	41,033	43,379
Lanao del Norte	305,645	338,124	301,471	336,647
Iligan City	160,834	170,121	160,322	168,936
Misamis Occidental	286,736	303,091	279,604	296,122
Misamis Oriental	417,043	454,551	395,583	429,877
Cagayan de Oro City	298,681	336,116	300,122	334,478

Source: Philippine statistics Authority

The distribution of the region’s population by age group is similar to the country’s structure where a large number consists of young dependents and a small portion belongs to the elderly. The age group can be categorized into young dependents (0-14), working population (15-64), and old dependents (65 and above).

According to the 2015 census, around 34% of the household population were young dependents. Working individuals comprised 62% of the total household population in Region X, while old dependents accounted for the remaining 4%. Table 3.2-5 and Table 3.2-6 show the distribution of the population by age group and the dependency ratio in the region, respectively.

**Table 3.2-5 Household Population by Age group in Region X (Census Years 2010 & 2015)**

Age group	2010		2015		2010	2015
	Male	Female	Male	Female	%	%
Under 5	262,491	246,917	282,590	264,404	11.89	11.73
5-9	258,140	244,291	278,583	261,787	11.73	11.59
10-14	249,157	237,077	261,386	248,038	11.35	10.92
15-19	239,365	231,875	242,105	232,002	11.00	10.17
20-24	203,653	191,406	218,918	211,998	9.22	9.24
25-29	166,500	156,279	195,543	183,443	7.53	8.13
30-34	152,546	143,020	163,234	151,432	6.90	6.75
35-39	135,337	128,530	150,316	139,990	6.16	6.23
40-44	124,612	119,496	131,790	123,926	5.70	5.48
45-49	108,168	104,116	118,194	113,789	4.95	4.97
50-54	90,216	87,696	100,813	98,351	4.15	4.27
55-59	68,842	66,936	81,820	81,168	3.17	3.50
60-64	47,579	47,954	61,497	62,943	2.23	2.67
65-69	30,449	34,263	39,197	42,441	1.51	1.75
70-74	23,113	27,882	23,176	28,613	1.19	1.11
75-79	13,393	17,547	15,633	21,569	0.72	0.80
80 and over	10,225	15,523	12,173	20,246	0.60	0.70

Source: Philippine statistics Authority

**Table 3.2-6 Dependency Ratio of Region X Provinces and Cities (Census Years 2010 & 2015)**

Region/Area	2010			2015		
	Total	Old-age Dependency	Child Dependency	Total	Old-age Dependency	Child Dependency
<b>Region X</b>	<b>63.9</b>	<b>6.6</b>	<b>57.3</b>	<b>62.9</b>	<b>7.1</b>	<b>55.8</b>
Bukidnon	67.5	5.7	61.8	67.2	6.2	60.9
Malaybalay	62.7	5.4	57.3	61.6	6.1	55.5
Valencia City	61.6	5.3	56.3	61.9	5.8	56
Camiguin	67.1	11.7	55.4	67.3	12.3	55
Lanao del Norte	74.8	5.4	69.4	72.5	5.8	66.7
Iligan City	56.4	5.7	50.7	56	6.6	49.4
Misamis Occidental	62	9.8	52.1	60.3	10.4	49.9
Oroquieta City	57.4	10.3	47.1	55.5	10.8	44.7
Ozamiz City	57.4	7.7	49.6	56.2	8.2	48
Tangub City	67.6	8.3	59.3	65.3	8.9	56.4
Misamis Oriental	64.7	7.6	57.1	63.8	7.8	55.9
El Salvador City	56.6	7	49.5	56.5	7.3	49.2
Gingoog City	72.6	8.3	64.3	72	8.4	63.7
Cagayan de Oro City	51.4	46.3	5.1	5.8	50.2	44.4

Source: Philippine statistics Authority

### 3.3 Economic Trend

Northern Mindanao is mainly known for its agricultural products but through the years, there is a booming growth of other sectors significantly contributing to the economy. The main industries in the region were categorized into three sectors: Agricultural, Hunting, Forestry & Fishing Sector (AHFF), Industry Sector, and Service Sector.

In 2017, the economy of the region in terms of gross regional domestic product (GRDP) grew by 5.9%, a slower rate than 7.5% in 2016. The region produced Php 323 billion worth of goods and services which contributed to 6.7% of the country's GDP growth. Among the main industries, Service Sector recorded the highest growth rate with 6.6% which is also the biggest contributor to economic growth accounting for 2.7 percentage points. It was followed by Industry Sector with 5.9% increase and contributed about 2.1 percentage points to the economy. Lastly, AHFF sector with the lowest increase of 4.7% which shared 1.0 percentage points only to the economic growth. However, despite the slower rate, the region was considered as the 3<sup>rd</sup> biggest sharer in nationwide AHFF at 9.5% Gross Value Added (GVA) in AHFF at constant 2000 prices. Among the subindustries, the three biggest contributors are Manufacturing – 20%; Agriculture and forestry – 19%; and Trade – 15.8%. Overall, the region ranked 11<sup>th</sup> in regional growth rate at constant 2000 prices and 7<sup>th</sup> biggest contributor to the country's GDP growth among the 17 regions.

In 2018, the economy of the region grew by 7.0%, with faster growth than the previous year. During this year, the region placed 9<sup>th</sup> among the fastest-growing economies in the country. Services remained to have the biggest growth of 8.9% among the major sectors and had the biggest share of the total economy at 44.1%. The industry sector also experienced rapid growth at 8.8%. Behind only 0.1% of the Services sector, subindustries that significantly contributed to its growth were the following: Construction, Mining and Quarrying; and Manufacturing, which experienced a faster growth rate compared to the previous year. On the other hand, AHFF sector decelerated its growth at 0.4%, a big percentage difference from the previous year due to the declining growth of its subindustries. Among the subindustries, Construction; Mining and Quarrying; and Transportation, Storage, and Communication recorded the fastest growth in the said year. Furthermore, subindustries such as Manufacturing; Agriculture, and forestry; and Trade and Repair of Motor Vehicles, Motorcycles,

Personal, and Household Goods were considered as the main economic drivers with a total share of 54% of the economic output in the region. Overall, the region was one of the 12 regions that recorded an economic growth rate higher than the national average of 6.2% in 2018.

In 2019, the economy of the region grew by 5.9%<sup>6</sup>, a slower rate compared to the previous year. The service sector still had the biggest growth at 8.9% which accounted for 55.4% of the total economy, followed by the industry sector at 3.8% growth with 24.3% share, and lastly AHFF at 1.5% growth with 20.3% share. The top 3 contributors to growth based on GRDP among the subindustries were: Trade – 1.9 percentage points, Construction – 0.7 percentage points, and Education – 0.6 percentage points. Among the subindustries, the three biggest on the said year were: Wholesale and Retail trade; repair of motor vehicles and motorcycles; followed by Agriculture, Forestry, and Fishing; and lastly Manufacturing. The fastest-growing industries on the other hand were: Public Administration and Defense, Compulsory Social Activities with 19.2% (highest rate of increase among 17 regions); and Education with 18.7% (ranked 3<sup>rd</sup> in terms of growth rate among 17 regions). Overall, the region accounted for 4.5% of the country's economy contributing 0.3 percentage points to the total GDP growth. Moreover, the region ranked 7<sup>th</sup> in both with the biggest regional economy and biggest contribution to the GDP growth.

Table 3.3-1 to Table 3.3-5 presented the GRDP of Northern Mindanao by industry, growth rates, percent distribution of industrial origin, and contribution to the growth of GDP at constant 2000 and 2018 prices. Percent distribution by industrial origin is different using 2000 and 2018 base years for years 2017 and 2018. The data were derived from the Philippine Statistics Authority (PSA) regional and national websites.

**Table 3.3-1 Region X - Northern Mindanao Gross Regional Domestic Product (GRDP)  
by Industry, Growth Rates (in %) at Constant 2000 Prices**

Industry/Period	15-16	16-17	17-18
<b>I. AGRICULTURE, HUNTING, FORESTRY &amp; FISHING</b>	<b>2.4</b>	<b>4.7</b>	<b>0.4</b>
a. Agriculture and Forestry	2.2	5.7	0.8
b. Fishing	4.0	(1.6)	(1.9)
<b>II. INDUSTRY SECTOR</b>	<b>9.8</b>	<b>5.9</b>	<b>8.8</b>
a. Mining and Quarrying	16.0	10.5	14.6
b. Manufacturing	5.9	5.5	6.6
c. Construction	27.7	2.2	16.3
d. Electricity, Gas and Water Supply	(1.2)	13.8	4.4
<b>III. SERVICE SECTOR</b>	<b>8.3</b>	<b>6.6</b>	<b>8.9</b>
a. Transportation, Storage & Communication	6.1	7.5	12.8
b. Trade and Repair of Motor Vehicles, Motorcycles, Personal and Household Goods	10.4	5.9	7.4
c. Financial Intermediation	11.0	7.6	8.7
d. Real Estate, Renting & Business Activities	5.0	5.1	5.7
e. Public Administration & Defense; Compulsory Social Security	4.7	5.4	12.6
f. Other Services	8.7	8.0	8.9
<b>GROSS DOMESTIC PRODUCT</b>	<b>7.5</b>	<b>5.9</b>	<b>7.0</b>

Source: Philippine Statistics Authority

<sup>6</sup> Based on the constant 2018 prices.

**Table 3.3-2 Region X - Northern Mindanao Gross Regional Domestic Product (GRDP)  
by Industrial Origin, Percent Distribution at Constant 2000 Prices**

Industry/ Year	2015	2016	2017	2018
<b>I. AGRICULTURE, HUNTING, FORESTRY &amp; FISHING</b>	<b>23.0</b>	<b>21.9</b>	<b>21.7</b>	<b>20.3</b>
a. Agriculture and Forestry	20.0	19.0	19.0	17.9
b. Fishing	3.0	2.9	2.7	2.5
<b>II. INDUSTRY SECTOR</b>	<b>34.2</b>	<b>35.0</b>	<b>35.0</b>	<b>35.6</b>
a. Mining and Quarrying	0.4	0.5	0.5	0.5
b. Manufacturing	20.5	20.2	20.2	20.1
c. Construction	7.8	9.2	8.9	9.7
d. Electricity, Gas and Water Supply	5.5	5.1	5.5	5.3
<b>III. SERVICE SECTOR</b>	<b>42.8</b>	<b>43.1</b>	<b>43.3</b>	<b>44.1</b>
a. Transportation, Storage & Communication	7.4	7.3	7.5	7.9
b. Trade and Repair of Motor Vehicles, Motorcycles, Personal and Household Goods	15.4	15.8	15.8	15.9
c. Financial Intermediation	3.5	3.6	3.7	3.7
d. Real Estate, Renting & Business Activities	5.2	5.1	5.1	5.0
e. Public Administration & Defense; Compulsory Social Security	3.1	3.0	3.1	3.2
f. Other Services	8.1	8.2	8.3	8.4
<b>GROSS DOMESTIC PRODUCT</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>

Source: Philippine Statistics Authority

**Table 3.3-3 Region X - Northern Mindanao Contribution to Growth of GDP  
(in Percentage Points) at Constant 2000 Prices**

Industry/ Period	15-16	16-17	17-18
<b>I. AGRICULTURE, HUNTING, FORESTRY &amp; FISHING</b>	<b>0.6</b>	<b>1.0</b>	<b>0.1</b>
a. Agriculture and Forestry	0.4	1.1	0.2
b. Fishing	0.1	(0.1)	(0.1)
<b>II. INDUSTRY SECTOR</b>	<b>3.4</b>	<b>2.1</b>	<b>3.1</b>
a. Mining and Quarrying	0.1	0.1	0.1
b. Manufacturing	1.2	1.1	1.3
c. Construction	2.2	0.2	1.5
d. Electricity, Gas and Water Supply	(0.1)	0.7	0.2
<b>III. SERVICE SECTOR</b>	<b>3.5</b>	<b>2.7</b>	<b>3.8</b>
a. Transportation, Storage & Communication	0.5	0.5	1.0
b. Trade and Repair of Motor Vehicles, Motorcycles, Personal and Household Goods	1.6	0.9	1.1
c. Financial Intermediation	0.4	0.3	0.3
d. Real Estate, Renting & Business Activities	0.3	0.3	0.3
e. Public Administration & Defense; Compulsory Social Security	0.1	0.2	0.4
f. Other Services	0.7	0.5	0.7
<b>GROSS DOMESTIC PRODUCT</b>	<b>7.5</b>	<b>5.8</b>	<b>7.0</b>

Source: Philippine Statistics Authority

**Table 3.3-4 Region X – Northern Mindanao Gross Regional Domestic Product (GRDP) by Industry, Growth Rates (in %) and Contribution to Growth (in Percentage Points) at Constant 2018 Prices**

Industry/ Period	18 -19	
	Growth Rate	Contribution to Growth
<b>I. AGRICULTURE, FORESTRY &amp; FISHING</b>	<b>1.5</b>	<b>0.4</b>
<b>II. INDUSTRY SECTOR</b>	<b>3.8</b>	<b>0.9</b>
a. Mining and quarrying	-12.2	-0.1
b. Manufacturing	1.5	0.2
c. Electricity, steam, water and waste management	2.4	0.1
d. Construction	8.4	0.7
<b>III. SERVICE SECTOR</b>	<b>8.5</b>	<b>4.6</b>
a. Wholesale and retail trade; repair of motor vehicles and motorcycles	7.3	1.9
b. Transportation and storage	6.5	0.2
c. Accommodation and food service activities	7.7	0.2
d. Information and communication	3.8	0.1
e. Financial and insurance activities	8.4	0.3
f. Real estate and ownership of dwellings	6.9	0.3
g. Professional and business services	5.7	0.1
h. Public administration and defense; compulsory social activities	19.2	0.5
i. Education	18.7	0.6
j. Human health and social work activities	6.1	0.1
k. Other services	13.7	0.1
<b>GROSS REGIONAL DOMESTIC PRODUCT</b>	<b>5.9</b>	<b>5.9</b>

Source: Philippine Statistics Authority

**Table 3.3-5 Region X – Northern Mindanao Gross Regional Domestic Product (GRDP) By Industrial Origin, Percent Distribution at Constant 2018 Prices**

Industry/ Year	2017	2018	2019
<b>I. AGRICULTURE, FORESTRY &amp; FISHING</b>	<b>22.1</b>	<b>21.1</b>	<b>20.3</b>
<b>II. INDUSTRY SECTOR</b>	<b>24.1</b>	<b>24.8</b>	<b>24.3</b>
a. Mining and quarrying	0.4	0.4	0.3
b. Manufacturing	11.3	11.5	11.0
c. Electricity, steam, water and waste management	4.6	4.5	4.4
d. Construction	7.7	8.4	8.6
<b>III. SERVICE SECTOR</b>	<b>53.8</b>	<b>54.0</b>	<b>55.4</b>
a. Wholesale and retail trade; repair of motor vehicles and motorcycles	26.8	26.7	27.0
b. Transportation and storage	3.3	3.6	3.6
c. Accommodation and food service activities	2.8	2.8	2.8
d. Information and communication	2.1	2.2	2.1
e. Financial and insurance activities	3.3	3.3	3.4
f. Real estate and ownership of dwellings	5.1	5.1	5.1
g. Professional and business services	2.1	2.0	2.0
h. Public administration and defense; compulsory social activities	2.7	2.9	3.2
i. Education	3.2	3.3	3.8
j. Human health and social work activities	1.5	1.3	1.3
k. Other services	1.0	0.9	1.0
<b>GROSS REGIONAL DOMESTIC PRODUCT</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>

Source: Philippine Statistics Authority

### 3.4 Per Capita GDP and GRDP

Table 3.4-1 and Table 3.4-2 summarized the per capita gross domestic product (GDP) and per capita gross regional domestic product (GRDP) of the Philippines and its regions in 2016 to 2019 at constant 2000 and 2018 prices, respectively.

Northern Mindanao's per capita GRDP increased from 2016 to 2019 based on the 2000 and 2018 prices. It placed 8<sup>th</sup> among 17 regions with the highest per capita GRDP in 2017, 7<sup>th</sup> highest in 2018, and 5<sup>th</sup> highest in 2019.

**Table 3.4-1 Per Capita Gross Regional Domestic Product (GRDP) and Gross Domestic Product (GDP) in Peso at Constant 2000 Prices**

REGION / YEAR		2016	2017	2018
<b>PHILIPPINES</b>		78,682	82,593	86,370
<b>LUZON</b>		<b>65,050</b>	<b>68,717</b>	<b>72,442</b>
NCR	National Capital Region	232,739	244,589	253,893
CAR	Cordillera Administrative Region	75,401	83,153	87,722
I	Ilocos Region	49,474	51,703	54,434
II	Cagayan Valley	39,344	41,571	42,387
III	Central Luzon	68,634	73,863	78,016
IVA	CALABARZON	94,811	99,346	104,708
IVB	MIMAROPA Region	39,837	41,069	43,715
V	Bicol Region	26,686	27,487	29,369
<b>VISAYAS</b>		<b>50,991</b>	<b>53,052</b>	<b>55,820</b>
VI	Western Visayas	41,420	44,368	46,440
VII	Central Visayas	69,322	71,743	76,024
VIII	Eastern Visayas	37,144	37,121	38,598
<b>MINDANAO</b>		<b>46,770</b>	<b>49,122</b>	<b>51,612</b>
IX	Zamboanga Peninsula	43,043	43,326	45,265
<b>X</b>	<b>Northern Mindanao</b>	<b>63,771</b>	<b>66,408</b>	<b>70,000</b>
XI	Davao Region	65,913	71,621	76,378
XII	SOCCSKSARGEN	45,459	48,277	50,644
XIII	Caraga	35,679	36,235	36,651
ARMM/ BARMM	Autonomous Region in Muslim Mindanao/ Bangsamoro Autonomous Region in Muslim Mindanao	13,366	14,012	14,657

Note: The ARMM was officially turned over to the BARMM on February 26, 2019.

Source: Philippines Statistics Authority (PSA)

**Table 3.4-2 Per Capita Gross Regional Domestic Product (GRDP) in Peso at Constant 2018 Prices**

REGION/YEAR		2017	2018	2019
<b>PHILIPPINES</b>		<b>164,885</b>	<b>172,712</b>	<b>180,528</b>
NCR	National Capital Region	415,210	432,181	457,034
CAR	Cordillera Administrative Region	165,997	173,651	179,484
I	Ilocos Region	108,156	113,471	120,153
II	Cagayan Valley	104,093	107,568	113,510
III	Central Luzon	165,346	173,452	179,954
IVA	CALABARZON	167,558	175,563	179,661
IVB	MIMAROPA Region	111,920	119,813	122,879
V	Bicol Region	82,254	86,916	92,314
VI	Western Visayas	106,750	110,783	116,803
VII	Central Visayas	144,511	152,478	159,223
VIII	Eastern Visayas	91,113	96,204	99,999
IX	Zamboanga Peninsula	96,610	101,872	105,707
X	<b>Northern Mindanao</b>	<b>158,825</b>	<b>167,832</b>	<b>175,373</b>
XI	Davao Region	155,504	164,042	172,820
XII	SOCCSKSARGEN	101,274	106,486	108,478
XIII	Caraga	103,863	107,932	112,009
ARMM/ BARMM	Autonomous Region in Muslim Mindanao/ Bangsamoro Autonomous Region in Muslim Mindanao	49,239	52,013	54,020

Note: The ARMM was officially turned over to the BARMM on February 26, 2019.

Source: Philippines Statistics Authority (PSA)

### 3.5 Land Use Plan and Development Potential

Table 3.5-1 shows the summary of the present and future land use of Northern Mindanao. Land use in the region is divided into three categories: built-up or settlement, production, and protection or forestland.

**Table 3.5-1 Northern Mindanao Existing and Proposed Land Use**

Land use	Existing* land area (Ha.)	Proposed** land area (Ha.)
Built-up/Settlement area	22,094	29,830
Production area	921,248	1,153,102
Protection/ Forestland	1,075,274	835,684

\*as of 2013

\*\*year 2040

Source: NMRDP 2017-2022

In 2040, the area dedicated to settlements is envisioned to account for 1.48% of the total land area of the region. According to the Northern Mindanao Regional Development Plan 2017-2022, as metro limits in highly urbanized centers like Cagayan de Oro City becomes tighter, subregional growth and urban centers that still have possible areas for settlements must be further developed to accommodate growth. Hence, vertical development with a safer and sufficient level of efficiency must be encouraged to control the urban spread.

The proposed production land use includes marginal areas in non-NIPAS (National Integrated Protected Areas System) areas suitable for agroforestry and production forest.<sup>7</sup> Future production land areas are about 57.1% of the region’s total land area to increase the region’s agricultural and industrial productivity, and to boost the level of production for the growing needs of the population. A deviation of 231,854 hectares from the existing land use is necessary to build new industrial centers and economic zones to help in establishing and operating agriculture-based industries and other emerging industries.

Protection land use is composed of NIPAS and non-NIPAS areas. About 41.4% of the region’s total land area is allocated to it. A decrease of 239,590 hectares from the existing land-use area is due to the utilization of the land to agroforestry and production forest, which leads to the increase of production land-use area.

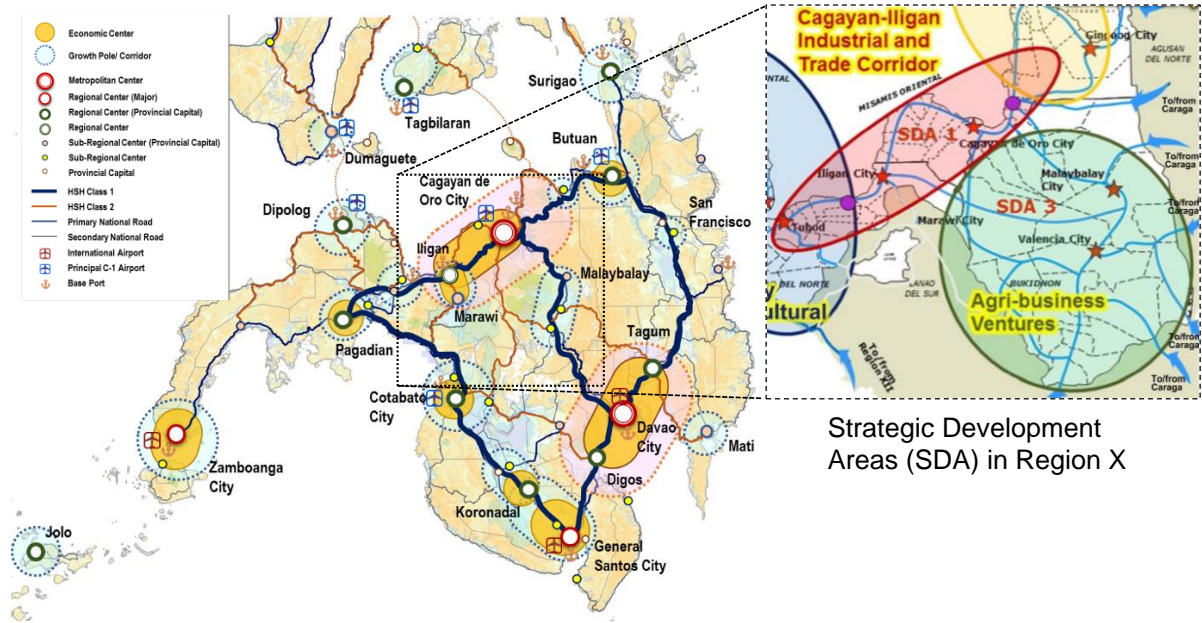
The areas along the project route have high potential for the development of agriculture, forestry and livestock industries. The inland areas are fertile and undeveloped. Large-scale plantations have already been established by foreign food company, and pineapples are grown and processed for export to the world through the port of Cagayan de Oro. In the foothills of Mt. Kitanglad near Malaybalay, cultivation of highland vegetables, such as cabbage has been tried. In fact, NEDA Regional Office X is planning a strategic development area (SDA). the SDAs identified are SDA1 for CDO City; and SDA3 for Bukidnon. These SDAs have the following components:

**Table 3.5-2 Development Potential in Project Area**

SDA 1: Industrial and Trade corridor (Iligan City – Cagayan de Oro City)	SDA 3: Agri-business ventures and Eco-tourism (Bukidnon)
<ul style="list-style-type: none"> <li>• Sea linkages to the growth areas of Visayas and Luzon,</li> <li>• Competitive edge in commodity transport and trading,</li> <li>• PHIVIDEC industrial estate is expected to become the south-gate of the Philippines for international trade with the development of agribusiness centers,</li> <li>• Cagayan de Oro area as melting pot and business hub of Northern Mindanao.</li> </ul>	<ul style="list-style-type: none"> <li>• Agricultural products and raw materials for the processing plants,</li> <li>• Potentials for eco-tourism and recreation,</li> <li>• Production of food crops, industrial crops, high value crops, poultry, piggery and large livestock,</li> <li>• High value cash crops and vegetables,</li> <li>• Highlands with temperate climate as a summer capital, retirement and vacation destination,</li> <li>• Manolo Fortich as the first pineapple plantation in the Far East.</li> </ul>

Source: NEDA X

<sup>7</sup> Northern Mindanao Regional Development Plan 2017-2022. Chapter 3 Overlay of Economic Growth, Demographic Trends, and Physical Characteristics. Page 21.



Source: NEDA X

Figure 3.5-1 Strategic Development Areas (SDA) in Region X



## CHAPTER 4 EXISTING AND PLANNED ROADS AND INFRASTRUCTURES

### 4.1 General

The following existing and planned roads, major ports and airport are illustrated in Figure 4.1-1.

- Proposed Central Mindanao Highway (CDO-Malaybalay Section) (This project)
- Sayre Highway
- Alae-PHIVIDEC Bypass Road (under construction)
- Butuan City-Cagayan de Oro City-Iligan City Road
- Manolo-Fortich- Libona-CDO Bypass/Alternate Road (road improvement)
- Proposed Villanueva-Cagayan de Oro City-Opol Expressway
- CDO Port/Mindanao Container Terminal/Laguindingan Airport

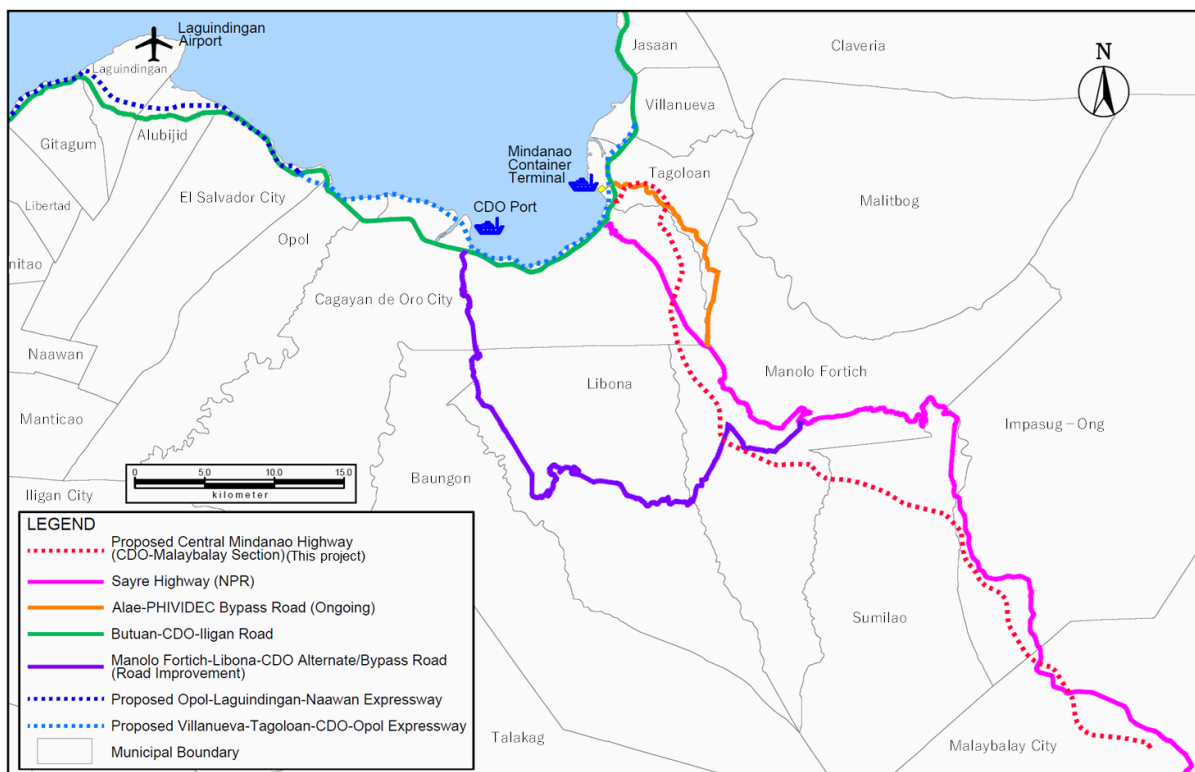


Figure 4.1-1 Location of Existing/Planned Roads and Port/Airport

## 4.2 Sayre Highway

Sayre Highway, also known as Francis Bowes Sayre Sr. Highway is a primary national highway with a total length of 192 kilometers that connects Cagayan de Oro City, Bukidnon and Kabacan, North Cotabato. It starts from Cagayan de Oro City (Puerto) and traverses the provinces of Bukidnon, and North Cotabato.

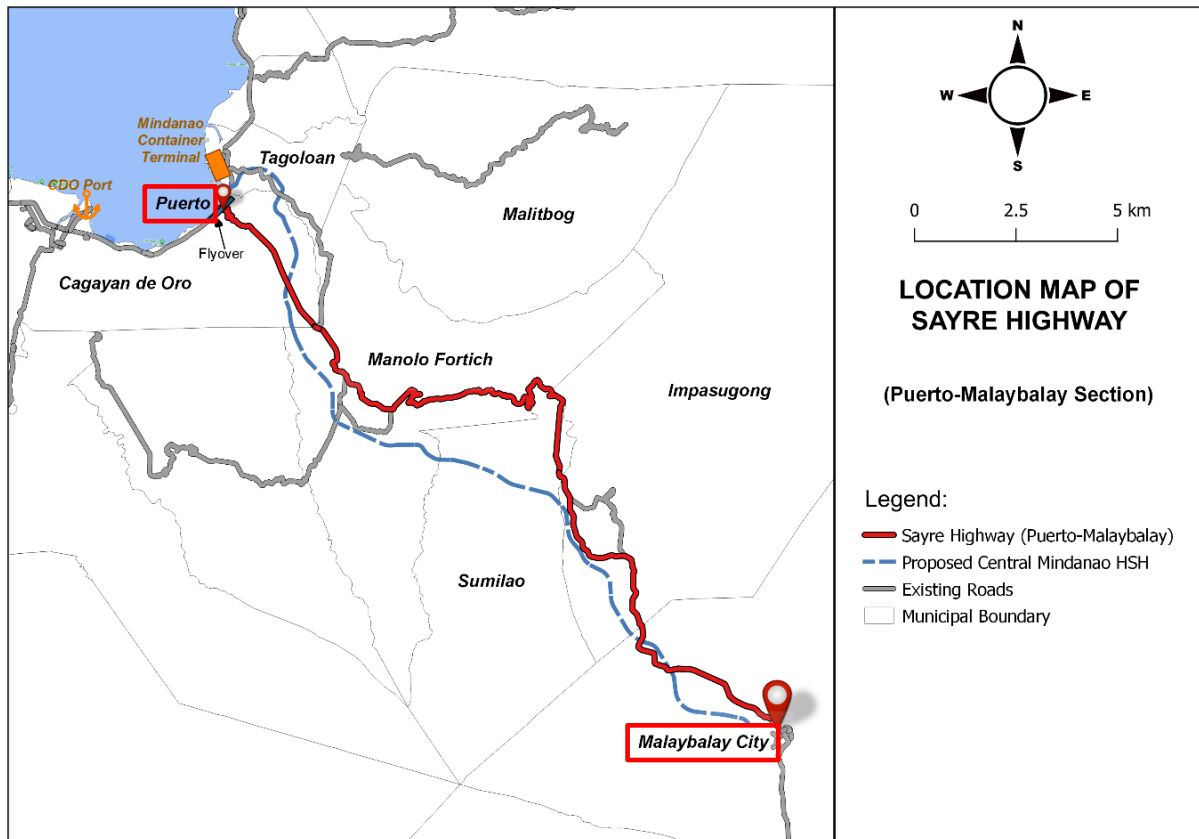
The main function of Sayre highway is to serve as the major road connecting different provinces of northern, central, and southern Mindanao and it contributes to inter-regional trade and transport of products, goods, and people. It also gives linkage with several road sections such as Butuan-Cagayan de Oro-Iligan Road, Dologon-Quezon Road, Maramag-Maridagao Road, Bukidnon-Davao Road, and Davao-Cotabato Road.

The existing Puerto-Malaybalay section of Sayre highway, which is a critical and relevant section of the study, is classified as primary road with a total length of 79.167 km consisting of both Portland Cement Concrete (PCC) and Asphalt Concrete (AC) pavement. It is composed of 2 to 6 lanes with carriageway width of about 6.7 to 20.10 meters. Figure 4.2-1 shows Sayre Highway (Puerto-Malaybalay) section which is the existing road running parallel to the project (CMH).

**Table 4.2-1 Summary of Sayre Highway: Existing National Primary Highway**

Name	Sayre Highway (Puerto-Malaybalay Section)
Classification	Primary National Road
Length	79.167 km
Number of Lanes	2-6 lanes PCC/AC, 240-280 mm thick
Carriageway width	2 lanes: 6.7-10.8 m; 3 lanes: 11.4 m; 4 lanes: 12.80-14.0 m; 5 lanes: 14.7 m; 6 lanes: 16.7-20.10 m

Source: Drawing by DPWH Region X



**Figure 4.2-1 Location of Sayre Highway (Puerto-Malaybalay Section)**

### 4.3 Alae-PHIVIDEC Link Road

The project involves the construction of a 17-km road (10-km new road, and 7 km existing road), construction of three bridges with a total bridge length of 237 meters, and construction of slope protection and drainage system components. The road starts from Barangay Casinglot, Tagoloan, Misamis Oriental and traverses through sitios Malaiba and Bugna in Barangay Mantibugao, also of Tagoloan and terminates at Barangay Alae, Manolo Fortich, Bukidnon (Figure 4.3-1).

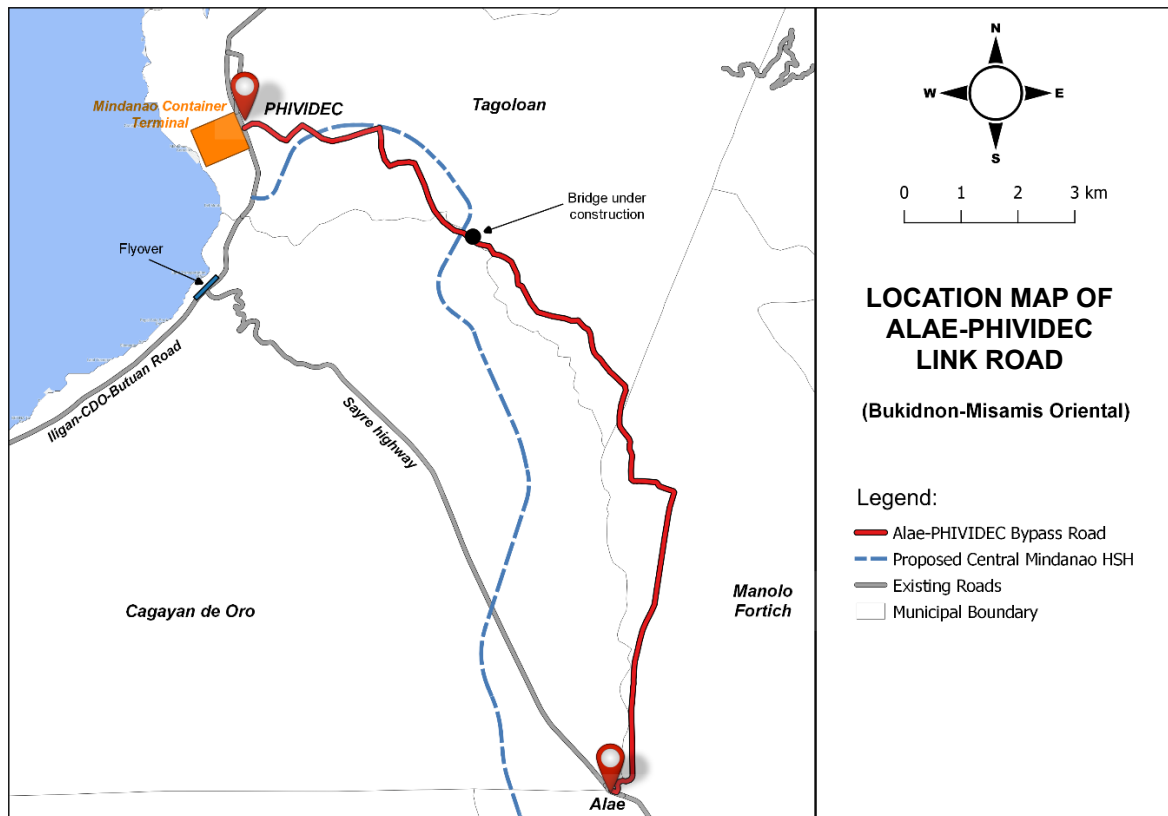
As of November 2020, the project was underway with the on-going construction of the last bridge which is approximately 5 km from the national highway junction at PHIVIDEC (Figure 4.3-2). Upon completion, it will divert traffic from Sayre Highway, and Puerto-Alae Section; and will also serve as an alternate route for vehicles especially cargo trucks from Bukidnon going to Mindanao Container Terminal (MCT) in Tagoloan.

As shown in Table 4.2-1, the road geometric element is not very high with such many steep slope sections and sharp curves. Design speed is 20 km/h based on design drawing’s grade and curve elements.

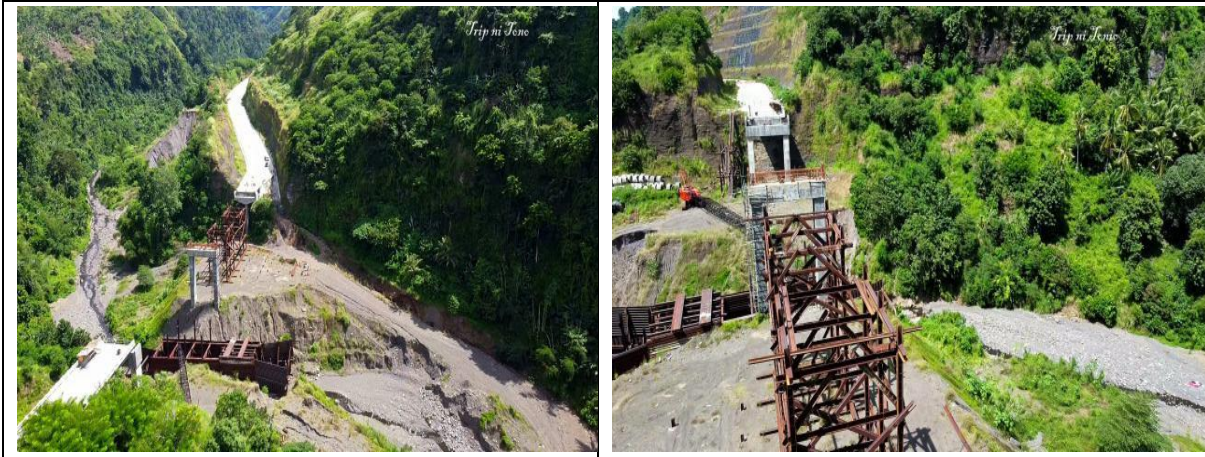
**Table 4.3-1 Summary of Alae-PHIVIDEC Link Road**

Name	Alae-PHIVIDEC Bypass Road (Bukidnon - Misamis Oriental)
Length	10 km (New Road) + 7km (Existing Road)
Number of Lanes	2 lanes PCCP, 280 mm thick
Cross section	Carriageway width: 6.0-7.0 m Shoulder width: 1.50 m
Radius	35m at 2 sections and 100 m
Grade	12% at 2 sections, 10%, 7%
Design Speed	20 km/h (judging from adopted grade)

Source: Drawing by DPWH Region X



**Figure 4.3-1 Location Map of Alae-PHIVIDEC Link Road Project**



(Source: <http://www.cdodex.com/2020/11/09/project-watch-alae-phividec-bypass-road-as-of-november-2020/>)

**Figure 4.3-2 Progress Photos of Ongoing Bridge Construction along Alae-PHIVIDEC Link Road Project**

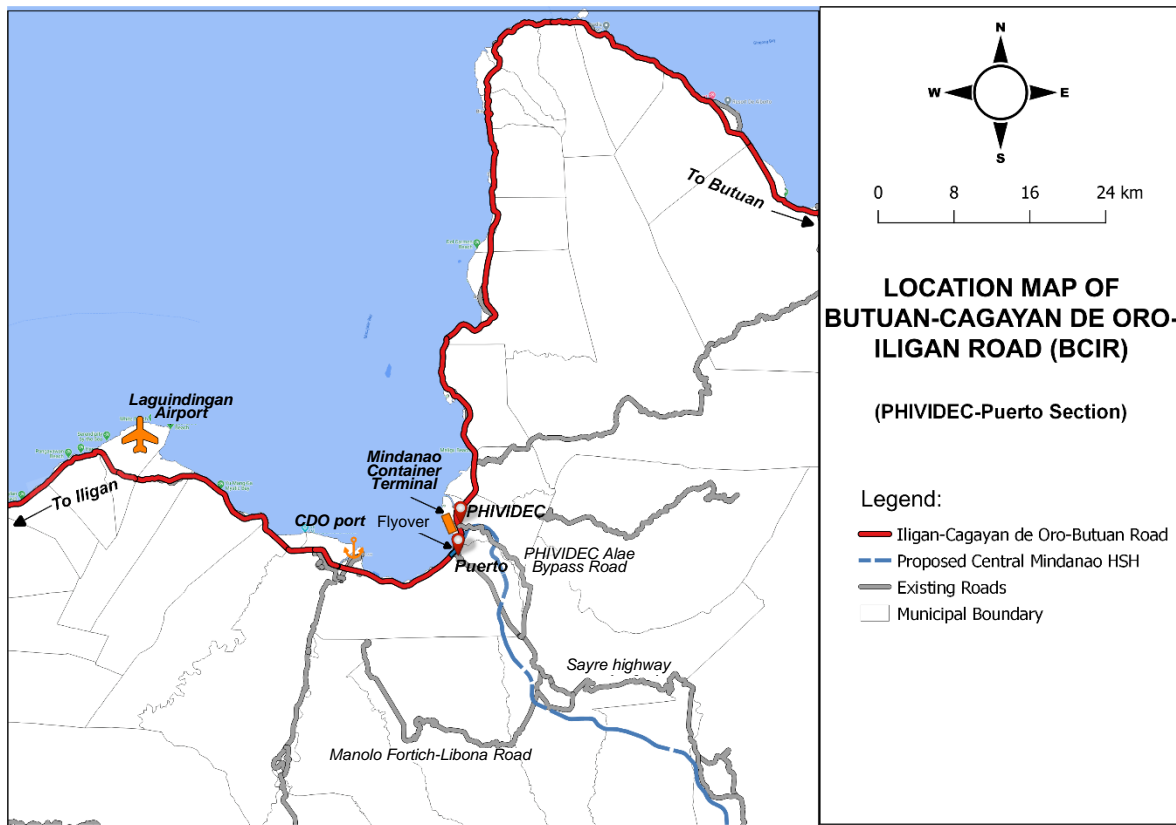
#### 4.4 Butuan City – Cagayan de Oro – Iligan City Road (BCIR)

BCIR has a total length of 416 kilometers that starts from Maharlika Highway in Ampayon, Butuan City, and ends in Iligan City. The road connects the provinces of Agusan del Norte (from Butuan City) and Misamis Oriental with Iligan City (although geographically within Lanao del Norte Province but administered independently from the province).

The existing PHIVIDEC – Puerto section along the Butuan – Cagayan de Oro – Iligan Road (Figure 4.4-1) is classified as a primary national road with a total length of approximately 2.992 kilometers. The said segment is a 4 to 6-lane road paved with Portland Cement Concrete (PCC) pavement or Asphalt Concrete (AC) pavement with a carriageway width ranging from 14.70 to 21.0 meters and pcc slab thickness of 230 mm.

**Table 4.4-1 Summary of Existing Perpendicular Road: BCIR (PHIVIDEC-Puerto Section)**

Name	Butuan City-Cagayan de Oro-Iligan City Road (PHIVIDEC-Puerto Section)
Classification	Primary road
Length	2.992 km
Number of Lanes	4-6 lanes PCC/AC Pavement
Cross section	Carriageway width: 14.7-21.0 m inclusive of shoulders



**Figure 4.4-1 Location Map of BCIR (PHIVIDEC-Puerto Section)**

#### 4.5 Manolo Fortich – Libona-CDO Alternate Road

The road sections between the municipality of Manolo Fortich, Bukidnon to Cagayan de Oro City has a total road length of approximately 55.14 km starting from Barangay Dalirig along the Sayre Highway and traverses Barangay Tangkulan, Libona Proper, Barangay Indahag and terminating are at Junction Jr. Borja in Cagayan de Oro City (Figure 4.5-1).

The purpose of the road is to bypass Sayre Highway along Mangima Canyon section and to serve as an alternate road from Libona to Cagayan de Oro and vice versa. The Mangima Canyon section is a winding road and prone to vehicular accidents, most of which heavy vehicle involvements. With this alternate road, motorists can avoid passing along the congested Sayre highway and the section of CDO-Puerto.

There are two proposed road sections: (1) section from Barangay Dalirig to Junction Tangkulan of about 3.84 km; and (2) section from Barangay Indahag to Junction Jr. Borja in Cagayan de Oro City which is approximately 5.8 km. Meanwhile, the two existing road sections are (1) Jct. Tangkulan-Libona section which is approximately 22 km composed of 2 to 4 lanes with a carriageway width ranging from 6.4 to 13.4 meters Portland Cement Concrete (PCC) pavement and a shoulder width of 1.0-2.0 meters; and (2) Libona to Jct. Indahag section which is approximately 23.5 km with 2 lanes having carriageway of 6.4 to 6.7 meters width and Portland Cement Concrete (PCC) pavement and shoulder width of 1.0-1.2 meters.

Most of the sections in Manolo Fortich-Libona-CDO Bypass/Alternate Road are with 2 lanes. Some of the sections with 4 lanes are roads along with pineapple plantation (3.355 km), Agusan Canyon proper (159 m), Libona crossing (1.03 km), and Libona proper (506 m).

**Table 4.5-1 Summary of Proposed Jct. Dalirig-Jct. Tangkulan Section (Section-1)**

Name	Jct. Dalirig-Jct. Tangkulan Section
Classification	Tertiary road
Length	3.84 km
Number of Lanes	2 lanes
Cross section	Carriageway width: 6.7 m Shoulder width: 1.5 m (gravel on both sides)
Slab thickness	250 mm
Structure	Mangima Bridge (RCDG, 200 m)

**Table 4.5-2 Summary of Existing Jct. Tangkulan – Libona Section (Section-2)**

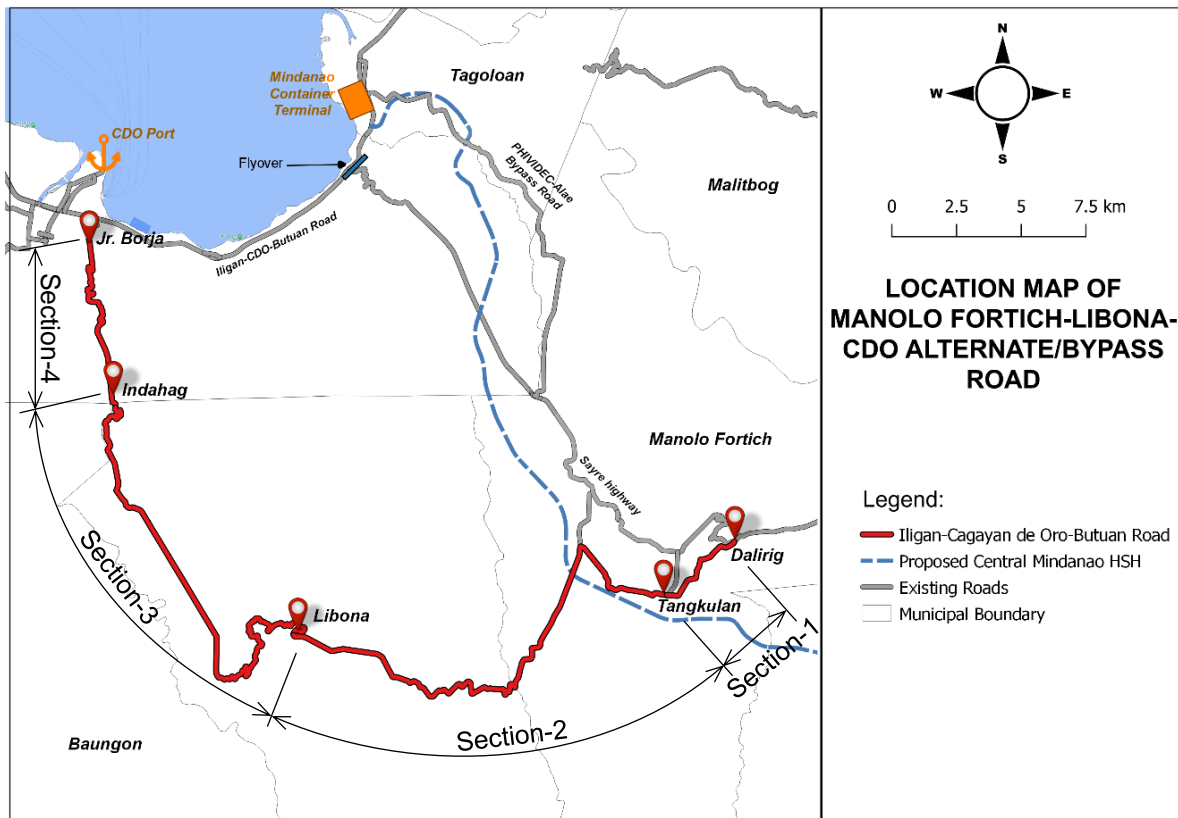
Name	Jct. Tangkulan-Libona Section
Classification	Tertiary road
Length	22 km
Number of Lanes	2-4 lanes
Cross section	Carriageway width: 2 lanes: 6.4-6.7 m (PCCP); 4 lanes: 12.7-13.4 m (PCCP) Shoulder width: 1.0-2.0 m (gravel and concrete)
Slab thickness	200-280 mm

**Table 4.5-3 Summary of Existing Libona – Jct. Indahag Section (Section-3)**

Name	Libona-Jct. Indahag Section
Classification	Tertiary road
Length	23.5 km
Number of Lanes	2 lanes
Cross section	Carriageway width: 2 lanes: 6.4-6.7 m (PCCP) Shoulder width: 1.0-1.2 m (gravel and concrete)
Slab thickness	200-280 mm 250 mm

**Table 4.5-4 Summary of Proposed Jct. Indahag – Jct. Jr. Borja Section (Section-4)**

Name	Jct. Indahag-Jct. Jr. Borja Section
Classification	Tertiary road
Length	5.8 km
Number of Lanes	2 lanes
Cross section	Carriageway width: 2 lanes: 6.7 m (PCCP) Shoulder width: 1.5 m (gravel)
Slab thickness	250 mm



**Figure 4.5-1 Location Map of Manolo Fortich-Libona-CDO Alternate Road**

#### 4.6 Cagayan de Oro Coastal Road

Cagayan de Oro Coastal Road is one of the priority transport projects of the region under the Build! Build! Build! (BBB) Program of the Duterte administration. The project has two sections: Gusa-Igpit section and Puerto-Gusa section with a total length of 27.1 km. The proposed budget for the project is around 3.166 billion PhP and to be constructed by DPWH. The project construction schedule for the Gusa-Igpit section started in November 2010 and expected to be completed in December 2021. On the other hand, the Puerto-Gusa section construction was started last January 2021 and expected to end in December 2027.



Source: Northern Mindanao Regional Development Report. Page 128

Figure 4.6-1 Location Map of Cagayan de Oro Coastal Road

#### 4.7 Other Road Projects

##### 4.7.1 Mindanao Connectivity Potential Project (MCPP)

Mindanao Connectivity Potential Project is conducted by DPWH RMC II and WB. These projects would not directly affect the CMH alignment, as shown in Figure 4.7-1, the CMH alignment will be crossing over MCPP by bridge or box culvert.

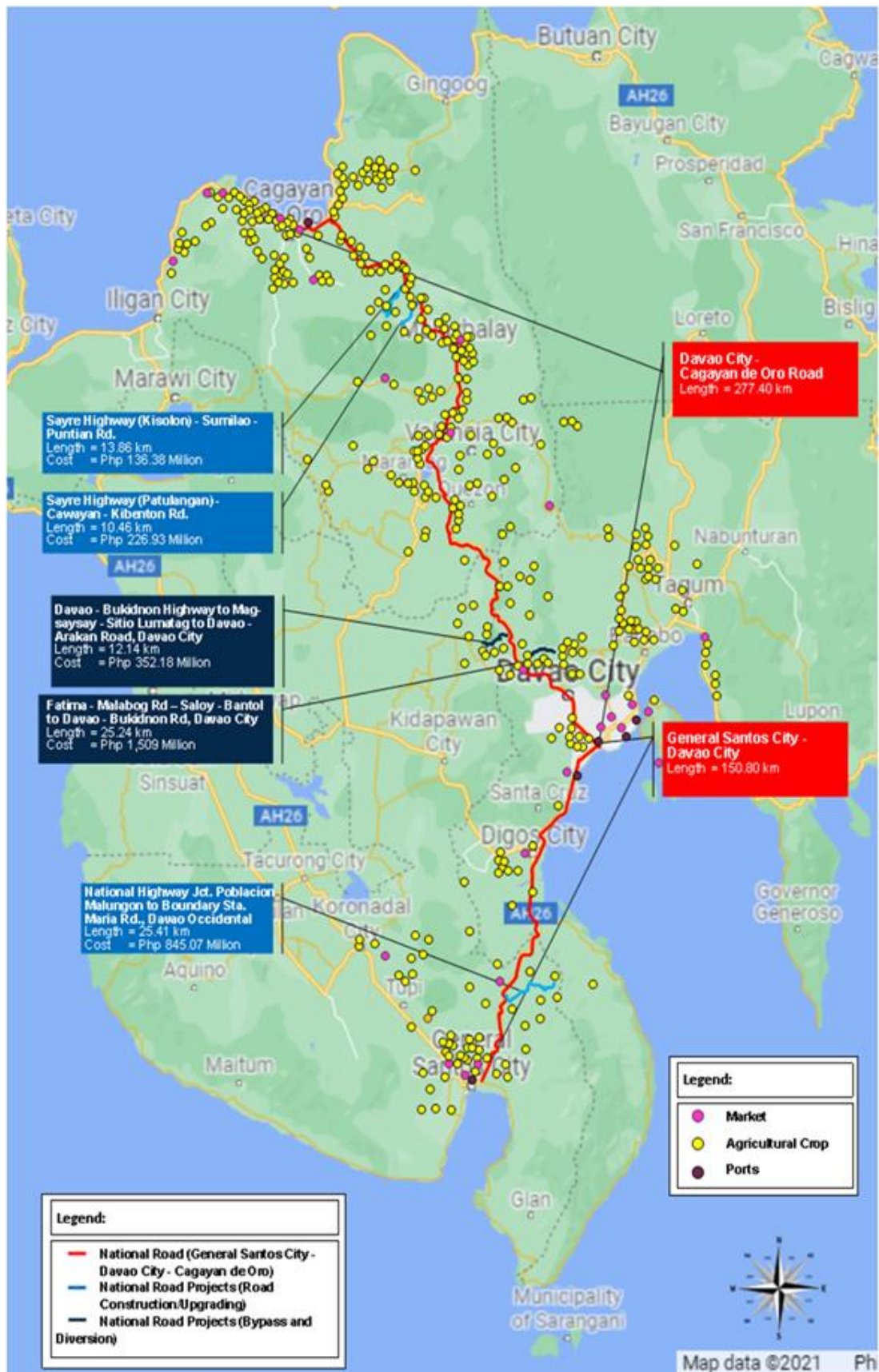
##### **Mindanao Connectivity Potential Project** (Blue line in Figure 4.7-1)

###### National Road Projects (Road Construction Upgrading)

- ✓ Sayre Highway (Kisolon) – Sumilao – Puntian Road, 13.86 km.
- ✓ Sayre Highway (Patulangan) – Cawayan – Kibenton Road, 10.46 km.
- ✓ National Highway Junction Poblacion Mlungon to Boundary Sta. Maria Road, Davao Occidental, 25.41 km.

###### National Road Projects (Bypass and Diversion)

- ✓ Davao – Bukidnon Highway to Magsaysay – Sitio Lumatag to Davao – Arakan Road, Davao City, 12.14 km.
- ✓ Fatima – Malabog Road – Saloy – Bantol to Davao – Bukidnon Road, Davao City, 25.24 km.



Note: Red Line, Present National Primary Road (Sayre Highway, Davao City-Cagayan de Oro Road, General Santos City-Davao City Road)

Source: DPWH

Figure 4.7-1 Location Map of Mindanao Connectivity Potential Project

#### **4.7.2 Villanueva-Cagayan de Oro City-Opol Expressway**

This is the indicative alignment of the proposed expressway in Region X, as shown in Figure 4.7-2. The outline of the project is described below.

The CDO City Development Council unanimously approved today the endorsement for the Villanueva-Tagoloan-CDO-Opol Expressway Project (REXPRI-6) and the Opol-Laguindingan-Naawan Expressway (REXPRI-7) of the DPWH.

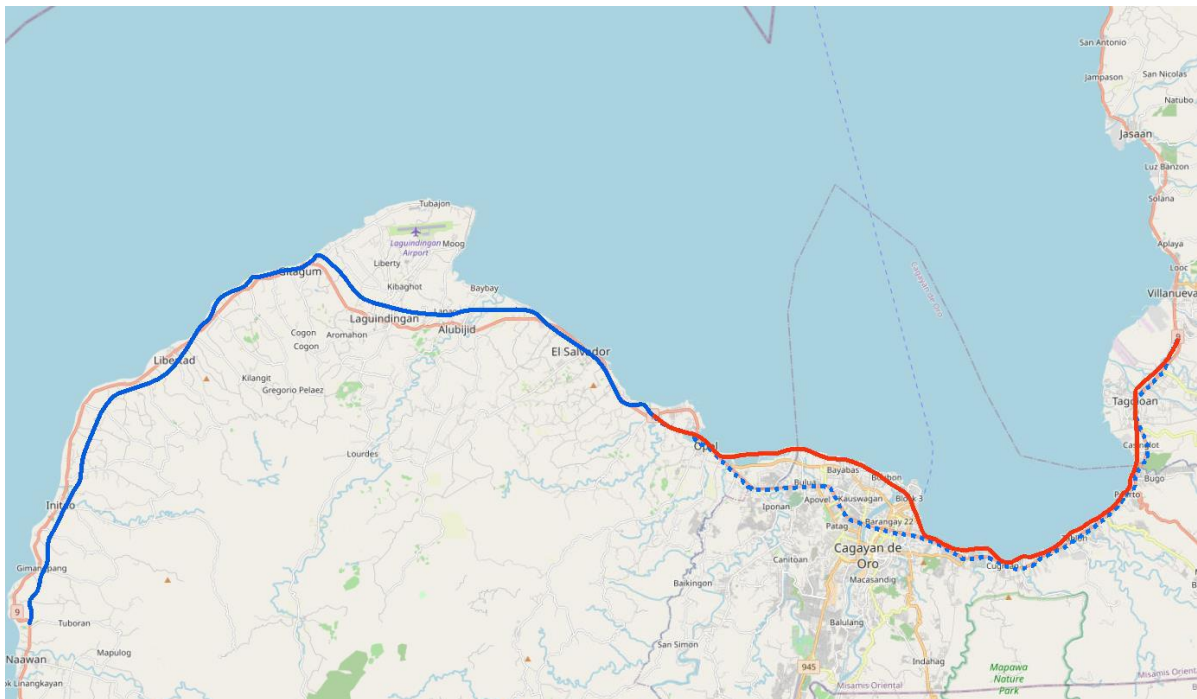
The Project is a 4-lane Expressway Road consisting of an At Grade Road, Viaduct, Causeway Road, Interchange and Ramps. It starts in Brgy San Martin, Municipality of Villanueva, Misamis Oriental and traversing the areas of Tagoloan and Cagayan de Oro City which will end in the Municipality of Opol, Misamis Oriental.

REXPRI-7 starts in Opol and will end in Naawan, Misamis Oriental.

The project aims to address road transportation constraints and induce economic development.

Source: CDO Development website(<http://www.cdodev.com/2018/12/19/project-watch-city-development-council-endorses-villanueva-cdo-opol-and-opol-laguindingan-naawan-expressway-project/>)

Since the beginning point of Central Mindanao High Standard Highway will be located at CDO (Puerto), hence, it should be considered to connect with REXPRI-6 in the future.



Note: Blue line: the Opol-Laguindingan-Naawan Expressway (REXPRI-7), Red line: Villanueva-Tagoloan-CDO-Opol Expressway Project (REXPRI-6) Blue dot line: previous REXPRI-6 alignment

Source: DPWH

**Figure 4.7-2 Location Map of Villanueva-Cagayan de Oro City-Opol Expressway**

## 4.8 Existing Infrastructure Projects

### 4.8.1 Cagayan de Oro Port

The port of Cagayan de Oro is dubbed as the Global Gateway to Mindanao that serves as the entry and exit point of goods and passengers from Cagayan de Oro City to neighboring provinces, such as Misamis Oriental, Agusan del Norte, Agusan del Sur, Bukidnon, Davao, and other parts of the country.

Cagayan de Oro Port Zone has a total land area of 365 hectares (340 ha. sea area and 25 ha. land area) bounded by MacArthur Memorial Marker in the north and the shores of Barangay Lapasan in the southeast. It is under the jurisdiction of the Philippine Ports Authority (PPA) since November 19, 2008, under Executive Order 769 issued by the former President Gloria Macapagal Arroyo.

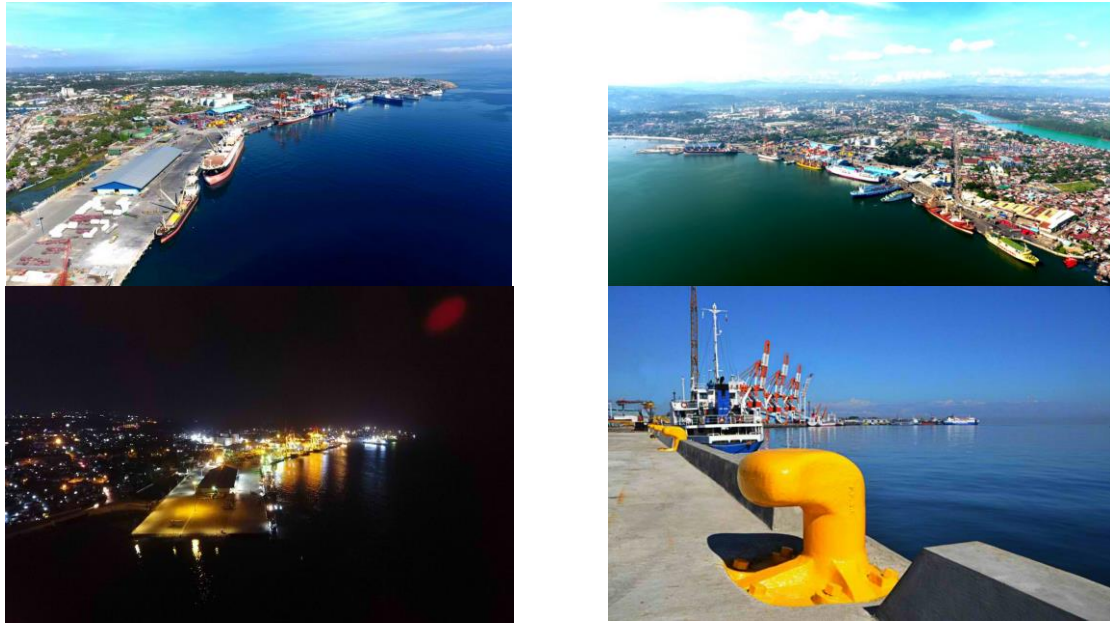
The port is considered the busiest government-operated port in Northern Mindanao in terms of cargo output. It is classified as a Class A cargo general port that caters to all sorts of goods, agricultural and industrial products, bottled and canned goods, chemicals and petrochemicals, and rolling cargoes.

In 2019, the biggest Passenger Terminal Building (PTB) among the PPA-owned seaports in the country that can accommodate approximately 3,000 passengers during peak seasons, and the 6-lane Cargo Gate Complex were both inaugurated and started to be used. Figure 4.8-1 shows the different facilities and capacities of the port of Cagayan de Oro.

**Table 4.8-1 Summary of Facilities/Services of Cagayan de Oro Port**

Facilities/Services	Area/Capacity
<b>Total port Area</b>	267,831.25 sq. m.
<b>Berthing Facilities</b>	
Quay length	1,398 linear meters
1 Ro-Ro ramp	10.50 x 12.50 m LCT type, 10 m draft
<b>R.C. Wharf</b>	
Berths 1-2	9.10 m draft
Berths 3-5	8.0 m draft
Berths 6-7	8.46 m draft
Berths 8-9	10.31 m draft
Berth 10	10.84 m draft
Berths 12-14	13.0 m draft
<b>Storage facilities</b>	
Open storage areas	40,087.50 sq. m.
Transit Shed 1	N/A
Transit Shed 2	2,760 sq. m.
Open Transit Shed 1	5,040 sq. m.
Open Transit Shed 1	5,000 sq. m.
Container Freight Station	10,872.25 sq. m.
Container Marshaling Yard	32,194.50 sq. m.
<b>Other Port Facilities</b>	
Weighbridge	5 units, 80-ton capacity
Reefer Outlets	36 units, 440 V
Shore-based power supply	6 units
Generator Sets	1 unit 1,000 KVA, 1 unit 500 KVA, 1 unit 300 KVA, 1 unit 150 KVA
Powerhouse	1 unit 1 MVA (480/400 V), 1 unit 500 KVA
Storage Tanks for Molasses by Private Sector	10,000 MT capacity
Cold Storage Facilities at CFS by CHO	1,260 MT capacity

Source: <http://www.pmocdo.ppa.com.ph/port-profile/port-of-cagayan-de-oro/>



Source: <http://www.pmocdo.ppa.com.ph/port-profile/port-of-cagayan-de-oro/>

**Figure 4.8-1 Photographs of Port of Cagayan de Oro**

**4.8.2 Mindanao Container Terminal (MCT)**

The Mindanao Container Terminal (MCT) is a government-owned and controlled corporation constructed by PHIVIDEC Industrial Authority (PIA). It is a modern world-class port that caters to products and cargoes for export and import coming from and to provinces of Davao, Bukidnon, Cotabato, and other areas of Mindanao.

MCT handles both domestic and international cargoes with direct routes to Kaohsiung, Taiwan, Hongkong, Kota Kinabalu, and Singapore. The capacity of the terminal is 270,000 TEUs expandable to 500,000 TEUs. It also has a 9.40 hectares container yard that can accommodate 6,816 TEUs at any given time and 4 rubber-tired gantry cranes that can stack up to 4 container vans upward in 6 rows. Table 4.8-2 shows the different facilities and capacity of MCT.

The primary purpose of MCT is to decongest the cargo traffic at Cagayan de Oro Port by providing the needs of PHIVIDEC clients. Also, to reinforce the country’s reputation as the leader in the international fresh and canned pineapple trade and as the powerhouse agro-industrial sector in Northern Mindanao.

**Table 4.8-2 Summary of MCT’s infrastructures capacity**

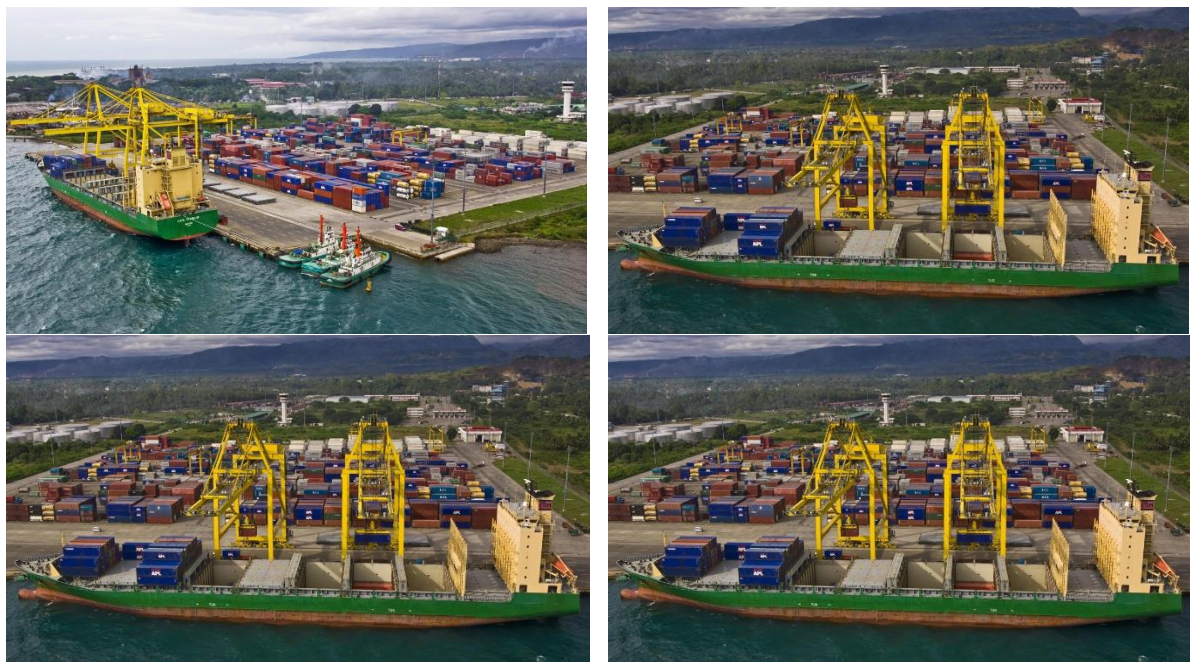
<b>Facilities</b>	<b>Capacity</b>
Terminal area	24 ha.
Container yard	11 ha.
Berth length	300 m
Berthing positions	2
Controlling depth	13 m
Reefer stack	262 (440V series 1)
Checking gate	8 lanes
Weigh bridges	2
Fuel oil station	0.01 ha.
Security boxes	8.8 security facility
Workshop	0.0825 ha.
Substation (powerhouse)	0.15 ha.



- Legend:
- 1 Terminal Gate
  - 2 Terminal Building
  - 3 Checking Gate
  - 4 Control Tower
  - 5 Workers' Facility and Maintenance Building
  - 6 Future Expansion
  - 7 Reefer Racks
  - 8 Container Yard

Source: <https://www.ictsi.com/what-we-do/our-terminals/mindanao-container-terminal>

**Figure 4.8-2 MCT Layout**



Source: <https://www.ictsi.com/media/photos/mindanao-container-terminal-philippines>

**Figure 4.8-3 Mindanao Container Terminal (MCT)**

### 4.8.3 Laguindingan Airport

Laguindingan Airport located in Laguindingan, Misamis Oriental is the first international airport in Northern Mindanao that caters to the cities of Cagayan de Oro, Iligan, and Marawi. It also serves the provinces of Misamis Oriental, Lanao del Norte, and Bukidnon, and is designed to have a capacity of approximately 1.6 million passengers per year. The airport started its operation in 2013 having two airlines with flights from Manila to Cagayan de Oro and vice versa averaging five flights per day, and three airlines with flights from Cebu to Cagayan de Oro and vice versa averaging 1-3 flights per day.

The airport's passenger terminal building has a total area of 7,184 square meters developed in a one and a half level terminal served by two aerobridges. The overall height of the terminal is 15 meters

with floor height of about 4.75 to 5.0 meters. Table 4.8-3 and Table 4.8-4 present the summary of the existing airside facilities and core facilities of Laguindingan Airport.

**Table 4.8-3 Summary of Airside Facilities in Laguindingan Airport**

Airside Facility	Description/Capacity
Area	354 hectares
Runway orientation	N 85°30'12" E
Runway length	2,100 meters, single runway
Runway width	45 meters, single runway
Runway strip width	300 meters
Taxiways	23 meters wide
Turning pad	Yes
Apron area	46,150 square meters
Passenger boarding bridge	2

Source: DOTR-CAAP. Laguindingan Airport PPP Project. Project information Memorandum. Page 14.

**Table 4.8-4 Summary of Core Airport Facilities in Laguindingan Airport**

Facility/Utility	Description/Capacity
Car parking	420 slots – 380 for passenger parking
Cargo	350 square meters
Air traffic control (ATC) tower building	1,139 square meters, 36.7 meters high
Aircraft rescue and firefighting (ARFF) building	553 square meters, 2 floors
Administration building	676 square meters, 2 floors
Maintenance building	740 square meters, 2 floors
Other utilities:	
Power supply system	
Water supply network	
Sewerage network	
Stormwater drain network	

Source: DOTR-CAAP. Laguindingan Airport PPP Project. Project information Memorandum. Page 14.

Table 4.8-5 summarizes the statistics of movements in Laguindingan Airport five years from the year it was opened. Passenger and aircraft movement experienced an increasing trend from the year 2014 to 2018. Cargo movement on the other hand, experienced fluctuating trend from the year 2014 to 2018 with peak movement in the year 2015.

**Table 4.8-5 Statistics of Domestic Movements in Laguindingan Airport**

Year	Frequency		
	Passenger movement	Aircraft movement	Cargo movement (in kg)
2013	1,732,518	14,544	19,818,949
2014	1,553,346	11,638	21,803,029
2015	1,756,445	13,702	25,983,455
2016	1,776,353	14,056	20,482,959
2017	1,814,644	15,802	17,604,861
2018	2,079,684	17,478	25,366,119



**Figure 4.8-4** Satellite Image of Laguindingan Airport

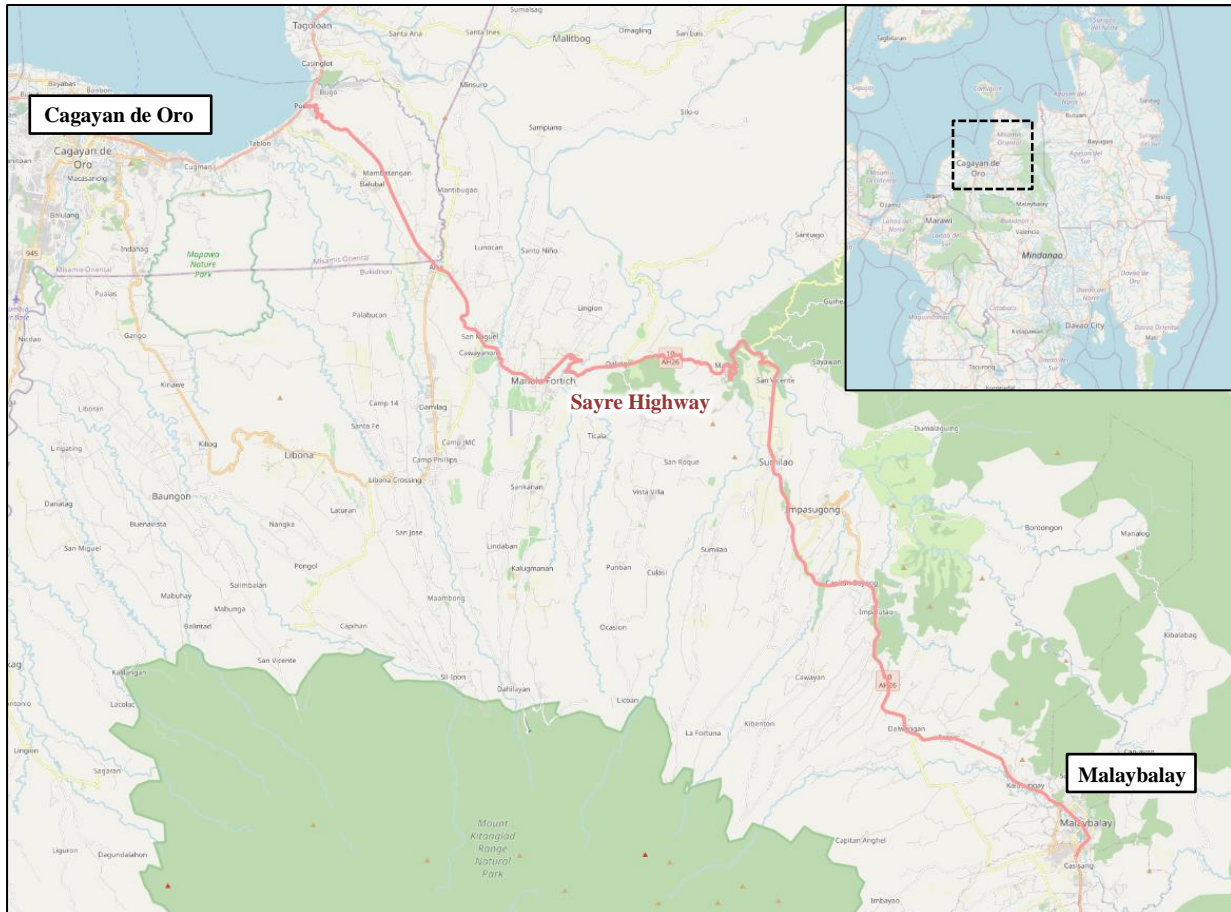


## CHAPTER 5 TRAFFIC SURVEY AND FUTURE TRAFFIC DEMAND

### 5.1 Present Traffic Condition

#### 5.1.1 Road Network Along Project Area

From Cagayan de Oro to Malaybalay, Sayre Highway is the only trunk road. Three kinds of traffic surveys were carried out to understand the travel characteristics within the study area.



Source: JICA Study Team

Figure 5.1-1 Route of Sayre Highway

#### 5.1.2 Traffic Survey Undertaken

The traffic count survey, travel speed survey, and logistics company interview survey were carried out. The objectives and method of the three surveys are shown in Table 5.1-1.

**Table 5.1-1 Objectives of Traffic Survey and Method of Survey**

No.	Type of Survey	Target	Objectives	Method
1	Traffic count survey	10 stations (9 stations on weekday and 1 station on Sunday) in around project area	To capture traffic volume by determining the number of vehicles passing through a road section over a period of time	Manual count (24-hour survey)
2	Travel speed survey	Sayre Highway (Cagayan de Oro-Malaybalay)	To analyze the effect of traffic congestion on vehicle speed (Passenger car and Truck)	Driving a survey car following passenger car and Truck along the selected route and using GPS to capture of time, position, and speed data.
3	Logistic company interview survey	11 companies	To get information on the type of commodities handled by the trucking company and understand how these products are transported	Interview with logistics administrator of selected company

Source: JICA Study Team

### (1) Traffic Count Survey

A 24-hour traffic count survey was carried out, at each of the ten stations along Sayre Highway. The survey was done manually, with surveyors positioned at the side of the road while recording the number of vehicles, per direction, per vehicle type (12 types of vehicles based on DPWH classification). The locations of the traffic count survey stations are shown in Figure 5.1-2.

The survey stations were selected based on the following reasons:

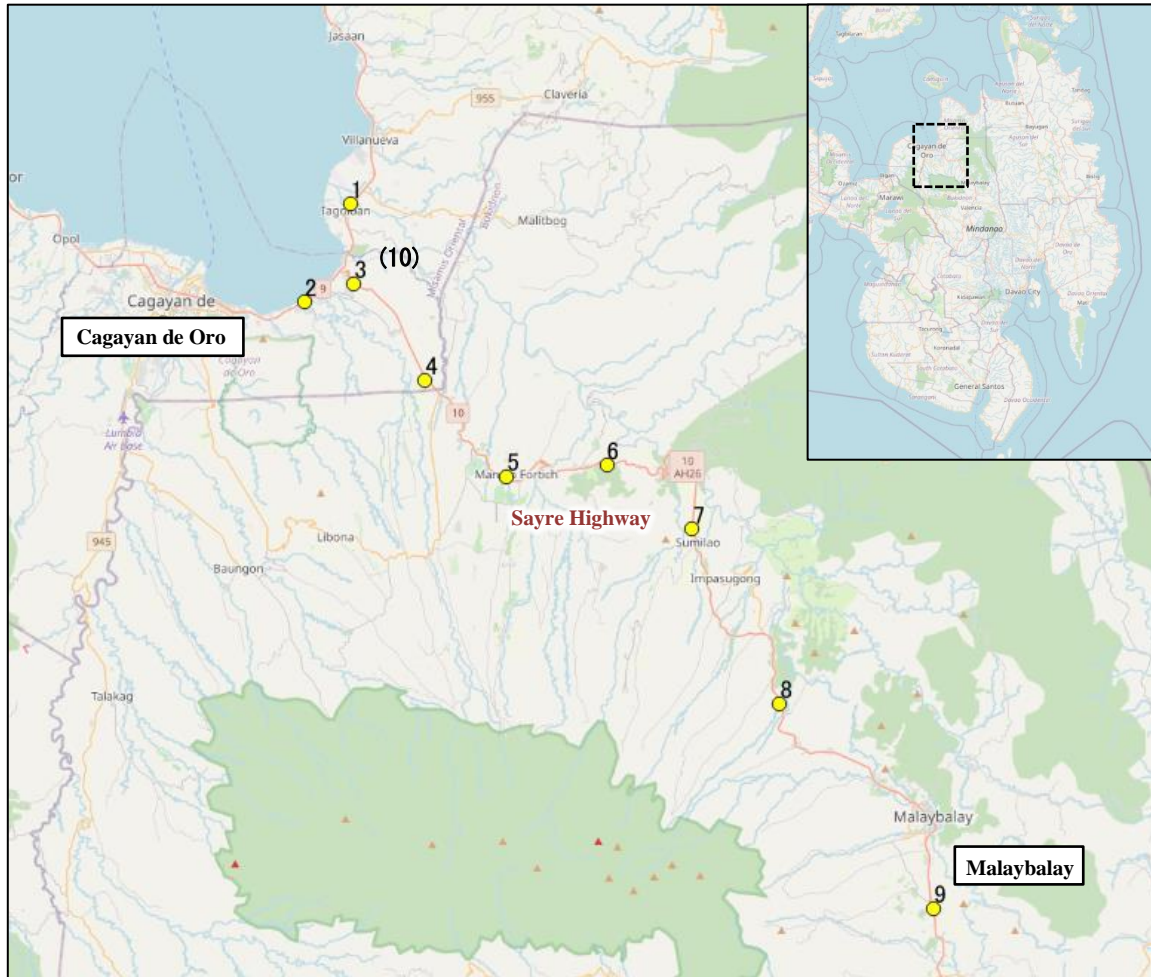
1. The survey stations along Sayre Highway were set between each IC based on the assumption of the IC interval of CMH, including the same survey point used in the HSH MP2. (Station 3 to 9)
2. The survey stations along coastal road in each of the north and south areas were selected to check the traffic conditions of the coastal roads connecting to CMH. (Station 1 and 2)
3. The survey points along Sayre Highway on a holiday were selected to confirm the difference of traffic volume between weekday and holidays. (Station 10)

Traffic count data are useful in identifying the traffic volume at each section and the characteristic of vehicle traffic. The traffic volume is usually stated in terms of passenger car units (PCUs) and is used to calculate the level of service (LOS) of the road and identify peak hours.

**Table 5.1-2 Traffic Count Survey Methodology**

Survey day	Station1-5: November18, 2020 (Wed), Station6-9: November 20, 2020 (Fri), Station10: November 22, 2020 (Sun)
Survey time	24 hours (from 6:00 AM to 6:00 AM)
Survey items	Traffic volume per type of vehicle

Source: JICA Study Team



Source: JICA Study Team

**Figure 5.1-2 Location of Traffic Count Stations**

## (2) Travel Speed Survey

A travel speed survey was conducted along Sayre Highway to analyze the effect of traffic congestion on passenger car and truck speed. To analyze the effect of traffic congestion due to heavy traffic on vehicle speed, the survey date was selected weekdays which have more traffic than weekends and holidays because of the characteristics of Sayre Highway.

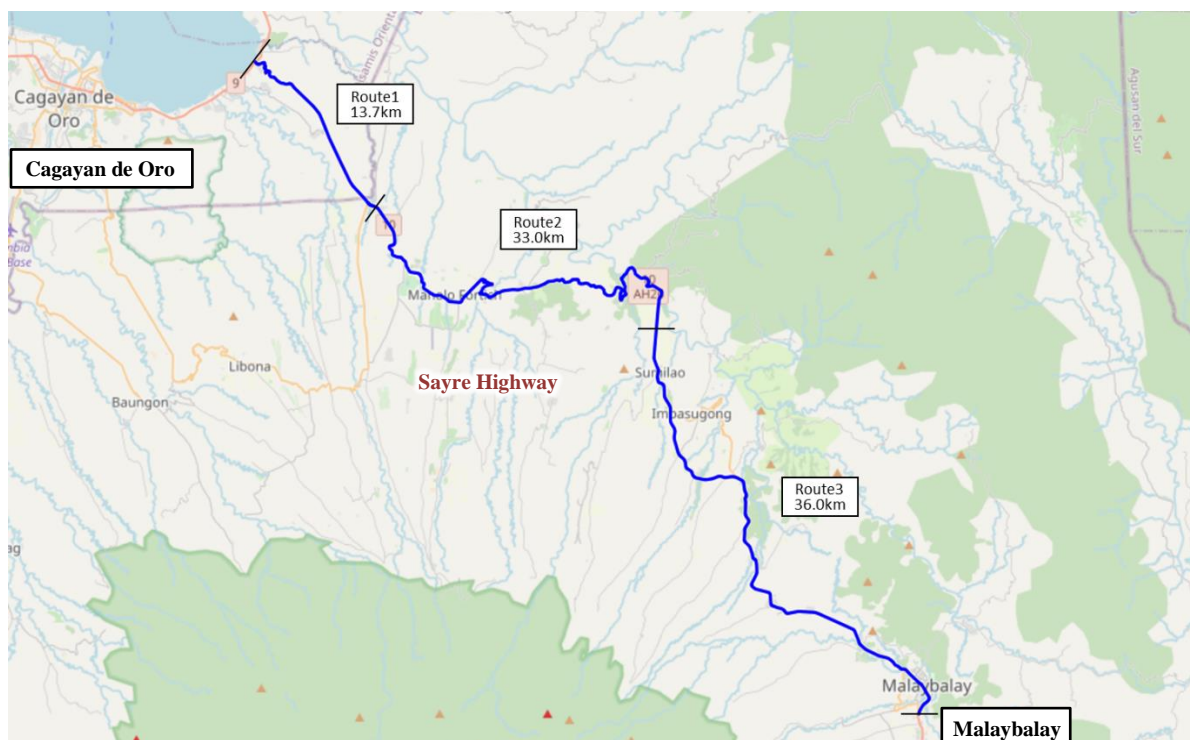
The method of the survey is to make a round trip in the morning peak hours, evening peak hours and off-peak hours. The travel data was continuously recorded using a GPS device.

A surveyor boarding the car records the departure and arrival times, as well as the causes and duration of every delay. Travel speed routes are shown in Figure 5.1-3.

**Table 5.1-3 Travel Speed Survey Methodology**

Survey day	November 18 (Wed), 20 (Fri) and 23 (Mon), 2020
Survey Target Vehicle	Passenger car, Truck Driving a survey car following target passenger car and Truck along the selected route. To survey the speed of the target vehicle, the survey car doesn't overtake the target vehicle.
Survey time	Morning peak time, evening peak time, off-peak time
Survey items	Time (departure and arrival), travel speed, information of positioning, cause of delay

Source: JICA Study Team



Source: JICA Study Team

**Figure 5.1-3 Location Map of Travel Speed Survey**

### (3) Logistic company interview survey

A logistics company interview survey was undertaken to determine the type of commodities handled by the trucking company and get information on how these commodities are transported. The surveyor asked the transport administrator for information on the logistics facilities, volume of commodities, and transport operations of the company.

A total of ten logistics companies were selected. The list of surveyed companies is shown in Table 5.1-5.

**Table 5.1-4 Logistics Company Interview Survey Methodology**

Survey day	November 20-December 4, 2020 (Weekday)
Survey time	Company office hours
Survey items	Cargo volume per commodity, loading condition, vehicle inventory, warehouse inventory, service area, origin and destination of trucks, staying time of commodity

Source: JICA Study Team

**Table 5.1-5 Number of Firms Covered by the Logistics Interview Survey per Area**

No.	Name	Location
1	Domestic Products	Cugman, Cagayan De Oro
2	Beverage Company	Tin-ao, Cagayan De Oro
3	Beverage Company	Katipunan, Villanueva
4	Beverage Company	Sta. Ana, Tagoloan
5	Domestic Products	San Vicente, Sumilao
6	Domestic Consumption Products	Tambaling II, Pedro Sa Baculio, El Salvador City
7	Local Consumption Goods	Poblacion Sur, Don Carlos
8	Supply Chain Management	Bulua, Cagayan De Oro
9	Transportation/Forwarding	Puntod, Cagayan De Oro
10	Trucking company	Tablon, Cagayan de Oro
11	Trucking company	Tangkulon, Manolo Fortich

Source: JICA Study Team

### 5.1.3 Traffic Survey Result

#### (1) Traffic Count Survey

##### 1) Survey Result

###### a) Annual Average Daily Traffic (AADT)

Traffic count results were converted to the annual average daily traffic (AADT) as shown in Figure 5.1-4. The AADT excludes traffic volume counts of Motorbike and Tricycle.

###### b) Traffic volume

The traffic volume along the Coastal Road at stations 1 and 2 are approximately 15,000 vehicles/day.

The traffic volume along Sayre Highway from Cagayan de Oro to Manolo Fortich is approximately 9,000~10,000 vehicles/day. The traffic volume along the Manolo Fortich to Malaybalay section is approximately 6,000~6,500 vehicles/day.

The traffic volume trend is observed to be different along the Cagayan de Oro to Manolo Fortich section, as compared to the section between Manolo Fortich and Malaybalay.

###### c) Vehicle type

Along Sayre Highway, passenger cars, taxis, and High Occupancy Vehicles (HOVs) occupied more than 50% of the traffic volume at stations 1-7.

The survey also found out that a significant number of trucks pass through Sayre Highway. Trucks comprised approximately 40% of the traffic volume. Large trucks, in particular, accounted for 25-30% of the traffic volume.

The results of the traffic count survey suggest that Sayre Highway plays an important role in logistics within the region.

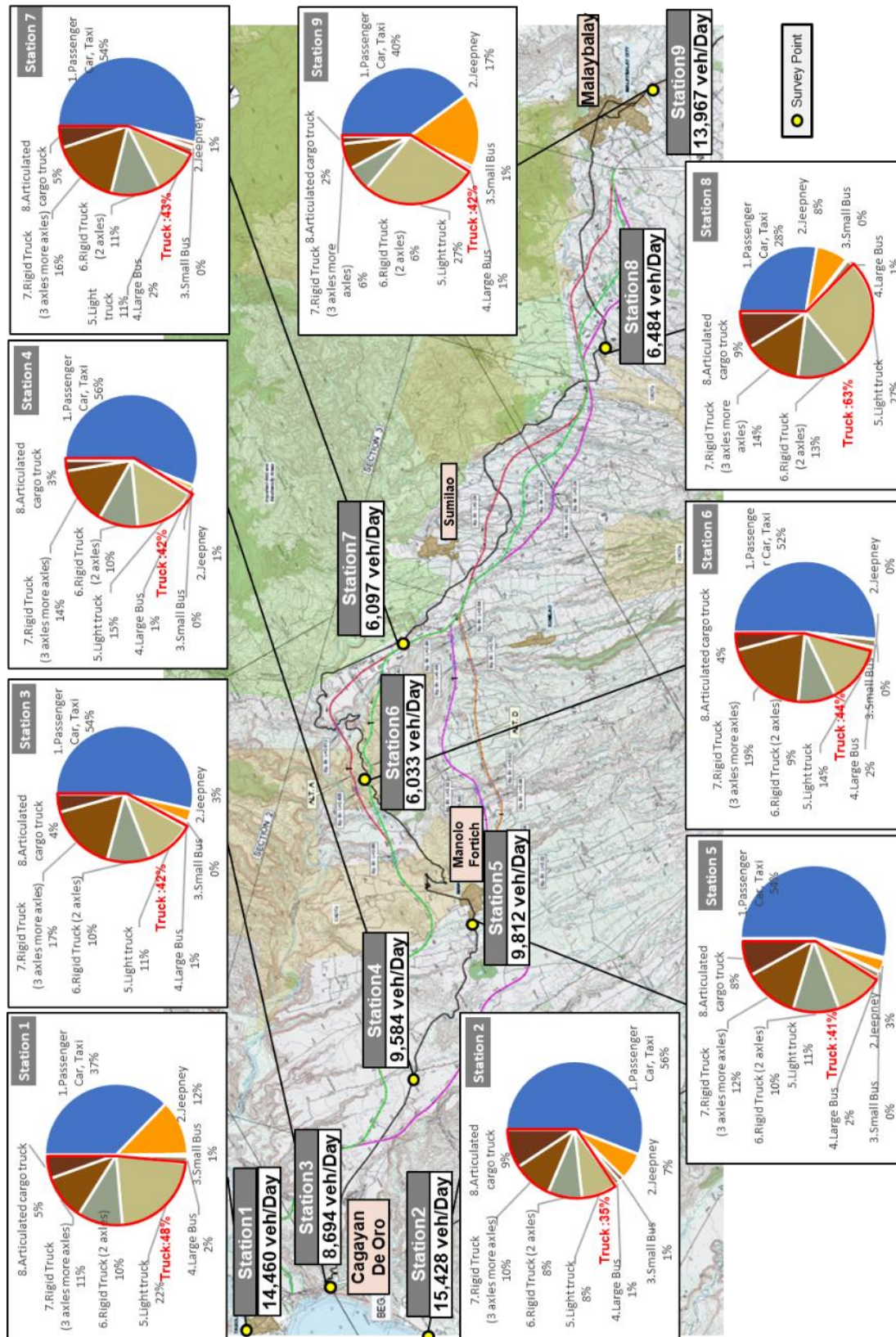


Figure 5.1-4 Traffic Volume and Vehicle Type

## **(2) Travel Speed Survey**

### **1) Survey Result**

The travel speed survey results during the afternoon peak hour are shown in Figure 5.1-5 and Figure 5.1-6. The average travel speed of a passenger car is 49km/h, but along the zigzag sections and along urban areas, the average travel speed is under 30 km/h.

The average travel speed of trucks is 37 km/h. Along zigzag sections and along urban areas, the travel speed is reduced to 23 km/h.

Along the zigzag sections and urban sections, the travel speed was observed to decrease by approximately 15-20 km/h.

The zigzag sections also feature steep slopes, thus significantly affecting the smooth travel of heavy trucks.

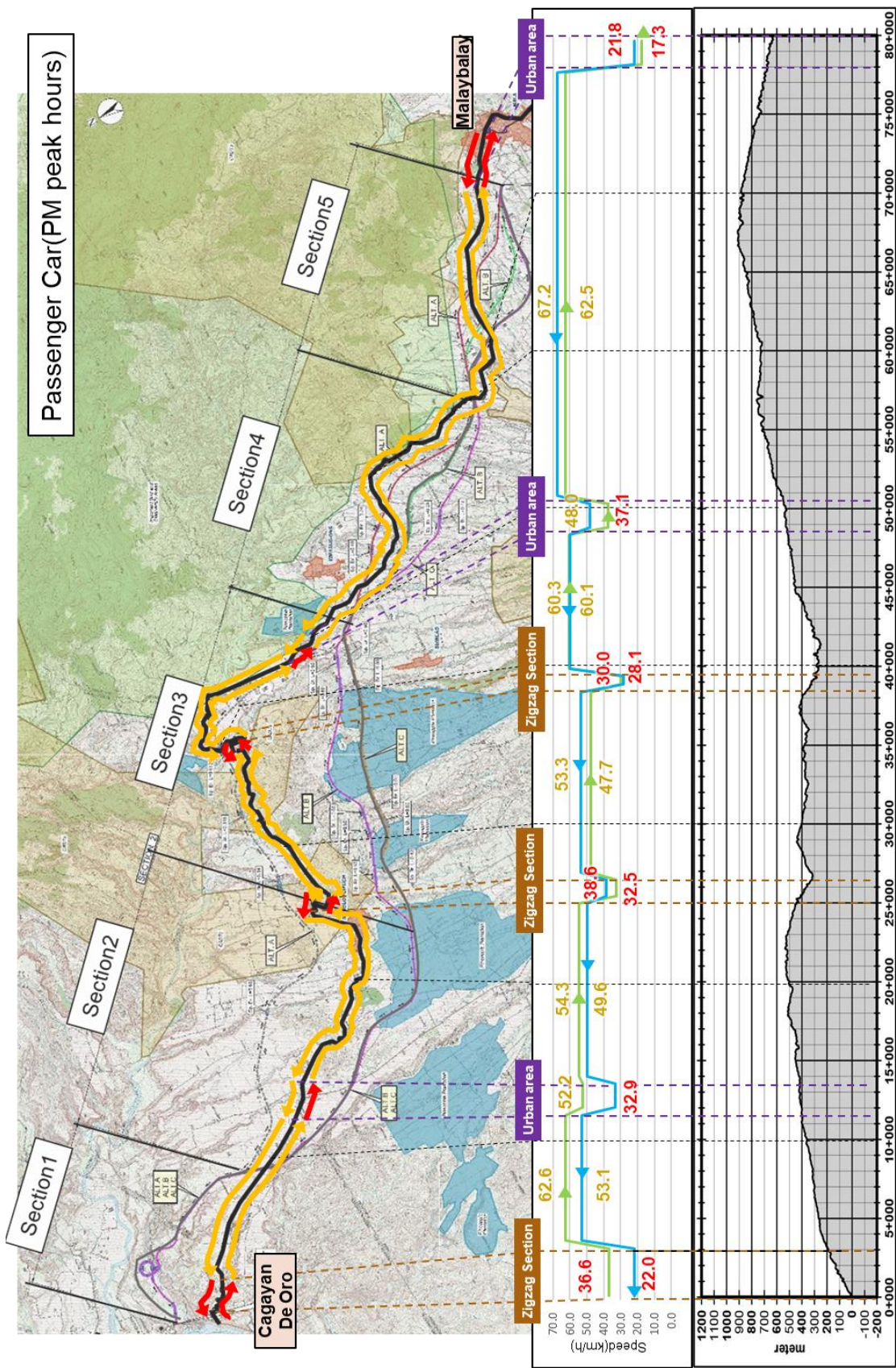


Figure 5.1-5 Passenger Car Travel Speed During PM Peak Hour on Sayre Highway

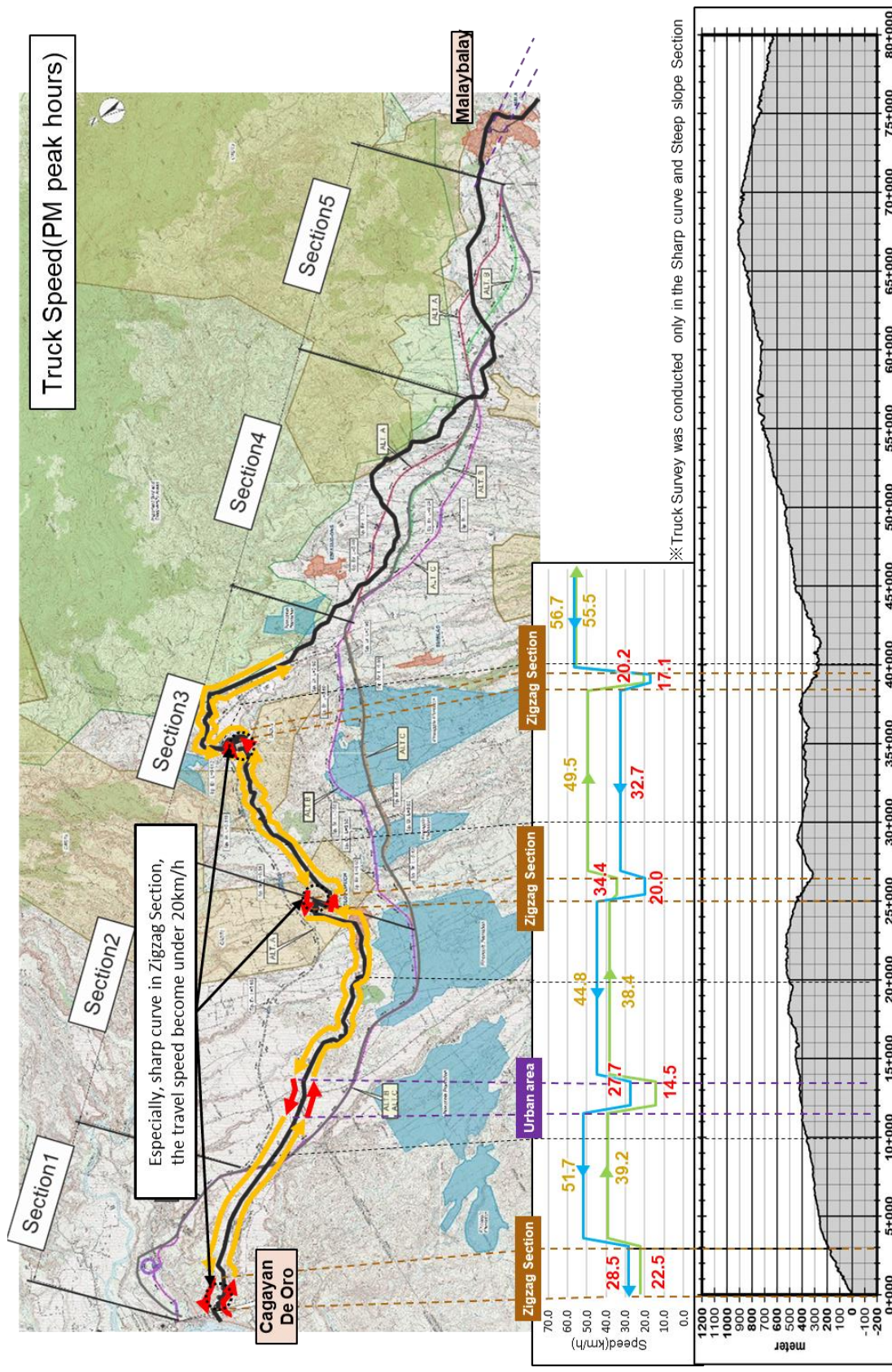


Figure 5.1-6 Truck Travel Speed During PM Peak Hour on Sayre Highway

**(3) Logistic Company Interview Survey**

11 logistics companies utilizing the Sayre Highway were included in the survey. The survey result was summarized in **Chapter 6** Necessity of the Project.

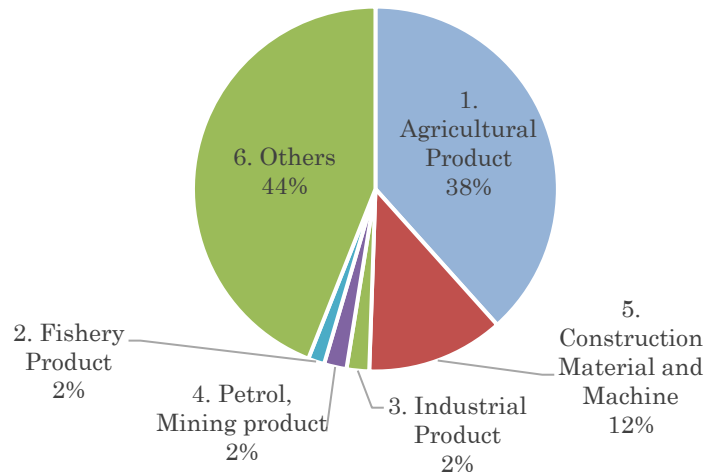
**5.1.4 Traffic Characteristics**

A roadside Origin-Destination (OD) Survey was conducted along Sayre Highway in 2019 in the High Standard Highway Master Plan project.

The traffic characteristics from the survey result is shown below.

**(1) Transported Commodity Type**

The commodity type transported by trucks using the Sayre Highway is shown in Figure 5.1-7. The figure below shows the percentile for the type of commodity being transported by the trucks. There are large plantations along the road, and the survey results revealed that agricultural products comprised approximately 40% of transported cargoes.



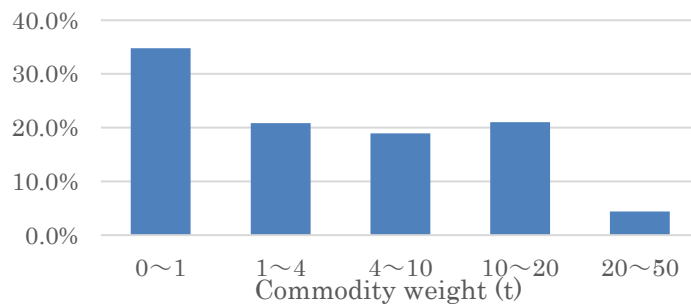
Source: JICA Study Team

**Figure 5.1-7 Transported Commodity Type**

**(2) Transported Commodity Weight**

The average commodity weight is 5.4 t. The distribution of the transported weight is shown in Figure 5.1-8. It was calculated based on the weight of the truck transporting the commodity (does not include empty trucks).

Trucks with commodity weights of 10 to 20 tons and 20 tons or more also use the Sayre Highway, and it is necessary to drive at a significantly low speed along zigzag sections with sharp curves.



Source: JICA Study Team

**Figure 5.1-8 Commodity Weight Distribution**

### **5.1.5 Summary of the Results**

- The traffic volume along Sayre Highway from Cagayan de Oro to Manolo Fortich is approximately 9,000-10,000 vehicles/day. Along the Manolo Fortich to Malaybalay section, the traffic volume is approximately 6,000-6,500 vehicles/day.
- The traffic volume trend is observed to be different along the Cagayan de Oro to Manolo Fortich section, as compared to the section between Manolo Fortich and Malaybalay.
- The survey also found out that a significant number of trucks pass through Sayre Highway. Trucks comprised approximately 40% of the traffic volume. Large trucks accounted for 25~30% of the traffic volume.
- Along zigzag and urban sections, the travel speed decrease by approximately 15-20 km/h.
- Sayre Highway is being utilized for travel from Cagayan de Oro to Malaybalay, as well as for long trips from Cagayan de Oro to Davao (over 200 km.).
- Agricultural products account for approximately 40% of transported goods along Sayre Highway.
- Trucks with commodity weights beyond 20 tons were also observed on Sayre Highway, so the overloaded truck through the CMH should be controlled by DPWH for the safety road pavement.

## **5.2 Traffic Demand Forecast**

### **5.2.1 Methodology of Traffic Demand Forecast**

Future traffic demand is estimated to obtain basic information for economic analysis of the project. The basic idea of traffic demand forecast is as follows: to calculate the planned traffic volume from the traffic assignment using the traffic assignment data used by HSH MP2).

- Year of Traffic Demand Forecast: 2040
- Methodology of Traffic Demand Forecast: Traffic Assignment
- Using Data
  - Present Condition (2019): Road Network (2019), OD table (2019)
  - Future Condition (2040): Road Network (2040), OD table (2040)

### **5.2.2 Social Economic Indicators condition**

The OD table is based from the one created by HSH MP2. The social economic indicators, population and the growth rate of traffic volume are discussed as follows.

#### **(1) Population Projection**

The population projection result is shown in Table 5.2-1. The project area is Region X: Northern Mindanao.

**Table 5.2-1 Population Projection by Region from 2020 to 2040**

Region	Population			Population Projection			Average Annual Growth Rate			
	2000	2010	2015	2020	2030	2040	2000-2010	2010-2020	2020-2030	2030-2040
Cordillera Administrative Region (CAR)	1,365,220	1,616,867	1,722,006	1,842,565	2,038,613	2,189,215	1.71%	1.32%	1.02%	0.72%
National Capital Region (NCR)	9,932,560	11,855,975	12,877,253	13,786,827	15,214,296	16,279,264	1.79%	1.52%	0.99%	0.68%
Region I - Ilocos Region	4,200,329	4,748,372	5,026,128	5,285,245	5,713,354	6,020,961	1.23%	1.08%	0.78%	0.53%
Region II - Cagayan Valley	2,813,159	3,229,163	3,451,410	3,649,181	3,988,067	4,240,585	1.39%	1.23%	0.89%	0.62%
Region III - Central Luzon	8,200,151	10,137,737	11,218,177	12,163,997	14,063,875	15,644,646	2.14%	1.84%	1.46%	1.07%
Region IV-A - CALABARZON	9,320,629	12,609,803	14,414,774	16,014,430	18,985,599	21,468,719	3.07%	2.42%	1.72%	1.24%
Region IV-B - MIMAROPA	2,298,796	2,744,671	2,963,360	3,177,164	3,544,354	3,831,043	1.79%	1.47%	1.10%	0.78%
Region V - Bicol Region	4,686,669	5,420,411	5,796,989	6,146,613	6,741,732	7,189,582	1.47%	1.27%	0.93%	0.65%
Region VI - Western Visayas	6,209,304	7,102,438	7,536,383	8,047,103	8,975,024	9,650,497	1.35%	1.26%	1.10%	0.73%
Region VII - Central Visayas	5,704,655	6,800,180	7,396,898	8,050,667	9,261,636	10,206,516	1.77%	1.70%	1.41%	0.98%
Region VIII - Eastern Visayas	3,610,191	4,101,322	4,440,150	4,723,794	5,293,789	5,714,478	1.28%	1.42%	1.15%	0.77%
Autonomous Region in Muslim Mindanao (ARMM)	2,803,045	3,256,140	3,781,387	4,041,809	4,692,075	5,213,117	1.51%	2.19%	1.50%	1.06%
Region IX - Zamboanga Peninsula	2,831,342	3,407,353	3,629,783	3,950,870	4,514,320	4,954,455	1.87%	1.49%	1.34%	0.93%
Region X - Northern Mindanao	3,493,806	4,297,323	4,689,302	5,108,727	5,912,767	6,546,516	2.09%	1.74%	1.47%	1.02%
Region XI - Davao Region	3,708,846	4,468,563	4,893,318	5,488,911	6,486,314	7,367,409	1.88%	2.08%	1.68%	1.28%
Region XII - SOCCSKSARGEN	3,222,169	4,109,571	4,545,276	5,012,148	5,910,024	6,635,592	2.46%	2.01%	1.66%	1.16%
Region XIII - Caraga	2,087,749	2,429,224	2,596,709	2,776,477	3,117,974	3,371,492	1.53%	1.35%	1.17%	0.78%
Philippine Grand Total	76,488,620	92,335,113	100,979,303	109,266,528	124,453,813	136,524,087	1.90%	1.70%	1.31%	0.93%

Source: Population Data 2000, 2010 and 2015: Population Census; and Population Projection from 2019 to 2040: JICA Study Team.

**(2) Economic indicator**

The estimated GDP and GRDP by industry from 2019 to 2040 is presented in Table 5.2-2 and Table 5.2-3.

**Table 5.2-2 Estimated GDP and GRDP (2019-2040) (in Billion PhP)**

		GDP and GRDP PREDICTION													
		PRIMARY							SECONDARY						
		2018	2019	2020	2025	2030	2035	2040	2018	2019	2020	2025	2030	2035	2040
Philippines		745.8	763.0	781.1	904.2	1,085.0	1,334.4	1,670.6	3,142.8	3,375.6	3,613.5	5,048.4	7,007.1	9,689.8	13,368.5
NCR	National Capital Region	5.3	5.5	5.7	6.7	8.2	10.3	13.1	561.9	623.5	659.5	879.4	1,182.4	1,597.8	2,166.1
CAR	Cordillera Administrative Region	12.0	12.1	12.1	12.2	12.7	13.4	14.3	87.5	88.4	93.8	127.0	172.6	235.2	320.8
I	Ilocos Region	51.6	53.7	54.7	61.7	72.2	86.8	106.3	87.4	93.3	101.2	148.2	211.8	299.0	418.6
II	Cagayan Valley	46.8	49.7	50.6	56.9	66.5	79.8	97.6	23.3	26.1	28.3	41.7	59.8	84.5	118.5
III	Central Luzon	125.0	130.0	135.0	167.0	212.0	273.7	357.4	438.8	475.1	517.4	768.8	1,109.0	1,574.4	2,214.1
IV-A	CALABARZON	74.7	77.4	79.4	92.9	112.4	139.3	175.7	973.2	1,021.3	1,085.0	1,472.9	2,005.2	2,734.7	3,733.8
IV-B	MIMAROPA	27.4	27.3	27.7	30.3	34.5	40.3	48.1	47.4	48.1	50.3	63.7	82.4	108.2	143.3
V	Bicol Region	34.9	35.2	35.9	41.1	48.9	59.5	73.9	44.7	48.4	52.7	78.0	112.2	159.0	223.4
VI	Western Visayas	64.3	63.9	64.7	71.2	81.4	95.6	114.6	91.9	102.8	112.6	171.0	249.9	357.7	505.9
VII	Central Visayas	30.8	31.1	31.9	37.4	45.3	56.3	71.0	230.3	245.5	262.8	367.2	509.7	704.9	972.5
VIII	Eastern Visayas	25.9	27.2	27.8	32.3	38.9	48.0	60.2	77.0	83.7	88.8	119.8	162.6	221.1	301.3
IX	Zamboanga Peninsula	30.1	30.5	30.9	34.1	39.1	46.1	55.4	66.2	73.6	78.5	108.2	148.9	204.6	281.0
X	Northern Mindanao	70.2	74.1	77.0	95.8	122.2	158.3	207.4	122.9	130.5	139.7	195.1	270.7	374.2	516.2
XI	Davao Region	42.6	42.2	42.8	47.4	54.4	64.2	77.3	160.5	175.0	193.1	300.1	444.1	641.1	912.1
XII	SOCCSKSARGEN	54.4	54.2	55.0	61.4	71.1	84.6	102.7	91.7	97.8	105.1	149.0	208.7	290.5	402.7
XIII	Caraga	17.1	16.8	16.9	18.0	19.9	22.6	26.1	34.6	39.0	41.0	53.5	70.8	94.5	126.9
ARMM	Autonomous Region in Muslim Mindanao	32.5	31.9	32.7	37.8	45.2	55.6	69.5	3.4	3.5	3.7	4.8	6.3	8.4	11.3

		Average Annual Growth Rate													
		PRIMARY							SECONDARY						
		2013-2018	2015-2020	2020-2025	2025-2030	2030-2035	2035-2040	AGR 2018-2040	2013-2018	2015-2020	2020-2025	2025-2030	2030-2035	2035-2040	AGR 2018-2040
Philippines		1.32%	1.65%	2.97%	3.71%	4.22%	4.60%	3.73%	9.06%	7.26%	6.92%	6.78%	6.70%	6.65%	6.80%
NCR	National Capital Region	1.28%	2.05%	3.41%	4.10%	4.57%	4.91%	4.16%	7.44%	4.81%	5.92%	6.10%	6.21%	6.28%	6.33%
CAR	Cordillera Administrative Region	-1.59%	-0.93%	0.16%	0.77%	1.13%	1.30%	0.78%	7.59%	6.77%	6.25%	6.33%	6.38%	6.41%	6.08%
I	Ilocos Region	0.78%	0.82%	2.42%	3.20%	3.75%	4.15%	3.34%	12.14%	10.01%	7.92%	7.41%	7.13%	6.97%	7.38%
II	Cagayan Valley	0.30%	0.67%	2.38%	3.16%	3.71%	4.11%	3.39%	13.42%	9.64%	8.04%	7.48%	7.18%	7.00%	7.68%
III	Central Luzon	4.05%	3.20%	4.35%	4.89%	5.24%	5.48%	4.89%	12.23%	10.83%	8.24%	7.60%	7.26%	7.06%	7.63%
IV-A	CALABARZON	1.70%	1.95%	3.17%	3.89%	4.39%	4.74%	3.97%	7.55%	6.09%	6.30%	6.37%	6.40%	6.43%	6.30%
IV-B	MIMAROPA	0.17%	-0.11%	1.84%	2.62%	3.18%	3.60%	2.59%	4.98%	4.16%	4.85%	5.30%	5.59%	5.78%	5.15%
V	Bicol Region	1.75%	1.70%	2.75%	3.50%	4.03%	4.42%	3.47%	13.30%	8.38%	8.16%	7.55%	7.23%	7.03%	7.58%
VI	Western Visayas	-0.15%	1.20%	1.93%	2.72%	3.27%	3.69%	2.66%	14.86%	9.86%	8.72%	7.87%	7.44%	7.18%	8.06%
VII	Central Visayas	1.63%	2.32%	3.21%	3.92%	4.42%	4.77%	3.87%	9.48%	7.97%	6.92%	6.78%	6.70%	6.65%	6.77%
VIII	Eastern Visayas	-4.15%	1.85%	3.04%	3.78%	4.28%	4.65%	3.91%	7.41%	6.96%	6.19%	6.29%	6.34%	6.38%	6.40%
IX	Zamboanga Peninsula	0.55%	-0.09%	1.99%	2.78%	3.33%	3.75%	2.81%	7.76%	5.66%	6.63%	6.59%	6.58%	6.55%	6.79%
X	Northern Mindanao	3.57%	3.40%	4.47%	4.98%	5.31%	5.54%	5.05%	8.98%	7.54%	6.91%	6.77%	6.69%	6.64%	6.74%
XI	Davao Region	-0.18%	0.75%	2.03%	2.82%	3.37%	3.79%	2.75%	17.63%	13.00%	9.22%	8.16%	7.62%	7.31%	8.22%
XII	SOCCSKSARGEN	1.53%	0.42%	2.20%	2.99%	3.54%	3.95%	2.93%	10.15%	8.69%	7.22%	6.98%	6.84%	6.75%	6.96%
XIII	Caraga	0.81%	0.52%	1.25%	2.02%	2.55%	2.94%	1.94%	5.72%	2.64%	5.46%	5.76%	5.95%	6.07%	6.08%
ARMM	Autonomous Region in Muslim Mindanao	2.15%	2.11%	2.93%	3.68%	4.19%	4.57%	3.51%	7.00%	5.64%	5.30%	5.65%	5.86%	6.01%	5.53%

Note: The ARMM was officially turned over to the BARMM on February 26, 2019.

Source: JICA Study Team

**Table 5.2-3 Estimated GDP and GRDP (2019-2040) (in Billion PhP) (Continued)**

		GDP and GRDP PREDICTION													
		TERTIARY							TOTAL						
		2018	2019	2020	2025	2030	2035	2040	2018	2019	2020	2025	2030	2035	2040
Philippines		5,318.3	5,666.8	6,048.1	8,354.8	11,510.2	15,832.7	21,757.2	9,206.9	9,805.3	10,442.7	14,307.4	19,602.4	26,856.9	36,796.3
NCR	National Capital Region	2,744.7	2,939.2	3,137.4	4,336.1	5,975.8	8,221.8	11,300.4	3,312.0	3,568.3	3,802.6	5,222.2	7,166.4	9,829.9	13,479.6
CAR	Cordillera Administrative Region	65.4	69.4	74.0	101.8	139.9	192.0	263.5	164.9	169.9	179.9	241.0	325.2	440.6	598.5
I	Ilocos Region	150.8	161.7	173.0	241.5	334.9	463.0	638.5	289.9	308.7	328.9	451.3	619.0	848.7	1,163.5
II	Cagayan Valley	84.4	89.1	95.3	133.0	184.5	255.0	351.7	154.4	164.9	174.2	231.6	310.7	419.3	567.8
III	Central Luzon	340.2	358.1	380.4	515.9	701.8	956.7	1,305.7	904.0	963.2	1,032.8	1,451.7	2,022.9	2,804.8	3,877.1
IV-A	CALABARZON	514.6	544.8	579.8	791.8	1,082.6	1,481.0	2,026.7	1,662.5	1,643.5	1,744.2	2,357.6	3,200.2	4,355.0	5,936.2
IV-B	MIMAROPA	68.5	72.2	77.3	108.3	150.7	208.6	288.2	143.4	147.6	155.2	202.3	267.6	357.2	479.6
V	Bicol Region	108.0	114.5	122.4	170.2	235.6	325.1	447.8	187.6	198.1	211.0	289.3	396.6	543.6	745.1
VI	Western Visayas	216.7	228.5	243.9	336.6	463.5	637.3	875.5	372.9	395.2	421.2	578.8	794.7	1,090.6	1,496.0
VII	Central Visayas	332.7	355.4	379.4	524.9	723.8	996.2	1,369.7	593.9	632.0	674.2	929.5	1,278.8	1,757.4	2,413.3
VIII	Eastern Visayas	82.0	85.2	90.8	125.1	171.9	236.1	324.1	184.9	196.0	207.4	277.2	373.4	505.2	685.6
IX	Zamboanga Peninsula	83.0	86.7	92.3	126.4	173.2	237.2	325.0	179.4	190.8	201.7	268.8	361.2	487.9	661.4
X	Northern Mindanao	152.2	161.7	173.2	242.4	336.9	466.2	643.6	345.3	366.3	389.9	533.3	729.8	998.8	1,367.2
XI	Davao Region	197.7	211.2	226.3	317.6	442.1	612.6	846.4	400.8	428.4	462.2	665.0	940.6	1,317.9	1,835.9
XII	SOCCSKSARGEN	100.6	107.3	115.1	162.0	226.0	313.6	433.8	246.7	259.3	275.2	372.3	505.8	688.7	939.2
XIII	Caraga	54.1	58.4	62.4	87.2	120.9	167.1	230.5	105.8	114.2	120.4	158.7	211.6	284.2	383.5
ARMM	Autonomous Region in Muslim Mindanao	22.6	23.5	25.0	33.9	46.2	63.1	86.1	58.5	59.0	61.4	76.5	97.8	127.0	166.9

		Average Annual Growth Rate													
		TERTIARY							TOTAL						
		2013-2018	2015-2020	2020-2025	2025-2030	2030-2035	2035-2040	AGR 2018-2040	2013-2018	2015-2020	2020-2025	2025-2030	2030-2035	2035-2040	AGR 2018-2040
Philippines		8.21%	6.89%	6.68%	6.62%	6.58%	6.56%	6.61%	6.40%	6.56%	6.50%	6.50%	6.50%	6.50%	6.50%
NCR	National Capital Region	8.16%	6.93%	6.69%	6.62%	6.59%	6.57%	6.64%	6.17%	6.54%	6.55%	6.53%	6.52%	6.52%	6.59%
CAR	Cordillera Administrative Region	8.19%	6.68%	6.58%	6.56%	6.54%	6.53%	6.54%	5.76%	6.10%	6.02%	6.17%	6.26%	6.32%	6.03%
I	Ilocos Region	8.80%	7.26%	6.89%	6.76%	6.69%	6.64%	6.78%	6.52%	6.76%	6.53%	6.52%	6.52%	6.51%	6.52%
II	Cagayan Valley	9.19%	7.10%	6.89%	6.76%	6.69%	6.64%	6.70%	5.09%	5.32%	5.86%	6.06%	6.17%	6.25%	6.10%
III	Central Luzon	7.49%	6.19%	6.28%	6.35%	6.39%	6.42%	6.30%	8.10%	7.89%	7.05%	6.86%	6.75%	6.69%	6.84%
IV-A	CALABARZON	7.74%	6.53%	6.43%	6.45%	6.47%	6.48%	6.43%	5.95%	6.02%	6.21%	6.30%	6.36%	6.39%	6.26%
IV-B	MIMAROPA	9.13%	7.67%	6.98%	6.82%	6.73%	6.67%	6.74%	5.32%	4.89%	5.44%	5.75%	5.94%	6.07%	5.64%
V	Bicol Region	8.89%	7.02%	6.82%	6.71%	6.65%	6.61%	6.68%	6.51%	6.30%	6.52%	6.51%	6.51%	6.51%	6.47%
VI	Western Visayas	7.99%	6.97%	6.66%	6.61%	6.58%	6.56%	6.55%	6.91%	6.63%	6.56%	6.54%	6.53%	6.53%	6.52%
VII	Central Visayas	8.32%	6.63%	6.71%	6.64%	6.60%	6.57%	6.64%	6.81%	6.90%	6.63%	6.59%	6.56%	6.55%	6.58%
VIII	Eastern Visayas	7.76%	7.11%	6.61%	6.57%	6.55%	6.54%	6.44%	4.27%	6.24%	5.98%	6.14%	6.23%	6.30%	6.14%
IX	Zamboanga Peninsula	7.91%	6.63%	6.49%	6.50%	6.50%	6.50%	6.40%	5.51%	5.06%	5.91%	6.09%	6.20%	6.27%	6.11%
X	Northern Mindanao	8.93%	7.36%	6.96%	6.80%	6.72%	6.68%	6.77%	6.62%	6.56%	6.46%	6.47%	6.48%	6.48%	6.46%
XI	Davao Region	9.13%	7.40%	7.01%	6.84%	6.74%	6.68%	6.83%	9.26%	8.71%	7.55%	7.18%	6.98%	6.85%	7.16%
XII	SOCCSKSARGEN	9.58%	7.55%	7.08%	6.88%	6.77%	6.70%	6.87%	5.89%	6.26%	6.23%	6.32%	6.37%	6.40%	6.27%
XIII	Caraga	8.98%	7.21%	6.90%	6.76%	6.69%	6.64%	6.81%	4.60%	4.51%	5.68%	5.93%	6.08%	6.18%	6.03%
ARMM	Autonomous Region in Muslim Mindanao	7.74%	6.40%	6.32%	6.38%	6.41%	6.43%	6.28%	3.49%	3.95%	4.51%	5.03%	5.37%	5.60%	4.88%

Note: The ARMM was officially turned over to the BARMM on February 26, 2019.

Source: JICA Study Team

### (3) Perspective of Traffic Demand Increase

#### 1) Growth Rate

The growth rate for the traffic demand is derived from HSH MP2. The growth rate of traffic demand for each region used is shown in Table 5.2-4. Annual growth rate in Region X is 2.68% (2018-2040) and traffic demand will increase 1.79 times (2040/2018).

**Table 5.2-4 Annual Growth Rate of Traffic Volume by Region**

Traffic Growth	NCR	CAR	Region I	Region II	Region III	Region IV-A	Region V	Region VI	Region VII	Region IX	Region X	Region XI	Region XII	Region XIII	Total (w/o NCR)
2018-2030	1.79%	4.07%	2.75%	5.54%	5.10%	3.97%	2.73%	3.54%	4.00%	3.39%	2.68%	4.79%	4.59%	2.38%	3.97%
2030-2040	1.67%	3.15%	2.56%	3.61%	5.55%	5.35%	2.25%	2.47%	4.81%	2.89%	2.69%	5.49%	3.13%	2.62%	3.99%
2018-2040	1.73%	3.65%	2.67%	4.66%	5.31%	4.60%	2.51%	3.06%	4.36%	3.16%	2.68%	5.10%	3.93%	2.49%	3.98%
2040/2018	1.46	2.20	1.78	2.72	3.12	2.69	1.73	1.94	2.56	1.98	1.79	2.99	2.33	1.72	2.36

Source: JICA Study Team

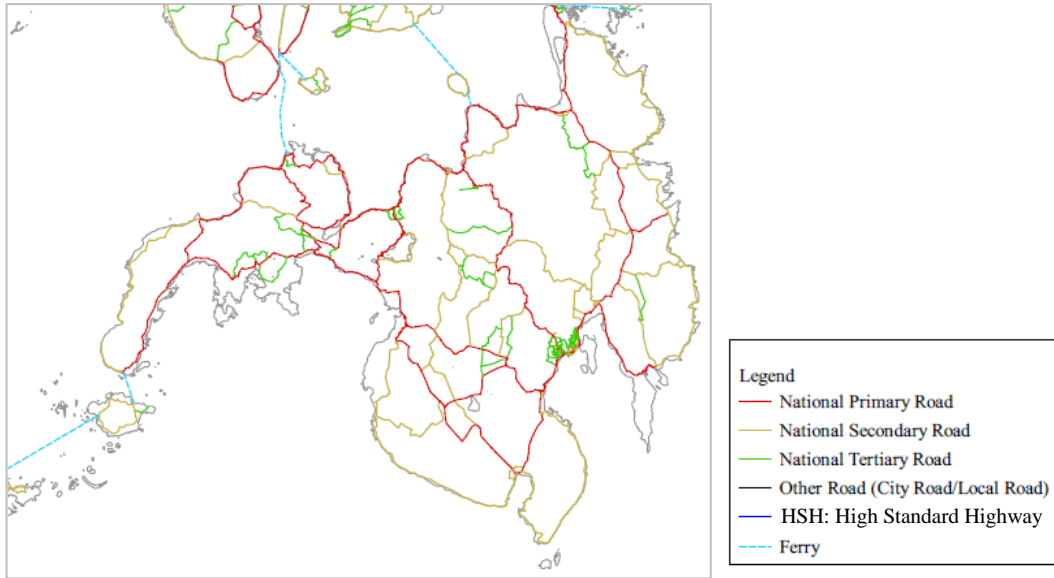
### 5.2.3 Road Network for Traffic Assignment

The road category shown in Table 5.2-5 was utilized for the creation of road network for traffic assignment.

**Table 5.2-5 Road Network for Traffic Assignment**

Area	Road Category
Entire country	All HSH sections planned in HSH MP2. All National Primary Roads (NPR) and National Secondary Roads (NSR) Major National Tertiary Roads (NTR)
Metropolitan centers	All types of roads shown above and major city roads
Inter islands	Ferry

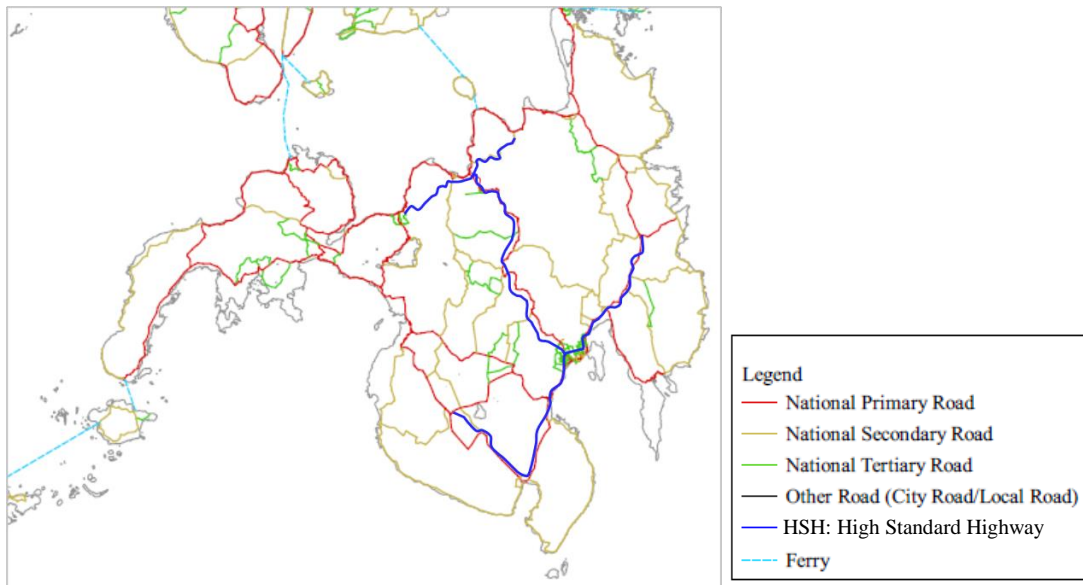
**(1) Present Road Network**



Source: JICA Study Team

**Figure 5.2-1 Road Network for Present Traffic Assignment (Mindanao)**

**(2) Future Road Network**



Source: JICA Study Team

**Figure 5.2-2 Road Network for Future Traffic Assignment**

**(3) Parameter**

**1) Passenger Car Unit**

Table 5.2-6 shows the values for the Passenger Car Unit (PCU) per type of vehicle, which are adopted by DPWH.

**Table 5.2-6 Passenger Car Unit**

Vehicle Type	Passenger Car Unit
Passenger Car	1.0
Jeepney	1.5
Bus	2.0
Truck	2.5

*Source: DPWH*

**2) Time Evaluation Value**

Value of time in 2015 was estimated by DPWH, based on “Procedure Manual for Updating Vehicle Costs and User Cost, Work Unit Cost, Asset Values, Traffic Growth Rates in 2014”. Current value of time was calculated using an Average Growth Rate of 2.60%, which was estimated using Inflation Rate from 2012 to 2018.

**Table 5.2-7 Value of Time**

Unit: PhP/min

Vehicle Type	Y2015	Y2020
Passenger Car	6.68	7.59
Jeepney	7.37	8.38
Bus	27.54	31.31
Truck	2.52	2.87

*Source: Y2015 Value from DPWH*

**(4) Link Cost Specification**

The link specification consisting of the Free Flow Speed at zero flow and Road Capacity is shown in Table 5.2-8 below.

**Table 5.2-8 Link Specification: Free Flow Speed and Road Capacity**

Type	Road Class	Topography	Lane	Free flow velocity (km/h)	Road Capacity (PCU/day)
1	HSH Class1 (Expressway)	Plain	10	100	200,000
2			8	100	160,000
3			6	100	120,000
4			4	100	80,000
5	HSH Class1 (Urban Area)	Plain	6	80	120,000
6			4	80	80,000
7	HSH Class 2 (Access Controlled National Road)	Plain	6	60	72,000
8			4	60	48,000
9			2	60	24,000
10	National Road (Primary)	Plain	8	50	96,000
11			6	50	72,000
12			5	50	60,000
13			4	50	48,000
14			2	40	10,000
15	National Road (Secondary)	Plain	6	40	60,000
16			4	40	40,000
17			2	30	8,000
18	National Road (Tertiary)	Plain	6	40	48,000
19			4	40	32,000
20			2	30	6,000

Type	Road Class	Topography	Lane	Free flow velocity (km/h)	Road Capacity (PCU/day)
21	HSH Class1	Mountainous	6	80	84,000
22			4	80	56,000
23	HSH Class 2	Mountainous	4	60	48,000
24			2	50	24,000
25	National Road (Primary)	Mountainous	8	40	67,200
26			6	40	50,400
27			4	40	33,600
28			2	30	7,000
29	National Road (Secondary)	Mountainous	6	30	42,000
30			4	30	28,000
31			2	20	5,600
32	National Road (Tertiary)	Mountainous	4	30	22,400
33			2	20	4,200
34	Ferry	-	-	5	1,000

Source: JICA Study Team

## (5) CMH Toll Fee

The toll rates for CMH are shown in Table 5.2-9.

This toll rate was set for the purpose of traffic demand forecast with reference to the existing interurban expressway toll in the Philippines. The actual toll rate for the project will be further examined in detail and the rate will be decided.

**Table 5.2-9 CMH Toll Rate**

Vehicle type	Toll Rate*
Passenger car	3.5 PhP/km
Jeepney	No Entry
Bus	8.7 PhP/km
Truck	10.5 PhP/km

\* According to the toll level of existing toll interurban expressway in the Philippines

### 5.2.4 Preparation of OD Matrix

The OD Matrix is derived from the one used in HSH MP2.

The number of zones has been changed from 920 zones to 923 zones. The zones of the project area have been divided based on the zones which were used in HSH MP2.

The divided zones are shown in Table 5.2-10. The population was used as basis for dividing the zones. The zone map is shown in Figure 5.2-3 to Figure 5.2-5.

**Table 5.2-10 Changed Zones and Split Rate**

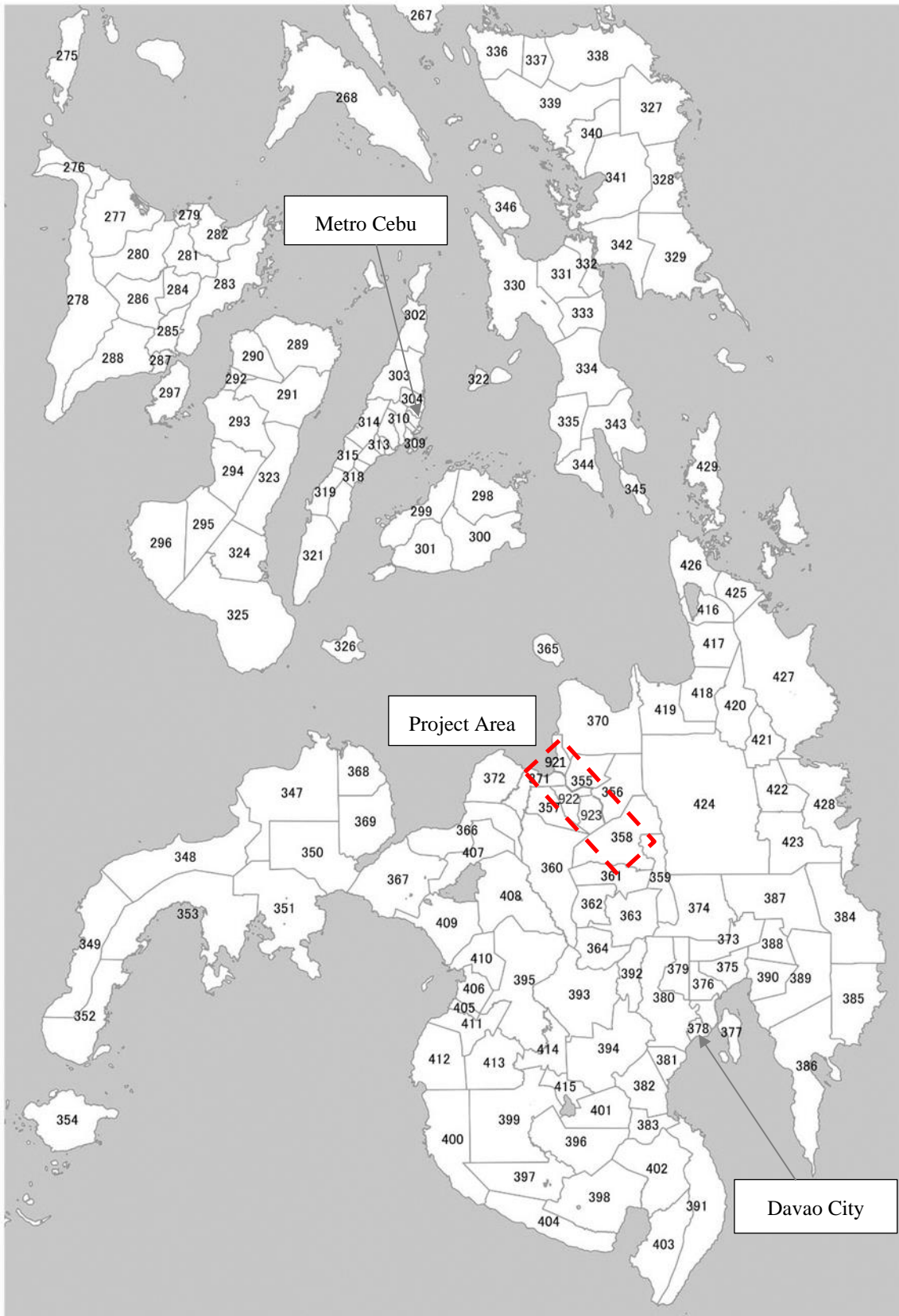
Before Zone No.	New Zone No.	Rate
371	371	86%
	921	14%
355	355	50%
	922	50%
356	356	37%
	923	63%

Source: JICA Study Team



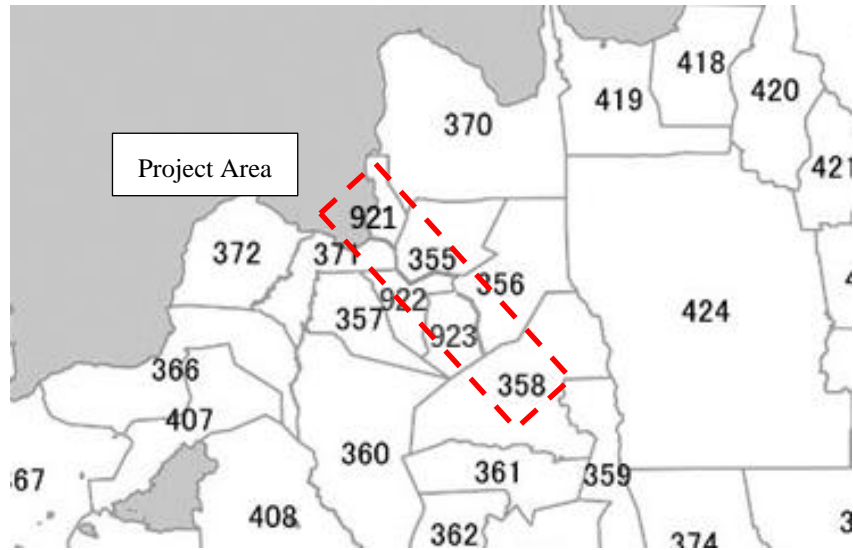
Source: JICA Study Team

Figure 5.2-3 Zoning System in Luzon



Source: JICA Study Team

Figure 5.2-4 Zoning System in Visayas and Mindanao



Source: JICA Study Team

**Figure 5.2-5 Zoning System in Project Area**

**(1) Zoning System**

The zoning system is primarily based on the traffic zones used in HSH MP2. The traffic zones in each area are shown in Table 5.2-11.

**Table 5.2-11 Zoning System for Traffic Demand Forecast**

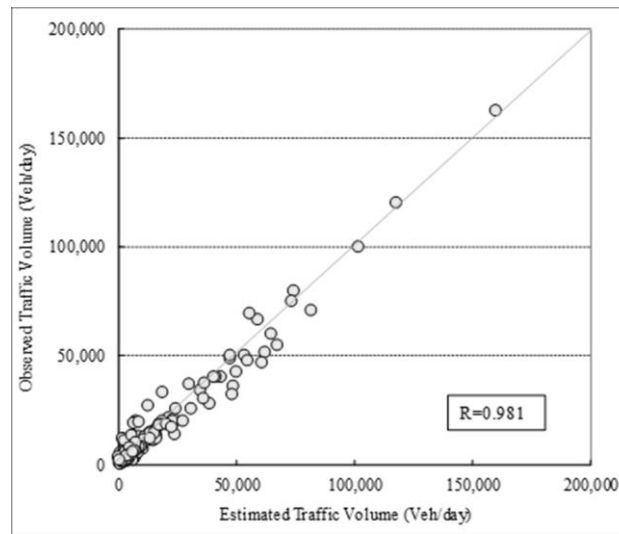
Region	Number of Zones	Number of Municipalities/Cities
Region I	33	125
Region II	24	93
Region III	82	130
NCR	289	17
Region IV-A	75	142
Region IV-B	7	73
Region V	19	114
Region VI	22	133
Region VII	210	132
(Metro Cebu)	(194)	(13)
Region VIII	20	143
Region IX	7	72
Region X	21	93
Region XI	57	49
(Davao City)	(49)	(11)
Region XII	14	50
Region XIII	14	73
ARMM	11	118
CAR	18	77
Total	923	1,634

Source: JICA Study Team

**5.2.5 Present Traffic Assignment**

Confirmation of validation was performed based on the reproducibility of the current traffic by checking the correlation between the observed traffic volume and the estimated traffic volume.

As a result of the validation of the present OD matrix, Figure 5.2-6 shows the result of correlation analysis. The correlation coefficient is 0.98, and it was confirmed that the estimated OD has high accuracy.



Source: JICA Study Team

**Figure 5.2-6 Validation Result for Present OD Matrix**

## **5.2.6 Future Traffic Assignment**

### **(1) Precondition**

The target year for future traffic assignment is 2040, which is the same with the target year set in the High Standard Highway Masterplan - Phase 2.

Method of Traffic Assignment:

- Road Network: 2040 road network all proposed road in HSH Master Plan
- OD matrix: 2040, 4 types of vehicles (Car, Jeepney, Bus, Truck)
- Link Condition of CMH: 4-lane, toll road

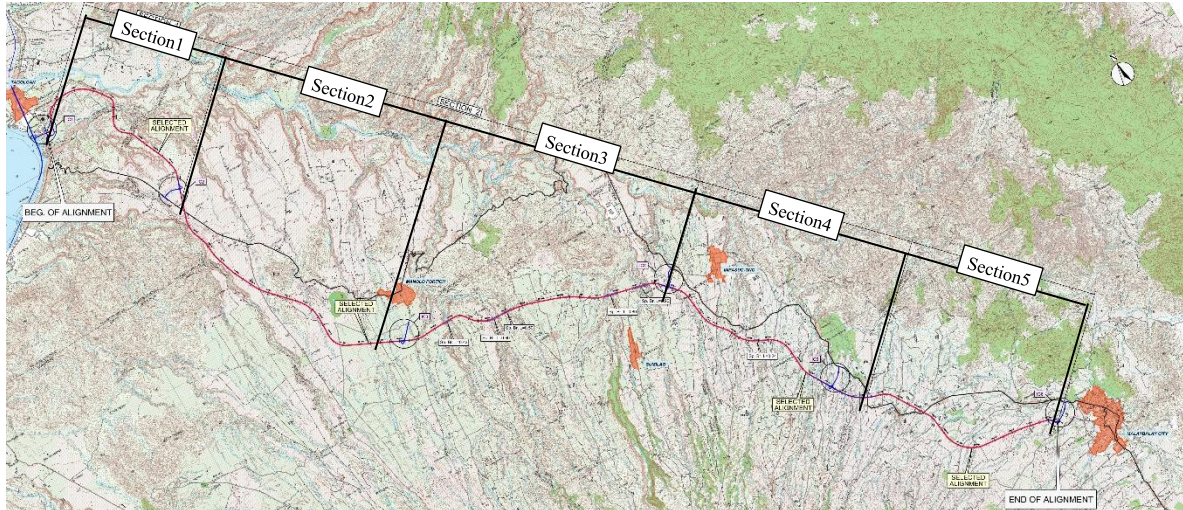
Similarly, future traffic assignment is conducted under two scenarios:

• Scenario 1: Malaybalay City - Davao HSH section is completed

Under this scenario, it is assumed that the remaining section (outside the study of this JICA-assisted study) from Malaybalay City to Davao City of the expressway is also constructed and completed.

• Scenario 2: Malaybalay - Davao National Road is improved to 4-lanes

Under this scenario, the parallel road (Sayre Highway) is improved and expanded to 4-lanes from Malaybalay City to Davao City.



Source: JICA Study Team

**Figure 5.2-7 Section Numbering of the CMH**

## (2) Level of Service (LOS)

### 1) Definition of LOS

The Level of Service (LOS) is an indicator used by planners and engineers to assess the quality of operations of roads. The definition of LOS by the Highway Capacity Manual, 6th Edition by the Transportation Research Board for multi-lane highways is shown in Table 5.2-12. In addition, the definition of LOS for the two-lane Class 1 highway (major intercity route) is shown in Table 5.2-13. Two-lane development is mentioned in Chapter 14.

**Table 5.2-12 Definition of LOS for Multi Lane Highways**

LOS A	LOS A describes free-flow operations. FFS prevails on the freeway or multilane highway, and vehicles are almost completely unimpeded in their ability to maneuver within the traffic stream. The effects of incidents or point breakdowns are easily absorbed.
LOS B	LOS B represents reasonably free-flow operations, and FFS on the freeway or multilane highway is maintained. The ability to maneuver within the traffic stream is only slightly restricted, and the general level of physical and psychological comfort provided to drivers is still high. The effects of minor incidents are still easily absorbed.
LOS C	LOS C provides for flow with speeds near the FFS of the freeway or multilane highway. Freedom to maneuver within the traffic stream is noticeably restricted, and lane changes require more care and vigilance on the part of the driver. Minor incidents may still be absorbed, but the local deterioration in service quality will be significant. Queues may be expected to form behind any significant blockages.
LOS D	LOS D is the level at which speeds begin to decline with increasing flows, with density increasing more quickly. Freedom to maneuver with increasing flows, with density increasing more quickly. Freedom to maneuver within the traffic stream is seriously limited, and drivers experience reduced physical and psychological comfort levels. Even minor incidents can be expected to create queuing, because the traffic stream has little space to absorb disruption.
LOS E	LOS E describes operation at or near capacity. Operations on the freeway or multilane highway at this level are highly volatile because there are virtually no usable gaps within the traffic stream, leaving little room to maneuver within the traffic stream. Any disruption to the traffic stream, such as vehicles entering from a ramp or an access point or a vehicle changing lanes, can establish a disruption wave that propagates throughout the upstream traffic stream. Toward the upper boundary of LOS E, the traffic stream has no ability to dissipate even the most minor disruption, and any incident can be expected to produce a serious breakdown and substantial queuing. The physical and psychological comfort afforded to drivers is poor.

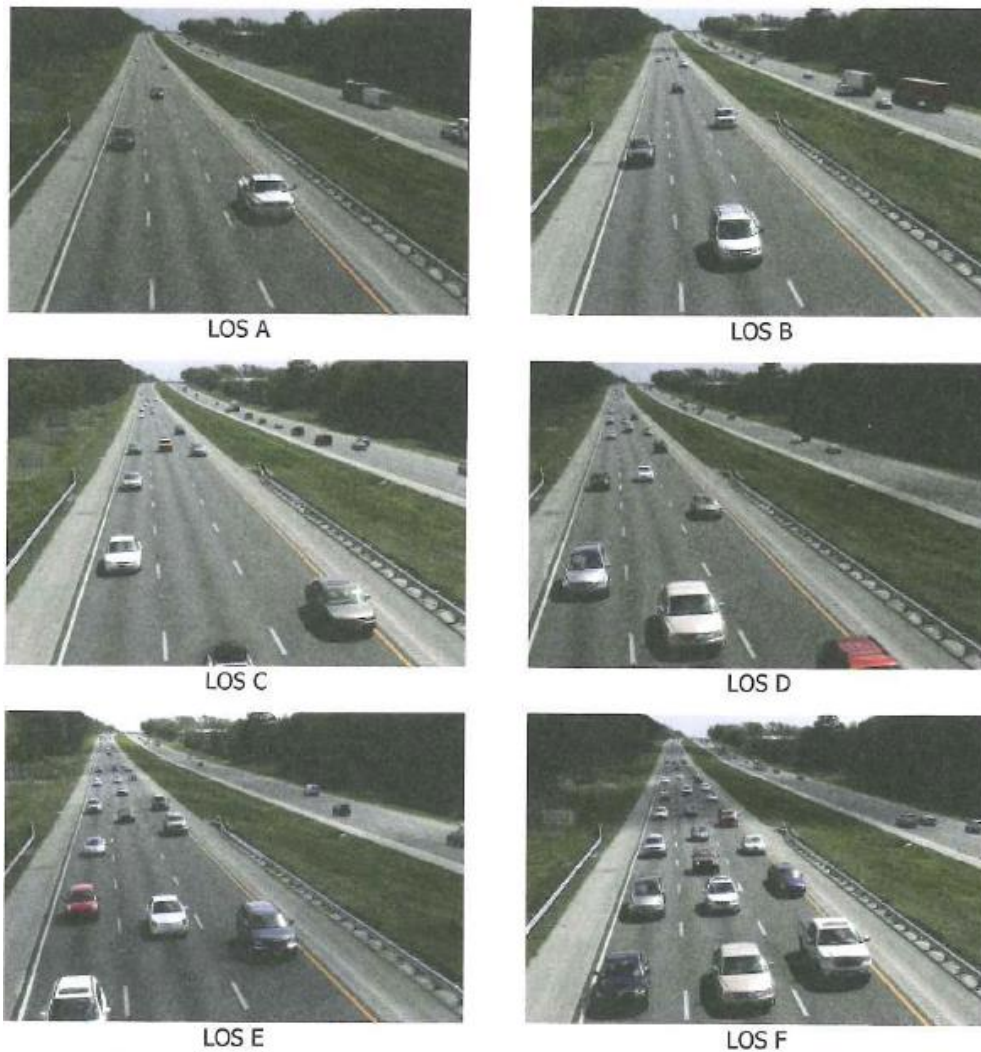
LOS F	<p>LOS F describes unstable flow. Such condition exists within queues forming behind bottlenecks. Breakdowns in vehicular flow. Such conditions generally exist within queues forming behind breakdown points. Breakdowns occur for a number of reasons:</p> <ul style="list-style-type: none"> <li>• Traffic incidents can cause a temporary reduction in the capacity of a short segment, so that the number of vehicles arriving at the point is greater than the number of vehicles that can move through it.</li> <li>• Points of recurring congestion, such as merge or weaving segments and lane drops, experience very high demand in which the number of vehicles arriving is greater than the number of vehicles discharged.</li> </ul> <p>In forecasting situations, the projected peak-hour (or other) flow rate can exceed the estimated capacity of the location.</p>
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*Source: Highway Capacity Manual, 6th Edition by Transportation Research Board*

**Table 5.2-13 Definition of LOS for Two Lane Highways**

LOS A	LOS A, motorists experience high operating speeds and little difficulty in passing. Platoons of three or more vehicles are rare.
LOS B	LOS B, passing demand and passing capacity are balanced. The degree of platooning becomes noticeable. Some speed reductions are present.
LOS C	LOS C, most vehicles travel in platoons. Speeds are noticeably curtailed.
LOS D	LOS D, platooning increases significantly. Passing demand is high but passing capacity approaches zero. A high percentage of vehicles travels in platoon.
LOS E	LOS E, demand is approaching capacity. Passing is virtually impossible. Speeds are seriously curtailed.
LOS F	LOS F, exists whenever demand flow in one or both directions exceeds the segment's capacity. Operation conditions are unstable, and heavy congestion exists.

*Source: Highway Capacity Manual, 6th Edition by Transportation Research Board*



Source: Highway Capacity Manual, 6th Edition by Transportation Research Board

**Figure 5.2-8 Visualization of Level of Service (LOS)**

**2) Appropriate Level of Service (LOS)**

A Policy on Geometric Design of Highways and Streets (AASHTO, 2014) suggests the appropriate level of service for each functional class of road, as shown in Table 5.2-14. According to the said guidelines, the recommended LOS for expressways in rural rolling areas is “B”.

**Table 5.2-14 Guidelines for Selection of Design LOS**

Functional class	Appropriate level of service for specified combinations of area and terrain type			
	Rural level	Rural rolling	Rural mountainous	Urban and suburban
Freeway	B	B	C	C
Arterial	B	B	C	C
Collector	C	C	D	D
Local	D	D	D	D

Source: A Policy on Geometric Design of Highways and Streets, 2004, AASHTO

**(3) Future Traffic Volume and LOS Results**

The future traffic volumes in 2040 for two scenarios are presented in the two tables below. As seen in Table 5.2-15, under Scenario 1 (Tolled Road) where the remaining section of the HSH from Malaybalay City to Davao City is also constructed and completed, the traffic volume at Section 1 is over 20,000 and at Section 5 over 16,000. When the CMH is operated without toll fee, the volume of traffic at Section 1 reaches to almost 27,000 and above 20,000 at Section 5. Consequently, the Level of Service (LOS) both under tolled road and non-tolled road operation of CMH at each section is B which met the guidelines shown in Table 5.2-14.

**Table 5.2-15 Result of Future Traffic Demand for Scenario 1 (Year 2040)**

(Malaybalay – Davao HSH section is completed)

Unit: Vehicle/day

Toll/No-toll	Road Name	Section1	Section2	Section3	Section4	Section5	Average*
Tolled Road	CMH (LOS)	21,700 (B)	19,400 (B)	18,300 (B)	16,000 (B)	16,100 (B)	18,300 (B)
	Sayre Highway	5,500	7,700	4,200	4,900	4,300	5,400
	Total	27,200	27,100	22,500	20,900	20,400	23,800
Non-Tolled Road	CMH (LOS)	26,900 (B)	26,700 (B)	21,000 (B)	20,300 (B)	20,800 (B)	23,300 (B)
	Sayre Highway	1,200	3,000	2,300	1,500	500	1,800
	Total	28,100	29,700	23,300	21,800	21,300	25,000

\*Note: Weighted average of traffic volume from Sections 1 to 5

Under Scenario 2, the traffic volume at the CMH is a bit lower. However, the LOS is still B except Section 5 (Tolled Road) where the LOS is higher at A.

**Table 5.2-16 Result of Future Traffic Demand for Scenario 2 (Year 2040)**

(Malaybalay – Davao National Road is improved to 4-lanes)

Unit: Vehicle/day

Toll/No-toll	Road Name	Section1	Section2	Section3	Section4	Section5	Average*
Tolled Road	CMH (LOS)	20,900 (B)	18,800 (B)	17,500 (B)	15,100 (B)	12,000 (A)	16,900 (B)
	Sayre Highway	5,500	7,500	4,100	5,000	7,600	6,000
	Total	26,400	26,300	21,600	20,100	19,600	22,900
Non-Tolled Road	CMH (LOS)	25,800 (B)	25,700 (B)	19,900 (B)	19,200 (B)	14,400 (B)	21,100 (B)
	Sayre Highway	1,100	1,500	2,200	1,400	5,700	2,400
	Total	26,900	27,200	22,100	20,600	20,100	23,500

\*Note: Weighted average of traffic volume from Sections 1 to 5

For reference, the future traffic volumes in 2036, two years after the project start into service, is shown in Table 5.2-17 and Table 5.2-18.

**Table 5.2-17 Result of Future Traffic Demand for Scenario 1 (Year 2036)**  
(Malaybalay – Davao HSH section is completed)

Unit: Vehicle/day

<b>Toll/No-toll</b>	<b>Road Name</b>	<b>Section1</b>	<b>Section2</b>	<b>Section3</b>	<b>Section4</b>	<b>Section5</b>	<b>Average*</b>
Tolled Road	CMH (LOS) (B)	19,000 (B)	17,000 (B)	16,000 (B)	14,000 (A)	14,100 (A)	16,100 (B)
	Sayre Highway	4,400	6,200	3,400	3,900	3,400	4,300
	Total	23,400	23,200	19,400	17,900	17,500	20,400
Non-Tolled Road	CMH (LOS) (B)	23,600 (B)	23,400 (B)	18,400 (B)	17,800 (B)	18,200 (B)	20,400 (B)
	Sayre Highway	1,000	2,400	1,800	1,200	400	1,400
	Total	24,600	25,800	20,200	19,000	18,600	21,800

\*Note: Weighted average of traffic volume from Sections 1 to 5

**Table 5.2-18 Result of Future Traffic Demand for Scenario 2 (Year 2036)**  
(Malaybalay – Davao National Road is improved to 4-lanes)

Unit: Vehicle/day

<b>Toll/No-toll</b>	<b>Road Name</b>	<b>Section1</b>	<b>Section2</b>	<b>Section3</b>	<b>Section4</b>	<b>Section5</b>	<b>Average*</b>
Tolled Road	CMH (LOS) (B)	18,300 (B)	16,500 (B)	15,300 (B)	13,200 (A)	10,500 (A)	14,800 (B)
	Sayre Highway	4,400	6,000	3,300	4,000	6,100	4,800
	Total	22,700	22,500	18,600	17,200	16,600	19,600
Non-Tolled Road	CMH (LOS) (B)	22,600 (B)	22,500 (B)	17,400 (B)	16,800 (B)	12,600 (B)	18,500 (B)
	Sayre Highway	900	1,200	1,800	1,100	4,600	1,900
	Total	26,900	27,200	22,100	20,600	20,100	20,400

\*Note: Weighted average of traffic volume from Sections 1 to 5



## CHAPTER 6 NECESSITY OF THE PROJECT

### 6.1 Outline of the Chapter

The objective of this project is to promote the development of an important transportation axis which shall eventually improve transportation access between north-central and southern Mindanao. Specifically, the project is to study the feasibility of the construction of around 65 km road section from Cagayan de Oro City to Malaybalay City, Bukidnon. This is part of the 300-km high standard road connecting Cagayan de Oro City and Davao City. Therefore, in implementing this work, it is necessary to fully understand the background and necessity for the project based on the National Development Plan of the Philippines along with the road improvement goals of DPWH in the Philippines.

In this chapter, the necessity of the project is summarized from the following perspectives:

- Necessity for the realization of development plans,
- Necessity for the improvement of quality of life of the residents,
- Necessity for the improvement of regional development potentials,
- Necessity for solving current road traffic problems on existing national road.

### 6.2 Necessity for the Realization of Development Plans

#### 6.2.1 Necessity for the Realization of the Philippine Development Plans

##### (1) PDP 2017-2022

The previous medium-term economic development plan, the Philippine Development Plan (PDP 2017-2022), present three policy pillars. Among the salient targets in the PDP 2017-2022 are: (1) GDP: annual growth rate of 7-8%; and (2) improvement of the national average poverty rate from 21.6% to 13-15%, and from 30% to 20% in the rural areas. Table 6.2-1 shows the effectiveness of this project and its consistency with each policy pillar.

The development of the high standard highways including the project is considered an essential transportation infrastructure which will substantially contribute to the achievement of goals enunciated in the national development plan of the Philippines.

**Table 6.2-1 Consistency Between the PDP (2017-2022) and This Project**

Policy Pillar	Consistency with the Project
Restore public trust in the government	Contribution to the formation of a stable community by raising the level of economic development in Mindanao region, which has had security problems in the past.
Correcting disparities	Due to security issues, infrastructure investment has been mainly focused on the island of Luzon. The project will promote development in Mindanao, especially in the northern part of the island, which has been lagged behind in development. The project will contribute to correcting regional disparities.
Raise growth potential	Increased connectivity of Mindanao's inland areas with the metropolitan centers (Cagayan de Oro metropolitan area and Davao metropolitan area) will improve the development potential of the inland areas in agriculture, forestry, livestock, light industry, and tourism sectors.

## **(2) PDP 2023-2028**

The current medium-term economic development plan, the Philippine Development Plan (PDP 2023-2028) is the Philippine's overall blueprint in development planning reflecting the government's policies, strategies, programs, and legislative priorities in support of and consistent with the Socioeconomic Agenda of the administration. It is geared toward the attainment of the long-term vision, the AmBisyon Natin 2040.

Taking off from the covid-19 pandemic, the PDP 2022-2028 has set socio-economic targets: (1) Maintain the annual economic growth rate between 6.0 to 7.0 percent in 2023 and between 6.5 to 8.0 percent from 2024 to 2028, for a sustained high levels of growth; (2) create more, better, and more resilient jobs, unemployment rate shall be within 4.0 to 5.0 percent by 2028; (3) Keep food and overall prices low and stable, an overall inflation rate will be kept to within 2.5 to 4.5 percent in 2023 and with 2.0 to 4.0 percent from 2024 to 2028; (4) Enforce fiscal discipline by gradually reducing of national government deficit to GDP ratio from 6.5 percent during the first half of 2022 to 3.0 percent in 2028 as well as reducing outstanding government debt to GDP ratio from 63.7 percent of September 2022 to 48.0 to 53 percent by end of 2028; (5) transform the production sectors through innovation by continuing progress by ranking higher and within the top 33 percent of Global Competitiveness Index by 2028; and (6) Reduced poverty incidence from 18.0 percent in 2021 to between 8.0 to 9.0 percent by 2028.

With the aim of expanding and upgrading critical infrastructures by building better more infrastructure projects in the country.

## **(3) NEDA's Infrastructure Flagship Projects (IFPs)**

In the recent NEDA Board Meeting last March 9, 2023, 194 IFPs were listed and approved as high impact, and urgently needed projects. Among these 194 projects is the Central Mindanao High Standard Highway Construction Project under the Pre-Project Preparation. Overview of the Infrastructure Flagship Projects under the Build Better More program of the Philippines is in Appendix 6.2.

### **6.2.2 Necessity for the Realization of the Regional Development Plan**

Similar to the policies stated in the National Spatial Strategy, the Mindanao Spatial Strategy/Development Framework 2015-2045, promotes the important policies on strengthening urban concentration in metropolitan centers, regional centers, sub-regional centers and connectivity between those urban centers.

In this context, the Cagayan de Oro City -Malaybalay City -Valencia City -Davao City axis is positioned as a major development axis in Mindanao Island. As the main infrastructure of the development axis, the development of high standard highway has been identified as a priority project.

The cities of Malaybalay and Valencia, both of Bukidnon Province are sub-regional centers located along the planned route of the Central Mindanao High Standard Highway. These cities have been identified as development centers for economic development featuring agribusiness and eco-tourism.

This project will be a pivotal transportation infrastructure to facilitate regional development in central Mindanao Island.

### **6.2.3 Necessity for Realization of DPWH Highway Development Policy**

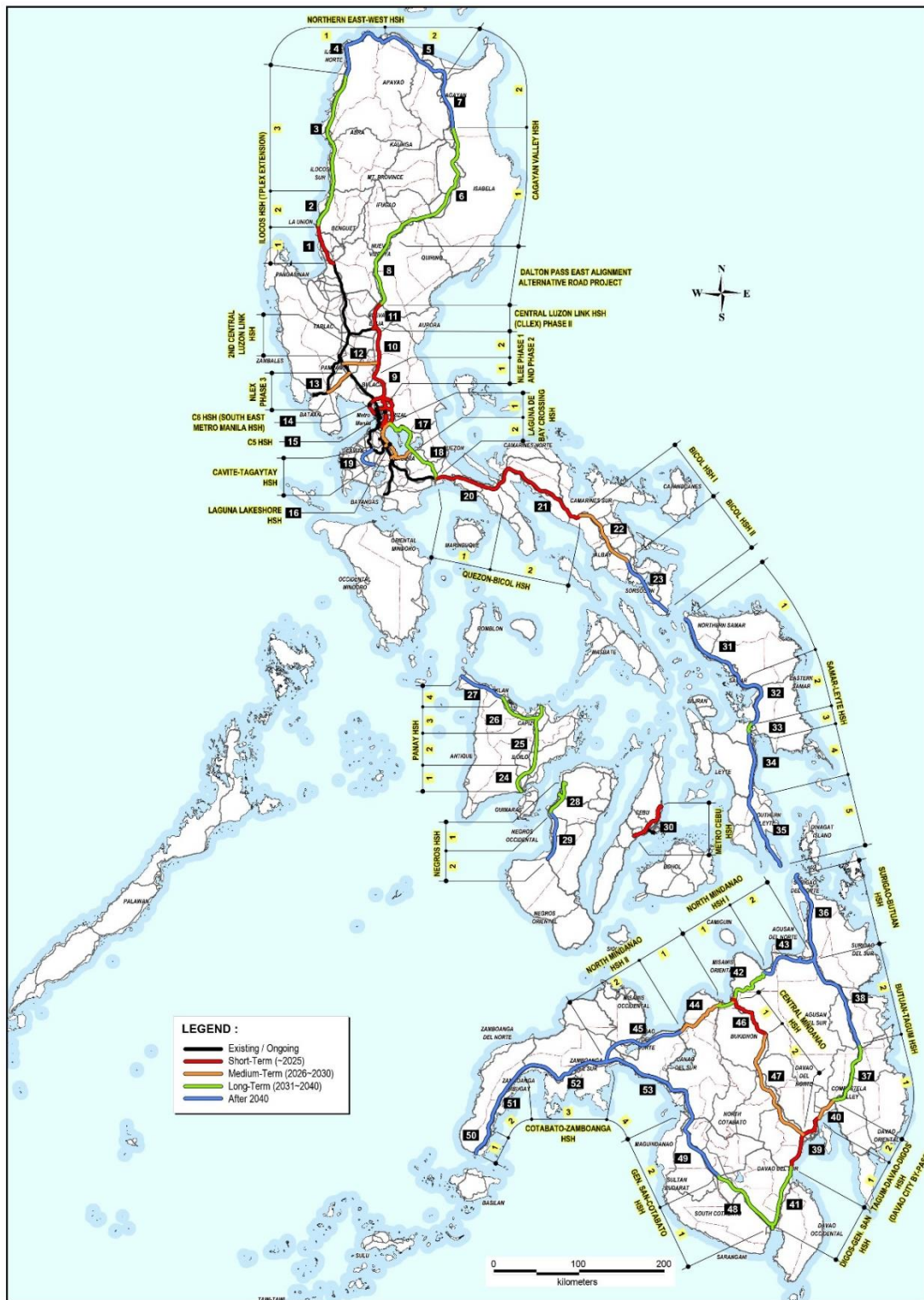
In the Master Plan for the High Standard Highway Development (Phase 2), the Central Mindanao High Standard Highway (Cagayan de Oro-Malaybalay section) is rated as a high priority project for implementation. The development timing of this project is positioned as a short-term in the HSH development program. Since the section requires overcoming a steep longitudinal gradient and therefore, technically challenging, the government of the Philippines has requested that the project be implemented as soon as possible by applying an advanced construction technology.

Based on the Philippine Development Plan 2017-2022, to sustain the expansion and enhancement of strategic corridors, future developments on the land-based transportation projects and implementation

of Philippine High Standard Highway Network Program Phase 2 shall be pursued. The program will add about 1,044.6 kilometers of high standard national roads and expressways across metropolitan areas nationwide.

Consequently, the Philippine Development Plan 2023-2028 is geared toward continuation and expansion of the current and on-going infrastructure projects from the previous PDP 2017-2022.

The schedules for the implementation of HSH Class-1 projects nationwide are fully illustrated in Figure 6.2-1. Section No.46 is the Central Mindanao High Standard Highway Project (Cagayan de Oro – Malaybalay section) which is a high priority project to be implemented in the short term. It aims to improve the transport efficiency and enhance connectivity between the two metropolitan cities, as well as to revitalize the regional economy in the surrounding areas.



Source: JICA Study Team

Figure 6.2-1 Development Program of HSH Class-1 Projects

### 6.3 Necessity for the Improvement of Quality of Life of the Residents

#### 6.3.1 Social and Economic Activities in the Area

The main characteristics of social and economic activities in the areas along the project route are shown in Table 6.3-1. The project will contribute greatly to improve the daily life and logistic activities in the areas along the Cagayan de Oro - Malaybalay section.

**Table 6.3-1 Social and Economic Activities in the Project Area**

Activity	Outline
<b>Social and economic activity</b>	<ul style="list-style-type: none"> <li>• Cagayan de Oro City is the regional center of Region X (Northern Mindanao Region). The city has a high concentration of urban services (employment opportunities, health care, education, administrative services, cultural facilities, etc.), with a nearby international airport in Laguindingan, Misamis Oriental, and a container port.</li> <li>• Plantations of major foreign companies are located along the existing road, forming a major production, processing, and export center for agricultural products, such as pineapple. The province of Bukidnon is the food basket and pineapple capital of the world.</li> </ul>
<b>Movement of persons</b>	<ul style="list-style-type: none"> <li>• The residents of the inland areas along the project route depend on Cagayan de Oro for employment and urban services and use the existing national highway on a daily basis for commuting, shopping, and enjoying various services.</li> <li>• The existing national highway is serviced by intercity bus transportation between Cagayan de Oro and Malaybalay, Valencia, Davao. The existing national highway is a major transportation route in the north-south traverse of Mindanao.</li> </ul>
<b>Logistics</b>	<ul style="list-style-type: none"> <li>• The existing national highway, the Cagayan de Oro - Malaybalay section functions as a transportation infrastructure that supports the distribution of raw and processed agricultural products. Currently, fifty percent of the road traffic along this route is used for the transport of agricultural products.</li> <li>• Cagayan de Oro City is the gateway to Northern Mindanao due to its strategic location, home to several industries, ports, and infrastructure facilities that drive agro-manufacturing and trade in the area. The port of Cagayan de Oro and the Mindanao Container Terminal (MCT) are used as ports for exports from large plantations in the area.</li> </ul>

Source: JICA Study Team

Better access to urban services from / to CDO along the Central Mindanao High Standard Highway would change the quality of life of residents. In addition to an international airport and a container port, Cagayan de Oro City, as a metropolitan center, features a high concentration of urban services (e.g., health care, education, cultural facilities, etc.). The project will provide inland inhabitants in Central Mindanao an equitable access to employment opportunities and other essential services, generally available in highly urbanized cities. For example, the one-hour access zone from Cagayan de Oro to areas along the project will be greatly expanded. The current one-hour access zone by car from Cagayan de Oro is limited to Manolo Fortich. After the opening of the Central Mindanao High Standard Highway, the one-hour access will be extended to Malaybalay.

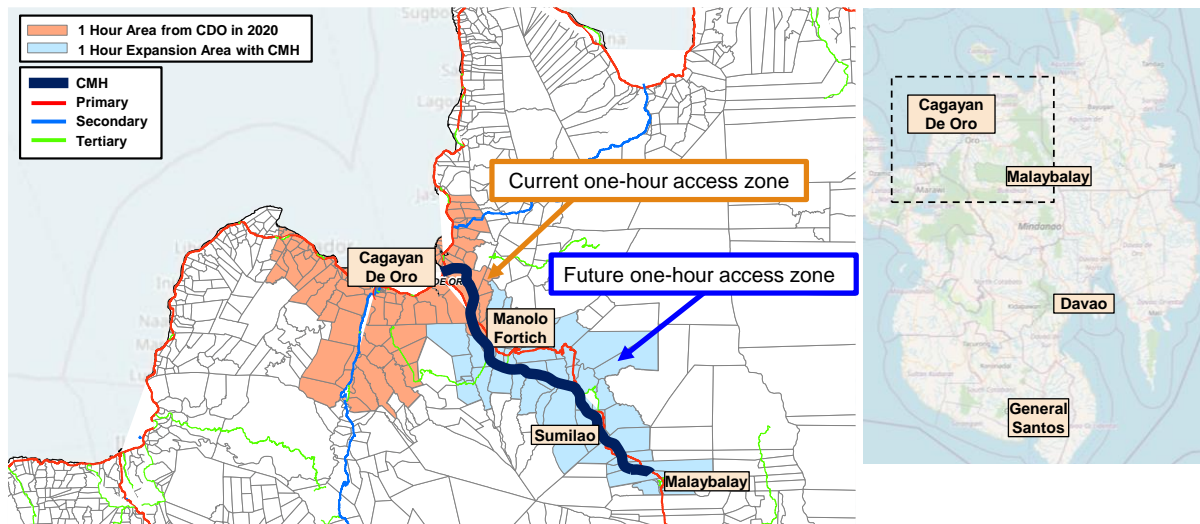


Figure 6.3-1 One-hour Access Zone from/to Cagayan De Ore

### 6.3.2 Results of Manufacturing and Logistics Company Survey

To clarify the current usage and problems of the Sayre Highway and to know the opinions and expectations of the users for the proposed Central Mindanao High Standard Highway, a Manufacturing and Logistics company survey was undertaken covering eleven (11) companies located in the proposed project area.

#### (1) Origin of Raw Materials and Destination of Finished Products

Based on collected information from among the interviewed companies, movement of cargoes from origin of the raw materials to destination of finished products being transported using the existing Sayre Highway are summarized in Table 6.3-2 and Table 6.3-3.

The colors of cells in these tables are explained below.

- Green: Movement of cargoes inside the Project area
- Yellow: Movement of cargoes from/to inside the Project area to/from outside the project area
- Orange: Movement of cargoes from/to outside the Project area to/from outside the project area

Table 6.3-2 Origin of Raw Materials (from Origin to Factory)

Company No.	Products	FROM		TO		No. of trucks used / day	Travel time (hours)
		City Name	Province	City Name	Province		
5	Feeds	Tagoloan	Misamis Oriental	Sumilao	Bukidnon	4/(week)	2.0-2.5
5	Veterinary Medicines	Malaybalay	Bukidnon	Sumilao	Bukidnon	1	0.8
9	Chemicals	Cagayan De Oro	Mis. Oriental	Manolo Fortich	Bukidnon	10	1.5
3	food products	Maramag	Bukidnon	Villanueva	Misamis Oriental	40	6.0
7	Fertilizer	Cagayan De Oro	Mis. Oriental	Camp1, Maramag	Bukidnon	3	5-6
7	Chemicals	Cagayan De Oro	Mis. Oriental	Don Carlos	Bukidnon	1	5-6
7	Seeds	Cagayan De Oro	Mis. Oriental	Don Carlos / Camp 1 Maramag	Bukidnon	1	5-6

Note: Green: Transportation inside the Project area, Yellow: Transportation from/to inside the Project area to/from outside the project area, Orange: Transportation from/to outside the Project area to/from outside the project area

Source: JICA Study Team

**Table 6.3-3 Destination of Finished Products (From Factory to Destination)**

Company No.	Products	FROM		TO		No. of trucks used / day	Travel time (hours)
		City Name	Province	City Name	Province		
4	Drink Products	Tagoloan	Mis. Oriental	Malaybalay	Bukidnon	1	2.0
4	Drink products	Tagoloan	Mis. Oriental	Manolo Fortich	Bukidnon	1	1.0
5	Livestock	Sumilao	Bukidnon	Tagoloan	Mis. Oriental	4-5	2.5-3.0
5	Livestock	Sumilao	Bukidnon	Maramag	Bukidnon	1	2.0
5	Livestock	Sumilao	Bukidnon	Malaybalay	Bukidnon	1(car)	0.5-0.75
8	Consumer Goods	Cagayan De Oro	Misamis Oriental	Malaybalay	Bukidnon	2 (/week)	3.0
8	Petroleum Lubricant	Cagayan De Oro	Misamis Oriental	Malaybalay	Bukidnon	1 (/month)	3.0
8	Cosmetics and Personal Care	Cagayan De Oro	Misamis Oriental	Malaybalay	Bukidnon	1 (/week)	3.0
9	Empty Container	Manolo Fortich	Bukidnon	Cagayan de Oro	Misamis Oriental	10	1.5
1	Feeds	Davao	Davao del Sur	Cagayan de Oro	Mis. Oriental	2	11.0-12.0
2	Drink products	Davao	Davao	Cagayan de Oro	Misamis Oriental	4 (/week)	10.0
3	Drink products	Villanueva	Misamis Oriental	Maramag	Bukidnon	6	3.5
4	Drink products	Tagoloan	Mis. Oriental	Valencia	Bukidnon	2	2.5
4	Drink products	Tagoloan	Mis. Oriental	Don Carlos	Bukidnon	3	3.5
7	Food products	Don Carlos	Bukidnon	Cagayan de Oro	Mis. Oriental	22	5.0-6.0
7	Food products	Maramag	Bukidnon	Cagayan de Oro	Mis. Oriental	18	5.0-6.0
10	Food products	Tagoloan	Mis. Oriental	Valencia	Bukidnon	4	3.0-4.0
11	Manufacturing Products	Davao	Davao del Sur	Manolo Fortich	Bukidnon	5	12
4	Drink products	Tagoloan	Mis. Oriental	Sta. Cruz	Davao Sur	1	8.0
6	Food products	El Salvador	Misamis Oriental	Gen. Santos	South Cotabato	1	24.0
6	Food products	El Salvador	Misamis Oriental	Davao	Davao del Sur	2	20.0
10	Gen. Merchandise	Tagoloan	Mis. Orienta	Davao	Davao Province	3	9.0-10.0
10	Building Materials	Tagoloan	Mis. Oriental	Gen. Santos	S. Cotabato	2	12.0

Note: Green: Transportation inside the Project area, Yellow: Transportation from/to inside the Project area to/from outside the project area, Orange: Transportation from/to outside the Project area to/from outside the project area

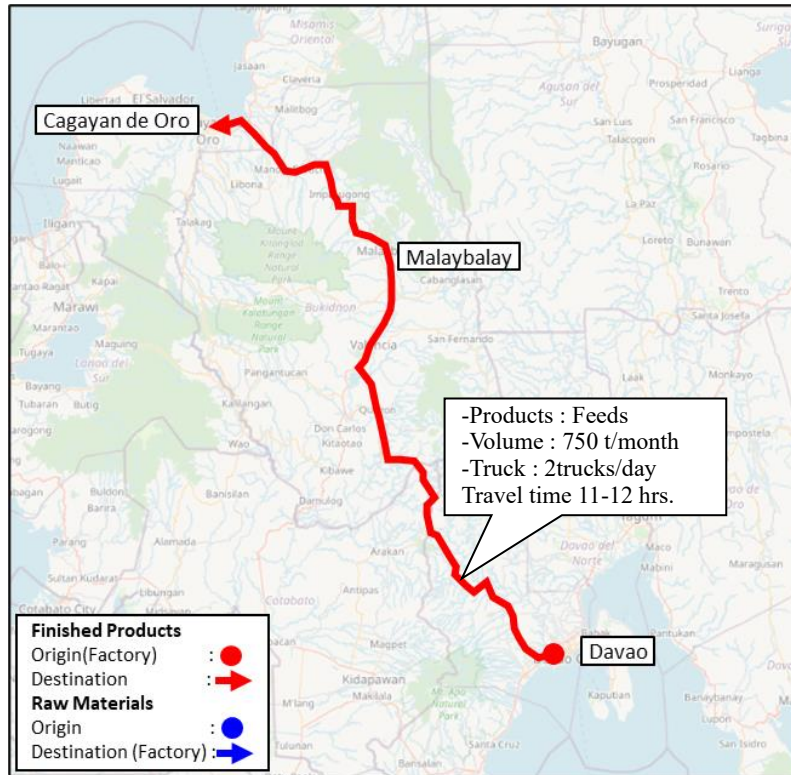
Source: JICA Study Team

Although the number of companies interviewed are only 11, it was observed that various items are transported along the Sayre Highway between CDO and Malaybalay.

The usual travel time of the surveyed companies for their raw materials ranges from 0.8 to 6 hours, as shown in Table 6.3-2. These items are transported from CDO to other areas.

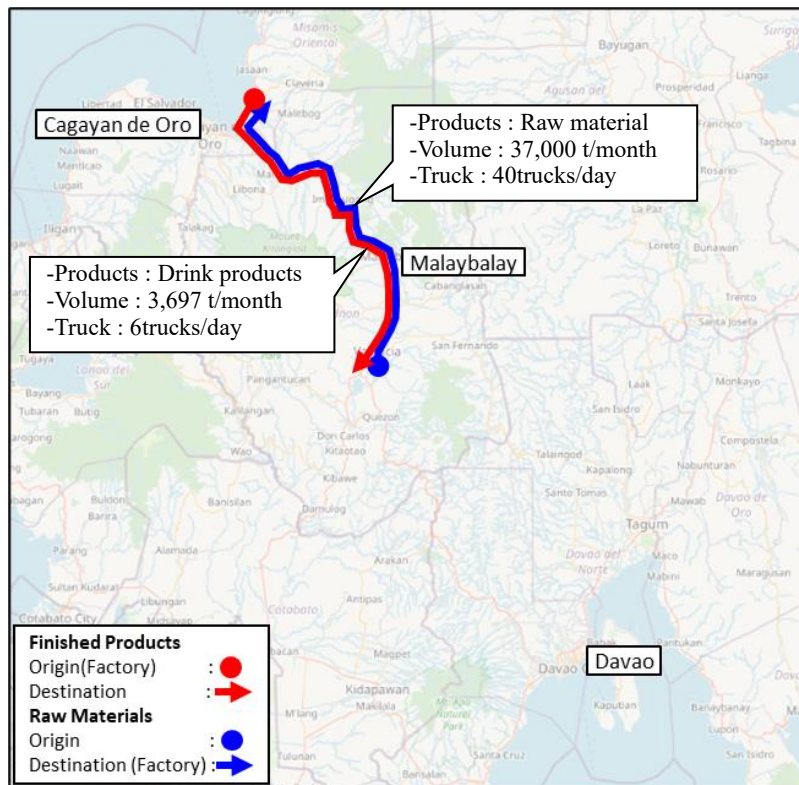
The travel time to the destination of the finished products by the surveyed companies ranges from 0.5 to 24 hours, as shown in Table 6.3-3. These items are transported from/to out of project area, such as cities of Davao, Valencia, and Gen. Santos.

Some of the products are transported between CDO and Davao, and the travel time is more than 10 hours. Cargo transportation sample routes using the existing Sayre Highway are shown in Figure 6.3-2 and Figure 6.3-3.



Source: JICA Study Team

Figure 6.3-2 Transportation Route of Company No.1 (CDO-Davao)



Source: JICA Study Team

Figure 6.3-3 Transportation Route of Company No.3 (Villanueva-Maramag)

**(2) Existing road (Sayre Highway) problems**

Table 6.3-4 shows the summary of problems of the existing route of Sayre Highway raised by interviewed companies:

**Table 6.3-4 Summary of Problems of the Existing Sayre Highway**

	Category of Company	Problem of Existing Route
1	Domestic Products	<ul style="list-style-type: none"> <li>• Heavy traffic</li> <li>• On-going construction of existing highway</li> <li>• Slippery</li> <li>• Landslide (Manolo Fortich)</li> <li>• Time consuming</li> </ul>
2	Beverage Company	<ul style="list-style-type: none"> <li>• Covid-19 Checkpoints</li> <li>• Obstacles in the road repairs</li> </ul>
3	Beverage Company	<ul style="list-style-type: none"> <li>• Truck ban</li> <li>• Location was not easy to find</li> <li>• Traffic congestion</li> <li>• Small road</li> </ul>
4	Beverage Company	<ul style="list-style-type: none"> <li>• Narrow roads (some segments are still two lanes)</li> <li>• Steep and zigzag roads</li> </ul>
5	Domestic Products	<ul style="list-style-type: none"> <li>• Hazard on vehicular accident due to constricted traffic</li> </ul>
6	Domestic Consumption Products	<ul style="list-style-type: none"> <li>• Route to Manolo Fortich, Bukidnon Area (Land Slide)</li> <li>• Slippery highway</li> </ul>
7	Local Consumption Goods	<ul style="list-style-type: none"> <li>• Narrow Highway/road</li> <li>• Traffic congestion</li> </ul>
8	Supply Chain Management	<ul style="list-style-type: none"> <li>• Landslides (Manolo Fortich)</li> <li>• Forced robbery while truck is in-transit at Upper Puerto, Carmen Hill</li> </ul>
9	Transportation/Forwarding	<ul style="list-style-type: none"> <li>• Traffic congestion</li> </ul>
10	Trucking company	<ul style="list-style-type: none"> <li>• Repair of road</li> <li>• Poor state of street lights</li> <li>• Debris in the middle of the road</li> <li>• Lack of road signs</li> <li>• Animals crossing</li> </ul>
11	Trucking company	<ul style="list-style-type: none"> <li>• Traffic congestion</li> <li>• Some areas are 2 lanes only</li> </ul>

*Source: JICA Study Team*

Most of the companies stated that common existing problems at Sayre Highway are traffic congestion, narrow road, steep slopes and zigzag roads.

**(3) Perceived Benefits**

Table 6.3-5 shows the summary of perceived benefits by the manufacturing companies once CMH is completed.

**Table 6.3-5 Perceived Benefits of CMH**

Perceived Benefits of Central Mindanao High Standard Highway	Interviewed Companies Agreed
1. Faster delivery of goods	100%
2. Reduction of Transportation Cost	64%
3. Minimizing Damage on Cargoes	73%
4. Increase Access to source of materials (suppliers)	64%
5. Accident Prevention	18%

*Source: JICA Study Team*

All the interviewed companies perceived that construction of the Central Mindanao High Standard Highway will help a lot in the faster delivery of goods which will minimize damage to their cargoes, especially to fresh and highly perishable goods.

#### **(4) Logistics Problems Encountered**

Logistics problems encountered by the manufacturing and logistics companies are listed in Table 6.3-6.

**Table 6.3-6 Summary of Problems Encountered by the Manufacturing and Logistics Companies**

	<b>Category of Company</b>	<b>Effects on Business Operation</b>
1	Domestic Consumption Products	<ul style="list-style-type: none"> <li>• Delayed deliveries</li> <li>• High transportation cost</li> </ul>
2	Beverage Company	<ul style="list-style-type: none"> <li>• Unpaved roads.</li> <li>• Slow road construction repair</li> </ul>
3	Beverage Company	<ul style="list-style-type: none"> <li>• Traffic Congestion</li> <li>• Truck Ban</li> <li>• Truck Machine issues</li> </ul>
4	Beverage Company	<ul style="list-style-type: none"> <li>• None</li> </ul>
5	Domestic Consumption Products	<ul style="list-style-type: none"> <li>• If original plan will be implemented, some of our facilities might be included in the new ROW since original layout of HSH will consume some portion of the farmland area.</li> </ul>
6	Domestic Consumption Products	<ul style="list-style-type: none"> <li>• Delivery of goods can be delayed sometime due to traffic congestion/ accident in the highway</li> </ul>
7	Local Consumption Goods	<ul style="list-style-type: none"> <li>• none</li> </ul>
8	Supply Chain Management	<ul style="list-style-type: none"> <li>• Landslides at Bukidnon area</li> <li>• Forced robbery while truck is in-transit at Upper Puerto, Carmen Hill.</li> </ul>
9	Transportation/Forwarding	<ul style="list-style-type: none"> <li>• Traffic congestion</li> <li>• Delays due to road repairs and construction</li> </ul>
10	Trucking company	<ul style="list-style-type: none"> <li>• Fuel consumption</li> <li>• Repair and maintenance of truck unit</li> <li>• Heavy traffic in nearby cities</li> </ul>
11	Trucking company	<ul style="list-style-type: none"> <li>• Traffic congestion</li> </ul>

Source: JICA Study Team

Common problems encountered by the manufacturing and logistic companies are traffic congestion brought about by narrow and steep highway, as well as traffic accidents. Another big problem shared by one Supply Chain Company is an incident of a forced robbery at Carmen Hill.

#### **(5) Benefits of CMH in Business Operations of Companies**

Companies were asked of their comments and suggestions that could improve their business operations by the improvement of CMH.

**Table 6.3-7 Summary of Perceived Benefits of CMH in Business Operations of Companies**

	<b>Category of Company</b>	<b>Comments/ Suggestion</b>
1	Domestic Consumption Products	<ul style="list-style-type: none"> <li>• Construct the highway as soon as possible.</li> <li>• Put patrol base or police outpost as soon as expressway is done.</li> </ul>
2	Beverage Company	<ul style="list-style-type: none"> <li>• To have an expressway so that deliveries will not be delayed.</li> </ul>
3	Beverage Company	<ul style="list-style-type: none"> <li>• Notify ahead of time and send map and instructions for re-routing.</li> </ul>
4	Beverage Company	<ul style="list-style-type: none"> <li>• None</li> </ul>
5	Domestic Consumption Products	<ul style="list-style-type: none"> <li>• Construction of the High Standard Highway will be beneficial to most of the companies but might be a problem if original layout of the proposal will be implemented. (Because it may overlap with the farmland of the company interviewed)</li> </ul>
6	Domestic Consumption Products	<ul style="list-style-type: none"> <li>• Highway needs regular maintenance.</li> </ul>
7	Local Consumption Goods	<ul style="list-style-type: none"> <li>• None</li> </ul>
8	Supply Chain Management	<ul style="list-style-type: none"> <li>• None</li> </ul>
9	Transportation/Forwarding	<ul style="list-style-type: none"> <li>• New roads mean new opportunity.</li> </ul>
10	Trucking company	<ul style="list-style-type: none"> <li>• Expects that the government shall improve our road condition, with visible road signages, diversion roads, widened roads and traffic lights</li> </ul>
11	Trucking company	<ul style="list-style-type: none"> <li>• None</li> </ul>

*Source: JICA Study Team*

Most of the trucking companies commented that the construction of the CMH will be beneficial to most of them. One company even stated that construction of new road would also mean new opportunity. Noted also was one company's apprehension about the layout which might affect their operation.

The results of the interview survey showed that the companies currently using the existing road have some problems, such as, traffic congestion, narrow road, steep slopes and zigzag roads. Most of the companies expect the benefit of "faster delivery of goods" by the construction of CMH. Hence, CMH is needed to improve logistics operation efficiency in Mindanao.

#### **6.4 Necessity for the Improvement of Regional Development Potentials**

This project is a construction of high standard highway connecting Cagayan de Oro City and Davao City, the two major metropolitan centers in Mindanao, and will form the most important national development axis in Mindanao.

The population along the project route is expected to reach about 8 million by 2040 from about 6 million in 2020, and about 23% of Mindanao's population will be included in the service area.

The current travel time by vehicle between the two cities is about 6 hours and 30 minutes. But with the opening of the entire section of high standard highway between Cagayan de Oro City and Davao City section including the project section (CDO-Malaybalay), the travel time is expected to be shortened to only 3 hours and 30 minutes.

With this drastic improvement in connectivity between the regions, the project is expected to contribute significantly to stimulating economic activities, such as person trip and logistics, as well as promoting development investment.

**Table 6.4-1 Population in Service Area of the Central Mindanao High Standard Highway**

Province	2020	2040
Province of Misamis Oriental (Cagayan de Oro)	1.72 million	2.25 million
Bukidnon (Malaybalay City)	1.54 million	1.97 million
Province of Davao del Sur (Davao City)	2.64 million	3.79 million
Total	5.90 million	8.01 million

*(Capital city)*

*Source: JICA study team projection based on HSH development masterplan phase2*

The areas along the project route have high potential for the development of agriculture, forestry and livestock industries. The inland areas are fertile and undeveloped, and the realization of this project is expected to contribute greatly to the promotion of the agricultural and livestock industries.

Large-scale plantations have already been established by foreign food company, and pineapples are grown and processed for export to the world through the port of Cagayan de Oro. In the foothills of Mt. Kitanglad near Malaybalay, cultivation of highland vegetables, such as cabbage has begun, and the area is expected to develop into a food supply base for Mindanao.

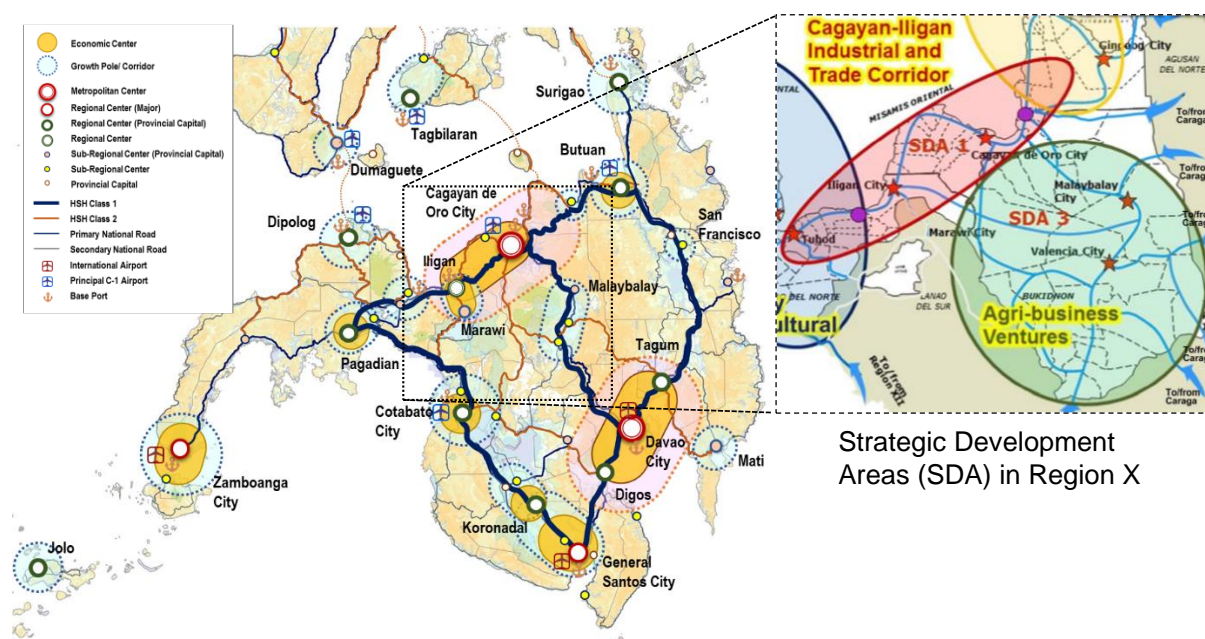
In fact, NEDA Regional X Office is planning a strategic development area (SDA). the SDAs identified are SDA1 for CDO City; and SDA3 for Bukidnon. These SDAs have the following components:

SDA 1: Industrial and Trade corridor (Iligan City – Cagayan de Oro City)

- Sea linkages to the growth areas of Visayas and Luzon,
- Competitive edge in commodity transport and trading,
- PHIVIDEC industrial estate is expected to become the south-gate of the Philippines for international trade with the development of agribusiness centers,
- Cagayan de Oro area as melting pot and business hub of Northern Mindanao.

SDA 3: Agri-business ventures and Eco-tourism (Bukidnon)

- Agricultural products and raw materials for the processing plants,
- Potentials for eco-tourism and recreation,
- Production of food crops, industrial crops, high value crops, poultry, piggery and large livestock,
- High value cash crops and vegetables,
- Highlands with temperate climate as a summer capital, retirement and vacation destination,
- Manolo Fortich as the first pineapple plantation in the Far East.



Regional Development Plan in Mindanao

Source: NEDA X and HSH-MP2 by JICA

Figure 6.4-1 Strategic Development Areas (SDA) in Region X

Table 6.4-2 Major Companies in Bukidnon

Agri-businesses	Eco-tourism
<ul style="list-style-type: none"> <li>● Del Monte Philippines: Pineapple production and cattle fattening</li> <li>● Bukidnon Sugar Milling Corp.</li> <li>● Sugar Milling Company</li> <li>● San Miguel Corporation</li> <li>● Monterey Farms Corporation</li> <li>● Swift Foods Incorporated</li> <li>● Tyson Agro Ventures Incorporated</li> </ul>	<ul style="list-style-type: none"> <li>● Misamis Oriental is a haven for eco-tourism.</li> <li>● Initao-Libertad protected landscape and seascape</li> <li>● Mount Balatukan Natural Park</li> </ul>

Source: JICA Study Team Survey

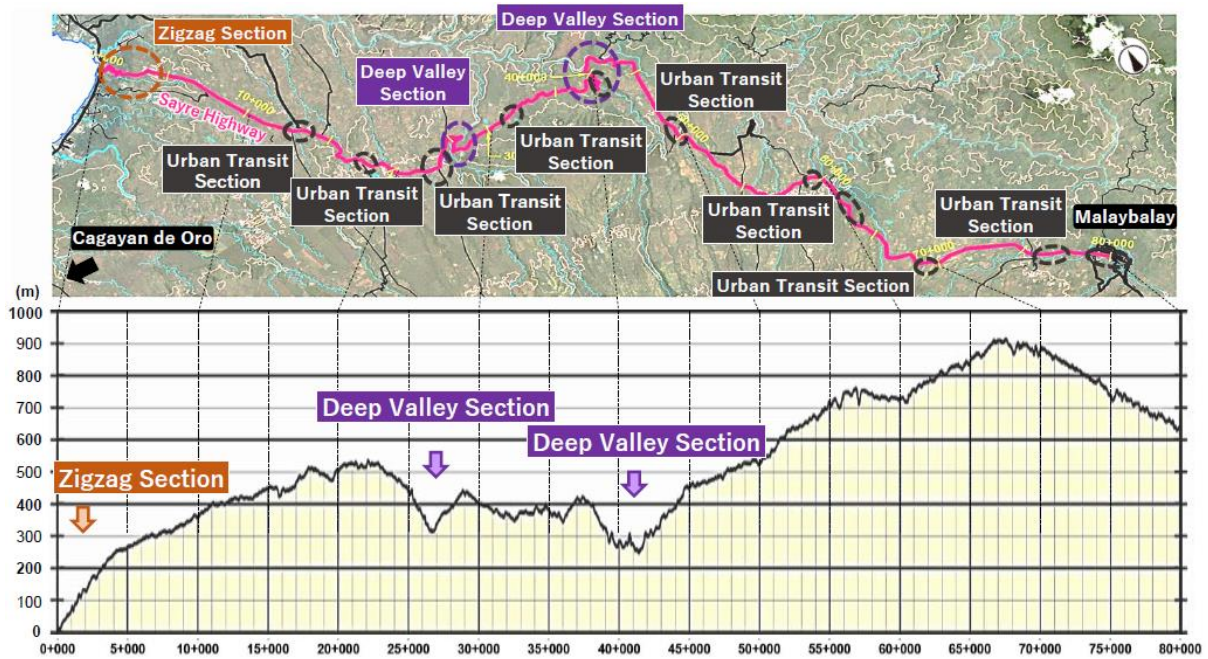
## 6.5 Necessity for Solving Current Road Traffic Problems on Existing National Road




### 6.5.1 Overall Road and Traffic Issues on the Existing National Highway

The existing national highway of the project (Sayre Highway) is a two-lane primary national highway. Many sections of the highway are with poor road alignment, hence, posing substantial risks to road users.

In particular, the 3-km section at the Cagayan de Oro side and the two canyon- zigzag sections with a series of sharp curves is considered the biggest problem along the route.

In addition, the low- speed driving of large vehicles on the steep slopes has become the norm, resulting in frequent vehicular accidents.



Zigzag Section	Deep Valley Section	Urban transit section
 <p>A steep zigzag gradient section of about 3 km with poor road alignment. Traffic accidents occur frequently as people are forced to travel at low speeds.</p>	 <p>Multiple deep valley sections with a height difference of 100 to 150 meters. The deep valley sections interfere with smooth driving. A drastic improvement of the existing national highway is difficult.</p>	 <p>Small urbanized areas with stores, schools, other urban facilities are scattered along the existing national highway. Large trucks traverse the urbanized area and is a problem in terms of traffic safety.</p>

Source: JICA Study Team

Figure 6.5-1 Road and Traffic Issues on the Existing National Road (Sayre Highway)

### 6.5.2 Issues of the Zig Zag Section on Existing National Highway (Sayre Highway)

The critical road and traffic issues on the existing national road have concentrated mainly at Zig Zag sections. The issues are summarized below.

#### Insufficient road traffic capacity:

The current traffic volume is approximately 9,000 vehicles/day, which is equivalent to the traffic capacity of a two-lane road.

It is also a logistics route where large trucks account for about 45% of the total number of vehicles passing along this road. The large number of heavy vehicles regularly use the route and causing a shortage of road traffic capacity.

**Extremely poor road alignment:**

Sharp curves with a radius of less than 60 m exist at eight locations, sections with vertical profile over 12% are observed at two sections. The average gradient of these sections is 6%. The road alignment is extremely poor with a series of sharp curves and steep gradient.

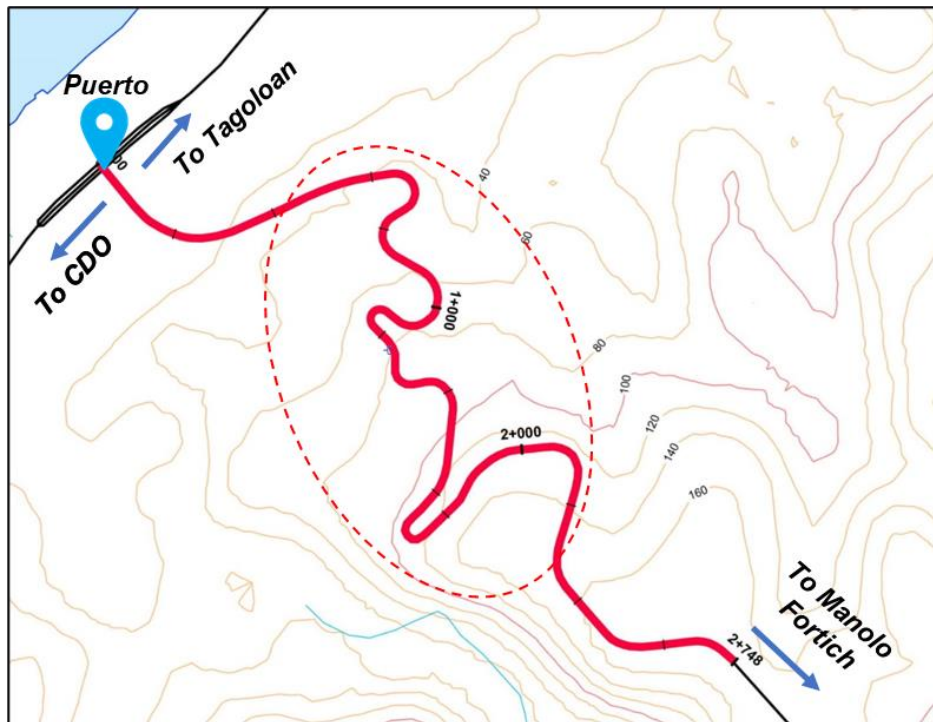
**Extremely low drivability:**

The average speed of passenger cars is less than 30km/hr, and even lower for large vehicles, which is less than 10 km/hr.

**High incidence of traffic accidents:**

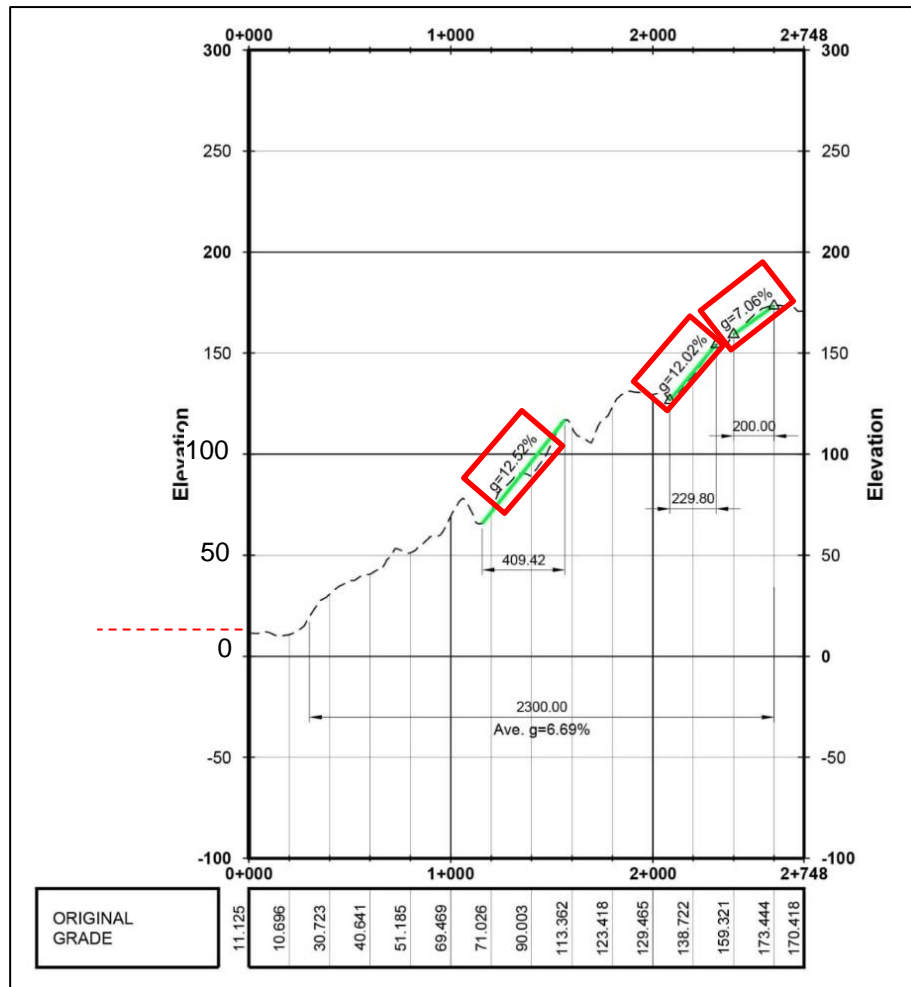
From January 2018 until March 2019, 66 accidents occurred along the zigzag section of the highway. The accident rate is four times higher than that of other sections.

Figure 6.5-2 shows the Zigzag section of Sayre Highway near Puerto section. This section creates bottlenecks especially for large trucks that are forced to drive at a very slow speed. The elevation difference in the first 2-km zigzag section is about 150 meters. This section has many sharp curves and a continuous gradient of more than 10% as shown in Figure 6.5-3.



Source: JICA Study Team

**Figure 6.5-2 Zigzag Portion of Sayre Highway**



Source: JICA Study Team

**Figure 6.5-3 Profile View of Sayre Highway Zigzag Section**

**(1) Traffic Situation**

Traffic survey was conducted along the Zigzag section of Sayre Highway. The survey revealed that the Annual Average Traffic Volume (AATV) in the section was 8,080 vehicles and the share of vehicles passing through the section is listed in Table 6.5-1. It was found out that most of the vehicles passing through the section were trucks that comprised 45% of the daily traffic. It was followed by cars with 39% share, then buses with 10% share, and having the least share were jeepneys with 6%.

**Table 6.5-1 Distribution of Vehicle Type Passing Through Sayre Highway Zigzag Section**

Vehicle type	% Share
Truck	45
Car	39
Bus	10
Jeepney	6
<b>Total</b>	<b>100</b>

Source: JICA Study Team

Roadside interview survey was also conducted in the section to determine the volume of the cargos carried by trucks. Based on the survey, truck loads were classified into five specific categories and a category for “others” was assigned for truck loads not belonging to the five specific categories. Majority

of cargos were agricultural products with 52% of the total share due to the presence of many agricultural plantation lands in the area. The complete list of truck load distribution is shown in Table 6.5-2.

**Table 6.5-2 Distribution of Truck Load Passing Through Sayre Highway Zigzag Section.**

Truck Load	% Share
Agricultural Products	52
Construction Materials	15
Petroleum Minerals	5
Industrial Products	2
Livestock Products	1
Others	25
<b>Total</b>	<b>100</b>

Source: JICA Study Team

Travel speed survey<sup>1</sup> was also conducted in the concerned section. The travel speed data were collected based on the free flow of a sedan car used in the survey. A speed of less than 20 km/hr was the lowest category observed along the surveyed section as illustrated in Figure 6.5-4.



Source: JICA Study Team

**Figure 6.5-4 Travel Speed Survey Result**

## (2) Traffic Accident

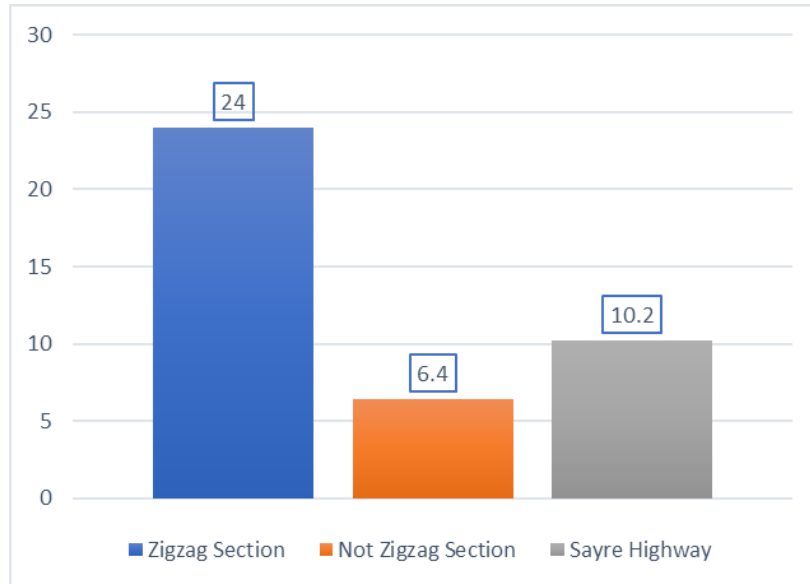
Traffic accident data were collected from DPWH Region X and then analyzed by the JICA Study Team. Based on the accident data gathered from January 2018 to March 2019 in Sayre Highway (both zigzag and not zigzag sections), it was found out that a total of 130 accidents occurred during that period. Furthermore, it was revealed that the accident rate in zigzag section is about 4 times higher than in non-zigzag section (Table 6.5-3).

<sup>1</sup> Conducted in 2019

**Table 6.5-3 Traffic Accident Along Sayre Highway.**

	Zigzag Section	Not Zigzag Section	Sayre Highway
No. of Accidents (a)	66	64	<b>130</b>
Road Length in km (b)	2.75	10.03	<b>12.78</b>
Accidents per km (c=a/b)	24.0	6.4	<b>10.2</b>

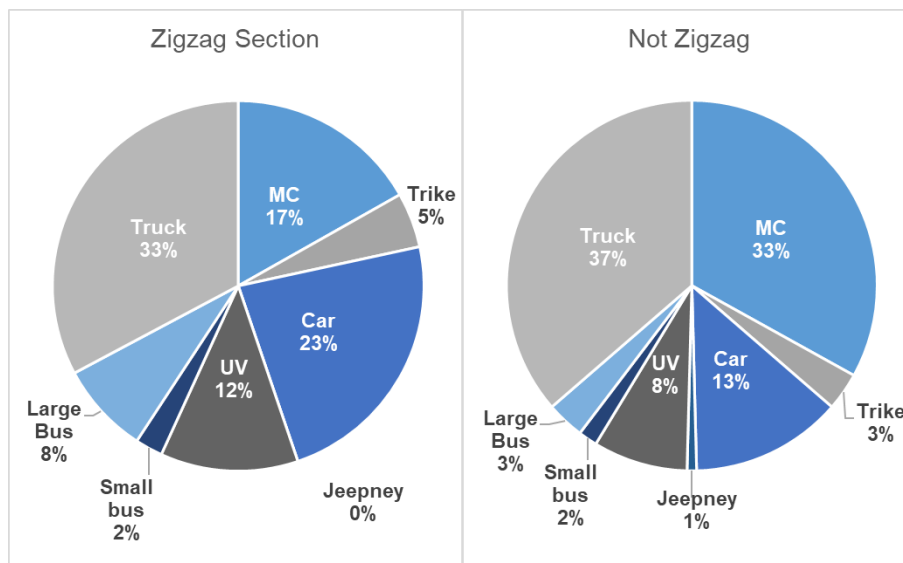
Source: Region X, DPWH



Source: JICA Study Team

**Figure 6.5-5 Accident Rate along Sections of Sayre Highway**

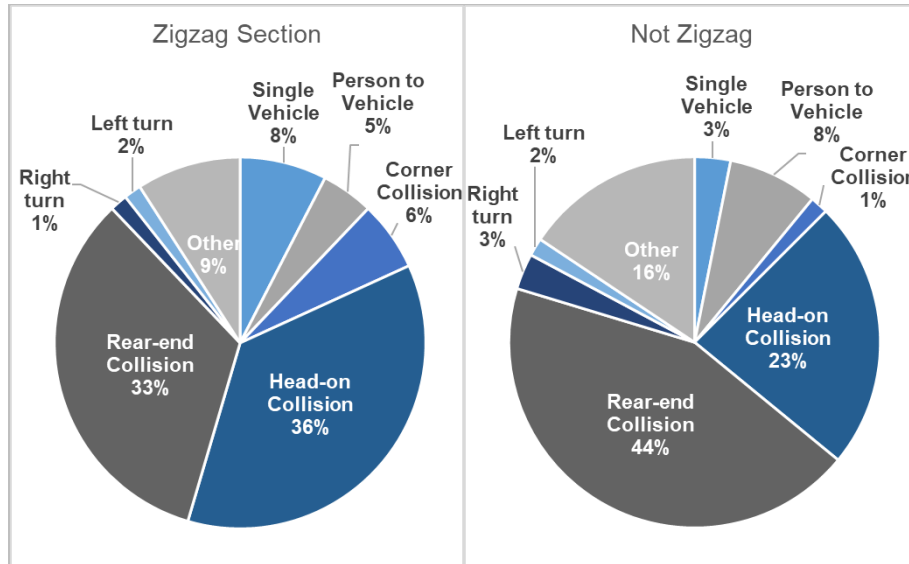
Figure 6.5-6 shows the component ratio of traffic accident by vehicle type along Sayre Highway in zigzag and non-zigzag sections. There is no significant difference between the two sections in terms of vehicle type. Trucks comprised 33-37% of the accidents along the road section followed by motorcycles (MC) with 17-33% of the traffic accidents.



Source: JICA Study Team

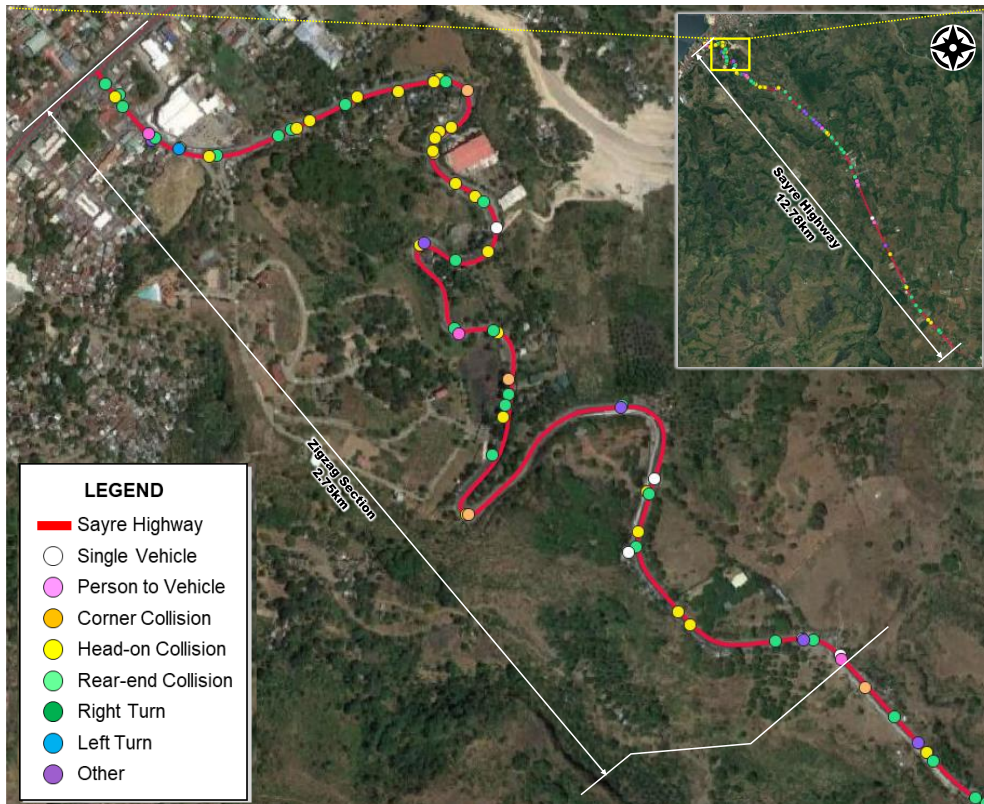
**Figure 6.5-6 Component Ratio of Traffic Accident by Vehicle Type**

The types of accidents in both zigzag and non-zigzag sections differ from each other as illustrated in Figure 6.5-7. In zigzag section, “head-on collision” got the highest percentage with 36% of the total, followed by the “rear-end collision” with 33%, a 3% less from the former. On the contrary, in non-zigzag section, “rear-end collision” got the highest percentage with 44% and “head-on collision” comprised 23% only. In addition, “single vehicle” and “corner collision” on zigzag sections were noted to be higher than on non-zigzag sections. The specific cause of these accidents seems to be brought by the sharp curve sections along the Sayre Highway. Figure 6.5-8 illustrates the plot of accident points on zigzag section along the Sayre Highway.



Source: JICA Study Team

Figure 6.5-7 Component Ratio of Traffic Accident Types



Source: JICA Study Team

Figure 6.5-8 Traffic Accident Points in Zigzag Section along Sayre Highway

## 6.6 Summary of the Necessity for the Project

### (1) Contribution to Development Plans

- **Contribution to the National Development Plan:** Transport infrastructure, such as high standard highways, are envisioned to facilitate national development, in line with the objectives of the Philippine Development Plan (2017-2022). The Central Mindanao High Standard Highway (CMH) will contribute to the enhancement of security in Mindanao, reduction of economic disparities, and increase in the growth potential of inland areas.
- **Contribution to the Regional Development Plan:** The Mindanao Spatial Strategy/ Development Framework 2015-2045 identified the Cagayan de Oro City-Malaybalay City-Valencia City-Davao City axis as a major development axis in Mindanao. Once completed, the CMH will traverse Malaybalay City and Valencia City, which are identified as sub-regional centers featuring agribusiness and eco-tourism.
- **Contribution to the DPWH Highway Development Policy:** The Government of the Philippines, through DPWH, pursues the development of land-based transportation projects to sustain the expansion of strategic corridors. The Master Plan for the High Standard Highway Network Development (Phase 2) identified the CMH (Cagayan de Oro-Malaybalay section) as a high priority project for short-term implementation. Once realized, the project will be part of a nationwide program that will add about 1,044.6 kilometers of high standard national roads and expressways.

### (2) Improvement of Quality of Life of the Residents

- **Better access to urban services:** In addition to an international airport and a container port, Cagayan de Oro City, as a metropolitan center, features a high concentration of urban services (e.g., health care, education, cultural facilities, etc.). The project will provide inland inhabitants in Central Mindanao an equitable access to employment opportunities and other essential services, generally available in highly urbanized cities.
- **Enhanced manufacturing and logistics:** According to the survey conducted by the JICA Study Team, the perceived benefits of manufacturing and logistics companies from the completion of the CMH include the following: (1) faster delivery of goods, (2) minimized damage on cargoes, (3) reduced transport cost, and (4) increased access to source of materials.

### (3) Improvement of Regional Development Potentials in the Project Area

- **Enhanced linkage of metropolitan centers:** The project will connect Cagayan de Oro City and Davao City, two important metropolitan centers in Mindanao. Once realized, travel time between the two cities will be reduced from six hours and thirty minutes to three hours and thirty minutes.
- **Development of industrial and trade corridor:** NEDA Regional Office X envisions the Iligan City – Cagayan de Oro corridor as a Strategic Development Area (SDA) for industry and trade. The CMH will enhance access to the businesses and shipping ports in Northern Mindanao, which serves as a major gateway to growth areas of Luzon and Visayas.
- **Development of agribusiness and eco-tourism:** Bukidnon is envisioned to serve as an SDA for agribusiness ventures and eco-tourism. With large-scale plantations and fertile land along the road alignment, the project has the capacity to develop the untapped potential of agriculture, forestry, and livestock industries in Bukidnon.

### (4) Solving Current Road Traffic Problems on Existing National Road

- **Additional road capacity:** The existing Sayre Highway is carrying approximately 9,000 vehicles/day. The capacity will imminently be surpassed by the traffic volume, and a new 4-lane highway would be needed. The project offers an alternate route that is designed to carry a significant traffic load within the corridor.
- **Increased travel speed:** The existing alignment of the Sayre Highway poses vertical (steep slopes) and horizontal (sharp curves) challenges to road users. This prevents the smooth travel

especially of large vehicles (buses and trucks), which comprise a combined 55% of the existing traffic. As a result, travel speed along sharp curves were observed to be less than 20 km/hr. The project is expected to facilitate faster travel within the corridor, with a design speed of 80 km/hr.

- ***Safer travel option:*** The zigzag sections of the existing national highway also pose traffic safety issues. From January 2018 to March 2019, a total of 130 accidents occurred along the Sayre Highway. The project, as a high standard highway, will be designed with gentle gradients (both horizontally and vertically) to ensure smooth and safe travel of road users.



## **CHAPTER 7**

### **ALIGNMENT SELECTION OF CENTRAL MINDANAO HIGHWAY**

#### **7.1 Alignment Study Procedure**

As part of the JICA-assisted study entitled “High Standard Highway Network Master Plan Development Project (Phase 2)” (hereinafter referred as HSH-MP2), the Project (Central Mindanao High Standard Highway Project) is identified as one of the high priority projects and should be developed in the short term. According to HSH-MP2, for High Standard Highway Class-1, it is required that the design speed of 80 km/h or more should be assured and the vertical gradient should be less than 5%. Further, the radius of curvature should be more than 280 m. These are among the basic requirements to be applied to the Project.

The Pre-F/S earlier conducted has resulted in the development of the road alignment to comply with the requirements. The alignment was designed by using geometric data obtained from google satellite map and ASTER GDM v2 Worldwide Elevation Data. In the Pre-F/S, it has shown that relatively rugged and rough geographic features have been distributed around the Project site, such as steep slopes, deep valleys. Considering such features and to comply with the requirements, building up long-span bridge crossings over deep valleys were attempted. A 4-lane carriageway was selected in accordance with future traffic demand.

The alignment has been adjusted considering the project cost-effectiveness, and at the same time the existing and potential environmental and social concerns. In this Preparatory Survey, new alternative routes are identified, and their alignment properties are comparatively analyzed.

As basic prerequisite for the alignment design, the following is given priority consideration:

- Road function and safety should be ensured to perform the same level with HSH Class-1 (see next section), complying with design speed of 80 km/h or more; maximum vertical gradient of  $i = 5\%$ ; minimum radius of curvature of  $R=252$  m, and a 4-lane carriageway.

To collect the most appropriate route, the following conditions are essentially considered.

- Bridge type and location should be determined considering cost-effectiveness.
- Bridge length necessary for crossing V-shaped deep valley should be set in a way of being cost-effectiveness and structural stability.
- Structural components like tunnel, high soil embankment and deep cutting section requiring large-scale soil excavation work should be reduced as much as possible, considering from the viewpoint of cost-effectiveness and adverse environmental impact minimization.
- As a general rule, environmental protection and indigenous peoples' residential areas should be preserved with priority; and alignment was avoided to pass through the areas covered by Certificate of Ancestral Domain Titles (CADTs) and Key Biodiversity Areas (KBAs). However, after the alignment was decided, it was revealed that there is a CADTs under application in the ROW of section 3. Therefore, the draft IPP was prepared as described in Chapter 14.
- The number of houses to be relocated should be minimized.
- Urban areas accommodating public facilities, like schools and religious structures should be protected and not be interfered with the alignment, as much as possible.

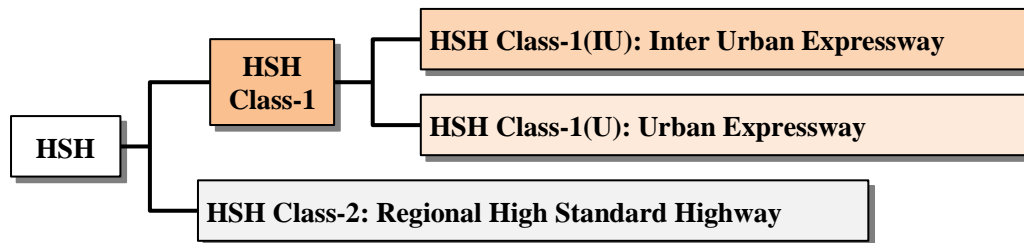
- Accessibility and connection to the Cagayan de Oro Container Terminal should be consistently considered.

## 7.2 HSH Design Criteria

The alternatives in this Alignment Selection were set to meet the various design criteria set out in the HSH Master Plan described below.

### 7.2.1 Composition of HSH

HSH is composed of HSH Class-1 and HSH Class-2.



HSH Class-1 is either an Inter-Urban Expressway (HSH Class-1(IU)) which traverses two (2) or more Regions or an Urban Expressway (HSH Class-1(U)) which is in major Urban Centers such as Metro Manila.

HSH Class-2 is located within one or more regions and connects regional traffic generation sources with HSH Class-1.

Central Mindanao HSH is classified as HSH Class-1(IU)

### 7.2.2 Development Objectives, Functions and Structural / Operational Characteristics

Development objectives, functions, and structural / operational characteristics of HSH Class-1 and HSH Class-2 are summarized in the HSH MP2. (see Table 7.2-1).

### 7.2.3 Design Standards of HSH

In the HSH MP2, the design standard was proposed as shown in Table 7.2-2 and Table 7.5-3. These table show the main design elements for HSHs, which directly affect project costs, together with those for HSHs in Asian Highway, in U.S.A., and in Japan for reference.

Table 7.2-1 Definition of High Standard Highway (HSH)

HSH Class		Development Objectives	Functions	Structural/ Operational Characteristics	Standard Cross Section <sup>*)</sup>	Example
HSH Class-1	HSH Class-1 (IU): Inter-Urban Expressway	<ul style="list-style-type: none"> <li>To achieve balanced development of the country</li> <li>To mitigate over-concentration of people and economic activities in Metro Manila</li> <li>To improve international competitiveness of the country</li> </ul>	<ul style="list-style-type: none"> <li>To provide high-speed, safe, and comfortable means of transportation for medium and long-distance trips</li> <li>To improve connectivity between major urban centers (Metropolitan Centers / Regional Centers) and the rest of the areas</li> <li>To provide efficient access to other important transport facilities such as base ports, international airports and principal airports – Class-1.</li> <li>To improve commodity transportation efficiency</li> <li>To expand one-day activity area</li> </ul>	<ul style="list-style-type: none"> <li>Access controlled. Only 4 or more-wheel vehicles can utilize this facility through an interchange.</li> <li>Grade separated at all intersecting roads</li> <li>High design speed of 80-120 km/hour [Flat Terrain] and 60/80 km/hour [Mountainous Area]</li> <li>Jeepneys, Motorcycles (less than 400 cc) and tricycles are not allowed on this road.</li> </ul>	<p><b>[Flat Terrain]</b></p> <p><b>[Mountainous Area]</b></p>	<ul style="list-style-type: none"> <li>North Luzon Expressway</li> <li>South Luzon Expressway</li> </ul>
	HSH Class-1 (U): Urban Expressway	<ul style="list-style-type: none"> <li>To mitigate chronic traffic congestion in and around major urban centers</li> <li>To vitally support urban socio-economic activities for development</li> <li>To improve international competitiveness</li> <li>To improve urban environment</li> </ul>	<ul style="list-style-type: none"> <li>To provide reliable means of transportation in terms of travel speed</li> <li>To provide smooth linkage with other transport modes and improve inter-modal linkage.</li> <li>To provide efficient link between traffic generations sources</li> </ul>	<ul style="list-style-type: none"> <li>Access controlled. Only 4 or more-wheel vehicles can utilize this facility through an interchange or an on/off ramp.</li> <li>Grade separated at all intersecting roads.</li> <li>High design speed of 60/80 km/hour.</li> <li>Jeepneys, Motorcycles (less than 400 cc) and tricycles are not allowed on this road</li> </ul>		<ul style="list-style-type: none"> <li>Skyway</li> <li>C-5 Expressway</li> <li>C-6 Expressway</li> </ul>
HSH Class-2	HSH Class-2: Regional High Standard Highway	<ul style="list-style-type: none"> <li>To accelerate regional development, particularly agricultural, industrial and tourism development.</li> <li>To strengthen linkage between regional urban centers and rural areas</li> <li>To accelerate development of underdeveloped areas</li> <li>To improve the standard of living of rural people.</li> <li>To develop roads which bypass congested urban areas to assure smooth travel throughout the trip route.</li> </ul>	<ul style="list-style-type: none"> <li>To provide reliable, safe and comfortable means of transportation at regional level after branching off from HSH Class-1.</li> <li>To strengthen linkage between major Sub-Regional Centers and also between production areas and consumption areas and support development of regional industries.</li> <li>To provide access to terminal ports, principal airport – Class-2 and community airports.</li> </ul>	<ul style="list-style-type: none"> <li>Partially access controlled for most of HSH Class-2, but if not feasible, non-access controlled.</li> <li>Bypass or diversion roads (to be 4-lane or more roads)</li> <li>Grade separated at major intersections.</li> <li>At-grade intersection for minor intersecting roads.</li> <li>Design speed 60 km/hr. (mountainous area, 50km/hr.)</li> <li>All vehicles are allowed to use this class of roads, including jeepneys, tricycles, bicycles, etc.</li> <li>In urban area, service road will be provided in order to segregate through traffic and local traffic.</li> </ul>	<p><b>[Flat Terrain]</b></p> <p><b>[Mountainous Area]</b></p>	<ul style="list-style-type: none"> <li>Davao City Diversion Road</li> <li>Roman Superhighway, Bataan</li> </ul>

\*) Shown above are typical cross-sectional drawing; for special cases such as bridges, tunnels and temporary two-lane highways, cross-sections shall be studied as an individual project.

Source High Standard Highway Network Master Plan Development Project (Phase 2)



**Table 7.2-2 Proposed Basic Design Elements for HSHs (Flat Terrain)**

		Philippines (Proposed)			USA		Japan		Asian Highway	
		HSH Class-1		HSH Class-2	AASHTO (Interstate Highway)		NEXCO	Metropolitan Expressway Co.	AH26 (Inter-Urban Highway)	
		HSH Class-1(IU)	HSH Class-1(U)	Regional High Standard	Inter-Urban	Intra-Urban	Inter-Urban	Intra-Urban	Primary (Expressway)	Class I <sup>*1)</sup>
Design Speed (km/h)		80-120	60-80	60-80	121	89	100-120	60-80	120	100
No. of Lanes <sup>*4)</sup>		4 or more		4 or more	4 or more		4 or 6	4	4 or more	
Lane Width (m)		3.65	3.50	3.50	3.65		3.50	3.25	3.75	3.50
Shoulder Width (m)	Outer Shoulder	2.50-3.00	2.00-2.50	2.00	3.05	-	2.50	1.25	3.0	3.0
	Inner Shoulder	1.25	0.75	0.75	1.22	-	1.25	0.75	-	-
Median Strip Width (m)		4.00-6.00	3.00	1.75	11.00	3.00	4.50	1.75	4.00	3.00
Bridge	Traffic Load	HS20-44		HS20-44	HS20-44		B Live Load <sup>*2)</sup>		HS20-44	
	Vertical Clearance (m)	5.30	5.30	5.00	4.88	4.27	4.50 <sup>*3)</sup>	4.50 <sup>*3)</sup>	4.50	4.50
Note		<p>*1) Class I may be corresponding to the Arterial Road in the Philippines.                      *2) Almost corresponding to (HS20-44) X1.25.                      *3) In case that allowance for extra layers of pavement is considered, the vertical clearance is to be 4.70m. A vertical clearance of 4.5m is the requirement for safe passage of standards ISO containers.                      *4) The HSH is designed to be 4-6 lanes highway, however, if the traffic demand is still low at the initial stage, a 2-lane highway will be possible.</p>								

Source: High Standard Highway Network Master Plan Development Project (Phase 2)

**Table 7.2-3 Proposed Basic Design Elements for HSHs (Mountainous Area)**

		Philippines (Proposed)		USA		Japan			Asian Highway	
		HSH Class-1	HSH Class-2	AASHTO (Interstate Highway)		NEXCO	Road Structure Ordinance <sup>*4)</sup>		AH26 (Inter-Urban Highway)	
		HSH Class-1(IU)	Regional High Standard	Inter-Urban	Intra-Urban	Inter-Urban, Mountainous, (Type 1 Class3, 4)	National Highway Flat Terrain (Type3 Class1)	National Highway Flat or Mountainous Area (Type3 Class2)	Primary (Expressway)	Class I <sup>*1)</sup>
Design Speed (km/h)		60-80	50	No difference in design elements in Flat Terrain and Mountainous Area		60-80	80	60	80	60
No. of Lanes <sup>*5)</sup>		4 or more	4 or more			4 or 6	4 or more	2 or 4	4 or more	
Lane Width (m)		3.50	3.25			3.50 (80kph) 3.25 (60kph)	3.50	3.25	3.75	3.50
Shoulder Width (m)	Outer Shoulder	1.75-2.50	0.75-1.25			1.75	1.25	0.75	2.50	2.50
	Inner Shoulder	1.00	0.50			1.00	0.50	0.50	-	-
Median Strip Width (m)		2.00	1.75			2.00	1.75	1.75	3.00	2.50
Bridge	Traffic Load	HS20-44	HS20-44			B Live Load <sup>*2)</sup>			HS20-44	
	Vertical Clearance (m)	5.30	5.00	4.50 <sup>*3)</sup>			4.50	4.50		
Note		<p>*1) Class I may be corresponding to the Arterial Road in the Philippines.</p> <p>*2) Almost corresponding to (HS20-44) X1.25.</p> <p>*3) In case that allowance for extra layers of pavement are considered, the vertical clearance is to be 4.70m. A vertical clearance of 4.5m is the requirement for safe passage of standards ISO containers.</p> <p>*4) Roads shall be classified into Type1 through 4. (National Expressway and access-controlled highway is Type 1(Rural) and Type 2(Urban Area). Other Roads such as National Highway, Prefectural Roads is Type 3(Rural) and Type 4(Urban Area).</p> <p>*5) The HSH is designed to be 4-6 lanes highway, however, if the traffic demand is still low at the initial stage, a 2-lane highway will be possible.</p>								

Source: High Standard Highway Network Master Plan Development Project (Phase 2)

### **7.3 Without Case Scenario**

The existing national highway (Sayre Highway) is classified as a primary two-lane national highway. At present, many sections of the road are in poor condition, a situation which becomes big problems for road users. Particularly, many zigzag paths with a series of sharp curves have been found along the 3-km stretch section near Cagayan de Oro and two canyons where serious traffic troubles often happen. Due to above road traffic problems on the Syre Highway, the Alae-PHIVIDEC Link Road is under construction, but the design speed is 20 km/h based on the bypass road design drawing' grade and curve elements, and this traffic problem has not been fully solved (see Sec. 4.3 Alae-PHIVIDEC Link).

Heavy trucks and vehicles driving at low speed along this zigzag and steep slopes in Sayre Highway often cause traffic accidents that are approximately four times higher than accidents occurring at other road sections.

The present daily traffic volume of 4-wheeled or more vehicles account for around 8,000 vehicles. Hence, the road is getting into full capacity. Just in case this road happened to be closed for certain reasons like traffic accidents, natural disasters, etc., many road users would have no choice but finding another path and forced to detour through a longer route which would also take longer travel time.

Moreover, there are some agri-business places with very high development potentials located near the project site. The NEDA Regional Office X is now planning to make the province of Bukidnon a strategic development area. The proposed CMH project could certainly provide strong infrastructure support and provide opportunities related to the following development plans of Region X:

#### Agri-business ventures and Eco-tourism (Bukidnon)

- Build factories to process agricultural products and raw materials,
- Revitalize eco-tourism and recreation,
- Increase productivity of food crops, industrial crops, high value crops, poultry, piggery and large livestock, and
- Develop production of high value-added crops and vegetables.

The project through high-speed mobility, is envisioned to provide a safe and comfortable travel of people and goods and propel the socio-economic development activities in Mindanao regions. From the foregoing, it could be deduced that the project implementation is therefore inevitable.

### **7.4 Alignment Selection**

#### **7.4.1 Interchange Locations**

In selecting the alignment, the interchange locations was first considered basend on the following criteria.

- The interchange should be located the road near the center of the city/municipality(Tagoloan; Manolo Fortrich; Impasug-ong; Sumilao; and City of Malaybalay).
- The interchanges in mountainouts areas should be placed at an average intervals of 10-15 km as per Japan standard(No standard for interchange intervals in the Philippines ).

Based on the above criteria, the detailed conditions of interchanges are stated as follows. The interchange location should:

- have an easy to access from/to the national road (Sayre Highway)
- have a smooth terrain that is approximately 500m to 1km away from the national road to allow space for an IC and a toll gate.
- not be a deformed intersection when intersecting with the national road.

- avoid direct connection to city center and high-density residential areas,

As a special case, the Manolo Fortich IC in Sections 2 and 3 is located near the existing access roads in Manolo Fortich due to the difficulty of connecting directly to the national road in a configuration that meets the above conditions(see Figure 7.4-1.).

#### **7.4.2 Sectioning of the Alignment**

After the identification of the location of the interchanges, the alignment was divided into five (5) sections. Each Section starting and ending in the interchanges based on discussions with DPWH as shown in Figure 7.4-1.

#### **7.4.3 Alternative Alignments**

There are three (3) alternative alignments under study by the JICA team. The alternatives are composed of the designed in the Pre-F/S, and an additional two more alternative routes are newly added to every section. All the three routes for each section are compared in accordance with the requirements described above and then scored quantitatively.

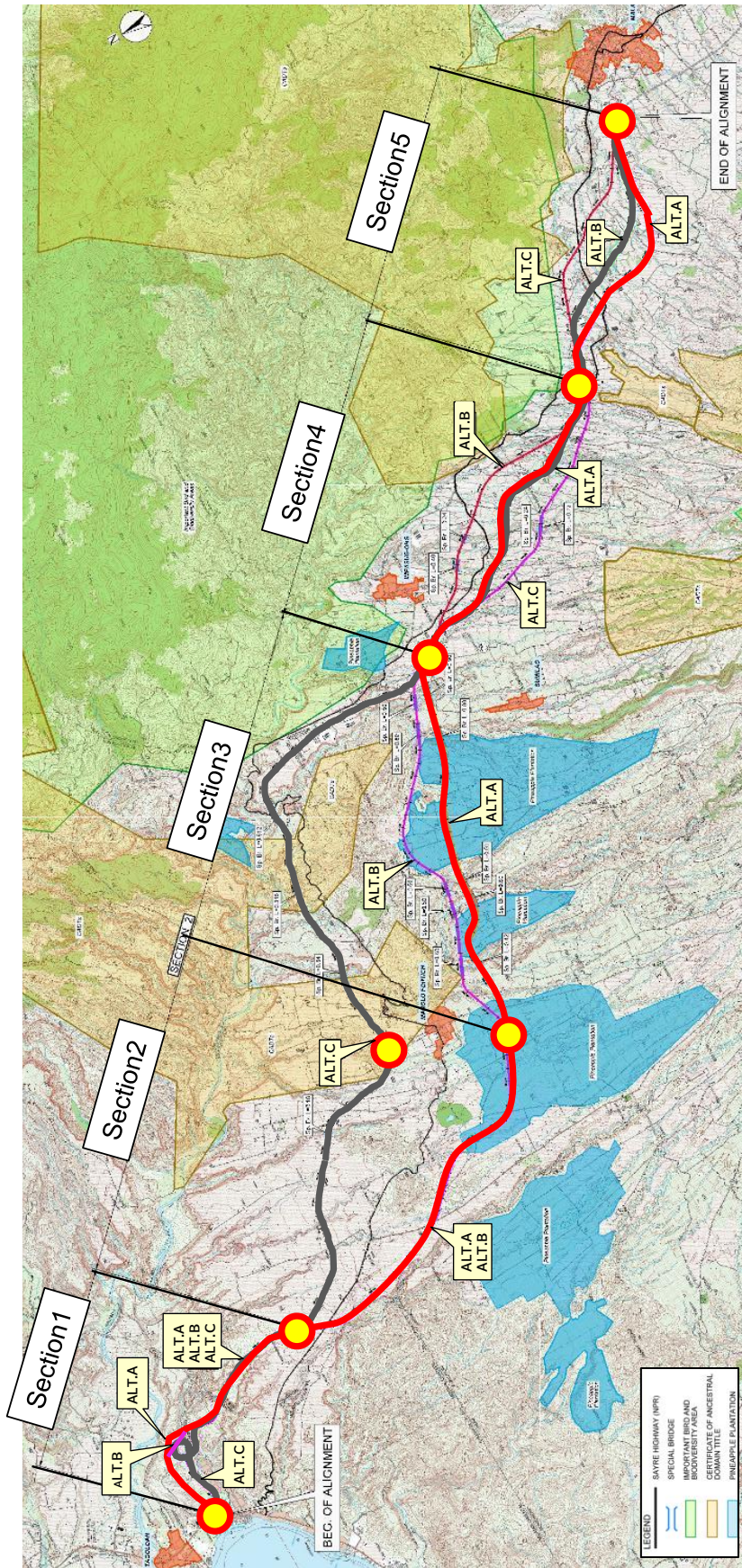


Figure 7.4-1 Section for Alignment Selection

Source: JICA Study Team

## **7.5 Evaluation Criteria for Alignment Selection**

The criteria are established for the quantitative evaluation for the alignment selection. The criteria include four main items related to the aspects of road performance, project cost, environmental and social impacts, and project constructability.

Road performance comprises of four sub items, namely: drivability, detour rate, traffic demand and time. These items are used to quantify road performance corresponding to the level of High Standard Highway Class 1. Drivability is normally affected by vertical curves used to change the elevations of highways, and horizontal circular curves which can be specified by the radius. To keep drivability requirement for High Standard Highway Class-1, vertical gradient is limited up to 4% and radii of horizontal curves should be as large as possible. Detour rate is also calculated to see how much longer or shorter a new route would be compared with the existing road. Traffic demand and travel time can indicate the design capacity that the highway can handle.

Project cost consists of construction cost like earthwork, medium-sized and long-span bridges which are more than 100 m of span length, and compensation expenses related to ROW. In order to make the Project economically feasible, cost estimate should be shown and reviewed to determine if the required function can be accomplished in a less expensive way.

Environmental and social impacts are divided into length of high cutting section, number of river crossings, lengths of passages through forest and agricultural areas, and number of affected houses. High cutting section may involve massive soil excavation work causing topographical and geographical change to some extent, which should be minimized as much as possible. Constructing river crossing structures as well as underpass/overpass may also affect the environment. When the alignment may pass through the existing forest and agricultural areas, not only landscape but cultivated land or local pathway would be disturbed. Involuntary resettlement may cause a conflict and force local communities to be divided physically and socially. To consider these kinds of impacts, their quantities are surveyed, calculated and used in the evaluation process.

Project constructability is taken as one of criteria items since the project anticipates the construction of a long bridge with a long span length and high piers in a mountainous valley, there are constraints on the choice of construction method and the application of appropriate construction machinery. Therefore, project constructability is one of the criterion items.

Scores allocation was set up considering the level of importance of each item in the criteria through the discussion with relevant departments of DPWH.

The criteria of the project cost and the environmental and social impacts are 35 points as the most important item in this project. Twenty points are allocated to the road performance criteria as the next most important items. The rest comes to constructability 10 points.

The criteria item and score allocation are defined and established with reference to the past FS by DPWH and based on a result of discussion and agreement with technical working group and relevant departments of DPWH, such as Planning Service (PS), Roads Management Cluster I (RMC-I), Bureau of Design (BOD), and Environmental and Social Safeguards Division (ESSD) and others.

Table 7.5-1 shows items for evaluation and allocated scores to each evaluation item.

**Table 7.5-1 Criteria Description**

Criteria		Score	Description
Road Performance (20)	Drivability (Comfort, Safety)	5	Road geometric features about horizontal and vertical alignments decide drivability. When a route has many sections with vertical gradient of more than 4%, it has a low drivability. As section becomes less rough and linear, the score increases.
	Detour rate	5	When a new route detours far away from the existing road and its length becomes longer, traveling vehicles would consume more gasoline cost and transportation cost increases. Detour rate is defined as new route length / existing road length. As detour rate decreases, the score increases.
	Traffic demand (2040)	5	Higher future traffic demand in 2040 would result in a higher score.
	Travel Time	5	As travel time become shorter, the score increases.
Cost (35)	Cost of Construction, Land Acquisition and Compensation	35	A total cost including construction, land acquisition and relocation compensation is estimated. As the cost decreases, the score increases.
Environmental and Social Impacts (35)	Length of High Cut section	5	High-cut section (H>10m) causes a large-scale topographic change. As the high-cut section becomes longer, the score decreases.
	No. of river crossing	5	As number of river crossings increases, the score decreases.
	Length through forest areas	5	Part of forest area would be affected by the planned route. As forest section to be affected becomes longer, the score decreases.
	Length through agricultural areas	5	Some existing farmlands decrease due to right-of-way acquisition and farmer's living may be affected. As farmland to be acquired becomes longer, the score decreases.
	Number of affected houses	15	How many houses would be affected and relocated on the route. As the number of houses to be relocated increases, the score decreases.
Constructability (10)		10	As the length of bridge increases, the score decreases.
Total		100	—

Source: JICA Study Team

Road Performance has sub-items of drivability, detour rate, traffic demand and travel time, they are allocated equally with five points. Environmental and Social Impacts includes sub-items of length of high cut section, number of river crossing, length of passage through forest and agricultural areas, and number of affected houses, to which five points are also equally allocated to each sub-item, except for the sub-item number of affected houses. The number of affected houses is given 15 points because it is considered highly important.

Table 7.5-2 shows the calculation and scoring for each of the above criteria items. Scoring is done in two ways. One is to score the maximum to the best and the rest is simply scored by multiplying the ratio with the given point. Another is to score within a range frame as defined, based on data obtained, because data are scattered. For example, the number of affected houses varies widely from a minimum of 8 to a maximum of 72, as a result of this study – estimated about 170 in the Pre-F/S. These data have been estimated from digital files and need to be refined more accurately through site survey. To make a buffer of accommodating some variation of the data as a result of the site survey, a range scoring is used.

**Table 7.5-2 Calculation and Scoring**

Item		Score	Criteria	Evaluation	
Road	Drivability	5	Horizontal curve radius: not less than 400m, Vertical gradient: not more than 4%	5-point is given when the curve length is 10% or less per total length. 1-point is subtracted for every 10% increase.	
	Detour Rate (r)*	5	$r = \text{Alignment length} / \text{Existing road length}$	Refer to the score calculation sheet (see Table 7.5-3).	
Traffic	Traffic Volume	5	Future traffic demand forecast	5-point is given when traffic volume is maximum. The rest is scored by multiplying the ratio with 5-point.	
	Travel Time	5	Alignment length / Travel speed	5-point is given when travel time is minimum. The rest is scored by multiplying the ratio with 5-point.	
Project Cost	Construction Cost, ROW Cost	35	Construction cost = Structure length x Unit price per structure type. ROW cost = Affected section length x Unit price per section type. Relocation cost = No. of affected houses x unit price per house.	35-point is given when Project Cost is minimum. The rest is scored by multiplying the ratio with 35-point.	
Environmental	High Cutting Section*	5	Total length of soil cutting section with the height over 10m	L < 0.1 km	5
				~0.3 km	4
				~0.6 km	3
~0.9 km				2	
~1.2 km				1	
L > 1.2 km	0				
River Crossing	5	Number of river crossings	5-point is given to the minimum number. The rest is scored by multiplying the ratio with 5-point.		
Affected Forest Section*	5	$e = \text{Affected forest length} / \text{Route length}$	Refer to the score calculation sheet (see Table 7.5-3).		
Social	Affected Agriculture Section*	5	$e = \text{Affected agricultural length} / \text{Route length}$	Refer to the score calculation sheet (see Table 7.5-3).	
	No. of Affected Houses*	15	Number of houses required for relocation (n)	n ≤ 10	15
				~20	14
				~30	13
				~40	12
				~50	11
				~60	10
				~70	9
				~80	8
				~90	7
				~100	6
				~110	5
				~120	4
				~130	3
~140	2				
~150	1				
n > 150	0				
Construction	Constructability*	10	Bridge section length (km)	Refer to the score calculation sheet (see Table 7.5-3).	
Total		100	-	-	

Note:\* Scoring is by a range set for each item, based on data range obtained from the survey.

Source: JICA Study Team

**Table 7.5-3 Score Calculation Sheet**

Detour Rate (r)	Score	Forest and Agricultural Section Length / Route Length (e)	Score	Bridge Length (km)	Score
$r < 0.6$	5.0	$e < 0.1$	5.0	$0.0 \leq L \leq 0.5$	10
$0.6 \leq r < 0.7$	4.5	$0.1 \leq e < 0.2$	4.5	$0.5 < L \leq 1.0$	9
$0.7 \leq r < 0.8$	4.0	$0.2 \leq e < 0.3$	4.0	$1.0 < L \leq 1.5$	8
$0.8 \leq r < 0.9$	3.5	$0.3 \leq e < 0.4$	3.5	$1.5 < L \leq 2.0$	7
$0.9 \leq r < 1.0$	3.0	$0.4 \leq e < 0.5$	3.0	$2.0 < L \leq 2.5$	6
1.0	2.5	$0.5 \leq e < 0.6$	2.5	$2.5 < L \leq 3.0$	5
$1.0 < r \leq 1.1$	2.0	$0.6 \leq e < 0.7$	2.0	$3.0 < L \leq 3.5$	4
$1.1 < r \leq 1.2$	1.5	$0.7 \leq e < 0.8$	1.5	$3.5 < L \leq 4.0$	3
$1.2 < r \leq 1.3$	1.0	$0.8 \leq e < 0.9$	1.0	$4.0 < L \leq 4.5$	2
$1.3 < r \leq 1.4$	0.5	$0.9 \leq e < 1$	0.5	$4.5 < L \leq 5.0$	1
$1.4 < r$	0	$1.0 = e$	0	$5.0 < L$	0

Note: Scoring range is framed, based on data obtained.

Source: JICA Study Team

## 7.6 Alignment Study Result

### 7.6.1 Summary of Alignment Study Result

Alternatives for each section were evaluated according to the Evaluation Criteria in the previous section. Table 7.6-1 summarized the evaluation results.

**Table 7.6-1 Summary of Alignment Study Result**

Criteria	Score	Section-1			Section-2 and 3		
		S1-ALT.A	S1-ALT.B	S1-ALT.C	S2 3-ALT.A	S2 3-ALT.B	S2 3-ALT.C
Road	10.0	<b>5.0</b>	5.5	3.0	<b>8.5</b>	8.0	See Section 7.6.3
Traffic	10.0	<b>10.0</b>	10.0	10.0	<b>10.0</b>	9.8	
PTJ Cost	35.0	<b>35.0</b>	30.1	22.4	<b>30.9</b>	30.9	
Environmental	15.0	<b>8.5</b>	8.5	8.5	<b>10.2</b>	8.2	
Social	20.0	<b>16.0</b>	16.0	14.0	<b>9.5</b>	10.5	
Constructability	10.0	<b>5.0</b>	5.0	2.0	<b>0.0</b>	0.0	
<b>Total</b>	100.0	<b>79.5</b>	75.1	59.9	<b>69.1</b>	67.4	
Recommendation		<b>O</b>			<b>O</b>		

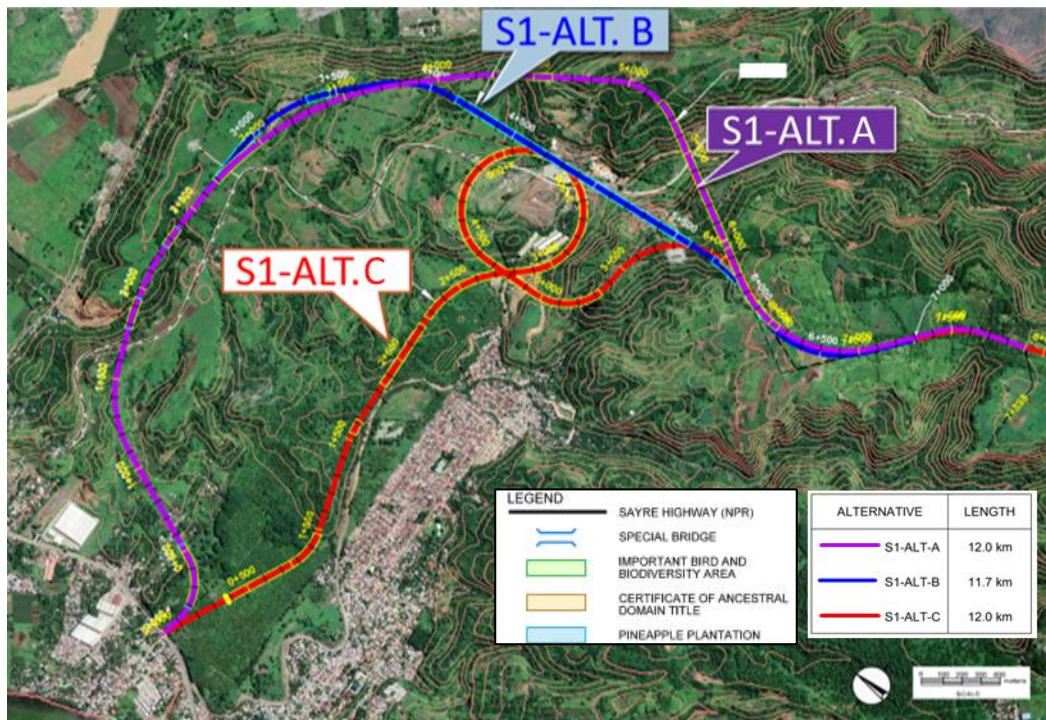
Criteria	Score	Section-4			Section-5		
		S4-ALT.A	S4-ALT.B	S4-ALT.C	S5-ALT.A	S5-ALT.B	S5-ALT.C
Road	10.0	<b>9.0</b>	9.0	8.5	<b>8.5</b>	8.5	9.0
Traffic	10.0	<b>10.0</b>	10.0	10.0	<b>9.6</b>	9.9	10.0
PTJ Cost	35.0	<b>35.0</b>	30.7	26.8	<b>35.0</b>	32.0	27.7
Environmental	15.0	<b>13.1</b>	9.0	13.3	<b>13.2</b>	14.5	12.7
Social	20.0	<b>12.0</b>	15.5	14.0	<b>16.5</b>	15.5	15.0
Constructability	10.0	<b>5.0</b>	5.0	2.0	<b>7.0</b>	5.0	3.0
<b>Total</b>	100.0	<b>84.1</b>	79.2	74.6	<b>89.8</b>	85.4	77.4
Recommendation		<b>O</b>			<b>O</b>		

Source: JICA Study Team

The results of these detailed alignment study for each section are shown in section 7.6.2 to 7.6.5. The recommended alignment was also shown in section 7.6.6.

## 7.6.2 Section 1

As a result of the Pre-F/S in the Master Plan, two alternative alignments were recommended – Alternative C, consisting of a continuous loop bridge, and Alternative A, detouring to avoid steep slopes with a relatively straight bridge – within a distance of about 8 km from the beginning point. In the Pre-F/S in the Master Plan with desk-based study, there was no difference from environmental and social aspects of each alternative, because the alternatives were almost same on the slope and hilly area and land was used as cultivated and bush area in section 1, and there were not so many structures. Although Alternative C was preferentially selected and its preliminary design was developed by the JICA Study Team at that time, it was concluded that it would be necessary to conduct a comparative study by adding more alternatives and select the best one through discussion with DPWH and related stakeholders. In this study, including Alternative C selected in the Pre-F/S, two more new alternative routes are added and compared with it. The outline of them is shown in Figure 7.6-1.



Source: JICA Study Team

**Figure 7.6-1 Alignments in Section 1**

- S1-ALT. A is making a detour north and climbing up gradually toward mountainous areas, like S1-ALT. B, and then going further and turning back slightly to cross a deep valley, which will lead to long-span bridge construction.
- S1-ALT. B is making a detour north and climbing up gradually toward mountainous areas, and then turning right to cross a deep valley, which will lead to long-span bridge construction.
- S1-ALT. C, renamed and proposed in the Pre-F/S, is passing through a flat terrain before hilly area comes out near where a loop bridge is situated about 100m high or higher above the ground, as shown in Figure 7.6-2.



Source: JICA Study Team

**Figure 7.6-2 Image of Loop Bridge Proposed in the Pre-F/S (Alt.C)**

The evaluation result is listed in Table 7.6-2.

**Table 7.6-2 Evaluation of Section 1**

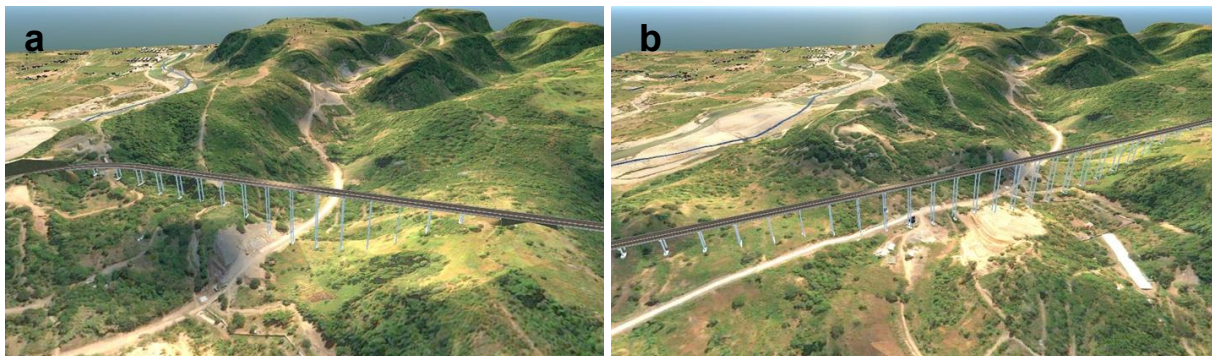
Criteria		Unit	Score	S1-ALT. A		S1-ALT. B		S1-ALT. C	
				Result	Score	Result	Score	Result	Score
Road	Drivability	-	5	No sharp curve	5.0	0.5 km long curve (R=500m)	5.0	1.8 km long curve (R=320m)	3.0
	Detour rate	-	5	1.403	0.0	1.368	0.5	1.403	0.0
	Sub total			10	-	5.0	-	5.5	-
Traffic	Traffic volume	veh./day	5	16,500	5.0	16,500	5.0	16,500	5.0
	Travel time	min	5	9.0	5.0	8.78	5.0	9.0	5.0
	Sub total			10	-	10.0	-	10.0	-
PJT Cost	Earthwork	mil. PhP							
	Medium-sized Bridge	mil. PhP							
	Long-span Bridge	mil. PhP							
	Construction	mil. PhP							
	ROW	mil. PhP							
Sub total (mil. PhP)			35						
Environmental	High Cut Section	km	5	1.2	1.0	1.1	1.0	1.0	1.0
	River Crossing	ea	5	1	5.0	1	5.0	1	5.0
	Aff. Forest	%	5	58	2.5	56	2.5	53	2.5
	Sub total			15	-	8.5	-	8.5	-
Social	Aff. Agriculture	%	5	25	4.0	27	4.0	28	4.0
	Aff. Houses	ea	15	32	12.0	32	12.0	54	10.0
	Sub total			20	-	16.0	-	16.0	-
Constructability		-	10	Bridge L=2.7 km	5.0	Bridge L=2.8 km	5.0	Bridge L=4.3 km	2.0
Total			100	1	79.5	2	75.1	3	59.9

Source: JICA Study Team

The above evaluation results are as follows.

- S1-ALT. A, like S1-ALT. B, is the route to ascend gradually toward mountainous areas and go further and turn back slightly to cross a deep valley through a long-span bridge. The long-span bridge has the superstructure made of steel box girder in the length of about 0.8 km and prestressed concrete girder or rigid frame in the length of about 0.8 km, respectively. The bridge construction costs less than that of S1-ALT. B despite of the same total length. Regarding environmental and social impacts, no difference is shown between S1-ALT. B and C.
- S1-ALT. B is the route to ascend gradually toward mountainous areas and then turn right to cross a deep valley through a long-span bridge. The long-span bridge has the superstructure made of steel box girder with the length of about 1.4 km and prestressed concrete box girder in the length of about 0.2 km. Constructing steel-type bridge may generally cost higher compared to prestressed concrete bridge, and steel box girder bridge accounts for over 80% of the total bridge length. Therefore, it may give a negative impact to the construction cost. The number of affected houses is 32, which is similar to the S1-ALT-A and less impactful than the S1-ALT-C. More than half of the proposed route passes through forests and other vegetated areas, but the other alternatives are almost identical and have comparable environmental impact.
- S1-ALT. C is consisting of a loop bridge that turns its direction around and goes up slowly about 100m high from the ground, attempting not to stay over vertical gradient to the maximum of 4%. The longitudinal line is curved at a radius of 320 m including relatively small curves on a carriageway. This may make drivability low. The superstructure of the bridge comprises largely of steel elements, and the superstructure needs to be supported on 100m high or taller piers, which implies that this may be less cost-effective and technically difficult. There are fifty-four (54) houses affected and required to be relocated, greater than those in other two alternatives. More than half of the proposed route passes through forests and other vegetated areas, but the other alternatives are almost identical and have comparable environmental impact.

As a result of the evaluation shown in table above, from a comprehensive perspective, S1-ALT. A is recommended for Section 1. However, the final bridge type will be compared in “8.5.4 Preliminary Design of Long Span Br-4 in Section-1” and the most applicable bridge type will be recommended.



Long-span Bridge on **S1-ALT. A**  
L=813 m (Steel Narrow Box Girder)  
Max. High Pier 140 m

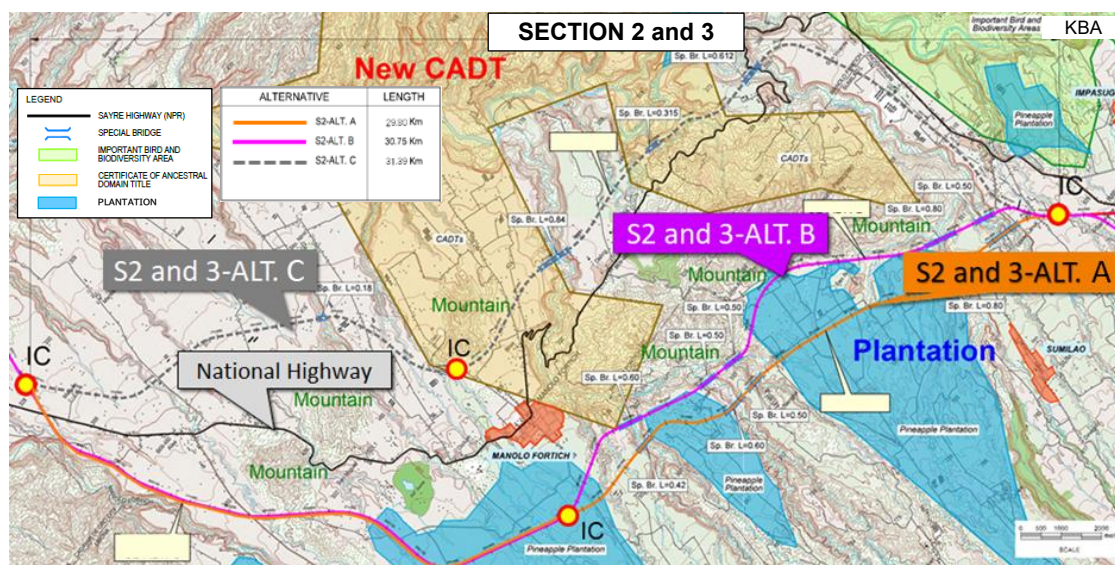
Long-span Bridge on **S1-ALT. B**  
L=1,440 m (Steel Narrow Box Girder)  
Max. High Pier 135 m

Source: JICA Study Team

**Figure 7.6-3 Steel Box Bridges on (a) S1-ALT. A (b) S1-ALT. B and in Section 1**

### 7.6.3 Section 2 and 3

The geographical features, such as mountains, hills, urban areas, plantations, farmlands, and golf courses near the existing road, are widely distributed in Section 2 and 3, and they put constraints on the alternative route planning. The outline of the alternative routes is shown in Figure 7.6-4.



Source: JICA Study Team

Figure 7.6-4 Alignment in Section 2 and 3

- S2 and 3-ALT. A is the south route going rather straighter on the flat terrain and avoiding mountains and urban areas, as well as the CADT but needs to pass through some plantation areas and CADT under application. However, passing through the CADT under application is unavoidable because of surrounding topographic conditions, so it is described about IPP in Chapter 14.
- S2 and 3-ALT. B is also the south route relatively stretching far away from the existing road and avoiding mountains and urban areas, as well as the CADT but needs to pass through some plantation areas and CADT under application. However, passing through the CADT under application is unavoidable because of surrounding topographic conditions, so it is described about IPP in Chapter 14.
- S2 and 3-ALT. C is the north route less far from the existing road, avoiding mountains and urban areas. During this study, it has been found that the new CADT is widely distributed in the northern part and S2 and 3-ALT. C is passing through parts of the CADT that consists of mostly mountainous and agricultural lands. This CADT was under review to see if it will be designated as development restriction and protection area in the time of this alignment selection study.

The evaluation result is listed in Table 7.6-3.

**Table 7.6-3 Evaluation of Section 2 and 3**

Criteria	Unit	Score	Route						
			S2 and 3-ALT. A		S2 and 3-ALT. B		S2 and 3-ALT. C		
			Result	Score	Result	Score	Result	Score	
Road	Drivability	-	5	Flat	4.0	Flat	4.0	-	-
	Detour rate	-	5	0.694	4.5	0.714	4.0	-	-
	Sub total		10	-	8.5	-	8.0	-	-
Traffic	Traffic volume	veh./day	5	18,500	5.0	18,000	4.9	-	-
	Travel time	min	5	22.72	5.0	23.35	4.9	-	-
	Sub total		10	-	10.0	-	9.8	-	-
PJT Cost	Earthwork	mil. PhP							
	Medium-sized Bridge	mil. PhP							
	Long-span Bridge	mil. PhP							
	Construction	mil. PhP							
	ROW	mil. PhP							
	Sub total (mil. PhP)								
Environmental	High Cut Section	km	5	0.8	2.0	2.2	0.0	-	-
	River Crossing	ea	5	18	4.2	18	4.2	-	-
	Aff. Forest	%	5	21	4.0	23	4.0	-	-
	Sub total		15	-	10.2	-	8.2	-	-
Social	Aff. Agriculture	%	5	74	1.5	72	1.5	-	-
	Aff. Houses	ea	15	72	8.0	61	9.0	-	-
	Sub total		20	-	9.5	-	10.5	-	-
Constructability	-	10	Bridge L=5.8 km	0.0	Bridge L=5.9 km	0.0	-	-	
Total		100	1	69.1	2	67.4	-	-	

Source: JICA Study Team

The above evaluation results are as follows.

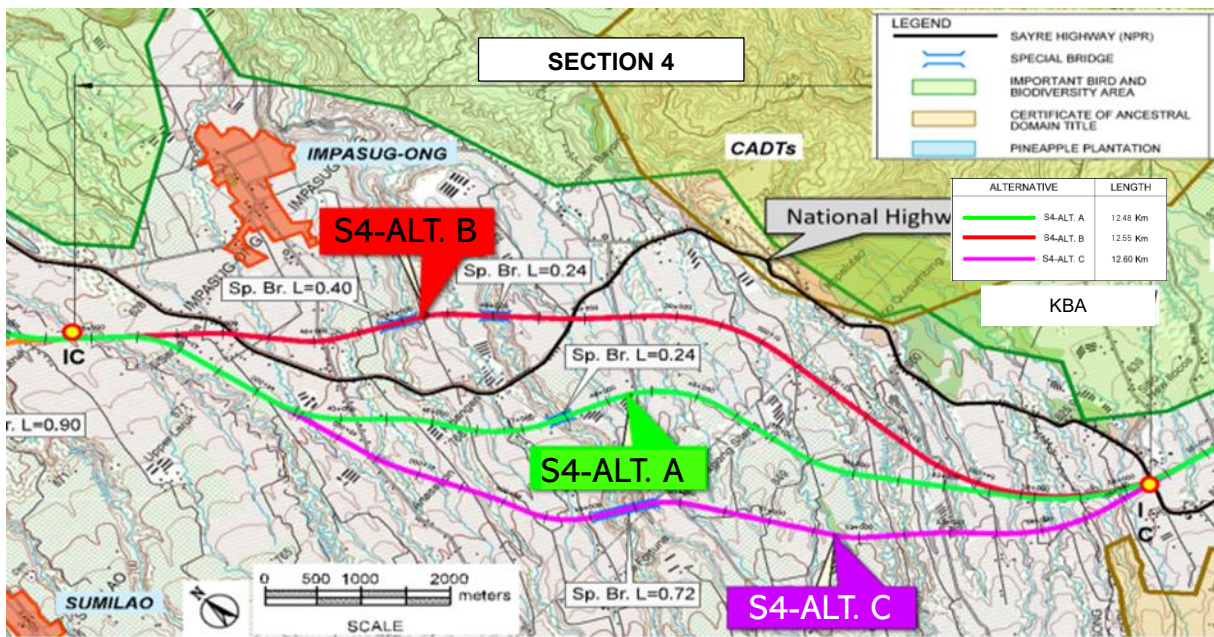
- S2 and 3-ALT. A is the south route going rather straighter on the flat terrain, showing a good drivability, and avoiding mountains and the CADT. The high cutting section is about 0.8km long, shorter than that of S2 and 3-ALT. B, and causes relatively less environmental change. The number of affected houses is 72, and is slightly higher than in S2 and 3-ALT-Proposal B.
- S2 and 3-ALT. B is also the south route going on the relatively flat terrain, showing a good drivability, and avoiding the mountainous areas and the CADT. However, there are about 2.2km long high cutting section that requires massive soil cutting work and may cause a radical change in environment and topography. The natural environment impact is high due to the major topographical changes with large scale cutting section. The number of affected houses is 61 and is slightly lower than in S2 and 3-ALT A.
- As both S2 and 3-ALT. B and S2 and 3-ALT. A require crossing deep valleys, both alternatives require the construction of long bridges: 2.9 km for S2 and 3-ALT. B and 3.2 km for S2 and 3-ALT. A. Although S2 and 3-ALT. A is slightly longer and has higher bridge costs, the project costs are the same for S2 and 3-ALT. A due to the shorter road length.

- S2 and 3-ALT. C, proposed in the Pre-F/S, is decided to be excluded from the route evaluation in this study, in order to avoid negative social impact to the people who live in the CADT.

As a result of evaluation shown in table above, from a comprehensive perspective, S2 and 3-ALT. A is recommended in Section 2 and 3.

#### 7.6.4 Section 4

In Section 4, the existing road is located close to the environmental preservation areas, Key Biodiversity Areas (KBA) and CADT – which is provisional and being applied for designation – so the alternative routes are laid out to go to the south, as shown in Figure 7.6-5.



Source: JICA Study Team

Figure 7.6-5 Alignment in Section 4

- S4-ALT. A is moving to the south from the existing road, as presented in the Pre-F/S with the purpose of improving the accessibility from the southern region.
- S4-ALT. B is going through the existing road and laid out in less curved direction, avoiding KBA and CADT areas.
- S4-ALT. C is laid out to go further southbound from the existing road and improve the accessibility to the southern region.

The evaluation result is listed in Table 7.6-4.

**Table 7.6-4 Evaluation of Section 4**

Criteria		Unit	Score	Route					
				S4-ALT. A		S4-ALT. B		S4-ALT. C	
				Result	Score	Result	Score	Result	Score
Road	Drivability	-	5	<b>Flat</b>	<b>5.0</b>	Flat	5.0	Flat	5.0
	Detour rate	%	5	<b>0.795</b>	<b>4.0</b>	0.799	4.0	0.803	3.5
	Sub total		10	-	<b>9.0</b>	-	9.0	-	8.5
Traffic	Traffic volume	veh./day	5	<b>17,400</b>	<b>5.0</b>	17,400	5.0	17,400	5.0
	Travel time	min	5	<b>9.48</b>	<b>5.0</b>	9.53	5.0	9.57	5.0
	Sub total		10	-	<b>10.0</b>	-	10.0	-	10.0
PJT Cost	Earthwork	mil. PhP							
	Medium-sized Bridge	mil. PhP							
	Long-span Bridge	mil. PhP							
	Construction	mil. PhP							
	ROW	mil. PhP							
Sub total (mil. PhP)			35						
Environmental	High Cut Section	km	5	<b>0.0</b>	<b>5.0</b>	2.0	0.0	0.0	5.0
	River Crossing	ea	5	<b>22</b>	<b>3.6</b>	16.0	5.0	21	3.8
	Aff. Forest	%	5	<b>11</b>	<b>4.5</b>	22.0	4.0	17	4.5
	Sub total			15		<b>13.1</b>	-	9.0	
Social	Aff. Agriculture	%	5	<b>84</b>	<b>1.0</b>	75.0	1.5	82	1.0
	Aff. Houses	ea	15	<b>49</b>	<b>11.0</b>	16.0	14.0	25	13.0
	Sub total			20		<b>12.0</b>	-	15.5	
Constructability		-	10	<b>Bridge L=2.6 km</b>	<b>5.0</b>	Bridge L=2.6 km	5.0	Bridge L=4.4 km	2.0
Total			100	<b>1</b>	<b>84.1</b>	2	79.2	3	74.6

Source: JICA Study Team

The above evaluation results are as follows.

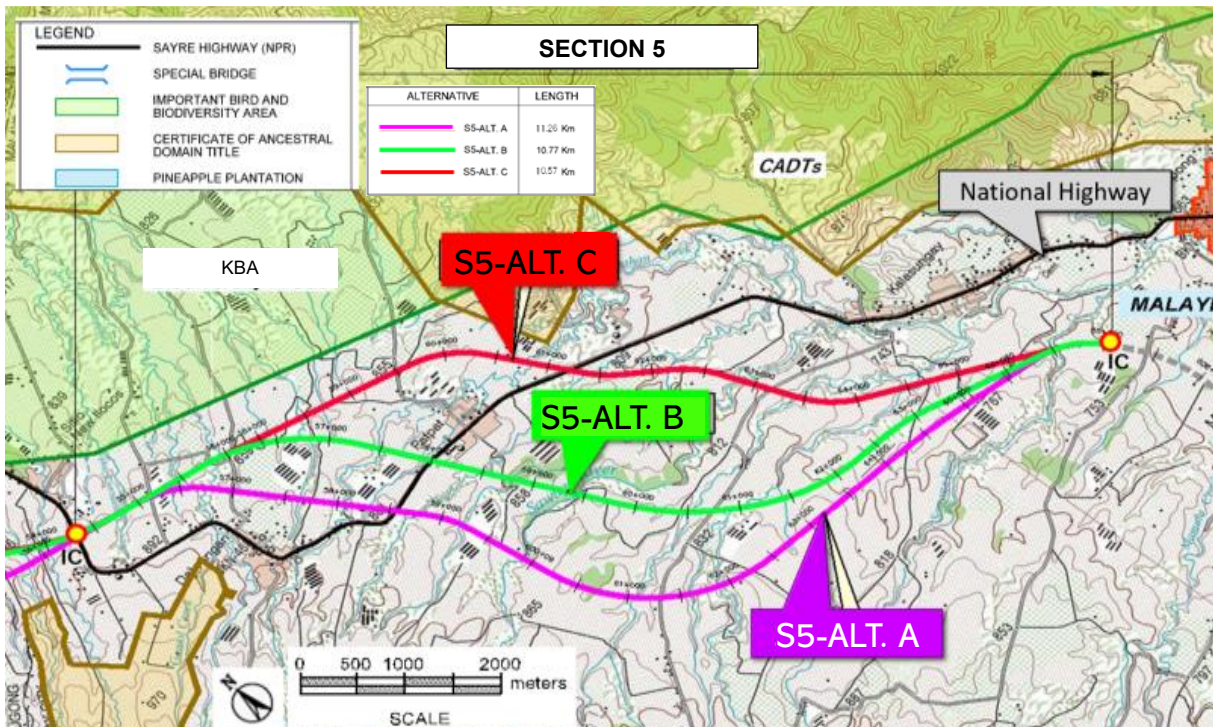
- S4-ALT. A has the total bridge length of 2.6 km, the same as S4-ALT. B has, and a long-span bridge which accounts for only 0.2 km. The project cost is less than those of both S4-ALT. B and S4-ALT. C. There is no high cutting section distributed, which gives less impact to the surroundings. The forest section to be affected is the shortest of the three alternatives. There are 49 houses affected and required to be relocated, and over 80% of agricultural land to be cultivated. The number is greater than those in other routes and its score is lowest but can be traded off with scores of project cost and environment.
- S4-ALT. B is going relatively along the existing road and crossing two long-span bridges in the length of 0.64 km and medium-sized bridge in the total length of 2.0 km. It has about 2.0 km long high cutting section that requires massive soil cutting work which may give a negative impact on the environment. There are 16 houses required to be relocated and 75% of agricultural land to be cultivated, the minimum compared to those of other two alternatives.

- S4-ALT. C detours the existing road far to the southward and no high cutting section is distributed like S4-ALT. A. The total bridge length reaches up to 4.4 km, the longest among the alternative routes, hence, the bridge construction becomes less cost-effective. The environmental impact is expected to be less than that of S4-ALT-B and about the same as that of S4-ALT-A. There are 25 houses affected and required to be relocated, which is intermediate compared to the other two proposals. More than 80% of the route is agricultural land and is expected to have about the same social impact as the S4-ALT-A. proposal.

As a result of evaluation shown in Table 7.6-4, from a comprehensive perspective, S4-ALT. A is recommended for Section 4.

### 7.6.5 Section 5

In Section 5, the environmental preservation areas, KBA and CADT, are distributed on the north, and the alternative routes are laid out to cross the existing road, as shown in Figure 7.6-6.



Source: JICA Study Team

**Figure 7.6-6 Alignment in Section 5**

- S5-ALT. A is making a detour south further and curving down to the terrain.
- S5-ALT. B, proposed in the Pre-F/S, is making a detour south and going through the existing road.
- S5-ALT. C is going straight along with the boundary of KBA and CADT and then crossing the existing road.

The evaluation result is listed in Figure 7.6-4.

**Table 7.6-5 Evaluation of Section 5**

Criteria	Unit	Score	Route						
			S5-ALT.A		S5-ALT.B		S5-ALT.C		
			Result	Score	Result	Score	Result	Score	
Road	Drivability	-	5	Flat	5.0	Flat	5.0	Flat	5.0
	Detour rate	-	5	0.84	3.5	0.804	3.5	0.789	4.0
	Sub total		10		8.5	-	8.5	-	9.0
Traffic	Traffic volume	veh./day	5	16,800	4.9	17,000	5.0	17,100	5.0
	Travel time	min	5	8.56	4.7	8.17	4.9	8.06	5.0
	Sub total		10		9.6	-	9.9	-	10.0
PJT Cost	Earthwork	mil. PhP							
	Medium-sized Bridge	mil. PhP							
	Long-span Bridge	mil. PhP							
	Construction	mil. PhP							
	ROW	mil. PhP							
	Sub total (mil. PhP)		35						
Environmental	High Cut Section	km	5	0.2	4.0	0.0	5.0	0	5.0
	River Crossing	ea	5	15	4.7	14	5.0	22	3.2
	Aff. Forest	%	5	15	4.5	18	4.5	13	4.5
	Sub total		15	-	13.2	-	14.5	-	12.7
Social	Aff. Agriculture	%	5	77	1.5	78	1.5	84	1.0
	Aff. Houses	ea	15	8	15.0	12	14.0	15	14.0
	Sub total		20	-	16.5	-	15.5	-	15.0
Constructability		-	10	Bridge L=1.9 km	7.0	Bridge L=2.9km	5.0	Bridge L=3.7 km	3.0
Total			100	1	89.8	2	85.4	3	77.4

Source: JICA Study Team

The above evaluation results are as follows.

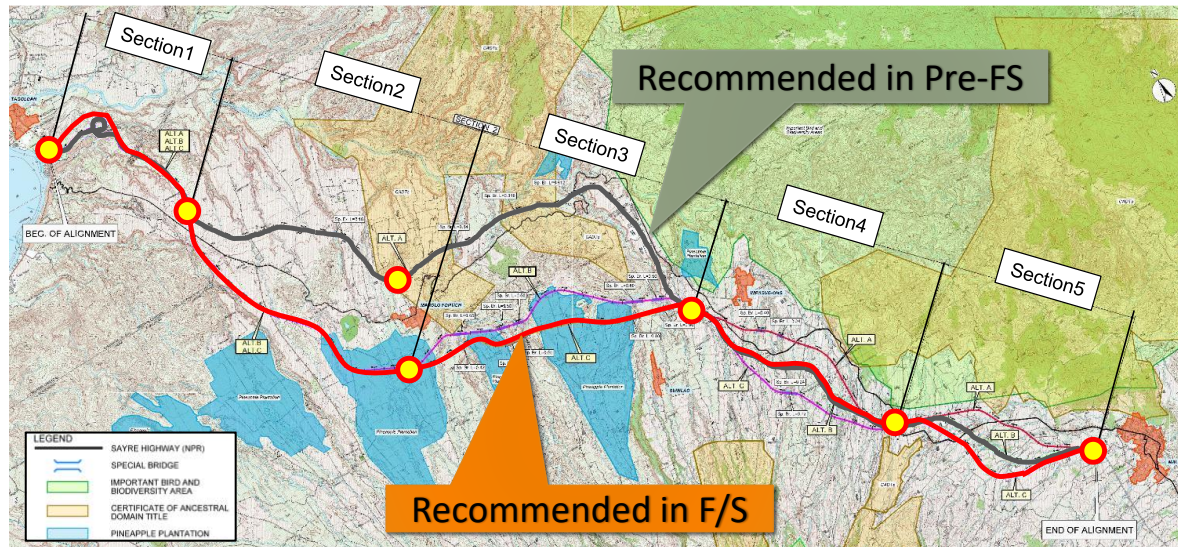
- S5-ALT. A has medium-sized bridges in the total length of 1.9km and the bridge construction cost is the least among the three routes. As for the natural environment, there is no high cuttings sections, this route is assessed as average of three alternatives. As for the social aspect, more than 80% of the route is agricultural land and the social impact is expected to be about the same as the S5-ALT-B, but the number of affected houses (8) is the lowest of the alternatives.
- S5-ALT. B has medium-sized bridges in the total length of 2.9 km and the bridge construction cost is the second largest, compared with those of other two alternatives. As for the natural environment, this plan is the highest evaluation of the three proposals, as there are few river crossings and no high cuttings. As for the social aspect, more than 80% of the route is agricultural land and the social impact is expected to be about the same as the S5-ALT-A proposal, and the number of affected houses (12) is about the average of the three alternatives.
- S5-ALT. C has medium-sized bridges in the total length of 3.7 km and the bridge construction cost is the largest, compared with those of other two alternatives. As for the natural environment, the forest affected section is the shortest, but there are more river crossings, which is the lowest rated

of the three alternatives. The impact on agricultural land and the number of affected houses (15) are the highest among the three alternatives.

As a result of evaluation shown in Figure 7.6-4, from a comprehensive perspective, S5-ALT. A is recommended for Section 5.

### 7.6.6 Summary of Alignment

The selected alternative route under this F/S is passing toward south direction with a total length of 64.7 km and having a total of 161 houses affected to be relocated.



Source: JICA Study Team

Figure 7.6-7 Recommended Alignment

