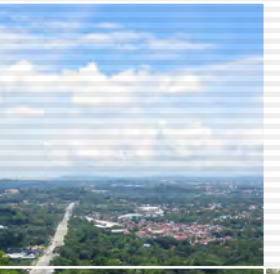
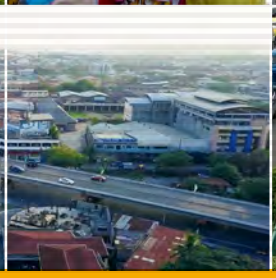
Republic of the Philippines
National Economic and Development Authority (NEDA)
City Government of Davao

Davao City Infrastructure Development Plan and Capacity Building Project






Final Report Vol. 2

Part II Development Plan
Part III Capacity Development

IM4Davao
Infrastructure Modernization for Davao City

June 2018

Japan International Cooperation Agency

ALMEC Corporation
Oriental Consultants Global Co., Ltd.
EX Research Institute Ltd.

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JR
18-076

Japan International Cooperation Agency (JICA)
National Economic and Development Authority (NEDA)
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DAVAO CITY INFRASTRUCTURE DEVELOPMENT PLAN AND CAPACITY BUILDING PROJECT

IM4Davao

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Exchange Rate

USD1 = JPY112.1575

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Average of JICA Rate from
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ABBREVIATIONS

AAII	Apo Agua Infrastructure Inc.
ABCD	Act for Beautiful and Clean Davao
ACDI-VOCA	Agricultural Cooperative Development International and Volunteers in Overseas Cooperative Assistance
ADB	Asian Development Bank
AI	artificial intelligence
ANFLOCOR	ANFLO Management and Investment Corporation
AP	action plan
ARMM	Autonomous Region in Muslim Mindanao
ASEAN	Association of Southeast Asian Nations
B2B	business to business
BAWASA	Barangay Waterworks and Sanitation Association
BBL	Bangsamoro Basic Law
BCCAD	Barangay and Cultural Communities Affairs Division
BCWCC	Barangay Callawa Women Consumers Cooperative
BIMP-EAGA	Brunei Darussalam-Indonesia-Malaysia-Philippines East ASEAN Growth Area
BLT	build–lease–transfer
BMBE	Barangay Micro Business Enterprise
BNR	business name registration
BOC	Bureau of Customs
BOD	biochemical oxygen demand
BOI	Board of Investments
BOT	build-operate-transfer
BPO	business process outsourcing
BRT	bus rapid transit
CAAP	Civil Aviation Authority of the Philippines
CADT	Certificate of Ancestral Domain Title
CAGR	compound annual growth rate
CAO	City Agriculturist's Office
CAR	Cordillera Administrative Region
CBD	Central Business District
CBFMA	Community-Based Forest Management Agreement
CCA	climate change adaptation
CCDO	City Cooperative Development Office
CDA	Cooperative Development Authority
CDITE	Council of Deans in ITE Education
CDP	Comprehensive Development Plan
CDRRMO	City Disaster Risk Reduction and Management Office
CENRO	City Environment and Natural Resources Office
CEO	City Engineers' Office
CFS	container freight station
CHED	Commission on Higher Education
CHO	City Health Office
CICSMIN	Cacao Industry Council of Southern Mindanao
CIDAMI	Cacao Industry Development Association of Mindanao, Inc.
CIO	City Information Office
CITES	Convention on International Trade of Endangered Species of Wid Fauna and Flora
CLUP	Comprehensive Land Use Plan
COCOPEA	Coordinating Council for Private Educational Associations
C.O.R.E.	Comprehensive Outcomes for Rural Empowerment
CPDO	City Planning and Development Office
CPFC	Central Pacific Fishery Commission
CSO	Civil Society Organization
CTOO	City Tourism Operations Office

CTTMO	City Transport and Traffic Management Office
DA	Department of Agriculture
DACS	Davao Association of Catholic Schools
DATC	Davao Agricultural Trading Center
DACUN	Davao Colleges and Universities Network
DAPTC	Davao Agri-Processing and Trading Center
DBM	Department of Budget and Management
DBP	Development Bank of the Philippines
DBR	Davao Basin River
DBWSS	Davao bulk supply system
DCAQMN	Davao City Air Quality Monitoring Network
DCIPC	Davao City Investment Promotion Center
DCWD	Davao City Water District
DENR	Department of Environment and Natural Resources
DEO	District Engineering Office
DepEd	Department of Education
DFC	Davao Food Complex
DFPC	Davao Fish Port Complex
DFTC	Davao Food Terminal Complex
DGADP	Davao Gulf Area Development Plan
DIA	Davao International Airport
DICT	Davao International Container Terminal
DID	densely inhabited districts
DIDP	Davao Integrated Development Program
DILG	Department of the Interior and Local Government
DIPSS	Davao Integrated Port and Stevedoring Services, Inc.
DLPC	Davao Light and Power Company
DMA	District Metering Areas
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
DRR	disaster risk reduction
DREAM	Disaster Risk Exposure and Assessment for Mitigation Program
DRPFP	Davao Regional Physical Framework Plan
DRSDF	Davao Region Spatial Development Framework
DSWD	Department of Social Welfare and Development
DTAP	Davao Tourism Access Program
DTI	Department of Trade and Industry
DTI XI	Department of Trade and Industry-Region XI
EAGA	East ASEAN Growth Area
EC	electric cooperative
EEZ	Exclusive Economic Zone
EIA	environmental impact assessment
EMB	Environmental Management Bureau
EMB-DENR	Environmental Management Bureau of the Department of Environment and Natural Resources
EPZ	Export Processing Zone
EV	electric vehicle
EVAP	Electric Vehicle Association of the Philippines
FBIA	Federal Bug Intelligence Agency
FDA	Food and Drug Administration
FDI	foreign direct investment
FIES	Family Income and Expenditure Survey
FIT	Feed in Tariff
FLUPs	Forest Land Use Plans

FMR	farm-to-market road
FPAD	Food Processors Association of Davao
FTE	full time employee
FTZ	Free Trade Zone
G2G	government to government
GAP	Good Agricultural Practice
GBE	Grading and Baling Establishments
GDP	gross domestic product
GFI	Government Financing Institutions
GIS	geographic information system
GRDP	gross regional domestic product
GPS	global positioning system
GRDP	gross regional domestic product
GSCFP	General Santos City Fish Port
GSFPC	General Santos Fish Port Complex
GVA	gross value added
HACCP	hazard analysis and critical control point
HCV	heavy commercial vehicles
HEI	higher education institution
HIP	Hiro International Port
HIPS	Hijo International Port Services, Inc.
HIS	Household Interview Survey
HLURB	Housing and Land Use Regulatory Board
HMI	human machine interface
HRC	Hijo Resources Corporation
HRD	human resource development
HSHN	High Standard Highway Network
HUC	highly urbanized cities
IASCS	Inter-Agency Steering Committee on SEA
iBPAP	IT-Business Processing Association of the Philippines
IC/R	Inception Report
ICC	Investment Coordinating Committee
ICCs	Indigenous Cultural Communities
ICCs/IP	Indigenous Cultural Communities / indigenous peoples (ICCs/IP)
ICS	integrated computer systems
ICT	information and communication technology
ICT-BPO:	information and communication technology-business process outsourcing
ICTO	Information and Communication Technology Office (of DOST)
ICTSI	International Container Terminal Services, Inc.
IE	industrial estate
IEC	Information, Education, Communication
IEE	initial environmental examination
IFC	International Finance Corporation
IGACOS	Island Garden City of Samal
IIC	Investment Incentives Code
IPs	indigenous peoples
IPP	individual power producer
IRA	internal revenue allotment
IRR	internal rate of return
IS	informal settlers
JBIC	Japan Bank for International Cooperation
JCM	joint committee meeting
JCCM	Japanese Chamber of Commerce in Mindanao
JICA	Japan International Cooperation Agency
JPT	JICA Project Team
JTIR	Japan Tourism and Investment Roadshow
JV	joint venture
JVA	joint venture agreement

JVACC	JV Angeles Construction Corporation
KDZ	Key Development Zone
KEC	Korea Engineering and Construction
KECC	Korea Engineering and Construction Corporation
KPO	knowledge process outsourcing
KSA	knowledge, skill and attitude
LBP	Land Bank of the Philippines
LCCAP	Individual Climate Change Action Plan
LCL	less container load
LCV	light commercial vehicles
LDC	Local Development Council
LGU	local government unit
LoLo	lift-on lift-off
LPDHI	Lanang Premiere Doctors Hospital, Inc.
LTFRB	Land Transportation Franchising and Regulatory Board
LTO	Land Transportation Office
LTO XI	Land Transportation Office-Region XI
LUCEM	land use capability and environmental management
LWUA	Local Water Utilities Administration
M&E	monitoring and evaluation
MAWASA	Manambulan Waterworks and Sanitation Association
MDFO	Municipal Development Fund Office
MERALCO	Manila Electric Co.
METI	Ministry of Economy, Trade and Industry (of Japan)
MGB	Mines and Geosciences Bureau
MHHW	mean higher high water
MHW	mean high water
MICE	meetings, incentives, conventions and exhibitions
MinDA	Mindanao Development Authority
MLIT	Ministry of Land, Infrastructure, Transport and Tourism
MLLW	mean lower low water
MLW	mean low water
MNC	multinational corporation
MMBFOE	million barrels of fuel oil equivalent
MNC	multinational company
MNF	minimum night flow
MOA	Memorandum of Agreement
MOFA	Ministry of Foreign Affairs of Japan
MOU	Memorandum of Understanding
MRF	material recovery facility
MSL	mean sea level
MSME	micro, small and medium enterprise
MSS/DF	Mindanao Spatial Strategy/ Development Framework
MSW	municipal solid waste
MT	metric ton
MTOE	million tonne of oil equivalent
NABCOR	National Agribusiness Corporation
NAMRIA	National Mapping and Resource Information Authority
NCCAP	National Climate Change Action Plan
NCR	National Capital Region
NDC	National Development Company
NDRRMC	National Disaster Risk Reduction and Management Council
NEDA	National Economic and Development Authority
NEDA CO	National Economic and Development Authority Central Office
NEDA ICC	NEDA Investment Coordinating Committee
NEDA XI	National Economic and Development Authority Region XI
NFSCC	National Framework Strategy on Climate Change
NG	national government

NGA	National Government Agency
NGO	Non-Government Organization
NIA	National Irrigation Administration
NICT	National ICT Confederation of the Philippines
NIPAS	National Integrated Protected Areas System
NPC	National Power Corporation
NOAH	Nationwide Operational Assessment of Hazards Project
NPFP	National Physical Framework Plan
NPO	non-profit organization
NREB	National Renewable Energy Board
NREP	National Renewable Energy Program
NRO XI	NEDA Regional Office XI
NRW	Non-Revenue Water
NSCB	National Statistics Coordination Board
NSO	National Statistics Office
NSS	National Spatial Strategy
NWRB	National Water Resources Board
OCPDC	Office of the City Planning and Development Coordinator
OCSP	Open and Competitive Selection Process
OD	origin–destination
ODA	official development assistance
OECF	Overseas Economic Cooperation Fund
OJT	on-the-job-training
OSFMC	One Stop Facilitation and Monitoring Center
OSM	open street map
OSS	one stop shop
OTP	off-take point specification
PAMBs	Protected Areas Management Boards
PAPs	programs, activities and projects
PAWD	Philippine Association of Water Districts
PBAC	Prequalification Bid and Award Committee
PCSO	Philippine Charity Sweepstakes Office
PCU	passenger car unit
PDCA	plan-do-check-action
PDP	Philippine Development Plan
PEMSEA	Partnerships in Environmental Management for the Seas of East Asia
PEP	Philippine Energy Plan
PEZA	Philippine Economic Zone Authority
PFDA	Philippine Fisheries Development Authority
PFI	private finance initiative
PHILEXPORT	Philippine Exporters Confederation, Inc.
PhilFIDA	Philippine Fiber Industry Development Authority
PhilHealth	Philippine Health Insurance Corporation
PHIVOLCS	Philippine Institute of Volcanology and Seismology
PHP	Philippine peso
PIC	Project Implementation Committee
PLC	programmable logic controller
PNP	Philippine National Police
PNSDW	Philippine National Standards for Drinking Water
PPA	Philippine Ports Authority
PPP	public-private partnership
PR/R	Progress Report
PSA	Philippine Statistical Authority
PSITE	Philippine Society of IT Educators
PSSCC	Public Safety and Security Command Center
PTVEA	Private Technical Vocational Educators Association
PUB	public utility bus
PUD	planned unit development

PUJ	public utility jeepney
PUV	public utility vehicle
QSGC	quay side gantry crane
R&D	research and development
RD&D	research, development and demonstration
RDC	Regional Development Council
RHU	rural health unit
RoPAX	roll on/roll off passenger vessel
RoRo	roll-on roll-off
RPS	renewable portfolio standard
RTG	rubber-tired gantries
S&T	science and technology
SAFDZ	Strategic Agriculture and Fishery Development Zone
SBF	Singapore Business Federation
SC	supply chain
SCA	septage collection area
SCADA	supervisory control and data acquisition
SEA	strategic environmental assessment
SEC	Securities and Exchange Commission
SEZ	special economic zone
SGMP	Strategic Growth Management Plan
SGR	smart green resilient
SME	small and medium enterprise
SMFI	San Miguel Foods Inc.
SOPA	Special Order for Project Assignment
SWIP	small water impounding project
SWITKIDS	Summer Workshop for IT for Kids
SWM	solid waste management
TADECO	Tagum Agricultural Development Company
TCC	Traffic control center
TDZ	Tourism Development Zone
TDD	Tagum-Davao-Digos
TDZ	Tourism Development Zone
TEFASCO	Terminal Facilities and Services Corporation
TESDA	Technical Education and Skills Development Authority
TEU	twenty-foot equivalent unit
TIEZA	Tourism Infrastructure and Enterprise Zone Authority
TOD	Transit-oriented development
TRB	Toll Regulatory Board
TRE	tourism related establishment
TRIAD	Three Ridges Integrated Area Development
TRIP	Three-Year Rolling Infrastructure Program
UPMin	University of the Philippines Mindanao
USAID	United States Agency for International Development
USD	United States dollar
UV	utility vehicles
VC	value chain
VA	Value analysis
VE	value engineering
VECO	Visayan Electric Company
VICSMIN	Vegetable Industry Council of Southern Mindanao
VM	value management or value methodology
VPN	virtual private network
WB	World Bank
WQMA	water quality management area
WSC	Water and Sanitation Council
WTE	waste-to-energy

PART II DEVELOPMENT PLAN

8 DEVELOPMENT FRAMEWORK

8.1 The Higher-Level Development Plans and Physical Framework Plans

8.1 This section provides an overview on the higher-level government plans and strategies that were formulated in consideration of the roles of the different national agencies and hierarchical layers of local government units (LGU) with their physical, social, and economic contribution to national growth. The development framework for Davao City takes its cue from these plans for a synchronized national and regional growth direction.

1) The National Physical Framework Plan 2016–2045 and Philippine Development Plan 2017–2022

8.2 An integrated national land use policy agenda guiding the development, use, and management of the physical resources of the country is set out on a long-term plan horizon unlike the economic plans that take the medium term of 5-year plan period cycle. The physical framework plan formulated and contained in the National Physical Framework Plan (NPFP) for 2001–2030 has been updated for the 2016–2045 period.

8.3 The Philippine Development Plan (PDP) 2017–2022, on the other hand, is a medium-term economic plan carrying a long-term vision for the country under the banner of “AmBisyon Natin 2040.” Targets were set to bring the country to an upper-middle nation status by 2022, which are to be achieved by a stronger gross domestic product (GDP) growth of 7% to 8%, lowered poverty rate from 21.6% to 114%, and reduced unemployment rate from 5.5% to 3% to 5%. The targets also include higher trust in the government and society as well as increasing resilience of individuals and communities.

8.4 On the direction for future growth, the PDP 2017–2022 adheres and supports the National Spatial Strategy (NSS), recognizing that population, geography, and cities are engines of economic growth. Davao City as the largest city in Mindanao Island has a crucial role in the "Build-Build-Build Program" of the Duterte Administration.

2) The National Spatial Strategy

8.5 The NSS, which is the core spatial strategy of the NPFP and laid out by the national government for its spatial development, highlights the contribution of cities to economic growth and poverty reduction through the provision of infrastructures to connect networks of sustainable communities. The main strategy is one of "national dispersion through regional agglomeration" using transportation and telecommunications as key sectors to support growth by providing accessibility and integration among production and settlement areas.

8.6 A network of settlements was identified throughout the country that consists of metropolitan, regional, sub-regional, provincial, and local centers. The metropolitan centers serve as the economic and administrative core of the three main island groups of the country. Metro Davao was identified as a major international gateway and Mindanao's premier commercial hub and center for education and health services. It is eyed as a place with higher forms of services and facilities domestically.

3) The Mindanao Spatial Strategy / Framework Plan 2015–2045

8.7 The Mindanao Spatial Strategy / Framework Plan 2015–2045 was formulated consistent with NSS. Its vision is a peaceful, safe, resilient, and socially-inclusive

Mindanao of diverse cultures harmoniously enjoying a sustainable and competitive agro-industrial economy. The plan, therefore, is aimed to improve productivity of all sectors; ensure access to adequate and quality basic and social and infrastructure services; enhance connectivity among production areas, markets and settlements; increase disaster resiliency of communities; ensure integrity of the environment; and forge various peace efforts. The overall strategy of the plan is for Mindanao to pursue its positioning as the country's agro-industrial center by adopting a multi-nodal spatial development strategy and the multi-polar network of settlements.

8.8 The Mindanao Spatial Strategy/Framework Plan tied its development strategies (consistent to the NSS) to the challenges facing the multitudes of LGUs in the Mindanao group of islands. The challenges and corresponding strategies fixed on concentration, connectivity and vulnerability reduction.

8.9 The spatial strategy identifies Davao as a Metropolitan Center for the island economy of Mindanao. Davao is envisioned to serve as the island's principal administrative, financial, and commercial hub. The regional centers are Cagayan de Oro City (metro area by 2025), General Santos City (metro by 2035) and Zamboanga City (metro by 2045). Mindanao's integration with the rest of the country and the world will be possible with these four gateways.

4) The Davao Region Spatial Development Framework 2015-2045 and Updated Regional Physical Framework Plan XI

8.10 As the regional level spatial plan formulated by NEDA XI, the Davao Region Spatial Development Framework (DRSDF) for the period 2015–2045 focuses on the NSS principles of concentration, connectivity, and vulnerability reduction. In the plan, Davao Region is envisaged at the logistics hub of Southern Philippines, resilient and with a rich biography, a haven for human growth and development. Moreover, the framework defines the space where the initiatives under Davao Regional Development Plan can be pursued.

8.11 The DRSDF identified Davao City as the regional center of Region XI and the city carries the role as the seat of regional government administration, political, and industrial center. The adjacent cities of Tagum, Panabo, and Digos were identified as the sub-regional and secondary urban growth and trade centers. The municipalities of Sta. Cruz and Carmen were designated provincial centers based on population size and economic activities. As such, these contiguously connected LGUs form a high growth corridor and carry the metropolitan influence that connects them to national and international trade centers. Hence, a metropolitan functional role of the agglomerated area is proposed for Region XI. The proposed Metro Davao Governance Framework and Structure that shall provide an institutional framework for successful planning and implementation of the metropolitan area. However, a metropolitan alliance among the LGUs is only implied at the moment and a formal understanding and recognition still has to be formed.

8.12 The updated Regional Physical Framework Plan XI (DRPFP), on the other hand, elaborates on strategies for the spatial development of the region. The previous DRPFP was set for implementation some time ago for the period 2003–2030. This has been updated recently for the period 2015–2045 to reflect current changes in the region's spatial dimensions and adopt the national government's focus from disaster response to disaster mitigation in all sectors. This entails the planning for resilient communities by the local

government.

8.13 The comprehensive land use plans of the provinces, cities, and municipalities are expected to set their spatial development directions on the DRSDF and DRPFP.

5) The Davao Region Development Framework 2017-2022

8.14 In the infrastructure chapter of the DRDP, 2017-2022, Davao City plays a critical spatial role in the achievement of the development outcomes of the Davao Region in the medium to long-term period. The strategies include:

(a) Institutionalize the planning, designing and construction of infrastructure facilities with disaster-resilient standards (Sustainable Development Goal 9 – Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation);

(b) Design and implement infrastructure facilities that reduce (if not eliminate) gender issues and achieve gender equality results, as well as enhance the mobility of the senior citizens and persons with physical disability;

(c) Integrate in the design and implementation of infrastructure facilities that will promote Filipino arts, culture and values; and

(d) Enhance the financial, technical and overall management capacity of the city for an integrated approach to the development, implementation, operation and maintenance of its road, water, and sewerage network of facilities and services.

6) Future Governance Platforms

8.15 There are some proposed or pending initiatives under the current administration that would have great bearing on the future platform for the implementation of development plans for Davao City and the whole country, if and when these are to be realized.

8.16 It has been a known that President Duterte is a strong advocate of a Federalism type of government. This political system embodies two orders of government; the central government and the regional governments. Both will function with different autonomous responsibilities. As such, the regions will self-rule. This is in keeping with President Duterte's promise to people in southern Philippines that regions outside Metro Manila will receive their fair share of budgets from the national government. He believes that self-rule is the key to bringing peace in Mindanao. An attempt to lay the timeline for this possibility with the initiative moving forward could see a plebiscite occurring in 2019. If all goes positively well, then the first election of officials of states and federal government could happen in 2022.[1] However, history has witnessed this movement to drag on due to the intricacies of establishing another form of democratic government.

8.17 On the regional scene, the creation of a Davao Gulf Development Authority (HB 6339) is with the House of Representatives and has gone through a first reading in September 2017. It will pave the way to the Davao Gulf Special Economic Freeport Zone and the Island Garden City of Samal as an Ecotourism Zone. Among others, it will harness the Davao Gulf sea lanes as an alternative transport system for redundancy purposes.

[1] Martial Law and Duterte's Quest for Federalism, *Chester Cabalza, Ph.D.*, May 2017.

8.2 The Project—Its Role and Strategies

8.18 The Comprehensive Land Use Plan (CLUP) of Davao City shows the city's roles under different viewpoints as follows:

8.19 **International Role:** Davao City, when fully developed, could serve as a center for manufacturing and services for the EAGA economic influence area with special reference to Indonesia, Malaysia, Brunei, Papua New Guinea, Guam, Australia, and New Zealand.

8.20 **National Role:** The National Framework Plan envisions the development of Davao City as the metropolitan center in Mindanao. The premier city in the south is designated as one of the priority areas for investment and location for the dispersal of commerce and industries. The rationale behind this is to achieve a balanced development and promote regional equity in the country. Furthermore, the city has been designated as one of the major tourist destinations in the country.

8.21 **Regional Role:** Davao City is the regional capital of Region XI and the established government center of the region. It is also the center of services, education, recreation, commerce, and industry in the area. Likewise, Davao City is also the center of transportation and communication in Region XI. Major road and communication systems lead to or originate from the place.

8.22 There are other visioning statements among local stakeholders. For instance, at the regional level, Davao City is seen to play a major role in realizing the region's vision as the nation's "Rising Global Frontier" propelled by a modern and competitive agriculture sector supported by highly competitive industry and services sectors, as well as the "Logistics Hub of Southern Philippines." The city is also working towards becoming the "Chocolate Capital of the Philippines" and the "durian town," highlighting on their local agricultural products.

8.23 The IM4Davao project has its prime objective of crafting an urban infrastructure development plan for Davao City with a priority project list, which will ultimately improve the city's competitiveness and security from disasters and general urban conditions. The second objective is the capacity enhancement for the planning and implementation of infrastructure development. The urban infrastructure development for Davao City actually abides with the current central government's "Build-Build-Build Program".

8.24 In order to realize any of the abovementioned vision statements, this infrastructure development plan must be the driving force. As such, the project was branded with a catch phrase of "Infrastructure Modernization for Davao (IM4Davao)" to give stress to the movement.[2]

8.25 The project focused on four strategies to amplify the selected nickname under an urban planning context. These are dynamic, distinguishable, diversified, and decentralized development.

8.26 **Dynamic Development:** The project's infrastructure modernization plan strengthens the resolve of the city to shift from the existing mono-centric urban structure to a robust city center with a poly-centric urban structure. High standard infrastructure such as trunk roads and bridges, inter-city and urban railways, gateway seaport, and airport, shall make it happen in a dynamic manner. Dynamism is in the form of a modern water

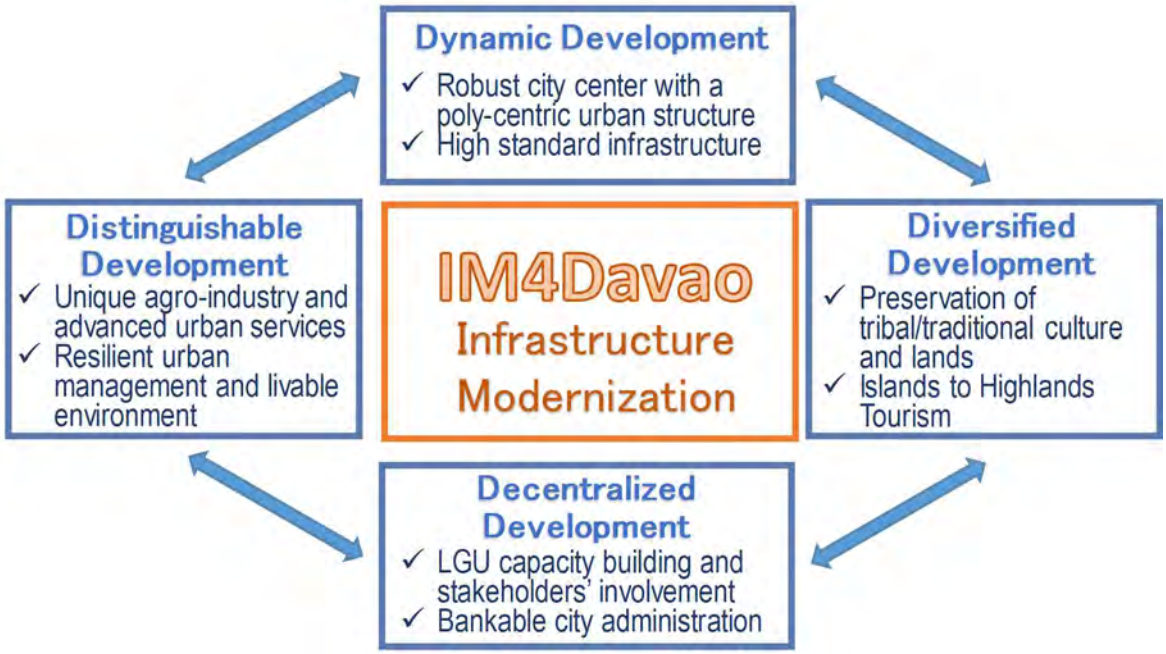
[2] The branding resulted from a project naming competition conducted in May 2017. The winning entry was awarded to a local high school student.

supply that looks toward the development of the surface water supply rather than numerous deep wells as well as upgrading services in the urban areas through the efficient and environmental friendly management of storm water, wastewater, septage and solid waste in the city. A robust city center shall attract unprecedented investments to the city while a poly-centric urban structure with several growth centers connected by a strong transport network shall mitigate traffic congestions.

8.27 **Distinguishable Development:** The project's infrastructure modernization gives more uniqueness to Davao City's economic activities and citizen's urban life. A combination of gateways and well-designed road network will enable agro-industry and manufacturing activities at many places in the city. Additionally, urban rail system shall foster growth centers beside the city center where advanced urban services such as ICT can accumulate. Permanent embankment of major rivers such as the Davao River in association with the river boulevard and recreational park shall change the area to be disaster resilient and provide a unique urban amenity. Such local potentials and issues shall be addressed in the project's infrastructure modernization for a distinguishable city development.

8.28 **Diversified Development:** Davao City has vast forest lands and massive agricultural lands forming the rural areas where many tribes and traditional communities reside with their own cultures. In order to realize diversified development, both in the urban and rural areas, the project's infrastructure modernization plan provides modest infrastructure in the rural areas for the local people to meet a level of subsistence without urbanization pressure. An adequate land use guideline was complementarily designed to delineate urban and rural areas for the future. Orderly urbanization is promoted in the former area while new development with an immigrant inflow is controlled in the latter area. As a result, the tribal and traditional culture and society will be preserved. The rural areas were provided with its share of necessary infrastructure to promote tourism as long as it coexists in the local environment. "Highlands to islands" tourism is a big advantage of Davao City when receiving international and domestic tourists**.**

8.29 **Decentralized Development:** Since capacity building to plan and implement infrastructure development is the second objective of the project, the LGU capacity building and stakeholders' involvement in planning and project implementation were conducted. Infrastructure development requires a huge investment in the case of Davao City. The LGU must tap central government funds including ODA grant and loan, and the PPP program as an opportunity for local development financing to large or technically difficult infrastructure projects while private investment can be the funding source for some profitable projects. Bankable city administration shall be kept through the best mix of development funds.



Source: IM4Davao Team

Figure 8.2.1 The Project with 4D Strategies

8.3 Socio-Economic Framework

1) Metro Davao

8.30 The socio-economic considerations on infrastructure development decisions are primarily hinged on looking forward to serving future populations. The Regional Physical Framework Plan formulated by NEDA XI for 2015 to 2045 took stock of the growth situation and trends in a wider area. It saw the role of Davao City as the metropolitan center of the region and has aptly worked out the population of the member provinces and Davao City until 2045 at a higher aggregation (Table 8.3.1). Davao City holds a large portion of the region's population at 34% by 2025 and would increase to 37% by 2045.

Table 8.3.1 Projected Population, Davao Region, 2015–2045

Province/City		2015	2025	2035	2045
1	Compostela Valley	745,855	885,712	1,048,977	1,242,336
2	Davao del Norte	1,066,461	1,356,028	1,724,214	2,192,372
3	Davao del Sur	929,471	1,064,087	1,218,197	1,394,627
4	Davao Oriental	557,516	646,775	750,323	870,446
5	Davao City	1,629,045	2,058,190	2,600,382	3,285,400
Total Davao Region		4,926,686	5,988,649	7,279,518	8,848,635

Source: Basic Primary Data: PSA; as presented in the Regional Physical Framework Plan 2015–2045

8.31 Six adjoining LGUs to Davao City belong to either Davao del Norte (Tagum City, Carmen, Panabo City and Samal City) or Davao del Sur (Santa Cruz and Digos City). Due to its proximity to Davao City, those LGUs are expected to increase population than their provincial average (refer to Table 8.3.2).

8.32 A new bridge between Davao City and Samal Island will be able to overcome current ferry service restriction across the Pakiputan Strait due to giving priority to mainline vessels to pay port-of-calls to Sasa Port and others and boost residential development and marine tourism development in Samal Island. Although unprecedented urbanization is expected in the island through a bridge, it is difficult to foresee its development impact.

8.33 In the Philippines, a development impact was observed between Cebu and Mactan Islands since 1975 when the first bridge was built and connected the islands. Obviously, the population of Lapu-Lapu City in Mactan Island jumped up at an annual growth rate that ranged from 4.0% to 5.5% between 1975 and1995 compared with 2.8% in the early 1970s. The first bridge reached its capacity and city population growth staggered at 2.4% yearly in the late 1990s. But island development spurred again after the second bridge started its operation in 1999. During the same period, Cebu City or the mother town of Lapu-Lapu City showed quite a different population curve. Due to the proximity of Samal Island to Davao City center area, it is highly plausible that a new bridge might bring similar accelerated development in the island.

Table 8.3.2 Population Projection of Metro Davao, 2015–2045

Province/City		2015 (actual)	2030	2045	AAGR (2015–2045)
Davao del Norte		1,066,461		2,192,372	2.431
1	Panabo City	184,599	284,997	440,000	2.938
2	Samal City	104,123	185,366	330,000	3.920
3	Carmen	74,697	109,323	160,000	2.572
4	Tagum City	259,444	374,299	540,000	2.474
Sub-total (1–4)		622,863	953,986	1,470,000	2.904
Davao del Sur		928,471		1,218,197	0.909
5	Sta Cruz	90,987	112,864	140,000	1.447
6	Digos City	169,393	209,862	260,000	1.438
Sub-total (5–6)		260,380	322,726	400,000	1.441
7	Davao City	1,629,045	2,313,456	3,285,400	2.366
Metro Davao (1–7)		2,512,288	3,590,167	5,155,400	2.425

Note: AAGR – Average Annual Growth Rate
Source: IM4Davao Team

Table 8.3.3 Population Records of Lapu-Lapu City and Cebu City, 1970–2015

Year	Lapu-Lapu City		Cebu City		Remarks
	Population	AAGR	Population	AAGR	
1970	69,268		347,116		
1975	79,484	+2.80	413,025	+3.55	1st bridge opened in 1975
1980	98,324	+4.34	490,281	+3.49	
1990	146,194	+4.05	610,417	+2.22	
1995	194,745	+5.52	662,299	+1.54	
2000	217,019	+2.35	718,821	+1.77	
2007	292,530	+4.20	799,762	+1.48	2nd bridge opened in 1999.
2010	350,467	+6.80	866,171	+2.95	
2015	408,112	+2.94	922,611	+1.21	

Source: PSO

(Left) 1st Mactan Bridge
(Right) 2nd Mactan Bridge

Source: IM4Davao Team

Figure 8.3.1 Mactan Bridges

2) Davao City

(a) Future Urban Population

8.34 There are basically two general development direction options for Davao City that were assumed to establish the socio-economic framework for the growth of the city. These are as follows:

8.35 **Option 1:** Assume current urban growth trend and development management will continue as the current trend. This means high density at the administrative districts of the Poblacion and Talomo, and urban cores of Toril, Calinan, Tugbok, Buhangin, Agdao, and

Bunawan. Low density in outer areas that are the districts of Marilog, Paquibato, and Baguio. Current trend shows that population is increasing relatively faster at the periphery areas of the mentioned urban cores (within political districts 2 and 3) while employment density is intensifying in the city centers.

8.36 **Option 2:** Establishment of a "strategic growth management plan (SGMP)" coupled with the development of strategic transport network to affect urban development of Davao City. Considerations will be given to strong land use controls and urban growth management with density control and strengthened urban functions. Current transport projects are being planned and many more are proposed without an overall plan for a coordinated implementation. The transport network will be planned in an integrated manner with the intended structure to direct growth of the fast-growing population in urban cores areas while controlling growth in preserved areas.

8.37 The estimation of the socio-economic settings by development options are conducted primarily based on population and its assessed characteristics brought about by the perceived impacts of the development direction. The "Current Trend" population calculation is straight forward using historical growth trends for each barangay with considerations enumerated in Table 8.3.4. This shows escalating densities in the already built up areas of the city similar to urban experiences in other cities with minimal development controls.

Table 8.3.4 Considerations in Calculations of Population by Scenario

Option 1: Current Trend	Option 2: Strategic Growth Management Plan
• Population growth trend in 2000 to 2015 is expected to continue without change with barangay. • Maximum population densities were assumed based on calculated net habitable lands per barangay (i.e., excluding waterways, protected and preservation areas, etc). • Employed and schooling population at residence (night time) and work or school place (day time) were assumed in proportion to population, but with logical assertions as to the location of major schools and employment centers.	• A guided growth policy with prescriptions for self-sufficiency and increased quality of living are the main considerations. • Population growth will be strongly influenced with land use plan and control. • An expanded road and transport network as well as effective urban growth controls will see population increase more in the areas outside Poblacion and Talomo districts. • Employment in secondary sector will more or less increase slightly from the current level, but more growth in the tertiary sector. • Future increments will occur mainly in planned development in areas outside congressional district 1 (i.e., Poblacion and Talomo). School enrolment increase is assumed to be accommodated in the areas where large universities are established and new ones will be located.

Source: IM4Davao Team

(b) Future Population under SGMP Method of Estimation

8.38 Under this method, it is assumed that strong interventions will be in place in terms of land use control. This takes into account the demand for urban land and the manner by which they are to be planned. As this would need the decision from the city, the initial estimation of future urban land and its plan for a balanced spread are explained in Section 8.3. Taking this as the platform for population distribution, the population was estimated as shown in Table 8.3.5.

Table 8.3.5 Distribution of SGMP Future Population by District

District	Population		Density (pax/ha)		Area (ha)
	2015	2045	2015	2045	
Agdao	102,267	124,800	172.5	210.5	593
Poblacion	174,121	208,700	153.0	183.4	1,138
Tugbok	121,334	381,600	8.0	25.1	15,230
Toril	148,522	485,000	7.8	25.6	18,963
Talomo	418,615	823,600	44.7	91.8	8,970
Paquibato	44,763	44,800	-	-	-
Marilog	52,201	52,200	-	-	-
Calinan	92,075	130,700	3.6	5.0	25,916
Bunawan	152,102	317,400	22.7	47.4	6,694
Buhangin	293,118	682,700	30.3	70.6	9,669
Baguio	33,873	33,900	-	-	-
Davao City	1,632,991	3,285,400	-	-	244,000

Source: IM4Davao Team

(c) Comparative Population Distribution Results of Future Estimations

8.39 Table 8.3.6 shows the population increase by administrative districts for both the current trend and the SGMP scenario.

8.40 The population distribution under the SGMP scenario realistically spreads the population in other urbanizing barangay, which will practically happen with developers already pursuing in-filling developments. These developments should be directed to provide ample spaces for better living conditions and daytime activities (as explained in section 8.3) by easing up highly dense areas and setting proper land uses in other barangays to satisfy land requirements for all activities ahead of realty developments.

Table 8.3.6 Comparative Population Projection by Development Scenario

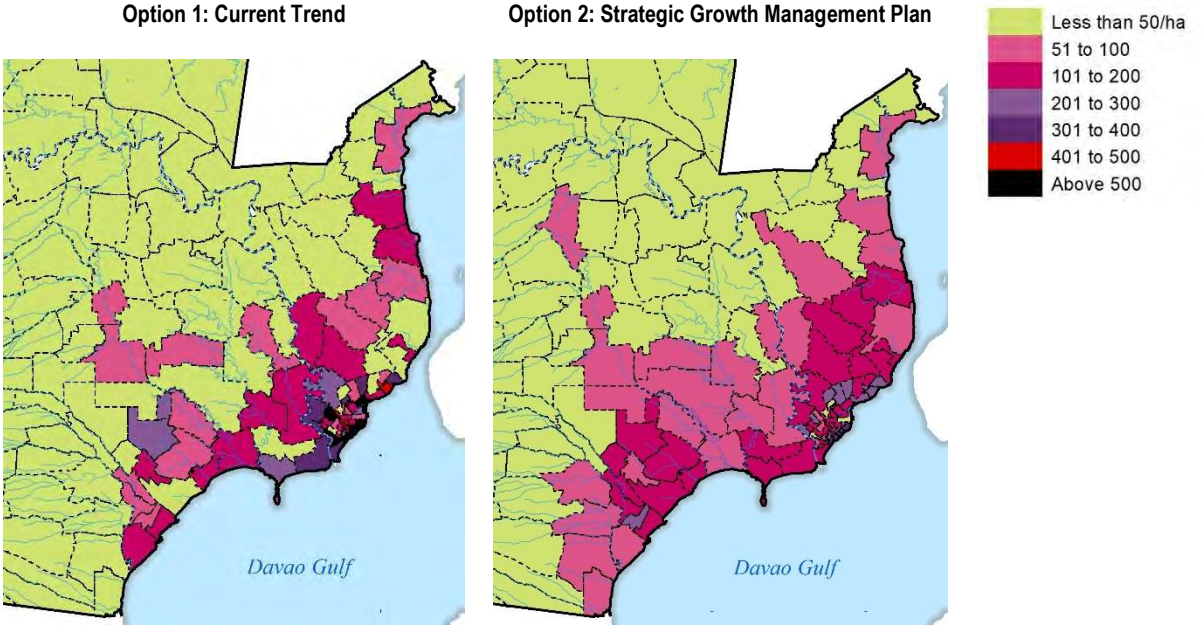
District	Current Trend Population Projection		SGMP Population Projection	
	2045	Density (pax/ha)	2045	Density (pax/ha)
Agdao	205,750	347	124,800	210
Poblacion	350,312	308	208,700	183
Tugbok	244,111	16	381,600	25
Toril	298,810	16	485,000	26
Talomo	842,208	94	823,600	92
Paquibato	90,058	1	44,800	1
Marilog	105,023	2	52,200	1
Calinan	185,245	7	130,700	5
Bunawan	306,013	46	317,400	47
Buhangin	589,721	61	682,700	71
Baguio	68,149	8	33,900	4
Davao City	3,285,400	15	3,285,400	15

Source: IM4Davao Team
Note: BAU projection to 2045 were calculated using growth rates of 2010–2015

8.41 While the current growth trend keeps the mono-centric spatial structure with high population densities at the Poblacion and Agdao districts, the SGMP scenario can achieve the poly-centric pattern of spatial structure (Figure 8.3.1). It is obvious that urban issues such as traffic congestions, lack of water resources, increase in informal settlers and deterioration of natural environment would worsen under a mono-centric structure while

the poly-centric pattern can alleviate these urban ills and accommodate further social and economic activities.

8.42 Therefore, the SGMP scenario with a poly-centric spatial structure was selected as a development scenario of the IM4Davao team.



Source: IM4Davao Team

Figure 8.3.2 Comparison of Population Density by Development Scneraio

(d) SGMP Employment and Schooling Population

8.43 **Employment:** Employment calculations were based on the analysis of workers by urbanity conducted by PSA for Davao in 2000 where the primary, secondary, and tertiary sectors of urban barangays employed 29%, 18% and 53% of total employed persons, respectively. For the rural barangays, the share is 65% in the primary, 8% in the secondary, and 27% in the tertiary employment sectors. This was further reinforced by the Davao City workers by employment status survey conducted by the LGU in 2017. Refinement of the primary sector employment was then further carried out based on the land use share for agriculture, grassland, and fishpond lands to the total land area per barangay. The secondary sector employment was based on land use share of agro-industrial lands, industrial, quarry lands, part of the built up, mix use areas, and residential lands. The tertiary sector, on the other hand, is based on the shares of the land use outside the primary and secondary sector employment. All these shares are multiplied to total employed persons of the barangay.

8.44 Table 8.3.7 gives the projected employed population for 2045 under the SGMP scenario. There is a structure shift in employment that the share of primary sector workers will dip from 32% of employed population in 2015 to 18% in 2045. Secondary and tertiary sector workers, on the other hand, will increase its share on the total employed population from 16% to 49% and 23% to 59%, respectively.

8.45 By 2045, Davao will have approximately 57% or 1.9 million of its population employed. Similar to the present situation, the service sector will continue to prosper and dominate the employment sector.

Table 8.3.7 Projections of Employment by Sector in Davao City, 2045

Administrative District	Population 2045	Total Employed 2045	Share of 2045 Pop Employed	Workers at Residence Place			Workers at Work Place		
				Primary Sector	Secondary Sector	Tertiary Sector	Primary Sector	Secondary Sector	Tertiary Sector
Agdao	124,773	70,746	56.70	0	21,224	49,522	0	16,611	43,353
Poblacion	208,729	118,349	56.70	0	35,505	82,844	-	20,943	100,452
Tugbok	381,553	212,396	55.67	70,362	34,803	107,230	29,008	21,887	81,766
Toril	485,011	275,001	56.70	28,537	71,418	175,046	28,697	94,702	131,660
Talomo	823,671	471,572	57.25	42,972	123,102	305,498	8,900	101,335	384,216
Paquibato	44,800	25,402	56.70	16,511	2,032	6,858	109,177	1,085	1,237
Marilog	52,200	29,597	56.70	19,238	2,368	7,991	90,183	2,289	42,193
Calinan	130,706	74,110	56.70	41,396	7,284	25,431	43,547	6,381	9,291
Bunawan	317,397	179,964	56.70	54,773	30,546	94,645	9,693	60,940	50,072
Buhangin	682,660	387,068	56.70	49,311	94,316	243,442	13,097	95,883	257,105
Baguio	33,900	19,221	56.70	12,494	1,538	5,190	3,292	2,079	2,354
Total	3,285,400	1,863,426	56.72	335,593	424,135	1,103,699	335,593	424,135	1,103,699
Share (%)		100.00		18.01	22.76	59.23	18.01	22.76	59.23

Sources: IM4Davao Team

8.46 **Schooling:** By 2045, Davao is estimated to have approximately 460,000 students in the elementary level and 650,000 in high school and university levels. The assumptions for the calculation are basically driven by the locations of schools, and the present and target locations of large universities for the older schooling group. However, the younger schooling children usually go to schools near their residence and, as such, no difference is foreseen between the day and night populations per barangay or administrative district.

8.47 The districts of Poblacion, Agdao and Talomo—locations of many large universities—will continue to hold its attraction for high school and university level students.

Table 8.3.8 Projections of Student Population in Davao City, 2045

Administrative District	Students at Residence Place (Nighttime)			Students at School Place (Daytime)		
	Elementary	HS & University	Total	Elementary	HS & University	Total
Agdao	20,752	24,955	45,707	20,752	169,118	189,870
Baguio	11,195	6,780	17,975	11,195	3,141	14,336
Buhangin	72,095	136,532	208,627	72,095	37,357	109,452
Bunawan	63,832	63,479	127,311	63,832	20,644	84,476
Calinan	28,975	26,141	55,116	28,975	12,925	41,900
Marilog	16,170	10,440	26,610	16,170	7,730	23,900
Paquibato	19,785	8,960	28,745	19,785	3,389	23,174
Poblacion	34,122	41,746	75,868	34,122	158,107	192,229
Talomo	117,300	164,734	282,034	117,300	189,638	306,938
Toril	45,431	97,002	142,433	45,431	27,945	73,376
Tugbok	31,242	76,311	107,553	31,242	27,087	58,329
Total	460,899	657,080	1,117,979	460,899	657,080	1,117,979

Note: Students from the other areas outside of Davao City are not included in the projection.
Source: IM4Davao Team

8.4 Estimated Urban Land Demand

1) Urbanization in Future

8.48 Future urban land demand by barangay was estimated in accordance with the expected future urbanization level and its location that was defined based on the proximity to the urban center (Poblacion District) and existing and future trunk roads including Philippine–Japan Friendship Highway (Davao City Diversion Road), Coastal Road, and Davao–Panabo Bypass Road.

8.49 Urbanization level was set into five categories depending on the amount of urban use of land. Some development constraint areas were considered as not-urbanizable land such as brushlands/shrubs, forest lands, quarrying lands, mangrove, and water bodies.

(i) Fully urbanized (100% urban use)
(ii) Mostly urbanized (more than 75% urban use)
(iii) Half urbanized (more than 50% urban use)
(iv) Partly urbanized (more than 25% urban use)
(v) Rural (less than 25% urban use)

8.50 Based on the above definition, the fully urbanized area will increase from 4,031 ha (1.8% of total area) in 2015 to 16,398 ha (7.4%) in 2045, while the rural area will decrease from 191,895 ha (86%) in 2015 to 188,615 ha (84%) in 2045.

Table 8.4.1 Area by Urbanization Category

Unit	Admin. Districts	Total Area	Area by Urbanization Category															
			Fully Urbanized		Mostly Urbanized		Half Urbanized		Partly Urbanized		Subcenter		Partly Industrialized		Partly Tourism		Rural	
			2015	2045	2015	2045	2015	2045	2015	2045	2015	2045	2015	2045	2015	2045	2015	2045
ha	Poblacion	1,138	725	1,138	413	-	-	-	-	-	-	-	-	-	-	-	-	-
	Talomo	8,970	708	5,986	3,019	1,632	1,259	1,352	3,008	-	-	-	-	-	-	-	976	-
	Agdao	593	593	593	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Buhangin	9,669	1,497	3,602	775	2,847	1,329	899	3,231	-	-	-	-	-	-	-	2,836	2,321
	Bunawan	6,694	-	726	726	1,378		823	2,975	644	-	774	-	-	-	-	2,992	2,349
	Paquibato	66,243	-	-	-	-	-	-	-	-	-	-	-	-	-	-	66,243	66,243
	Baguio	8,528	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8,528	8,528
	Calinan	25,916	-	-	-	-	-	853	853	1,376	-	-	-	-	-	-	25,062	23,686
	Marilog	61,121	-	-	-	-	-	-	-	-	-	-	-	-	-	-	61,121	61,121
	Toril	18,963	355	3,480	-	845	863	-	3,278	350	-	170	841	841	779	779	12,848	12,498
	Tugbok	15,230	153	873	-	1,763		1,304	3,787	1,420	-	-	-	-	-	-	11,290	9,870
	Total	223,063	4,031	16,398	4,933	8,466	3,452	5,230	17,133	3,790	-	944	841	841	779	779	191,895	186,615
%	Poblacion	100.0	63.7	100.0	36.3	0.0	0.0	0.0	0.0	-	-	-	-	-	-	-	-	-
	Talomo	100.0	7.9	66.7	33.7	18.2	14.0	15.1	33.5	-	-	-	-	-	-	-	10.9	-
	Agdao	100.0	100.0	100.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Buhangin	100.0	15.5	37.2	8.0	29.4	13.7	9.3	33.4	-	-	-	-	-	-	-	29.3	24.0
	Bunawan	100.0	-	10.8	10.8	20.6	0.0	12.3	44.4	9.6	-	11.6	-	-	-	-	44.7	35.1
	Paquibato	100.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	100.0	100.0
	Baguio	100.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	100.0	100.0
	Calinan	100.0	-	-	-	-	-	3.3	3.3	5.3	-	-	-	-	-	-	96.7	91.4
	Marilog	100.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	100.0	100.0
	Toril	100.0	1.9	18.4	-	4.5	4.6	-	17.3	1.8	-	-	4.4	4.4	4.1	4.1	67.8	65.9
	Tugbok	100.0	1.0	5.7	-	11.6	0.0	8.6	24.9	9.3	-	-	-	-	-	-	74.1	64.8
	Total	100.0	1.8	7.4	2.2	3.8	1.5	2.3	7.7	1.7	-	0.4	0.4	0.4	0.3	0.3	86.0	83.7

Source: IM4Davao Team

2) Urban Land Demand by Main Land Use

8.51 Based on the urbanization level as defined in the above section, urban land demand in 2045 was predicted using the following criteria.

(a) Residential Lands

8.52 In order to develop liveable communities, the different net population densities were applied to residential lands depending on the function of the barangays and its relative location from the city center.

(i) City center: 400 persons/ha

(ii) Other growth center: 300 persons/ha

(iii) Extensive suburban areas: 200 persons/ha

(iv) Ongoing urbanized area: 100 persons/ha

8.53 These are net population densities only on residential land. Two hundred (200) persons/ha can be interpreted as one detached housing lot (200 m^2) with an average household size of four persons. Some existing residential areas have more than 400 persons/ha where most of the residents are informal settlers. In line with economic development and by government's intervention to urban renewal and social housing provision, those high-density areas will be relaxed to a sustainable level in terms of urban management by 2045.

Table 8.4.2 Example of Net Population Density in Davao City

Project Name	Net Population Density (person/ha)	Assumption
Camella Northpoint (condominium)	962	Area: 2.8 ha; No. of units: 898 units; Ave. No. of residents/unit: 3 persons
One Oasis (condominium)	755	Area: 2.3 ha; No. of units: 579 units; Ave. No. of residents/unit: 3 persons
South Grove (sub-division)	104	Area: 17 ha; No. of lots: 421; Ave. No. of residents/unit: 4 persons
Orchid Hills Subdivision	130	Area: 4.7 ha; No. of lots: 153; Ave. No. of residents/unit: 4 persons

Source: IM4Davao Team calculated based on HLURB database

(b) Infrastructure Lands

8.54 To guide land use planning and infrastructure development, the infrastructure ratio of 15% is for all planned urban areas. Infrastructure lands will be allocated mainly for roads, other infrastructure, and urban parks. Currently in Davao City, only Poblacion District holds a road space ratio of 12% while other urban areas are less than 10%.

8.55 Lands for urban infrastructure and parks are very important for sustainable urban management. In the case of Japan, land readjustment is a major urbanization tool that has provided one third for urban areas. The land adjustment method guides to allocate 20–25% of the development land for infrastructure, parks, and other public use. Road space always accounts for the largest portion of infrastructure and other public land use. The three metropolitan areas in Japan—Tokyo, Osaka, and Nagoya—have road space ratios that range from 16 to 18% where land readjustment has been largely attributed. Big cities in Europe and North America have road space ratios that mostly exceed 20% of the city territories. Large cities in developing countries, however, have poorly provided road space (e.g. less than 10%).

Box 8.4.1 Urbanization and Urban Redevelopment Tools[3]

1. Land Readjustment

Land readjustment is a method to realize the re-plotting of land and development of infrastructure (roads, parks, urban utilities) simultaneously. The most conspicuous characteristic of this method is that land for infrastructure is generated through land contribution by land owners instead of land acquisition. Therefore, land owners can maintain their land use rights and participate in the development and attain land post its development.

This is practiced in Japan, Thailand, Nepal, Indonesia, etc. in Asia. It is especially actively in practice in Japan, being used for housing development in suburban areas and land and infrastructure development to resolve many issues in urban development.

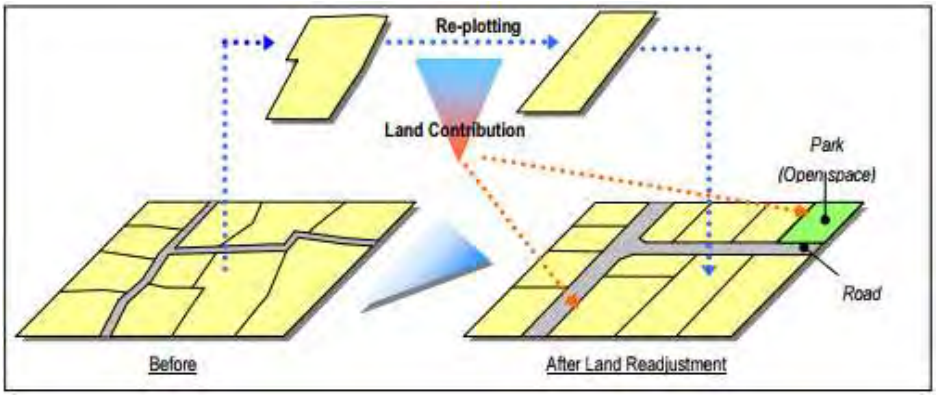


Figure 8.4.1 Schematic Model of Land Readjustment

2. Right Conversion System (Re-development Project)

Right conversion system is a method in which ownership rights of real estate property are converted with the ownership right of entitled floors of the newly constructed building. Note that the entitled floors will be granted maintaining the same value as the land owners' original land. This scheme is useful for redevelopment in urban core areas and renovation of old apartments. It is also possible to reserve a portion of the floor in order to use it as a source of funding for the new building.

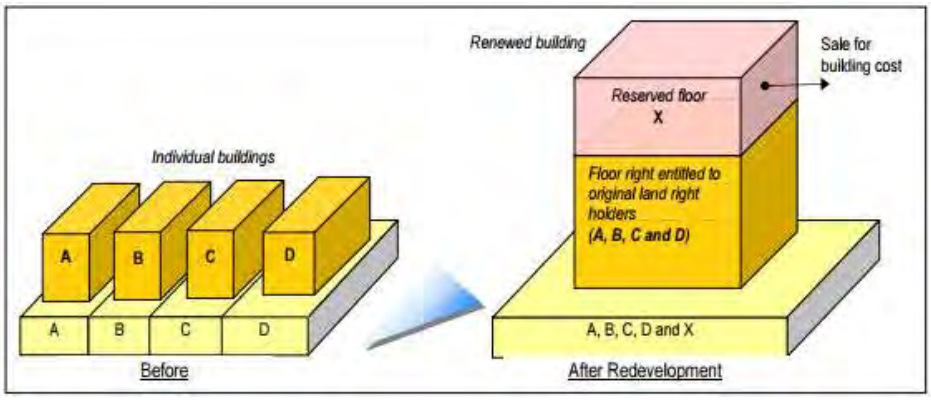


Figure 8.4.2 Schematic Model of Urban Redevelopment by Right Conversion System

[3] In Japan, land readjustment and redevelopment projects have been implemented by establishing the development council or other association. It usually takes 10 – 30 years to complete the land readjustment and redevelopment project due to the consensus building and other arrangement.

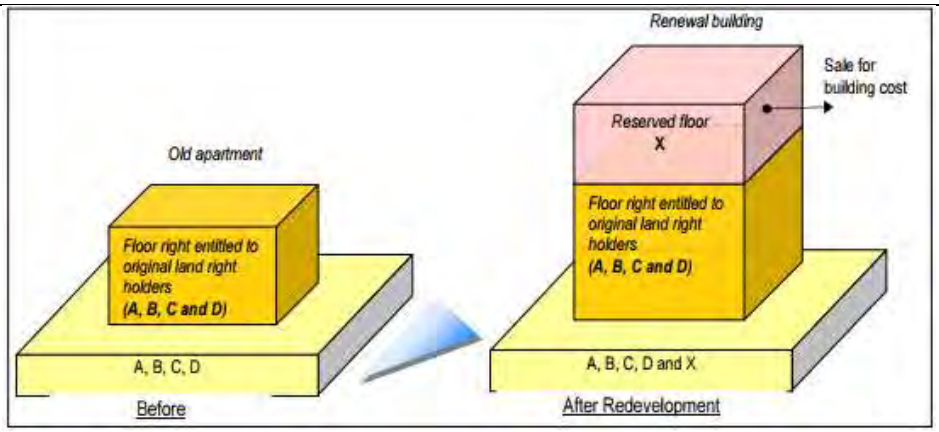


Figure 8.4.3 Schematic Model of Old apartment Redevelopment by Right Conversion System

Source: IM4Davao Team

(c) Daytime Activity Lands

8.56 Urban residents need the lands for their daytime activities including workplaces, commercial places, schools, and amusement places. Spacious and attractive daytime activity lands also attract visitors to the city like MICE and urban tourism. The existing land use database reveals that those daytime activity lands allocated to Davao citizens are 18 m^2 per inhabitant. Considering developing more job opportunities in urban areas, the target to allocate such daytime activity lands is 20 m^2 per inhabitant.

(d) Open Space/Parks and Recreational Area

8.57 In the Philippines, the standard for sports and recreational areas recommended by the Housing and Land Use Regulatory Board (HLURB) is 1.0 m^2/person at the minimum. On the other hand, the World Health Organization (WHO) suggests minimum of 9 m^2 of green space per person. In order to becoming the competitive and livable city, the suggested standard of WHO is applied for the urban areas of Davao City. Thus, the target to allocate the urban green areas (open space/parks and recreational area) is 9 m^2 per person.

3) Projection of Future Urban Land Demand

8.58 Using the above criteria, the demand for additional urban land by 2045 is 15,755 ha. Thus, future urban land will be almost double of the current. Of the 15,755 ha total additional urban land, Talomo District has the most share at 27%, followed by Toril District at 25%, Tugbok District at 22%, and Buhangin District at 19%. In terms of land use type, residential area accounts for nearly 55% of the additional urban land.

8.59 Poblacion, Agado, and Talomo Districts will achieve more than 95% of urbanization while Tugbok, Torial, and Calina Districts will still have low urbanization with less than 30%. By 2045, the urbanization of Davao City will reach 13%.

Table 8.4.3 Urban Land Demand by District in 2045 (ha)

District	District Area (C)	Existing Urban Lands (A)	Development Need in Urban Lands (B)					Comparison	
			Residential	Infrastructure	Daytime Activity	Open Space/ Parks	Total	(B)/(A)	((A)+(B))/(C)
Bunawan	6,694	1,799	1,016	300	127	248	1,691	0.94	0.52
Buhangin	9,669	3,740	1,249	449	776	506	2,980	0.80	0.70
Agdao	593	507	27	35	0	24	86	0.17	1.00
Poblacion	1,138	1,127	-60	70	0	0	10	0.01	1.00
Talomo	8,970	4,665	2,202	774	868	23	3,867	0.83	0.95
Toril	18,963	1,734	1,956	568	525	407	3,456	1.99	0.27
Tugbok	15,230	1,131	1,617	411	471	328	2,827	2.50	0.26
Calinan	25,916	391	480	45	196	117	838	2.14	0.05
Davao City	244,000	15,095	8,487	2,652	2,963	1,653	15,755	1.04	0.13

Note 1: Urban Lands are composed of residential land and infrastructure land and daytime activity land.
2: Infrastructure land includes roads and other infrastructure lands and urban parks.
3: Daytime activity land is defined for the land for urban daytime activities such as commercial, industrial, institutional and special use.
Source: IM4Davao Team

8.5 SEA for Development Framework

1) Background of SEA Policy in the Philippines

8.60 The Strategic Environmental Assessment (SEA) has been utilized worldwide in recent years. It has evolved to be a multi-disciplinary tool for environmentally assessing plans and programs but it is not a stringent requirement for many countries. The approach and legal status varies, and some see it very confusing for programmatic application. The diversity and dynamic approach of SEA is seen to be an efficient approach for decision making by policy makers, planners and stakeholders.

8.61 Broadly, the rational of SEA is to “ensure that environmental considerations are taken into account and inform higher levels of decision-making, including policies, plans and programmes”. Introducing SEA has been an integral part of developing EIA and, from that perspective, it responds partly to the limitations of EIA as applied only or largely to projects. SEA rounds out and scales up the scope of review to the tier of development proposals above the project level, most importantly to genuinely strategic, agenda and direction setting decisions that shape the trajectory of economic growth with potentially significant implications for the use of land, resources and ecosystems. In short, it is the approach from ‘do least harm’ to ‘do most good’[4].

8.62 In the Philippines, SEA has been attempted to be included in the draft bill on "An Act to Establish the Assessment (EIA) for projects". The draft bill is intended for most proposed policies, plans or programs and enumerates several priority policies, plans and programs that should undertake a SEA within five years from the date of effectivity of the law[5].

8.63 The proposed law designates to undertake a SEA under sub-national development plans and programs, such as land use plans at the regional, provincial, and local levels, and policies involving development plans for IPs. Since the Davao City Infrastructure Development Plan falls into these categories, SEA is recommended to be included for the planning.

8.64 SEA Principles and activities conducted are summarized in Table 8.5.1. SEA process was applied in the IM4Davao Project, although not rigorously, through the following steps: (i) Examination of specific methodology of SEA (review existing documents, map analysis, etc.); (ii) Identification of stakeholder and implementation of initial environmental examination (IEE); (iii) Evaluation of zero option (do-nothing scenario); (iv) Evaluation of development orientation and objectives; (v) Evaluation of environmental and social impacts of drafted urban infrastructure development plan, alternative scenarios, and mitigation measures of environmental impacts; (vi) Implementation of environmental and social considerations on priority projects through public consultation and stakeholder meetings.

8.65 Several stakeholder meetings that involve barangay captains, representatives of informal settlers, NPOs, and others were conducted as shown in the Chapter 17.

[4] Barry Sadler, et al.2011. Handbook of Strategic Environmental Assessment, New York:Earth scan from Routledge

[5] Once SEA legislation become enacted, an Inter-Agency Steering Committee on SEA (IASCS) will be created to oversee the undertaking of SEA. The IASCS is composed of different executive agency heads and representatives from the local government, business sector, and NGOs. An Executive Committee consisting of the Secretaries of the DENR, DILG and Social Planning Office/NEDA will head the IASCS, with NEDA as its secretariat. The Executive Committee members will elect a Chairperson from among themselves.

Table 8.5.1 SEA Principles and Planned Activities under the Project

	SEA Principle	Conducted/ To be Conducted
Decision Level	Policies, plans, programs	Review the past and on-going policies. Set the strategic vision utilizing the existing consultation mechanisms, etc.
Features of Action	Strategic, conceptual, vision first	
Output Level/ Schedule	General/ Mid- to long-term	
Impact Scale	Wide scale, cumulative	Cumulative impacts are carefully assessed based on the listed plans, and maps.
Approach to Alternatives	Regional, political, economic and financial, technical	The other methodologies, policies on environment are reviewed.
Approach of Analysis (benchmark)	Qualitative, sustainable perspective (greenery and wetland protection, coastal area protection, water quality protection, etc.)	Jointly integrated with sector policies as well as land use.
Stakeholders/ Decision makers	Government agencies as coordinator, LGUs, representatives of local community, private investors, academia, non-government organizations, etc.	Decision needs to be made whether Davao City will set up special SEA mechanism such as IAES in national level or try to tap the existing functions of inter-agency consulting mechanisms.

Source: IM4Davao Team based on data from several sources

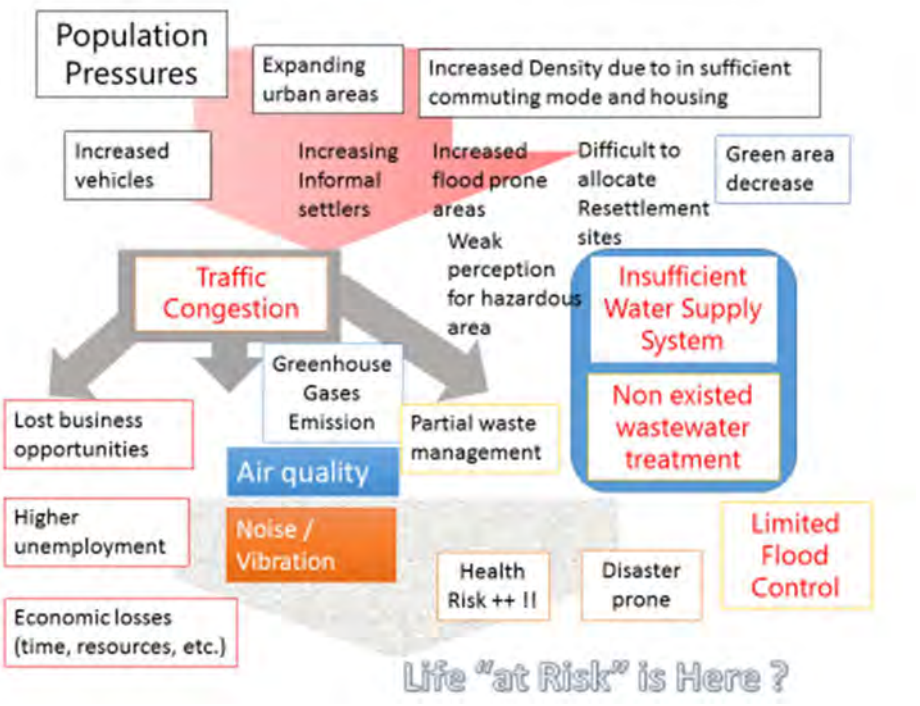
2) Toward a Safe, Resilient and Sustainable Davao City

8.66 Davao City is envisioned as the "Premier Socio-economic, Investment, Tourism Center in Mindanao, East ASEAN Growth Area (EAGA) and the Asia-Pacific Region propelled by enlightened leaders and empowered citizenry and committed to sustainable social growth and development, and economic growth without compromising the environment under the guidance of Divine Providence."

8.67 The LGU's commitments to transform Davao City into a modern, vibrant, and a well-planned settlement and investment center in Mindanao and the Asia-Pacific region, propelled by socially enlightened leaders and empowered citizenry, spiritually committed to attaining sustainable growth and optimum development within the context of balance ecology. These commitments are aligned with Sustainable Development Goals (SDGs) of making cities and human settlements inclusive, safe, resilient and sustainable (SDG 11).

8.68 Recently, Davao City receives the ASEAN Award for Clean Tourist City. The city was chosen for conforming to the criteria and requirements set by the ASEAN Clean Tourist City Standard (ACTCS), which include a solid environment management program, cleanliness, waste management, awareness-building about environmental protection and cleanliness, green spaces, health safety, urban Safety and security, tourism infrastructure and facilities, water supply- ground & surface water. Improving water quality in Davao City is a sustainable development imperative.

8.69 While there are good visions and awards, various environmental and disaster concerns have been expressed by the citizens. This is due to rapid urbanisation caused by influx of population surrounding provinces and even outer islands, and infrastructure to control pollution, and traffics have not been planned. Population pressures with uncontrolled environment and land use directly exacerbated traffic congestion and contamination of water and soil as well as decreased green areas. Under such worsening conditions, the citizens of Davao city become more prone to disaster and contamination (Figure 8.5.1).



Source: IM4Davao Team

Figure 8.5.1 Increased Environmental Concerns in Davao

8.70 In order to work towards a safe, resilient and sustainable city and maintain the image of a clean tourist city (per award received), the application of the SEA process for designing the spatial plans and infrastructure projects is incorporated in the planning activities of IM4Davao.

8.71 As briefly elaborated in the Chapter 2.3, the water quality of the major rivers and beaches have already far exceeded the standard values. Thus, this is one of the critical focus of the SEA in order to control the environmental risks.

9 FUTURE URBAN STRUCTURE AND LAND USE PLAN

9.1 Future Urban Structure

1) The Perspective of Metro Davao

9.1 As already discussed in ***Chapter 3.1***, Davao City today seems to be an independent metropolitan area. Upon closer inspection, however, some urban management issues are found to be unsolvable by Davao City alone. Representative issues include the following:

- The daily traffic congestion between Davao City and Panabo City mainly due to increased traffic volume of commuters and logistics services;
- The ferry services between Davao City and Samal City, which are saturated particularly during morning peak hours because of increased commuters to Davao City and tourists to Samal City; and
- The city's need for a new sanitary landfill, as the New Carmen landfill will be totally full within a couple of years, and one of the candidate sites is located in Panabo City.

9.2 These interrelationship and interdependence among LGUs are key to better urban and metropolitan management and service delivery, and the same will certainly grow in scale and breadth in the future.

9.3 At the same time, transport infrastructure has a strategic role in enhancing connectivity, but its development must be planned to guide urbanization, industrialization, and other spatial development. In this sense, the first phase of the Mindanao Railway between Tagum and Digos via Davao City is very strategic, while an expressway which has access control and thus ensures high-speed travel is also a strategic concept for Metro Davao. The intercity Tagum–Davao–Digos (TDD) Railway will serve passengers, particularly long-distance passengers, while the Metro Davao Expressway will serve trucks and private vehicles, especially when there is good accessibility to the gateway airport and seaports.

9.4 The two metropolitan transport corridors mentioned above (i.e., intercity rail and expressway) cannot provide inter-island connection with Samal, which is currently being provided by inter-island ferries. But ferry operation across Pakiputan Strait is constrained by mainstream shipping activities of large container, general cargo, and RORO vessels which call at Sasa Port, TEFASCO Port, and others. Due to this safety constraint, ferry service frequency cannot be increased during peak hours when long vehicle queues occur. Hence, a bridge will be considered for the planning period up to 2045.

9.5 Gateway infrastructure is another type of metropolitan-level infrastructure. Because the Davao International Airport has enough runway capacity to meet civil aviation demand over 20 years from now, as discussed in Section 6.5, it will be considered as the gateway airport when planning for Metro Davao's development up to 2045.

9.6 On the other hand, the Sasa Port, the PPA's base port in the Davao Region, has recorded sluggish cargo throughput in recent years, which is largely attributed to outdated port infrastructure and facilities and to an emerging regional container port, the Davao International Container Terminal (DICT) in Panabo City. There is a need to rehabilitate and modernize Sasa Port. Considering its port land area (as small as 17 ha), berth depth (as shallow as 9 m, which does not meet the prevailing requirement for international container

shipping), and heavily congested access road (Davao City–Panabo City Road), however, Metro Davao will need some other gateway port. The DICT, with its expansion plan, can work as a gateway. The proposed Hijo International Port project in Tagum City may create another gateway port, judging from its development plan. These three or some other ports can work as metropolitan gateway ports, provided their respective functions are clearly demarcated.

2) Davao City Urban Centers

9.7 Historically, Davao City's center is the Poblacion District, which has kept its primacy over other districts. The second city center has always been Toril, followed by other smaller urban centers such as Talomo, Mintal, Buhangin, Bunawan, and Calinan. Today, the city center has expanded to encompass the districts of Agdao, Buhangin, and Talomo. There is now a large urban area that has taken on the typical monocentric urban structure.

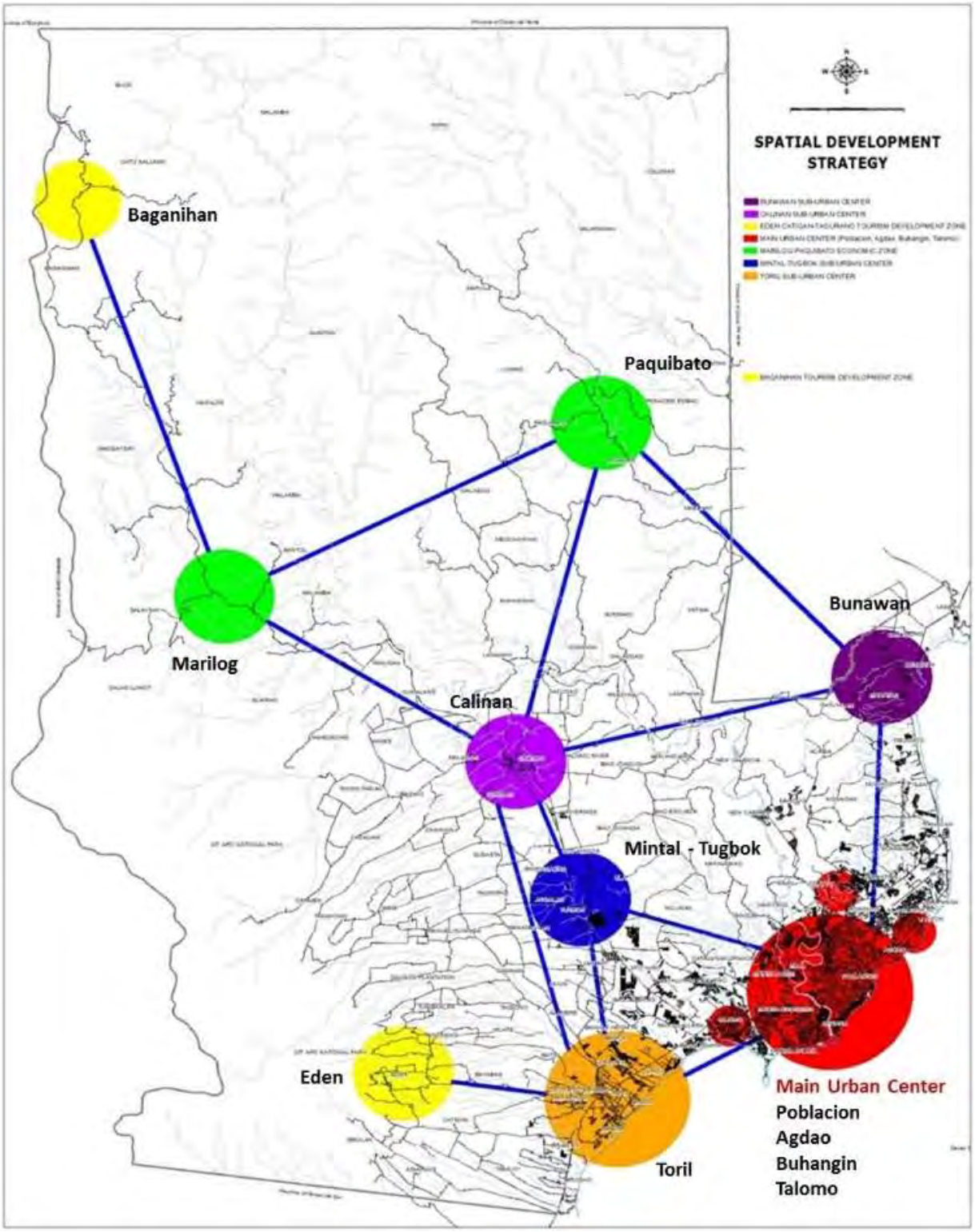
9.8 The city now intends to realize a vision of a multinodal spatial development that comprises the following:

- Main urban center covering Poblacion, Agdao, Buhangin, and Talomo;
- Suburban centers in Calinan, Bunawan, Toril, and Mintal-Tugbok;
- Economic zones in Marilog and Paquibato; and
- Tourism development zones such as the Eden-Catigan-Tagurano axis on the upland areas of Mt. Apo and Baganihan.

9.9 Transforming a monocentric urban structure into a polycentric one is inevitable for Davao City in order to promote a balanced development with minimal traffic congestion and other negative effects of urban development. For that purpose, the designated subcenters will have to attract a higher daytime population by providing more workplaces, commercial and business areas, and institutional lands.

9.10 There is a need to develop new subcenters particularly in the suburbs. Without city planning, these areas could become residential lands. One candidate site for a new subcenter is the area around the proposed Davao Central Station of the TDD Rail Line located in both Barangay Waan and Barangay Magtuod. There are several hundred hectares of underdeveloped land here which sits along the midstream of the Davao River. Together with the proposed Davao River Boulevard, the site could be a crosspoint for the intercity railway and the intra-urban mass transit, thereby promoting a transit-oriented development (TOD). The IM4Davao Team has named the project as the Davao Transit Center.

9.11 Encroaching urbanization is a danger to the tourism development zone of Eden–Catigan–Tagurano. Due to its natural and cultural value and its terrain which is unsuitable to urban development being on the slopes of Mt. Apo, more careful attention should be paid to control urbanization and to designate the area for unique tourism development only.



Source: Originally CPDO and modified by the IM4Davao Team.

Figure 9.1.1 Spatial Development Strategy for Davao City

3) Davao City Urban Structure

9.12 It is possible to delineate an urban structure by providing primary transport infrastructure. For the future metropolitan structure of Metro Davao or even the area which covers the Tagum–Davao–Digos corridor, the brief discussion on intercity railway and expressway, inter-island bridge, and metropolitan gateways in the preceding pages provides a snapshot of how these transport infrastructures affect urbanization to some extent. Meanwhile, the daily movement of urban residents in Davao City will still be supported mainly by the intra-urban road network and mass transit services.

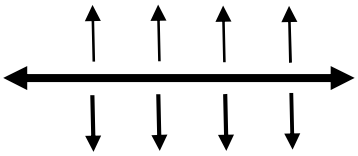
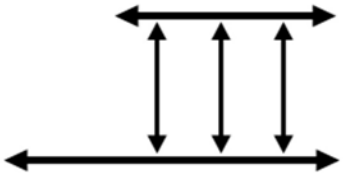
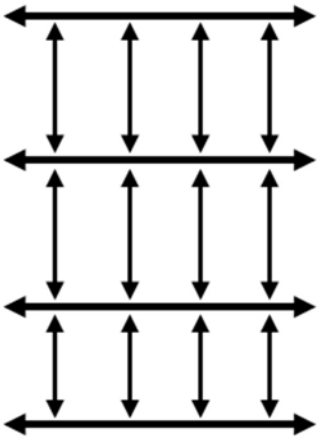
9.13 In view of the above, there is a need to prepare an urban transport network plan to carry out two planning objectives, namely: (i) to provide short-term solutions to mitigate traffic congestion and improve transport services; and (2) to prepare a long-term transport network plan so as to guide not only transport infrastructure development but also urbanization and urban redevelopment. JICA has historically contributed to transport network planning in Davao City. This is through the following:

- Davao City Urban Transport cum Land Use Study (DCUTLUS, 1981); and
- The Study on the Davao Integrated Development Program Master Planning (DIDP, 1999).

9.14 At the time the studies were carried out, urbanization in Davao City had occurred along the coast of Davao Gulf and was expanding to inland suburbs, while urbanization along the Davao–Bukidnon Road was already at a fledgling level. Both the studies proposed to change the city's transport network pattern from "fishbone type" to "ladder type."

9.15 More precisely, DCUTLUS 1981 proposed a double ladder pattern between Toril and Buhangin (comprising the proposed coastal road, the existing national highway, and proposed diversion road at that time). Then, when the Davao City Diversion Road was constructed between Talomo and Buhangin in the 1990s, DIDP 1999 proposed to extend it to Toril and to construct the coastal road. Today, the extension of the diversion road and the construction of the coastal road have not been done yet. In this sense, the present transport network pattern is one of an incomplete ladder.

9.16 Currently, two important trunk road projects in Davao City are under different development stages toward their completion by 2022. These are the Davao City Bypass Construction Project (package 1: 28.8 km) financed by JICA and the Coastal Road Project (18.3 km) financed by the DPWH. If the Diversion Road extension is implemented using advanced tunneling and bridging technologies, a triple-ladder pattern of the city road network will be achieved together with the said two ongoing projects.

Past (in the 1980s): Fishbone Pattern ◆ National Highway (Davao–Cotabato Road and Panabo–Davao Road)	
Present: Incomplete Ladder Pattern ◆ Diversion Road (incomplete) ◆ National Highway (Davao–Cotabato Road and Panabo–Davao Road)	
Future (until 2030): Triple-Ladder Pattern ◆ Davao City Bypass ◆ Diversion Road with Extension ◆ National Highways (Davao–Cotabato Road and Panabo–Davao Road) ◆ Davao City Coastal Road	

Source: IM4Davao Team

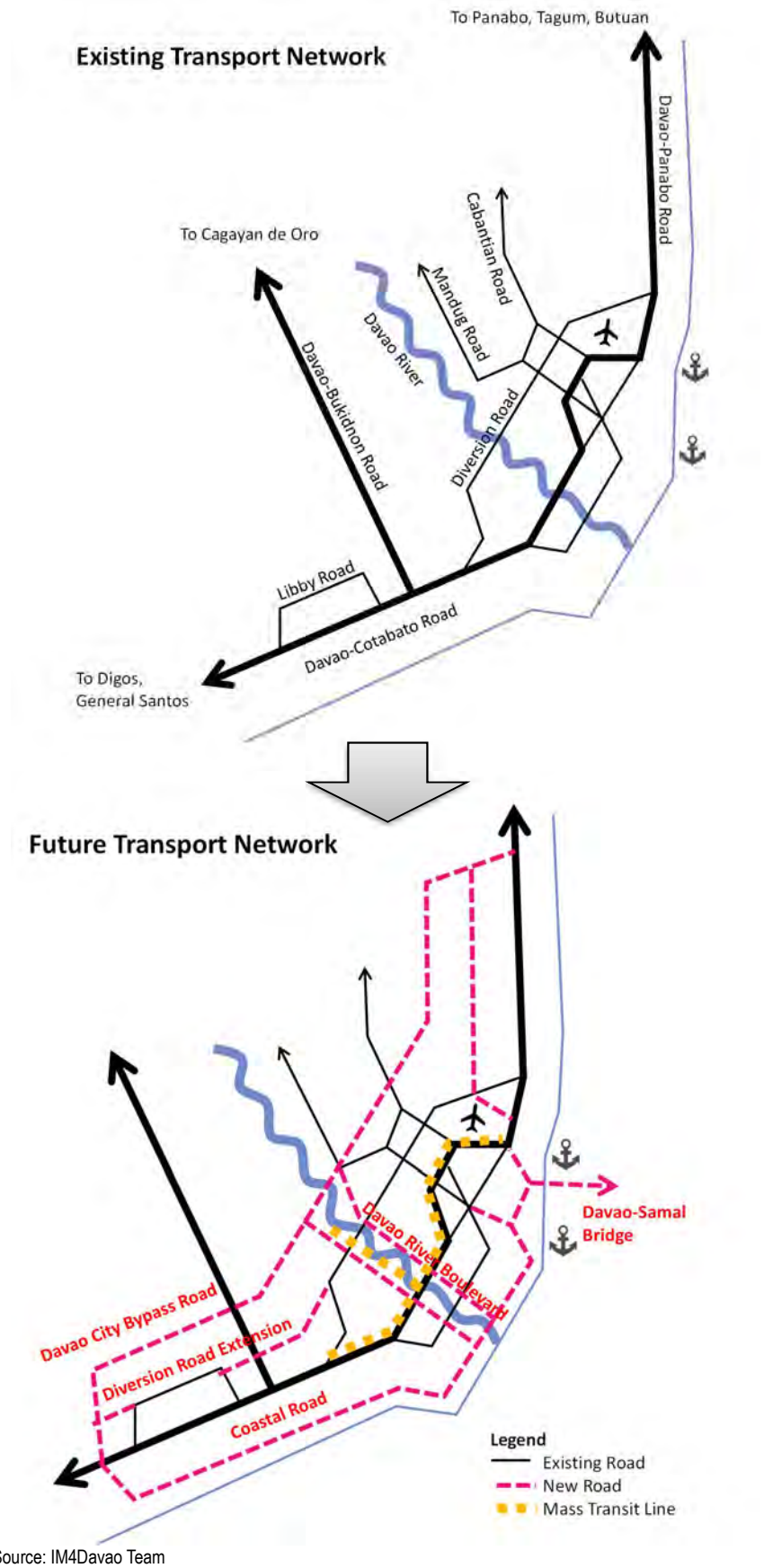
Figure 9.1.2 Present and Future Road Network Pattern

9.17 It should be noted that even when the triple-ladder road network pattern is developed in the future, traffic congestion, particularly in the city center, may still happen. Hence, a mass transit line will be introduced within the city center to connect to other urban centers so as to provide scheduled and fast transit services for passengers.

9.18 The Bukidnon Road currently provides intercity and interprovincial services. Historical and modest urban centers, such as Calinan and Mintal-Tugbok, lie along this corridor. In the future this corridor will become largely urbanized. In addition to an increased nighttime population, a higher daytime population will carry out their activities at industrial estates, research parks, and educational facilities.

9.19 Davao City's urban structure toward the year 2030 is to be led by transport infrastructure, as illustrated in Figure 9.1.3 with a comparison with the existing one.

9.20 To determine the desirable urban structure up to 2045, the IM4Davao Team will examine additional road and rail transport infrastructures in terms of spatial coverage and transport capacity through integrated land use planning and assignment of future traffic to alternative transport networks.



Source: IM4Davao Team

Figure 9.1.3 Transport-guided Future Urban Structure of Davao City

9.2 Urban Land Use Policy and Planning Procedure

1) Existing Urban Land Use Policy of Davao City

9.21 Davao City defines its development objectives and land use policies in the Comprehensive Land Use Plan 2013–2022 (CLUP 2013–2022). The development objectives of the city are to:

(i) Build an all-encompassing and vibrant city;

(ii) Create a sustainable city;

(iii) Establish an accessible, attractive, and lively city; and,

(iv) Integrate land use planning, transport planning, water planning, energy provision, and infrastructure planning.

9.22 In order to achieve the above objectives, CLUP 2013–2022 defines general and urban land use policies, as shown below (Table 9.2.1).

Table 9.2.1 Land Use Policies of Davao CIty in CLUP 2013–2022

Policy	Content
General Land Use	• Promote development while minimizing adverse effect to environment. • Enable land to be efficiently and effectively used for its intended use. • Enable development that is energy-efficient. • Enforce development that enhances the public environment by providing sufficient open space for greenery. • Complement and enhance the existing landscape character. • Provide amenity for residents. • Ensure that developments along the road right of way comply with minimum requirements of road setbacks.
Land Use for Urban Areas	• Promote high-density accommodation that is associated with the primary land use (zone) within the urban center, with medium-density housing in surrounding areas where possible and appropriate. • Enhance and strengthen urban centers by encouraging the expansion of existing facilities, adding related business activities, incorporating a mix of other uses (including after-hours' activities and further housing opportunities) and improving access to and within urban centers. • Promote more 'live near work' opportunities by increasing the level of medium-density housing matched to the types of employment activity created. • Ensure commercial and industrial activity within urban centers has regard for the amenity of adjacent residential areas. • Provide retail development in urban centers which directly supports activities or amenities of residents within the area. • Prepare a structured, planned development within urban centers. • Discourage ribbon-type development along main roads. • Encourage transit-oriented development (TOD) in urban centers where appropriate. • Ensure that there is no reclassification and / or rezoning from one use to another for a period of five years. • Ensure that there is no exemption for a period of three years.

Source: CLUP 2013–2022 of Davao City

9.23 Observing the current situation of the urban areas in Davao City, high-density development in urban centers has been gradually promoted, but accessibility to and mobility within urban centers have not yet improved. It can be said that the concept of TOD has not been introduced.

9.24 According to the CPDO of Davao City, development permissions have been issued strictly following the zoning proposed in the CLUP 2013–2022. Reclassification and/or rezoning will be possible from 2018.

2) Proposed Urban Land Use Policy for Davao City

9.25 The primary objective of land use planning for urban areas is to provide the orientation for the overall use of the land and the growth of urban areas. A land use plan translates the socio-economic development orientation of an area, including its vision and development strategies, into the desired spatial development scenario of an area, that is, the direction or pattern of the physical growth. The plan therefore provides the foundation for an area's sustainable development which refers to good living conditions, competitive economic development and employment, and a well-preserved natural environment.

9.26 The key concept in the entire development planning is "4D Developments," which stands for dynamic, distinguishable, diversified, and decentralized. A 4D Developments plan makes it clear where new urban areas should be developed, where redevelopment/ revitalization should be introduced, what roles/functions each district should have, and how the city should manage the natural environment. The 4D Developments approach can achieve balance between robust economic growth and environmental preservation. The land use policies for urban areas under 4D Developments are described below.

(a)General Urban Land Use Policies

9.27 **Integration of Existing Plans:** In order to maximize the benefits to be obtained from projects/programs by the national and regional government, the main orientations stated in existing plans at the central and the regional levels have to be considered in planning. For the IM4Davao Project, these refer to the: (i) National Physical Framework Plan 2016-2045, (ii) Philippine Development Plan 2017-2022, (ii) Mindanao Spatial Strategy / Framework Plan 2015-2045, (iv) Davao Region Spatial Development Framework 2015-2045, and (v) Regional Physical Framework Plan XI.

9.28 **Development of International Hub for EAGA and Oceania:** In order to ensure that the future growth of Davao City is sustainable, spatial integration at international levels is important which can be done by developing international gateways, i.e., international airport, and international hubs.

9.29 **Coordination with Adjoining Cities/Municipalities:** The expansion of urban areas in adjoining cities/municipalities is expected to progress further along major transport corridors and at/around the gateway airport and sea ports. Thus, the functions/roles of urban areas within the region should be taken into consideration.

9.30 **Decentralization of Urban Areas' Function in CBD:** The urban areas of Davao City are expected to expand rapidly toward the outer areas. In the process of growth, development pressures have been seen both on existing urban areas and on new lands. In order for Davao City to function as an efficient whole, urban areas with different characteristics must be developed.

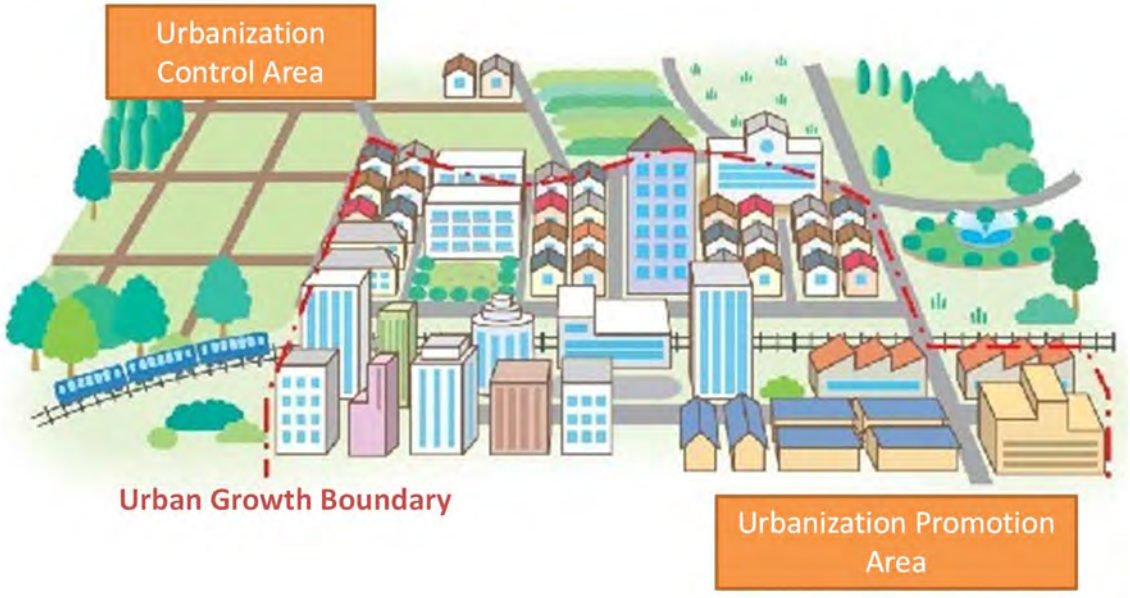
9.31 **Integration of Urban and Transport Infrastructure Development:** Infrastructure development is a means to promote the planned urban development and achieve the desired quality of life for the people. Where there is good infrastructure, development takes place and activities become dynamic. To achieve these, infrastructure provision must be undertaken in an integrated manner with land use development.

9.32 **Balanced Development between Environmental Conservation and Urbanization:** Incorporating the environment in land use policies for Davao City is very important since the former can and does bring both benefits and losses. Large water

bodies, abundant greeneries, and a rich culture are the city's valuable resources that can maintain ecological balance, promote tourism, and preserve traditional values, among other benefits. On the other hand, natural disasters, such as floods and landslides, affect the city negatively. In order to manage the city's future growth in a sustainable manner, therefore, environmental conservation and disaster management were considered by the IM4Davao Team. As part of this policy, the realignment of the Davao River's channel is proposed to lessen flood risk.

9.33 **Consideration of Current Development Trends:** The current expansion of the urban areas is mainly toward the northeast (Buhangin and Bunawan districts) and the southwest (Talomo, Tugbok, and Toril districts). Development trends must be considered because urban development is difficult to control in large urban areas where the demand for economic growth and market forces are strong. Future increases in population and the transfer of population from the city center to areas with suitable development conditions must be properly guided.

9.34 **Introduction of the Concept of Urban Growth Boundaries:** Similar to other cities in the Philippines and other developing countries, the urban areas in Davao City have expanded in a disorderly manner because the urban management capacity of local authorities is limited. In many cities, the concept of urban growth boundary (UGB) is adopted to stop urban sprawl, protect conservation areas (such as green spaces and prime agricultural lands), and promote the development of efficient urban areas with adequate infrastructure (Figure 9.2.1). With this, limited public investments can be used to prioritize urban areas within UGBs. The concept of UGBs is illustrated in the figure below.



Source: Saitama City

Figure 9.2.1 Concept of Urban Growth Boundary

(i) **City Planning Boundary:** This delineates the boundary within which planning must be made and includes rural areas. In the case of Davao City, it may be the same as the administrative boundary, although the coverage of land use planning in this IM4Davao Project is only the urban areas.

(ii) **Urban Growth Boundary:** This boundary delineates the areas which will become

urbanized within 10–15 years. The boundary must be reviewed, say, every 3–5 years to match changing or emerging development needs. In the case of Davao City, this is about two times bigger than the current urban area. Areas within the UGB are defined as urbanization promotion areas where infrastructure provision will be prioritized.

(iii) **Urbanization Control Area:** Areas outside the urban growth boundary are defined as urbanization control areas. This does not preclude any development activities in the area, only that they are more controlled and guided more strictly to comply with the development master plan. In the case of Davao City, it is recommended that public investments be allotted to mainly environmental and infrastructure improvements in rural areas and villages within urbanization control areas.

9.35 **Development of Urban and Activity Centers:** The urban structure is shaped by a combination of major activity centers, such as commercial centers, industrial estates, government center, and other special centers such as university complexes, medical centers, high-tech parks, sports centers, etc., of which modern and competitive commercial centers and industrial estates/zones are the most important for promoting growth and generating employment. Main urban and activity centers proposed are shown in Table 9.2.2.

Table 9.2.2 Facilities and Possible Location of Urban and Activity Centers

Urban and Activity Center	Major Function	Recommended Facility	Pobalicon	Talmo	Agdao	Buhangin	Bunawan	Calinan	Toril	Tugbok
1. Commercial and Business	International Trade and Communication	• World trade center • Convention and business center • Satellite telecommunications center • Airport service center	O				O			
	Financial Center	• Stock exchange • Offshore market center • Financial support center & foundations for industries • Insurance and support	O							
	Trade Center	• Wholesale market (fresh food) • Regional wholesale market (commodities)		O					O	
	New Business Center	• Software development center • Development center for venture and service industries • Local production promotion center • Product design center		O				O	O	
	Retail Commercial	• Hypermarket, mega mall • Department store • Hardware and home center, etc. • Agriculture materials center		O					O	
	Administrative & Political Center	• Information and knowledge center (ITC) • E-government center • Center for political science (think-tank)	O	O		O		O	O	O
2. Industry and Logistics	Industrial Park	• Export-oriented industrial estate • Research & development park • Software development					O			O
	Light Industry	• Supporting and consulting center • SME industrial village • Handcraft manufacture center			O		O	O		
	Logistics Service	• Post office logistics center • Regional logistics terminal • Urban service logistics center				O	O			

Urban and Activity Center	Major Function	Recommended Facility	Pobalicon	Talmo	Agdao	Buhangin	Bunawan	Calinan	Toril	Tugbok
3. Education and Culture	Higher Education	• Training capacity development • Political & administrative studies • Thematic college institutes and studies		O						O
	Research and Development	• Research & institutions for light industry • Advanced technology training center		O	O					O
	Cultural Center	• Museum • Performing arts center • Regional theater			O			O		O
4. Health and Medical Care	Advanced Medical/Health Care	• Advanced medical center • Regional healthcare center	O	O	O					
	Regional Health Care	• Infectious disease control center • Regional public health institution	O		O					
5. Tourism and Recreation	Tourist Information and Hospitality	• Davao City tourist information center • Regional tourism information center				O		O	O	O
	Tourism Trade and Promotion	• Davao City tourism promotion center • MICE promotion center	O			O			O	O
	Sports and Recreation	• Cycling and trekking network • Water sports center • River cruise center	O	O						

Source: IM4Davao Team

9.36 **Promotion of Transit-oriented Development:** Transit-oriented development (TOD) is a development approach that primarily aims to promote public transport use with multiplier effects through the integration of transport development and urban development. TOD stimulates the growth of public transport and contributes to the improvement of the local community in terms of social, economic, and environmental aspects. Thus, TOD is the comprehensive approach for urban (re-)development with transport node between different transport modes. The influence areas of TOD are characterized according to their distance from transit stations, as follows:

(i) **Station Area:** Areas within a 200-m radius from a station and where the station building and transfer facilities are developed.

(ii) **Transit Neighborhood:** Walkable areas from a station and where people can live, work, shop, and dine. Some transit neighborhoods function as urban centers in their communities.

9.37 Since railway and bus systems will be introduced in Davao City, as part of the infrastructure roadmap to be proposed in this project, TOD opportunities at/around railway stations and bus terminal areas must be enhanced.

(b) Development Orientation by District

9.38 Considering the characteristics of each district, the future development of the districts is proposed as follows:

9.39 **Poblacion District:** Poblacion will continue with the role of administrative center, where the main offices of local, regional, and national government agencies are located. As an administrative center, Poblacion District will also accommodate the public safety and security center, life safety learning center, and traffic control center, among others. In

addition, it will be the financial and advanced medical care center in the region.

9.40 **Talomo District:** Talomo will be the second CBD of Davao City after Poblacion District. New commercial and business areas will be developed around the future railway stations (Mindanao Railway and proposed mass transit lines). Although the district will become more urbanized, its environmental resources will be protected. One such area is Punta Dumalag which hosts a marine protected area including the Cleanergy Park.

9.41 **Agdao District:** Agdao will be the center for meetings, incentives, conferences and events (MICE), taking advantage of its proximity to the international airport. Besides developing convention centers and accommodation facilities, the city will actively market the area as a MICE center in the region. Together with Poblacion District, Agdao will also serve as financial center.

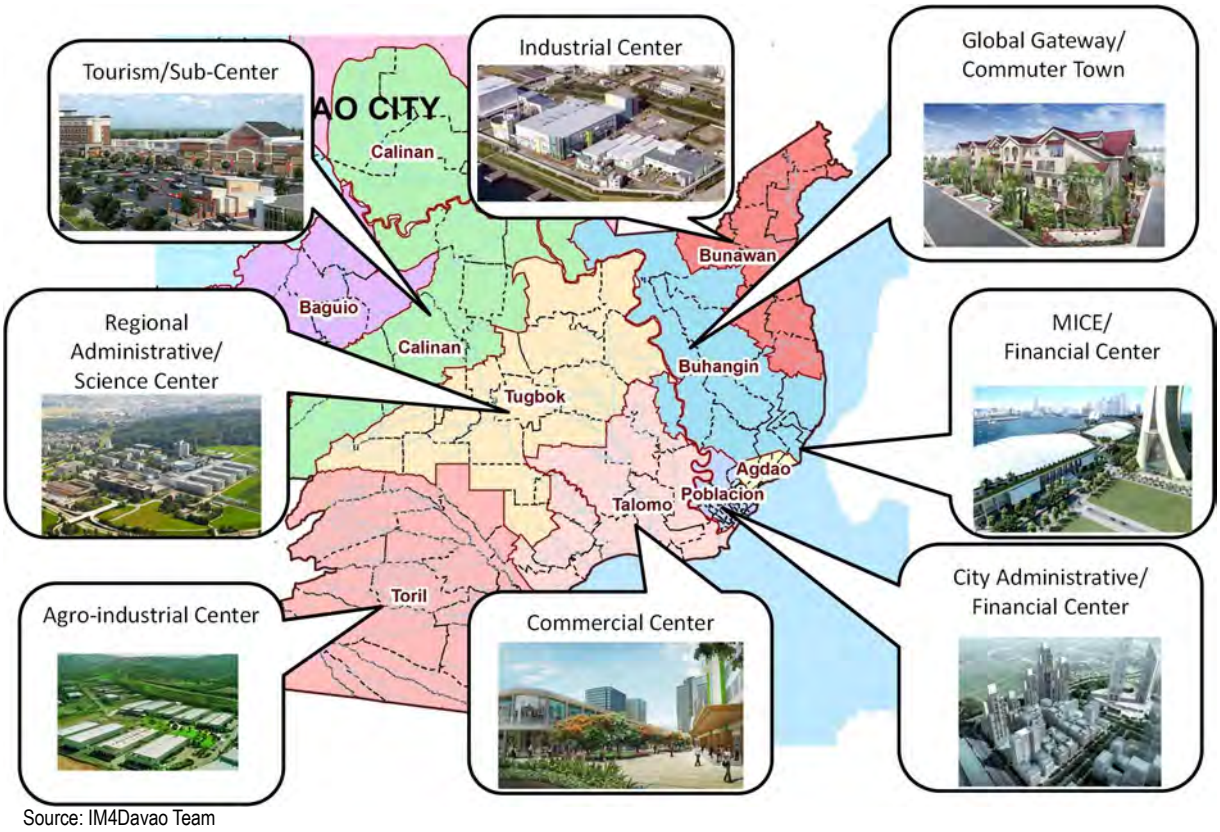
9.42 **Buhangin District:** Buhangin will be the global gateway and logistics hub in the region due to the existing international airport and sea port. In order to strengthen its function as a global gateway, it will be necessary to expand the airport terminal and develop logistics facilities and the transport network. The northern part of the district will be developed as a commuter town with a livable environment.

9.43 **Bunawan Distrcit:** Bunawan will continue to be the industrial center of the city due to its proximity to both airport and sea port in Davao City and the Davao International Container Terminal in Panabo City. However, because the inland area of the district is relatively hilly, industrial zones can be developed only in the coastal areas.

9.44 **Calinan District:** Calinan will be a subcenter linking the urban and rural areas of Davao City and where people can access basic public services such as administrative services, medical services, and social welfare services, among others. Furthermore, in order to encourage economic activities in suburban and rural areas, agro-industry, eco-tourism, artisan craft villages, and others will be promoted in Calinan.

9.45 **Toril District:** Toril will be the agro-industrial center of Davao City. The Davao Fish Port Complex and the proposed Davao Food Terminal Complex will be the base for promoting agro-industry in the district. In addition, due to its proximity to Mt. Apo, tourism industry in the area will also be developed.

9.46 **Tugbok District:** Tugbok will be a regional institutional center as well as the science center of the city and the region, where the regional government offices, educational facilities, research and development institutions, and others will be located. The University of the Philippines Mindanao will take the lead as the science center. Innovations and new technologies can be introduced to other areas in the region from this center. The concepts of smart cities and eco-towns will also be applied to this district as pilot projects.



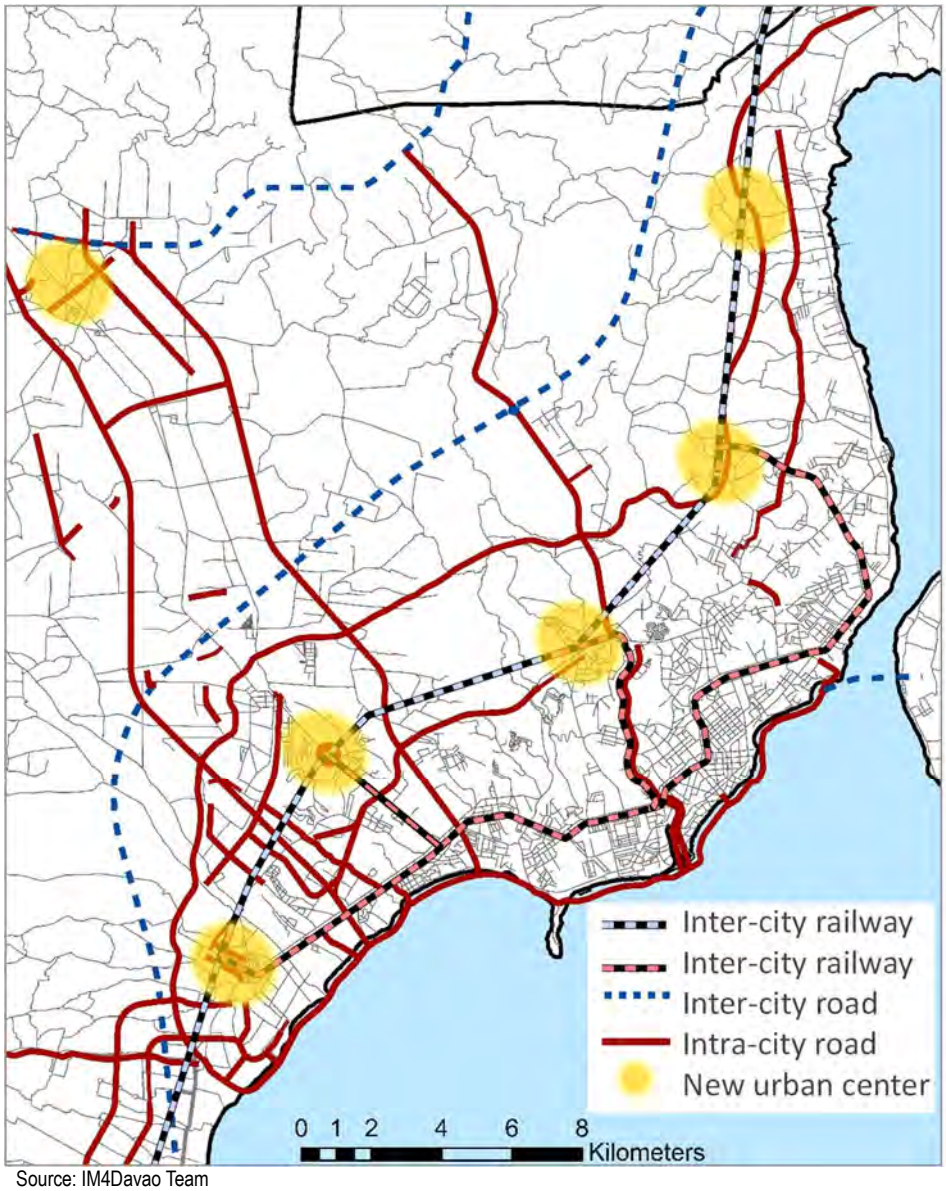
Source: IM4Davao Team

Figure 9.2.2 Future Role of Davao City's Administrative Districts

3) Transport Network as Catalyst

9.47 In order to transform from the current monocentric structure to future monocentric structure with the proposed role of administrative districts, the improved transportation network will be the catalyst. The detail is discussed in ***Chapter 12***, however the network is composed of inter-city roads, inter-city railways (Mindanao Railway), inner-city roads including Davao – Panabo Bypass and Diversion Road Extension, and inner-city railway (mass-transit system line) (Figure 9.2.3).

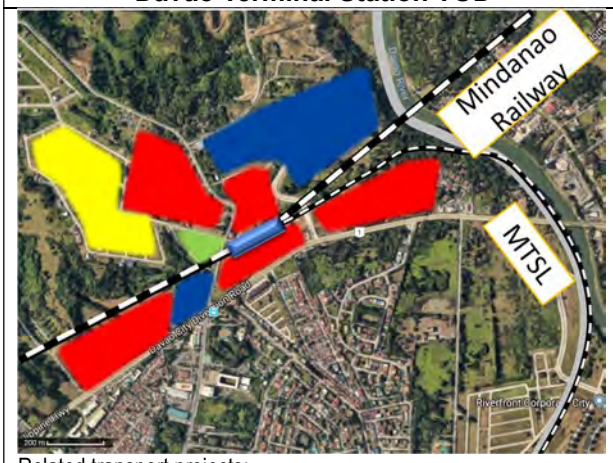
9.48 New urban centers will emerge at the station areas of Mindanao Railway and Davao mass-transit system line except Calinan Urban Center (Figure 9.2.3). The transit-oriented development (TOD) at the station will lead the economic development in the districts. The development concept of each urban center is shown in Figure 9.2.4. The areas within 200m away from the station will accommodate more commercial and institutional development while the residential areas locate farther than 200m radius from the stations. Since the open space or parks and recreation areas are lacking in the city, it is recommended to provide those areas around the stations.



Source: IM4Davao Team

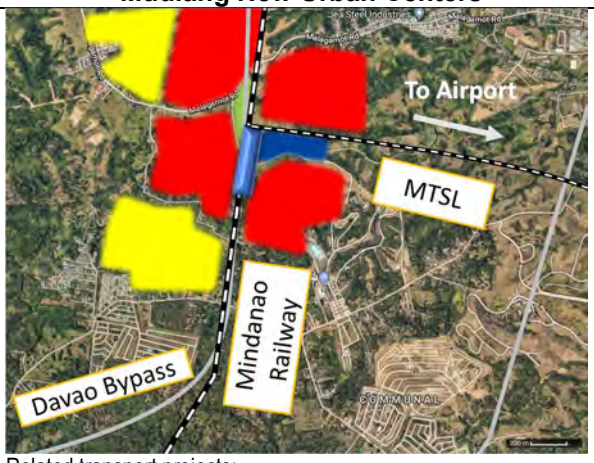
Figure 9.2.3 Future Transport Network

Davao Terminal Station TOD



Related transport projects:
- Davao City Diversion Road (extension)
- Mindanao Railway
- Davao MTSL

Mudiang New Urban Centers



Related transport projects:
- Davao – Panabo Bypass
- Mindanao Railway
- Davao MTSL

Bunawan New Urban Center

Related transport projects:
- Davao – Panabo Bypass
- Mindanao Railway

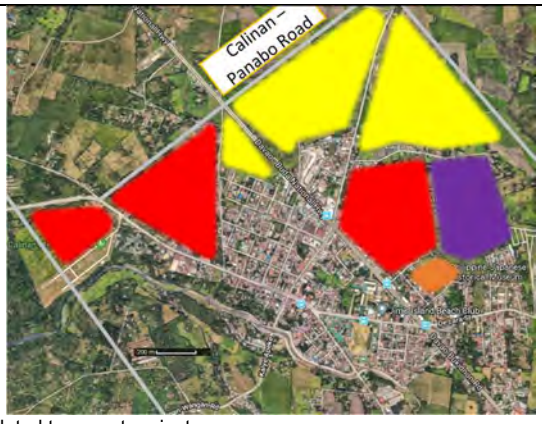
Mintal Science Park and Institutional Center

Related transport projects:
- Mindanao Railway
- Davao MTSL

Toril Agro-indstury Center

Related transport projects:
- Mindanao Railway
- Davao MTSL

Calinan Sub-center



Related transport projects:
- Calinan – Panabo Road
- Other secondary roads

Legend: Residential | Commerical | Industrial | Institutional | Parks/Open Space | Tourism

Source: IM4Davao Team

Figure 9.2.4 Concept of Urban Centers

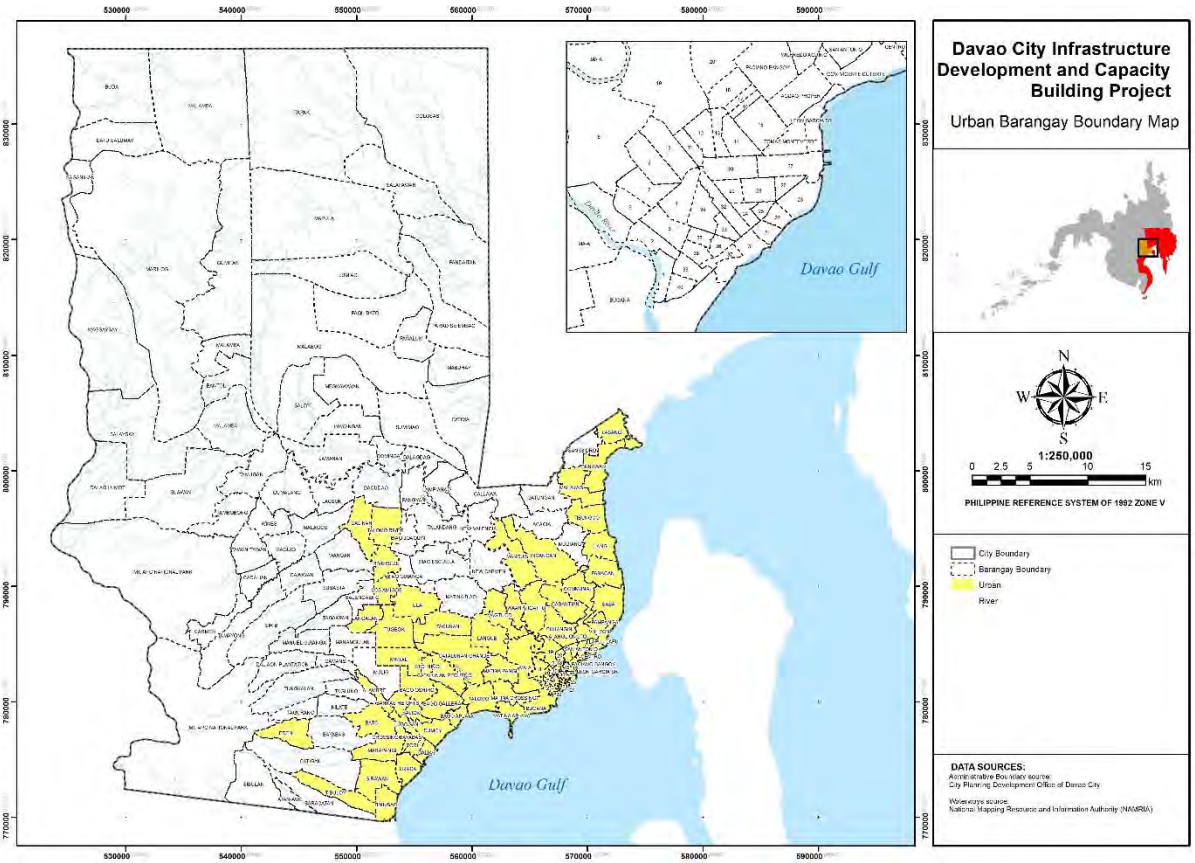
9.3 Land Use Plan for the Year 2045

1) Methodology of Urban Land Use Plan

9.49 The following sections discuss the various analyses conducted by the IM4Davao Team in order to prepare the land use plan of Davao City in 2045.

(a)Coverage

9.50 Using the land use demand projected by IM4Davao Team in ***Chapter 8.3***, various GIS operations and analyses were used to formulate the urban land use plan for 2045. The planning area is limited to the urban barangays of Davao city as shown in Figure 9.3.1.



Sources: DCPDO, IM4Davao

Figure 9.3.1 Planning Area for Land Use 2045 (Urban Barangays)

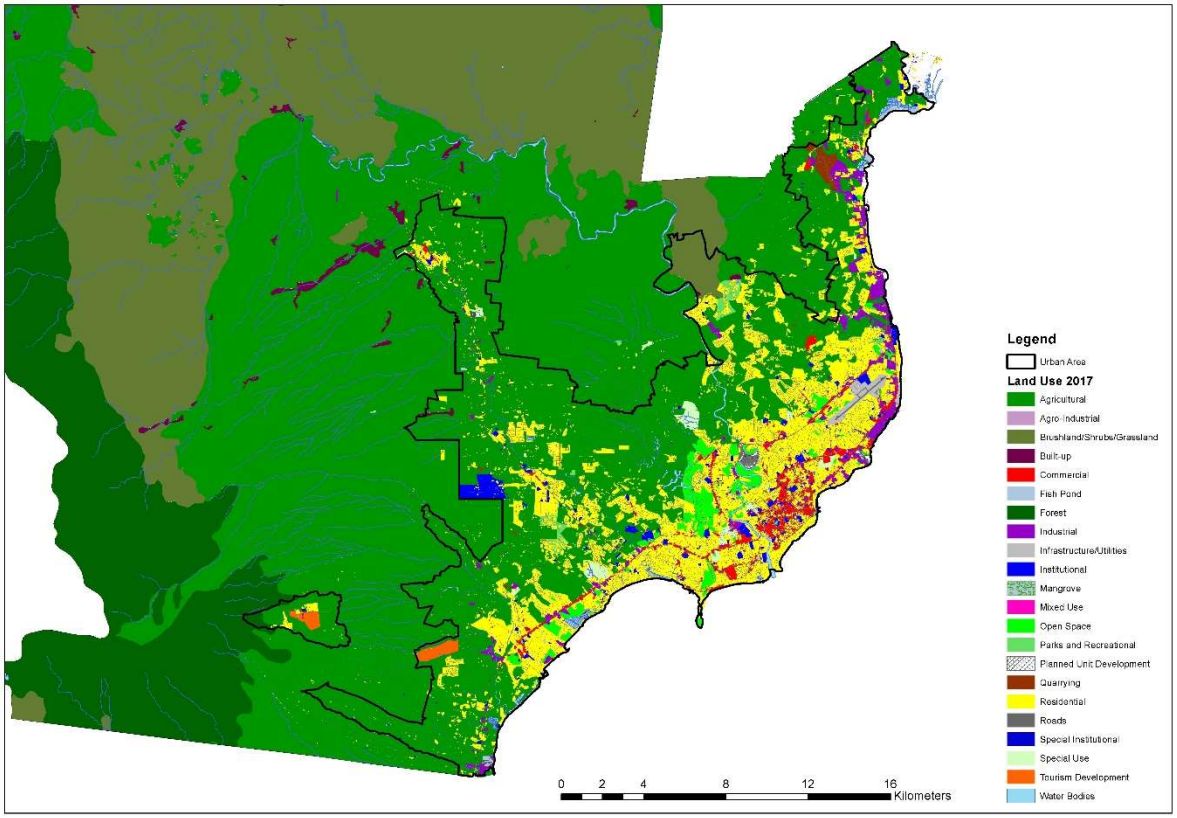
9.51 The following future land uses are included in the preliminary results of planning land use in 2045:

- Water Areas in 2045
- Open Space Areas in 2045
- Institutional Areas in 2045
- Industrial Areas in 2045
- Commercial Areas in 2045
- Residential Areas in 2045

9.52 In order to formulate land use in Davao City in 2045, the following data were used:

- Land Use Suitability tables formulated by the IM4Davao Team

- Future road and rail transport projects collected from various agencies
- Hazard Data collected from various sources:
  - Landslide (MGB)
  - Storm surge (DREAM)
  - Earthquake (PHIVOLCS)
  - Flood (DREAM/MGB)
- Topographic Data from NAMRIA
- Road Data from DPWH, Davao CPDO, OSM
- Land use map of 2017 developed by IM4Davao Team (Figure 9.3.2)

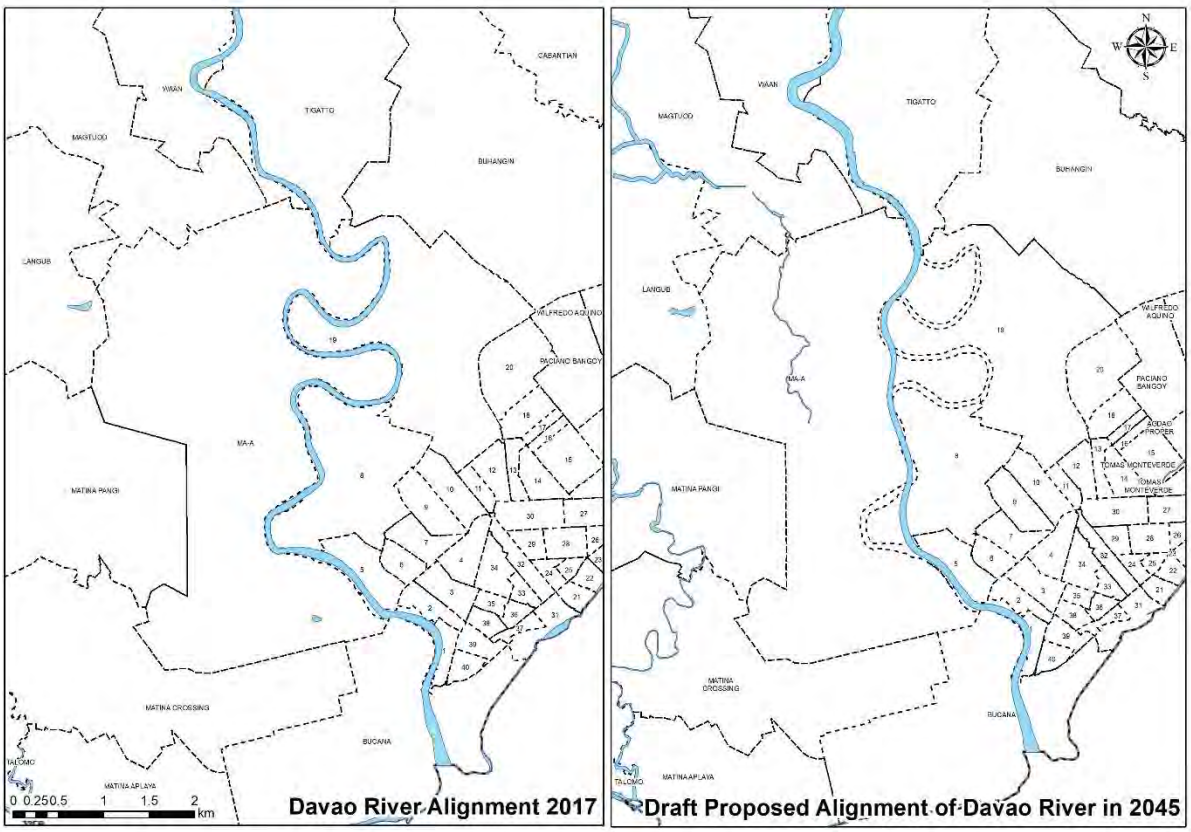


Source: IM4Davao Team

Figure 9.3.2 Land Use Map of 2017

(b) Water Areas in 2045

9.53 By 2045, the IM4Davao Team proposes the realignment of Davao River for flood control purposes and to open up more land for urban use. The draft proposed river alignment is shown in Figure 9.3.3.



Source: IM4Davao Team

Figure 9.3.3 Side by Side Comparison of Davao River Alignment in 2017 and Draft Proposed Realignment of Davao River in 2045

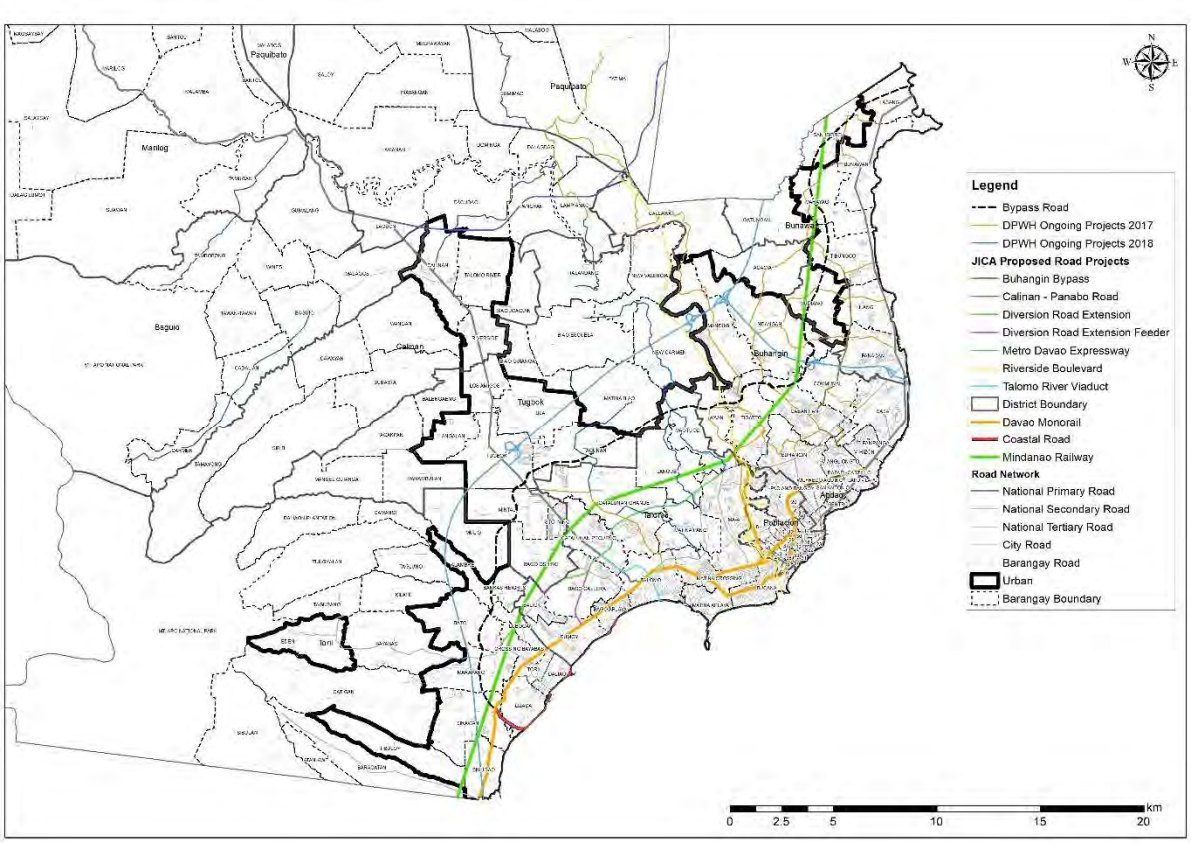
(c)Transportation in 2045

9.54 **Roads:** In addition to existing roads in 2017, the following planned road projects were projected to be part of the road network in 2045:

- Diversion Road Extension
- Bypass Road
- Calinan-Panabo Road
- Coastal Road
- Coastal Road Extension
- Davao Riverside Boulevard
- Buhangin-Banawan Bypass Road
- Davao Expressway
- DPWH projects (2017/2018)

9.55 **Railway:** Two future railway projects were considered in the land use plan in 2045, these are the following:

- Mindanao railway alignment and stations
- Davao Mass Transport System (MTS) and station proposed by IM4Davao Team

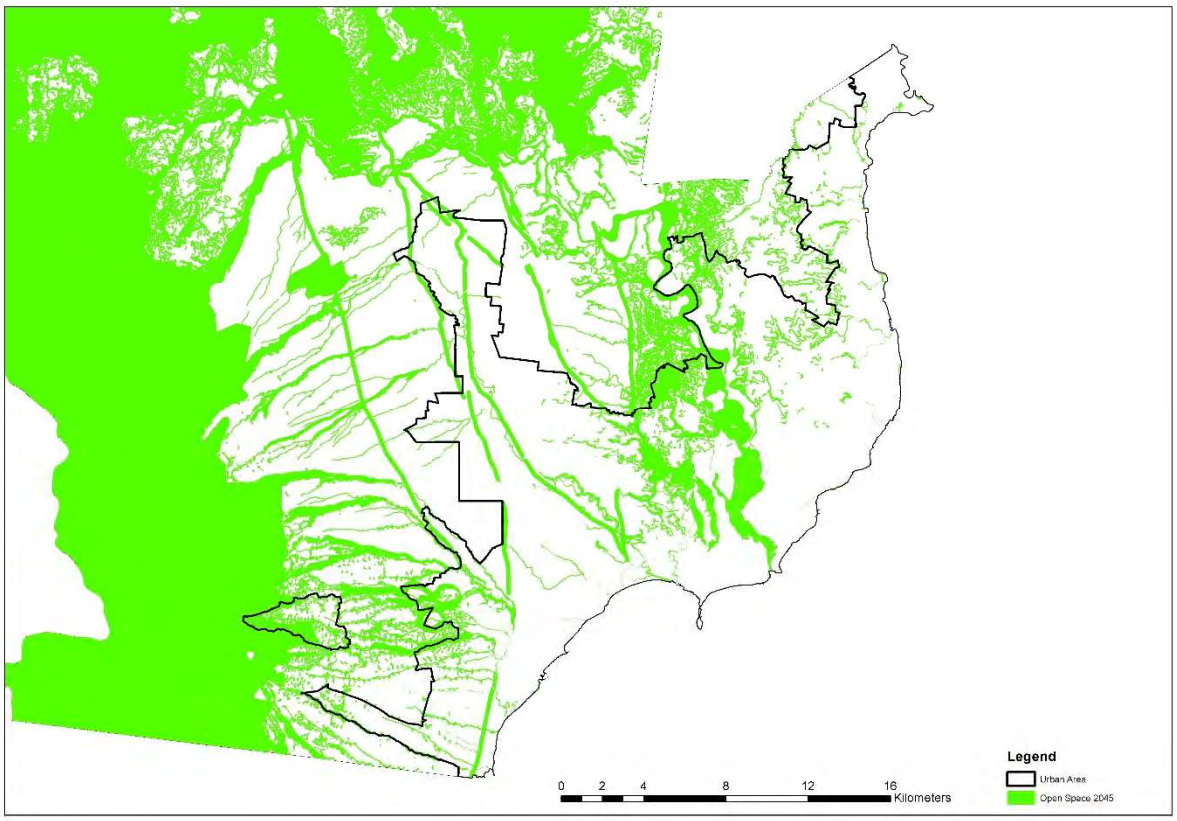


Source: ADB, DPWH, JICA, IM4Davao Team

Figure 9.3.4 Future Tansportation Network considered in the Land Use Plan for 2045

(d) Open Space Areas in 2045

9.56 In 2045, the IM4Davao Team proposes that unhabitable areas as delineated in the habitable lands analysis of the IM4Davao Team in ***Chapter 4.2*** be defined as open spaces in 2045. The following map show open spaces delineated from unhabitable areas analysis:

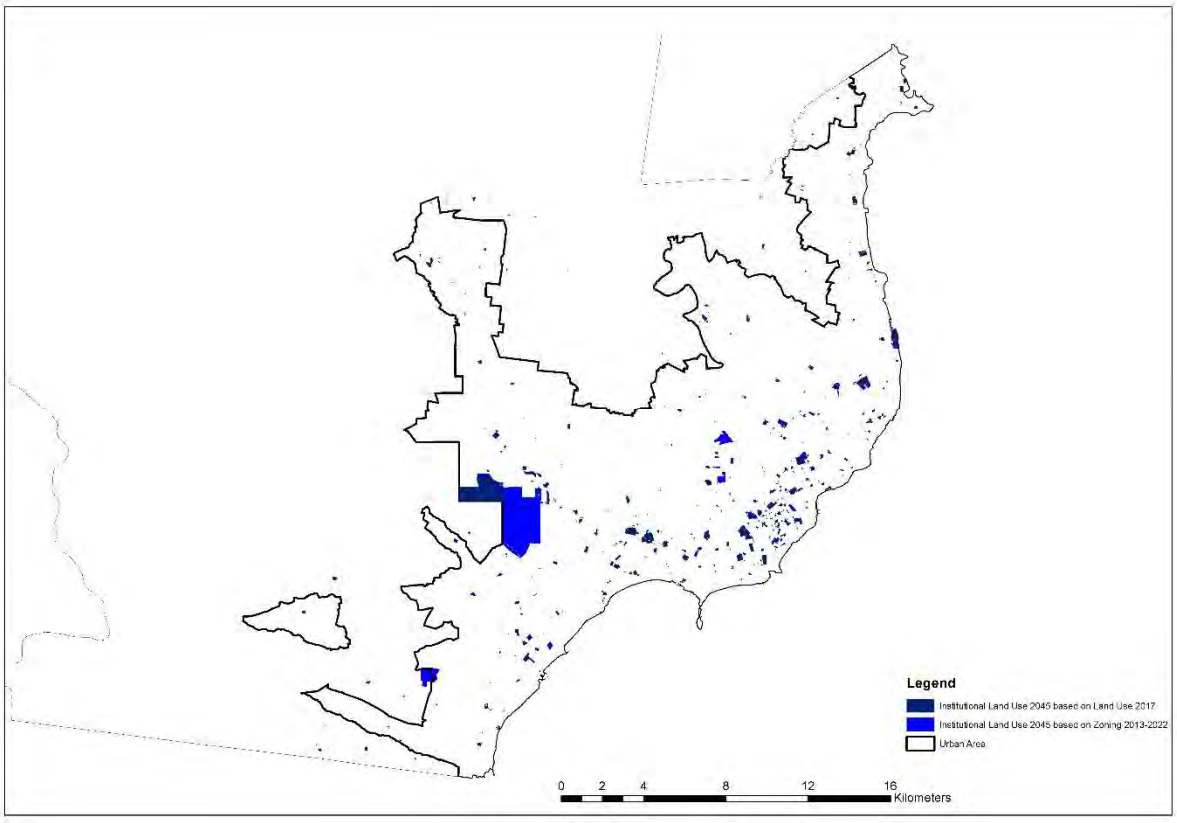


Source: IM4Davao Team

Figure 9.3.5 Open Areas in 2045 Defined from Unhabitable Lands

(e)Institutional Areas in 2045

9.57 Areas defined as institutional lands in the Davao Zoning maps (2013-2022) and existing institutional lands in the 2017 land use map will be kept as institutional lands in 2045. The following map shows the lands to be used as institutional in 2045.



Source: Davao City CLUP 2013 - 2022

Figure 9.3.6 Intitutional Lands in 2045 (Based on Zoning 2013-2022 and Land Use Map 2017)

(f) Industrial/Commercial/Residential Areas in 2045

9.58 A series of land suitability analyses were conducted to identify the most suitable areas for industrial, commercial and residential uses in 2045. Land suitability analysis basically consists of the following steps:

Step 1. Identifying categories and factors used for the suitability analyses

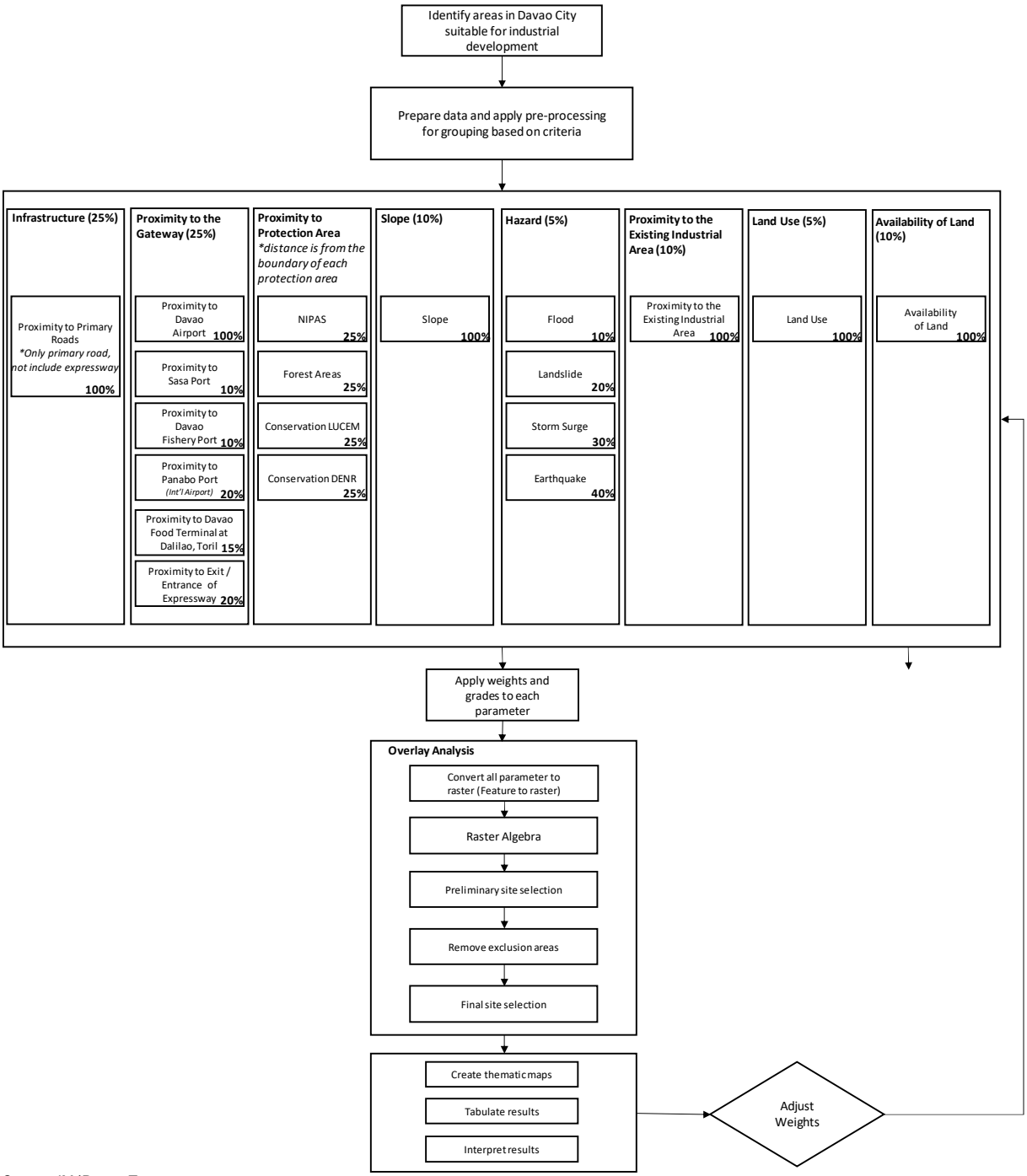
Step 2. Applying weights to each category and grades to each factor to be used in the analysis

Step 3. Preparation of GIS layers for each factor

Step 4. Overlay analyses using GIS to come up with suitability ratings

Step 5. Interpreting results of the suitability ratings, if the results do not satisfy the objectives of the analysis, the processes repeated from step 2

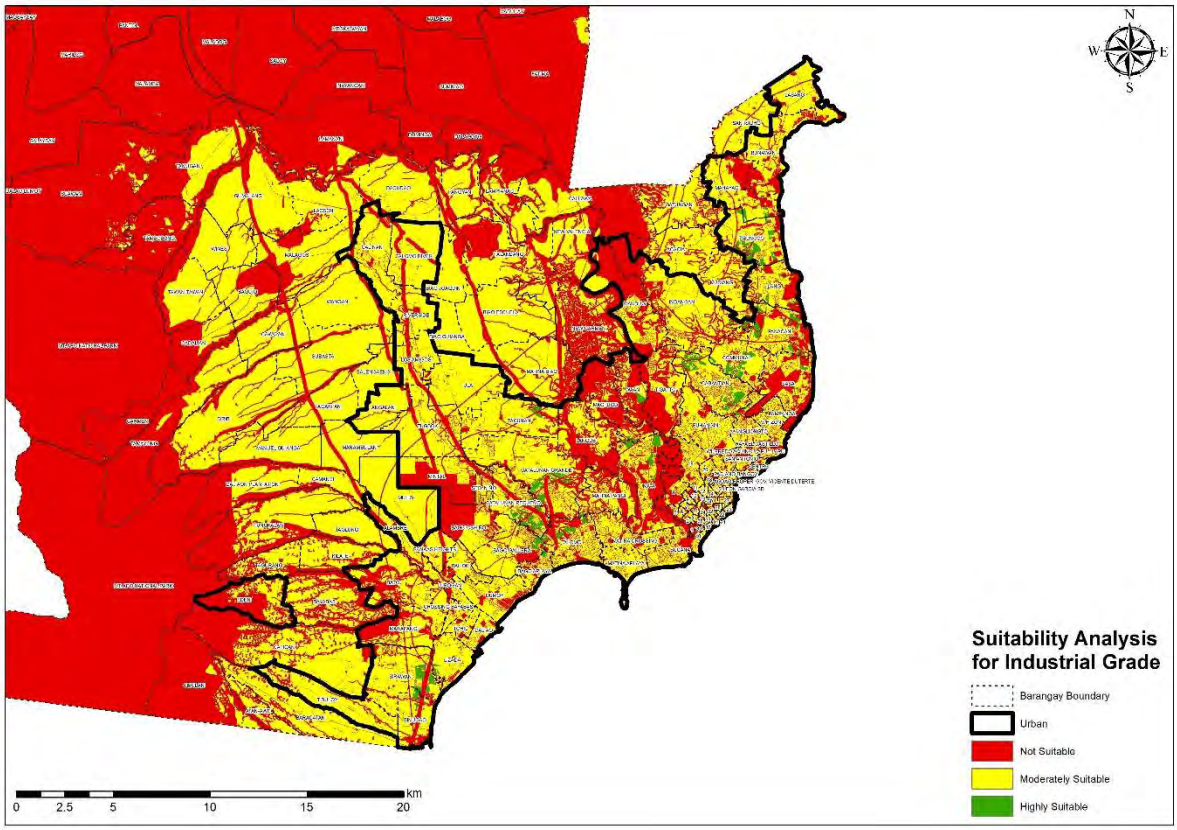
9.59 The following flowchart shows the process of suitability analysis for industrial use in 2045.



Source: IM4Davao Team

Figure 9.3.7 Flowchart of Suitability Analysis for Industrial Aeas in 2045

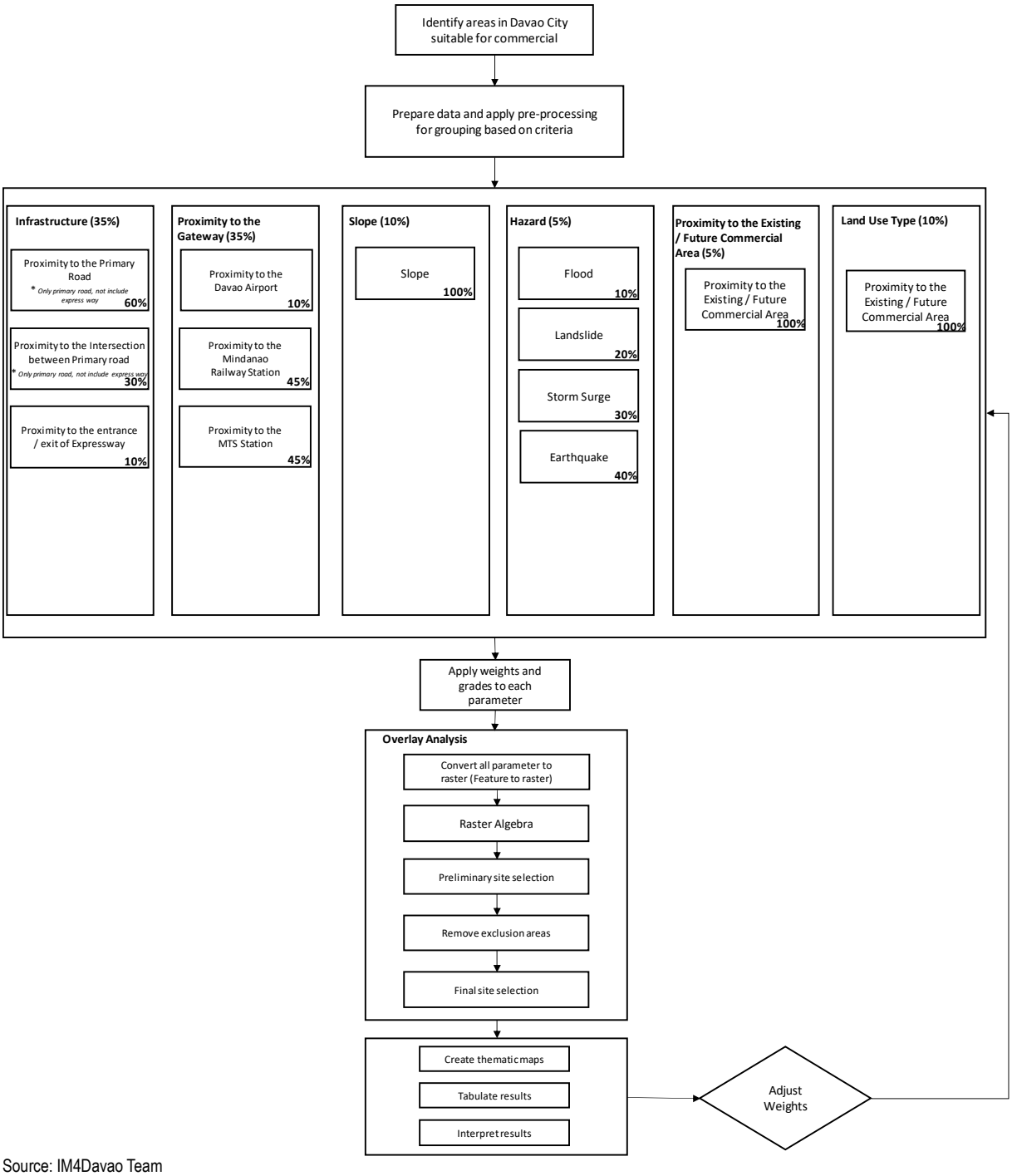
9.60 The following shows the results of suitability analysis for industrial use in 2045.



Source: IM4Davao Team

Figure 9.3.8 Suitability Map of Industrial Areas in 2045

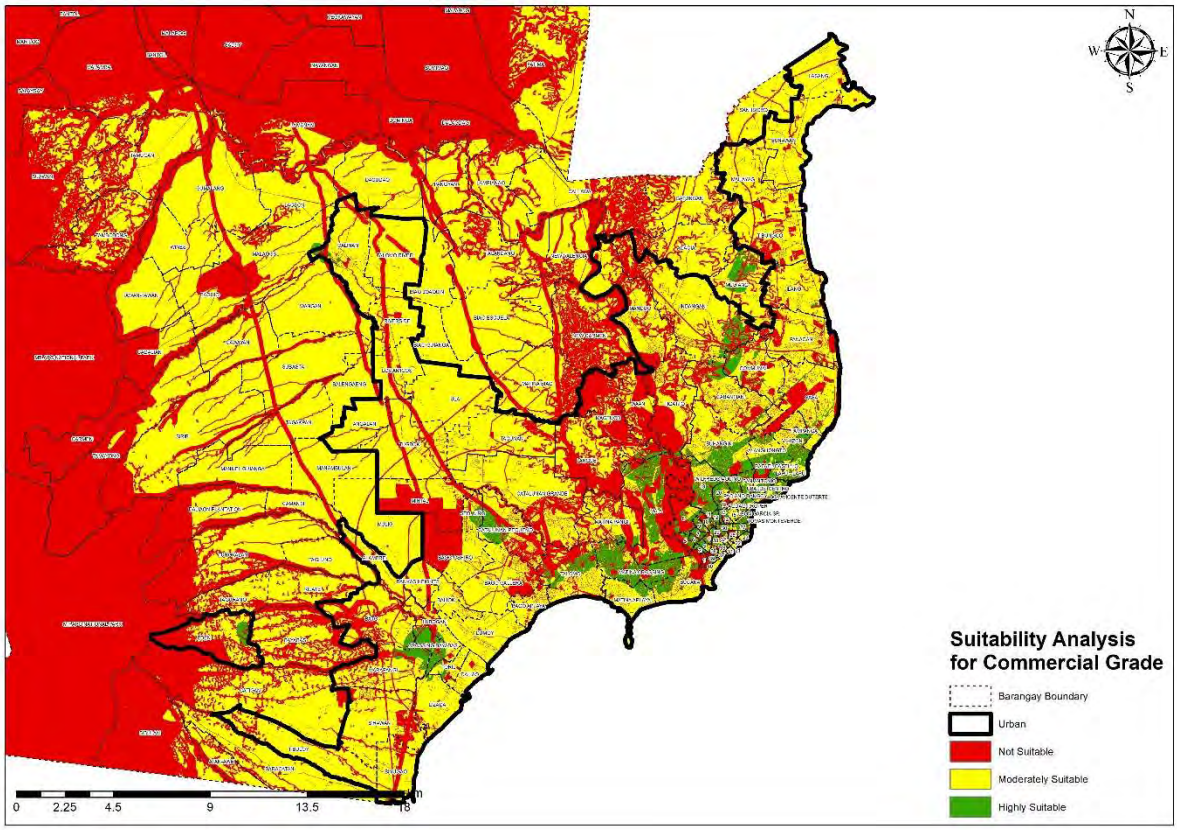
9.61 The following flowchart shows the process of suitability analysis for commercial use in 2045.



Source: IM4Davao Team

Figure 9.3.9 Flowchart of Suitability Analysis for Commercial areas in 2045

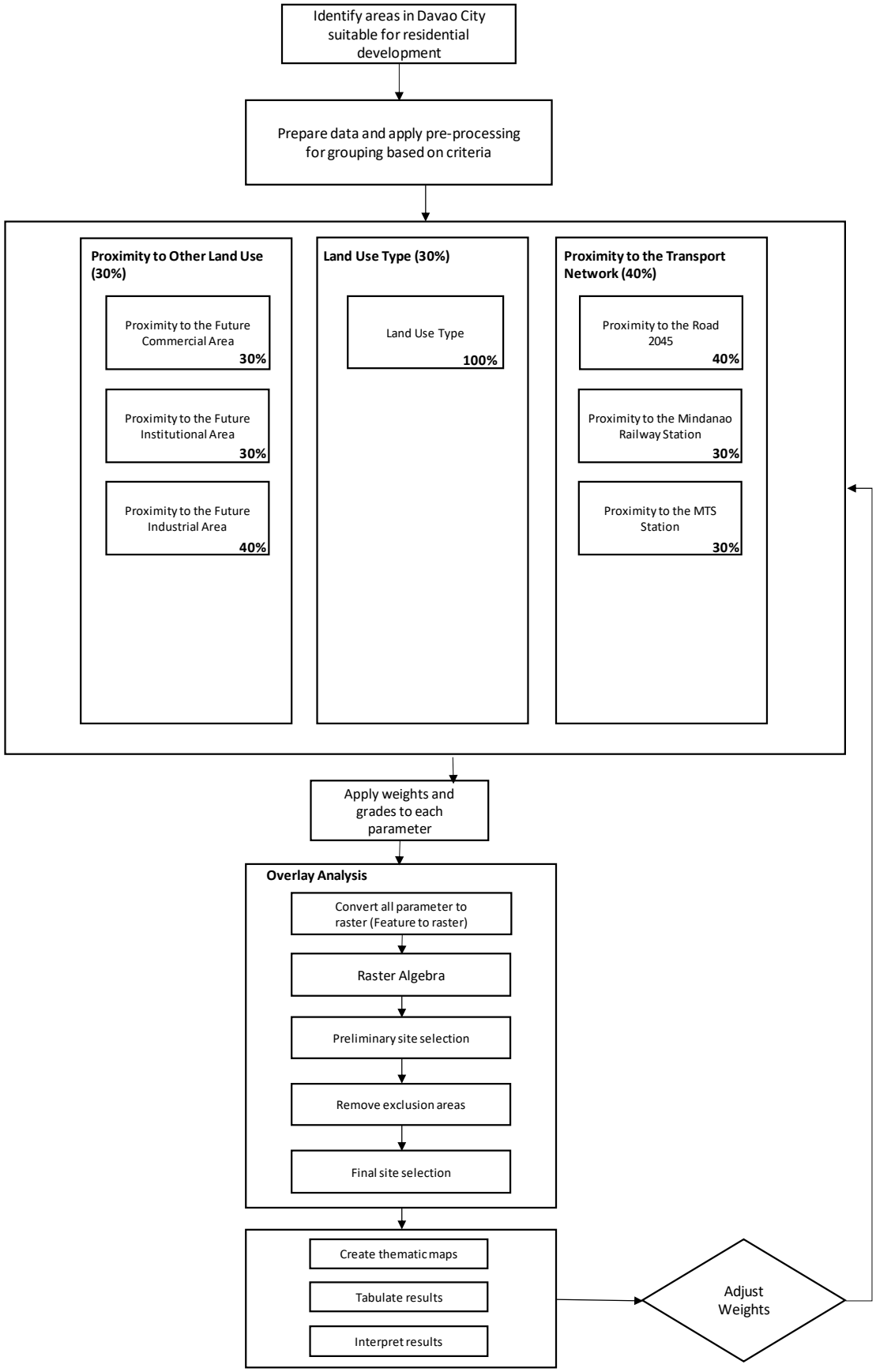
9.62 The following shows the results of suitability analysis for commercial use in 2045.



Source: IM4Davao Team

Figure 9.3.10 Suitability map of Commercial Areas in 2045

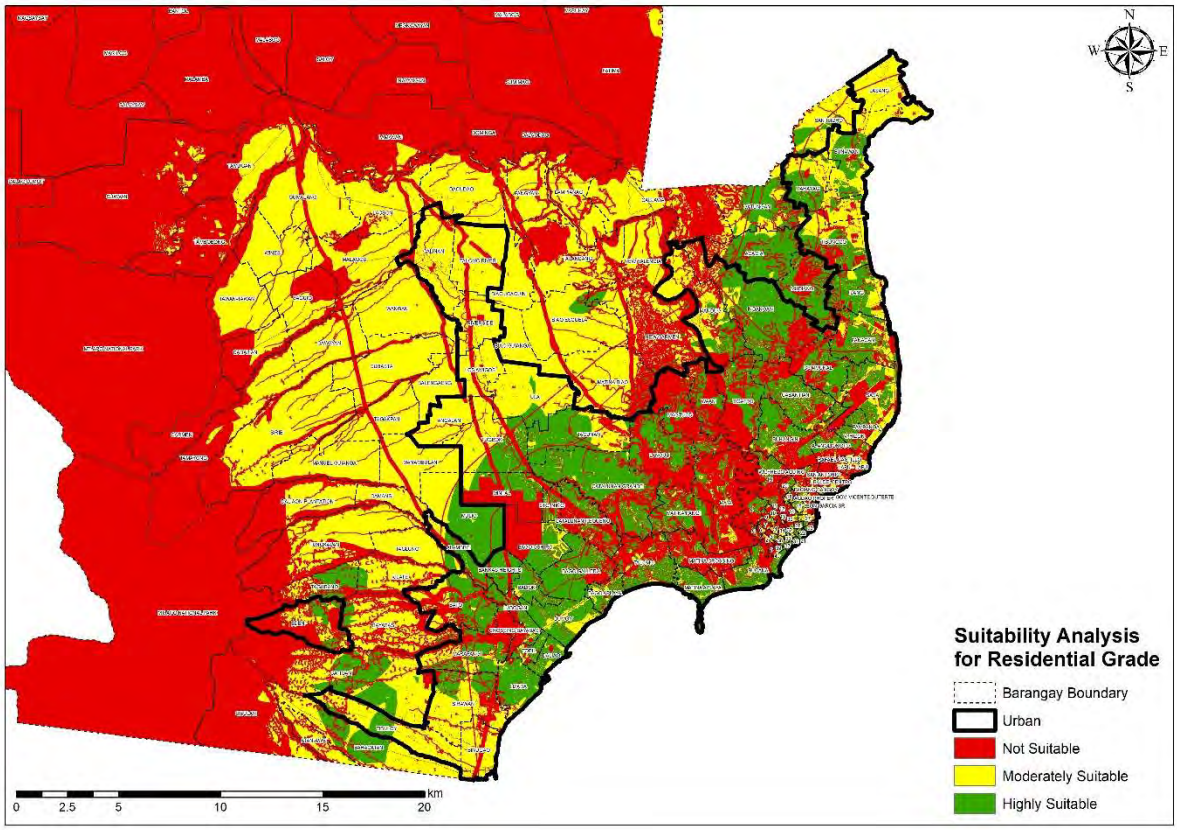
9.63 The following flowchart shows the process of suitability analysis for residential use in 2045.



Source: IM4Davao Team

Figure 9.3.11 Flowchart of Suitability Analysis for Residential Areas in 2045

9.64 The following shows the results of suitability analysis for residential use in 2045.

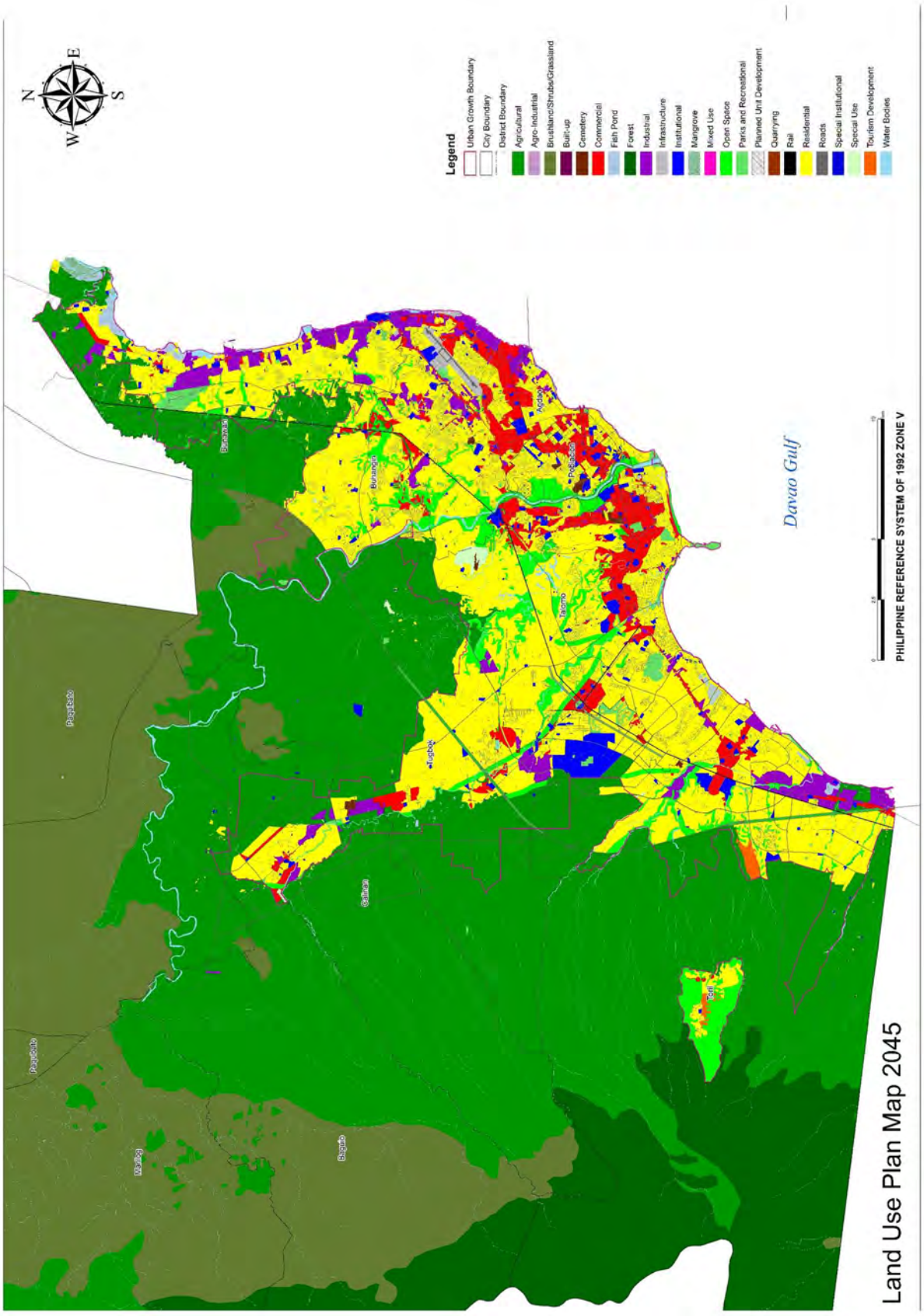


Source: IM4Davao Team

Figure 9.3.12 Suitability Map of Residential areas in 2045

2) Land Use Plan 2045

9.65 The results of the analyses for each land use in 2045 were then overlayed to come up with the land use plan of 2045. The results are preliminary and will undergo several iterations by the IM4Davao Team before finalizing the plan considering comments coming from the different experts of the IM4Davao Team. The following map shows the projected Land uses in 2045.



Source: IM4Davao Team

Figure 9.3.13 Davao Land Use in 2045

9.4 Implications to CLUP

1) Difference between the Proposed Land Use Plan 2045 and the Current CLUP

9.66 The target year and coverage of two plans are different. The target year of CLUP 2013 – 2022 is by 2022 and its coverage is entire Davao City. On the other hand, the target year of Land Use Plan 2045 of IM4Davao is by 2045 and its coverage is only limited to the urban areas of Davao City, which composed of eight districts (Poblacion, Agdao, Talomo, Buhangin, Bunawan, Toril and Calinan). Besides that, there are several differences between two land use plans.

9.67 **Planning Standards:** The base of land use planning, i.e., planning standards, is different (Table 9.4.1). Population density of residential areas is uniform for the entire area in CLUP 2013 – 2022 while it is varied by the location in Land Use Plan 2045 of IM4Davao. For the daily activity, the standard is similar. The standard for parks and open spaces is quite different between two land use plans.

Table 9.4.1 Physical Planning Standards

Land Use Type	CLUP 2013 - 2022	Land Use Plan 2045 of IM4Davao
Residential	200 m^2/household (=215 person/ha)	- City center: 400 persons/ha - Other growth center: 300 persons/ha - Extensive suburban areas: 200 persons/ha - Ongoing urbanized area: 100 persons/ha
Daily Activity	Commercial: 1.5 ha/1,000pop. (=15m^2/person) Industrial: 2.4ha/1,000pop. (=24m^2/person)	20m^2/person
Parks/Open Spaces	500m^2/1,000pop. (=0.5m^2/person)	9m^2/person
Infrastructure	-	15% of urban areas

Source: Davao CLUP 2013-2022, IM4Davao Team

9.68 **Land Use Classification:** Land use type in Land Use Plan 2045 of IM4Davao is simpler in terms of residential, commercial and industrial areas. Thus, there is no category by density or types of business. In addition, high hazard areas are allocated for open spaces in Land Use Plan 2045 of IM4Davao instead of assigned as hazard mitigation areas.

9.69 **Transport Network:** Proposed transport network will be the breakthrough for Land Use Plan 2045 of IM4Davao. Therefore, all proposed transport projects composed of railway and road projects are included in the land use plan. This network is totally different from the one in CLUP 2013 – 2022.

9.70 **Davao River:** The alignment of Davao River will be modified under Land Use Plan 2045 of IM4Davao. In related with this, the adjacent areas of Davao River will be utilized for open spaces, parks and recreational areas and residential areas especially for socialized housing.

2) Implications to CLUP

9.71 Based on the overall assessment, a polycentric urban development strategy has been recommended for Davao City's further growth. It identifies a number of urban centers and sub-centers that are envisioned to serve as counter-magnets to the traditional Davao central business district which is becoming more and more congested. Directly linked with key transport projects, these alternative centers are aimed to deconcentrate Davao's

further urban growth and cater to the demand for new developable land.

9.72 In order to enhance and facilitate the implementation of this plan, the following actions are recommended:

(i) Integrate the proposed urban centers and sub-centers in the Davao City Comprehensive Land Use Plan (CLUP) and Comprehensive Development Plan (CDP), and ensure the allocation of appropriate funds for the related capital investment projects through the Local Development Investment Plan (LDIP) and Annual Investment Plan (AIP).

(ii) In order to enhance enforcement of the desired land uses and public facilities, more detailed land use plans and explicit development guidelines (e.g., parking, FAR, drainage system, etc.) should be prepared for each of the identified urban centers and sub-centers, taking into consideration the interests and concerns of the landowners concerned and the transit stations that can serve as the transport nodes of these centers.

(iii) Each of the aforementioned detailed plans and guidelines should include an explicit implementation strategy and timeline, including especially the funding or financing of the necessary capital investment projects. It is essential to delineate the responsibilities for funding/financing and implementation of the private landowners, the national government, and the Davao City Government.

(iv) The attractiveness of the identified urban centers and sub-centers to investors and business locators can be significantly enhanced if the Davao City Investment Incentives Code is aligned with the plans and implementation strategies. It is also recommended that the Board of Investments (BOI) and Philippine Economic Zone Authority (PEZA) also target the identified urban centers for the provision of their investment incentives.

(v) The detailed plans should also include the appropriate network of secondary or collector roads to ensure connectivity among the individual privately owned land parcels, as well as provide the public right-of-way for the drainage and other utility trunk-lines. This road network should be integrated into the CLUP and Zoning Ordinance so that landowners concerned can be required to implement the segment traversing their properties when they apply for a development permit.

(vi) The inclusion of affordable housing in the identified urban centers and sub-centers should be considered, linking this with the resettlement of the informal settler families presently occupying hazard prone and other high-risk areas. This may require the purchase by the Davao City Government of land for the development of the resettlement sites. Alternatively, the Davao City Government may opt to adopt an ordinance requiring real estate developers to construct the 15% Balanced Housing requirement within the identified urban centers.

(vii) The preparation of the detailed plans and development guidelines is best undertaken with the involvement and participation of the private landowners concerned in order to help ensure that their particular interests and concerns are incorporated into the plans and thus foster their support of its implementation.

10 ECONOMIC AND INDUSTRIAL DEVELOPMENT PLAN

10.1 ***Chapter 10*** describes the plan on industrial development and investment promotion for Davao City from a long-term perspective. It gives an overview of the city's long-term economic and industrial plan, discusses the directions to be followed for some of the city's 10 investment priority sectors, and proposes some potential projects in these sectors. Finally, it recommends improvements in the investment promotion strategy for the city in line with the economic and industrial development plan.

10.1 Economy and Industry Development Framework

1) Future Labor Force by Major Industrial Sector

10.2 In ***Chapter 8*** of this report, Davao City's projected employment in 2045 is estimated under the SGMP method. Table 10.1.1 presents the result of this estimation by industry sector. The total number of employed persons will be 1,863,427. Of this, the top contributor is the tertiary sector (59.2%), followed by the secondary (22.8%) and primary (18.0%) sectors.

Table 10.1.1 Estimation of Employment in 2045 by Sector in Davao City (SGMP Method)

	Workers at Work Place			
	Primary Sector	Secondary Sector	Tertiary Sector	Total
Employed	335,593	424,135	1,103,699	1,863,427
Share (%)	18.0	22.8	59.2	100.0

Source: IM4Davao Team (excerpted from ***Chapter 8***).

2) Future Workplaces by Administrative District

10.3 Table 10.1.2 shows the projected employment in 2045 by industry sector and by administrative district. The top three districts generating the highest employment in the agriculture, fishery and forestry sector are Paquibato, Marilog and Calinan. Talomo, Buhangin and Toril will employ the most number of workers both in the manufacturing and the services sector. Bunawan will also be a significant generator of manufacturing employment while Poblacion will be another major services sector employer.

Table 10.1.2 Estimation of Employment in 2045 by Administrative District and by Sector in Davao City (SGMP Method)

Administrative District	Workers at Work Place			
	Primary Sector	Secondary Sector	Tertiary Sector	Total
Agdao	0	16,611	43,353	70,746
Poblacion	-	20,943	100,452	121,395
Tugbok	29,008	21,887	81,766	132,661
Toril	28,697	94,702	131,660	255,329
Talomo	8,900	101,335	384,216	494,451
Paquibato	109,117	1,085	1,237	111,439
Marilog	90,183	2,289	42,193	134,665
Calinan	43,547	6,381	9,291	59,219
Bunawan	9,693	60,940	50,072	120,705
Buhangin	13,097	95,883	257,105	366,085
Baguio	3,292	2,079	2,354	7,725
Total	335,593	424,135	1,103,699	1,863,427
Share (%)	18.0	22.8	59.2	100.0

Source: IM4Davao Team (excerpted from ***Chapter 8***).

3) Investment Forecast

10.4 This section attempts to estimate the amount of investments in Davao City in 2045. As of this writing, CPDO is validating the data on registered capitalization of all business establishments issued with business permits by the City's Business Bureau between 2013 and 2016.[1] Preliminary results of this validation exercise indicate a revised total investment amount of PHP176 billion in 2016 (Table 10.1.3), with the tertiary sector contributing 92.6%, followed by the secondary sector (6.9%) and the primary sector (0.5%). By district, Poblacion has the largest share of investments (54.2%), followed by Buhangin (18.8%), Bunawan (8.4%), and Toril (7.1%).

10.5 The estimation of investment levels in 2045 involves a two-step process. First, the capitalization per unit of employment (number of workers at the workplace) was derived from the above validated 2016 capitalization and the latest (2015) employment figures. Then these unit amounts were multiplied by the projected employment in 2045 (SGMP method) to calculate the projected capitalization in that year. It is estimated that total investments (or registered capitalization of business establishments) will be PHP591.3 billion by 2045. This translates to an average increase of about 8% per year over the 29-year planning period. A similar pattern of sectoral allocation of investments is observed, with the services sector still contributing the bulk of investments.

Table 10.1.3 Projected Investments in 2045, by Sector

Congressional District	Administrative District	Registered Capitalization 2016 (PHP mil.)			
		Primary Sector	Secondary Sector	Tertiary Sector	Total
1	Poblacion	64.0	167.2	95,245.4	95,476.6
	Talomo	25.6	686.9	11,585.1	12,297.6
2	Agdao	28.2	136.9	5,550.5	5,715.6
	Buhangin	48.5	268.9	32,791.2	33,108.6
	Bunawan	31.1	1,390.9	13,321.8	14,743.8
	Paquibato	0.5	0.7	7.8	9.0
3	Baguio	10.1	3.3	278.1	291.4
	Calinan	453.0	55.9	663.0	1,171.9
	Marilog	5.8	1.8	54.1	61.8
	Toril	181.5	9,261.2	3,063.6	12,506.3
	Tugbok	67.8	201.2	485.4	754.5
(1) Total Capitalization 2016		916.2	12,174.9	163,046.0	176,137.0
(2) Workers at Work Place 2015		0.243	0.108	0.332	0.683
(3) Capitalization per Unit of Employment (1) / (2)		0.004	0.113	0.491	0.258
(4) Workers at Work Place 2045 (SGMP Method)		0.336	0.424	1.104	1.863
(5) Capitalization 2045 (3) x (4)		**1,263.0**	**47,907.0**	**542,087.9**	**591,258.0**

Source: IM4Davao Team using business capitalization data from Davao City Business Bureau and employment data from PSA-XI.

[1] Current Davao City official figures place total investments at PHP230 billion as of 2016. However, a review of business permit records revealed that there were many instances of multiple counting/ overlapping of capitalization amounts. Thus, the validation process is ongoing.

10.2 Development Plans of Davao City's Priority Sectors

10.6 As discussed in ***Chapter 5***, the city is focusing its development efforts on its 10 priority investment sectors. While all these will contribute to the city's socioeconomic development in the medium and long term, the IM4Davao economic and industrial plan will include the sectors deemed most critical to sustainable industrial development such as agribusiness/ agro-industry, ICT, tourism, low-carbon energy, and transport and logistics. The recommended directions and strategies for the development of these critical sectors are discussed in the following sections.

1) Agribusiness and Agro-Industry

(a) Sector Overview

10.7 Davao City should continue capitalizing on its strength and competitive advantage of having huge tracts of fertile land and the right climate suitable for agriculture. Some 67,000 ha of its land are devoted to agriculture and further expansion of production areas can be made using its 110,000 ha of grassland and pasture areas. It can produce a wide variety of agricultural commodities in areas suitable for tropical and semi-temperate to temperate crops because of the availability of high elevation, low temperature, and low and high temperature agricultural sites. Aside from maintaining its traditional agricultural sectors, such as banana, coconut, major fruits (e.g., mango, durian, pineapple, and pomelo), livestock, fish and seafoods, the city should also focus on further developing these agricultural products beyond their traditional fresh markets. This means adding value to these commodities through processing for both the domestic and export markets. The worldwide trend of changing to more health-conscious lifestyles has triggered the emergence and growth of consumer markets for organic foods, snack foods, and health and beauty supplements from fruits and vegetables, ready-to-eat meals (e.g., microwaveable and quick frozen), condiments, medicines, pet food, etc. Aside from the food industry, rapid industrialization in many countries has spurred the demand for various kinds of agro-industrial products (e.g., coconut-based activated carbon, organic fertilizers, and natural fiber-based industrial products). While local producers have begun to go into these emerging industries in the last few decades, the worldwide market demand for such products has grown tremendously in more recent years due to changing lifestyles, growing affluence, rapid industrialization, etc. Davao City is, therefore, envisioned to take this leap from traditional agriculture to a dynamic agribusiness industry.

10.8 Agribusiness and agro-industrial development requires upgrading the value chains (VCs) for the agri-based products involved. These VCs should determine the specific hard and soft infrastructure support needed in each link of the VCs, from farm production to packaging and delivery of the finished products in the target markets. Aside from its traditional crops, the City has promising prospects to continue developing its industries for initially the following agribusiness subsectors identified in the Davao City Commodity Investment Plan (CCIP) 2015-2018:[2] (i) cacao, (ii) Cardava banana, (iii) cassava, (iv) abaca, and (v) rubber. This requires addressing technical, financial and institutional constraints confronting these sectors across their respective VCs.

[2] The CCIP is based on an earlier study done with DA (under its World Bank-assisted Philippine Rural Development Project) and the Davao City Development Council. It identified priority commodities ranked high through the Expanded Vulnerability and Sustainability Analysis Tool which looks into the value of the commodity, production aspects, number of farmers, area planted, and poverty incidence.

10.9 Cacao will continue to be a major agribusiness industry in Davao City in the medium to long term. In 2020, it is forecasted that there will be a production shortfall of 1.0 million MT of cacao beans worldwide. To take advantage of this market opportunity, the Philippine government prepared its 2020 Cacao Challenge which aims to produce 100,000 MT (or 10% of the projected world supply gap) of fermented cacao beans by 2020 (Table 10.2.1).

Table 10.2.1 Production Schedule of the Cacao 2020 Challenge

Production Year	National Production @40% Growth Rate (MT)	Davao Region @70% Share (MT)
2013	10,000	7,000
2014	14,000	9,800
2015	19,600	13,700
2016	27,500	19,200
2017	38,400	26,900
2018	53,800	37,600
2019	75,300	52,700
2020	105,400	73,800

Source: Davao Region Industry Clusters Roadmaps, 2014-2030, RDC XI.

10.10 Mindanao had a share of around 90% of the national cacao production of 6,262.8 MT in 2016, with the Davao Region contributing 81% (5,073 MT).[3] Both national and regional production levels were short of the target volumes of 27,500 MT and 19,200 MT, respectively. In order to achieve the target figures of the 2020 Cacao Challenge, the industry needs to take advantage of the opportunities and address the bottlenecks/constraints indicated in Table 10.2.2. While there are a lot of opportunities in terms of market demand, availability of production resources (e.g., land and farmers), technology and support services, there are challenges mainly in the area of productivity, skills, product quality, cost of inputs and transport, and access to finance.

Table 10.2.2 Opportunities and Constraints in Davao City's Cacao Industry

Value Chain Function	Opportunity	Constraint	Cross-cutting Issue
Consolidating/ Exporting	• Chronic undersupply in domestic production • Stable demand with upward trend	• High transport cost due to poor conditions of most farm-to-market roads leading to production areas	Opportunity: • Institutionalization of branding as part of industry-wide quality assurance system and marketing strategies
Processing	• Underutilized capacity • Opportunities for tolling services • Presence of support facilities	• Limited supply of beans • Low value-added (for beans exporting/ trading) • Lack of food-grade equipment for processing into chocolate (expensive and small farmers cannot afford)	
Trading	• Presence of consolidators/ exporters • Continuous entry of new players resulting in healthy competition	• Low level of awareness on product quality and compliance with standards • Farmers' lower bargaining power	
Fermentation/ Drying	• Premium price for fermented and certified cacao beans	• Inadequate drying and fermentation facilities • Inadequate skills in cacao fermentation and drying • Lack of post-harvest facilities (e.g., mechanical driers)	
Production	• Large coconut and banana areas available for intercropping	• Poor resources of farmers • Low-level productivity of farms	Constraint: • Limited/ Poor

[3] http://www.cidami.org/philippine-2020-challenge/ and http://www.mindanews.com/top-stories/2017/07/davao-region-now-the-countrys-cacao-and-chocolate-capital2/ (accessed on 29 September 2017).

Value Chain Function	Opportunity	Constraint	Cross-cutting Issue
	• Availability of most favorable location for cacao • Presence of Mars Cacao Development Center (MCDC) • Availability of government support programs	• Low-level of technical skills and knowledge • Lack of irrigation facilities in production areas	access to financing
Nursery Operation	• Extensive R&D of USM for varietal improvement • Good germplasm	• Inadequate supply of good quality seedling materials • Proliferation of non-accredited nurseries	
Input Supply	• Availability of inputs supplier	• High cost of farm inputs	

Source: IM4Davao Team based on Davao Region Industry Clusters Roadmaps, 2014-2030; Interview with CIDAMI (February 2017).

10.11 While Davao Region is already an established leader in the production and marketing of Cavendish banana, it is equally asserting its position as the country's leader in the Cardava banana industry. Cardava banana is a variety required for processing into chips, flour, and frozen (individually quick frozen or IQF) whole bananas (Figure 10.2.1). The Davao Region, especially Davao City, is where most of the banana chip producers/ processors are located, marketing their products for both domestic and export markets. Local preparations from Cardava are for "turon," "banana cue," "maruya" and also mixed with local dishes. In 2016, Davao exported USD4 million worth of banana chips. Firms involved in the export of frozen whole banana require more raw materials as their markets in Europe and the Middle East are growing fast. Banana flour is a promising product especially from Cardava. It is even considered a super food since it contains potassium, magnesium, calcium and other amino acids and vitamins in contrast to traditional flour from wheat, corn, cassava, and other carbohydrate-based flours. It can be used as partial substitute for other flours in the preparation of cookies, bread, cakes, pizza crust, noodles and others to enhance taste and nutritional content. Likewise, together with other varieties like the Cavendish banana, this is currently used as major ingredient for the popular banana ketchup.

Source: Banana Cluster Report, DTI.

Figure 10.2.1 Some Products from Philippine Banana

10.12 Producers of Cardava banana are mostly small farmers, in contrast to the Cavendish variety which is grown by multinational companies and big investors in the region. Cardava farmers are projected to earn much from planting Cardava banana and even more if they also level up in the VC to do the commodity transformation or

processing into banana chips, powder, flour and other high value products. There are more available suitable areas to grow Cardava in Davao City given the push and support the industry needs.

10.13 Cassava is among the agricultural crops that have direct synergy benefits with other agricultural sectors. It is becoming a main ingredient for animal feeds and inasmuch as livestock and poultry is a major industry in Mindanao, the cassava processing sector has potential for growth in the future. This is evident in the substantial increase in cassava production in the city over the last several years, particularly in the major production areas in Marilog, Paquibato, Toril and Baguio.

10.14 Abaca has been a major crop in Davao City for decades. This is one crop where the Philippines is considered the key supplier in the world market, supplying 85% of global requirements. The huge and continuously growing demand for abaca is because of its versatility in terms of uses/ applications, including cordage, ropes and twines, pulp and specialty papers (e.g., electrolytic condenser paper, high grade decorative paper, tea bag, coffee filter, coffee cup, meat and sausage casings, special art paper, cable insulation paper, adhesive tape paper, currency paper, checks, cigarette paper, vacuum cleaner bag, etc.), fiber crafts, textiles/fabrics, composites for automobiles. More recently, it has been found to be the ideal insulator for spark plugs. Although the city is still currently a minor supplier (5%) of abaca in Davao Region, it still has large potential land for expanding its production.

10.15 Despite the modest production volume of rubber in Davao City, it has been identified as a priority commodity of the city considering the big domestic and international markets for rubber. It has been estimated that current production areas in Marilog, Toril, Calinan and Baguio can still be expanded by almost 20 times.

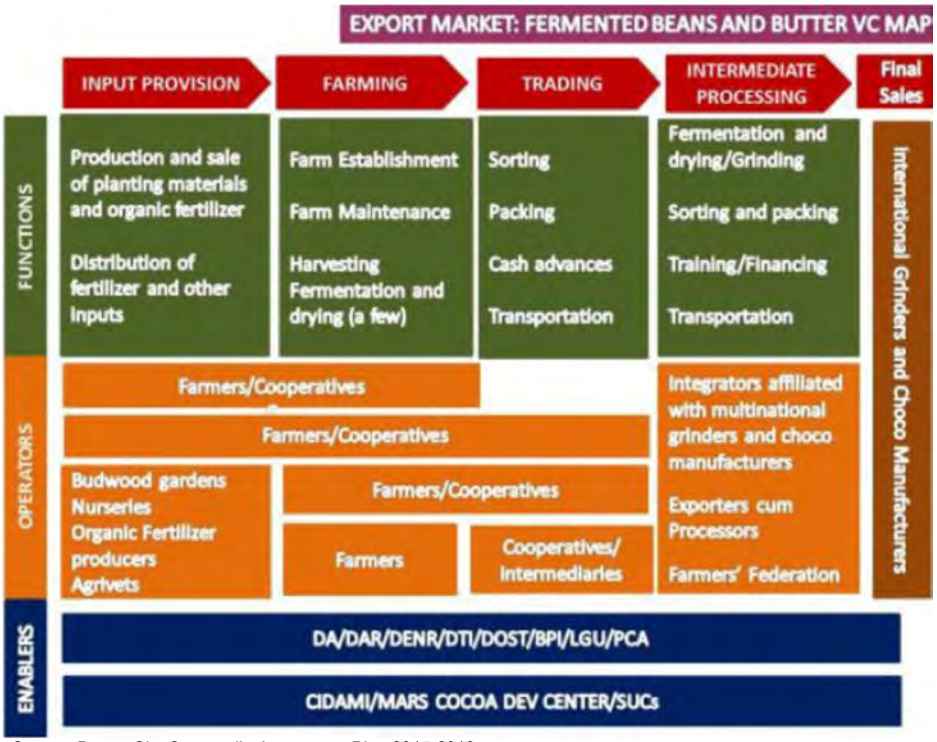
(b) Directions of Development

10.16 The overall goals of Davao City for its agriculture and agro-industrial sector are to (i) achieve food security; (ii) increase production and productivity of its priority crops especially those of high value and where it has comparative agro-climatic advantages and domestic/ international market opportunities; (iii) increase higher value processing of agricultural and agro-industrial products; and (iv) develop the sector in an environmentally friendly and sustainable manner. Achieving these goals entails the implementation of various strategies and interventions that encompass the agriculture/ agribusiness VC including the provision of quality seeds, planting materials, and production inputs; improvement of farming practices, skills and technologies; strengthening of farmers' and industry groups (e.g., cooperatives, industry development councils); research and development (R&D) support; expansion of market linkages and services; improvement of access to finance; higher value-added processing of produce and development of marketable products; and provision of agricultural support infrastructure and technical services. The following sections discuss the development directions of the 6 priority agri-based sectors identified in Davao City's CCIP (2015-2018) in the short, medium and long terms.

(1) Cacao Industry

10.17 The medium- to long-term goal of the cacao stakeholders in Davao City and Davao region is to help the Philippines become a globally competitive player in the cacao industry global VC by taking the lead in achieving the regional target production level of

70,000 MT by 2020 and sustain such growth thereafter. At least 30% of this should be sustainably produced and certified, and substantially improve farmers' income. These targets will be achieved by empowering cacao farmers and communities, strengthening relationships among industry stakeholders, providing adequate support facilities and services (e.g., shared service facility for cacao fermentation), improving productivity and quality assurance, and expanding export markets for higher valued semi-processed and processed cacao products. These strategies are part of the VC mapping prepared for Davao City's cacao industry (Figure 10.2.2). All of the VC players and enablers are present in Davao City. Key institutional users/ buyers are here, including some that are authorized buyers for international brands such as Mars Chocolate and popular Belgian brands. Recent developments have been encouraging, with some key integrators like Kennemer Foods Inc. extending contract growing schemes for wet beans buying, providing quality planting materials of grafted UF-18 variety as well as technical assistance to growers.



Source: Davao City Commodity Investment Plan 2015-2018.

Figure 10.2.2 Cacao Value Chain Map

10.18 There is a need to further strengthen collaboration efforts among industry enablers and other industry players. At the first stage, CIDAMI plays a pivotal role in promoting the cacao industry, with the assistance of relevant national government agencies (NGAs) and other development institutions such as the Agricultural Cooperative Development International and Volunteers in Overseas Cooperative Assistance (ACDI/VOCA). Although the 2013–2020 National Cacao Industry Strategic Plan was drafted in 2012, its implementation had remained slow.[4] This was partly because of the absence of an industry council. In this context, the Cacao Industry Council of Southern Mindanao (CICSMin) was created to spearhead the implementation of the strategic plan.

[4] Davao Region Industry Clusters Roadmaps, 2014–2030.

10.19 The stronger relationship among cacao industry players is evident in current collaborative programs among the City Government of Davao, DA, DTI, DOT, CIDAMI, and other government and private organizations in expanding the local industry. These include, among others, technical and financial support to cacao farmers' groups especially in Calinan, Tugbok, Baguio and Marilog districts to expand cacao production and improve quality standards; development by local processors of cacao-based products such as chocolate, cacao nibs, cacao tablea, cacao powder and powdered tea, cacao vinegar, etc.; improvement of product packaging and labelling; establishment in October 2017 of "Cacao City Café" beside People's Park, which serves as a café, showcase and retail store of locally-made chocolate and cacao-based products; holding of industry forums in Davao City (e.g., Kakao Konek 2017 Conference and Exhibit); participation of local chocolate manufacturers in international exhibitions and competitions for the chocolate industry;[5] and participation of cacao industry players in investment missions abroad. During the investment mission in November 2017 of the Davao City delegation led by Mayor Sara Duterte-Carpio to Kitakyushu City, Japan to sign a Green Sister City Cooperation, among the agreements initiated is for Davao City to supply cacao beans to be processed into chocolates in the Japanese counterpart city. To further boost Davao's image and position as the leading cacao player in the country, CIDAMI has requested Senator Cynthia Villar, who chairs the Senate Committee on Agriculture and Food, to sponsor a resolution to declare Davao City as the "Chocolate Capital of the Philippines."

10.20 These efforts to boost production volume, quality, domestic and export marketing of cacao beans and cacao-based products will continue to be pursued in the medium to long term by the city and Davao Region's industry stakeholders.

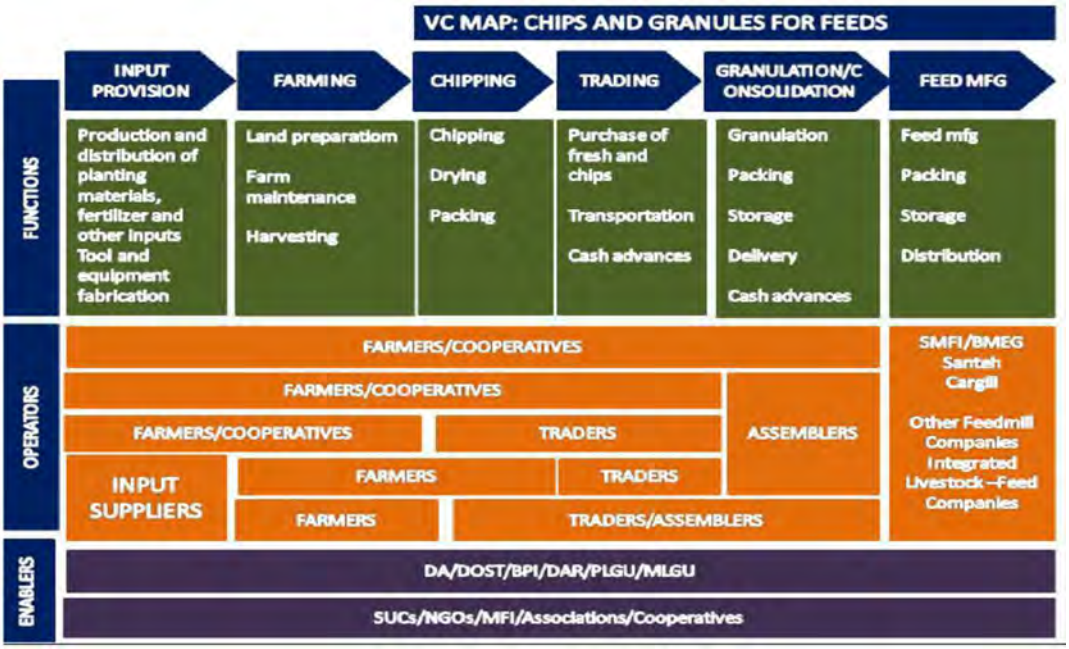
(2) Banana Industry (Cardava/ Saba Variety)

10.21 For the short, medium and long terms, banana industry stakeholders aim to sustain the region's leadership position in the banana export market by undertaking efforts to further increase production of Cavendish and Cardava banana, increase farm gate prices and export prices, improve product quality, improve marketing and promotions, and address the disease problem through R&D and better farm management practices. Major efforts in all aspects of the VC from production to marketing will be undertaken to further develop the processed banana subsector (e.g., chips, frozen/microwavable, fried, vacuum-packed, flour and puree) mainly through the strengthening of the institutional players in the industry including the corporate growers, cooperatives, and small and medium-scale growers, and continuing provision by the government and private sectors of financial and non-financial support services to enhance the industry's competitiveness.

(3) Cassava Industry

10.22 The cassava industry VC actors and enablers are present in Davao City (Figure 10.2.3). Thus, it is seen to be a viable agricultural enterprise for the city's farmers. The major buyer/ end user is San Miguel Foods Inc. (SMFI), the producer of B-Meg Feeds. Other feed producers are interested to shift from yellow corn to cassava as a key ingredient to their feeds.

[5] Malagos Chocolates, for example, has already won 9 major international awards in fine chocolate and food competitions in Germany, London, UK and Paris since 2015.



Source: Davao City Commodity Investment Plan 2015-2018.

Figure 10.2.3 Value Chain Map for Cassava Chips and Granules

10.23 To meet the growing demand for cassava, the medium- to long-term development plan for the industry is to expand production volume as well as linkages to the domestic market. CAO has identified an additional potential area of 1,196 ha for expanding cassava production in Davao City. DA, DTI and the city government have been assisting cassava farmers associations and cooperatives with inputs, processing machines (chippers and granulators), and mechanical dryers.

(4) Abaca Industry

10.24 The abaca industry is requiring more than what the country is currently producing. In fact, some processors even import abaca fibers from Ecuador. The Philippines supplies as much as 85% of the world requirements. Recently, PhilFIDA has proposed a rehabilitation and expansion plan for the country's abaca sector. With its large tracts of suitable agricultural land, Davao City can take advantage of these opportunities.

10.25 Abaca growers are mostly smallholders. There is a need for them to be organized as a business structure that can forge marketing contracts with processors, which would not be possible as individual growers. They need to be trained on proper classification and be registered as Grading and Baling Establishments (GBE). They also need to install the necessary abaca processing equipment and facilities like spindle strippers/ decorticators, drying facilities, and baling machines. Investment in such facilities, however, requires certain amounts of production volume to ensure economies of scale and requires significant capital funds. This further points to the need to organize abaca farmers into cooperatives, associations or an industry council that will strengthen their production, marketing and financial position.

10.26 CAO, DTI and other concerned agencies can assist Davao's abaca growers in accessing technical assistance from PhilFIDA, getting them organized, providing training, and accessing funds for production inputs and shared service facilities/ equipment. Furthermore, the agencies can help the growers identify and connect with processors and other industry players, and provide them training on manufacturing abaca products like

place mats, “sinamay cloth,” specialty products like those insulators required by the spark plug manufacturers such as Denso, a major Japanese automotive component supplier, among others.

(5) Rubber Industry

10.27 Rubber, aside from its potential for income generation for the farmers, is a permanent crop that is also environmentally desired when it comes to minimizing soil erosion. Once already at tapping age, it assures the growers with daily or weekly income as the sap continues to flow, making it desirable for small growers.

10.28 Rubber growers need to be trained on appropriate technologies and provided with the right equipment and machines to maximize returns by producing high value outputs such as gloves, bushings, and others. CAO and other concerned agencies need to also organize them into business structures to be able to attain economies of scale and access technologies, finance and markets for high end products.

(6) Organic Vegetables

10.29 Davao City is a significant producer of a variety of vegetables (e.g., eggplant, squash, bitter gourd, tomatoes, gourd, kangkong, cauliflower, petchay, legumes, and root crops). Much of the volume of vegetables is supplied by the upland and lowland barangays in Marilog and Toril districts, as well as the surrounding areas in Davao del Sur. Meanwhile, as discussed earlier, there has been an increasing demand in consumer markets for organically grown vegetables brought about by more health-conscious lifestyles. While retail consumption is still mainly through traditional local wet/dry public markets, rising urbanization has brought about a growing trend for consumers to source their vegetables from groceries and supermarkets. Higher-end, organic vegetables directly supplied by bigger vegetable-growing companies in Davao (e.g., Eden Farms and Dizon Farms) now also come in pre-packed form in supermarkets.

10.30 Among the major challenges facing the local vegetable industry in Davao are the vulnerability of vegetable farms to weather conditions; high input prices; seasonality of production and prices of some vegetables; inadequate support infrastructure, for instance, farm-to-market roads (FMRs), transport, irrigation, hydro cooling facilities, storage and other post-harvest facilities; product quality degradation and spoilage; lack of processing technologies and equipment; mainly traditional wholesale-retail distribution system which generally allows middlemen to control buying prices from farmers; and need to strengthen institutions such as farmers’ cooperatives/groups to provide them with economies of scale, bargaining power, and better access to support services (e.g., finance, purchasing of inputs, etc.). Combined, these constraints ultimately contribute to low income of farmers.

10.31 Aside from providing farmers with the necessary agricultural support infrastructure such as irrigation, FMRs, cheaper inputs, know-how on efficient farming technology and practices, access to credit, marketing assistance, etc. by public and private organizations, there are a couple of ongoing projects that are specifically intended to address most of the aforementioned constraints to farmers in Davao City and surrounding areas in the short and medium term. These are the development of the DATC and the DFC in Toril. As discussed in ***Chapter 5*** of this report, the LGU-initiated DATC project would provide farmers’ groups with an alternative wholesale market system that is expected to reduce their transport and marketing costs, wean them away from the price control of middlemen, and thereby improve their incomes. The DATC project also aims to organize the

vegetables and fruit growers and give them the responsibility of managing the operation of the trading center and directly benefiting from such operation. The first DATC building has been completed and is targeted to start operating in June 2018. Meanwhile, the DFC project will complement the wholesale terminal by providing a business-ready site for investors/ locators of agribusiness processing/ food manufacturing industries including vegetable processors. Once the JV partnership for the DFC is successfully established, the food complex is targeted to start operating by 2019 or 2020. Taking off from the experience of the DATC and DFC in their initial years of operation, other similar vegetable processing technologies to develop new vegetable products in the long term should be pursued and more manufacturing sites or ecozones established to expand the domestic and export markets for such products.

(7) Other High Value Products

10.32 Aside from the listed priority commodities, the traditional commodities would continue to be sustained and developed into higher value products. These include durian, pomelo, rambutan, mangosteen, and other fruits. It is envisioned to upscale the current practices and activities and technologies to enhance their respective value-adding potentials. Examples of possible interventions and projected outputs are the following:

(i) Durian – Processing to puree and soluble powder processed by spray drying. This will provide the industry with wider market possibilities and, at the same time, address concerns relative to shelf life.

(ii) Pomelo – Processing to puree and soluble powder processed by spray drying. Similarly, this will provide the industry with wider market possibilities and address concerns relative to shelf life.

(iii) Rambutan – Bottled rambutan in syrup.

(iv) Coconut – Improved processing technologies for coco sugar, clear coco syrup (which can directly compete with stevia sweetener), Virgin Coconut Oil, and others.

10.33 New commodities can also be developed, such as the following:

(i) White Scallion (*Rakkyo*) – cultivation and processing of *Rakkyo* into pickles, targeting both the domestic and international markets (such as Japan where *Rakkyo* is a popular food).

(ii) Ginger – cultivation and processing of ginger into pickles for the domestic and international markets.

(iii) Flour – from banana, sago, apali, etc.

(iv) Calamansi Powder – a high value product from calamansi to be used for flavoring and marinating.

(v) Dehydrated meat and vegetables (for example, as ingredients for instant noodles and canned foods).

(vi) Specialty Coffee – like fermented honey processed coffee.

(c) Potential Projects

10.34 Table 10.2.3 summarizes the proposed projects for the agribusiness and agro-industry sector which give indications to the future land use plan in 2045.

Table 10.2.3 Potential Projects for the Agribusiness/ Agro-Industry Sector

Projects	Brief Outline
1. Davao Agricultural Trading Center (DATC)	The DATC is on a 5-ha lot being leased by the City Government of Davao initially for 15 years within the 25-ha property of NDC in Daliao, Toril. It aims to provide mostly small and medium-sized fruit and vegetable farmers in Davao City (located mostly in the Toril and Marilog districts and nearby southern provinces in the Davao region) with a ready market for their fresh and processed products, regulate the present market system by reducing the layers of middlemen, and improve the farmers' and food producers' incomes. The first building of the Center, which will house the sales area for wholesale trading and a washing, packing and grading area, was completed in March 2018 with DA funding, and will start its soft operations by June 2018 (Figure 10.2.4). The Center, however, needs around PHP320 million additional funds to complete its facilities including a warehouse, a cold storage facility, parking area with loading and unloading spaces, a training center/ dormitory, laboratory, machinery and equipment, generator, a road network within the complex, etc. On the city government's request, DA has included this funding request in its proposed 2019 budget. Meanwhile, the City has also requested JICA for funding either all or some of the required facilities including the ESL trading system software and hardware facilities from Japan.  Source: IM4Davao Team **Figure 10.2.4 Actual Photo of DATC (as of August 2017)**
2. Davao Food Complex (DFC)	NDC, a national government agency under DTI, owns the 25-ha property in Daliao, Toril part of which is being leased by the city government for its DATC. NDC plans to develop its remaining 20-ha site into the DFC for mainly food-based industry locators. The complex will house food processing centers, cold storage facility, warehouses, business technology/ incubation center, agri-aquaculture facilities, water filtration and bottling facility, and agro-tourism facilities (Figure 10.2.5). NDC is currently looking for a JV partner to develop and operate the complex, with NDC providing its property, valued at PHP400 million, as its equity. Estimated project development cost of the JV partner is PHP600 million. Depending on the JV partnership, the complex may be registered as an ecozone.  Source: NDC **Figure 10.2.5 Master Plan Perspective of DFC**
3. Integrated Agro-Servicing Complex	This Complex will provide farmers groups with pre-processing shared service facilities (SSFs) such as for sorting/washing for fresh fruits and vegetables (before they go to the DATC), demo farms and nurseries of certified seeds and planting materials, mechanical drying facilities for cacao and coffee, mechanical chippers and granulators, agricultural technology training and demonstration center, research and testing laboratory, agro-tourism visitor facilities, etc. This can be located in Barangay Maraan in Marilog District where DA has a 400 ha property, a portion of which can be developed for such purpose. Estimated project cost is PHP125 million, to cover the costs of land (5 ha), buildings and equipment.
4. Farm/ Agro-Industrial Mobile Cable System	Infrastructure support aside from post-harvest facilities would be helpful to the farmers in Davao City. Aside from the enormous finance required to construct all-weather gravel and concrete FMRs to enhance access and connectivity of production areas to markets, especially in hilly/ mountainous sites like Marilog and Paquibato, a mobile cable system (Figure 10.2.6) would be fastest to install and with least cost and maintenance (around PHP500,000 per kilometer vs. PHP10 million per kilometer of paved road). It could even replace the need for expensive bridges and roads without negatively affecting the environment since none or very minimal disturbance of standing trees would be cut. Vulnerability to landslides in the mountainous areas can also be avoided or minimized. This cable system is not the typical straight line structure. It can run with the terrain of the sites. This can also be an enterprise to be run by the respective farm communities in the targeted sites. There can be developed a network of cable systems leading to consolidation sites where existing or still to be constructed FMRs would be used as terminals where their goods would be delivered and transferred to the trucks going to the markets/ buyers or even to the DATC in Toril. This farm cable system is already practiced in Colombia. Estimated project cost for 10-km cable systems in two locations (Marilog and Paquibato) is PHP20 million.  Source: Centro Aceros (Colombia) **Figure 10.2.6 Examples of Mobile Cable Systems**

Projects	Brief Outline
5. Cacao Processing Center and Chocolate Processing Zone	There is industrial accumulation of the Davao City cacao industry (e.g., farmers/ growers and processors) in Calinan especially in Brgy. Subasta, Wangan and Sirib. Cacao growers are smallholders who manually break the cacao pods, some directly dry the pods after washing in makeshift dryers over asphalt or concrete roads, screens or fish nets. Other farmers who do ferment their wet beans use their recycled polypropylene woven plastic/straw sacks (or rice sacks). These practices result in very inferior quality of cacao beans which command very low prices. Some sell their wet beans directly to other consolidators. The small cacao growers do not have their own facilities to produce quality beans that they can sell at higher prices. Chocolate quality is determined by the efficiency and quality of post-harvest operations such as pod breaking, fermentation and drying of beans (Figure 10.2.7). The first phase of the proposed project will establish a cacao processing center in Calinan that will provide farmers shared service facilities for efficiently breaking the pods, fermenting and drying the cacao beans, and transporting them to buyers. Farmers can bring their pods to the facility or the center operator can pick them up using its trucking service. The center will be equipped with 3 sets of mechanical pod breakers and at least 30 sets of fermentation houses of about 30 boxes each and 24 all-weather drying structures (covered with UV plastic sheets). The land (5 ha), equipment and facilities are estimated to cost PHP166 million Farmers can use the center's facilities and services for minimal or even subsidized rates. The improved quality of cacao beans processed in the center is expected to increase the market price of the beans by 30%. The second phase of the project will establish a chocolate manufacturing/ processing zone to attract domestic and foreign manufacturers of chocolate and other cacao-based products including their waste and by-products (e.g., feeds, organic fertilizer, etc.). The proposed Farm/ Agro-tourism Circuit will include the Cacao Center where visitors and tourists can enjoy learning about cacao processing, shopping and eating various kinds of chocolate and cacao-based products. Cacao Pods >>> Mechanically Broken Pods >>> Fermentation >>> Drying >>> Quality Dried Cacao Beans  **Figure 10.2.7 Process Flow of Cacao Beans**
6. Cardava Banana Flour Processing Plant	Davao City produces about 26,000 MT of Cardava bananas a year from 1,808 ha of land mostly in Tugbok, Toril, Calinan and Bunawan Districts. Unlike the Cavendish banana—the rejects of the fresh banana export markets due to over-sizing, under-sizing against buyers' specifications and some disease and physiological defects—which has limited processing potential, Cardava banana has many possible value-added uses/ applications such as chips, snack food, condiments, pastries, etc. At present, however, most smallholder Cardava banana farmers deliver their green mature Cardava bananas to banana chips processing plants which mostly export their processed chips. The proposed project will establish plants for processing green mature Cardava banana into flour, which can be further used to manufacture banana ketchup, cookies and pastries, and other final products for domestic and export markets. This banana variety is ideal for flour processing.Compared to most traditional sources of flour like wheat, potato and corn which only contain carbohydrates, banana flour has protein content, is rich in minerals such as potassium, calcium, magnesium and others, vitamins and amino acids. Banana flour is also non-gluten, which is preferred for those suffering from "celiac disorder" or gluten intolerance. Thus, it is considered healthy flour. The simple process of banana flour processing involves: (a) removing the fruit from the bunch, (b) steaming and peeling the fruit, (c) slicing the peeled fruit, (d) soaking, draining and drying the sliced banana, and (e) milling and packaging the banana flour (Figure 10.2.8). The flour can be marketed to local industries to fortify local bread, noodles, cookies, pastries, etc., manufacture banana ketchup, among others. There is also potential for exporting it to USA, Europe, India, etc.  Cardava Banana Fruit Banana Powder Banana Flour Cookies and Pastries Source: WEDO Banana Flour **Figure 10.2.8 Cardava Banana Flour and Uses** A start-up facility will involve an investment cost including land (0.5 ha), buildings and equipment (weighing scales, washing modules, chippers/ slicers, cooking/ steaming woks, pulverizers or hammer mills, vibrating sieves and sealing machines) of PHP7 million. Expansion of the plant may be made later as the market increases. This business model is ideal for farmer cooperatives who are into Cardava banana growing. A kilo of flour processed from PHP40 worth of fresh Cardava bananas fetches a price of PHP70-250 per kilo. The same banana flour is priced USD30 per kilo in Australia. The proposed banana flour processing plants are proposed to be initially located in Bunawan (which would also cater to Paquibato growers) and in Calinan (which would also cater to growers from Tugbok).

Projects	Brief Outline
7. Abaca Processing Center	This project aims to establish a central abaca fiber processing center in Paquibato and Marilog. It is envisioned to provide technical training on proper abaca agronomics and handling and fiber classifications, as well as machineries to process them for their intended markets whether for textile or pulp. Those for textiles would be processed using spindle strippers and for pulp, the fiber decorticators (Figure 10.2.9). The center's output is abaca fiber in standard bales (equivalent to 125 kg, measuring around 100 cm x 55 cm x 60 cm. Each center will need an investment cost of PHP36 million for land (2 ha), buildings and equipment.  Abaca Tuxy >>> Fiber Extraction by Spindle >>> Classified Fiber >>> Fiber Hanged in UV Dryer >>> Baled Fiber **Figure 10.2.9 Process Flow of Abaca Fiber**
8. Consortium of Agricultural Equipment Fabricators	One of the commonly cited constraint of the agricultural/ agribusiness sector, especially the small farmers and processors, is the lack of and/or expensive cost of agricultural equipment and machinery. Davao City has quite a number of local steel fabricators and equipment manufacturers. Many of them are micro and small enterprises operating in the Agdao district. The proposed project will organize these enterprises into a consortium that will manufacture the sets of agricultural equipment and machinery needed by the farmers and processors in the city's priority sectors. These will include mechanical pod breakers and dryers, mechanical chippers and granulators, pressers, decorticating machines, spindle strippers, etc. The consortium will work closely with industry stakeholders in determining the types, standard specifications and target prices of the equipment they need to fabricate which would be viable for the operations and income of the producers/ processors.

Source: IM4Davao Team

2) Information and Communications Technology

(a) Sector Overview

10.35 As earlier discussed in Chapter 5, the Philippines has become one of the world's top outsourcing destinations. In 2016, Davao City was ranked 66th worldwide, while NCR was 2nd and Cebu City was 7th. For the coming several years at least, the country's ICT-BPO sector is expected to continue growing steadily. However, some experts insist that traditional BPO services (i.e., voice and non-voice services) may become obsolete in the mid-2020s or in the 2030s because of the technological advancement of robotics and AI. Other challenges to Davao City's ICT sector are the slow connectivity and high subscription rates of ICT services (which affects the whole country) and the need to further improve ICT infrastructure, incentives and services. There is also a need to address the proliferation of unregistered home-based BPOs.

(b) Directions of Development

10.36 The Roadmap 2022 released by the Information Technology and Business Process Association of the Philippines (IBPAP) in 2016 envisions a 15% share of global ICT-BPO market, USD40 billion in revenue, 1.8 million direct jobs, 7.6 million direct and indirect ICT-BPO employment by the year 2022. Davao City's plan for its ICT-BPO sector should be devised in harmony with this roadmap, and the plan should also consider the said robotics and AI's prospective replacement of voice and non-voice services. Table 10.2.4 summarizes the opportunities and constraints in Davao's ICT industry.

Table 10.2.4 Opportunities and Constraints in the ICT Industry

Value Chain Functions	Opportunities and Constraints
Products and Services	• ICT industry consists of the following sectors: (i) manufacturing (e.g., computer equipment); (ii) wholesaling (e.g., electronic equipment); (iii) telecommunications services and computer services (e.g., computer maintenance and consultancy); and (iv) content production (e.g., recorded media manufacturing and publishing). The products and services of these sectors are being showcased in various invention and innovation contests and exhibits, etc. However, access to these events outside Davao still entails financial support.
Logistics and Infrastructure	• The functions of higher education institutions (HEIs) should be improved in accordance with the increasing demands for AI and robotics.
R&D	• With the emergence of the Information and Communication Technology Office of Department of Science and Technology (ICTO-DOST), the funding is now streamlined for ICT programs and projects. However, there is still a need for advanced research and training opportunities for students and educators to maximize the potential of the HEIs.
Human Resource Development	• Considering the increasing number of locators opting to operate in Davao, there is a potential demand for qualified talents. This demand is expected to further increase due to the availability and need for home-based workers and developers. • There is a need to train specialists in the field of AI and robotics. • It is important to clarify what kind of personnel are needed by existing and potential locators and investors and to nurture such human resources.
Policies	• The various laws implemented for the application and development of ICT products and services provide security and assurance to ICT companies and developers alike. Relevant policies should be formulated and implemented in close consultation with the private sector. • There is a need for national legal policies and legislation to allow more TELCOs to enter the industry and provide more efficient ICT infrastructure and services, as well as national/ local policies and legislation to regulate home-based BPOs.

Source: IM4Davao Team based on Davao Region Industry Clusters Roadmaps (2014-2030) and Davao City Draft Updated CDP (2018-2022).

10.37 Meanwhile, from the viewpoint of investment promotion, it is worth noting that Fujitsu, one of Japan's major ICT companies, opened its office in Davao City in August 2017.[6] By establishing a new office in the city, the firm aims to provide ICT infrastructure services and ICT support solutions and services in accordance with local customers' needs. In the coming years ahead, more and more ICT firms are expected to open offices for the same purpose as Fujitsu. To meet growing demand, therefore, there is a need for the city government to promote the development of more IT parks in addition to the 2 currently operating (i.e., Damosa and Matina IT Parks) and another 2 being developed (Davao Park District and Lanang Business Park). Aside from IT park development, it is also critical that DCIPC and CIO should gather information on other needs of the ICT firms (e.g., recruitment of local ICT personnel), which already operate in Manila and are considering to branch out in Davao City, so that their needs may be addressed by the city.

10.38 To address the said challenges, Davao City's ICT sector should focus on the enhancement of the ICT talent pool and the infrastructure and support services for necessary innovations. In the short term, core ICT teams will be formed to undertake activities intended to improve education and skills training, expand the talent pool, promotion and marketing initiatives for the ICT sector, sourcing of funds for commercialization of ICT products, expansion of location destinations outside Davao City (to Davao del Norte and Davao del Sur), and expansion of membership in the ICT association. The medium- to long-term plan will work towards institutionalizing ICT

[6] URL (http://www.sunstar.com.ph/davao/business/2017/08/25/fujitsu-opens-office-davao-city-560500).

innovation in the school curriculum, ICT support activities, skills training programs and facilities, promotion and marketing activities, expansion of employment in the industry, etc.

(c) Potential Projects

10.39 The potential projects proposed by IM4Davao Team for the ICT sector are summarized in Table 10.2.5.

Table 10.2.5 Potential Projects for the ICT Industry

Projects	Brief Outline
1. Establishment of IT Parks	The number of ICT firms has increased, which establish their offices in Davao City to provide local customers with ICT infrastructure services and ICT support solutions and services. In view of such trends, the City Government of Davao has opportunities to satisfy such needs by establishing more IT Parks in the city to accommodate the ICT firms such as in the abovementioned case of Fujitsu. Estimated development cost for a 2-ha IT park is around PHP40 million. IT parks may be established in Poblacion, Talomo, Buhangin and Toril.
2. Establishment of Multi-Lingual ICT Training Facilities	In order to upgrade the infrastructure and support services and to improve the ICT talent pool, it is proposed that multi-lingual training facilities should be established in the city. The languages used in the facilities are English, Chinese, Japanese, Korean, and Indonesian languages. The city's ICT sector can take advantage of proximity to Indonesia to attract Indonesian as well as Mindanaoan/ Filipino young and talented ICT engineers. Estimated development cost for one 0.5-ha facility is PHP36 million. These facilities can be established in Poblacion and Talomo.
3. AI Education for Young ICT Engineers and Students	As discussed earlier in this section, some experts argue that traditional BPO services may become obsolete between the mid-2020s and the 2030s owing to the technological progress of robotics and AI. In order to keep pace with the technological advancement from the long-term point of view, the city government and other stakeholders should provide training courses for students and younger ICT engineers in these new fields. These courses can be integrated into the curriculum of existing educational institutions.

Source: IM4Davao Team

3) Tourism Industry

(a) Sector Overview

10.40 As one of Mindanao's major tourist destinations, Davao City offers a wide spectrum of tourism products based on its rich natural resource endowment: namely, nature-based, farm/ agro-industrial, historico-cultural, food and shopping, educational, leisure and entertainment, sports and adventure, MICE, etc. The city is also the gateway and jump-off point to other tourist destinations in the Davao Region. As mentioned in ***Chapter 5*** of this report, the number of inbound tourists (domestic and foreign tourists, and overseas Filipinos) to the city has increased by 170% from 744,275 in 2011 to 2,000,000 in 2017, the highest ever recorded.[7] Over the years, however, domestic tourists have always far outnumbered foreign visitors. The challenge, therefore, for the City Tourism Operations Office (CTOO), DOT, private sector tourism stakeholders, etc. is to continue stepping up concerted efforts to attract more foreign tourists to the city.

10.41 It is also worth noting that Davao City's Chinatown, which was formally established in 2003 by virtue of an executive order by then City Mayor Rodrigo Duterte, is the largest one in the country and is the only one in Mindanao. Besides being the center of commerce and industry of the city's Filipino-Chinese community, Chinatown is well-known for its Chinese New Year festivities which attract local residents as well as a number of

[7] For the 2017 figures, please refer to http://www.sunstar.com.ph/davao/business/2018/01/12/tourist-arrivals-davao-city-hit-2-million-583691.

tourists every year. It has potential to become one of the major tourist attractions of the city.

(b) Directions of Development

10.42 The common goal of Davao City's tourism stakeholders is to attract more and more tourists, especially foreign tourists. However, the city's tourism sector faces some challenges such as the (i) negative publicity and misimpression on Mindanao, including Davao, as an unsafe area for visitors; (ii) inadequate promotion of the city as a major tourist destination; (iii) lack of compliance of some tourism establishments to tourism standards; (iv) need to improve tourism support infrastructure and physical access/ linkages; and (v) commercialization of the cultural heritage of IPs and exploitation and possible destruction of social values.[8] To address these challenges, Davao City's tourism industry stakeholders crafted the Davao Turismo Agenda,[9] setting down strategies to strengthen the promotion of the city as "the most tourist-friendly city in the Philippines."

(c) Potential Projects

10.43 The potential tourism projects proposed by IM4Davao Team are summarized in Table 10.2.6. For details of these projects, please refer to Section 18.9 of ***Chapter 18*** of this report.

Table 10.2.6 Potential Projects for the Tourism Industry

Projects	Brief Outline
1. Little Tokyo in Mintal	Subsequent to the sentimental visit of the Japanese Prime Minister's wife in January 2017 to existing legacies (e.g., Japanese-owned abaca plantation and its related buildings) in Mintal, Tugbok, in view of their historical and cultural significance, the local leaders of Mintal requested TIEZA to fund the preparation of a Tourism Master Plan of Barangay Mintal to establish it as the "Little Tokyo of Pre-War Philippines." Proposed tourism facilities include signages, a Visitor Information Center and Museum, parking lots, paved roads, transportation facilities, toilets, etc. To be located on a 20.2 ha land owned by the local government, the project is estimated to require an investment of PHP687 million for the land, buildings and facilities. This can be a collaboration between the national government (e.g., DOT and TIEZA) and the LGU, with the latter providing the land.
2. Davao Pioneer Museum	The Philippine-Japan Historical Museum in Calinan[10] was established by Japanese volunteers in 1994 and is being managed by the Philippine Nikkei-Jin Kai, Inc. In the museum, old relics, Japanese World War II vintage books, pamphlets, and other materials are displayed for public viewing. However, since the building of the museum is too small and has deteriorated, the construction of a new building and related facilities (to be renamed Davao Pioneer Museum) has been proposed. Estimated project cost is PHP17 million.
3. Kadayawan Cultural Village in Eden[11]	As discussed in Chapter 2, the population of IPs in Davao City is approximately 66,000 (2010-2013), belonging to 11 ethnic groups. Currently, the various ways of living and culture of these tribes are showcased in the Cultural Village in Magsaysay Park.[12] While it has become a popular visitor destination, the village is constrained by the lack of space and resources to further develop it. Meanwhile, the city government owns a 10.2-ha land in Eden, Toril District. It is proposed that an IP village, to be called Kadayawan Cultural Village, should be developed on this site. The new village will include a multi-purpose amphitheater, a cultural village showcasing the houses and living traditions of the 11 tribes, prayer areas, restaurants, souvenir shop, parking spaces, comfort rooms, etc. Estimated to cost PHP367 million, this project can be a collaboration between the national government (e.g., DOT and TIEZA) and the LGU, with the latter providing the land and sharing the development cost with the NG on a 50-50 basis.
4. Farm/ Agro-Tourism Circuit	Davao City is home to many agricultural plantations and farms. Led by CTOO and DOT-Region XI, local tourism stakeholders should continue pursuing the institutionalization of agro-tourism in the city by developing a circuit tour package that will bring visitors to different farms to observe and participate in farming operations, partake

[8] As cited in the Davao City Draft Updated CDP (2018-2022).
[9] Information on the Davao Tourismo Agenda was provided by CTOO in December 2017.
[10] For the details of this museum, please refer to http://pnjkincdavao.com/japan-philippine-historical-museum/ (accessed on March 8, 2018).
[11] For the details of IP, please refer to Chapter 2 and ANNEX 1.
[12] For details of the Magsaysay Park Cultural Village, please refer to http://www.sunstar.com.ph/davao/weekend/2017/09/02/11-tribes-davao-iranun-561913 (accessed on March 9, 2018).

Projects	Brief Outline
	and buy fresh and processed farm produce, commune with local farmers, and even provide voluntary technical and financial support towards improving the lives of farming communities. The agro-tourism circuit will include the DATC, DFC (once it becomes operational), and farm sites owned/ operated by IPs whereby tour participants can also learn about the culture and traditions of the IPs. Initially, the circuit may include around 10 different agro-tourism destinations and will require at least PHP10 million investment cost for improving basic facilities such as toilets, visitor receiving areas, pathways, etc. where necessary.
5. Madayaw Travellers' Facility in Los Amigos	This travellers' facility is located along the Davao-Bukidnon Road, in which there are parking lot, comfort rooms, tourist information center, souvenir shop, restaurant, etc. Drivers/ customers can stop by the facility not only to take a rest but also to enjoy shopping and eating local agricultural and marine products. Estimated project cost is PHP117 million which will cover the cost of a 6,410 m^2. commercial lot, building and related facilities. To be an LGU project, the city government can also explore possible collaboration with DOT, DTI, DPWH, DA and other NG agencies.
6. Redevelopment of Chinatown	As the largest Chinatown in the Philippines, covering an area of 44 ha and 4 barangays, and the only one in Mindanao, Davao Chinatown is the main commercial and residential area of the Filipino-Chinese community in the city. Created in 2003 by the Mayor's executive order, the Davao City Chinatown Development Council (DCCDC) formally launched Davao Chinatown during the Chinese New Year 2009. Aside from restaurants and other food establishments, there are numerous business establishments such as malls, shopping centers which sell goods from items made in China and elsewhere, groceries, pharmacies, electronics shops, hardwares, trading companies, retail stores, banks, and many others. Every Chinese New Year, there are lined up programs and activities which highlight the culture of the Chinese community in Davao City. The proposed project aims to design and develop physical improvements in Chinatown in collaboration with DCCDC, and further boost its promotion as a major tourist destination in the city. Estimated project cost is PHP250 million.

Source: IM4Davao Team

4) Industries to Promote Low-Carbon Society

(a) Sector Overview

10.44 Philippine low carbon development policies are embedded in relevant government departments' programs to promote low carbon development. Among others, the National Climate Change Action Plan (NCCAP, 2011) and the National Framework Strategy on Climate Change (NFSCC, 2012) outlined the economy's agenda for adaptation and mitigation for 2011 to 2028 and the policy framework and the guiding principles on climate change. Through the NFSCC, the NCCAP redefined its mitigation strategies as follows:

- Accelerate the use of renewable energy (RE) and alternative energy sources (e.g., biofuels);
- Promote efficient power generation and conservation (DOE);
- Promote production efficiency and use of low carbon technologies (DTI); and
- Develop dry land cultivation and minimize waste decomposition; promote wider use of organic fertilizer and reduce pesticide use (DA).

10.45 Davao City is keen on sustainable urban development. Efficient solid waste collection and cleanliness of urban streets are considered to be the best practice in the city. However, there are alternative methods, technologies and tools to enhance sustainable urban development, particularly, to address climate change towards a low-carbon society. Many of them to be discussed in this section are technically applicable and the related departments have made concerted efforts to set adequate policies and other measures to practice them in the Philippines.

10.46 The Davao Region Industry Clusters Roadmaps (2014-2030, RDC XI) designates renewable energy (RE) as one of Davao City's priority sectors. In fact, the City has already adopted some RE measures such as hydro-power plants (by Hedcor Sibulan Inc. and Hedcor Tudaya Inc.), solar photovoltaic installations, and biodiesel fuel from used cooking oil which is utilized by city government service vehicles as a demonstration

project by a Japanese company through JICA-Davao City cooperation. Furthermore, a waste-to-energy (WTE) plant will be operational in the near future.

10.47 This section intends to explore the city's possibilities to attract substantial private investments which contribute to creating a low-carbon society including RE, energy saving and management, and recycling/reuse of industrial products.

(b) Directions of Development

10.48 The IM4Davao Project is helping prepare an integrated urban infrastructure development plan for Davao City towards the year 2045. Within such a long-term planning period, a number of new environmental technologies and services will be proposed and many of them will be put into practice in the field of urban economy, urban service and environmental management. Table 10.2.7 shows a selection of environmental technologies and services to be applicable for the city. Assessment of individual environmental technologies and services in terms of local applicability and practice timing is not an easy task because all the tabulated technologies and services must deal with the markets where the private sector takes an important role except environmental impact assessment, environmental PR and education.

Table 10.2.7 Selected Urban Environment Technologies for Davao City

Area			Technology and Services
Environmental Technology Projects	End Processing Technology (Pollution Prevention)		Air pollution prevention, Water pollution prevention, Improvement of solid contaminant, Processing of domestic waste water
	Solid Waste Recycling and 5RE	Solid Waste Recycling	Waste-to-energy plant, Intermediate processing depot, Final treatment site, Hazardous waste control
		5RE	Separating waste, Solid waste reduction (weight, volume), Reuse, Recycling and Regeneration, Transformation to fuel
	Ecological Materials		Biodegradable plastic, Biodegradable lubricant, Titanium dioxide, Non-wood pulp paper, Non-VOC ink
	Ecological Houses		Heat insulating materials, Diagnosis of sick-building syndrome, Roof-top greenery, Reuse of waste water, Roof-top solar power generation
	Green Transport System		Mass transit, Low carbon vehicle, Battery and plug for electric vehicles (EV)
	New Energy / Saving Energy	New Energy	RE (Sunlight, Wind, Tidal wave, Geothermal power, etc.), Hydrogen energy system, Biomass plant
		Saving Energy	Cogeneration (combined heat and power) system, Heating pump, Energy utilization from incineration plant, Energy saving devices
	Nature Restoration		Greenery business, Biotope, Restoration of natural river, Artificial beach, Forest restoration, Conservation oriented agriculture
Environmental Service Projects	Environmental Consulting		Environmental management system, ESCO (Environment Service Company), Purification of contaminated solid, Property assessment
	Environmental Impact Assessment		Environmental survey/ analysis/ assessment
	Information/Education		Public information (environmental reporting, environment account), Environment education, Ecotourism
	Finance		Ecological fund (trust fund), Environmental damage liability insurance, Emission trading
	Logistics		Ecological shop/mail order, Recycling markets
	Transport	Service	Low carbon fuel taxi/bus, Rental and sharing of low carbon fuel vehicles
		Others	Ecological vehicle maintenance and inspection, Ecological driving

Source: IM4Davao Team

10.49 Many cities have a dilemma between demand and supply in providing environmental technologies and services. Considerable environmental issues apparently exist but solution providers or environmental companies may not appear responsive. LGUs need to take a conducive role to solve such a dilemma. The Kitakyushu Story

emphasizes the importance of LGUs to promote environmental companies' investment and operation in their cities. The Japanese LGU has successfully transformed from an 'industrial city' to an 'environmental city' by attracting many environmental companies to several designated sites such as Hibiki Recycling Estate, Research and Laboratory Park, and Academy and Science Park. Most of the sites are located at the reclamation area where heavy industries had been designated but some areas remained vacant due to their relocation. Then, the Japanese city renamed the site as Kitakyushu Eco Town to attract environment companies (Figure 10.2.10). ***Chapter 22*** of this report discusses the details of the Kitakyushu model.

Source: Kitakyushu City

Figure 10.2.10 Kitakyushu Eco Town (colored sites)

10.50 As a result of the synergy effects based on the Kitakyushu Eco Town Plan, many of environment companies are now operating in Kitakyushu City. Representative companies and their business lines are indicated in Table 10.2.8 and Figure 10.2.11.

Table 10.2.8 Indicative List of Environmental Companies in Kitakyushu City

Company	Main Business Line
NS Wind Power Hibiki	Generating electricity from wind power to serve Hibiki Recycling Park
Kitakyushu Research Institute of Wind Power Generation	Generating wind power to be sold to a local power supplier
Eco Wood	Recycling of wood and plastic materials to produce wood deck
AMITA Kitakyushu Resource Recycling Plant	Recycling of sludge, plastic waste and others for fuels to produce cement and steel products
West Japan Automobile Recycling	Dismantling of automobiles and recycling of their parts
West Japan Home Appliance Recycling	Recycling of home appliances in compliance with the relevant law in 2001
Aso-Group	Recycling of medical waste
NSR	Recycling of construction waste
West Japan Paper Recycling	Recycling of used paper for livestock bedding and moisture-adjusting agent
KARS	Recycling of used can for aluminum pallet and steel pallet
The Merry Corporation	Recycling of organic waste to compost

Source: Kitakyushu Eco Town

Wind Power Station

Recycling of Organic Solvent Waste

Car Breaking and Recycling

Recycled Product: Livestock Bedding

Recycled Product: Construction Materials

Recycled Product: Wood Deck

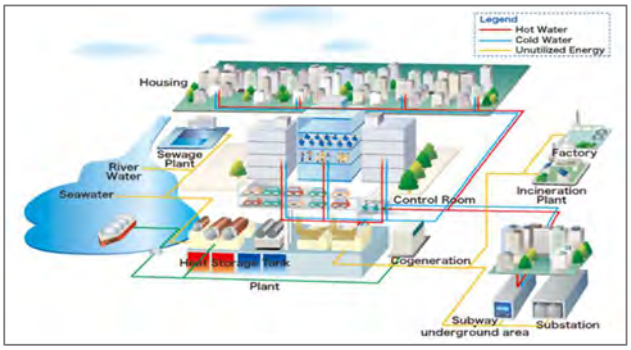
Source: Kitakyushu Eco Town

Figure 10.2.11 Activities and Products of Some Environmental Companies in Kitakyushu City

(c) Potential Projects

10.51 The potential projects proposed by IM4Davao Team for the low carbon energy sector are summarized in Table 10.2.9.

Table 10.2.9 Potential Projects for the Low Carbon Energy Industry

Projects	Brief Outline
1. Master Plan for Low-Carbon City Development	Judging from the local leaders' enthusiasm for sustainable environment and the citizens' understanding and cooperation on the city's initiatives for being a clean city, Davao City is considered eligible to become a champion city for low carbon development in the country. To make this happen, a well-prepared master plan document is necessary to map out coordinated undertakings between the city government and other stakeholders from short- to long-term viewpoints. It is desirable that a master plan be made based on integrated policies of industrial development and environmental management of the city and find solutions by environmental technologies and services which may also show new business opportunities particularly for environmental companies.
2. Utilization of Renewable Energy	As reported earlier, Davao City has been practicing and attempting several RE sources. It is recommended to expand their services. Among others, solar power generation is more promising taking into account future trends in innovative and more economical solar photovoltaic panels and the high solar radiation climate of the Philippines. Solar power is a suitable energy source to EV (Figure 10.2.12). Another big environmental investment opportunity are roof-top solar photovoltaic installations.  Source: HONDA **Figure 10.2.12 Example of a Solar Battery Charging Station** The Renewable Energy Act 2008 regards energy utilization from a WTE plant as RE. There are many examples in the world where WTE plant-generated energy is used for District Heating and Cooling System (DHCS) (Figure 10.2.13). In this sense, a WTE plant should not stand alone. Instead, it is designed to be part of an integrated area development for industry, public, residential or any other purpose where DHCS service is provided from a WTE plant. As utilization of those alternative energy sources grow, more investment of environment companies will be required or vice versa.  Source: Japan Heat Supply Business Association **Figure 10.2.13 District Heating and Cooling Conceptual Diagram**
3. Recycling Industrial Estate/ Park	Kitakyushu Eco Park successfully shows that a recycling industry estate/ park (such as Hibiki Recycling Estate) is a potent tool to attract environment companies. Those firms prefer a recycling estate partly because most of them are small- and medium- sized enterprises and, thus, they require appropriate sites for

Projects	Brief Outline
	operation and partly because they are not allowed to operate in residential areas. They can also expect a synergy effect within a recycling estate such as secondary use of other companies' residual materials. It is suggested that Davao City should develop a recycling estate to attract foreign and domestic recycling firms to make the city clean and sustainable.

Source: IM4Davao Team

5) Industries to Facilitate Transport Mobility and Logistics

(a) Sector Overview

10.52 In Davao City, the transport and logistics sectors play a major role in the city's economy and environment. The city's tertiary (services) industry, including transport and logistics, contributes 48.6% of total employment. It is also noteworthy that the CO_2 emission of the transport and logistics sectors may comprise about half of the city's total, judging from Cebu City's emission profile (51% from transport, 36% from industry and 13% from others)[13]. The transport and logistics sector is considered to be strategically important to enhance the city's mobility and competitiveness in a sustainable manner. Davao City has the largest number of vehicle population in Mindanao (i.e., 200,593 in 2016 with a sharp increase from 132,213 in 2011). The number of PUVs was 7,475 as of the end of 2016, providing employment to more than 10,000 drivers and conductors. Aside from vehicle manufacturing, these vehicles require many support services (e.g., dealers, repair and maintenance, fuel stations, etc.). As discussed in ***Chapter 5***, the "Wholesale and Retail Trade, Repair of Motor Vehicle and Motorcycles" sector is the top generator (29.2%) of employment. Aside from internal city demand, the city deals with external demand especially in Mindanao because the city is an economic hub with air and sea gateways. For example, Toyota spare parts for all its dealer branches in Mindanao come in through Davao first from Manila.

10.53 Sasa Port is a homeport of PPA as well as an old gateway port in Davao Region. PPA data show a recent downward trend in container handling volume from 500,288 TEUs in 2012 to 304,795 TEUs in 2016. Meanwhile, DICT in Panabo City has expanded its container handling service during the same period. A couple of Davao City-based major logistics companies and forwarders[14] analyzed the comparative advantages of the two ports. While port fees at DICT are higher than in Sasa Port, the private port has more efficient operations, faster turnaround time, and adequate cranes for loading/unloading. Due to deeper berths as well as increasing cargo volumes (much of which used to enter/exit through Sasa Port), international container vessels prefer to call on DICT. Despite lower port fees, vessels calling on Sasa Port are still having problems due to limited berthing space, operational inefficiency because of the absence of port cranes aside from on-board ship cranes, and congestion on port access roads. There are still mixed signals regarding what to do with Sasa Port. Clearly, international containerized cargo traffic especially from the north has been diverting to DICT. However, there are still cargo shippers, including those whose products come from the south as well as the city-based importers, who are said to prefer using Sasa. They, together with PPA and the private port services operator at Sasa Port, attest that with additional investment by

[13] 'Energizing Green Cities in Southeast Asia, Applying Sustainable Urban Energy and Emission Planning' (World Bank, 2013)
[14] DAMCO Philippines, Inc., MCC Transport Philippines, Inc. and Transmodal International, Inc. interviewed in March 2017.

PPA/DOTr, Sasa Port will be able to regain its competitiveness with DICT to some extent. But the port's inherent weaknesses in the international container shipping market has remained unsolved such as the limited land area (16.8 ha) and water depth (-11 m).

10.54 Davao City's Francisco Bangoy International Airport (FBIA) has been receiving substantially increasing international and domestic flights especially in recent years. In terms of cargo, the airport has constantly increased its handling volume from 39,770 MT in 2011 to 53,658 MT in 2016. So far, no dedicated cargo flight uses the airport. In order to improve cargo space utilization, air carriers accept small consignment besides passengers' luggage. Due to the valuable nature of air cargo, it seems a lucrative business particularly when the airport develops a higher capacity cargo terminal and attracts dedicated cargo flights. Since the airport and Sasa seaport are located in the same barangay, sea and air service can be arranged. It enables smart delivery to reduce transport cost within a contracted lead time.

(b) Directions of Development

(1) Modernization and Rationalization of Public Transport Vehicles

10.55 Road public transport services by jeepneys are labor-intensive and nowadays they cause traffic congestion on trunk roads in Davao City. In order to develop sustainable urban transport, ADB has been extending its technical assistance to the city in the 2010s. The first technical assistance project[15] proposed a bus rapid transit (BRT) system on trunk roads. Due to limited space even on the trunk roads, BRT has not been introduced so far. The ADB-funded Davao Public Transport Modernization Project started in 2017 is assisting the city in preparing the bidding and loan documents for a trunk bus system. If it is implemented, the project would be able to achieve fleet modernization through the replacement of jeepneys and multicab units with brand-new buses. Logically, it will require fleet rationalization since bus seating capacity is three to four times bigger than the jeepney's. It would result in reduction in the numbers of drivers and conductors and some thousands of them will be forced to transfer to other jobs.

(2) Improvement of Gateway Infrastructure

10.56 In 2015, DOTr opened a bidding for the redevelopment of Sasa Port via PPP. The huge investment cost required (PHP18.99 billion), however, invited criticisms which consequently resulted in the PPP tender being placed on-hold. DOTr and PPA are still keen on modernizing Sasa Port, including the new apron, linear quay, expansion of the backup area, container yards, warehouses, and the installation of new equipment like ship-to-shore cranes and rubber-tired gantry at the land area. While there is a growing consensus that Sasa Port will not take a dominant role in the region, the port's current capacity limitation and inefficient operation would still need to be addressed.

10.57 FBIA needs urgent capacity expansion. The scope defined in the 2015 bid documents for the development, operations and maintenance of five airports shows the following components for FBIA:

- Expansion of the passenger terminal building (from 65,000 sqm to 125,000 sqm);
- Expansion of the cargo terminal building (from 13,000 sqm to 27,000 sqm);
- Construction of a full parallel taxiway;

[15] Sustainable Urban Transport Study for Davao City (ADB, 2011).

- Expansion of other facilities such as car parking and administration building; and
- Additional apron areas.

10.58 The PPP tender, however, was aborted in November 2016 and unbundled, such that each of the five airports would be put into auction separately and independently of each other. Therefore, it is likely that the above scope will be realized by a single FBIA PPP project in the near future.

(c) Potential Projects

10.59 The potential projects proposed by IM4Davao Team for the transport and logistics sector are summarized in Table 10.2.10.

Table 10.2.10 Potential Projects for the Transport and Logistics Industry

Projects	Brief Outline
1. Re-training of Jeepney Drivers and Conductors	There will be a need to provide re-training programs to some thousands of jeepney and multicab drivers and conductors in the course of the PUV modernization and rationalization in Davao City. TESDA is an agency to meet such re-training demand. In the Cebu City BRT Project, for example, DoTr is going to start the employment assistance and skills training for jeepney operators and conductors who will be affected by the project together with TESDA and the City Government of Davao. The number of affected jeepneys is around 1,100 along the project route of 16 km. The DOTr - TESDA program consists of 16 courses including driving of container tractors and other special purpose vehicles, shielded metal art welding, auto servicing, electrical maintenance, plumbing, masonry, carpentry, refrigeration and air-condition, computer systems servicing and others. A similar program will be badly needed in Davao City particularly when the road public transport fleets are largely reorganized. One re-training direction is to upgrade the trainees' skill to handle vehicles to other types of vehicles such as construction vehicles and cargo handling equipment for local transport, construction and logistics services (Figure 10.2.14).   Source: Free Vendor **Figure 10.2.14 Construction and Specialized Vehicles**
2. Logistics Estate	With improved efficiency at Sasa Port and FBIA in the near future, local shippers and forwarders can invest more for efficiency improvement in their logistic chains as well. It will also be true to the warehousing industry. In this regard, locational proximity between Sasa Port and FBIA in the same barangay must be a big advantage for logistics chain management and, thus, the city's economy. In Davao City and its vicinity, agricultural products such as banana, mango, pomelo, cacao, coconut, durian, etc. and their processed products are main cargoes. They are mostly shipped out in bulk. Some need reefer arrangement but one kind of product is stored per container. Generally speaking, a competitive metropolitan economy enables handling small consignments such as industrial products and parts in an efficient and economic manner. In the case of Davao City, small consignments are largely imported and domestically incoming. As shown in the Toyota case, logistics services for small consignments are growing in every aspect of logistics such as hauling, storage, packing, labelling and distribution.   Source: Chitose International Logistics Estate **Figure 10.2.15 Examples of a Logistics Estate (top) and a Distripark Warehouse Operation (bottom)**

Projects	Brief Outline
	In order to provide valuable logistics services particularly for small consigners, the 'Ditripark concept'—which is a multi-tenanted, modern cargo distribution complex comprising of various warehousing and office facilities—is strategic. The concept was advocated and realized in the 1990s. In the Philippines, MD Distripark Manila Inc. (a PEZA Facilities Enterprise) in Laguna Technopark is the first operator. It is desirable to develop a logistics estate near Sasa Port and FBIA where Distripark, container freight station (CFS) for cargo consolidation into one container, truck terminal, bonded warehouses and various specialized warehouses are located (Figure 10.2.15).

Source: IM4Davao Team

10.3 Summary of Development Plans by District

1) Development Plan

10.60 The development plans for Davao City's districts necessarily consider the differences of the areas in terms of demography, economic features, and their respective roles and contributions in the current and future economy of the city. Table 10.3.1 presents a summary of the development plans by district.

10.61 Being the highly urbanized and densely populated areas, Poblacion and Talomo (in District I) as well as Agdao, Buhangin and Bunawan (in District II) should focus on strengthening their roles as the commercial, business, finance, logistics and urban tourism hubs of the city. Sustaining such roles will entail a careful balance of further expanding the urban service facilities (e.g., ICT, MICE, tourist accommodations, education and training, transport and logistics, etc.) while at the same time controlling urban sprawl, traffic congestion, and pollution. The promotion of a low-carbon society in these highly urbanized areas is an important goal.

10.62 The rest of the districts are still predominantly agricultural areas, including Paquibato (in District II) and the whole of District III (Baguio, Calinan, Marilog, Toril and Tugbok). These are the production areas for the city's important agricultural produce such as vegetables, fruits, coconut, cacao, banana, etc. and are target areas for further expansion of such farms and plantations including for emerging commodities like cassava, abaca and rubber. Therefore, the focus of the development plans for these districts is on expanding production volumes, organizing the small producers and improving their productivity, and providing them technical, financial, marketing and infrastructure support. The fruit and vegetable farmers are expected to benefit from the forthcoming operation of the DATC in Toril. Food processors will soon have a designated estate to locate their operations once the DFC in Toril finally gets developed and operational hopefully within the next two years.

10.63 Some districts like Calinan, Marilog, Toril and Tugbok have a rich pre-war history and legacy. They are also homes to various farms and nature resorts. Toril and Marilog also have large IP communities. They will participate in the tourism development program of Davao City's history and agriculture which will include a farm/ agro-tourism circuit tour package, Little Tokyo in Mintal, the Kadayawan Cultural Village, and the first of a possible network of Madayaw Travellers' Facility in Tugbok.

2) Investment Promotion[16]

10.64 Davao City's investment promotion program should be guided by the principle that the task of attracting investors and visitors to the city is a shared responsibility of stakeholders in all the sectors including its citizens. However, there are also designated organizations that should take the lead in implementing the program. For the city government, the leader is DCIPC which should collaborate closely with other local offices (CAO, CTOO, CIO, CPDO, etc.), national government agencies (DTI, BOI, DA, DOT, MinDA, etc.), and private/ non-government organizations (chambers, industry associations, etc.). These frontline promoters should work closely and pool their resources together to look for investors, domestic and foreign, for the city's investment priority projects.

[16] In relation to investment promotion, IM4Davao Team conducted a capacity building workshop for DCIPC and other stakeholders in October 2017. For details, please refer to 21.3 of Chapter 21.

Table 10.3.1 Summary of Development Plan by District

Cong. District	Admin District	Economic Features	Development Plan	Potential Projects
1	Poblacion	• Most densely populated • Urban core, CBD, center of commerce, finance, leisure, etc. • Transport and logistics hub, domestic and international gateway • Center of MICE, shopping, food, entertainment, and health and wellness tourism • Museums, leisure parks, places of worship • Site of many IT centers/ parks • Significant employment in services sector	• ICT hub (ICT parks/ centers) • Expansion to non-voice BPO services • Training of ICT manpower • Promote as "most tourist-friendly city in the Philippines" • Strengthen position as MICE, food, entertainment, health and wellness tourism hub • Improve gateway infrastructure • More international flights • More MICE and hotel facilities • Improve/ Modernize transport and logistics • Decongest traffic • Promote a low carbon society	• Establishment of IT Parks • Establishment of Multi-Lingual ICT Training Facilities • AI Education for Young ICT Engineers and Students • Transport modernization • Re-training of PUV Drivers/ Conductors • Master Plan for Low-Carbon City Development • Utilization of RE • Accommodation and convention facilities • Promotion of MICE, food and health and wellness tourism • Improvement of roads • Redevelopment of Chinatown
	Talomo	• Highly urbanized • Highest employment in manufacturing and services sectors • Davao City Overland Transport Terminal • Malls, shopping centers, hotels, food and entertainment, etc. • Tertiary education hub (ADDU, PWC, UM, Mapua, St. John Paul, etc.)	• Improve/ Modernize transport and logistics • Decongest traffic • Strengthen educational and training programs • Strengthen education and sports, and health and wellness tourism	• Establishment of IT Parks/ IT Centers • Establishment of Multi-Lingual ICT Training Facilities • AI Education for Young ICT Engineers and Students • Technical Skills Training Center • Transport modernization • Promotion of educational and health and wellness tourism
2	Agdao	• 2nd most densely populated • Highly urbanized • Significant number of manufacturing and service shops (e.g., hardwares, metal fabrication, machinery manufacture and repair, construction materials, etc.) • Agdao market, fruit stalls	• Improve/ Modernize transport and logistics • Decongest traffic • Possibly develop as a hub for manufacturing farm equipment and machineries	• Transport modernization • Improvement of roads • Consortium of Agricultural Equipment Fabricators
	Buhangin	• 2nd highest population • Highly urbanized • Second highest employment in services sector • Location of gateway airport and ports	• Improve/ Modernize transport and logistics • Decongest traffic • Expand production and processing of cardava banana	• Expansion and modernization of airport • Rehabilitation of Sasa Port • Redevelopment of Sta. Ana Wharf for Tourism • Improvement of roads • Cardava Banana Flour Processing Plant • IT Parks/IT Centers

Cong. District	Admin District	Economic Features	Development Plan	Potential Projects
				• Logistics Estates
	Bunawan	• Highly urbanized • Production areas of cardava banana • Significant employment in manufacturing sector	• Expand production and processing of cardava banana • Improve/ Modernize transport and logistics • Decongest traffic	• Agro-Processing/ Manufacturing Estate • Light to Medium Industrial Estate • Logistics Estate • Integrated Transport Terminal • Cardava Banana Flour Processing Plant • Improvement of roads
	Paquibato	• Biggest land area, predominantly agricultural • Rural population • Production areas of cacao, cassava (2nd) • Highest employment in agricultural sector	• Expand production and processing of cacao, cassava • Provide technical, financial and marketing assistance to farmers • Improve agricultural support infrastructure (e.g., FMRs, agricultural machinery and equipment, etc.) • Provide irrigation facilities	• Installation of Farm Mobile Cable System • Improvement of FMRs • Cacao Nursery • Cardava banana collection center • Cassava Processing Center • Abaca Processing Center • GBE registration of abaca processing center with PhilFIDA
3	Baguio	• Predominantly agricultural area • Mostly rural population • Production areas of cacao (2nd) • Resorts/ Parks (Philippine Eagle, Eden Nature Park, etc.)	• Expand production and processing of cacao • Provide technical, financial and marketing assistance to farmers • Improve agricultural support infrastructure (e.g., FMRs, agricultural machinery and equipment, etc.) • Provide irrigation facilities	• Improvement of FMRs • Cacao Nursery • Include in agro-tourism circuit
	Calinan	• Predominantly agricultural area • Mostly rural population • Production areas of cacao (1st), cardava banana (3rd), rubber (2nd) • Trading center for cacao • Significant employment in agricultural sector • Many small food producers • Nature resorts, wild water rafting • Rich pre-WWII legacy	• Expand production and processing of cacao, cardava banana, rubber • Provide technical, financial and marketing assistance to farmers • Improve agricultural support infrastructure (e.g., FMRs, agricultural machinery and equipment, etc.) • Provide irrigation facilities • Promote farm/ agro-tourism and legacy tourism	• Davao Pioneer Museum • Cacao Processing Center/ Chocolate Processing Zone • Cacao Nursery • Cardava Banana Flour Processing Plant • Improvement of FMRs • Rubber Tree Nursery • Include in agro-tourism circuit
	Marilog	• 2nd biggest land area, predominantly agricultural • Rural population • Second highest employment in agricultural sector	• Expand production of vegetables, cacao, cassava, cardava banana, rubber • Promote organic farming • Organize smallholder farmers • Provide technical, financial and marketing assistance to	• Development of Integrated Agro-Servicing Complex (Brgy. Maraan) • Installation of Farm Mobile Cable System • Improvement of FMRs • Cacao Nursery

Cong. District	Admin District	Economic Features	Development Plan	Potential Projects
		• Production areas of vegetables, cassava (1st), rubber (1st), cacao, cardava banana • Large potential area for rubber production • Mountain nature resorts • IP communities (Matigsalog-Manobo tribe)	farmers • Improve agricultural support infrastructure (e.g., FMRs, agricultural machinery and equipment, etc.) • Provide irrigation facilities • Promote farm/ agro-tourism • Preserve IP cultural heritage	• Rubber Tree Nursery • Satellite consolidation centers for vegetables • Certification for organic vegetables and fruits • Cassava Processing Center • Abaca Processing Center • GBE registration of abaca processing center with PhilFIDA • Include in agro-tourism circuit (Mapantaw Farm and Coffee Shop, Antayapan Living Museum and Organic Farm, BEMWA Farm)
	Toril	• Production areas of vegetables, cardava banana (2nd) • Site of DATC, Fish Port (Brgy. Daliao) • Significant employment in manufacturing sector • Many medium and large industries (food products, coco oil, beverage, non-metallic mineral products, etc.) • Mountain nature resorts/ centers (Eden Nature Park, etc.)	• Operation of DATC in June 2018 • Possible expansion and modernization of Fish Port • Expand production of vegetables, cardava banana, and other farm produce • Promote organic farming • Organize smallholder farmers • Provide technical, financial and marketing assistance to farmers • Improve agricultural support infrastructure (e.g., FMRs, agricultural machinery and equipment, etc.) • Provide irrigation facilities • Promote farm/ agro-tourism	• Completion of DATC facilities • Development and target operation of DFC in 2020 • Improvement of FMRs • Certification of organic vegetables and fruits • Cardava Banana Flour Processing Plant • Kadayawan Cultural Village (Eden) • Include in agro-tourism circuit (DATC, Eden Park, Malagos Garden, etc.) • IT Parks/IT Centers
	Tugbok	• Production areas of cacao (3rd), cardava banana (1st) • Many small food producers and manufacturers of non-metallic mineral products • Mountain resorts, durian farms, orchid farms • Rich pre-WWII heritage	• Expand production of cacao, cardava banana and other farm produce • Organize smallholder farmers • Provide technical, financial and marketing assistance to farmers • Improve agricultural support infrastructure (e.g., FMRs, agricultural machinery and equipment, etc.) • Provide irrigation facilities • Promote farm/ agro-tourism and legacy tourism	• Cardava Banana Nursery • Cacao Nursery • Cardava Banana Flour Processing Plant • Improvement of FMRs • Little Tokyo (Mintal) • Madayaw Travellers' Facility (Los Amigos) • Include in agro-tourism circuit (Los Amigos) • Recycling Industrial Estate/ Park

Source: IM4Davao Team

10.65 It is timely that the city government is now in the process of updating its Investment Incentives Code (IIC). In this process, it is important for the city to consider the following:

(i) Ensure extensive consultations of all concerned multisectoral stakeholders, especially those in the private sector and targeted priority industries in gathering inputs, comments and suggestions on proposed investment areas and incentives. Perhaps, the city can consider creating a multisectoral committee or task force with adequate representation from all concerned government and private sector organizations (e.g., DCCCII, Davao Tourism Association, ICT association, VICSMIN, etc.) that can serve as a technical and advisory group to provide inputs and monitor the progress of work of the consultant commissioned to update the ICC.

(ii) Validate the investment priority areas taking into consideration a thorough assessment of Davao City's comparative advantages in physical and human resources, infrastructure, market linkages, finance, technology, etc. Agriculture has been and continues to be the city's strongest advantage. Agricultural and agro-industrial processing should, therefore, be among the most preferred investment areas. This should include agricultural support industries such as nurseries, organic fertilizer and inputs, manufacture of agricultural machinery and equipment, etc.

(iii) Carefully consider the spatial dimensions of investment and economic development, especially in terms of availability of suitable land, water, power, transport and logistics, and other economic factors; and in appropriate land uses and zoning. For example, while the current investment priorities include light manufacturing and assembly, there are no specific commercial sites (e.g., industrial estate, agro-processing zones, etc.) in the city for hosting such types of industries. The city's updated CLUP, with inputs from the IM4Davao Project, can be used to identify appropriate investment areas based on available locations. Conversely, the IIC can be used to complement the CLUP in that preferential incentives could be given to investments locating in specific designated locations/ zones that could contribute to the city's goals of dispersing industries and development benefits, decongesting the urban core, creating employment and improving incomes in rural barangays, and controlling settlement in undevelopable areas (e.g., hazard-prone areas), among others. Thus, the timetable for updating the CLUP should be ideally synchronized and coordinated with the updating of the IIC.

(iv) The updating of the IIC should be used as a learning opportunity for personnel of the lead and frontliner investment promotion organizations (IPOs) of the city government. Specific staff of DCIPC, CAO, CEE, etc. should be designated to work closely with the IIC consultant on relevant aspects of the undertaking as a learn-by-doing exercise. This capacity building measure will also benefit the consultant in getting technical inputs of the city IPOs who are more familiar with the local situation and needs. Selected staff may be assigned as members of the proposed committee/ task force earlier mentioned.

10.66 DCIPC, as the city's lead organization for promoting investments, and CTOO as the lead for tourism promotion, are currently exerting best efforts to perform their tasks and meet their targets. However, aggressive investment and tourism promotion are

gargantuan tasks that need a lot of human resources both in terms of quantity and quality. It has been observed that DCIPC and CTOO are currently undermanned, lack regular plantilla personnel (thus, requiring the hiring of contractual staff), and are generally manned by relatively young staff. There is a need to augment the regular personnel complement of these offices and implement regular training and capacity building programs. As a way of OJT for frontline IPO staff, they may be regularly involved as counterpart staff in technical assistance projects for the city such as the ongoing IIC updating, JICA and ADB infrastructure planning projects, etc.

10.67 While the job of promoting investments and tourism rests mainly in the hands of the city's IPOs, the personal involvement of the local chief executive (the mayor) and senior officials in such promotion efforts is a powerful tool and, in fact, a good practice in many public and private organizations. More recently, for instance, Mayor Sarah Duterte-Carpio has been leading the Davao City delegations to Japan (e.g., Kitakyushu) to meet with counterpart officials and sign a sister city agreement. Such high-level missions have resulted in agreements on investment, tourism and cultural exchanges. Aside from Kitakyushu, Davao City has similar cooperation agreements with Manado City and Bitung City (both in North Sulawesi, Indonesia), Nanning City (China), and Koror City (Palau), among others. These agreements should be revisited and nurtured as a way of forging more investment, trade and tourism exchanges. Missions should be well-prepared and well-orchestrated events that should be allotted adequate lead time for arrangements.

10.68 One under-tapped resource for investment promotion are the Philippine embassies and consulates in foreign countries. Davao City's and the regional IPOs should establish and strengthen their linkages and coordination with the country's commercial and tourism attaches especially in target investment partner countries in collecting economic intelligence information, identifying target investor groups, arranging G2G and B2B investment/ trade/ tourism missions and forums, arranging participation of city delegations to international exhibitions and conferences, promoting locally made exportable products abroad, among others. The embassy/ consulate personnel are more familiar with the local situations and business opportunities in their assigned countries and can tap their networks to help the city's IPOs in exploring such opportunities.

10.69 The local IPOs are already using the trimedia, internet and social networks in their investment, trade and tourism promotion work. They also continue to innovate in preparing informative and attractive promotion collaterals (e.g., industry profiles, compendium of economic indices, brochures and investment guides with Japanese translation) in printed and electronic forms. They should continue improving on these collaterals and, more importantly, widening their distribution to target clientele through various channels including Philippine embassies/ consulates, foreign chambers of commerce and industry associations, etc. The IPOs should also consider preparing investment project-specific collaterals such as project profiles, investment prospectus, studies, etc. of specific targeted priority projects for the city. Content-wise, the promotion collaterals should include zoning maps, industrial locations, site-specific costs of doing business, etc. and should include business infrastructure readiness as another economic advantage. Still, the city should work towards identifying business locations such as industrial estates and ecozones in its CLUP.

10.70 Aside from obtaining information from promotion collaterals and the internet, some foreign investors such as the Japanese normally validate this information and get

additional insights by consulting with existing investors from their countries who are already doing business in the Philippines. Thus, it would be a good practice for the city's IPOs to consult with these in-country firms to get information leads on potential investors before arranging foreign missions. Particularly for Japan, JICA, Japan External Trade Organization (JETRO), and Japanese Chamber of Commerce in Mindanao (JCCM) are good partners for promoting the city to potential Japanese investors and tourists. Thus, it is also crucial to maintain good relationships with JICA, JCCM, etc. The city government may also consider the possibility of establishing a Japan Desk in one of their offices, most probably DCIPC, to be manned by staff from JICA or JETRO who will focus on establishing networking linkages between Davao City and Japanese investors. This is being practiced in some countries. Likewise, by analyzing the information collected from the said foreign agencies, it is also important for DCIPC to benchmark the city's investment promotions program against those of foreign competitor cities, such as those in China and Vietnam, and to formulate more aggressive investment promotion strategies to entice foreign investors to relocate and/or expand their operations from the foreign cities to Davao City.

3) Action Plan

10.71 The IM4Davao Team has so far made recommendations on the directions and strategies for the agribusiness and agro-industry, ICT, tourism, low-carbon energy and transport and logistics sectors. However, there are challenges and issues to be addressed in the process of their implementation. The team proposes the following Action Plan (AP) to address the challenges and issues in implementing these strategies effectively.

(a) Activities and Schedule of Action Plan

10.72 The AP consists of three kinds of activities, namely: (1) governance; (2) planning and implementation; and (3) monitoring and evaluation (M&E). The AP also incorporates the cycle of Plan-Do-Check-Action/Adjustment (PDCA).

10.73 The activities and schedule of the proposed AP are shown in Table 10.3.2.

Table 10.3.2 Activities and Schedule of Action Plan

Activities		2018								2019											
		May	June	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
1	Governance																				
1-1	Establish the secretariat	■																			
1-2	Organize Working Group (WG)		■																		
1-3	Convene WG meeting at least twice a year		■						■					■							■
2	Planning and Implementation																				
2-1	Formulate Development Plan (DP)			■																	
2-2	Revise DP in view of feedback									■											
2-3	Hold hearing session from private sector					■						■						■			
3	Monitoring & Evaluation (M&E)																				
3-1	Conduct evaluation (by 3rd party)						■												■		
3-2	Submit evaluation report							■												■	
3-3	Provide feedback for WG								■												■

Source: IM4Davao Team

(b) Secretariat and Working Group (WG) of Priority Sectors

10.74 The secretariat and key members of the WG play a pivotal role in planning and implementing the Action Plan, facilitating public-private partnership, etc. IM4Davao Team proposes the secretariat and the key members as follows.

Table 10.3.3 Working Group's Secretariat and Key Members

Sectors	Secretariat	Key Members
Agribusiness and Agro-Industry	CAO	DA, DTI, DCCCII, CIDAMI, VICSMIN), etc.
ICT	CIO and/or DCIPC	DOST, DTI, TESDA, Department of Labor and Education (DOLE), DCCCII, ICT Davao
Tourism	CTOO	DOT, DTI, TIEZA, Davao Tourism Association (DATA), National Association of Independent Travel Agencies (NAITAS), etc.
Low Carbon Energy	CENRO	DENR), DPWH, MinDA, DCCCII, etc.
Transport and Logistics	CPDO, CTTMO	DPWH, DOTr, DCCCII, PUV associations, etc.

Source: IM4Davao Team

11 TRAFFIC DEMAND FORECAST

11.1 Database Development

1) Development Process

11.1 The IM4Davao Project has developed the latest city traffic database through the integration of both secondary and primary information sources. An existing data on origin-destination (OD) trip information of Davao City residents, gathered in the early 2015, was acquired from a previous project conducted by the Cities Development Initiative for Asia (CDIA)[1]. The IM4Davao Project, then, generated a 2017 data from its various surveys to update and supplement the earlier data.

11.2 The traffic surveys conducted during this project are: (i) traffic count, vehicle occupancy survey, and OD interview survey at the cordon line; (ii) traffic count and vehicle occupancy survey at the screen line; and (iii) traffic count at major intersections. This OD traffic data was used to adjust the CDIA OD traffic data to produce the 2017 OD matrices which cover 182 traffic analysis zones within the city and 10 zones for other areas outside the city[2].

11.3 The initial traffic demand assignment using the CDIA OD matrix and the existing road network could not replicate the existing road traffic situation of the city. More precisely, when the assigned traffic was adjusted to the surveyed vehicular traffic across the screen line (Davao River), the assigned traffic on other roads were still considerably different from the actual traffic on those roads. It was considered a calibration error which appeared during the preparation of this project's Interim Report in October 2017.

11.4 The calibration error was attributed to the very limited data of car trips in the CDIA OD matrix. Said car trips had to be expanded 8.3 times just to meet the screen line survey results. Nevertheless, the expanded car trips could not replicate the car movements on other road sections.

11.5 Under such situation, JICA decided to conduct a supplemental household interview survey (HIS) focusing on car owning households in the city in order to develop a reliable traffic database for transport planning. The supplemental HIS: Person Trip Survey for Car-Owned Households (see ***ANNEX 5***) was conducted in January 2018, which covered 975 households capturing 4,888 personal trips per day including the 1,685 trips made with their own cars. These data were added to the original CDIA OD matrix resulting in the drastic reduction of car trip expansion rate from 8.3 to 2.7 times on the same screen line. After using adjustment techniques based on the traffic survey results from the screen line, cordon line and other roadside traffic count results, the 2017 OD matrix became reliable as a starting point for the various transport planning works required for Davao City.

[1] The CDIA-funded “Managing the Cities in Asia: Davao Sustainable Urban Transport Project” aimed to provide support to the local government of Davao City in developing its approach to the modernization and improvement of its transport system, with a view to identifying specific interventions that could be the subjects of more detailed feasibility studies and subsequent investment.

[2] Davao City and its surrounding areas were divided into 182 and 10 traffic analysis zones, respectively. Each zone in the city represents a barangay while each of the 10 zones outside the city represent one or more municipalities.

Table 11.1.1 Adjustment of Vehicular Traffic across the Screen Line (Davao River)

Version	Mode				
	Motorcycle	Car	Taxi	Public	Water
Before Additional HIS	1.194	8.322	0.647	1.246	6.281
After Additional HIS	0.886	2.674	0.612	1.173	4.766

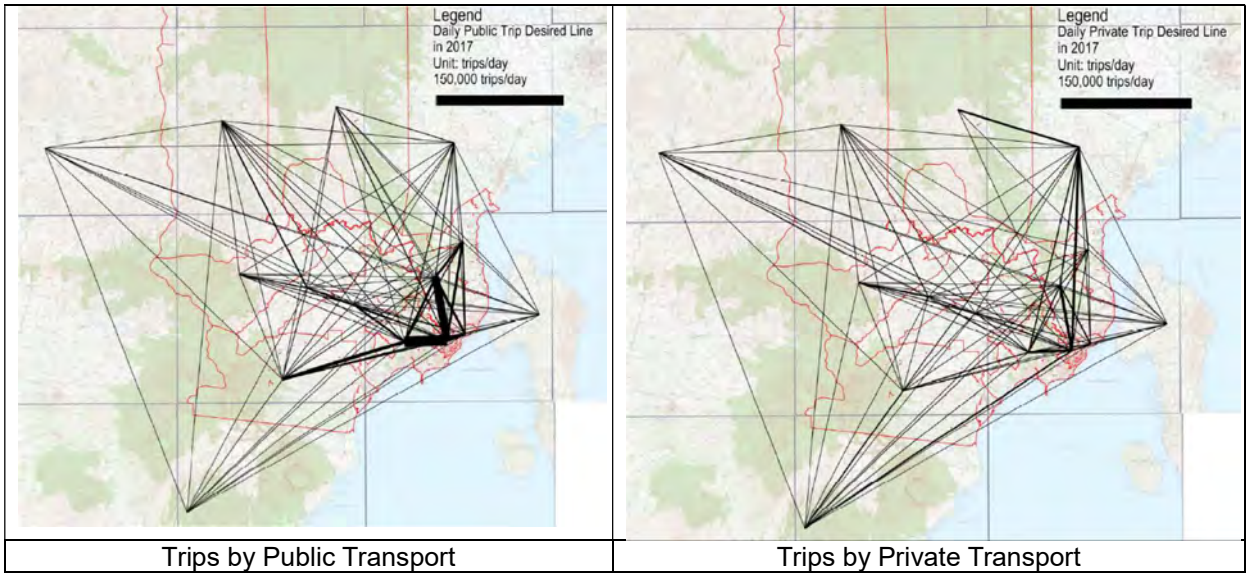
Source: IM4Davao Team

11.6 Trip generation and attraction models, or patterns, were then developed to show the 2017 generated and attracted trips by traffic zone. A major input to the calculation of generated and attracted traffic is the nighttime and daytime population of students and employment by sector (i.e., primary, secondary, and tertiary). Using the 2017 trip generation and attraction models, the generated and attracted trips by zone for 2030 and 2045 were then estimated.

11.7 Subsequently, the future OD matrices were prepared based on the 2017 OD matrices. The Fratar method was used to combine OD trip numbers into zonal totals.

2) Characteristics of OD Matrices

11.8 The OD matrices for 2017 show the person trips by public transport and by private transport. By comparison, the trips on public transport show a concentration at the city center. Longer trips from areas outside the city to other outside areas are observed such as trips from/to Samal Island and Bukidnon. Trip distribution by mode and by purpose are summarized in ***ANNEX 5***.

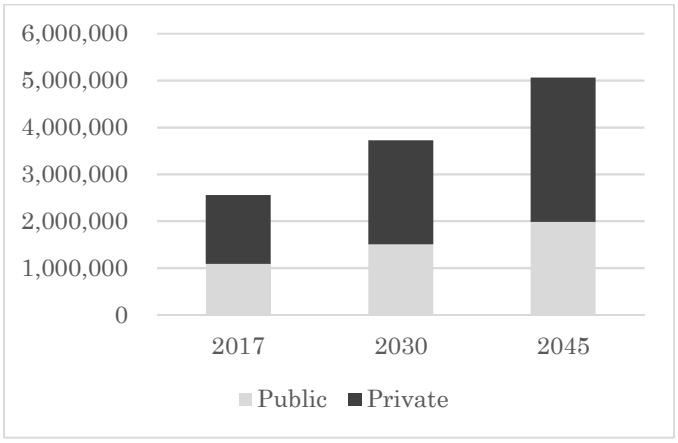


Trips by Public Transport | Trips by Private Transport

Source: IM4Davao Team

Figure 11.1.1 Person Trip Patterns, 2017

11.9 The OD matrices for 2017, 2030, and 2045 contain motorized trips totaling 2.558 million, 3.721 million, and 5.063 million, respectively (Figure 11.1.2). In the forecast, both the number of trips and shares of private vehicles will increase, i.e., 57% in 2017 to 61% in 2045. The increase in trips can largely be explained by population growth, while the increase in private vehicle use is attributed to population growth in the suburbs.



Source: IM4Davao Team

Figure 11.1.2 Number of Daily Motorized Trips in 2017, 2030, and 2045

11.2 Analysis of Existing Road Network and Ongoing Projects

1) Capacity of Existing Road Network

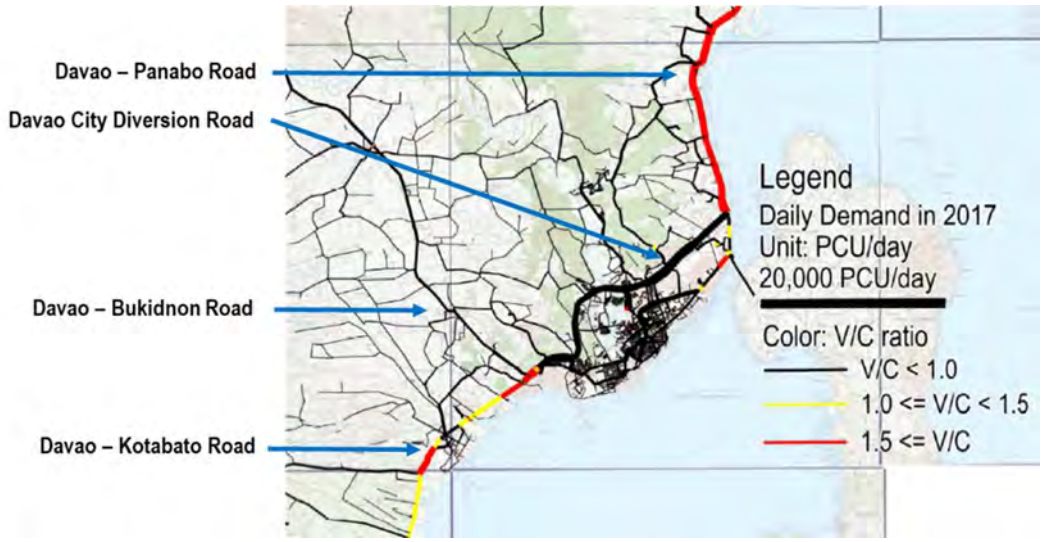
11.10 In order to replicate the existing traffic movement and volume on the existing road network, calibration of the traffic assignment was done using the results of the screen line and other surveys. Results of the assignment show that the current traffic exceeds the current capacity of two coastal trunk roads, i.e., Davao-Cotabato Road and Davao-Panabo Road. On the other hand, smooth traffic flows are depicted on Davao-Bukidnon Road and the Davao City Diversion Road. These results replicate reality. since the two coastal roads are indeed congested at anytime (refer to Figure 11.2.1 (upper image)).

11.11 When the 2030 OD matrix was assigned to the existing road network, the current road congestion became severe. Under such a situation, the Davao-Bukidnon Road would experience daily congestion and intercity traffic movement cannot be smoothly maintained (refer to Figure 11.2.1 (middle image)). Moreover, the assigning of the 2045 OD matrix on the existing road network illustrated even more congestion that the Diversion Road became congested over long sections and bottlenecks appeared on minor inland roads (refer to Figure 11.2.1 (lower image)).

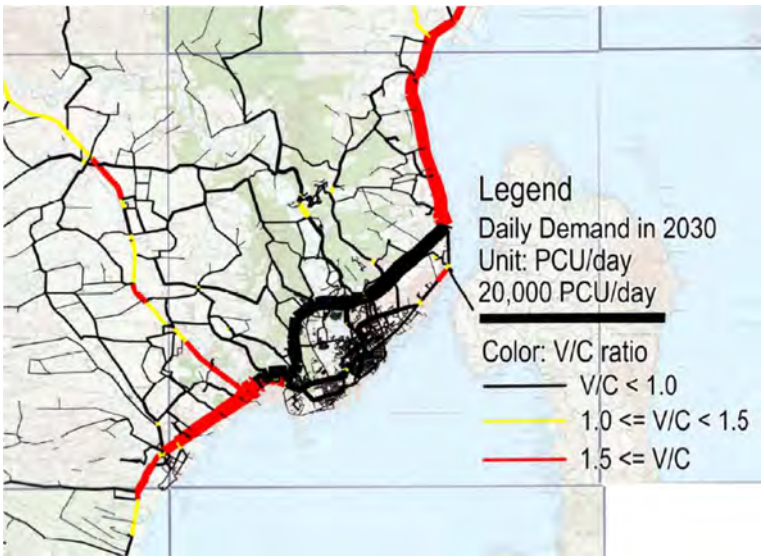
2) Impact of Ongoing Road Projects

11.12 Fortunately, Davao City has ongoing trunk road projects; the Davao City Coastal Road Project and the Davao City Bypass Road Project. Detail design works and partial land acquisition are being undertaken for both the projects as of 2018. To elaborate the development impact of these road projects on the existing road network, the 2030 and 2045 OD matrices were assigned on the existing road network plus the two road projects.

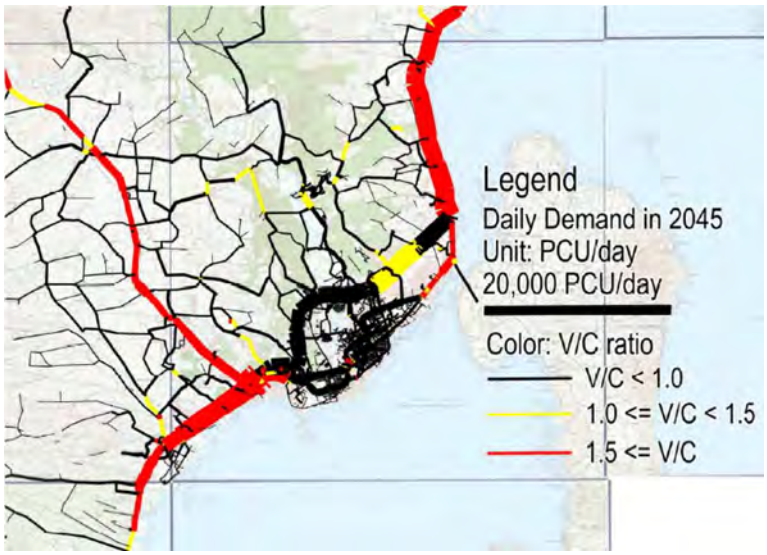
11.13 The assignment results using the 2030 OD matrix shows that the two projects would greatly alleviate traffic congestion. More of the traffic would be diverted to the bypass road rather than the coastal road. However, some districts would still not be free from traffic congestions such as Bunawan, Talomo, Toril, Tugbok and Calinan. The on-going projects are designed to bypass the coastal trunk road (Davao-Cotabato Road and Davao-Panabo Road) and therefore they will not provide additional road capacity between the coastline and inland areas. As a result, the Davao-Bukidnon Road would be seriously congested (refer to Figure 11.2.2 (upper image)).



(Upper) Year 2017 OD Matrix



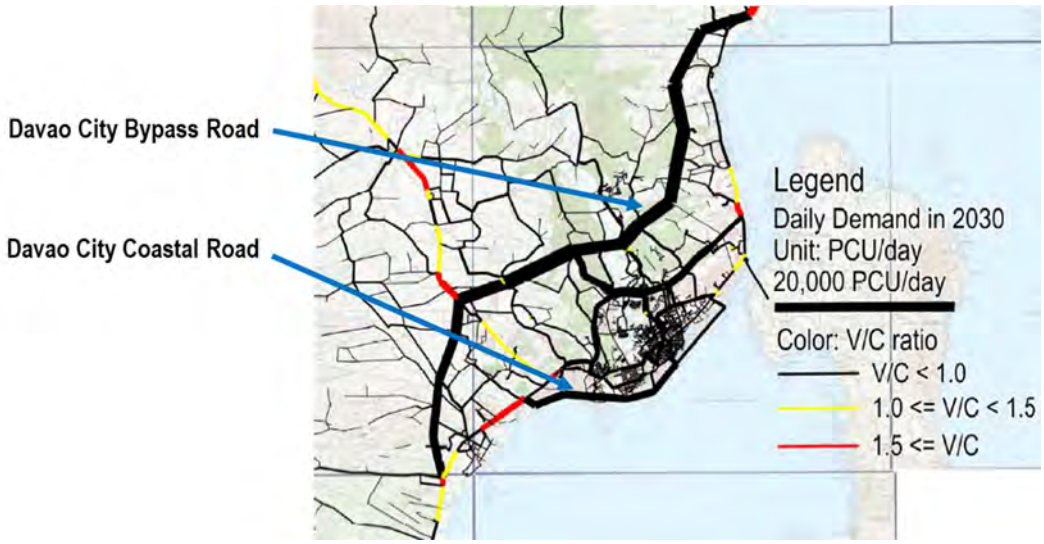
(Middle) Year 2030 OD Matrix



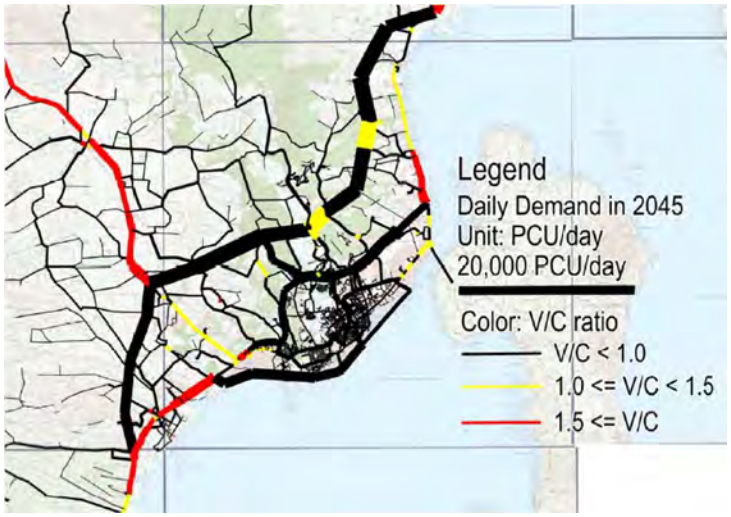
(Lower) Year 2045 OD Matrix

Source: IM4Davao Team

Figure 11.2.1 Traffic Assignment Results on the Existing Road Network



(Upper) Year 2030 OD Matrix



(Lower) Year 2045 OD Matrices

Source: IM4Davao Team

Figure 11.2.2 Traffic Assignment Results on the Existing Road Network plus Ongoing Road Projects

11.14 The assignment results using the 2045 OD matrix indicated that the already congested sections in 2030 became even be more exaggerated and some sections on the Davao City Bypass Road became congested.

11.15 The above-mentioned traffic assignment results are summarized in Table 11.2.1. The 2 ongoing road projects would improve vehicular traffic. Thus, in the case of year 2030, the road network with the 2 projects recorded longer vehicular traffic distance (passenger car unit or PCU x KM) by 2.8% but it accelerated vehicular traffic speed by 4.9 km/hour compared with the traffic flow simulation on the existing road network.

Table 11.2.1 Summary of Traffic Assignment Results with or without the 2 Ongoing Projects

	Existing Network			Existing Network + 2 Ongoing Projects	
	2017	2030	2045	2030	2045
PCU x KM	3,747,240	5,990,504	7,614,168	6,158,261	7,805,902
PCU x Hour	215,810	361,174	533,559	286.216	417,401
Average Speed	17.4	16.6	14.3	21.5	18.7

Source: IM4Davao Team

11.3 Identification of New Road Projects and Their Impact on the Network

1) Project Identification

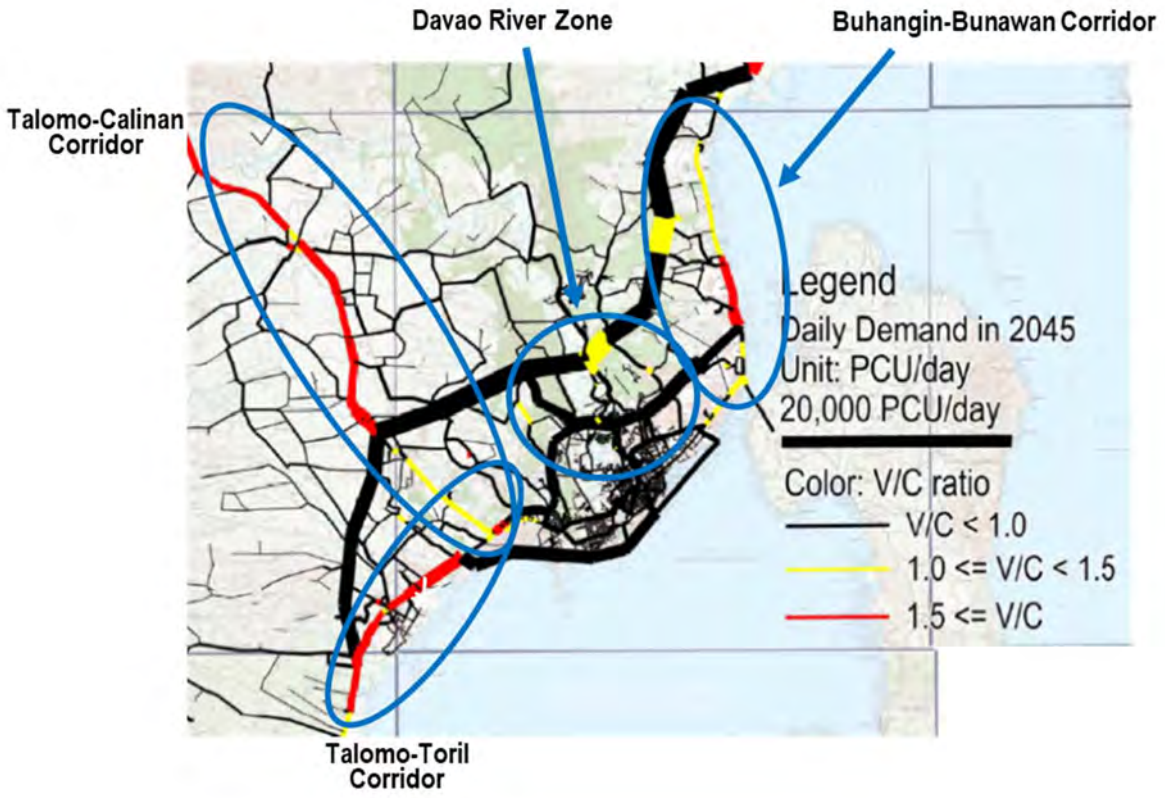
11.16 The traffic assignment results forecast that there would be 4 bottleneck sections after the completion of the 2 ongoing trunk road projects, i.e. the Davao City Bypass Road Project and the Davao City Coastal Road Project. They are indicated based on congestion reasons: (Refer to Figure 11.3.1)

- The Buhangin-Bunawan Corridor: The corridor capacity (consisting of the Davao City Bypass Road in the north section and Davao-Panabo Road) would not be enough in the future and the connecting roads between the 2 trunk roads are narrow and in need of widening.
- The Davao River Zone: The corridor capacity (the Davao City Bypass Road in the middle section and the Davao City Diversion Road) would not be enough in the future. The diversion road does not have a good alignment to connect with Talomo and Toril. There is a lack of roads between the coast and inland in the middle of the city's urban area while existing roads are narrow and in need of widening.
- The Talomo-Calinan Corridor: The existing corridor capacity, which is equal to the capacity of Davao-Bukdnon Road, would not be enough. The 2 ongoing road projects would not help in expanding this particular corridor's capacity.
- The Talomo-Toril Corridor: The corridor's capacity (the Davao City Bypass Road at the south section and Davao-Cotabato Road) would not be enough in the future. There would be many trips on the route of Toril-Talomo-Poblacion. Most of them, however, may not use the bypass road due to the considerable detour distance.

11.17 Taking the above analysis into account, the following new road projects are considered to alleviate the bottleneck corridors and zone (refer to Chapter 12 for new road projects):

- The Buhangin-Bunawan Bypass Road Project for the Buhangin-Bunawan Corridor is a 15 km long bypass road to be located between the Davao City Bypass Road in the north section and Davao-Panabo Road. The road project is listed in Davao City's CLUP. Since the corridor area is fast urbanizing with the emergence of factories and subdivisions, the ROW acquisition and resettlement of affected parties would take a long time.
- The Davao Riverside Boulevard Project for the Davao River Zone is an 11km long riverside road. The road project is listed in Davao City's CLUP. It will strengthen the city's road network particularly between the coast and the inland. areas. The river and its surrounding areas are mostly public lands but many informal settlers and IPs have settled here. Historically, the river has repeatedly overflowed and flooded nearby areas thereby damaging nearby residents' properties including those who live in the Poblacion. When the river is improved to control flooding, the riverside boulevard will become a reality.
- The Talomo-Calinan Bypass Project for the Talomo-Calinan Corridor is a 22 km long bypass stretching parallel to the Davao-Bukdnon Road. The widening work of the Davao-Bukidnon Road may be limited due to roadside developments. However, the proposed bypass may also suffer from ROW acquisition and resettlement issues and, thus the project must be undertaken in the long-term.

- The Extension of Davao City Diversion Road Project is a 16 km long road including widening of existing roads (4.5 km). The road project is listed in Davao City's CLUP and it is a long waiting project. The project is technically difficult to be implemented by a local contractor due to the hilly terrain. However, the number of affected parties to be resettlement is comparatively smaller than the other 3 projects.



Source: IM4Davao Team

Figure 11.3.1 Anticipated Road Traffic Bottleneck Zones

2) Development Impact on the Road Network

11.18 All the proposed 4 projects have peculiar issues for implementation. Among them, the Davao Riverside Boulevard Project and the Davao City Diversion Road Extension Project may have breakthrough advantages to hasten project implementation. The former is the synergy effect of the Davao River flood control project. The latter is an international bidding for construction.

11.19 There is some expectation that the 2 proposed new projects will be able to develop a better road network to mitigate other anticipated bottleneck corridors. For instance, with the extension project, the Davao City Diversion Road will be able to cope with more diversion traffic in the north section. It will reduce the burden of the Davao City Bypass Road at the north section and Davao-Panabo Road. The Davao Riverside Boulevard Project, on the other hand, will provide a strong link between the coastal area and the inland area which may reduce traffic burden between Talomo and Mintal on Davao-Bukidnon Road.

11.20 With the above considerations, the proposed 4 new roads are divided into two groups in terms of implementation timing:

(Opening by Year 2030)

- The Davao River Boulevard Project
- The Davao City Diversion Road Extension Project

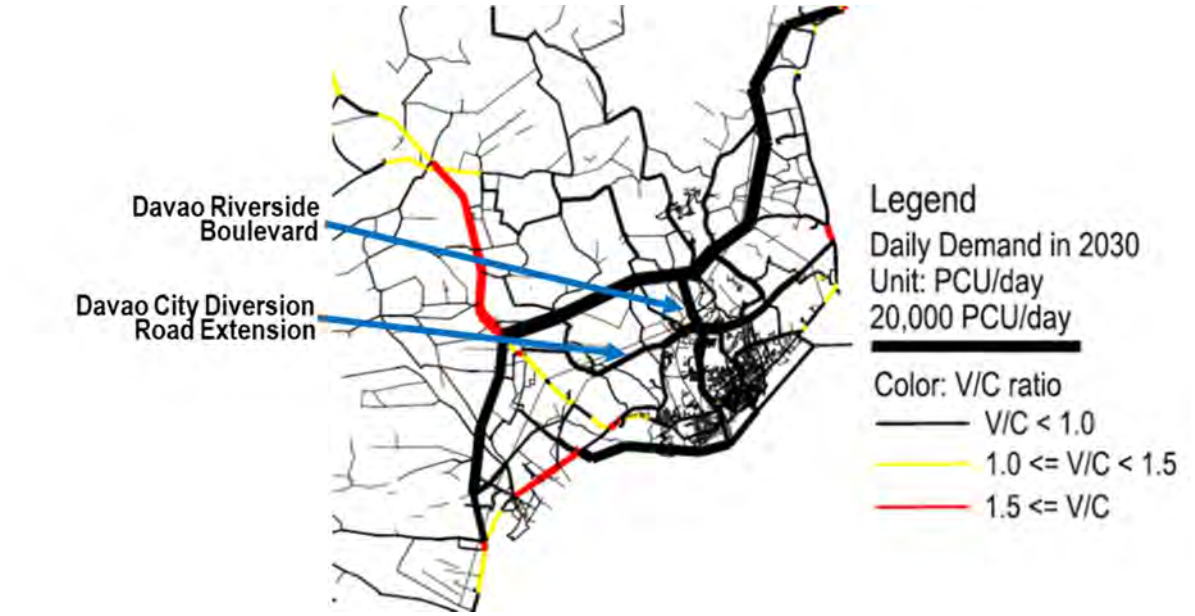
(Opening by Year 2045)

- The Buhangin-Bunawan Bypass Project
- The Talomo-Calinan Bypass Project

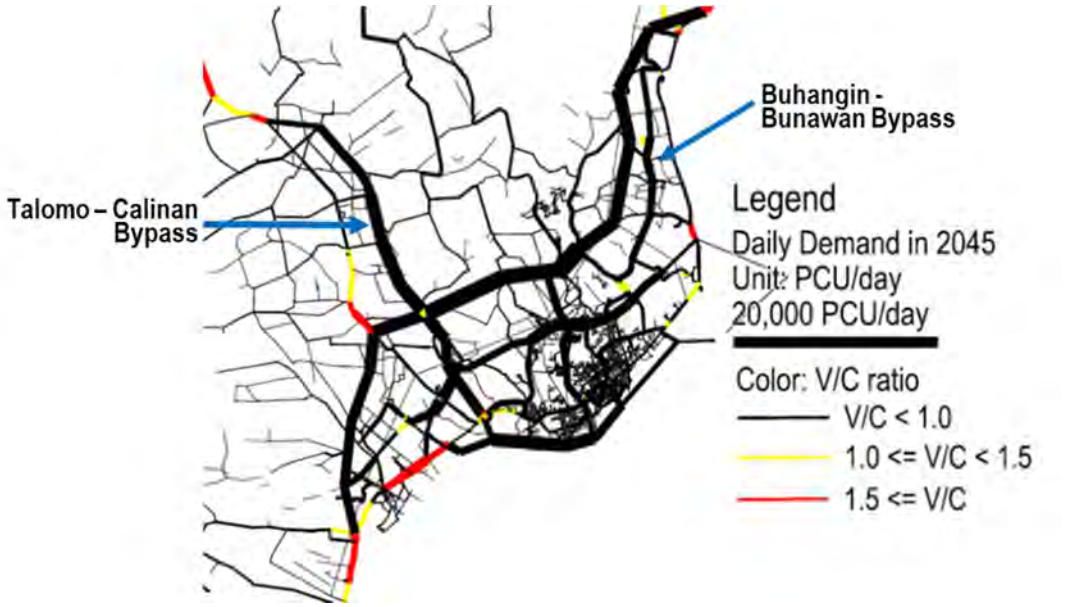
11.21 Traffic assignment exercises were performed to assess the proposed road network after the 2 ongoing road projects have been completed. The results are shown in Figure 11.3.2 and Table 11.3.1.

11.22 Compared with Figure 11.2.2, modest traffic congestion impact can be observed under the 2030 OD matrix at Davao-Panabo Road and Davao-Bukidnon Road between Talomo and MIntal with the 2 proposed new road projects. The network traffic speed increased by 0.8 km/hour.

11.23 Under the 2045 OD matrix, it was observed that the 4 proposed new road projects solved most of the anticipated traffic congestions shown in Figure 11.2.2 and network traffic speed increased by 2.9 km/hour. Only this network would keep an average network traffic speed of over 20 km/hour. However, only the section between Talomo and Toril on Davao-Cotabato Road would still be congested while the extension section of the Davao City Diversion Road would start to congest. Since public transport users do not want to change their route, one solution to mitigate congestion between Talomo and Toril is to introduce an urban rail service.



(Upper) Year 2030 OD Matrix



(Lower) Year 2045 OD Matrices

Source: IM4Davao Team

Figure 11.3.2 Traffic Assignment Results on the Existing Road Network plus Ongoing Road Projects plus Proposed 2 Road Projects for 2030 and Proposed 4 Road Projects for 2045

Table 11.3.1 Summary of Traffic Assignment Results with 2 or 4 New Projects

	Existing Network + 2 Ongoing Projects		Addition of 2 New Projects		Addition of 4 New Projects
	2030	2045	2030	2045	2045
PCU x KM	6,158,261	7,805,902	6,168,612	7,786,983	7,808,361
PCU x Hour	286.216	417,401	276,015	398,949	361,141
Average Speed	21.5	18.7	22.3	19.5	21.6

Source: IM4Davao Team

11.4 Railway Development Forecast

11.24 The DOTr's Mindanao Railway Project is currently ongoing. The project will provide inter-city passenger railway service from Tagum City to Digos City. Therefore, it is called the TDD (Tagum- Davao-Digos) Line. Within Davao City, the conceptual alignment passes through currently underdeveloped areas. These areas, however, are supposed to be urbanized in the IM4 Davao land use plan for the year 2045. The project will construct 4 stations in the city. They are, from the north, Mudiang, Davao Terminal, Mintal and Toril.

11.25 In recent years, a couple of foreign groups conducted prefeasibility studies for urban rail systems such as a monorail for Davao City. Under the IM4Davao Project, a forecast of the rail traffic demand was conducted. For this purpose, an urban rail main line is set along the public transit corridor where many buses and jeepneys are assigned between Toril and Sasa (i.e., nearby area of the Davao International Airport) traversing through the Poblacion. Branch lines are also considered to connect with the Mindanao Railway in order to develop a network of intercity rail and urban rail.

11.26 Traffic assignment was performed under the OD matrices of 2030 and 2045. The results are illustrated in Figure 11.4.1 and calculated in Table 11.4.1. In 2030, the urban rail would carry 249 thousand passengers on the main line mostly between Agdao and Toril. This number is deemed attractive to consider a railway investment. The branch lines, on the other hand, show mere demand passing through currently underdeveloped areas. In 2045, the main line would carry 326 thousand passengers per day. Its traffic demand pattern is the almost same as that of the year 2030.

11.27 The maximum passengers per section would be 265 thousand across Davao River. This is considered one planning indicator when selecting and designing a suitable urban rail system.

11.28 The urban rail can provide faster and punctual services when compared with road based public transport services. However, rail service areas, in terms of station catchment areas, are limited. With the rail network in 2030, the share of rail among the public transport demand segments would be 26.8%.

Year 2030

Year 2045

Source: IM4Davao Team

Figure 11.4.1 Railway Demand Forecast

Table 11.4.1 Railway Demand Forecast by Lines

Line	Year 2030		Year 2045	
	100 Pax/Day	100 PaxKm/Day	100 Pax/Day	100 PaxKm/Day
Davao City Mass Transit Main Line	2,490	27,922	3,255	36,931
- Branch to Mudiang	703	3,389	945	4,559
- Branch to Davao Terminal	45	166	57	210
- Branch to Mintal	27	122	32	145
Max Pax Section (Davao River)	2,023	-	2,646	-
Mindanao Railway (within Davao City)	1,572	-	2,181	-

Source: IM4Davao Team

12 ROAD NETWORK AND TRAFFIC MANAGEMENT PLAN

12.1 Road Traffic and Network Analysis

1) Davao City Road Traffic Patterns

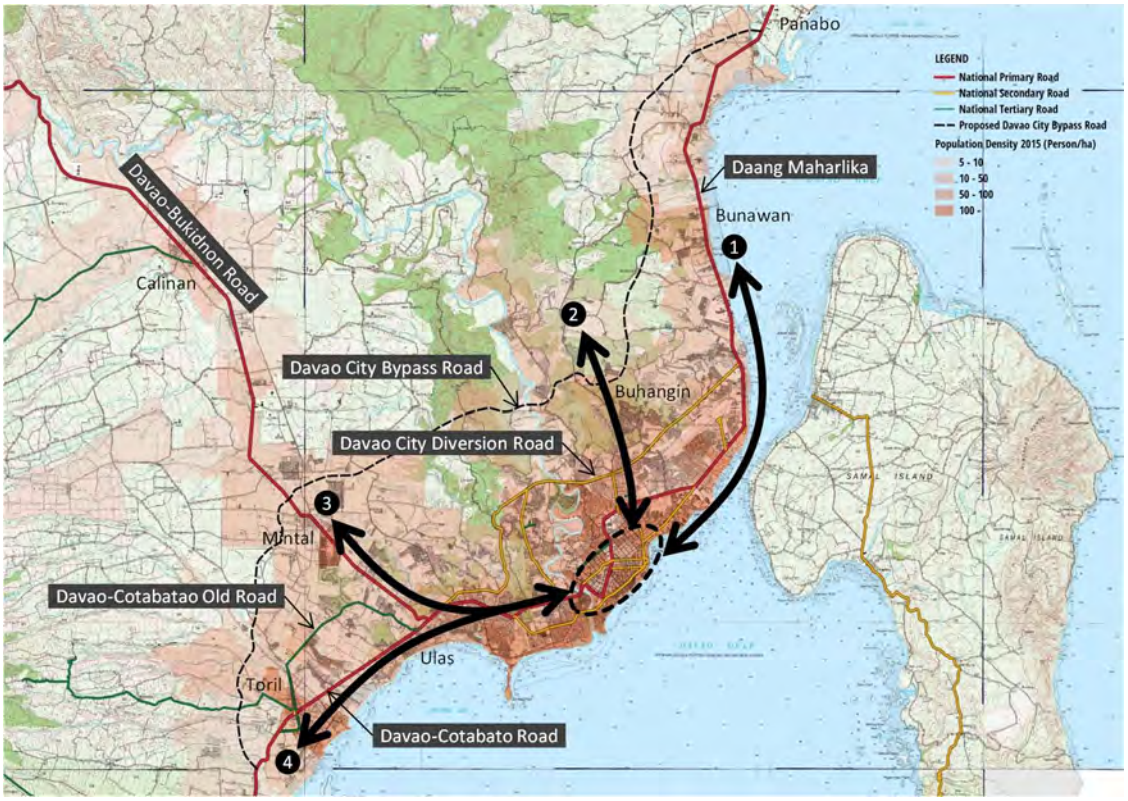
12.1 The urbanization of Davao City developed along the coastal line; mainly along the corridor of Daang Maharlika and Davao–Cotabato Road. Since the early 1900s, Poblacion area has been the central area of Davao City. Even now, most of the travel demand in Davao City is generated in the central area (mainly in Poblacion and Talomo Districts). In the whole travel demand, there are four major traffic patterns as follows:

(i) road traffic from Bunawan, Panabo, and Tagum;

(ii) road traffic from Buhangin and Paquibato;

(iii) road traffic from Tugbok, Calinan, Baguio, and Marilog; and,

(iv) road traffic from Toril and Digos.



Source: IM4Davao Team

Figure 12.1.1 Major Road Traffic Flows in Davao City

(a) Road Traffic from Bunawan, Panabo, and Tagum

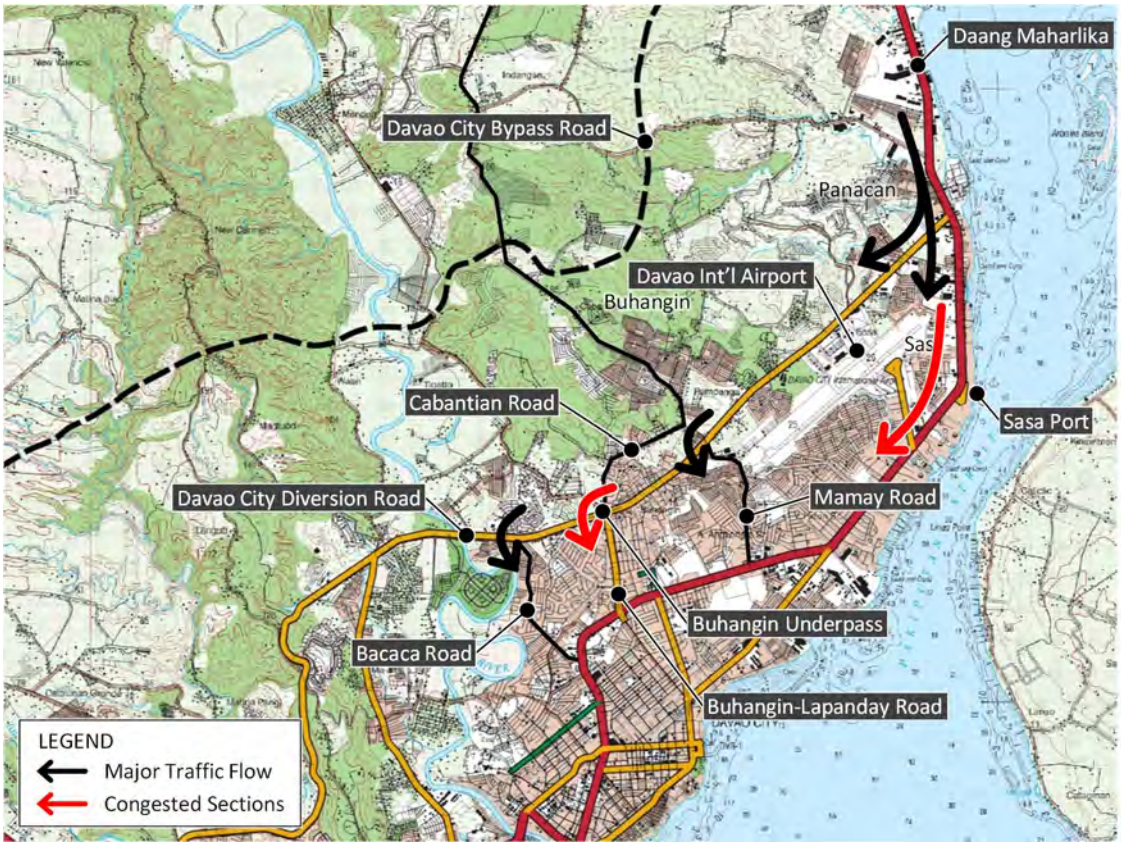
12.2 Traffic from the north passes through Daang Maharlika, which is a four to six-lane National Primary Road, and section of the road in Panacan and Sasa is often congested due to the centralization of traffic from the north or cargo traffic going to Sasa Port as well as the several traffic bottlenecks along the road (e.g. four-lane sections due to the existence of the river bridges and pedestrian bridges). Thus, most traffic diverts to Davao City Diversion Road and enter into city center through Mamay Road, Buhangin-Lapanday Road from the intersection at Buhangin Underpass, or Bacaca Road. It should be also

noted that although the widening of Daang Maharlika from four to six lanes is on-going, the relocation of utilities has not yet been completed and outer lanes of the six lanes have not yet been fully utilized (e.g. electric poles still exist on the original positions where they were installed outside of four-lane carriageway but are now on the carriageway).

12.3 Cabantian Road is the alternate road of Daang Maharlika with traffic from outside of Davao City (e.g. Panabo or Tagum) and is under construction works for widening to four lanes by the Department of Public Works (DPWH) Regional Office. For this traffic, Davao City Diversion Road and Davao International Airport are the physical barriers to enter the city center, and Buhangin Underpass and Mamay Road are the only available entry points. Therefore, the traffic along the routes to these entry points are often congested.

12.4 Davao City Bypass Road, which is a new road to be constructed soon, will run through the middle of Daang Maharlika and Cabantian Road and is expected to balance the traffic for this directional flow. However, the issue of centralization of traffic at the abovementioned entry points will remain even after opening of the Davao City Bypass Road.

12.5 Therefore, improvement of accessibility across Davao City Diversion Road should be considered.



Source: IM4Davao Team

Figure 12.1.2 Road Traffic from Bunawan, Panabo, and Tagum

(b) Road Traffic from Buhangin and Paquibato

12.6 Housing development in Buhangin District is currently advancing, but there is no national level arterial road in this area. The accessibility from this area to the city center is not good for the same reason mentioned about the traffic in Bunawan, Panabo, and Tagum. Buhangin–Lapanday and Mamay Roads are available connection to the city center but

chronic traffic congestions are observed at the intersections across Davao City Diversion Road.

12.7 Therefore, improvement of accessibility across Davao City Diversion Road is the same challenge for this direction of traffic flow as well.

Source: IM4Davao Team

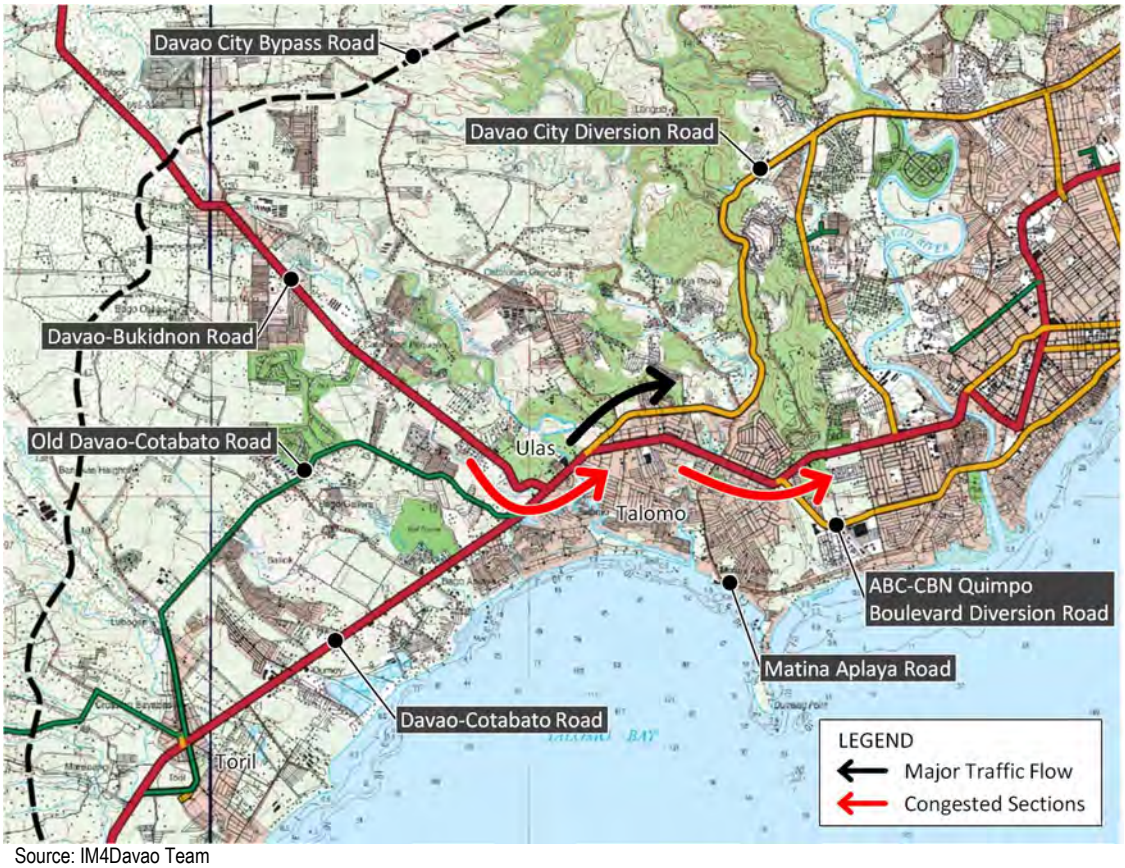
Figure 12.1.3 Road Traffic from Buhangin and Paquibato

(c) Road Traffic from Tugbok, Calinan, Baguio and Marilog

12.8 Davao–Bukidnon Road, which is a two to four-lane national primary road, caters traffic from Tugbok, Calinan, and Bukidnon Province, but there is no other alternate arterial road along this corridor. In addition, this road ends at Ulas in Talomo District that is a bit far from the city center and majority of the traffic from this direction heads to the city center through Davao–Cotabato Road. Because Davao–Cotabato Road is one of the busiest corridors of the coastal line, the intersection of Davao–Cotabato and Davao–Bukidnon Roads is often congested.

12.9 Even though the Davao City Bypass Road will be opened, traffic from this direction to the city center will not utilize the Davao City Bypass Road because there is no vertical directional road connecting from the bypass road to city center.

12.10 Therefore, strengthening of road network for this directional traffic, especially for accessibility to the central area of Davao City, should be considered.



Source: IM4Davao Team

Figure 12.1.4 Road Traffic from Tugbok, Calinan, Baguio and Marilog

(d) Road Traffic from Toril and Digos

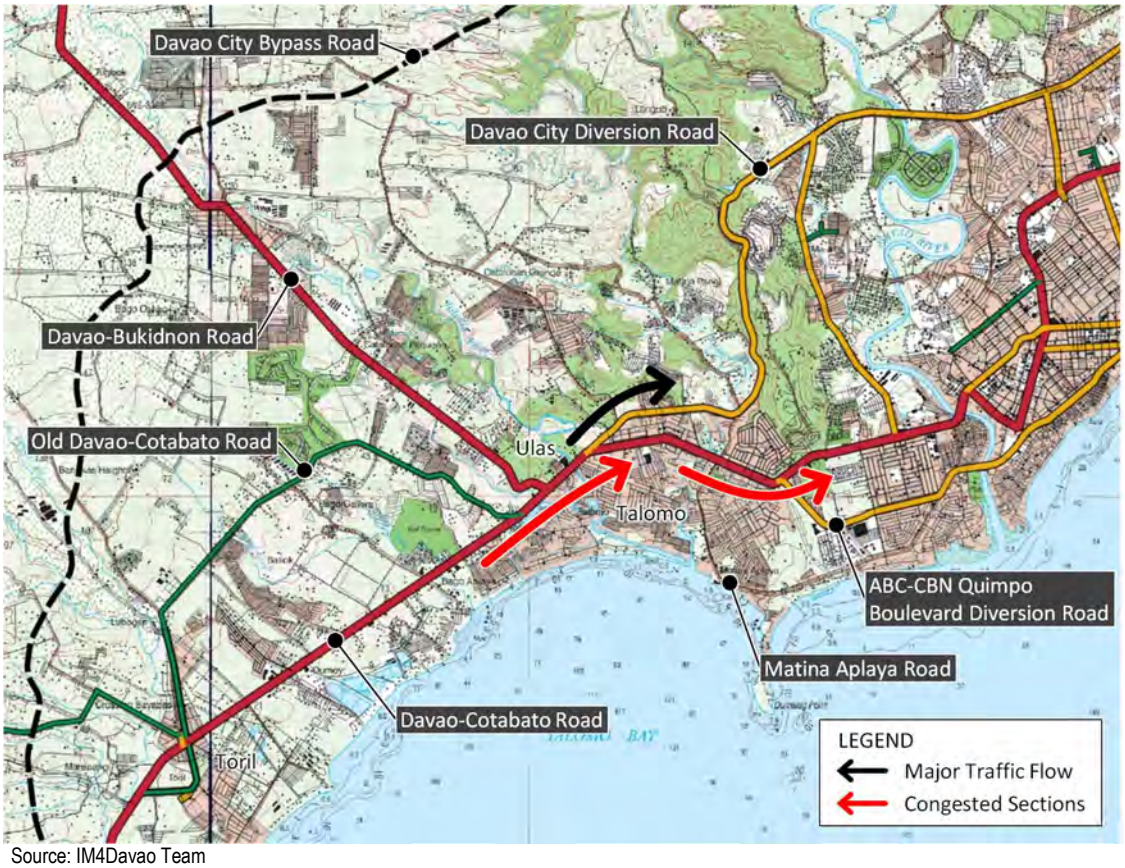
12.11 Davao–Cotabato Road, which is a six-lane national primary road that accommodates traffic to and from Toril, Digos, and General Santos, is one of the most important roads in the region. Passenger traffic from Toril and Digos is mainly towards the central area through this road, while freight traffic from this direction to the port area in Panacan and Sasa are through Davao City Diversion Road.

12.12 The section from Ulas to Poblacion is often congested as mentioned earlier due to low-connectivity of roads along this corridor and the centralization of traffic to this road. The intersections with the major roads Davao–Bukidnon, Davao City Diversion, Matina Aplaya, ABC-CBN–Quimpo Boulevard Diversion, and Ma-a are the major traffic bottlenecks.

12.13 Davao–Cotabato Old Road (or called Libby Road) forms a secondary road for this corridor, but the function to divert traffic from the primary road is imperfect due to the low-interconnectivity of the road network.

12.14 Also, it should be noted that the section of Davao City Diversion Road passing through hilly terrain is weak against natural disaster such as landslides. The cut slopes were often collapsed after heavy rains due to the insufficient slope protections.

12.15 In these regards, strengthening of road network along this corridor should be considered in order to balance or decentralize the volume of traffic for this direction and to provide alternate route even after the natural disasters.

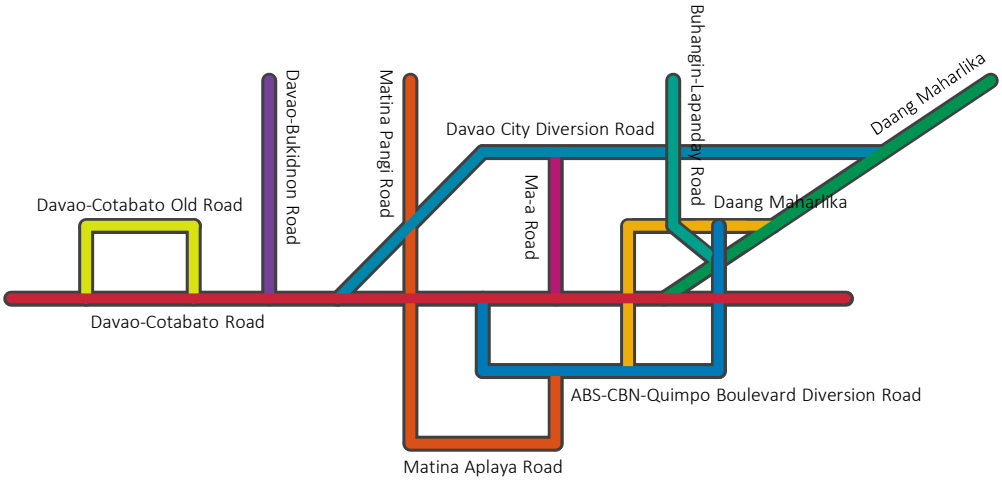


Source: IM4Davao Team

Figure 12.1.5 Road Traffic from Toril and Digos

2) Road Traffic in City Center

12.16 Road network in the city center of Davao City has a complex web of intersections with low-interconnectivity and it causes complex vehicle turning movements on the network. As shown in Figure 12.1.6, all major roads form independently and are not interconnected with each other. Due to this complexity, the hierarchy of roads are not so clear and thus traffic management of the road network is difficult.

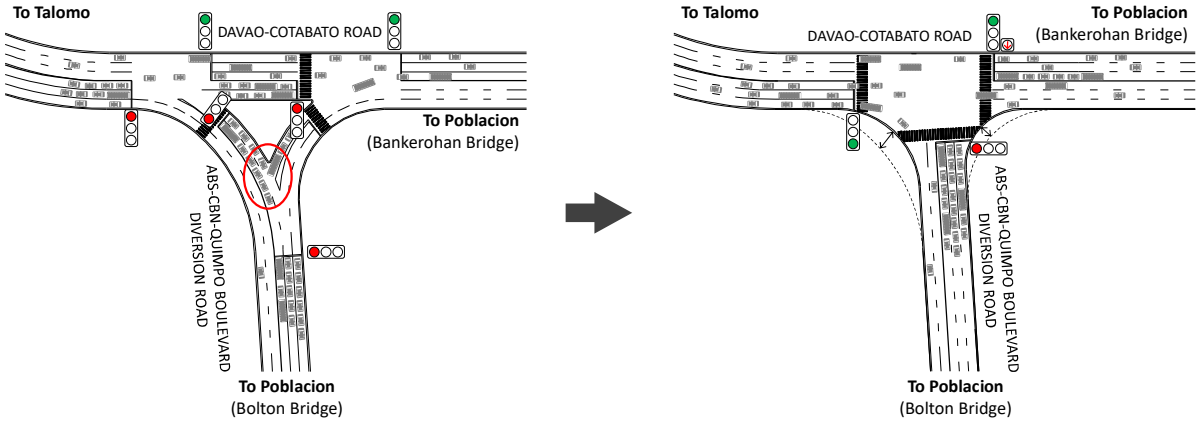


Source: IM4Davao Team

Figure 12.1.6 Simplified Schematic of Current Road Network

12.17 Also, the geometric design of the major intersections should be reviewed and optimized to the expected traffic flow and its volume. For example, the intersection of

Davao–Cotabato and ABS-CBN–Quimpo Boulevard Diversion Roads should be changed to a simple three-leg intersection (the present configuration has two stopping lines for every direction and the cue of first stopping line sometimes block inflow traffic).



Current Geometry
There are two stopping lines for each direction.
Signal control is complicated.

Possible Improvement
The size of intersection should be minimized for simplifying the traffic flow and shortening pedestrian crossings.

Source: IM4Davao Team

Figure 12.1.7 Example of Intersection Improvement

12.18 Considering the size of the central area of Davao City, the road link beyond Davao River would not be enough to accommodate the travel demand across the river. Thus, even the internal traffic across Davao River need to pass through the congested arterial roads, namely Davao City Diversion Road, Davao-Cotabato, Road and ABC-CBN–Quimpo Boulevard Diversion Road.

12.19 There is much pedestrian traffic in the corridor of Davao–Cotabato Road and Daang Maharlika especially in Poblacion and Talomo Districts. However, the space for pedestrians are limited and should be improved for betterment of the traffic condition in the central area.

12.20 Currently, many private car users come to the central area and park near their destination. But parking spaces in the central area are limited and parking demand has already exceeded the capacity of available space that, consequently, the road spaces are now used for parking. Considering that the travel/parking demand is increasing, restrictive measures for parking in the central area or proactive measures to shift use of public transport should be implemented.

3) Current Issues and Necessary Measures

12.21 Based on the analysis of the existing road network and traffic condition in Davao City, the following issues and challenges were identified to improve traffic condition.

(a) Challenge 1: Strengthening road network for decentralizing traffic

12.22 Connectivity of roads in Davao City is bad due to lack of a holistic road network development plan and its implementation. Also, the current road network forms unbalanced web due to the topographical constraints (e.g. rivers and hilly terrain). Thus, there are many traffic bottlenecks in the current road network.

12.23 Meanwhile, travel demand pattern in Davao City is simple and the most is generated in the central area namely Poblacion and Talomo. But there are limited

alternative routes and most of the arterial roads are congested in peak hours. Therefore, the road network in Davao City should be reinforced to fulfil the missing links and multiple route options should be provided for road users. Traffic would accordingly be balanced on the road network.

(b) Challenge 2: Efficient investment for improving road conditions

12.24 Accessibility to the inland area is bad due to the bad road surface condition (60% of roads in Davao City are not paved) and at least about 1,500 km length of roads are needed to be improved, which mainly consist of city and barangay roads.

12.25 DPWH Regional Office plans to improve these roads using their annual budget. Completion of the improvement of 1,500 km-long road would take considerable years. Therefore, a strategical approach would be required for selection of roads to be improved in order to efficiently invest for the road development in Davao City.

(c) Challenge 3: Proactive road development for navigating proper land use and urbanization

12.26 Disorganized urban sprawl has grown due to lack of long-term development plan and ad hoc implementation of projects, especially lack of public transportation network plan. Low-density urbanization would require un-efficient infrastructure investment cost.

12.27 Therefore, the road network should be improved proactively to navigate proper urbanization and settlement instead of road improvement after urban development.

(d) Challenge 4: Renovate urban street to support public transport system

12.28 Road development is an indispensable infrastructure development to support people’s lives and activities, but it would not be the single solution to solve fundamental issues on urban growth. Many cities in the world including Metro Manila experience a dilemma that more road development would lead more vehicular traffic.

12.29 In order to avoid improving roads to catch up with the growing demand, proactive measures should be implemented to shift travel demand to public transportation system. To support efficient and strong public transportation system, the road sector should contribute to improve accessibility for foot traffic to the transport nodes such as railway stations or bus stops. Therefore, urban streets should be renovated in order to accommodate many pedestrians.

12.2 Proposed Future Road Network

1) Planning Principles

12.30 To plan the future road network in Davao City, the following planning principles are applied in this study to improve the traffic condition in Davao City:

(i) to create efficient arterial road network for balancing traffic as the fundamental mode of transport;

(ii) to improve accessibility to both the central area and the inland area for supporting people's lives and activities; and,

(iii) to navigate proper urban developments in suburban areas by providing multi-layered road network.

12.31 Also, the following road hierarchy and required functions of roads should be taken into consideration for planning the future road network.

(i) Arterial roads are the main strategic arteries for moving traffic between different parts of the region or city.

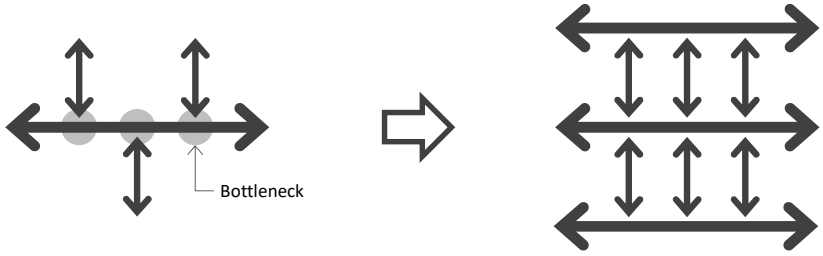
(ii) Collector roads collect traffic from local roads and distribute it to arterial roads.

(iii) Local roads (residential access roads) provide local access, have the lowest speed limit and carry low volume of traffic.

(iv) Expressways provide smooth and high-speed traffic for the inter-regional travellers with access control.

12.32 Based on the above planning principles, the road network in Davao City should be strengthened with the following strategies:

(i) More primary arterial roads should be constructed by forming a ladderized road network along the coastal line in order to create a redundant road network. Davao City Bypass Road and Davao City Coastal Road will be constructed soon and these roads are expected to improve the accessibility of the horizontal directional traffic along the coastal line, but there will still be some missing links on the ladderized road network. In order to provide smooth traffic condition, interconnectivity of horizontal and vertical directional roads should be improved by more primary arterial roads.

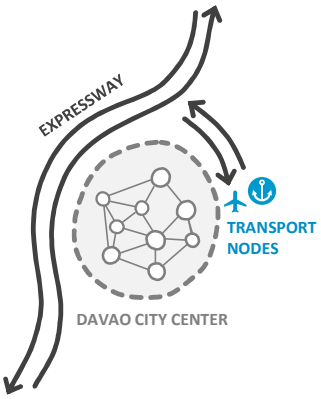


Source: IM4Davao Team

Figure 12.2.1 Conceptual Image for Improvement of Road Network

(ii) More secondary arterial roads should be constructed to navigate the settlements based on the proposed land use plan. The secondary arterial roads will support the abovementioned ladderized road network by adding more resilience and redundancy.

(iii) Inter-regional access should also be improved not to centralize traffic into the city center and to strengthen economic activities in region. Davao City is the center of development of Mindanao and construction of an expressway in Metro Davao area may be worth considering to cater the inter-regional traffic going to major transport nodes such as airport and sea port. This will also contribute to eliminate cargo traffic from urban roads and to improve its road safety. However, planning of inter-regional road network is beyond this project scope and it should be well-planned by the regional-level study. Therefore, this project proposes just a conceptual idea of inter-regional expressway instead of proposing concrete alignment of it.



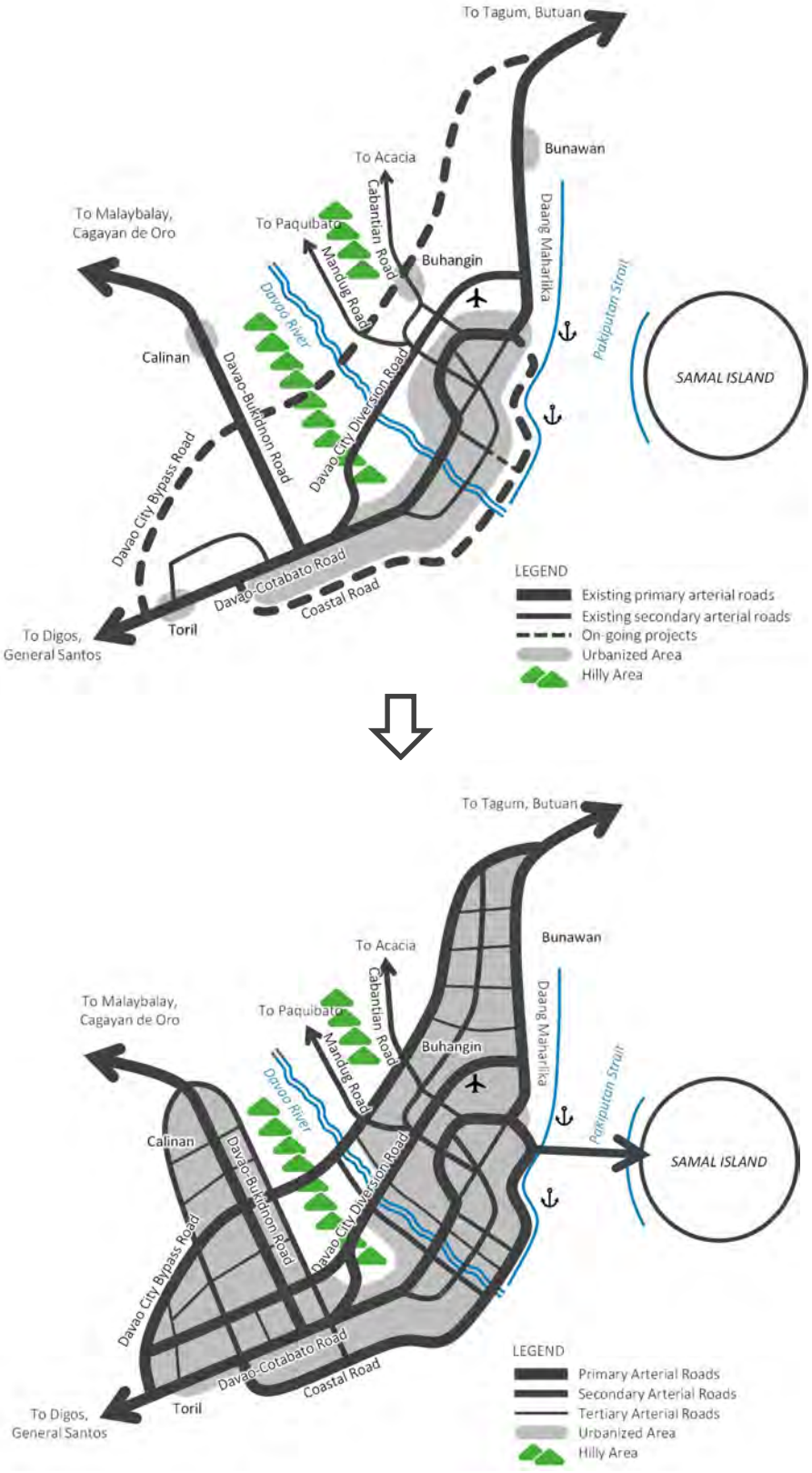
Source: IM4Davao Team

Figure 12.2.2 Conceptual Image of Inter-Regional Expressway

12.33 Figure 12.2.3 represents the conceptual image of preferable future road network formed by ladderized primary arterial roads and supported by secondary and tertiary arterial roads, which covers the area of approximately 5 km bandwidth along the coastal line from Sasa to Toril where is already highly populated area as well as the area of approximately 5 km bandwidth along Davao-Bukidnon Road as the potential areas for urbanization.

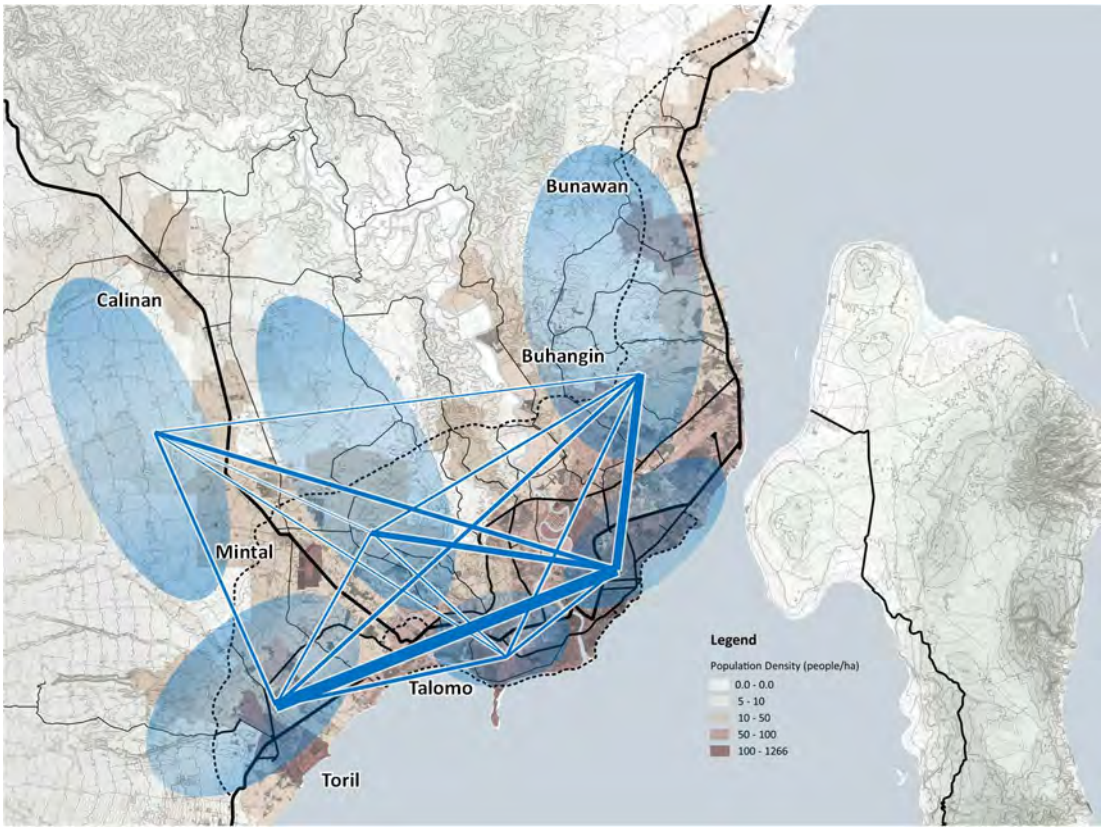
12.34 Basically, Davao City Bypass Road should be an urban growth boundary to control urban sprawl but the area beyond Davao City Bypass Road in Buhangin has already been developed for residential area. Therefore, the road network in this area should also be taken into consideration.

12.35 According to the traffic demand forecast, almost all trip demand in Davao City will be generated within the proposed future urban area. Figure 12.2.4 represents the different volume of inter-zonal trip demand. The upper figure represents the trip demand between the zones bordered by major roads and the lower figure represents the trip demand between major urban centers. By this figure, it is obvious that improvement of the road network is necessary especially in the directions between (i) Toril and Poblacion, (ii) Buhangin and Poblacion and (iii) Mintal and Poblacion.

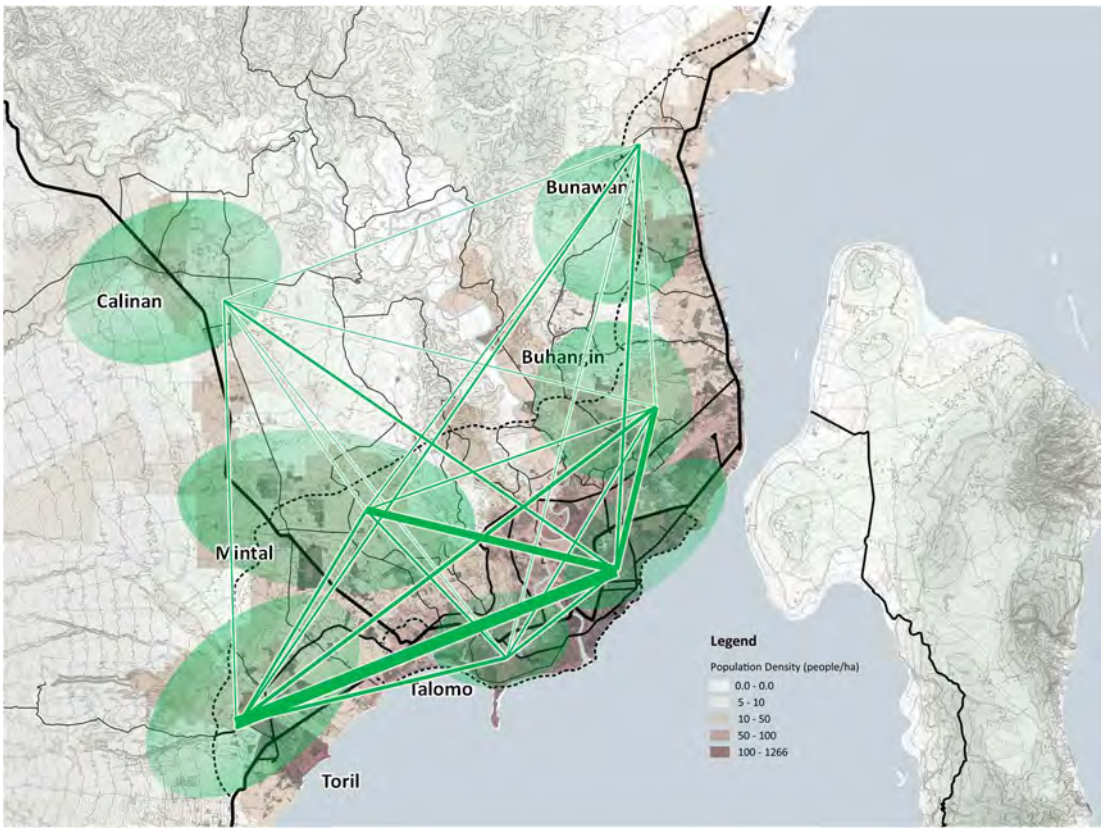


Source: IM4Davao Team

Figure 12.2.3 Conceptual Image of Future Road Network



Trips across Major Roads



Trips between Major Urban centers

Source: IM4Davao Team

Figure 12.2.4 Trip Demand from OD Matrices

2) Road Network Roadmap

12.36 A total of 29 projects are long-listed for the road network roadmap projects consisting of primary, secondary and tertiary arterial roads as shown in Table 12.2.1.

12.37 For the mid-term target by the year 2030, Davao City Diversion Road Extension, Davao Riverside Boulevard, and other 11 projects are selected as the priority projects to reinforce the road network in the present urbanized area by connecting the identified missing links.

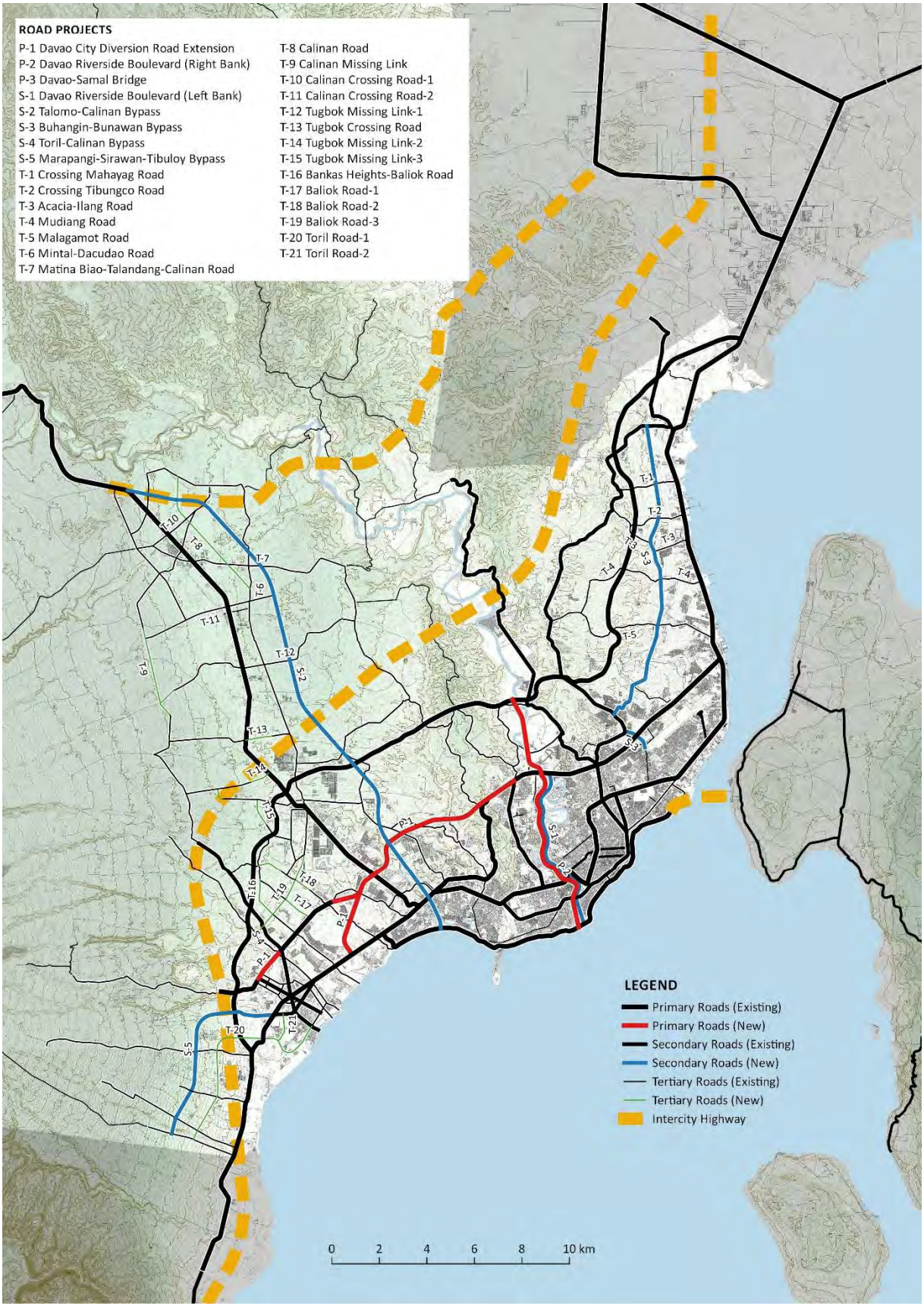
12.38 For the long-term target by the year 2045, Talomo-Calinan Bypass Road, Bunawan-Buhangin Bypass Road and other 12 projects are selected to reinforce the road network in the proposed future urbanized area.

12.39 Davao-Samal Bridge is also proposed for the target year 2030. However, comprehensive development plan of Samal Island would be required for justification of this project.

Table 12.2.1 Road Network Roadmap Project List

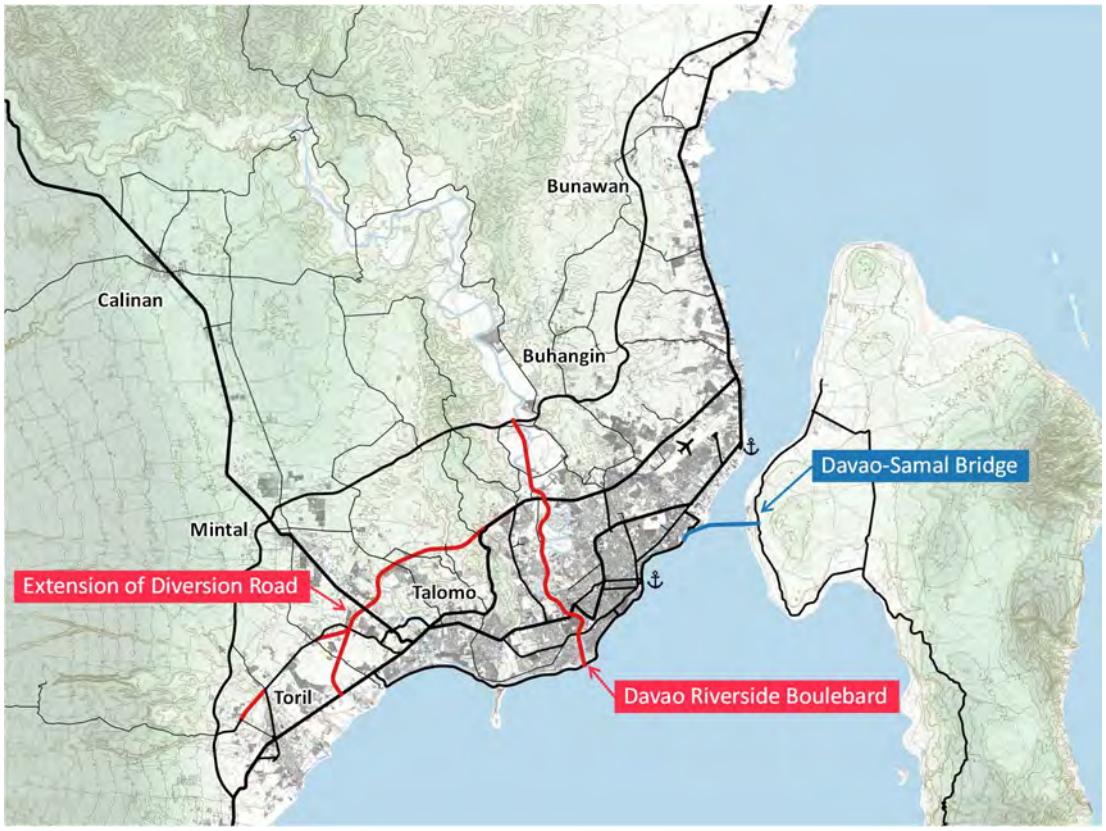
No.	Road Name	Road Classification	Type of Project	Length (km)	Project Cost (Million PHP)	Target Year
P-1	Davao City Diversion Road Extension	Primary	New Construction	15.5	10,800	2,030
P-2	Davao Riverside Boulevard (Right Bank)	Primary	New Construction	11.0	7,730	2,030
P-3	Davao-Samal Bridge	Primary	New Construction	3.0	30,000	2,030
S-1	Davao Riverside Boulevard (Left Bank)	Secondary	New Construction	7.5	4,330	2,030
S-2	Talomo-Calinan Bypass	Secondary	New Construction	22.0	3,550	2,045
S-3	Buhangin-Bunawan Bypass	Secondary	New Construction	15.0	2,420	2,045
S-4	Toril-Calinan Bypass	Secondary	New Construction	24.5	3,960	2,045
S-5	Marapangi-Sirawan-Tibuloy Bypass	Secondary	New Construction	7.5	1,210	2,045
T-1	Crossing Mahayag Road	Tertiary	Upgrading	2.5	134	2,030
T-2	Crossing Tibungco Road	Tertiary	Upgrading	2.5	134	2,030
T-3	Acacia-Ilang Road	Tertiary	Upgrading	4.0	215	2,030
T-4	Mudiang Road	Tertiary	Upgrading	6.5	349	2,030
T-5	Malagamot Road	Tertiary	Upgrading	8.0	429	2,030
T-6	Mintal-Dacudao Road	Tertiary	Upgrading	20.0	1,070	2,030
T-7	Matina Biao-Talandang-Calinan Road	Tertiary	Upgrading	15.0	805	2,030
T-8	Calinan Road	Tertiary	New Construction	6.0	425	2,030
T-9	Calinan Missing Link	Tertiary	New Construction	3.5	248	2,030
T-10	Calinan Crossing Road-1	Tertiary	New Construction	3.0	213	2,045
T-11	Calinan Crossing Road-2	Tertiary	New Construction	4.0	283	2,045
T-12	Tugbok Missing Link-1	Tertiary	New Construction	1.0	71	2,045
T-13	Tugbok Crossing Road	Tertiary	New Construction	1.0	71	2,045
T-14	Tugbok Missing Link-2	Tertiary	New Construction	1.0	71	2,045
T-15	Tugbok Missing Link-3	Tertiary	New Construction	1.2	85	2,030
T-16	Bankas Heights-Baliok Road	Tertiary	New Construction	1.7	120	2,045
T-17	Baliok Road-1	Tertiary	New Construction	1.3	92	2,045
T-18	Baliok Road-2	Tertiary	New Construction	1.0	71	2,045
T-19	Baliok Road-3	Tertiary	New Construction	4.0	283	2,045
T-20	Toril Road-1	Tertiary	New Construction	10.0	709	2,030
T-21	Toril Road-2	Tertiary	New Construction	1.2	85	2,045
Total				204.4	66,827	

Source: IM4Davao Team

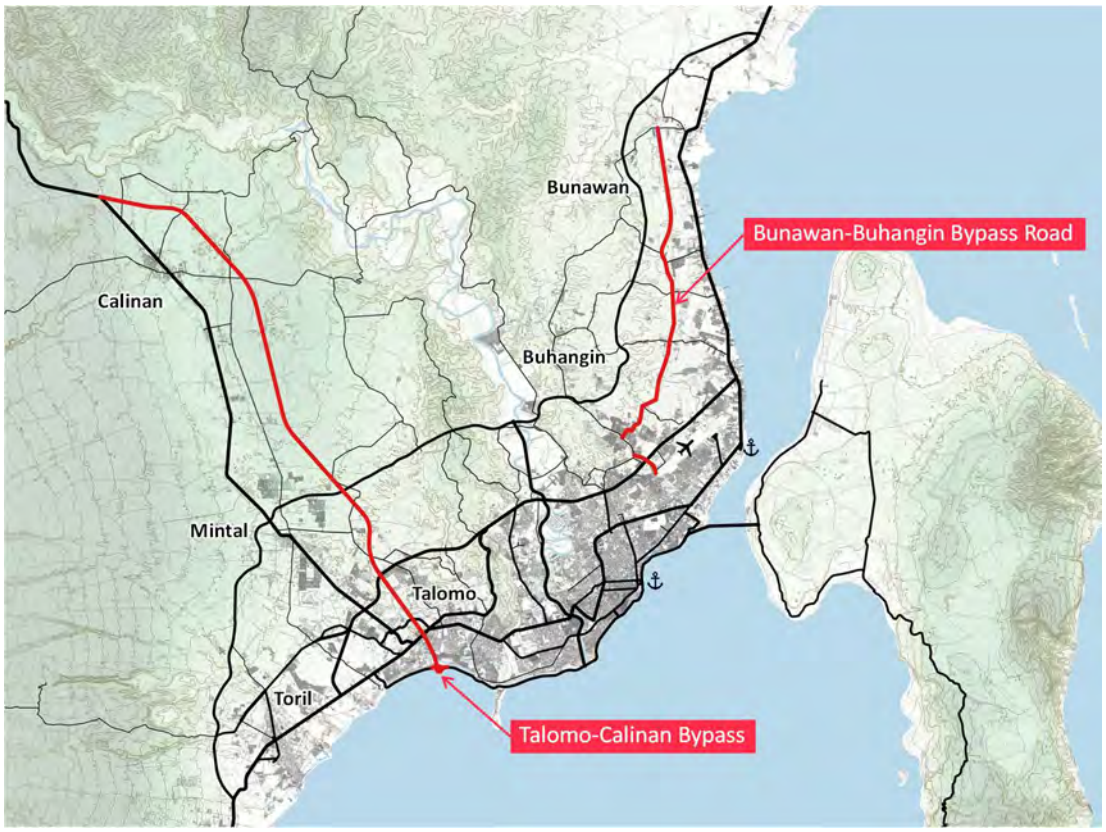


Source: IM4Davao Team

Figure 12.2.5 Future Road Network Roadmap



Road Network by 2030

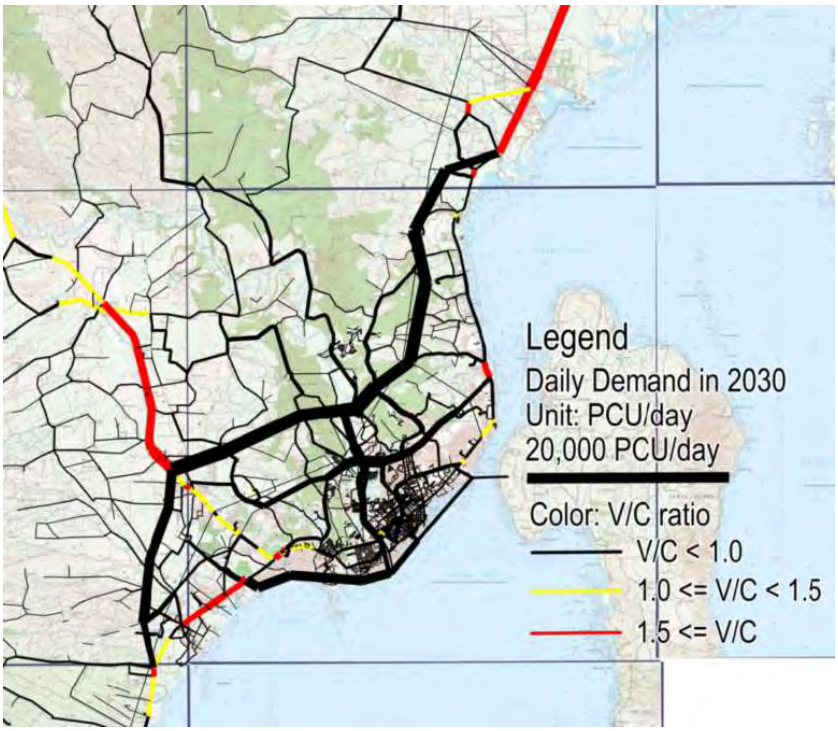


Road Network by 2045

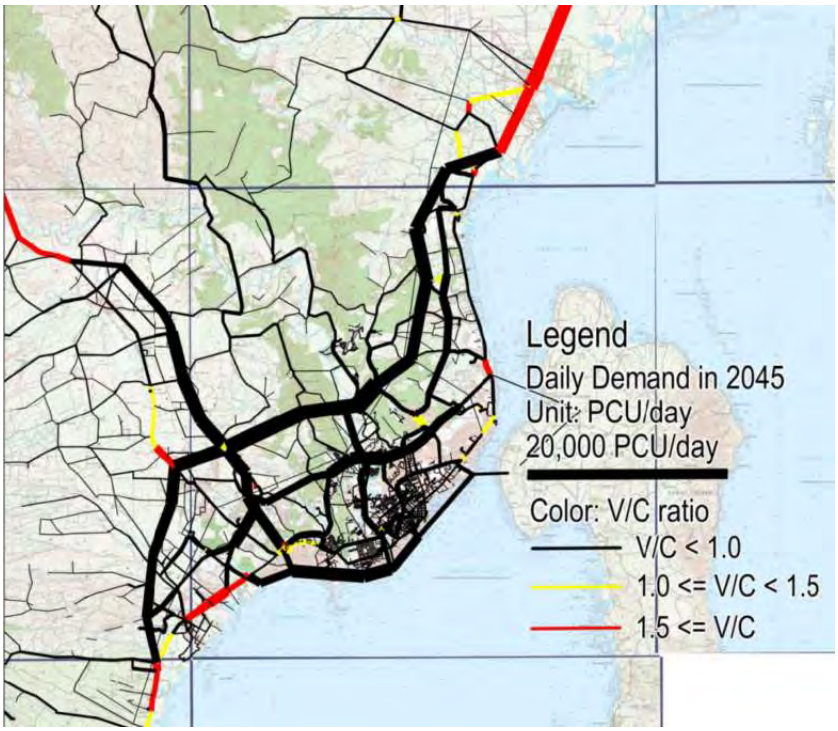
Source: IM4Davao Team

Figure 12.2.6 Priority Road Projects

12.40 Figure 12.2.8 represents the result of trip distribution on the proposed road network in the year 2030 and 2045 with consideration of railway network and airport users. It is forecasted that the daily traffic volume on the major arterial roads within the priority corridors will be accommodated in its capacity. Therefore, it is expected that the proposed projects will contribute to smoothen the traffic situation in Davao City if these are implemented accordingly.



2030 Road Network



2045 Road Network

Source: IM4Davao Team

Figure 12.2.7 Trip Distribution and Traffic Assignment

12.3 Identified Major Road Projects

12.41 Based on the above-mentioned planning principles, the identified necessary projects to fulfill the missing gaps are the following (Figure 12.3.1):

(i) Davao City Diversion Road Extension;

(ii) Davao Riverside Boulevard;

(iii) Talomo-Calinan Bypass Road; and

(iv) Bunawan-Buhangin Bypass Road.

1) Davao City Diversion Road Extension

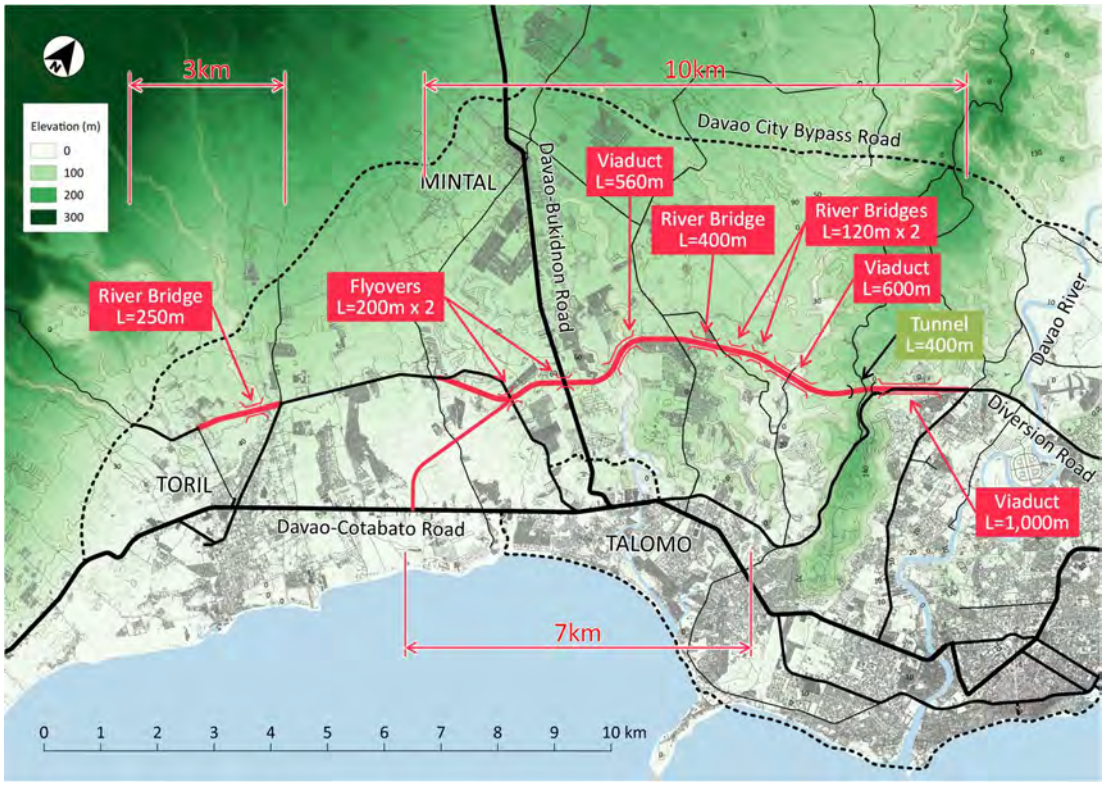
12.42 The Davao City Diversion Road is an important road link in the city road network that literally diversifies road traffic, gives airport access, and supports many subdivisions in the suburbs. The Davao City CLUP 2013–2022 suggests that the diversion road be extended to Toril partly using Libby Road (also called Davao Cotabato Old Road).

12.43 DPWH Regional Office XI has considered for a long time that the road extension is technically difficult over hilly terrain in Langub. However, the road can be constructed with tunnel and some long bridges, which may require high construction technologies such as avoiding settlement of structures on top of the hill or viaduct construction in hilly or mountainous terrain.

12.44 The road extension project is expected to expand the existing effects brought about by the Diversion Road such as traffic diversion, airport access and suburbanization. After completion of this project, four corridors of arterial road along the coastal line will be created and the traffic congestion in Talomo would be mitigated.

12.45 Moreover, the road extension project is expected to provide safe road condition against natural disasters such as landslides. The existing Diversion Road alignment passes through hilly terrain and has experienced several landslides during rainy seasons every year. Considering that the Diversion Road is a vital road for cargo trucks and commuters, provision of an alternate arterial road would be indispensable.

12.46 For the section through the residential area, service roads should be provided at the both sides of the road for separation of local traffic and through traffic, which would be mainly cargo trucks. With these service roads, smooth traffic flow in residential areas would be provided and it would navigate well-planned residential developments along the corridor.



Source: IM4Davao Team

Figure 12.3.1 Outline of the Davao City Diversion Road Extension Project

2) Davao Riverside Boulevard[1]

12.47 This is also suggested by Davao City CLUP. In relation to the Davao River Boulevard project, the CLUP suggests some relevant projects as follows:

(i) Construction of bank/shore protection and river flood control structure in highly populated areas with high flood susceptibility;

(ii) Integrated Davao River Development Plan; and,

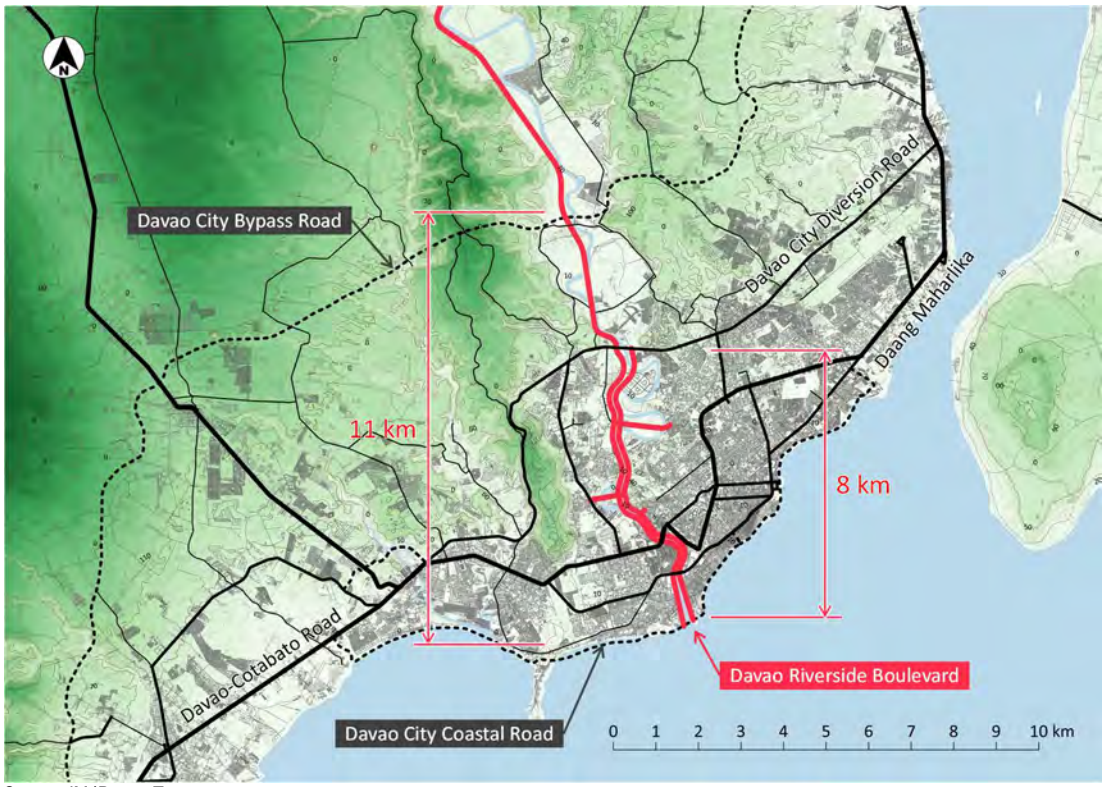
(iii) Development of bay walks and parks in riverbanks.

12.48 Davao River in the lower stream flows along densely urbanized areas such as Poblacion and Ecoland. But most of the river shape meanders naturally without solid riverbank. If the river flow could be modified more straight and fixed by wide and strong riverbanks on the both sides, wide road or boulevard can be constructed on the riverbank and recreational parks can be open to the public at the sites for meandering river shapes currently or dried up lands in the future after the river flow modification. The IM4Davao Project intends to create a Davao Transit Center where the TDD Rail Line and city mass transit line joins along Davao River and the proposed Davao River Boulevard.

12.49 Currently, the vertical directional road network in Davao City is very weak so there are many traffic bottlenecks such as Buhangin Underpass and Mamay Road. The project road is expected to reinforce the vertical directional road network and provide higher interconnectivity with horizontal directional roads such as Davao City Bypass Road, Diversion Road, Davao–Cotabato Road, and Coastal Road.

[1] The feasibility and alignment of Davao Riverside Boulevard needs to be evaluated from the view point of flood control. JICA will commence the new study on the flood control of major rivers in Davao City in 2018. Therefore, this proposed project will be also examined in the new study.

12.50 The biggest challenge on the implementation of the project would be right-of-way acquisition and large-scale resettlement of informal settlers.



Source: IM4Davao Team

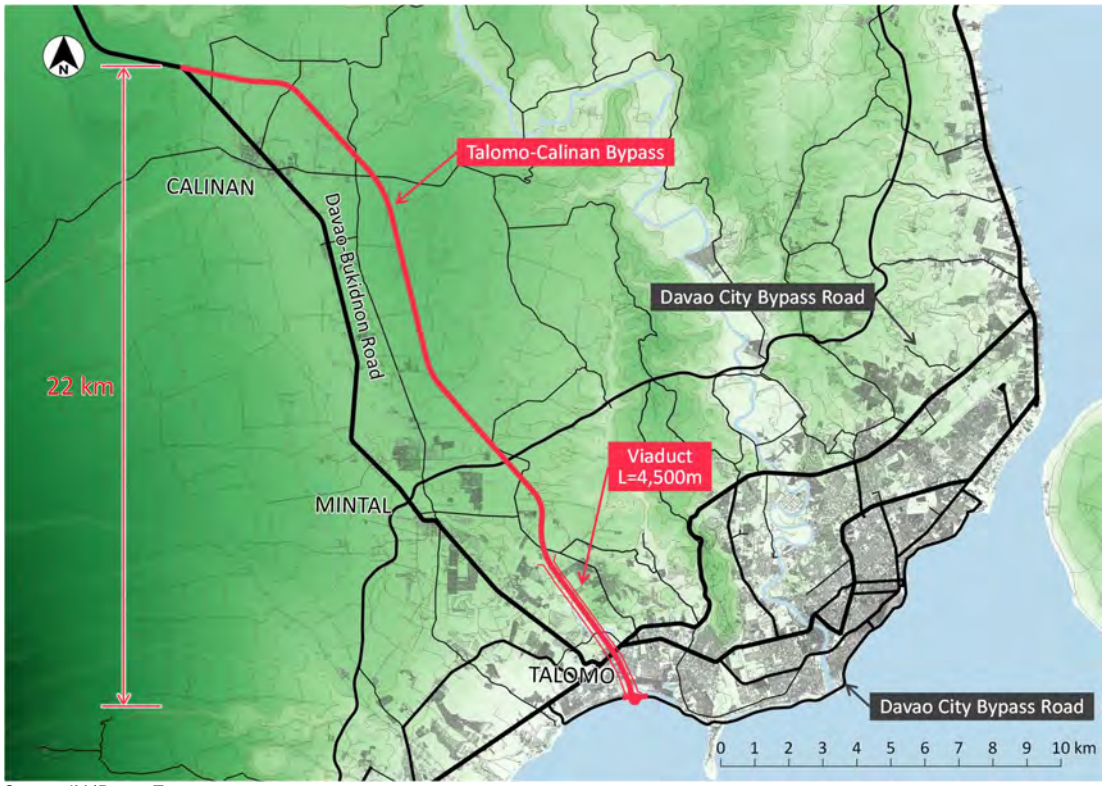
Figure 12.3.2 Outline of the Davao River Boulevard Project

3) Talomo-Calinan Bypass Road

12.51 One of the severely congested road sections in Davao City is the Davao–Cotabato Road between the intersections with Davao-Bukidnon Road and Davao City Diversion Road where Talomo River flows under the road section. The Davao City Coastal Road Project, which is expected to be operational by 2022, is expected to ease severe traffic congestion on the road section. To optimize the development impact of the coastal road project, Davao–Bukidnon Road should be directly connected with the coastal road.

12.52 However, the area around the intersection of Davao–Bukidonon and Davao–Cotabato Roads is highly urbanized and has a lot of hourses. In order to avoid large-scale resettlement, the possible option to connect the missing link would be construction of a viaduct along Talomo River, which is the only available space in the area. Talomo River meanders at the downstream, so that the piers of viaduct could be constructed outside of river stream at a reasonable span of girders.

12.53 Also, considering the proposed land use plan in Talomo, Tugbok and Calinan, a secondary road of Davao-Bukidnon Road should be constructed to support the urbanization of the area. Therefore, the viaduct should be connected to the secondary road of Davao-Bukidnon Road. The end point of the road should be away from the urban area of Calinan. This road will function as a bypass road of Calinan.



Source: IM4Davao Team

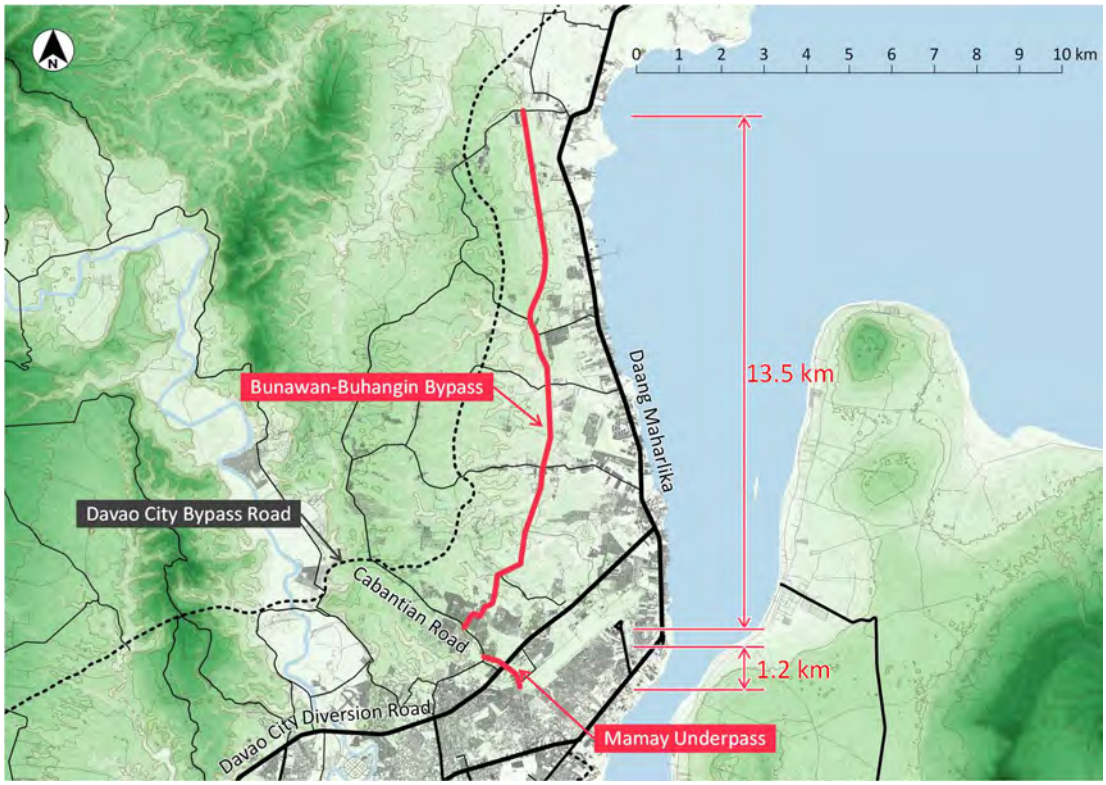
Figure 12.3.3 Outline of the Talomo-Calinan Bypass Road Project

4) Bunawan–Buhangin Bypass Road

12.54 This idea is also suggested by the Davao City CLUP. The project road has a length of 15 km. The project road intends to reinforce a scarce local road network in the districts of Bunawan and Buhangin and promote urbanization, particularly, industrial lands between Bunawan and Panacan.

12.55 The end point of the road should be carefully considered (connecting to either Davao City Diversion Road or Cabantian Road) because providing good interconnectivity of roads across Davao City Diversion Road is a big challenge due to the existence of Davao International Airport and few vertical directional arterial roads.

12.56 Together with the project road, construction of a short bypass road of Mamay Road should be constructed as the grade separation with Davao City Diversion Road. The section of the Diversion Road near the intersection with Mamay Road is relatively higher than surrounding areas, so the bypass road can be constructed as an underpass with box culvert. This short bypass road would improve the accessibility across Diversion Road.



Source: IM4Davao Team

Figure 12.3.4 Outline of the Bunawan–Buhangin Bypass Road Project

12.4 Improvement of Urban Roads in Davao City CBD

1) Street Renovation for People-Friendly Transport System

12.57 Davao City should focus on people-friendly transport environment in order to become a more liveable city. Streets are not just for movement, but to support the activities for work, commercial, social exchange, children playing, and enjoyment of residents and visitors. Good public space and public transport system are closely linked with each other and are two sides of the same coin.

12.58 Street spaces in urban area should have pedestrian priority rather than vehicular traffic to develop lively, safe, sustainable, and healthy city. In urban areas, on-street parking should be strictly controlled under a comprehensive parking management plan that provides proper demarcation of street space for pedestrian, vehicular traffic, public activities, and on-street parking.

12.59 To provide smooth traffic, some renovation works are necessary to increase capacity of traffic and decrease traffic congestion with an effective multi-modal transport system. Enhancing pedestrian comfort can be made by designing streets to accommodate all mode of transport balanced with the roles and required functions of streets.

2) New Design Approach

12.60 Urban streets should not be designed based only on a functional classification of streets which categorises only according to their ability to move traffic and provide vehicular access and should be designed with the principle that streets are public spaces for people as well as corridors for movement based on local context, the needs of multiple users, and larger social, economic and environmental goals.

12.61 There are two major factors necessary to be considered in the design of streets:

- For Places: To examine how the built, natural, social, cultural, and economic context of a street defines the physical scale and character of the space.

  To look at how the surrounding land uses, densities, and larger networks influence mobility and use patterns.

- For People: To identify the people who use a street today and quantify when and how they use it.

  To determine the desired breakdown of users and activities for future street conditions and ensure that the design meets these people's needs.

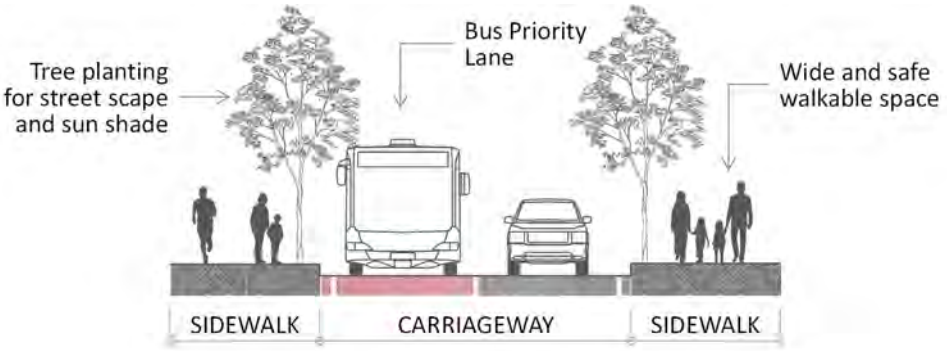
12.62 For sustainable development of the urban area of Davao City, the following user priorities should be taken into consideration for planning and designing urban streets:

(i) 1st Priority: Pedestrian
(ii) 2nd Priority: Public transport users
(iii) 3rd Priority: Cyclists (in near future)
(iv) 4th Priority: Motor vehicles

3) Composition of Urban Streets

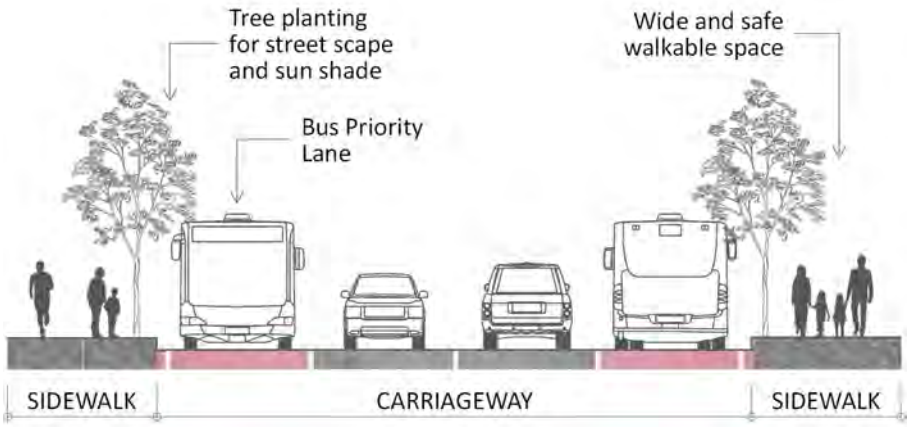
12.63 Currently, the spaces of urban streets in Davao City are not efficiently used such as the occupancy of street spaces by on-street parking cars. In order to change Davao City to be a lively, safe, sustainable, and healthy city, it is necessary to re-allocate street spaces with appropriate composition of street space depending on the characteristics of streets with respect for pedestrian traffic.

12.64 Figure 12.4.1 and 12.4.2 show an example of better composition of urban streets.



Source: IM4Davao Team

Figure 12.4.1 Better Composition of Urban Street (2 Lanes)



Source: IM4Davao Team

Figure 12.4.2 Better Composition of Urban Street (4 Lanes)

4) Composition of Sidewalk Zone

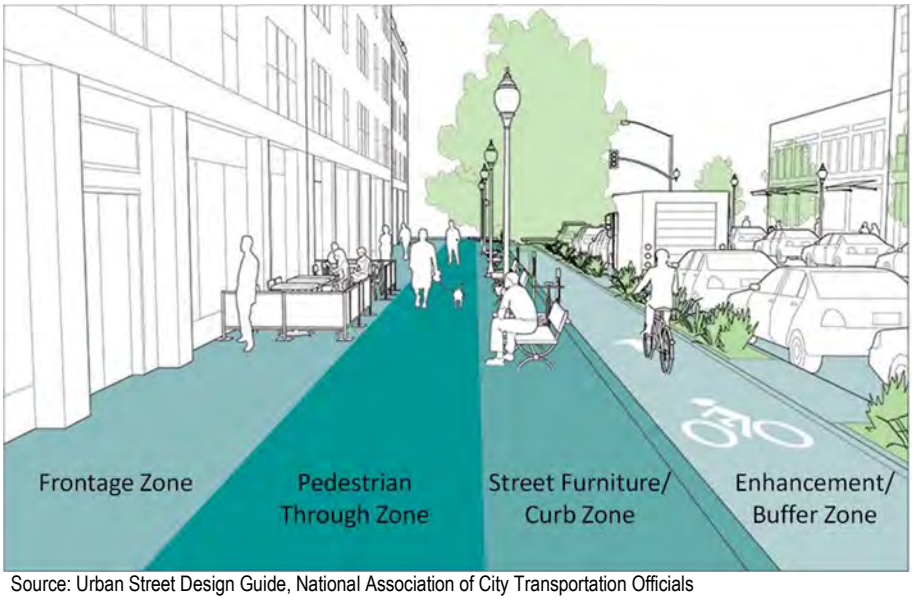
12.65 Sidewalk zone can be classified into the following:

(i) **Frontage zone**: In front of buildings.

(ii) **Pedestrian through zone**: For pedestrian mobility.

(iii) **Street furniture/ curb zone**: For social exchange and enjoyment of residents and visitors.

(iv) **Enhancement/ buffer zone**: For Non-Motorized Transport (NMT) users.



Source: Urban Street Design Guide, National Association of City Transportation Officials

Figure 12.4.3 Composition of Sidewalk Zone

5) Transit Mall

12.66 Introduction of transit mall to Davao City should also be considered. A transit mall is a street or set of streets in a city or town along which vehicular traffic is prohibited or greatly restricted and only public transit vehicles, bicycles, and pedestrians are permitted.

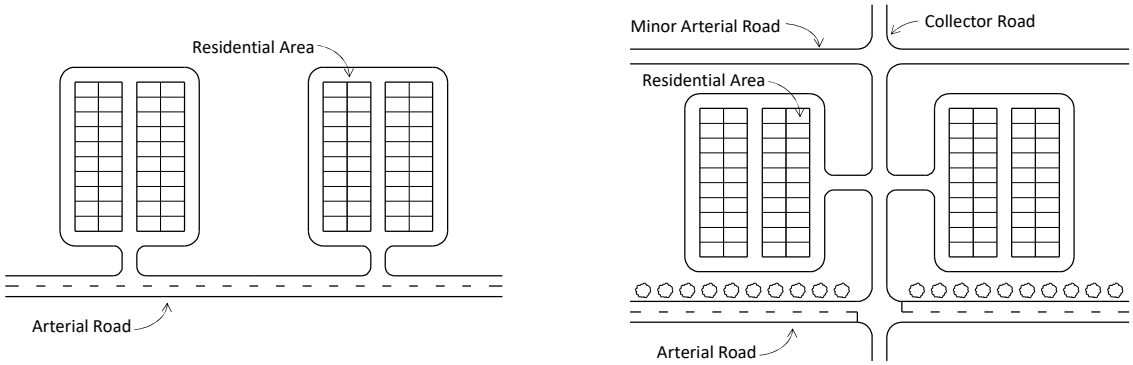
12.67 Transit malls should be instituted by the city government and communities who feel that it is desirable to have areas not dominated by the vehicles, or as interchanges, making them more efficient and, thereby, more attractive as an alternative than to use car.

12.68 Converting a street or an area to a transit mall can be a form of pedestrianization that shall allow pedestrians and cyclists as well as transit vehicles to move more freely and unimpeded by private vehicular traffic if such vehicles are banned completely.

12.5 Improvement of Residential Access Road

12.69 Residential areas in Davao City are mainly developed along the major arterial roads. Due to insufficient road network a lot of subdivisions are directly connected to the major arterial roads such as Davao City Diversion Road and Davao-Bukidnon Road.

12.70 If such subdivisions are directly connected to arterial roads, it is difficult to develop the hinterland of the subdivisions because there is no enough space for constructing new roads leading to the hinterland. For the new residential developments proposed by the land use plan, road network should be developed in advance to the residential developments with road hierarchy to separate through traffic and local traffic in order to provide road safety on residential roads and smooth traffic flow on arterial roads.



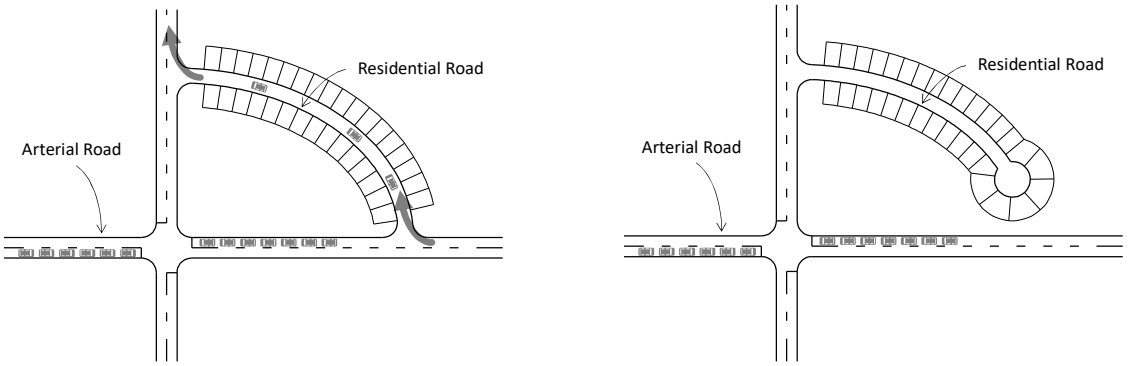
Problems
Housing developments rely on a single arterial road.

Possible Solutions
Housing developments on good road network having road hierarchy can create multi-layered development.

Source: IM4Davao Team

Figure 12.5.1 Road Network and Road Hierarchy for Residential Access

12.71 Not only for subdivision developments, through traffic should not be invited into any other residential roads. For example, if a residential road is connected two arterial roads, through traffic would divert from the congested arterial road to the residential road. Therefore, proper access control should be provided for designing of a residential access road.



Problems
Bad road network design attracts through traffic onto residential access road.

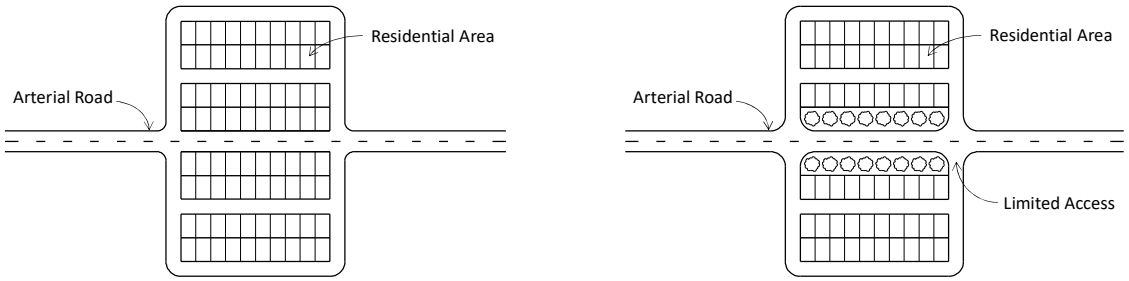
Possible Solutions
Good road network design deters through traffic from using residential access road.

Source: IM4Davao Team

Figure 12.5.2 Planning of Residential Access Road

12.72 In some residential area, individual residential houses along an arterial road have their own access onto the road. Such uncontrolled access to premises fronting an arterial road can impede traffic flow and create severe road safety hazards. In order to avoid such

development, individual houses should not have direct access but have access via a residential access road with limited access onto an arterial road.



Problems
Individual houses along an arterial road have their own access onto the road.

Possible Solutions
Individual houses have access via a residential access road with limited access onto arterial road.

Source: IM4Davao Team

Figure 12.5.3 Planning of Residential Access Road

12.6 Traffic Management Plan

12.73 Traffic engineering and traffic management systems are necessary to optimize traffic flows on the available urban transport infrastructure to provide smooth transport service. This requires comprehensive management covering on-street parking, effective management of intersection, traffic light system, etc. Private, public and cargo purpose vehicles, bicycle, pedestrian, and para-transit should be considered for traffic management improvement. Having traffic congestion in Davao City, there must be an effort to improve Davao traffic management. Several measures are introduced here for future reference.

1) Traffic Control Center

12.74 The objectives of traffic control center are to provide better transport environment and ensure road safety as well as smoothness. In order to utilize the control system by intelligent system, it collects, processes, and provides traffic related information and, most importantly, the system can synchronize traffic lights by monitoring real-time traffic condition to relief congestion and safety. For a dense and populated city, an efficient and reliable traffic control center to manage complex traffic is essential and important.

(a) Current Davao Traffic Control

12.75 Currently in Davao City, the Public Safety and Security Command Center (PSSCC) is in charge of safety monitoring and traffic control functions under CTTMO's supervision since 2010. Signal system, facility procurement, and maintenance are outsourced to American company Abratique and Associates with an office based in Davao. The company has engineers and field technicians on-call for unexpected disorder and repair purpose. Car sensors at 65 intersections and 17 CCTVs have been installed and some of them are wireless to eliminate the common problem of hitting the underground wire during road repairs.

12.76 PSSCC uses CCTV to monitor traffic condition and communicate with on-site traffic enforcers, but has no access to signal control function and car sensor data. Therefore, although around 40% of traffic signals in main roads are synchronized, adjusting signal phase owing to real-time traffic flows is desired.

12.77 There is also a plan for PSSCC to focus on security concern, and transfer the traffic system to CTTMO to operate. CTTMO has prepared the land for building new traffic control center, but budget and detailed design are not confirmed.

(b) Concept of Traffic Control System in Davao

12.78 A traffic control system was proposed to Davao (see Figure 12.6.1), which has four functions:

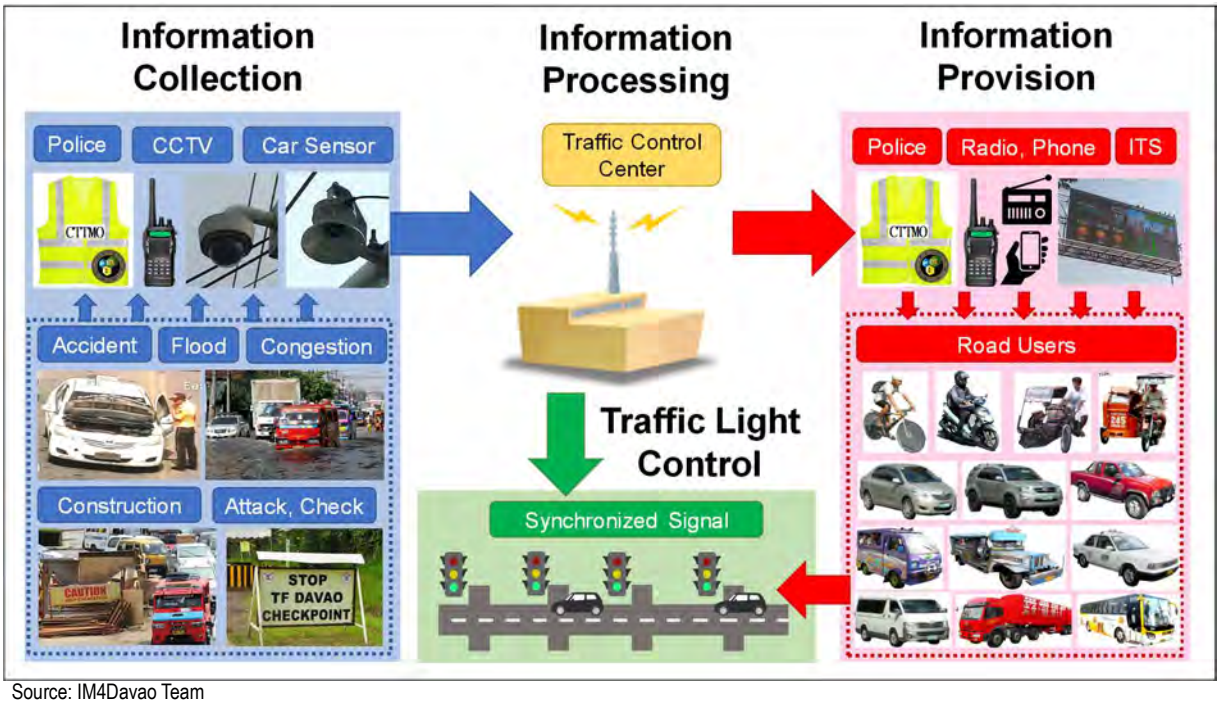
(i) **Information collection:** Congestion, accident, flood, construction, maintenance, attack or checkpoint caused traffic condition can be collected via car sensor, CCTV, or patrol cars then sent to traffic control center.

(ii) **Information processing:** Computer in traffic control center can compute and analyze the traffic flow, to automatically determine a suggestion to relief traffic burden.

(iii) **Information provision:** Police, radio, smart phone and ICT sign can update the latest condition to road users, and provide alternative routes to avoid congestion.

(iv) **Traffic light control:** Synchronized signals are automatically adjusted to meet

real-time traffic flow for smoother transportation.



Source: IM4Davao Team

Figure 12.6.1 Proposed Traffic Control System in Davao

12.79 The advantages of traffic control system are summarized below to explain the necessity and importance for Davao City to solve short-term traffic problems.

(i) Prevention of accidents: traffic flow gets smooth to avoid collision accidents.

(ii) Reduction of fuel consumption: fuel can be saved if vehicles operate in shorter period.

(iii) Mitigation of traffic congestion: depending on traffic condition, signal and signs can be controlled to adjust different phases and provide real-time info to road users to mitigate congestion.

(iv) Elimination of traffic pollution: because vehicles stop less times, emitted gas and noise can be reduced.

2) Parking Building

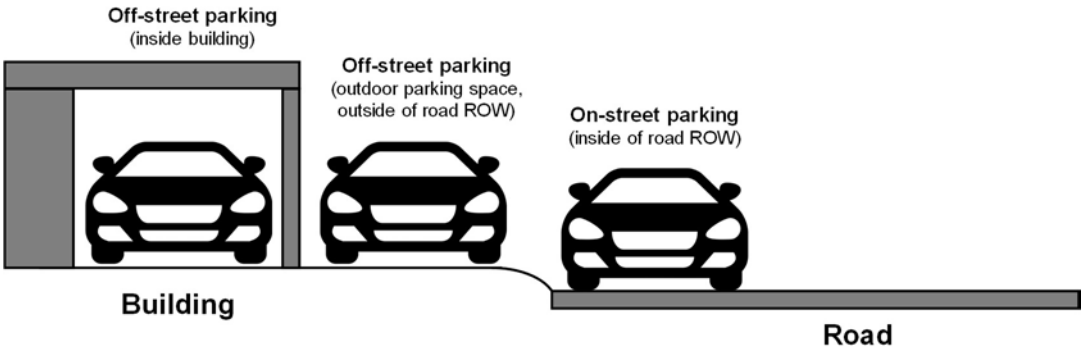
(a) On-Street Parking Problem

12.80 With the growth of private vehicle ownership, parking (including taxi waiting areas) becomes a serious traffic problem in Davao, which disrupts to traffic flow and public transport vehicles. Shopping malls, churches, governmental organizations, or some restaurants provide parking space for customers. Huge parking demands occur in CBD, but limited parking space for vehicles results in illegal parking.

12.81 There is a proposal for parking charges in Poblacion, but is not yet implemented. Major shopping malls have been allowed to construct extensive car parks in order to accommodate more visitors using private vehicles.

12.82 Generally, parking has three types (see Figure 12.6.2): inside building, outdoor parking space but outside of road ROW, and inside of road ROW. According to OD interview survey results for 934 private mode drivers (Table 12.6.1), 12.7% stop their cars

inside building to ensure the vehicle and passengers' safety, 63.7% use the space between the building and the road, and almost quarter of drivers park their vehicles on the street.



Source: IM4Davao Team

Figure 12.6.2 Off-Street Parking

Table 12.6.1 Types of Parking for Private Mode Drivers

	No.	%
Off-street parking (inside building)	119	12.7
Off-street parking (outdoor parking space, outside of road ROW)	595	63.7
On-street parking (inside of road ROW)	220	23.6
Total	934	100

Source: IM4Davao Team

12.83 On-street parking is a potential danger to road safety. Especially for those vehicles inside of road become obstacles on the street and create issues on traffic congestion. From the survey (see Table 12.6.2), although almost 90% of drivers only stop on the street temporarily (less than 5 minutes), it may still cause delay and disrupt traffic flows. The results also reveal that many drivers need to park their cars for several hours, suggesting inadequacy of parking spaces for private users. Off-street parking fee is averagely collected at PHP 2 to 50 per day, while illegal on-street parking needs to be underpinned by strong enforcement. Besides, the city authorities should create paid parking zone on streets or in parking facilities. However, due to limited land space inside CBD, an efficient way to store parking demands is desirable.

Table 12.6.2 Parking Time at Parking Space for Private Mode Drivers

Park time	Off-street parking (inside building)		Off-street parking (outdoor parking space, outside of road ROW)		On-street parking (inside of road ROW)	
	No.	%	No.	%	No.	%
1-5 min	20	18.7	74	44.8	143	89.9
6-10 min	3	2.8	2	1.2	2	1.3
10-15 min	1	0.9	6	3.6	0	0.0
15-30 min	4	3.7	11	6.7	2	1.3
30 min-1 hr	12	11.2	19	11.5	7	4.4
1-2 hrs	25	23.4	15	9.1	1	0.6
2-3 hrs	6	5.6	7	4.2	1	0.6
3-4 hrs	7	6.5	1	0.6	1	0.6
4-5 hrs	6	5.6	11	6.7	0	0.0
5-6 hrs	3	2.8	4	2.4	1	0.6
6-7 hrs	2	1.9	2	1.2	0	0.0

Park time	Off-street parking (inside building)		Off-street parking (outdoor parking space, outside of road ROW)		On-street parking (inside of road ROW)	
	No.	%	No.	%	No.	%
7-8 hrs	4	3.7	6	3.6	0	0.0
> 8 hrs	14	13.1	7	4.2	1	0.6

Source: IM4Davao Team

(b) Types of Parking Facilities

12.84 Apart from traditional ground parking lot, drive-in parking building and mechanic parking facility provide more parking space and shelter vehicles from sunshine and rain. Table 12.6.3 summarizes the pros and cons of the three types of park facilities. Automatic parking facility has several advantages such as space-efficiency, robbery prevention, and ease in monitoring and management. According to parking location or geometric limitation, it has underground and tower types.

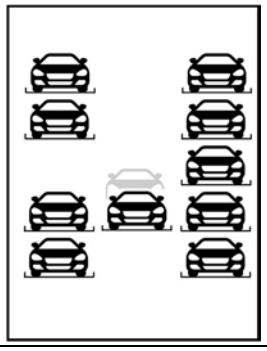
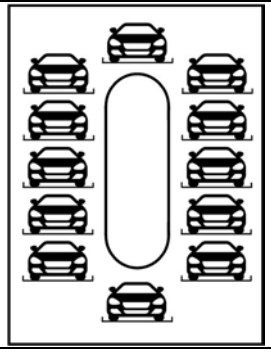
Table 12.6.3 Types of Parking Facilities

	Ground Parking Lot	Drive-in Parking Building	Mechanic Parking Facility	
			Underground	Building
Image				
Pros	• Easy to go in • Convenient to load/unload stuff	• Drivers can drive in by themselves • Less time consuming than mechanic parking facility • No weather influences • Sun shine prevented • More parking space	• Automatic parking: convenient for drivers to stop cars • Space-efficient: underground can down to max 6 levels • Car robbery prevention • Convenient to manage and monitor • Suitable for CBD: smaller land to acquire • Convenient to load/unload stuff at entrance/exit	
Cons	• Threaten of robbery • Constraint to bad weather condition • Hard for drivers to move in/out	• Car-exhausted gas and noise to adjoined building • Height limitation • Queuing at the slope if many cars	• Need sufficient and steady electricity supply (eq. generator) • Take time to get vehicles (around 3 minutes) • Vehicle size and height limitation • Noise • Require regular maintenance	

Source: IM4Davao Team

12.85 Considering limited space for parking lot in CBD and difficulty in land requisition, multi-story parking building is suggested to be the solution. Mechanism of parking building can be elevator or rotary style as seen in Table 12.6.4. Elevator means a vehicle will be lifted up in the middle of the building and the automatic system will park the car to an empty space, while rotary style shows that a new coming car has to wait in front of entrance until one empty tray rotates inside the building to the correspondent site, and then the car will be parked in. Both styles require strong structural design, steady electricity supply, and regular maintenance. This parking building only occupies less than 50 m^2 and depends on building height to provide different vehicle parking capacity and can accommodate various kinds of vehicles including normal, middle-roof, and high-roof cars.

Table 12.6.4 Capacity of Parking Building

		Elevator Style	Rotary Style
			
Land Area		45-52m^2	39-45m^2
Height	15m	14 vehicles	12-16 vehicles
	20m	16-22 vehicles	16-22 vehicles
	25m	20-28 vehicles	20-28 vehicles
	30m	26-34 vehicles	24-32 vehicles
	35m	30-40 vehicles	36-40 vehicles
	40m	34-46 vehicles	38-44 vehicles
	45m	42-52 vehicles	
	50m	50-56 vehicles	
	55m	56-64 vehicles	
	60m	64-68 vehicles	
	65m	72-76 vehicles	

Source: IM4Davao Team

12.86 Given a service area of one parking lot with a radius of 500 meters, CBD inside can base on demands to decide for the height of the parking building. According to survey results, 75% of respondents in Davao are willing to walk up to 500 meters, suggesting the feasibility of using minimum space to solve parking problems. However, the city authority has to draw a red line on the street and strictly enforce or illegal on-street parking may still occur instead of using parking facilities.

Source: IM4Davao

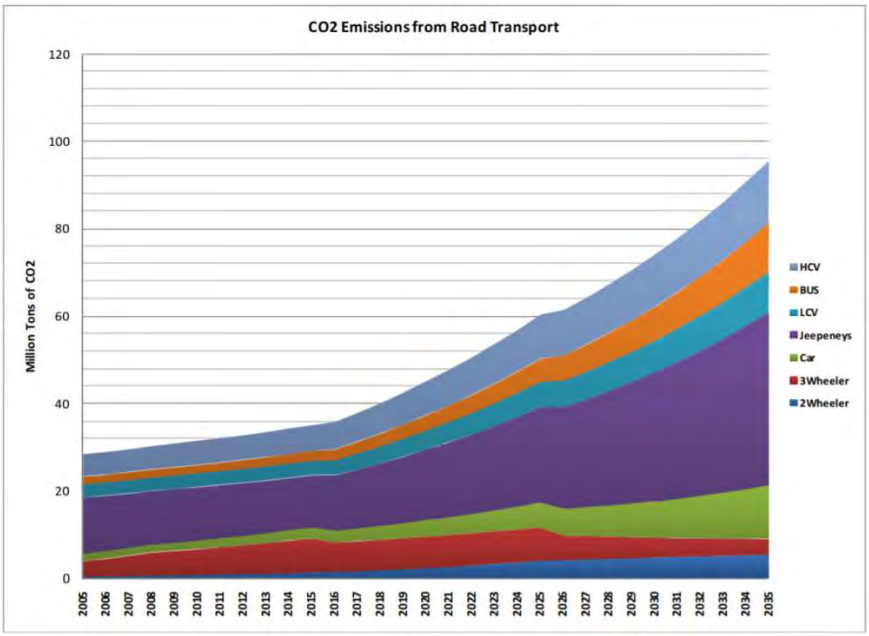
Figure 12.6.3 Service Area of Parking Building

3) Promotion of Environmental Friendly Transport

(a) Background

12.87 Local air pollution problems and impacts of climate change arouse people's attention to clean and ecological transport. According to the estimes of the Environmental Management Bureau of the Department of Environment and Natural Resources (EMB-DENR), transport sector contributes 31% of total particulate (PM10) emissions, 38% of NO2 emissions, and 85% of COx emissions to the air in the Philippines, which emphasizes the necessity of low-carbon and non-motorized transport development plan in the future.

12.88 DENR said 80% of air pollution comes from motor vehicles while 20% comes from stationary sources including factory smoke stacks and open burning. Figure 12.6.4 illustrates the projected growth of CO_2 emission from land transport by mode in the Philippines. Main categories include 2-wheelers (2W), 3-wheelers (3W), personal cars/ SUVs (PC), jeepneys/utility vehicles, light commercial vehicles (LCV), buses, and heavy commercial vehicles (HCV). Among them, jeepney is considered to be the major source of emission while other transport modes maintain similar or less. This explains the importance of PUJ emission control, otherwise, CO_2 will double in 20 years. Table 12.6.4 explains the estimated pollution by vehicle and fuel types in 2015. Gasoline fuel for utility vehicle, motorcycle, and tricycle also cause huge amount of PM10. In line with this, transport operators are encouraged to submit their PUJs for voluntary testing jointly conducted by the DENR, LTFRB, and LTO, but efforts on emission reduction are limited.



Source: CO_2 Emissions from the Land Transport Sector in the Philippines: Estimates and Policy Implications

Figure 12.6.4 Projected CO_2 Emissions in the Philippines from 2005–2035 (in Million Tons)

Table 12.6.5 Estimated Pollution Emitted by Transport Mode in 2015 (tons/year)

Type	Fuel Type	CO	NO_x	SO_x	PM10
Cars	Gasoline	269,281	14,688	626	538
	Diesel	247	260	17	75
Utility Vehicle	Gasoline	479,502	23,975	384	951
	Diesel	44,825	25,102	1,775	15,492
Buses	Gasoline	1,126	122	1	1
	Diesel	8,027	8,091	39	285
Trunks	Gasoline	8,220	891	7	11
	Diesel	43,700	44,053	2,806	1,551
Motorcycle, Tricycle	Gasoline	174,280	1,341	962	13,339

Source: DENR–EMB

12.89 Non-motorized transport (NMT) is the future trend of transport, which has been prompting several counties to be a key element of sustainable transport. The motor is designed with a compact size and operates with little noise, making it unobtrusive through crowded areas. Longer lifespan, less maintenance frequency, and no CO_2 emission encourage its potential market in the future. As Electric Vehicle Association of the Philippines (EVAP) wanted to increase to one million electric vehicles by 2020, a number of non-motorized transport projects have been implemented in the Philippines such as e-Jeepney and e-Trick. Table 12.6.6 summarizes two e-Jeepney cases in Manila. With a fleet of around 20 vehicles, a jeepney can accommodate 16–20 persons. Energy cost is PHP 2 to 3 per kilometre, but owing to high unit cost, funding should be secured to ensure the financial feasibility.

Table 12.6.6 e-Jeepney in Metro Manila

	Green Route e-Jeepney	SM North–ADMU Route Jeepney
		
Location	Legaspi Village Route and Salcedo Village Route, Makati City	SM North to Ateneo De Manila University, Quezon City
Fleet	21	15
Capacity	16	20
Time	Initiated in 2008, operating from 2012	2014
Unit cost	PHP 650,000	PHP 950,000 + batteries PHP 360,000
Energy Cost (PHP/km)	PHP 2.42	PHP 3.27

Source: Clean Air Asia, JPT

12.90 Electric tricycles (e-trikes) projects are also implemented in several cities (see Figure 12.6.5). ADB-funded “Market Transformation through Introduction of Energy Efficient Electric Vehicles (E-Trikes) Project” is distributing 100,000 e-trike units to selected local government units (LGUs) in the country to replace 200,000 conventional tricycles by the end of 2017. Performances of e-trikes depend on company products. BEMAC 68VM can carry up to 7 people (6 passengers plus a driver) with maximum speed 50kph and 60 km running distance per charge at 20kph constant. Unit cost is around PHP 470,000.

Source: IM4Davao Team

Figure 12.6.5 e-Trike in Manila and Boracay

12.91 Aside from gasoline station, these electric vehicles should be charged using specific chargers. Examples of chargers are in Table 12.6.7. Normal type takes several hours to fully charge, but quick charger can take less than one hour.

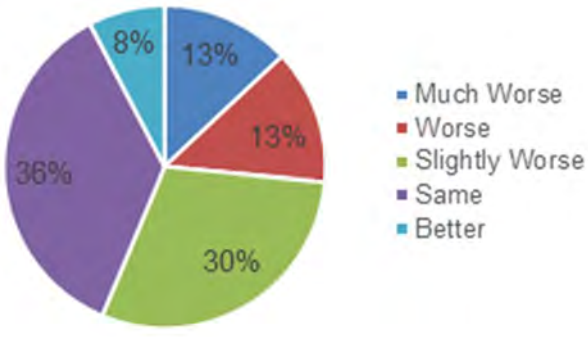
Table 12.6.7 EV Charger

Normal Charger		Quick Charger			
					

Source: MLIT and Others

(b) Suggestion to Davao

12.92 Air pollution coming from vehicular emissions is believed to be the major cause of respiratory and cardiovascular diseases. From the 2014 HIS results in Figure 12.6.6, 53% of respondents evaluated worse compared to five years ago. According to data of registered vehicles (inclusive of private, for hire, government categories, and renewed in 3 years) provided by LTO-XI (Davao City, Digos, Samal, Tagum, Mati, Comval), there are over 500,000 vehicles where Davao City accounts for 45% of them (Table 12.6.8). Moreover, number of vehicles increased to 30% in 3 years, revealing that transport management plan with environment strategies is urgent to improve air quality in Davao.



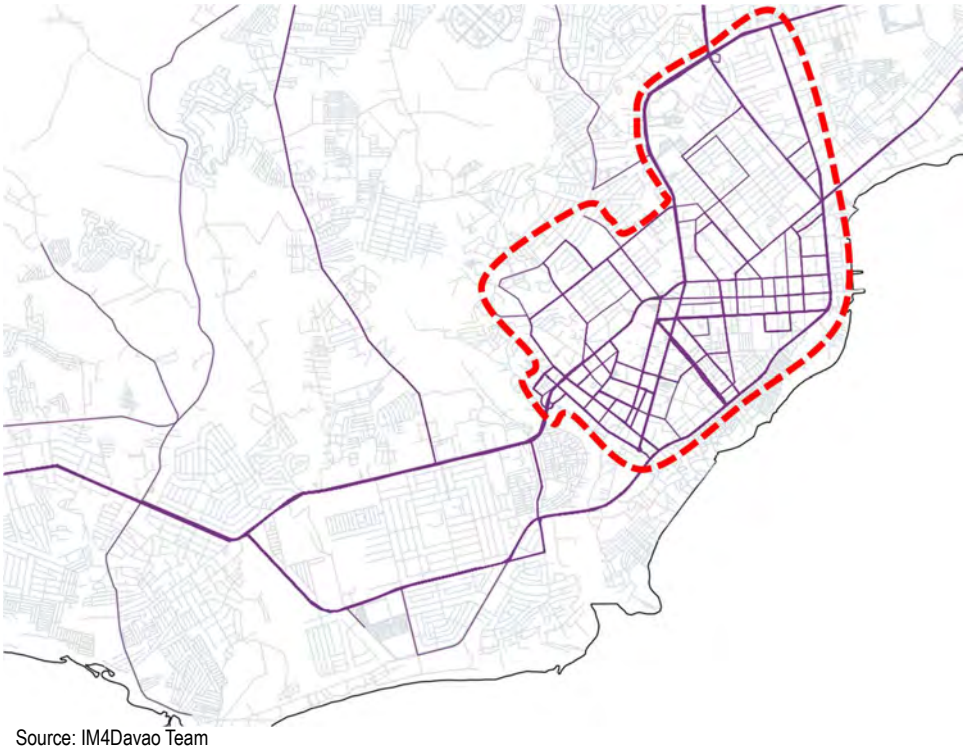
Source: IM4Davao Team

Figure 12.6.6 Assessment of Traffic-Caused Air Quality Compared to 5 Years Ago

Table 12.6.8 Registered Vehicles in Region XI

Year	Registered Vehicles
2013	383,960
2014	396,762
2015	466,528
2016	500,701

Source: LTO Region XI



Source: IM4Davao Team

Figure 12.6.7 Proposed e-PUJ Test Area in Davao

12.93 Figure 12.6.7 illustrates the current PUJ routes in Davao urban area. Jeepneys operate through most streets in Poblacion. On the other hand, when they cross Davao River to Talomo District, majority of PUJ use Quimpo Boulevard, McArthur Highway, Ecoland Drive, and Ma-a Road. Aside from small towns and municipalities, which rely more on smaller vehicles such as pedicabs and tricycles, jeepneys play the important role in serving transport needs to the public in Davao urban area. Only 8% tricycle ownership of drivers are in Davao and, considering the big portion of emission source, jeepneys are recommended to upgrade to electric vehicles in priority. Several reasons to start from electric jeepneys are summarized as follows:

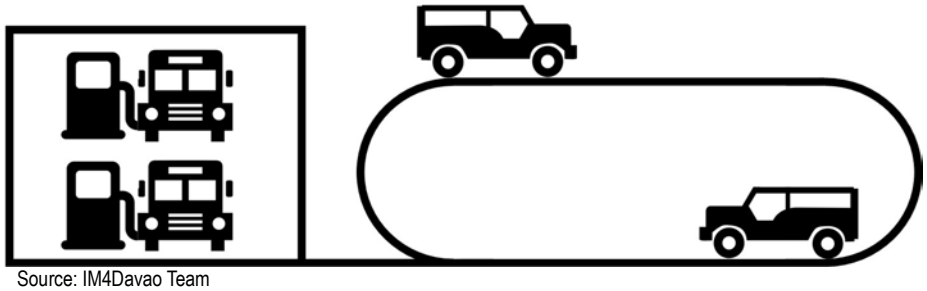
12.94 **Charging station:** Owing to limited land space, charging facilities can be equipped at operator respective garages and terminals instead of setting in down area, which ensures the regular maintenance, convenient access to power sources and necessary time for fully power charged when jeepneys stop over there.

12.95 **Emission reduction:** Huge demands and major source of air pollution, PUJs are supposed to improve at high priority for greater effect in emission reduction.

12.96 **Promotion of public transport:** To encourage people from private cars to public transport, a better and user-friendly jeepney environment is attractive.

12.97 The e-jeepney cycle (see Figure 12.6.8) was drafted for Davao City. Charging

facilities at garages can guarantee sufficient parking space and required charging time. Once the battery is completely powered, jeepneys can start to operate until battery is drained. The only concern is that due to traffic congestion or other unavoidable condition, jeepneys may run out of power before arriving at respective garages or terminals. Therefore, a joint alliance among operators at different areas can provide urgent assistance if necessary.



Source: IM4Davao Team

Figure 12.6.8 e-Jeepney Cycle

12.98 With motorized vehicles increasing, globally, there has been significant moves of electric vehicles in public transport fleets and several challenges have been addressed as well.

12.99 **Power supply for electricity:** If electricity is generated by fire-power plants, which needs huge coal or natural gas consumption instead of renewables such as wind and solar energy, this will not help reduce CO_2 emission.

12.100 **High cost of electric vehicles:** For private operators, it is not attractive and financially feasible to purchase high-expense fleets without promise of steady profits. Successful supporting financial mechanism or soft loan system have been realized in other cities of the Philippines that imply the possibility of implementation in Davao City.

12.101 **Battery waste-management concerns:** Every battery has limited lifespan and must be disposed appropriately to prevent pollution of heavy metal.

12.102 **Cooperation and coordination among national government, LGU, and operators:** Willingness of private operators to transfer to EV relies on strong support from the government for sound policy design and planning system. The city authority also has to build a platform or an organization to communicate and manage with all public transport operators. Drivers and operators who are willing to adopt clean technologies and own performance and dependability should be considered at the first stage

12.103 Above listed issues may be overcome. A sustainable and successful non-motorized transport vision also requires an integrated urban transport plan together with each elements of the transport network inclusive of EV infrastructure together with urban railway, pedestrian walkways, safe road crossings, segregated cycle paths, and parking facilities to realize low-carbon society.

13 GATEWAY AND PUBLIC TRANSPORT DEVELOPMENT PLAN

13.1 Gateway Development

1) Gateway Airport

13.1 In a national context, Davao International Airport (otherwise known as Francisco Bangoy International Airport or FBIA) is the third busiest airport in the country. In Mindanao, especially in the southern region, it is the principal gateway airport and a key hub to the sub-regional trade block (EAGA) promoting trade, tourism, and investment among the Philippines, Malaysia, Brunei, and Indonesia.

13.2 From 2011 to 2016, the airport recorded a healthy CAGR of 6.21% in passenger traffic and 6.17% in cargo volume. Over the same period, aircraft movements rose from 11,206 to 33,757 or an annual growth rate of 7.93%. The latter implies an annual average per day of 92.5 aircraft movements. On a peak-hour factor of 10, the peak-hour volume would be 10 movements.

13.3 With a single runway, the airport could comfortably achieve 20 aircraft movements per hour (i.e. 3 minutes separation) especially with the provision of a parallel taxiway and navigation system. Assuming 7.9% growth rate, that capacity would be reached in 10 years or year 2026. On the other hand, Gatwick airport has shown that 900 flights a day is possible on a single runway, which is more than 4 times the 200 upper bound assumed earlier for Davao. In the case of Manila, 38 flights per hour was indicated as a safe target. Using the latter, it implies that the runway capacity of Davao would still be adequate until year 2040.

13.4 The urgent measure is to implement most, if not all, project components contained in the 2016 PPP documents for five regional airports that was scuttled by Department of Transportation (DOTr) in early 2017. The passenger terminal has reached design capacity of 2 million passengers a year, and is crowded on frequent occasions.

13.5 With only 209 hectares, it can be conceded that FBIA does not have sufficient land area for a second parallel runway neither can it accommodate hub operation for an airline. In any case. the prospect of such an event is nil. Driven by fears about what has happened to NAIA, several studies were initiated in the past to explore an alternative site, in lieu of FBIA. Among the candidates were (i) Samal Island, which is partly to justify the Samal Bridge; (ii) Callawa to keep the airport within the city boundary; (iii) Tagum; (iv) Panabo; and, (v) Sta. Cruz. Tagum City, which also hosts the modern Hijo International Port Services, is found to be the most technically feasible among the candidate sites. However, there is strong pressure to build a replacement airport on the coast of Panabo.

13.6 There are cogent reasons why consideration of an alternative to FBIA is premature and could divert attention away from the urgent steps needed such as expand passenger and cargo terminal. These are as follows:

13.7 Existing FBIA still has the capacity to accommodate growth in traffic for at least 20 years more by which time, development in aviation could squeeze more capacities (digital air navigation system plus shift to larger aircraft). A new airport at this point will be uneconomic.

13.8 Metro Davao is projected to have a population of 5.2 million in 2045. In many cases, mega cities are served by a couple of airports. FBIA located at the most convenient site in

Metro Davao will not need to close its operation when a new metropolitan airport is constructed.

13.9 General Santos Airport in South Cotabato (about 151 km distance) can be viewed as a twin airport for Davao. Overflow in one airport can be diverted to the other or takeover from the other in case of temporary disruption.

13.10 For regional balance, it may be more efficient to expand the other airports in Mindanao, such as in Bukidnon and Cotabato. If federalization materializes, the primacy of FBIA could wane and its traffic growth could taper off. This means that the future capacity constraint of FBIA should be addressed by looking at a system of airports complementing each other in Southern Mindanao.

13.11 An act (House Bill 2002) transforming FBIA into an autonomous Davao International Airport Authority (DIAA) received steam in Congress. It is likely to be enacted into law. Similar in concept as the Manila International Airport Authority and the Mactan-Cebu International Airport Authority, the DIAA should be given the opportunity to address the issue, considering that its jurisdiction includes all other airports in the provinces of Davao del Sur, Davao del Norte, Compostela Valley, and Davao Oriental. This means it would assume responsibility for the newly-constructed Mati Airport, which is about 187 km away from Davao City.

13.12 The central location of FBIA within the City is a competitive advantage. Very few cities have an international airport that is within a few minutes of its CBD. New York City, for example, has JFK and La Guardia airports. Those cities that tried to relocate their gateway airports ended up retaining them, e.g., Bangkok, Tokyo, Washington DC, etc.

Source: IM4Davao Team

Figure 13.1.1 Sites for Terminal Expansion and New Terminal

13.13 A key issue that needs to be resolved is the land area for terminal expansion of FBIA. As indicated above, the runway capacity appears to be adequate for the next 20 years. The passenger terminal capacity has already been exceeded. The contemplated expansion (from 65,000 to 125,000sqm) could be accommodated, but the next phase might be constrained by space.

13.14 Should the airport authority be created, one aspect it should explore is to regain control of the old terminal building and its land area, which was ceded to and currently the main office of Mindanao Development Authority.

13.15 In the long run, it is recommended that the operations and maintenance of the airport, starting with the expansion of the passenger and cargo terminal buildings, be handed over to the private sector under a PPP concession similar to the Mactan-Cebu Airport PPP. Learning from the Cebu experience, responsibilities for the land side should be included in the PPP arrangement, rather than left out.

13.16 The development road map for the FBIA can be outlined as follows:

Table 13.1.1 Airport Development Roadmap

Period	Description	Arrangement
2017-2019	Construction of a full parallel taxiway Additional apron area Expansion of car parking and administration building	Funding from GAA
2018	Formation of the Davao International Airport Authority ROW acquisition on the land side	Act of Congress
2019 up	Expansion (or new) Passenger Terminal Building Expansion of Cargo Terminal Building	PPP as part of O&M concession
2020-2045	Expansion as maybe necessary, on the land side facilities, depending on actual demand. Airport authority to monitor the compliance of the concessionaire.	Private sector funding

Source: IM4Davao Team

2) Gateway Seaport

13.17 The private sector led investments and expansion of port facilities in the Davao region would continue until year 2045.

13.18 To the north, DICT in Panabo and Hiro International Port (HIP) in Tagum would be able to expand without necessity for government intervention.

13.19 In the center of Davao City, Sasa Wharf would continue to operate albeit with declining market share. In 2016, DOTr embarked on a major upgrade of Sasa Wharf inviting a PPP tender that envisaged a major expansion in land area and capacity at an indicative project cost of Php 18.99 billion. This was scuttled in early 2017 for several reasons, not the least of which is the high cost as well as the excess port capacity available from other container ports in the Davao Gulf. The latest plan of PPA is to proceed with the repair and rehabilitation of the wharf, but without expansion in land area and to hand over the port terminal operations to a single private operator that is also expected to cover the Php 4 to 5 billion investment. Currently, Sasa Wharf is served by two port operators. The bidding is scheduled for early 2018, and construction expected by the 4th quarter of 2018. By 2020, the Sasa Wharf is seen to be in tip top condition with capacity for 700,000 TEUs.

Source: PPA

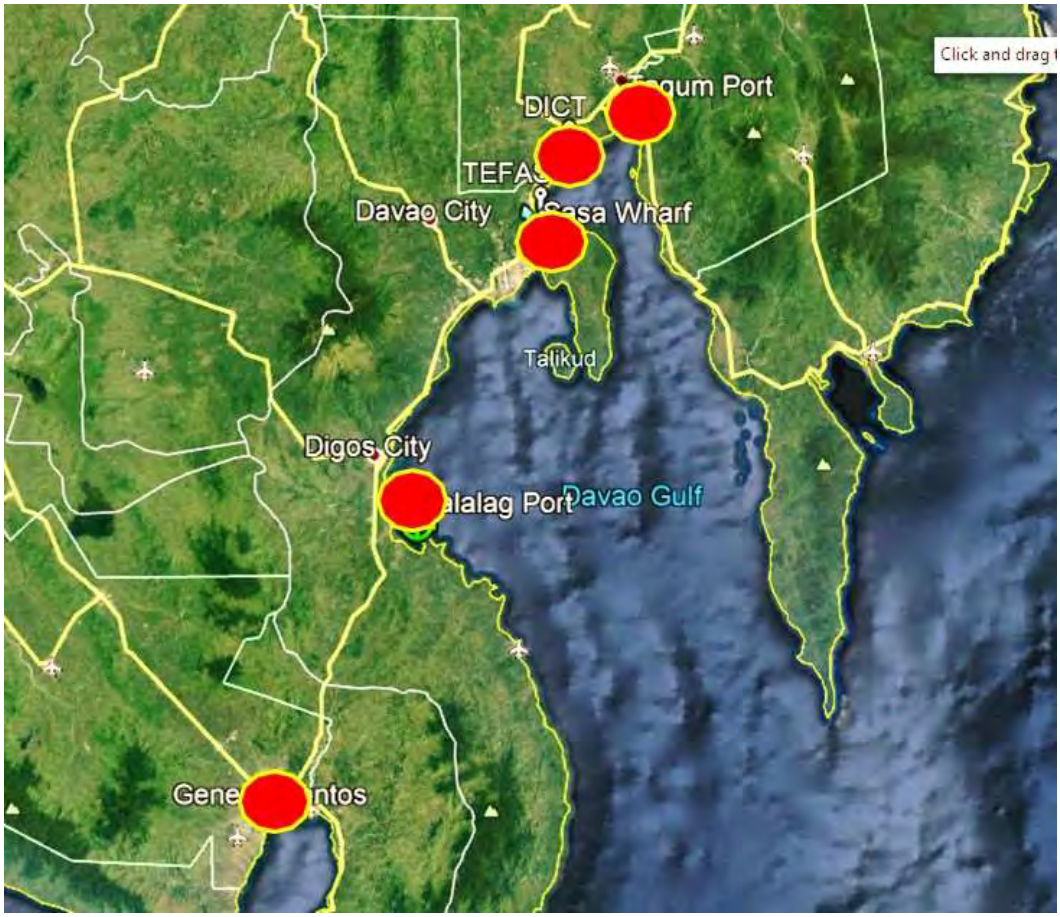
Figure 13.1.2 Aerial View of Sasa Port

13.20 To the south of Davao City and about 20 km from Digos City is the Port of Malalag, which PPA is developing into a major port. This will be the main recipient of public investments over the next decade. Although there are talks that San Miguel Infrastructure is planning a new port in Sta. Cruz as part of its industrial estate business, there is still no submitted plan to PPA.

13.21 PPA projects container demand to hit 1.4 million TEU in 2020 and 3.1 million in 2040. The bulk of these volumes can be met by DICT, HIP, and Sasa Wharf and only a small share from the southern ports of Malalag and, maybe, Sta. Cruz).

13.22 A strategic issue that could have an impact on the overall port development is the proposal to create an autonomous Davao Port Authority that will, in effect, devolve the regulation and operation of ports from a national SOE, PPA to a regional SOE. From a financial standpoint, PMO-Davao could stand on its own and be autonomous. Without the burden of foreign loan and with the robust streams of fees from private ports, it is in a better position than Cebu-PMO when it got spun off into a Cebu Port Authority. However, such a devolution could also turn into an ordeal similar to when Port of Polloc was handed over to ARMM. With no shortage in capacity, a regional port authority can be risky, but becomes inevitable if and when the shift to a federal form of government materializes.

13.23 In the long run, the future operations of Sasa Wharf needs to be re-examined, as to whether it should continue to operate as a container port or shut down and re-purposed into a waterfront CBD. If the City wants to retain a logistical hub, then it should expand Sasa. However, this option would exacerbate urban congestion on the roads around Sasa, especially if (and when) the Samal Bridge is built on that location near and to the north of Sasa. The Study Team recommends a broader perspective on the role of Sasa Wharf, by looking a system of ports – from Malalag in the south to Tagum in the north (see Figure 13.1.3).



Source: IM4Davao Team

Figure 13.1.3 Existing Sta. Ana Wharf

3) Ferry Port (Sta. Ana Wharf)

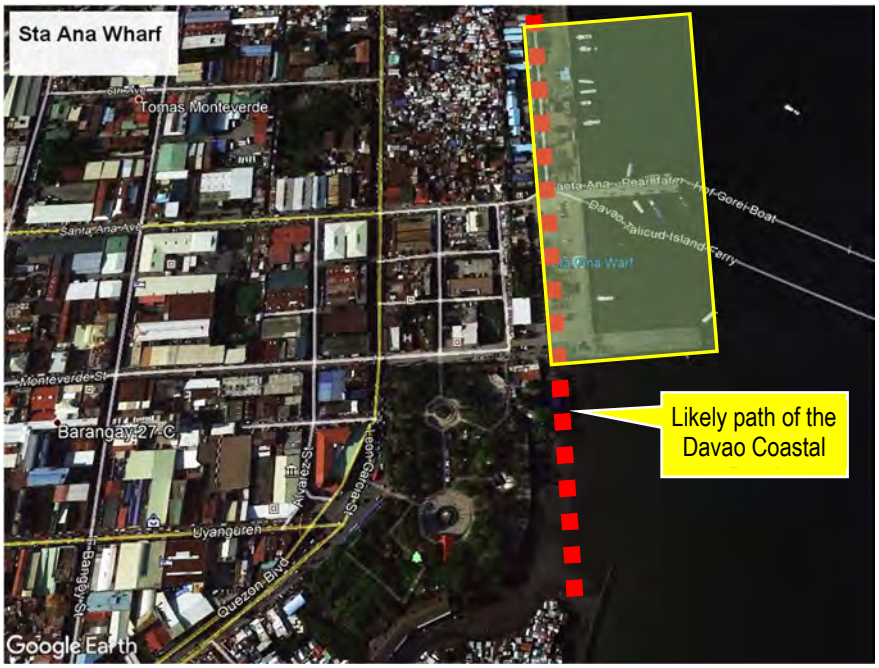
13.24 The CLUP of Davao pinpointed Sta. Ana Wharf as an eco-tourism port complex. At present, the port caters mostly to local ferry service among the city, Samal Island, and Talikub Island. Its significance in domestic shipping has declined in importance that PPA, which is the asset owner and developer, consented to the turnover of the wharf to the city government. Under a Memorandum of Agreement, the city took over operations and maintenance of the complex and, in exchange, would share a percentage of the revenues to PPA. The agreement expired, but was renewed. There is no reason for PPA to take it back, since revenues are too small to cover annual maintenance expenses. The wharf's problem is siltation. It can be safely assumed that the City can re-develop the property without need for a change in ownership. A joint venture agreement may be necessary if the redevelopment is outsourced as a concession to the private sector.

Source: IM4Davao Team

Figure 13.1.4 Existing Sta. Ana Wharf

13.25 For tourist destinations to some islands in the Davao Gulf, the Sta. Ana Wharf offers a convenient jump off point for visitors transiting through the city. The beaches and natural attractions of Samal and Talikud Islands are selling points. There are, however, very little of this kind of traffic at the moment. Casual observation points to residents of islands as the predominant traffic.

13.26 Developing the potentials of the wharf must take into account the threats of (i) construction of the Davao–Samal Bridge that would decrease ferry traffic on the wharf and (ii) construction of the Davao Coastal Road that would cut across the frontage of the complex or alter its character.



Source: IM4Davao Team

Figure 13.1.5 Sta. Ana Wharf Redevelopment Site (idea)

13.27 A compromise solution is for the Coastal Road to be elevated as it crosses the Sta. Ana Wharf, so that entrance to and from the wharf will not be impeded. The flyover, while obstructing the view to the complex, would create a boundary separating the urban shanties on one side to a green oasis of a seaside promenade on the other. The current Department of Public Works and Highways plan does not call for a viaduct or flyover, but an access road at-grade.

13.28 The recommended approach for the re-development of the Sta. Ana Wharf is to invite proposals from the private sector. From these proposals, the city government and DOTr can decide the kind of development they want. It would harness the inherent strengths of the private sector without fiscal demands on the city's coffers. Various models the city can adapt could be upscale as shown in the examples below or modest similar to Boardwalk and Bay Cruise ship on Manila City's Roxas Boulevard.

Baltimore Waterfront Promenade

Fisherman's Wharf in San Francisco

Source: Respective Websites

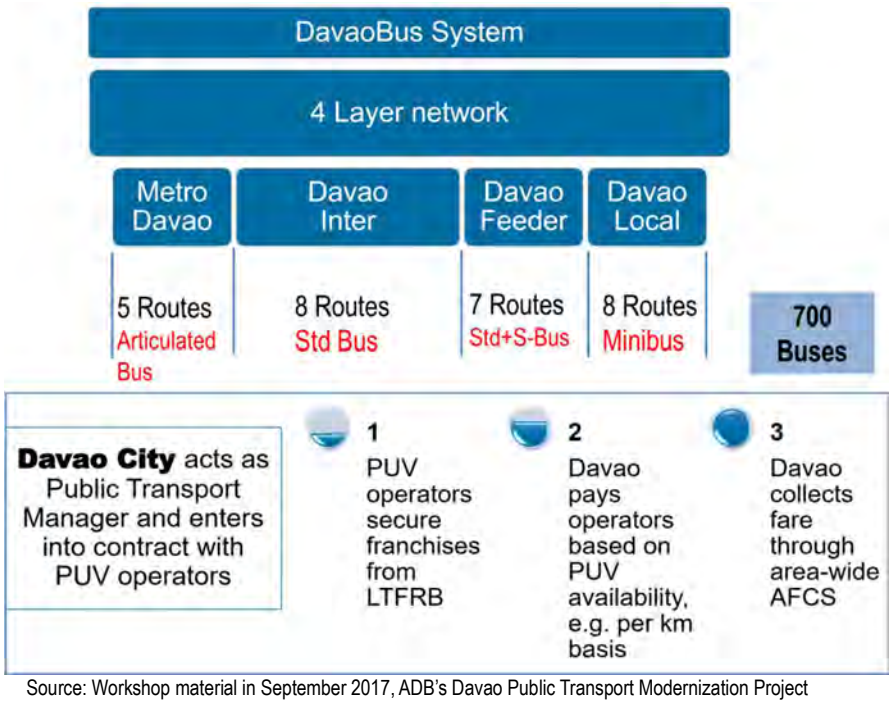
Figure 13.1.6 Wharf Redevelopment Examples

13.2 Road-based Public Transport Improvement

13.29 There are two ongoing initiatives that will characterize the short to long-term development of road-based public transport system in Davao as well as its neighboring LGUs. These are the Asian Development Bank (ADB) funded Davao Public Transport Modernization Project and Department of Transportation PUV Modernization (PUVM) Project. Both represent a major shift in policy—from "hands-off-leave-everything" to the private sector into direct intervention and investments in bus and paratransit operation.

1) ADB Project

13.30 With financing from ADB, the government through DOTr hopes to replace more than 7,400 antiquated jeepney and multi-cab units that operate in Davao City with about 700 buses that consist of articulated buses for the primary route Metro Davao, and standard and minibuses for other routes as shown on Figure 13.2.1. The project would re-structure about 125 into 28 routes of four types. The tentative bus routing plan is to replace the 131 PUJ routes with 29 bus routes operating buses in four service levels. The top tier will operate on five routes on national roads from Toril in the southwest, Calinan in the west through the central business district (CBD) to Panacan, Bunawan, and Panabo to the north. Articulated buses are being considered to ply these routes.



Source: Workshop material in September 2017, ADB's Davao Public Transport Modernization Project

Figure 13.2.1 Capsulized Diagram of ADB's PTM Project

13.31 Understandably, some of the five metro routes will overlap with the proposed MRT. The economic logic is to rely on the high-capacity buses until its at-grade capacity is reached. At the indicated bus size (=110 pax) and headways (=5 minutes at peak), that capacity is 1,320 passengers per hour per direction (pphpd). This is compared with 4,000 pphpd indicated in Figure 13.3.3. Thus, the bus capacity already exceeded under current (2017) level of demand.

13.32 Based on the project's timetable, new buses will replace non-standard jeepneys and multi-cabs as early as 2020. Hence, in the next 10 years, urban buses can be expected to ply around Davao's major roads. buses will have signal priority at intersections to ensure

shorter travel times and desired headways. The key reforms that the project intend to accomplish are as follows:

(i) At most six bus operators contracted by the government, instead of the current 7,000 plus operators

(ii) Each operator will have hundreds (or more) buses that are scheduled and deployed by a central fleet manager.

(iii) Drivers will be paid on salary rather than “on boundary.”

(iv) Government shall provide the support infrastructure such as depot, terminals, and bus stops for its own account.

(v) Automated fare collection system across all operators, instead of current cash method, with all revenues pooled and collected by the city.

13.33 ADB will provide a loan to the national government to finance the purchase of new buses, construction of infrastructure, institutional development (driver and operator training), traffic signalization, social mitigation program, and project management.

13.34 The first option of the project is for the contracted private operators to procure their buses, presumably, with some government financing. Given that existing operators start with low capital base, none will likely step forward to apply for the right to serve the routes. In such case, the city government may result to invest in the five Metro Davao routes.

2) PUV Modernization

13.35 DOTr unveiled the Public Utility Modernization Program to replace about 235,000 jeepneys throughout the country. The objectives of the program are:

(i) modernize the current PUV fleet;

(ii) reform and consolidate the industry;

(iii) move towards low-emission PUVs;

(iv) improve welfare of commuters and encourage modal shift; and,

(v) improve living standards of drivers, operators, and their families.

13.36 The aforementioned ADB project is deemed as the implementation of the program for the City of Davao.

13.37 An unstated goal is the eventual devolution to LGUs of the franchising of PUVs. The starting point is the re-structuring of the PUV routes by the LGU. DOTr has signed a joint circular with DILG for route planning by LGUs then followed with the signing of Omnibus Franchising Guidelines. This means the City of Davao will have to review the existing routes that evolved through the years under LTFRB’s guidance and then revise them according to demand and supply and their keen understanding on the needs of the riding public. The preceding ADB project would produce new route configurations that will be the jump off point for the PUV in Davao.

13.38 The first requirement of route rationalization to be done by the city has already been satisfied because of the ADB project. The next step is for LTFRB to approve this route rationalization plan after which the city will have to enter into contracts with PUV operators. These operators have yet to be identified; they are to be formed from consolidation of existing PUV operators following the DOTr guidelines. There is no clarity yet of which office, such as LTFRB, DOTr, or the city government, that will initiate the formation.

13.39 Assuming all the teething problems are resolved, all current PUV fleet should be removed from Davao's roads and replaced by the ADB-funded buses and mini-buses.

Present Fleet	PT Fleet (2020–2030)	PT Fleet (2030–2045)
 Jeepney	 Mini-buses (~350)  Articulated Buses (~550)	 Regular Buses (~550) Future fleet expansion ~6,000
 Multi-Cab	The PUV proto-type, Launched by DOTr 	Electric Buses??? 

Source: IM4Davao Team

Figure 13.2.2 A Visual Timeline of PT Development

13.40 Any inconsistency between the ADB project and PUVM program should be resolved in favor of the former. The objectives are the same except the means are vastly different. The guidelines issued by PUVM, particularly on the Omnibus Franchising Guideline, implies a bottom-up approach whereby the new bus operators shall emerge out of the consolidation of more than 7,000 franchise holders into, at most, 28 operators at one operator per route. On the other hand, ADB PT Modernization Project envisage a top-down approach whereby a bus company is formed that owns the fleet of buses with financing from ADB and/or GFIs. Equity can be sold to existing PUV operators depending on their appetite and financial capability. PUV operators could be persuaded to invest proceeds from the sale of their old units. Unless government buys these units, the scrap value would be nil.

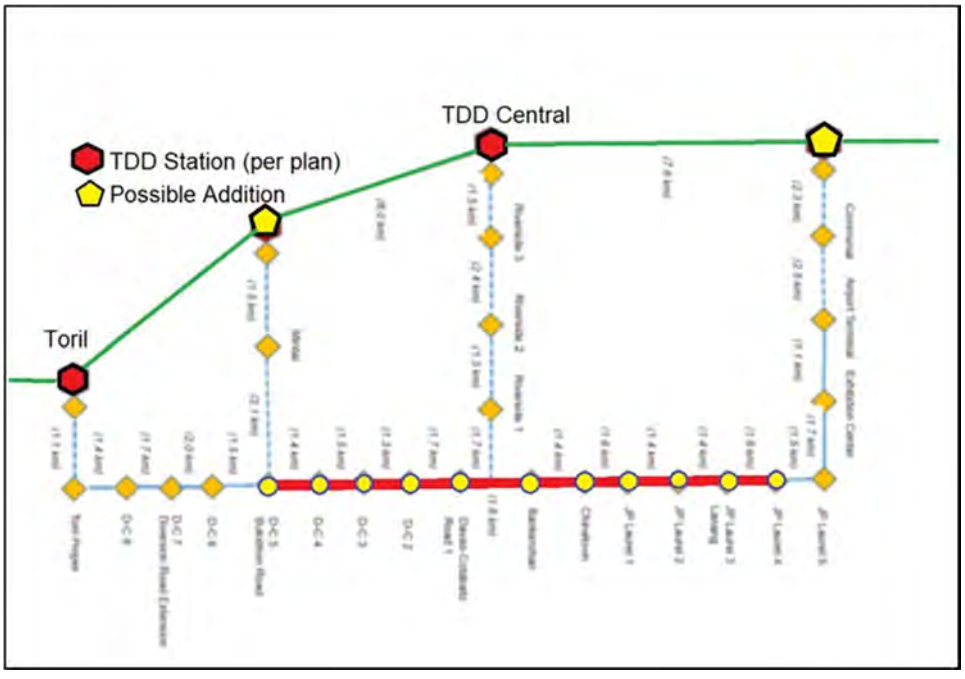
13.3 Mass Transit Network Plan

1) Project Contents

13.41 The long-term urban mass transit network for the City is shown on Figure 13.3-1. It consists of a Main Line of about 15-km, plus 4 spur lines with a total length of 24.4 km, or a total network spanning 39.4 km by 2045.

Source: Google Map

Figure 13.3.1 The City Mass Transit Network, 2045



Source: IM4Davao Team

Figure 13.3.2 Schematic of the City Mass Transit Network in relation to TDD Railway

13.42 The proposed development of the Mass Transit Line is by phases. Stage 1 is the highest priority, because of the current and future demand. It consists of 12 stations – running on the middle of Douglas MacArthur Highway, Quirino Highway and Jose P. Laurel

Avenue, from the junction of the Davao-Bukidnon Road on the west and the junction of JP Laurel and R. Castillo Street on the east. Total length is 15-km.

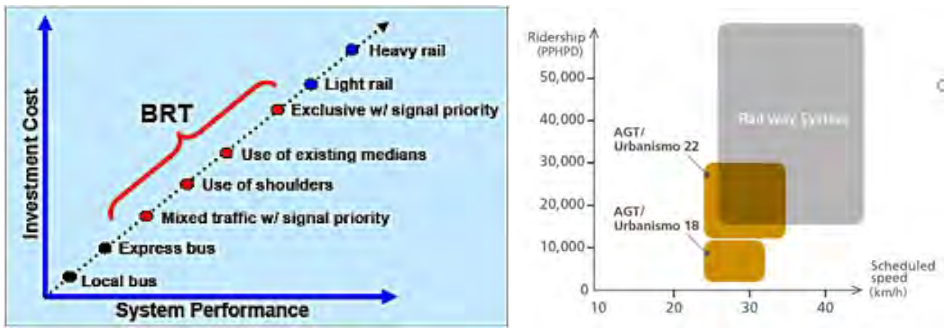
13.43 The demand forecast per day from Chapter 11 is shown in Table 13.3.1, with conversion into passenger per hour per direction (pphpd). The latter figure is the key variable in choosing the most appropriate railway technology.

Table 13.3.1 Peak Hour Ridership (in pphpd)

	2017	2030	2045
Main Line (15-km)	3,670	15,610	20,350
Branch Line to Mudiang	220	820	1,070
Branch Line to TDD Central Station	610	310	400
Branch Line to Mintal	70	90	240
Branch Line to Toril	10	130	190

Source: IM4Davao Team

13.44 The above Table suggests that a rail system is not necessary now, as the ridership of 3,670 pphpd can be carried by a bus system without crowding. Also, it points to the inadvisability of building all the four branch lines, as none has reached more than 6,000 pphpd by year 2045. The demand by year 2024 on the main line is calculated to be 8,000 (equivalent to 133,400 per day).



Source: IM4Davao Team

Figure 13.3.3 Transport Selection Criteria

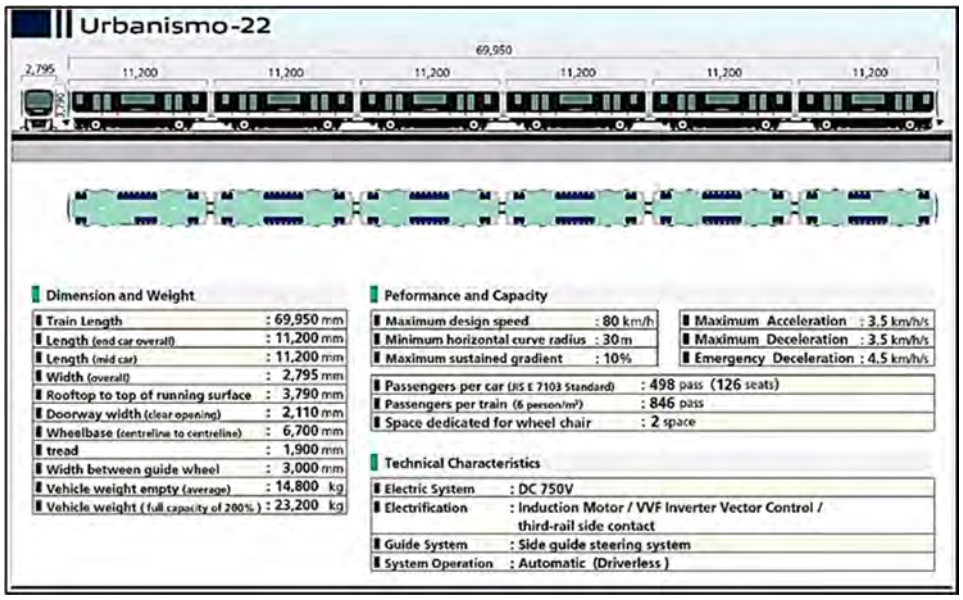
13.45 Guided by the preceding chart (Figure 13.3.3), the recommended technology is a monorail system based on the key factors shown on Table 13.3.2.

Table 13.3.2 Evaluation Criteria for Choice of Technology

	Bus	Monorail/AGT	LRT
Capacity (pphd) @ 2-minute headway	3,600 (large bus) 6,000 (BRT)	15,000(4-car) 22,500 (6-car)	37,500 (4-car train)
Relative capital cost	Low	Medium	High
Minimum radius of curvature (meters)	13	30	170
Length of station platform (meters)	5-m bus stop	60	100
Width of guideway - both directions (meters)	7.0	9.2	10.0
Recommended Maximum Gradient	10%	6%	4%

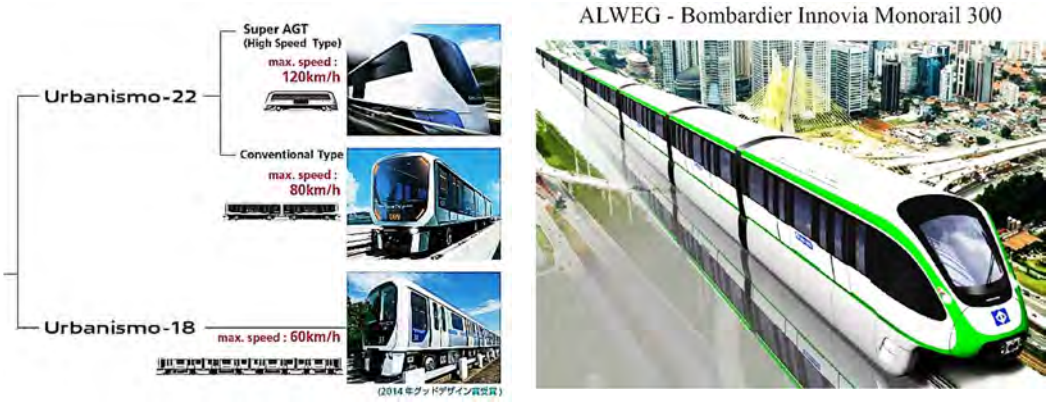
Source: IM4Davao Team

13.46 Thus, a monorail system is adequate for Davao City. For example, the Urbanismo 22 AGT model of MHI Japan (see Figure 13.3.4) can achieve 25,400 pphpd at 2-min headway, and 33,800 pphpd at 90 seconds headway. Another example of a product in the market is that of Bombardier, which supplied the monorail system in Sao Paolo Brazil, with 30,000 pphpd capacity on 2-minute headway. These systems can meet the needs of Davao (20,350 pphpd) by year 2045 and beyond.



Source: Related websites

Figure 13.3.4 Specifications of the MHI Urbanismo 22 AGT System



Source: Related websites

Figure 13.3.5 Two Possible Rail System for Davao

2) Summary of Projects

13.47 The strategic projects for transportation are the following:

1) Expansion of the Davao International Airport – doubling of the passenger terminal space and cargo handling facility, parallel taxiway, expansion of the car parking area and the administrative building
2) Rehabilitation and improvement of Sasa Wharf – this will involve urgent repairs, rehabilitation of the port, and installation of gantry cranes
3) Conversion of Sta. Ana Wharf into a boardwalk, waterfront mixed-used development
4) Modernization of the road-based public transport system in terms of fleet replacement and change in regulation and mode of business operation
5) Urban Mass Transit Line (phase 1) – 15-km line along MacArthur, Quirino, and JP Laurel, starting with 8 trains (4-car/train) based on monorail/AGT technology

13.4 Other Measures

1) RoRo Links to EAGA

13.48 The Mindanao Development Authority has promoted the BIMP–EAGA initiative that begun in 1994. Aside from the establishment of air links among Indonesia, Malaysia, and Philippines, the initiative has called for three pilot RoRo routes based on the 2012 JICA Feasibility Study on the Establishment of the ASEAN RoRo Network.

Source: Related websites

Figure 13.4.1 The 1st of 3 Planned RoRo Service in the Philippines

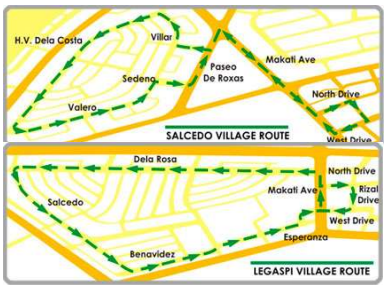
13.49 Last April 2017, the inaugural run of the Davao–General Santos–Bitung Route took place with attendance of the Presidents of Indonesia and Philippines. Other sea linkages eyed are: Bitung–Tahuna–General Santos, Brooke's Point–Sandakan–Kota Kinabalu, Brooke's Point–Bataraza–Kudat, and Brooke's Point–Brunei.

13.50 The touted benefits of the RoRo line are (i) shorter travel time from Davao to the largest city of Indonesia's North Sulawesi province from 2 weeks to 2 days and (ii) lower freight costs from $2,000 to $700 for the Davao–Manila–Jakarta route. While it is too early to tell, the experience of shippers and shipping line (Asian Marine Transport) is not promising. The 500 TEU capacity of the vessel is hardly filled. The weekly service has become fewer. Complementation in traded goods appears to be lacking aside from customs barriers. Proponents are now looking at smaller vessel to remedy the problem.

13.51 The long-term sustainability of sea links in the BIMP region will depend less on supply of transport, but on the underlying economic trading activities. After all, transport is an enabler and not the creator of freight traffic.

2) Electric Vehicles

13.52 In the priority project list of the Davao CLUP is the promotion of electric vehicles in the CBDs. The CBD is seen as a high-density location for offices that also have linkages to public transport and residential development. Accordingly, EV in this context would be for internal circulation and to provide a short link to a mass transit station.



Source: IM4Davao Team

Figure 13.4.2 The EV of Makati

13.53 This idea may have been inspired by the e-Jeepney in Makati CBD introduced by the City Government of Makati sometime in 2009. Called the Makati Green Route, it started with free rides between two nearby residential areas and the commercial and business zones. The electric jeepneys are powered by lead-acid batteries. The service has not been a roaring success in spite of support from environmentalists and the city government. At present, it operates 20 EVs in two routes and charges fares equal to ordinary jeepney fare. It encountered problems with vehicle registration in the absence of a motor engine, short-range between charging, and unattractive design.

13.54 A pilot EV could be realized in Davao if the property-owner of a large CBD takes the lead by providing charging stations within the complex, constructing dedicated pathways for the EVs, and discouraging use of cars. The potential for such a service to emerge in Davao are in SM Toril and in the emerging CBD of Azuela Cove in Lanang. Both have manageable scale and the commercial incentive to introduce EVs.

13.55 With progress in EV technologies, Davao should avoid heavy and short-range traditional lead-acid batteries. Batteries for electric vehicles are characterized by their relatively high power-to-weight ratio, energy-to-weight ratio, and energy density. Smaller and lighter batteries reduce the weight of the vehicle and improve its performance. The battery makes up a substantial cost of the vehicle and currently the main resistance to shift from gas to electric. One local EV introduced in Metro Manila had a battery that accounted for 50% of its total price.

Source: IM4Davao Team

Figure 13.4.3 Best Potentials in Davao for EV in CBD

3) Towards a Transport and Traffic Authority

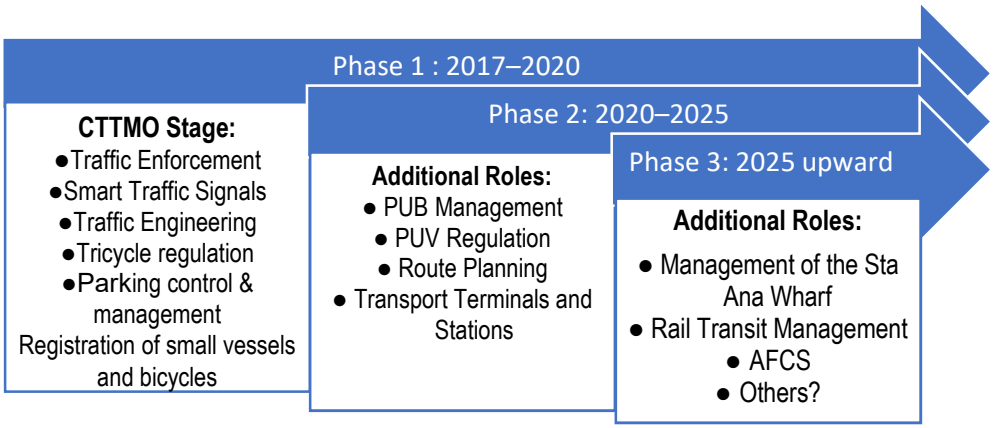
13.56 Corresponding with the changing system of public transport in Davao, the city should also create the appropriate institutions to manage the system. At present, the city has City Transport and Traffic Management Office (CTTMO), which is responsible for traffic management.

Source: IM4Davao Team

Figure 13.4.4 Candidate EVs for Davao

13.57 This organization has to evolve gradually into a full-blown Davao Transport and Traffic Authority. At present, it is pre-occupied with traffic enforcement and operation of the city's computerized traffic signaling system.

13.58 Its first major assignment in the area of transport is the pending implementation of the ADB Public Transport Modernization project. Transport infrastructure such as depot and bus terminals and stations will be built, and bus vehicles will be procured and deployed. Although the plan is for private entities to operate and maintain the buses, there will still be the need for a government body to regulate and exact performance. The devolution of PUV franchising powers from LTFRB to the city is another function to add to the Tricycle Regulation Unit. At some time in the future, this authority also has to oversee the rail mass transit system on a similar footing as the buses and the new jeepneys. The evolution of CTTMO into an authority is illustrated below.



Source: IM4Davao Team

Figure 13.4.5 Institutional Development Towards a New Authority

14 WATER SUPPLY DEVELOPMENT PLAN

14.1 Institutional and Financial Framework

14.1 The two main entities tasked with water supply service provision are local government units and water districts. This responsibility is mandated by the Local Government Code for LGUs and Presidential Decree 198 for Water Districts.

14.2 The Local Government Code gives the LGUs, particularly cities and municipalities, the fundamental responsibility to provide basic services, including water supply. LGUs are empowered to find the means to do so, be it on their own account, through private providers or through partnership with civil society groups. With respect to water supply and wastewater management, it can also opt to establish water districts to spin off the service provision from the LGUs.

14.3 Enabled by the Decree, water districts are formed through Local Sanggunian resolutions, which stipulate transferring water supply assets to the water district but to be paid back over time. Water districts then become autonomous entities, expected to be financially self-sufficient considering that they are not entitled to government equity or subsidy. Because of this peculiar condition, they were for a while considered quasi- public entities. However, later the Supreme Court ruled them to be government owned and controlled corporations, categorically bringing them into the fold of the government bureaucracy—subject to civil service rules, COA audit, budgeting, procurement rules and regulations, and the like.

14.4 Once formed, the water districts are required to get their respective licenses to operate from the Local Water Utilities Administration (LWUA). The same PD 198 created LWUA as the economic regulator, as well as a special lending entity. Apart from the license to operate which also delineates the area of operation, LWUA as the economic regulator also has the authority to set facility and performance standards, guidelines for tariff setting, and approval of tariffs.

14.5 LGUs, on the other hand, self-regulate. In theory, LGU-run systems are regulated by the Local Sanggunians. However, in practice most Sanggunians do not have a system for economic regulation, hence does benign exercise of this function.

14.6 In the case of Davao City, water supply provision is a shared responsibility of Davao City Water District (DCWD) and the City Government. Although the franchise of DCWD covers the entire city, financial viability has compelled it to limit operations in urban barangays, leaving the far-flung and sparsely populated rural barangays for the City to serve.

14.7 With respect to financing, DCWD finances its capital investments, operation and maintenance from revenues. It has leveraged internal resources earnings with LWUA and commercial bank credit, and recently with private equity (i.e., for Tamugan bulk water supply project implemented through a joint venture agreement between the District and Apo Agua Company), which will all be paid back from user fees.

14.8 The City, on the other hand, relies on its budget and sometimes on the Congressional representative's local development funds. Operation and maintenance of the system is given to community-based, barangay water service associations. As it will become evident later in the discussion of rural water supply in this Chapter, the water

supply systems run by barangay associations are not up to standards in construction, operation and maintenance. Hence, they will likely not reach their planned economic lives, necessitating capital investments again in the nearer future.

14.9 One way to make the City-funded systems sustainable is to put them under a central management system and provide the community-based associations with capacity building. The best way to do this is for the City and the District to enter into a formal cooperation agreement or a Memorandum of Agreement. While the City funds the capital investments, the District can provide the technical assistance for the design and operating and management plan. It can also train the day to day operators on the technical aspects of properly running and maintaining the systems, as well as on financial management aspects. Performance and financial management standards will be set by the District, including tariff setting and adjustment guidelines.

14.2 Water Supply System for the Year 2045

1) Population Projection

14.10 As discussed in ***Chapter 8***, the population projection at each district in Davao City up to 2045 is shown in Table 14.2.1.

Table 14.2.1 Population Projection, 2015-2045

District	Population		
	2015	2030	2045
Bunawan	152,102	218,700	317,400
Buhangin	293,118	450,100	682,700
Agdao	102,267	111,300	124,800
Poblacion	174,121	188,100	208,700
Talomo	418,615	581,810	823,600
Toril	148,522	284,100	485,000
Tugbok	121,334	226,200	381,600
Calinan	92,075	107,600	130,700
Marilog	52,201	52,200	52,200
Paquibato	44,763	44,800	44,800
Baguio	33,873	33,900	33,900
DAVAO CITY	1,632,991	2,298,800	3,285,400

Source: IM4Davao Team

2) Forecasted Water Demand in 2045

14.11 Water demand in 2045 can be forecasted by using population projection, forecasted per capita consumption (liter/capita/day), forecasted population served ratio (%), and forecasted non-revenue water (NRW) factor.

(a) Per Capita Consumption in 2045

14.12 As per LWUA's Feasibility Study Guidelines: "In urbanized cities and municipalities, however, the per capita consumption would go as high as 140 liters/ capita/ day (lpcd) or more. The present unit consumption may be projected to increase by 1% annually or the following assumptions for the future unit consumptions may be used."

Table 14.2.2 Unit Consumption

	Present lpcd	5 Years After Project Completion	10 Years After Project Completion
1	Less than 120 lpcd	125 lpcd	130 lpcd
2	120 to 130 lpcd	Present lpcd + 5 lpcd	Present lpcd + 10 lpcd
3	130 to 135 lpcd	Present lpcd + 5 lpcd	140 lpcd
4	135 to 140 lpcd	140 lpcd	140 lpcd
5	More than 140 lpcd	Present lpcd but not more than 145 lpcd	Present lpcd but not more than 145 lpcd

Source: DCWD

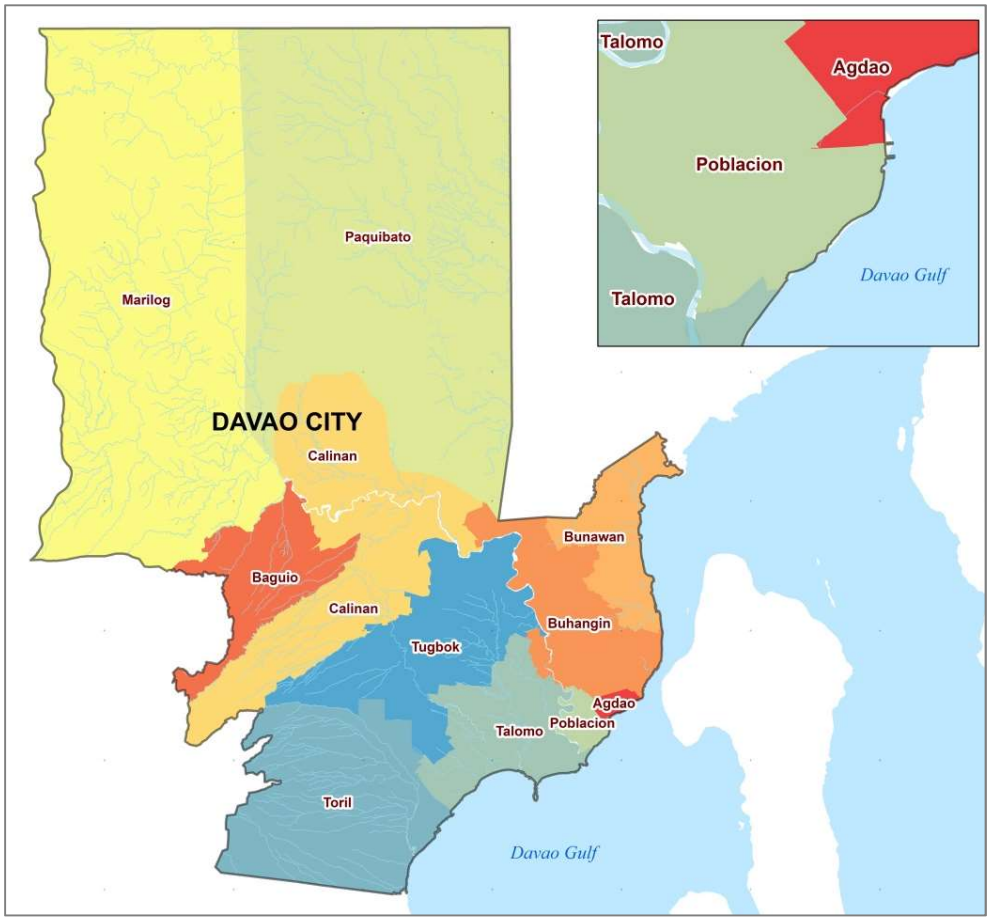
14.13 Table 14.2.2 shows suggested guidelines and should not be taken as a rule. The planner should assess the consumption patterns in the study area, particularly in the case when the present per capita consumption is significantly lower than 115/120 lpcd or higher than 130/140 lpcd, and use the experience to determine future consumption.

14.14 The per capita consumption of DCWD as of December 2016 is 193 lpcd, which is higher than 140 lpcd. Based on this, the per capita consumption will increase annually and gradually. In case of annual increase of 0.3% from 2016 to 2045, the per capita consumption will become around 1.09 times the original amount. Thus, the forecasted per capita consumption will be 210 lcpd (193 lpcd x 1.09 = 210 lcpd).

(b) Forecasted Population Served Ratio (%) in 2045

14.15 Based on the population projection, the total population of the four districts of Malilog, Paquibato, Calinan, and Baguio in the northern area of Davao City (Figure 14.2.1) in 2045 is estimated at 261,600. This number accounts for 8% of the city's population in 2045, hence, the southern part of the city with seven 7 districts accounts for 92% of total population.

14.16 The current population served ratio as of 2016 by DCWD in the urban area is 62.2%. On the other hand, current population served ratio in the rural area ranges from 40 to 60%. In 2045, if the population served ratio in the urban area served by DCWD, BAWASA, and LGU becomes 90% and the population served ratio in four districts in the rural area by BAWASA and LGU is assumed to be at 70%, then the total population served ratio in 2045 would be approximately 90% (0.08 x 0.7 + 0.92 x 0.9 = 0.884).



Source: DCWD

Figure 14.2.1 District Map in Davao City

(c) Forecasted NRW in 2045

14.17 NRW from 2012 to 2016 are 25.0% in 2012, 26.2% in 2013, 28.9% in 2014, 30.0% in 2015, and 30.8% in 2016. The NRW level has become worse since 2012.

14.18 Based on its Medium-Term Development Plan 2017–2021 (currently timeline was changed to 2018–2023), which implementation is led by its NRW Management Division, DCWD aims to reduce the NRW volume of 32,906,641 m^3 in 2016 to 26,676,905 m^3 by 2021. This is a reduction of 1.2% in the NRW level using the 2016 System Input Volume

and NRW level baseline from 30.8% to approximately at 20%.

14.19 Based on the above, the target NRW in 2045 is estimated at 20%.

(d) Water Demand in 2045

14.20 Based on the foregoing forecasted factors, the estimated water demand by 2045 is 776,200 m^3/day (Table 14.2.3).

Table 14.2.3 Water Demand in 2045

No.	Factors	2015	2030	2045
1	Population	1,632,991	2,298,800	3,285,400
2	Population served ratio (%)	61.4	75	90
3	Served population	1,002,700	1,724100	2,956,900
4	Unit water consumption (lcpd)	190	200	210
5	Water consumption (m^3/day)	190,500	344,820	620,950
6	NRW (%)	30	25	20
7	Required Production Water (water demand; m^3/day)	272,100	459,800	776,200
8	Current Water Production by DCWD (m^3/day; as of December 2015)	275,000		
9	Bulk Water Supply (m^3/day)	0	300,000	300,000
10	Required water production amount by DCWD, BAWASA, and LGU except bulk water supply (m^3/day)	0	159,800	476,200

Source: IM4Davao Team

3) Water Supply Development Plan

14.21 The projected water demand by 2045 of 776,200 m^3/day is over the 575,000 m^3/day total production amount of current water production of 275,000 m^3/day by the wells and the springs, and 300,000 m^3/day by the bulk water supply. Hence, before 2045 new water sources with the capacity of 201,200 m^3/day should be developed.

14.22 DCWD acquired National Water Resources Board (NWRB) Water Permit No. 12141 at Lipadas River with a capacity of 397 liters per second, which is equivalent to around 34,000 m^3/day as of May 20, 1990. However, required water production amount is still short of 167,200 m^3/day against the water demand in 2045. In order to meet this future water demand, around 38 deep wells with a capacity of 4,500 m^3/day/well should be constructed. The springs and rain water harvesting should be considered as additional water sources.

14.23 The SCADA System is to be placed in Toril Water Supply System (TWSS) under MTDP. Project will start on July 2018 and will complete within 300 calendar days after commencement. Project cost is PHP 80 million which covers site development, new construction of production well, new pipeline, etc. The TWSS has four exiting facilities, two wells and two reservoirs and one new production well. This shall be put in full automation and to be connected to SCADA Center in Matina or Talomo Pumping station. The facilities in TWSS shall be interconnected, monitored and controlled. The documentation protocol to the SCADA Center is via radio frequency.

14.24 The following measures are recommended to satisfy water demand in 2045:

(i) Development of new production wells based on the Hydrogeological Map: output of DCWD's Groundwater Assessment and Development of Groundwater Flow Model for Davao City Aquifers;

(ii) Development of new surface water with NWRB water permit;

(iii) NRW reduction, establishment of DMA and complete SCADA system, and patrol work (circulating checking);

(iv) Educational campaign for water conservation (for reduction of per capita consumption);

(v) Rainwater harvesting; and

(vi) Groundwater occurrence.

14.3 Proposed Water Supply Projects

1) Introduction of Supervisory Control and Data Acquisition (SCADA) System

(a) Necessity and Purpose of SCADA System

14.25 DCWD's water supply system network consists of 62 production wells, 22 reservoirs, and transmission and distribution pipelines. After completion of the Davao City Bulk Water Supply Project by the first quarter of 2021, new reservoirs with an off-take point and new transmission pipelines will be integrated into the current DCWD water supply system.

14.26 Utilization of the limited water source effectively and efficiently towards equitable water distribution will require the following measures:

(i) Efficient management of production wells;

(ii) Reduction of NRW; and

(iii) Control of transmission and distribution.

(b) SCADA System and Its Effect

14.27 In order to effectively utilize the limited water source and undertake equitable water distribution, water demands in the command area should be known by the operator. District Metered Area (DMA) is regarded as a basic command area that was proposed to be created based on NRW reduction measures.

14.28 SCADA system is the tool for comprehensive data acquisition through which important decisions would be based. This system can gather data for flow, valve status, and reservoir water level. After analysis of the gathered data, the operator can decide the equitable distribution flow, NRW reduction, etc.

14.29 Equitable water distribution will be the main objective for the water supply system over entire transmission and distribution systems. Water should be distributed to each DMA based on the DMA demand. DMA is proposed as a basic demand unit in the water master plan as well as a minimum NRW in the NRW reduction measures.

14.30 In case total demand in every DMA is below available supply amount, water is allocated to each DMA in proportion to each DMA demand. In order to equitably distribute water to every consumer, SCADA is first utilized for monitoring every inflow of DMA.

(c) SCADA Component

14.31 Flow control requires information on (i) flow at outlet at the production well, inlet and outlet of the reservoir, and inlet of DMA; (ii) water level of the reservoir; and (iii) pressure at DMA. The main components and functions of distribution of the SCADA system are as follows:

(i) **Server computer:** Brain of the system to create and store the database and to control the Human Machine Interface (HMI) information.

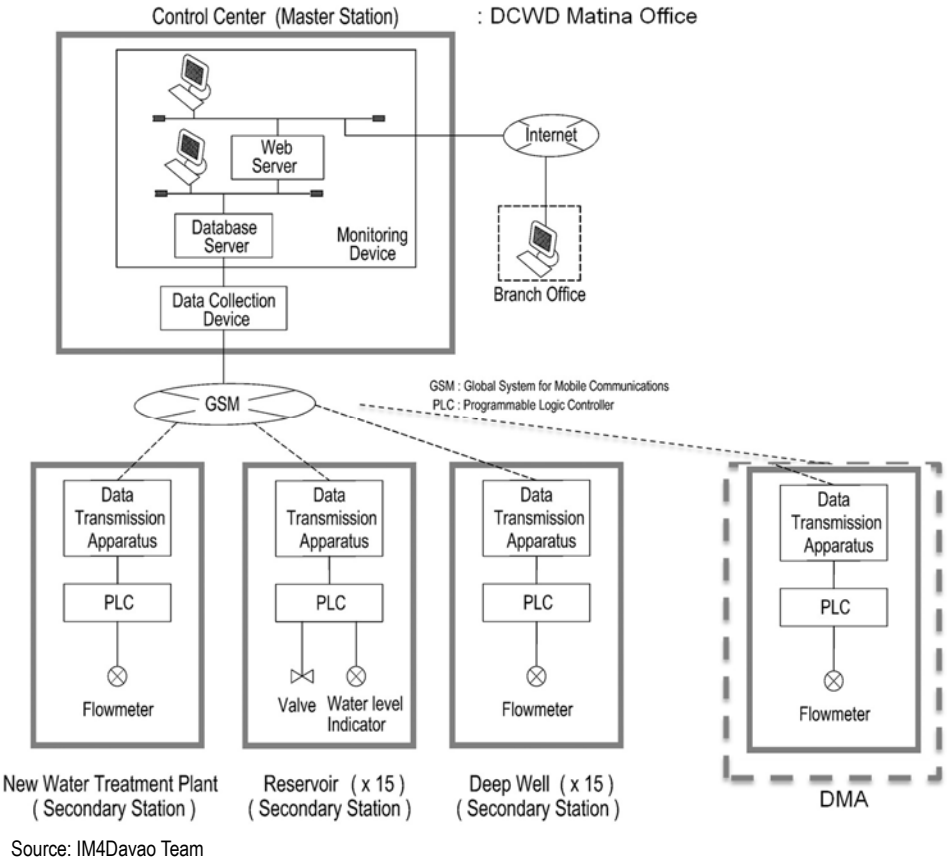
(ii) **Client PC and printer:** HMI terminal and display unit to print out the report.

(iii) **Programmable Logic Controller (PLC)**: Input/Output unit for the signal to store the application software for the automatic control.

(iv) **Communication equipment:** Optical fiber LAN, communication terminal (short message services), dedicated network, virtual private network, etc.

14.32 The basic SCADA system for distribution consists of a redundant server, two work stations for the engineers, a monitor for display of process parameters, and a laser printer with necessary UPS for printing reports. A local control panel (LCP) is provided to each reservoir and production well. There will be a selector switch in the LPC for manual or central control.

14.33 The following is the proposed schematic diagram of the SCADA system for DCWD.



Source: IM4Davao Team

Figure 14.3.1 Schematic Diagram of SCADA System for DCWD

(d) Implementation Schedule

14.34 The project implementation schedule (Table 14.3.1) will take into consideration the following conditions: (i) completion of initial TWSS SCADA System; and (ii) completion of Bulk Water Supply System. Proposed implementation schedule is as the following table.

Table 14.3.1 Implementation Schedule

No.	Item	Duration	2019	2020	2021	Remarks
1	Preliminary Survey and Basic Design	3 months				Start is in October, 2019
2	Detailed Design	6 months				
3	International Bidding including PQ	6 months				
4	Installation/Construction of SCADA	12 months				
5	Total	27 months				

Source: IM4Davao Team

(e) Project Cost

14.35 The estimated project cost is PHP505 million (JPY1,073 million). The cost components are indicated in Table 14.3.2. The exchange rate is PHP1.00=JPY2.126.

Table 14.3.2 Project Cost for SCADA System

No.	Item		Qty.	Unit	Unit Cost in JPY (x 1,000)	JPY (x 1000)	Equivalent in PHP (x 1000)	Remarks
1	Consultant Fee for Survey and Design		1	L.S.	80,000	80,000	38,000	
2	Construction Cost	Master Station	1	L.S.	100,000	100,000	47,000	
		Secondary Station (Boundary of Bulk Water Supply System)	1	Set	8,000	8,000	3,800	
		Secondary Station (Reservoir)	17	Set	16,000	272,000	128,000	
		Secondary Station (Deep Well)	14	Set	8,000	112,000	53,000	
		Secondary Station (off-take point)	7	Set	7,000	49,000	23,000	
		DMA	30	L.S.	8,000	240,000	113,000	
		Sub-Total				761,000	358,000	
3	VAT		1	L.S.		84,000	40,000	(1+2) x 0.1
4	Engineering Fee for Supervision		1	L.S.		50,000	23,500	
5	Total (1+2+3+4)					975,000	459,000	
6	Contingency		1	L.S.		98,000	46,000	5 x 0.1
7	Total (5+6)					1,073,000	505,000	

Note: L.S. – lump sum
Source: IM4Davao Team

2) NRW Reduction by DMA Establishment

(a) Background

14.36 As defined by the International Water Association (IWA), NRW consists of water losses divided into apparent and real losses, and unbilled authorized consumption (Table 14.3.3).

Table 14.3.3 NRW Based on IWA Standards

System input volume	Authorized consumption	Billed authorized consumption	Metered consumption	Revenue water
			Unmetered consumption	
		Unbilled authorized consumption (ex. firefighting, cleaning)	Metered consumption	Non-Revenue Water
			Unmetered consumption	
	Water losses	Apparent losses	Unauthorized consumption (i.e. Illegal use)	
			Customer metering inaccuracies	
		Real losses	Leakage (Mains, basins, service pipes)	

Source: IWA

14.37 Understanding the existing NRW level is an important first step towards formulating NRW reduction policy and plans. Arriving at a reliable NRW figure requires reliable data on its components.

(b) Current NRW Level in DCWD

14.38 As shown in Table 14.3.4, the NRW level in DCWD worsened between 2012 and

2016. However, 30.5% NRW in DCWD is not so bad compared to neighboring developing countries.

14.39 NRW reduction is very important for DCWD taking into consideration future water source.

Table 14.3.4 NRW in DCWD, 2012-2016

No.	Description	Unit	2012	2013	2014	2015	2016*1
1	Total Production	m^3/year	91,430,012	93,302,571	96,655,246	100,636,204	97,420,521
2	Revenue Water						
	Billed metered consumption	m^3/year	68,593,480	68,874,118	68,714,668	70,699,567	67,757,518
	Billed unmetered consumption	m^3/year	564	721	417	884	799
	Total revenue water	m^3/year	68,594,044	68,873,397	68,715,085	70,700,451	67,758,317
3	NRW	m^3/year	22,835,969	24,428,453	27,940,579	29,935,753	29,662,204
	Percentage NRW	%	24.98%	26.18%	28.91%	29.75%	30.45%

Note: *1 as of November 2016.
Source: IM4Davao Team

(c) Methodology of NRW Reduction by DMA Approach

14.40 The steps of NRW reduction by DMA approach are outlined below:

(i) Mark DMA on the map;

(ii) Select a DMA;

(iii) Update pipe network drawing/information;

(iv) Update and analyze customer data and conduct household survey;

(v) Prepare DMA that includes procurement and installation of bulk meters and isolation valve;

(vi) Conduct NRW baseline survey by water balance, measurement of minimum night flow (MNF) in case of 24 hours supply;

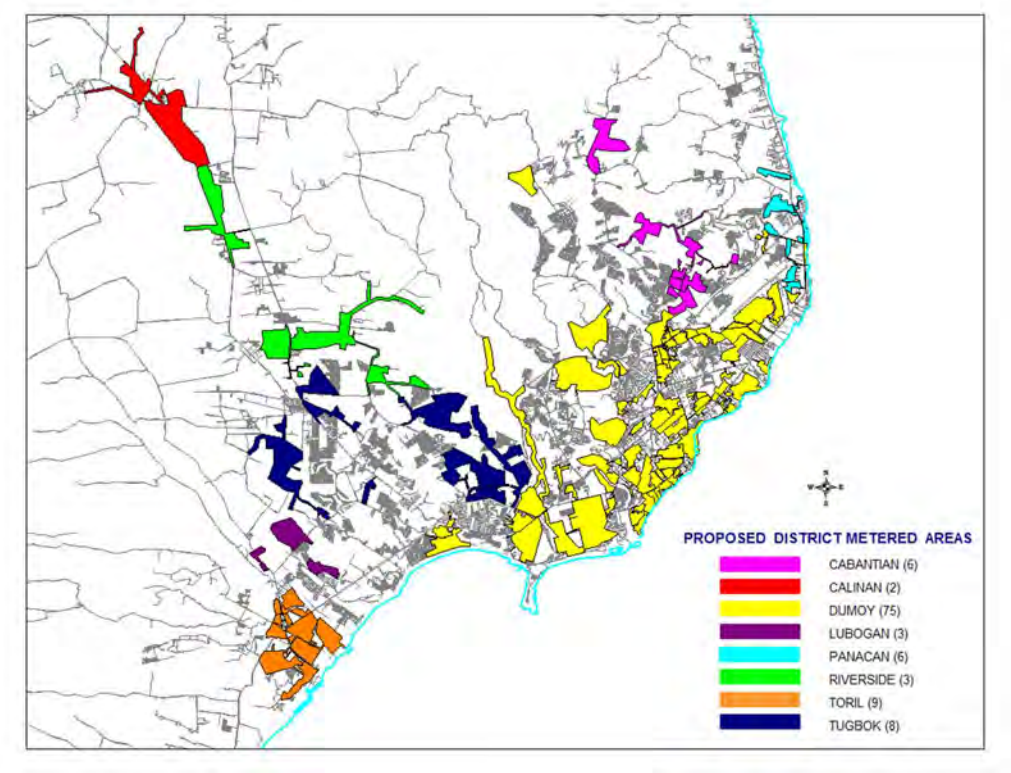
(vii) Implement countermeasures such as detection and repair of leaks, replacement of defective water meters, regulation of illegal connections, and removing of missing customers; and

(viii) Evaluate results by repeating water balance and MNF measure.

(d) Proposed DMAs in DCWD

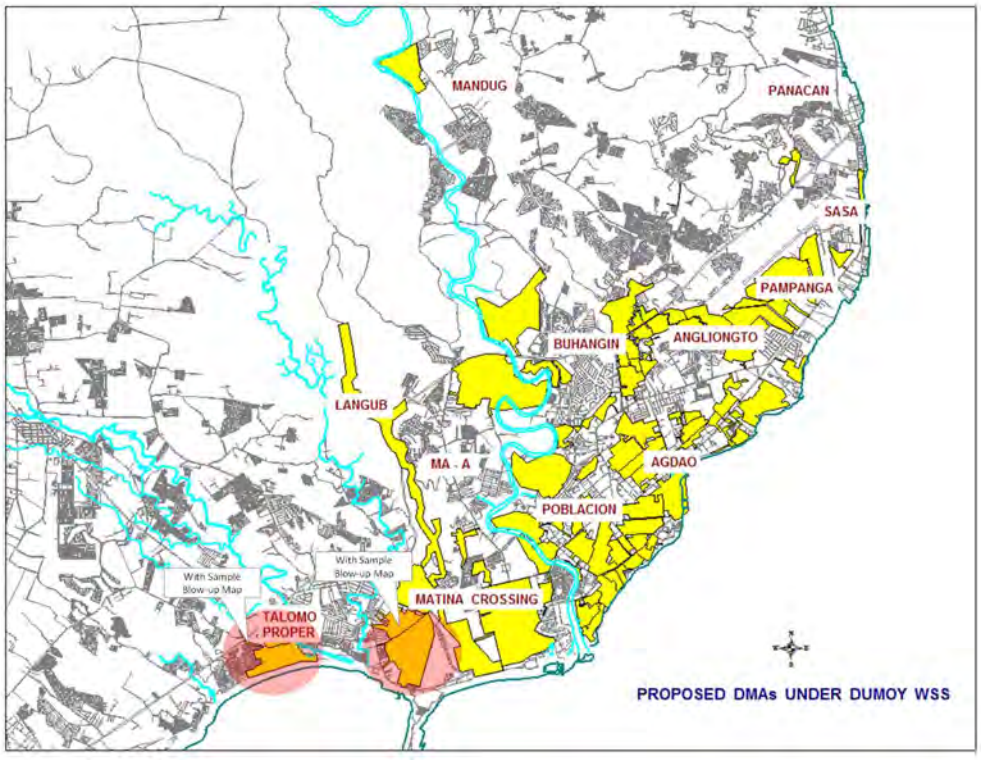
14.41 DCWD has 38 existing established DMAs. These existing DMAs cover only 20% of the existing service connections of DCWD. In 2018, DCWD will establish 112 additional DMAs under its project on “Investigation, Design, Construction, and System Proving of District Metered Areas with Pressure Management Scheme for the Water Distribution Network of DCWD.” These additional DMAs will increase the service connection coverage of DMAs to 80%. Flow monitoring for the remaining service connections that will not be covered with DMAs will be done by installing large flowmeters at strategic locations in the distribution networks which will form part of the network metering zones.

14.42 All proposed DMAs in the pipeline network are shown in Figure 14.3.2. Proposed DMAs under Dumoy WSS, which covers 60% of DCWD connections, is shown in Figure 14.3.3, and sample outline design for DMAs in Dumoy WSS is shown in the Figure 14.3.4.



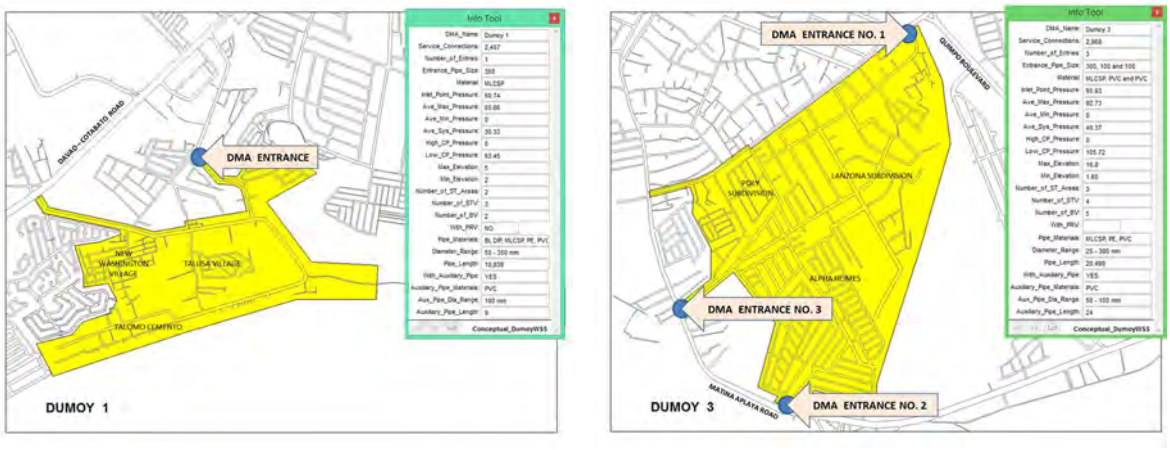
Source: DCWD

Figure 14.3.2 Proposed DMAs Map in DCWD



Source: DCWD

Figure 14.3.3 Proposed DMAs Under Dumoy WSS



Source: DCWD

Figure 14.3.4 Sample Outline Design of the Proposed DMAs in the Dumoy WSS

(e) Project Implementation Schedule by DCWD

14.43 DCWD's DMA expansion project was due for procurement in 2017 and the project awarding was due for completion by the first quarter of 2018. The duration of the project is set at 900 calendar days including detailed design (240 calendar days) and system proving. The fund for this project is from DCWD's internal funds and has already been appropriated.

(f) Proposed Technical Assistance Project Funded by JICA

14.44 DCWD's DMA expansion project has an NRW reduction component. Technical assistance for NRW reduction was proposed as a JICA project. During implementation of the NRW reduction project that would be conducted by DCWD, the dispatched Japanese experts will assist and support the engineers in charge and part of the DCWD's technical team (i.e., NRW Management Division, Pipelines and Appurtenances Maintenance Department, and Engineering and Construction Department). Only very few engineers/ technical personnel from DCWD have technical know-how or are familiar with leakage detection, and there is no Comprehensive Active Leak Detection and Management Program in place yet. Therefore, the Japanese experts on leakage detection can assist and support them.

(g) Implementation Schedule

14.45 Two years for project implementation was proposed. During implementation, the Japanese specialist will assist and train DCWD engineers and, lastly, transfer the Japanese technology for leakage detection.

(h) Project Cost

14.46 Table 14.3.5 indicates the estimated project cost of PHP62.1 million. This includes the provision of equipment such as acoustic rod, electronic leakage detector, amplifier with wireless radio device, correlation device, etc. (Figure 14.3.5).

Table 14.3.5 Project Cost for JICA TA on NRW Reduction

No.	Item	Qty.	Unit	Unit Cost in JPY (x1,000)	JPY (x 1000)	Equivalent in PHP (x1000)	Remarks
1	Japanese experts	25	month	3,500	87,500	39,500	
2	Equipment for leakage detection	1	LS		50,000	22,600	
3	Total				137,500	62,100	

Source: IM4Davao Team

Acoustic Rod

Electronic leakage detector

Amplifier with wireless radio device and Correlation device

Source: IM4Davao Team

Figure 14.3.5 Equipment for Leakage Detection

3) Assistance for Water Supply System in the Rural Areas

(a) Necessary Assistance for Rural Water Supply System

14.47 The drinking water sources in the rural areas are springs, deep wells, and rain water. The people who live in the rural areas always suffer from shortage of water during the dry season, unpredictable water supply in case the water source is springs, water is non-potable, and insufficient funds to develop new water sources by deep well.

14.48 Generally, CPDO will assist the barangays and BAWASAs if they propose drilling the wells and procurement of the distribution pipeline. After receiving the proposal, CPDO will prepare to request funds through the City Mayor's Office. This, however, takes time.

14.49 Previously, JICA supported the barangays to establish a water supply system in the rural areas including drilling wells, construction of elevated water tanks, and procurement of the pipeline.

14.50 The proposed project consists of technical assistance from the Japanese expert, drilling the wells, construction of reservoirs (elevated water tanks), and procurement of pipeline. After pipeline design, the members of the barangays and BAWASAs will install the pipes, which are installed above the ground.

(b) Project Implementation

14.51 Project implementation is dependent on the request.

(c) Project Cost

14.52 The estimated project cost for rural water supply systems in at least 10 barangays is PHP166.9 million (Table 14.3.6).

Table 14.3.6 Project Cost of TA on Rural Water Supply System

No.	Item	Qty	Unit	Unit Cost in JPY (x1,000)	JPY (x 1000)	Equivalent in PHP (x1000)
1	Japanese expert	20	month	3,500	70,000	31,600
2	Drilling well (Deep well) including installation of pump	10	set	20,000	200,000	90,200
3	Reservoir (Elevated Tank)	10	Set	5,000	50,000	22,600
4	Reservoir (ground)	10	set	1,000	0,000	4,500
5	Pipe material (100mm)	20	km	2,000	40,000	18,000
Total					370,000	167,000

Source: IM4Davao Team

14.4 Management Improvement

1) Organizational Structure of DCWD and Financial Status

14.53 The organizational structure of DCWD is shown in Figure 14.4.1. According to DCWD data, the current number of staff is around 1,100 as of 2016 and has been so since 2012. Meanwhile, the number of population served increased by 13.4% since 2012 from 924,775 to 1,048,990. Production water also increased by 16.7% from 249,800 m^3/day to 291,500 m^3/day and the number of connections increased by 13.6% from 184,688 to 209,797.

14.54 DCWD's cumulative total net income in 2016 was PHP930 million. In the last five years, annual net income always shows a surplus, indicating the organization's very good financial status.

2) Water Supply Management

(a) Water Source

14.55 DCWD's main water source is deep well. Currently, there are 62 existing deep wells which produce 290,000 m^3/day of drinking water and supply to customers by gravity.

14.56 Most production deep wells are located at high-elevated areas, which pump up and transmit water to reservoirs also located at high-elevated places. There is no intermittent pumping station except that located near Panorama reservoir.

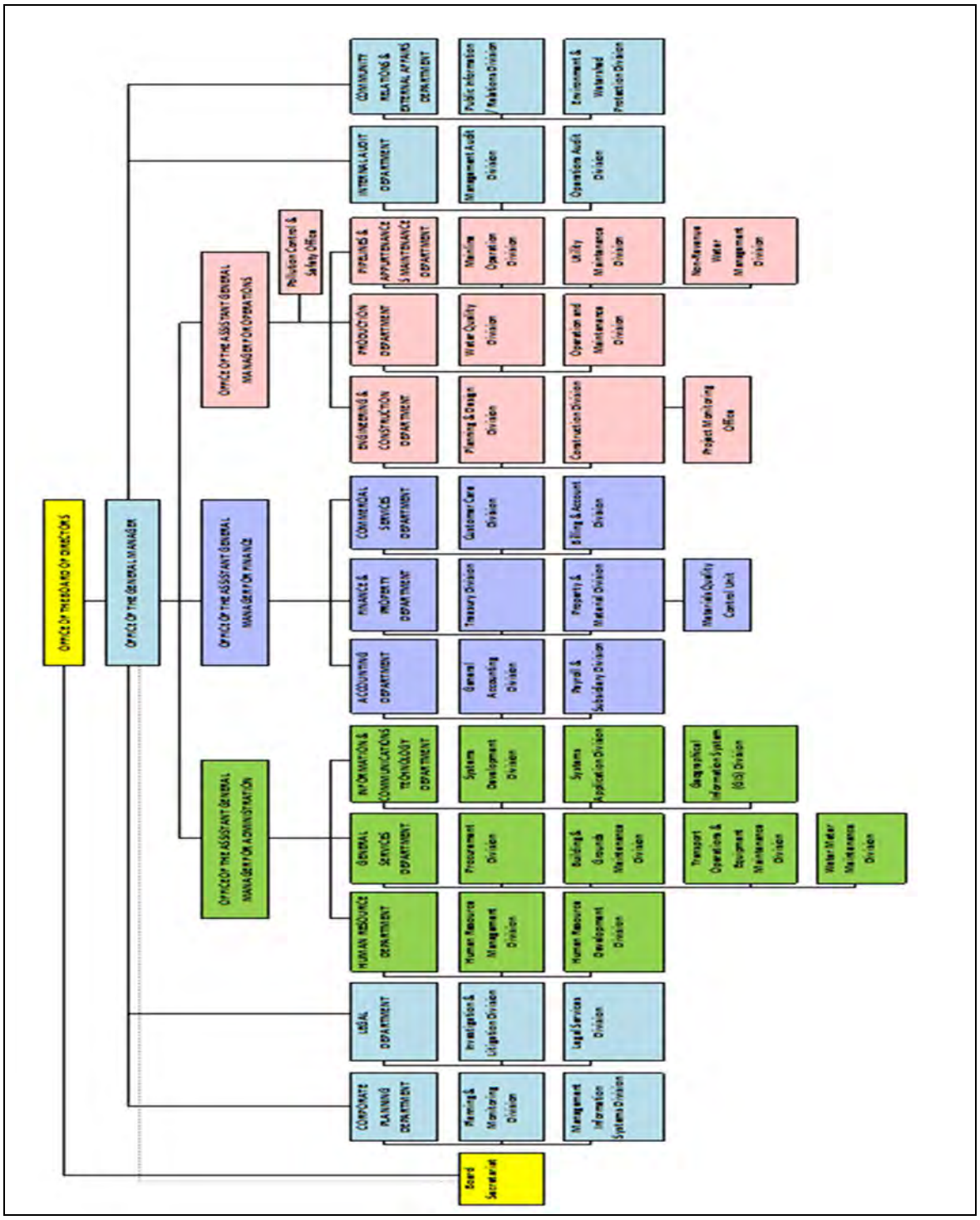
(b) SCADA System

14.57 DCWD received a budget for the proposed supply, delivery, installation, testing, and commissioning of a SCADA Open System interconnecting Talomo Sum 1 and Dumoy Production Well Nos. 1–18. However, the bidding process was cancelled in 2016 since it was resolved that the project should cover the entire production wells at Dumoy WSS (PW Nos. 1–36 and 38).

14.58 At present, DCWD has lined up a project for the "General Improvement of Toril Water Supply System" including the installation of SCADA system for the said WSS. To be financed through DCWD internal funds, the project includes the design, supply, installation, and commissioning of brand new controller, wireless radio for network communications, SCADA workstations, and SCADA software.

(c) NRW Reduction by DMA

14.59 DCWD is now working on the ongoing DMA expansion project targeted to commence in 2018 and to be completed by 2020.



Source: DCWD

Figure 14.4.1 Organizational Chart of DCWD

3) Management Improvement

(a) DCWD

14.60 As mentioned in the previous section, the financial status of DCWD has been in good condition while the population served ratio, amount of water production, and number of house connections are going to increase. NRW reduction by DMA has already started to improve the NRW. However, the data control and system management has not been established.

14.61 The plan to introduce the SCADA system has already started. The establishment of Toril SCADA system, which covers only 4% of all WSS in Davao, will start in September 2018 and will be completed by June 2019. The bulk water supply system project will be completed in 2021.

14.62 It is advisable that the establishment of the entire SCADA system should be completed before 2021 so that the flow rate and pressure from the bulk water supply system can be controlled easily at 8 off-take points.

14.63 Regarding the water supply system in the rural areas, the population served ratio is very low and the water source is poor. Therefore, per capita consumption is also very low compared to urban areas served by DCWD and the funds are always short. In the future, improvement of the water supply system is the most important matter for DCWD and the City Government.

(b) Rural Waterworks

14.64 The ownership, management, and operation of rural waterworks are through an association or barangay. Associations must have regular training on organizational strengthening, record keeping, lobbying, and effective IEC campaigning, among others. This could be initiated by the assigned department/division from the LGU or by an accredited service provider. It is also important to develop training modules on these areas. By doing so, representatives can do trainers' training or mentoring by concerned or all officers of the association by the time they go back to their respective offices. The intervention should also include regular monitoring on the performance of the associations by requiring them to submit quarterly or yearly accomplishment reports if not status reports. By doing so, the LGU can monitor areas of improvement of the associations that are timely and relevant. Also, part of the intervention is benchmarking of good practices of model associations.

14.65 For barangays, it is still recommended that the responsibility for rural waterworks should be endorsed to associations and/or cooperatives.

14.5 Summary of Projects

1) Summary of Projects

14.66 The proposed projects on water supply development are summarized in Table 14.5.1 below.

Table 14.5.1 Summary of Water Supply Development Projects

Exchange rate PHP1.00 = JPY2.217

Project	Executing Body	Required Budget	
		PHP (mil.)	JPY (mil.)
Establishment of SCADA System	DCWD	414.0	918.0
Technical Assistance Project for NRW Reduction	DCWD	62.0	137.0
Project for Assistance for Rural Water Supply System	CPDO/ DPWH	167.0	370.0

Source: IM4Davao Team

2) Implementation Schedule

14.67 In the short term, DCWD will accomplish pressing tasks such as shifting the main water resource from deep wells to Tamugan Weir and its related management improvement (Table 14.5.2). The establishment of the entire DMA and SCADA system covering the whole area should also be undertaken. The NRW reduction project will be implemented continuously until the NRW ratio is reduced to 20%.

14.68 In the medium term, rural water supply will be improved while further resource development and coverage expansion will be undertaken in the long term.

Table 14.5.2 Roadmap for Water Supply Development

Planning Term	Projects, Programs and Activities
Short-term (until 2022)	• Commencement of surface water supply from Tamugan Weir to almost all DCWD service areas • Establishment of SCADA system for all WSS in DCWD • Technical assistance for DMA establishment and NRW reduction management including leakage detection • Capacity building and training for NRW reduction management
Mid-term (2023-2030)	• Technical assistance for the Rural Water Supply system for BAWASAs and Associations in Barangays such as drilling well, construction of the elevated water tank for distribution, and provision of the pipeline materials • Capacity building and training for rural water supply system management
Long-term (2031-2045)	• Development of new water source, surface water and deep well in order to keep the sustainable water supply system. • Expansion of the water supply system to the unserved area in order to increase the population served ratio up to 75%

Source: IM4Davao Team

15 WASTEWATER MANAGEMENT SYSTEM DEVELOPMENT PLAN

15.1 Institutional and Financial Framework

15.1 As mentioned in ***Chapter 14***, PD 198 created the water districts and gave them the responsibility to provide water supply and wastewater treatment services—specifically mentioning sewerage systems. This mandate is also recognized in the Philippine Clean Water Act of 2004 (Republic Act No. 9275) in the following provision of the law: *"Section 8.6 Role of Water Supply Utilities. In the case of HUCs, non-HUCs and LGUs where water districts, water utilities and LGU water works have already been constituted and operational, the water supply utility provider shall be responsible for the sewerage facilities and the main lines pursuant to PD 198 and other relevant laws. In areas where there are no existing facilities, the LGUs, water districts or water utilities may adopt septage management program to other sanitation alternatives."*

15.2 The same law stipulated one area of support from LGUs, particularly: *"Section 7.4. Provision of Lands and ROWs by LGUs. Each LGU, through the enactment of an ordinance shall appropriate the necessary land including the required rights of way or road access to the land for the construction of the sewage and/or treatment facilities in accordance with the Local Government Code."*

15.3 It will also be recalled in the discussion in ***Chapter 14*** that the economic regulator of the water districts is LWUA, which shall review and approve tariffs for both water supply and wastewater management. A side note, but an important consideration later on, is that presently LWUA has a requirement that the combined lifeline tariff for these services should not exceed 5% of the monthly income of the lowest income group.

15.4 The institutional arrangement for wastewater treatment is summarized in Table 15.1.1 below.

Table 15.1.1 Institutional Arrangements for Wastewater Treatment

Water District	LGU	LWUA
• Service provider • Project executing agency - FS preparation - Procurement - Implementation • Financing	• Provision of right of way and land for the treatment plant • Other possible areas of support: - Help poor households install sanitary toilet facilities - Include the correct design of a septic tank in the building code - Require retro-fitting of septic tanks that do not follow the correct design - Conduct information, education and communication campaign regarding the importance of wastewater treatment	• As economic regulator - Set performance standards - Set tariff guidelines - Approve tariffs

Source: IM4Davao Team

15.5 Although most water districts have been in existence since the mid-seventies, including those in Davao City, not a single one has built any sewerage system. Only a few since 2012 or so have put up septage management systems. The common reasons cited by water districts are that they have yet to fully fulfill their water supply mandate and that sewerage systems are just too costly. A contributory factor is LWUA's inaction to enforce the delivery of this service by water districts. In short, there is no compelling factor or punishment for water districts to provide the service.

15.6 In around 2013, the national government decided to provide financial incentives to LGUs/WDs in highly-urbanized cities (Davao City is one of these HUCs) to put up sewerage systems. The government programmed in DPWH's budget PHP2 billion to fund up to 40% of the capital investments under the National Sewerage and Septage Management Program (NSSMP). For several years, DPWH maintained the PHP2 billion allocation in its budget, then cut it to PHP1 billion when there were no takers. To date, there are still no takers. Note that the NSSMP is a special grant program of the government that has to be appropriated annually through the General Appropriations Act or the national budget approved by Congress every year. Thus, it is not an assured long-term source of funding.

15.7 This leads to a discussion of financing options for the District as the executing agency. In theory, it should finance WWT projects the way it does water supply projects, that is, from revenues. It can do so with reasonable ease for the septage management program, as the capital and operating costs are not exorbitant (in the magnitude of PHP400 million for the capital cost), the tariffs are affordable (only 8 to 10% increase over the current water bills, and within the 5% requirement of lifeline tariff), and technically easy enough to set up the program including the septage treatment plant. However, as will be apparent in the discussion in this Chapter, septage management is an interim solution. The gold standard for WWT is still sewerage systems, but as these costs so much more, the financing will also be different.

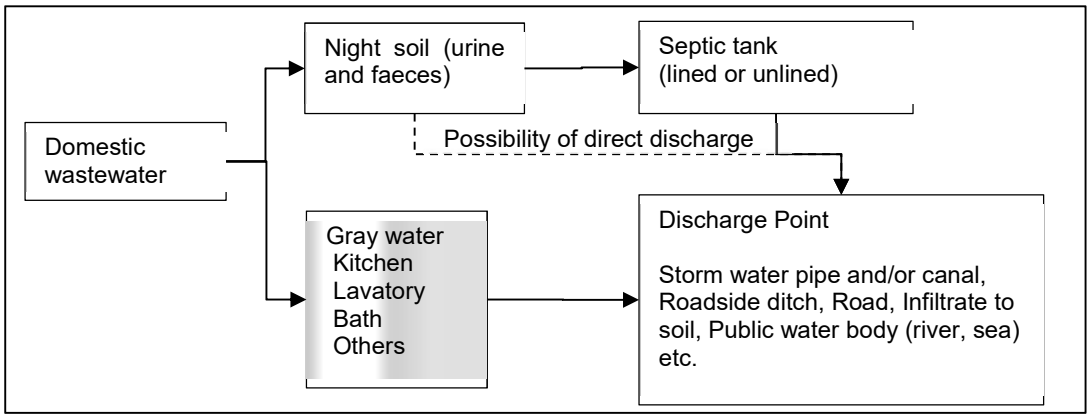
15.8 In terms of modalities, the District can do pure public financing, PPP arrangements or hybrid PPPs, where some components are publicly funded, and others plus usually operation and maintenance are funded by the private sector. The most important issue in any of this is the source of the viability gap fund, given that the costs are unlikely to be recoverable from tariffs alone. National government grant through the NSSMP may be a source but the question is up to how much will it provide? The total program was between PHP2 to 1 billion pesos only, barely 15 to 7% of the estimated cost for Phase 1 alone. The City can also contribute the ROW and the land for the treatment plant plus more if it so desires. The City can fund its contribution from IRA or local revenues such as increasing real property taxes. Still the remaining cost burden to the water district will likely be substantial.

15.9 As of this writing, the national government through NEDA is preparing a water supply and sanitation sector master plan. It will have a financing policy component and will hopefully recommend the financing policy for sewerage systems. The master plan is expected to be completed in May 2018.

15.2 Wastewater Management System for the Year 2045

1) Present Situation

15.10 Currently, there is no installed sewage system for domestic wastewater in Davao City. Hence, in many cases, night soil from the toilet is put into a septic tank. Treated water from the septic tank is discharged into the roadside ditch and/or rainwater drainage with gray water (Figure 15.2.1).



Source: IM4Davao Team based on internet information and site reconnaissance.

Figure 15.2.1 Current Domestic Wastewater Stream

15.11 The population coverage ratio of septic tanks in the city is from 90 to 97% (weighted average of 93%) as shown in Table 15.2.1.

Table 15.2.1 Septic Tank Population Coverage Ratio

District	Septic Tank Coverage Ratio
Poblacion	96.4%
Talomo	97.0%
Agdao	90.7%
Buhangin	86.9%
Bunawan	92.6%
Paquibato	96.5%
Baguio	94.0%
Calinan	91.3%
Marilog	90.3%
Toril	91.9%
Tugbok	96.4%

Source: IM4Davao Team based on results of the home interview survey.

15.12 However, many households do not desludge their septic tanks at an appropriate frequency (Table 15.2.2).

Table 15.2.2 Desludge Frequency of Septic Tank

Desludge Frequency	No. of Households	Rate
Annually	36	2%
Once per 2 years	91	5%
Once per 3–5 years	109	6%
Once per more than 5 years	86	5%
Never	1,105	63%
Not sure	341	19%
Total	1,768	100%

Source: IM4Davao Team based on results of the home interview survey.

15.13 The percentage of "never" and "not sure" in the HIS is 82%. Many households do not desludge their septic tanks, which means that night soil from households are not sufficiently treated by the septic tanks. Effluents from the septic tanks would be discharged into a public water body. As a result, there is a great possibility that the number of fecal coliform in public water bodies is high. The same is true with gray water that is directly discharged into public water bodies or infiltrate the ground without any treatment (Table 15.2.3).

Table 15.2.3 Discharge Point of Gray Water

Discharge Point	No. of Households	Rate
Discharge to sewer pipe	316	15.9%
Discharge to roadside ditch	780	39.2%
Discharge to road	12	0.6%
Infiltrate to ground	768	38.6%
Discharge to public water body (river, sea, etc.)	62	3.1%
I don't know	51	2.6%
Other	0	0.0%
Total	1,989	100.0%

Source: IM4Davao Team based on results of the home interview survey.

15.14 Table 15.2.4 shows the water quality and water quality criteria in the lower stream of Davao River.

Table 15.2.4 Water Quality of Downstream of Davao River

Parameter	Minimum	Maximum	Average	Water Quality Criteria for Class B Water
Temperature (°C)	27.0	32.0	28.8	26 – 30
pH	7.6	8.9	8.3	6.5 – 8.5
Dissolved oxygen (mg/l)	3.4	9.4	6.9	5.0 (Minimum)
BOD (mg/l)	0.2	5.5	1.3	5
Total Suspended Solid (mg/l)	3	940	141	65
Fecal Coliform (MPN/100ml)	2 000	5 400 000	107 562	100
Nitrates-N (mg/l)	0.89	29.23	11.83	7
Phosphates-P (mg/l)	0.11	2.03	0.8	0.5
Lead (mg/l)	<0.01	0.15	0.02	0.01
Cadmium (mg/l)	<0.003	0.006	0.003	0.003
Copper as Dissolved Copper (mg/l)	<0.001	0.04	0.01	0.02
Zinc (mg/l)	<0.001	0.06	0.03	2

Source: Water Quality Assessment Report (CY2016), DENR Region XI.

15.15 These indicators show that there is a high level of fecal coliform in Davao River, which is caused by human and animal feces. If the situation of septic tanks and gray water do not change in the future, the quality of public water will further deteriorate with the increase in population.

2) Pollution Load

15.16 BOD, COD, nitrogen, and phosphorus are indicators of water pollution in domestic wastewater. BOD, in particular, is widely used as an indicator and is, therefore, used in this project.

(1) Pollutant Reduction of Septic Tank System and Sewerage System

15.17 The BOD pollution rates of night soil and gray water in the Philippines are shown in Table 15.2.5 below.

Table 15.2.5 BOD Pollution Rate in the Philippines

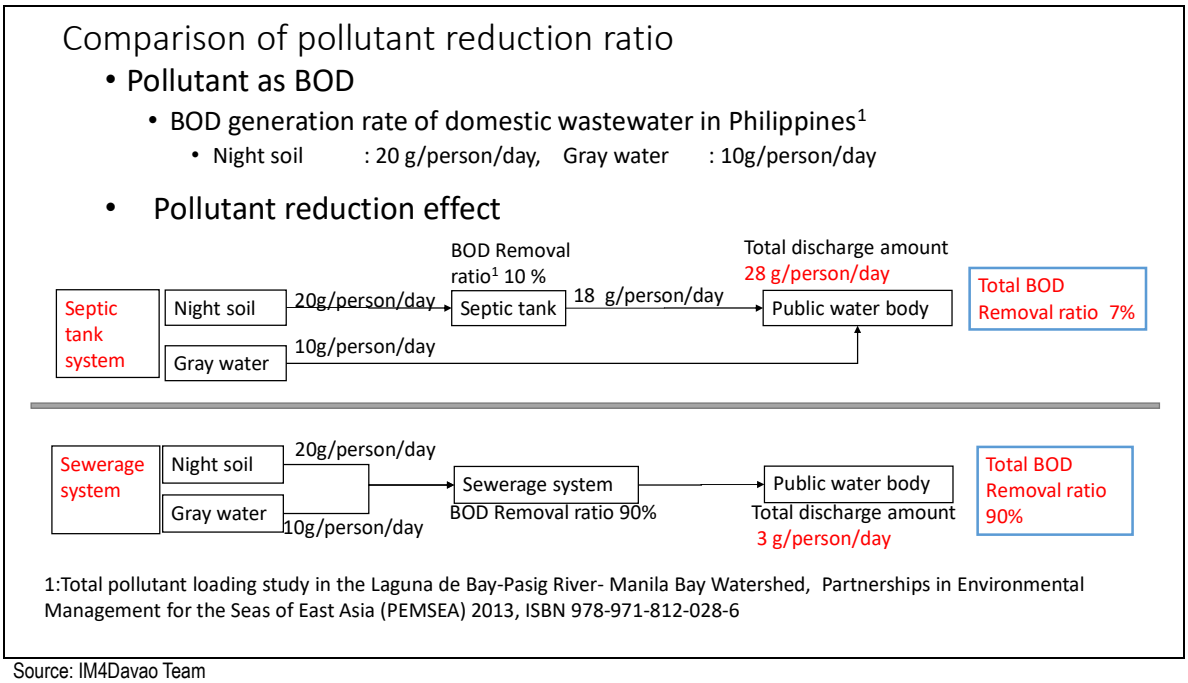
Item	BOD Pollution Rate (g/person/day)
Night soil	20
Gray water	10
Total	30[1]

Source: Total Pollutant Loading Study in the Laguna de Bay–Pasig River–Manila Bay Watershed, Partnerships in Environmental Management for the Seas of East Asia (PEMSEA) 2013, ISBN 978-971-812-028-6.

15.18 Generally, the BOD removal ratio of a septic tank is 30 to 50%.[2] However, given the current situation in the Philippines, the BOD removal ratio of septic tanks is about 10%.[3]

15.19 The current BOD removal ratio is 7% of the septic tank system because it only receives night soil (wastewater from a toilet), while the BOD removal ratio is 10% with gray water (wastewater from household other than night soil) that is discharged to public water without treatment. The BOD removal ratio of the sewerage system is about 90% with both night soil and gray water. The pollution load reduction effect of the sewerage system is much higher than the septic tank system.

15.20 Applying these BOD reduction ratios, the IM4Davao Team estimated the pollution load of the septic tank and the sewage systems (Figure 15.2.2).



Source: IM4Davao Team

Figure 15.2.2 Comparison of Pollutant Reduction Ratio

[1] Sewage (mixed wastewater of human excreta and domestic wastewater) BOD concentration is about 200 mg/liter in generally. Unit water supply amount in Davao City is 190 liters/ person/day. Unit sewage amount is about 80% of the unit water supply amount. Therefore, unit sewage amount in the city becomes 190 liters/ person/ day × 80% = 152 liters/ person/ day. Assuming a unit BOD generation amount of 30g/person/day, the BOD concentration of domestic wastewater becomes 200 mg/liter. It is a reasonable number, therefore, the IM4Davao Team considers 30g/person/day is fair.

[2] Septic Tank Effluent Values, John Eliasson, Washington State Department of Health Wastewater Management Program, USA. (Typical septic tank BOD5 removal efficiencies are 30 to 50%.)

[3] Total Pollutant Loading Study in the Laguna de Bay–Pasig River–Manila Bay Watershed, Partnerships in Environmental Management for the Seas of East Asia (PEMSEA) 2013, ISBN 978-971-812-028-6.

(2) Estimation of BOD Pollution Load

15.21 The BOD pollution load of the septic tank system was estimated taking account future population, BOD loading rate, septic tank population coverage ratio (93%), and septic tank BOD removal ratio (10 to 50%). The results of the estimation are presented in Table 15.2.6 and Figure 15.2.3.

Table 15.2.6 BOD Generation and Discharge Amount

Item		Year			
		2015	2022	2030	2045
BOD Generation amount (kg/day)		48,990	58,311	68,964	98,562
BOD discharge amount (kg/day)	Septic tank BOD removal ratio 10%	45,952	54,696	64,688	92,451
	Septic tank BOD removal ratio 20%	42,915	51,081	60,412	86,340
	Septic tank BOD removal ratio 30%	39,878	47,465	56,137	80,229
	Septic tank BOD removal ratio 40%	36,840	43,850	51,861	74,119
	Septic tank BOD removal ratio 50%	33,803	40,235	47,585	68,008

Source: IM4Davao Team

Source: IM4Davao Team

Figure 15.2.3 BOD Generation and Discharge Amount

15.22 Measures to remove this pollution load are important to improve the urban sanitation environment and conserve water quality of public water.

15.23 The IM4Davao Team estimated the pollutant reduction effect of domestic wastewater by the septic tank system and sewer system. However, the actual situation of pollutants discharged to public water bodies is not only for domestic wastewater but also for industrial wastewater, livestock wastewater, etc.

15.24 Therefore, preventing pollution of public water bodies cannot be solved by introducing a sewer system only. It is also necessary to institute emission regulation of various pollution sources such as industrial wastewater and livestock wastewater, etc.

15.25 In this regard, DENR sets discharge limits for different types of pollution sources and water body classification. It manages the water quality of public water bodies by regulating compliance to the discharge limits by the discharger. Also in this project, the treated water quality of the sewerage treatment plant adopts the DENR discharge limits values.

(3) Measures to Reduce Discharge Pollution Load

15.26 As shown in Table 15.2.7, the BOD pollution load compared with 2015 will be 1.2 times more in 2022, 1.4 times more in 2030, and twice more in 2045.

Table 15.2.7 BOD Generation Ratio, 2015-2045

	Year			
	2015	2022	2030	2045
BOD Generation ratio	1.0	1.2	1.4	2.0

Source: IM4Davao Team

15.27 Even by raising the BOD removal ratio to 50% through proper septic tank management, the BOD discharge amount from the septic tank system by 2045 will be 1.4 times higher than in 2015. However, the development of the sewer system requires a considerable investment and a long time. The introduction of proper septage management is less effective in preventing water pollution than the sewage system. But it can be realized with less investment and within a shorter time compared with the sewerage system. For this reason, Davao City can first implement the improvement of septage management, which DCWD is currently pursuing. In parallel, the introduction of a sewage system from a long-term perspective is appropriate.

15.28 From the viewpoint of improvement of the urban sanitation environment and preservation of water quality of public bodies of water, it is necessary to reduce the BOD discharge amount through introduction of the sewage system in densely populated areas.

3) Identification of Target area

15.29 The future population and population density by district in Davao City are shown in Table 15.2.8.

Table 15.2.8 Future Population and Population Density by District

Name of District	Population			Density (Persons/ha)			Area (ha)
	2015	2030	2045	2015	2030	2045	
Bunawan	152,102	218,700	317,400	22.7	32.7	47.4	6,694
Buhangin	293,118	450,100	682,700	30.3	46.6	70.6	9,669
Agdao	102,267	111,300	124,800	172.5	187.7	210.5	593
Poblacion	174,121	188,100	208,700	153.0	165.3	183.4	1,138
Talomo	418,615	581,800	823,600	44.7	64.9	91.8	8,970
Toril	148,522	284,100	485,000	7.8	15.0	25.6	18,963
Tugbok	121,334	226,200	381,600	8.0	14.9	25.1	15,230
Calinan	92,075	107,600	130,700	3.6	4.2	5.0	25,916
Marilog	52,201	52,200	52,200	-	-	-	-
Paquibato	44,763	44,800	44,800	-	-	-	-
Baguio	33,873	33,900	33,900	-	-	-	-
Davao City	1,632,991	2,298,800	3,285,400	-	-	-	244,000

Source: IM4Davao Team

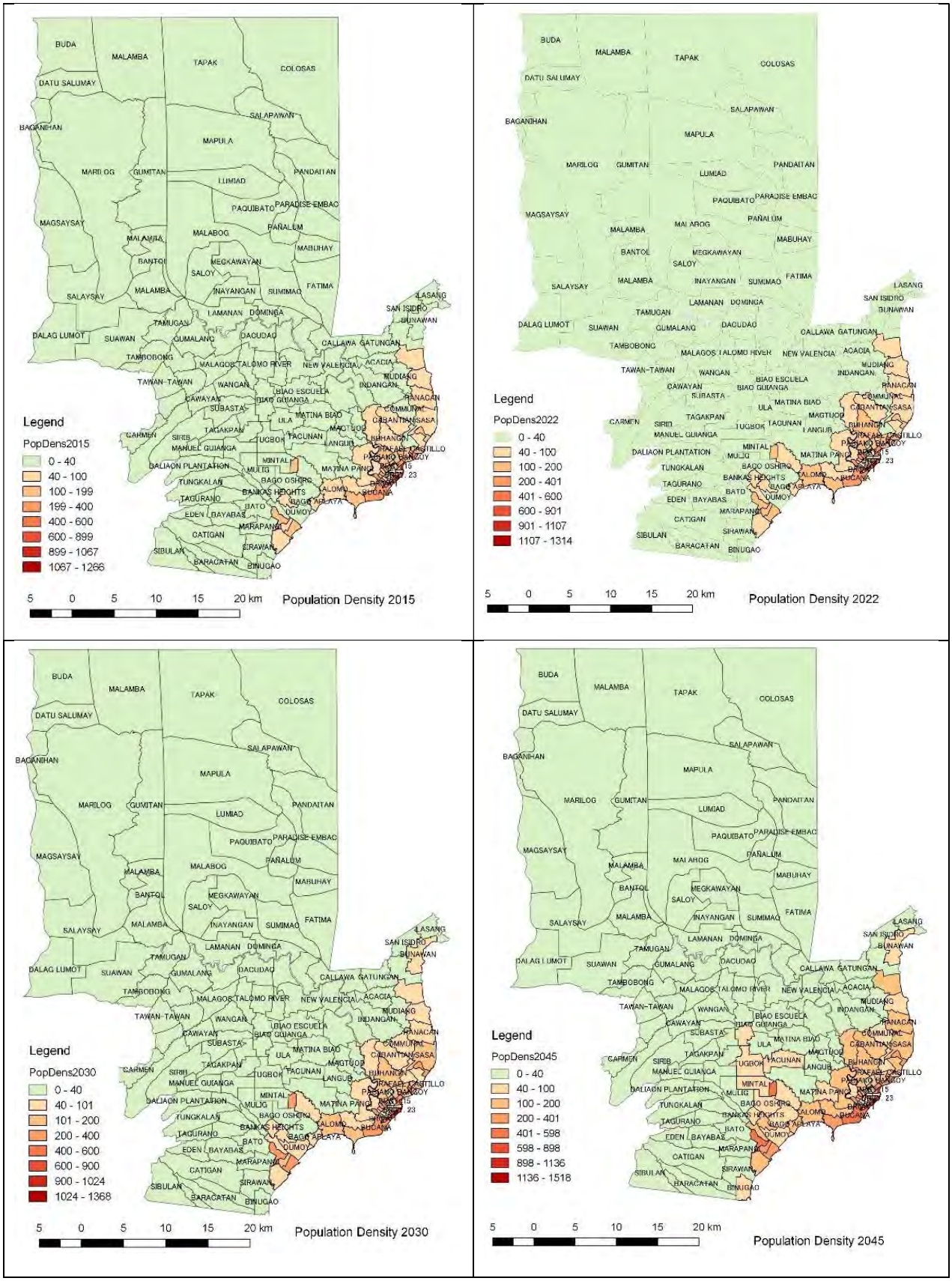
15.30 The selection criterion for introducing the sewerage system is population density. The appropriate area to introduce a sewerage system has to have a population density of

40 persons/ha[4] or more, while proper management of the septic tank system should be introduced in areas with less than 40 persons/ha.

15.31 Measures identified in DCWD's study[5] contributing to the proper management of the septic tank system have been implemented in 2013 and it is appropriate to implement projects that follow the study.

15.32 The population density by barangay in 2015, 2022, 2030, and 2045 are shown in Figure 15.2.4. Barangays with more than 40 persons/ha are concentrated in the coastal areas.

[4] Population density which is considered appropriate to introduce the sewerage system is based on Japan's experience when its sewerage system was introduced.
[5] Septage Management Project Feasibility Study, Davao City Water District, June 2013.



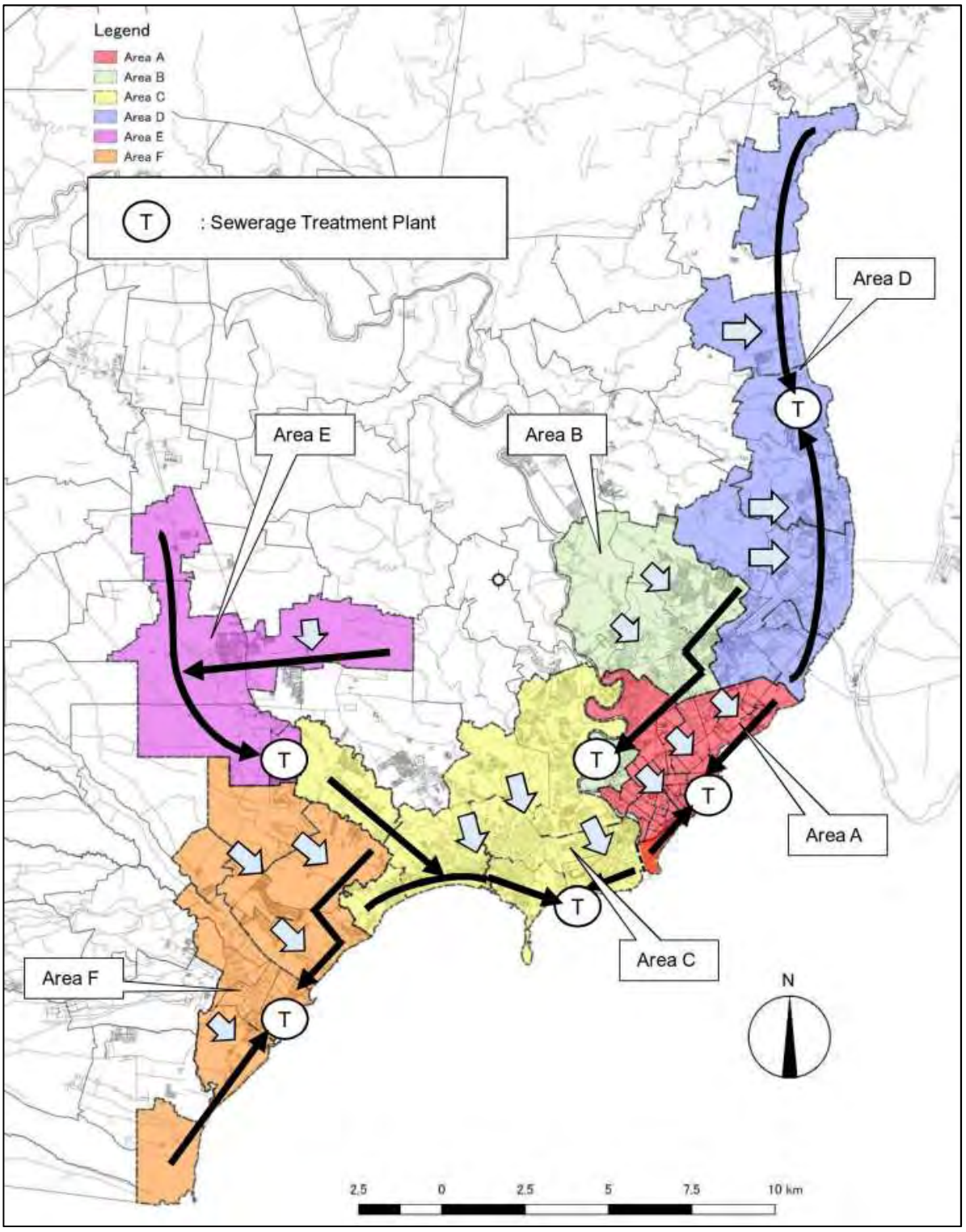
Source: IM4Davao Team

Figure 15.2.4 Population Density by Barangay

15.3 Sewerage System

1) Sewerage Treatment Area

15.33 The sewerage treatment area is identified based on the distribution of population density (shown in Figure 15.2.4) and ground surface gradient. As a result, it is appropriate to establish six treatment areas in Davao City, as shown in Figure 15.3.1.



Source: IM4Davao Team

Figure 15.3.1 Sewerage Treatment Areas

15.34 If following the surface gradient, all sewage of Areas A and B will flow to the sewerage treatment plant in Area A on the coastline. Since it is difficult to secure a large land area for the sewerage treatment plant in Area A, the main sewer line should be installed on the mountain side of Area A and conduct sewage from Area B to Davao riverside and set up a sewerage treatment plant in Area B.

2) Sewer Line System

15.35 Davao City already has many pipelines for rainwater drainage. Also, effluents from septic tanks and gray water are found to be discharged to the rainwater drainage via roadside ditch, etc. With this information and considering the urgent need to introduce the sewerage system, the recommendable sewer line system is a combined sewer system that can effectively utilize the existing rainwater drainage.

3) Scale of Facilities

(1) Sewerage Discharge Rate

15.36 To estimate the sewerage discharge rate, the project assumes that 80% of the water supply amount is set as the daily average sewage volume, the daily maximum sewage volume is 150% of the daily average sewage amount, the groundwater intrusion amount is 10% of the daily maximum amount, and the sewage from business entities is 10% of the daily maximum amount (Table 15.3.1). This results in a daily maximum sewerage amount of 270 liters/ person/ day.

Table 15.3.1 Sewerage Discharge Rate

Item		Amount (liter/person/day)
1. Daily average amount		
Water supply amount		190
Daily average amount sewerage amount	80%of water supply amount	≒150
2. Daily maximum amount	150% of daily average	225
3. Ground water infiltration amount	10 of daily maximum	22.5
4. Wastewater from business entities	10 of daily maximum	22.5
Daily maximum sewerage amount		270

Source: IM4Davao Team

(2) Sewerage Treatment Plant

15.37 Tables 15.3.2 to 15.3.7 show the results of calculating the facility size for each sewage treatment area by using the wastewater generation rate and the future population.

Table 15.3.2 Future Population and Required Sewerage Treatment Amount (Area A)

Area A	Zone Area (CLUP, ha)	Population			
		2015	2022	2030	2045
Agdao	593.0	102,267	106,482	111,300	124,800
Poblacion	1,138.2	174,121	180,645	188,100	208,700
Poblacion 8	-159.1	-11,075	-11,490	-11,964	-13,274
Sub-total Poblacion	979.1	163,046	169,155	176,136	195,425
Part of BUCANA (30%)	120.6	25,189	29,772	35,009	49,558
Total	1,692.6	290,502	305,409	322,445	369,783
Population density	-	171.6	180.4	190.5	218.5
Daily max. m^3/person/day	-	0.27	0.27	0.27	0.27
Daily max. m^3/day		78,436	82,461	87,060	99,841

Source: IM4Davao Team

Table 15.3.3 Future Population and Required Sewerage Treatment Amount (Area B)

Area B	Zone Area (CLUP, ha)	Population			
		2015	2022	2030	2045
Cabantian	758.7	43,758	54,694	67,193	101,917
Poblacion 8	159.1	11,075	11,490	11,964	13,274
Tigatto	770.0	36,387	45,481	55,874	84,749
Buhangin	682.0	57,606	72,003	88,457	134,169
Total	2,369.8	148,826	183,669	223,489	334,109
Population density		62.8	77.5	94.3	141.0
Daily max. m^3/person/day		0.27	0.27	0.27	0.27
Daily max. m^3/day		40,183	49,591	60,342	90,209

Source: IM4Davao Team

Table 15.3.4 Future Population and Required Sewerage Treatment Amount (Area C)

Area C	Zone Area (CLUP, ha)	Population			
		2015	2022	2030	2045
Matina Pangi	641.4				35,573
Catalunan Pequeno	617.8	22,809	26,958	31,700	44,875
Ma-a	1,014.9	59,803	70,682	83,115	117,659
Talomo	659.7	59,678	70,535	82,942	117,413
Matina Crossing	529.3	32,436	38,337	45,080	63,816
Matina Aplaya	306.6	33,384	39,457	46,398	65,681
Bago Aplaya	221.5	15,918	18,814	22,123	31,318
Bunawan	681.2	20,676	24,900	29,728	43,145
Total	4,672.4	244,704	289,683	341,087	519,480
Population density		52.4	62.0	73.0	111.2
Daily max. m^3/person/day		0.27	0.27	0.27	0.27
Daily max. m^3/day		66,070	78,215	92,093	140,260

Source: IM4Davao Team

Table 15.3.5 Future Population and Required Sewerage Treatment Amount (Area D)

Area D	Zone Area (CLUP, ha)	Population			
		2015	2022	2030	2045
Tibungco	780.5	41,864	50,418	60,194	87,360
Panacan	726.1	35,806	43,122	51,484	74,719
Ilang	597.7	24,947	30,044	35,870	52,058
V. Hizon	212.0	11,265	14,080	17,298	26,237
A. Angliongto	495.3	13,539	16,923	20,790	31,534
Pampanga	94.7	14,381	17,975	22,083	33,495
Communal	570.8	16,740	20,924	25,705	38,989
Cabantian	758.7	43,758	54,694	67,193	101,917
Sasa	695.0	52,386	65,479	80,442	122,012
Buhangin	93.0	7,855	9,819	12,062	18,296
Bunawan	774.1			33,782	49,028
Total	5,798.0	262,541.3	323,478.9	426,903.5	635,645.1
Population density		45.3	55.8	73.6	109.6
Daily max. m^3/person/day		0.27	0.27	0.27	0.27
Daily max. m^3/day		70,886	87,339	115,264	171,624

Source: IM4Davao Team

Table 15.3.6 Future Population and Required Sewerage Treatment Amount (Area E)

Area E	Zone Area (CLUP, ha)	Population			
		2015	2022	2030	2045
Tacunan	823.0				40,172
Sto. Nino	152.8	20,103	28,211	37,477	63,225
Los Amigos	480.6				30,576
Tugbok	994.9				47,537
Mintal	768.2				41,599
Total	3,219.5	20,103	28,211	37,477	223,109
Population density		6.2	8.8	11.6	69.3
Daily max. m^3/person/day		0.27	0.27	0.27	0.27
Daily max. m^3/day		5,428	7,617	10,119	60,239

Source: IM4Davao Team

Table 15.3.7 Future Population and Required Sewerage Treatment Amount (Area E)

Area F	Zone Area (CLUP, ha)	Population			
		2015	2022	2030	2045
Bago Oshiro	720.4				37,527
Bankas Heights	251.3				25,050
Toril	170.4	12,140	17,312	23,222	39,643
Lubogan	357.5	12,156	17,334	23,253	39,696
Lizada	421.7	20,112	28,680	38,471	65,676
Daliao	184.5	21,124	30,123	40,407	68,981
Crossing Bayabas	84.0	11,490	16,385	21,979	37,521
Baliok	238.4	16,140	19,076	22,432	31,754
Bago Gallera	761.0	17,378	20,539	24,152	34,190
Dumoy	593.2				36,638
Binugao	502.9				22,643
Total	4,285.2	110,540	149,449	193,916	439,318
Population density		25.8	34.9	45.3	102.5
Daily max. m^3/person/day		0.27	0.27	0.27	0.27
Daily max. m^3/day		29,846	40,351	52,357	118,616

Source: IM4Davao Team

(3) Main Intercepting Sewer Line

15.38 The capacity of the sewer line is the hourly maximum sewage amount (1.8 times more than the daily maximum sewage amount) as the planned sewage amount and selection of the size of the pipe should be able to flow 1.5 times the required flow rate at 80% water depth with the pipe slope of 0.5 to 0.3%. Table 15.3.8 presents the sewer line capacities for Areas A to F.

Table 15.3.8 Outline of Main Intercepting Serer Line

Area	Diameter of the Main Intercepting Line	Total Length (m)
A	500 to 1650 mm	7,300
B	400 to 1350 mm	6,500
C	400 to 1350 mm	13,700
D	400 to 1200 mm	18,800
E	400 to 1000 mm	16,600
F	400 to 1350 mm	14,000

Source: IM4Davao Team

4) Facility Plan

15.39 The facility plan is formulated based on the following preconditions in order to predict what magnitudes of the sewerage treatment plant, main sewer line, construction cost, maintenance cost, etc. are required:

- selection criteria for introducing sewerage system : 40 persons/ha;
- daily maximum sewerage discharge rate: 270 liters/person/day; and
- topographical conditions: acquired from Google Earth.

15.40 The next step is to formulate a sewerage master plan and select the priority area for introducing sewerage system. This is followed by the conduct of the F/S, basic design and detailed design of the sewer system, and the start of construction works.

(1) Target Treated Water Qualities

15.41 DENR has set up emission standards for treated wastewater effluents by industrial classification and by type of water body. The sewerage treatment facility falls under PSIC Code 37000. The discharge water quality standards corresponding to this code are shown in Table 15.3.9.

Table 15.3.9 Effluent Standards for Sewerage Treatment Plant

Significant Parameter	Unit	Water Body Classification								
		AA	A	B	C	D	SA	SB	SC	SD
Ammonia as NH_3-N	mg/L	NDA	0.5	0.5	0.5	7.5	NDA	0.5	0.5	7.5
BOD	mg/L	NDA	20	30	50	120	NDA	30	100	150
COD	mg/L	NDA	60	60	100	200	NDA	60	200	300
Nitrate as NO_3-N	mg/L	NDA	14	14	14	30	NDA	20	20	30
pH (Range)	mg/L	NDA	6.0 - 9.0	6.0 - 9.0	6.0 - 9.5	6.0 - 9.5	NDA	6.0 - 9.0	6.0 - 9.0	6.0 - 9.5
Phosphate	mg/L	NDA	1	1	1	10	NDA	1	1	10
Surfactants (MBAS)	mg/L	NDA	2	3	15	30	NDA	3	15	30
Total Suspended Solid	mg/L	NDA	70	85	100	150	NDA	70	100	150
Oil and Grease	mg/L	NDA	5	5	5	15	NDA	5	10	15
Fecal Coliform	MPN/100ml	NDA	4	200	400	800	NDA	200	400	800
NDA: No Discharge Allowed										

Source: DENR Administrative Order No.2016-08, Water Quality Guidelines and General Effluent Standards of 2016.

(2) Sewerage Treatment Plant

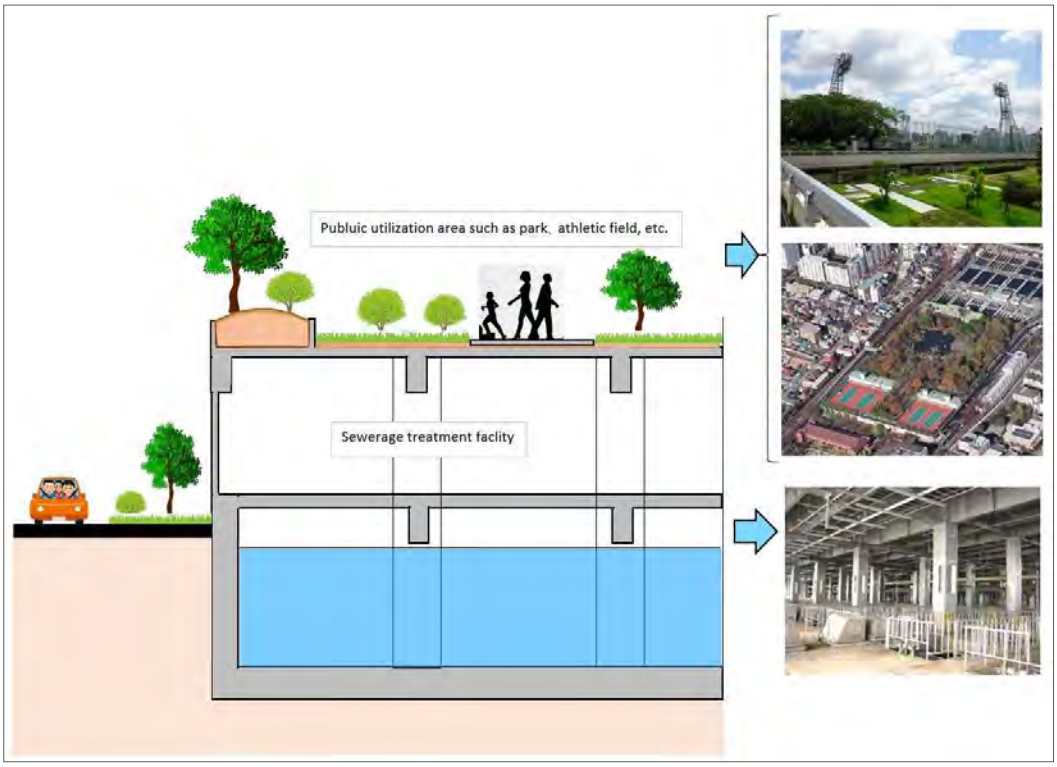
15.42 BOD, COD, Total Suspended Solids, and Fecal Coliforms in the discharge standards of sewage treatment plants can obtain the emission standard value by the standard activated sludge method. However, the values of Ammonia as NH_3-N and Phosphate cannot be obtained by the standard activated sludge method. To get these treated water quality standards, it is necessary to adopt the Anaerobic Oxygen-free Aerobic activated sludge process. The sludge treatment system will use sludge concentration and sludge dehydration (Table 15.3.10).

15.43 In addition, the basic structure of the sewerage treatment plant will be a double covering type wherein its roof can be used as a park (Figures 15.3.2 and 15.3.3).

Table 15.3.10 Outline of Sewerage Treatment Plant

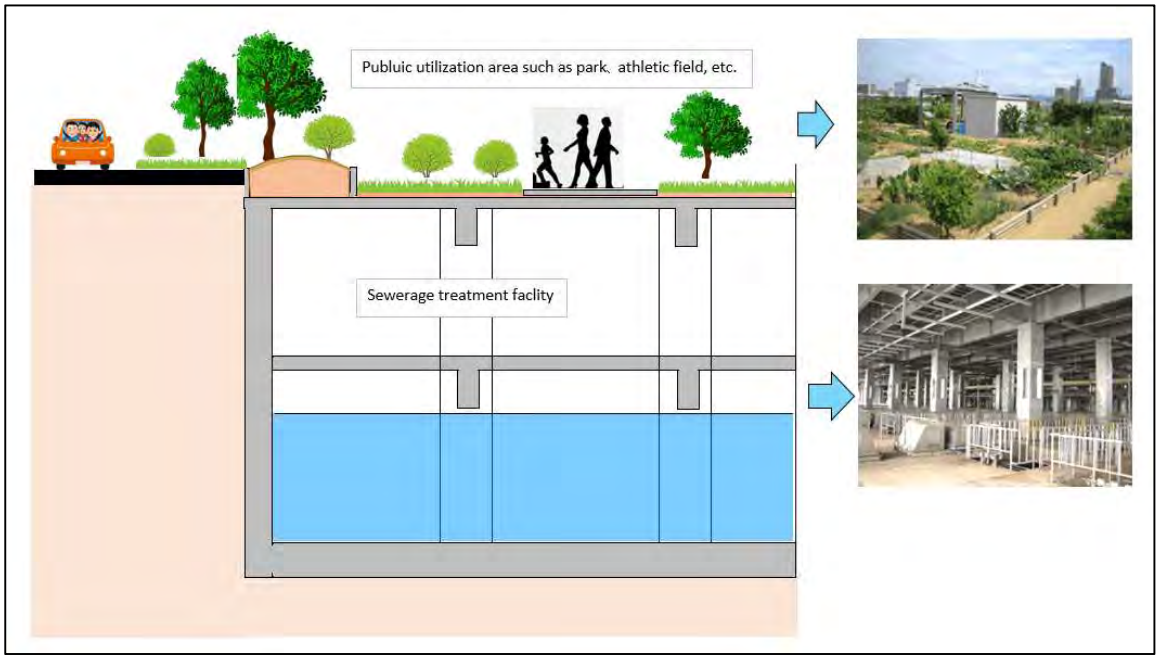
Area	Target Population			Daily Maximum Sewerage Amount (m^3/day)		Treatment Capacity in 2045 (m^3/day)	Sewerage Treatment Method	
	Year 2022	Year 2030	Year 2045	Year 2030	Year 2045		Wastewater Treatment	Sludge Treatment
A	305,409	322,445	369,783	87,060	99,841	100,000	Anaerobic Oxygen-free Aerobic Activated sludge process	Concentration and dehydration
B	183,669	223,489	334,109	60,342	90,209	90,000		
C	323,479	426,904	635,645	115,264	171,624	172,000		
D	289,683	341,087	519,480	92,093	140,260	140,000		
E	28,211	37,477	223,109	10,119	60,239	60,000		
F	149,449	193,916	439,318	52,357	118,616	119,000		
Total	1,279,901	1,545,317	2,521,444	417,235	680,789	681,000	-	-

Source: IM4Davao Team



Source: IM4Davao Team

Figure 15.3.2 Conceptual Image of Sewerage Treatment Plant (half underground type)



Source: IM4Davao Team

Figure 15.3.3 Conceptual Image of Sewerage Treatment Plant (full underground type)

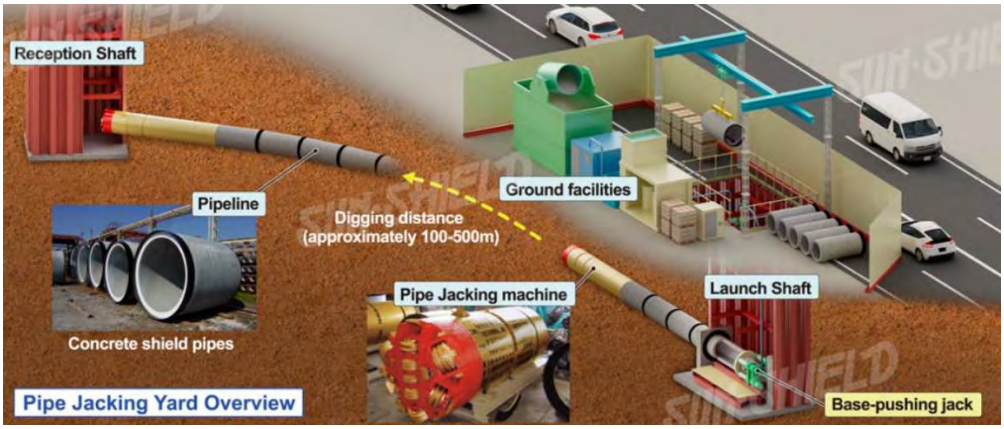
(3) Main Intercepting Sewer line

15.44 For the planned sewage collection area, the roads are completey paved, traffic volume is large, and many buildings are dense in the surrounding area. It is difficult to use the open cut method for installation of the main intercepting sewer pipe line. Therefore, the installation method will be the jacking method (Figure 15.3.4). The length and diameter of the intercepting sewer line are shown in Table 15.3.11.

Table 15.3.11 Outline of Main Intercepting Sewer Line and Construction Method

Area	Diameter of the Main Intercepting Line	Total Length (m)	Construction Method
A	500 to 1650 mm	7,300	Jacking method
B	400 to 1350 mm	6,500	Jacking method
C	400 to 1350 mm	13,700	Jacking method
D	400 to 1200 mm	18,800	Jacking method
E	400 to 1000 mm	16,600	Jacking method
F	400 to 1350 mm	14,000	Jacking method

Source: IM4Davao Team



Source: http://www.sunshield.co.jp/home-en/

Figure 15.3.4 Conceptual Image of Jacking Method

5) Implementation Plan

15.45 The preparation period for implementation of the first priority project is assumed to be from 2018 to 2022. Construction works will start by year 2023 and finish by 2027. The schedule for starting the sewage treatment in six areas by 2045 is shown below.

Table 15.3.12 Implementation Plan for Six Areas by 2045

Year	Area A	Area B	Area C	Area D	Area E	Area F
2018	Preparation (5 years)					
2019						
2020						
2021						
2022						
2023	Construction of intercepting sewer line and sewerage treatment plant	Preparation (3 years)				
2024						
2025						
2026		Construction of intercepting sewer line and sewerage treatment plant	Preparation (3 years)			
2027						
2028	Operation					
2029			Construction of intercepting sewer line and sewerage treatment plant	Preparation (3 years)		
2030						
2031		Operation				
2032				Construction of intercepting sewer line and sewerage treatment plant		Preparation (3 years)
2033						
2034			Operation			
2035						Construction of intercepting sewer line and sewerage treatment plant
2036						
2037				Operation	Preparation (3 years)	
2038						
2039						
2040					Construction of intercepting sewer line and sewerage treatment plant	Operation
2041						
2042						
2043						
2044						
2045					Operation	

Source: IM4Davao Team

6) Project Cost

(1) Main Intercepting Line and Sewerage Treatment Plant

15.46 Construction, operation, and maintenance costs for areas A to F are shown in the following tables. Total construction cost for 6 areas is estimated at PHP99.1 billion and will entail total operating and maintenance costs of PHP1.7 billion a year.

Table 15.3.13 Construction Cost

Area	Item	Construction Cost (million PHP)	Remarks
A	Main intercepting line	1,329	
	Sewerage treatment plant	11,491	
	Contingency	1,923	15%
	Total	14,743	
B	Main intercepting line	1,145	
	Sewerage treatment plant	10,764	

Area	Item	Construction Cost (million PHP)	Remarks
	Contingency	1,786	15%
	Total	13,695	
C	Main intercepting line	2,273	
	Sewerage treatment plant	14,167	
	Contingency	2,466	15%
	Total	18,906	
D	Main intercepting line	3,259	
	Sewerage treatment plant	16,111	
	Contingency	2,906	15%
	Total	22,276	
E	Main intercepting line	2,086	
	Sewerage treatment plant	8,378	
	Contingency	1,570	15%
	Total	12,033	
F	Main intercepting line	2,344	
	Sewerage treatment plant	12,803	
	Contingency	2,272	15%
	Total	17,419	
Total	Main intercepting line	12,435	
	Sewerage treatment plant	73,715	
	Contingency	12,923	
	Total	99,073	

Notes:
- half underground type
- do not include land cost
- Cost of main intersecting line and sewage treatment plant estimated based on “cost function” for sewer system by Ministry of Land, Infrastructure, Transport, and Tourism in Japan
- Price level: PHP/JPY=0.6
- Exchange rate: PHP1.00=JPY2.00

Source: IM4Davao Team

Table 15.3.14 Operation and Maintenance Cost

Area	Item	Operation and Maintenance Cost in 2045 (million PHP/year)	Remarks
A	Main intercepting line	26.6	2% of CAPEX
	Sewerage treatment plant	199.5	
	Contingency	22.6	10%
	Total:	248.7	
B	Main intercepting line	22.9	2% of CAPEX
	Sewerage treatment plant	184.2	
	Contingency	20.7	10%
	Total	227.8	
C	Main intercepting line	45.5	2% of CAPEX
	Sewerage treatment plant	258.0	
	Contingency	30.3	10%
	Total	333.8	
D	Main intercepting line	65.2	2% of CAPEX
	Sewerage treatment plant	302.2	
	Contingency	36.7	10%
	Total	404.2	
E	Main intercepting line	41.7	2% of CAPEX
	Sewerage treatment plant	135.6	

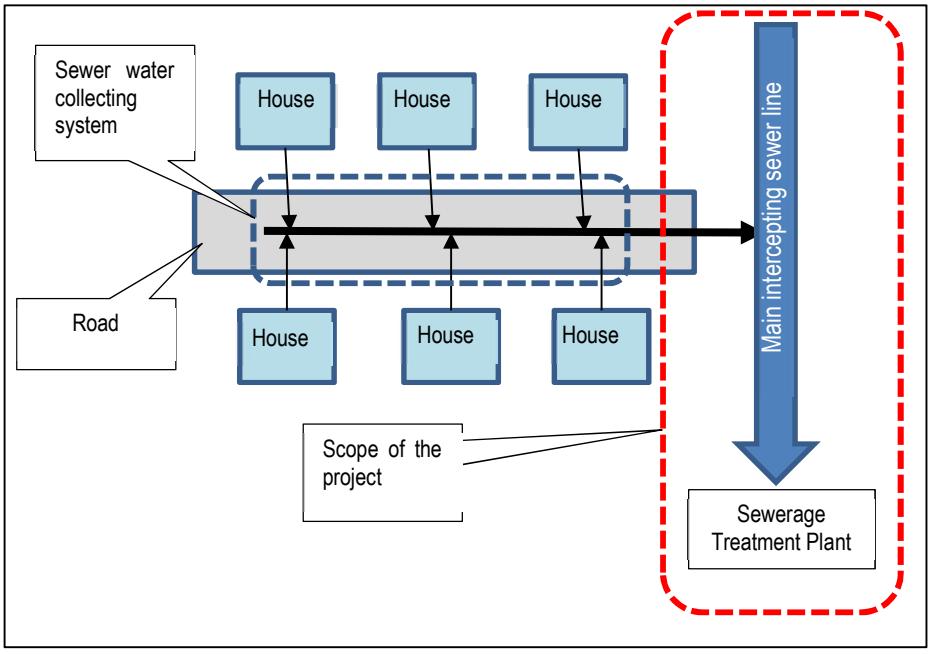
Area	Item	Operation and Maintenance Cost in 2045 (million PHP/year)	Remarks
	Contingency	17.7	10%
	Total	195.1	
F	Main intercepting line	46.9	2% of CAPEX
	Sewerage treatment plant	227.8	
	Contingency	27.5	10%
	Total	302.2	
Total	Main intercepting line	249	
	Sewerage treatment plant	1,307	
	Contingency	156	
	Total	1,712	

Notes:
- Cost of sewage treatment plant estimated based on "cost function" for sewer system by Ministry of Land, Infrastructure, Transport, and Tourism in Japan
- Price level: PHP/JPY=0.6
- Exchange rate: PHP1.00=JPY2.00

Source: IM4Davao Team

(2) Cost of Sewer Water Collecting System

15.47 The scope of the work of the previous chapter is mentioned in Figure 15.3.5 (scope of the project). Hence Table 15.3.13 does not include the construction cost of the sewer water collecting system. The sewer water collecting system can use the urban drainage system which has already been installed in Davao City.



Source: IM4Davao Team

Figure 15.3.5 Sewer Water Collecting System

15.48 In fact, effluents from septic tanks and gray water are discharged to the urban drainage directly or indirectly. Based on this situation, the urban drainage system can be near a sewer water collection system. The sewer water collecting system is included as part of the urban rainwater drainage system, therefore, it is not included in the scope of this project.

15.49 However, to get the total cost of the sewer system, it is necessary to cost of the sewer water collecting system. For this purpose, it is necessary to conduct a detailed survey during the formulation of the sewage master plan.

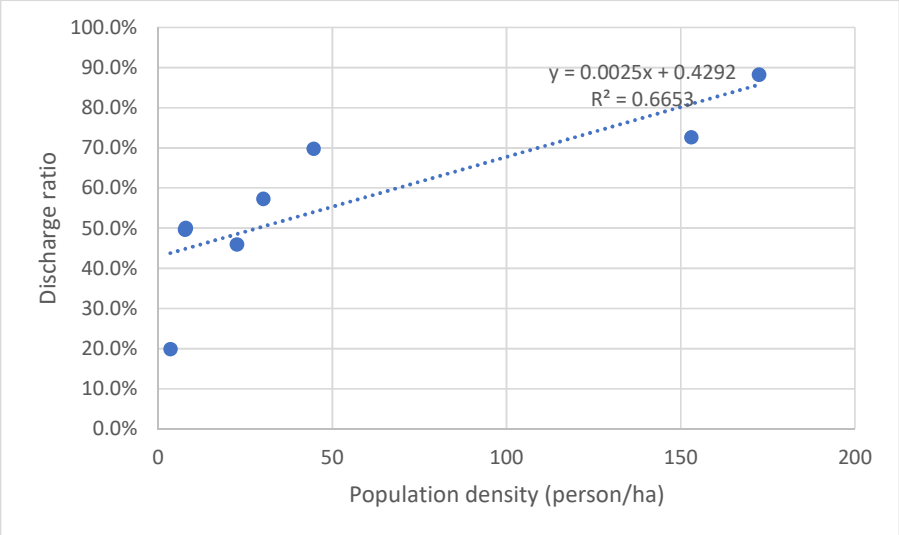
15.50 Based on the objectives of this project, the IM4Davao Team estimated the current installation rate of the sewerage collecting pipe using the HIS results and estimated the cost for the construction of the sewer water collecting system in the future.

15.51 The installation ratio was estimated using the households' answers to the HIS question F3_3_Q8. If the answer from the household is "sewer pipe" or "roadside ditch," it is assumed that the household is already connected to the urban drainage system. The relation between the installation ratio and population density is shown Table 15.3.15 and Figure 15.3.6.

Table 15.3.15 Population Density and Urban Drainage Discharge Ratio

District	Population Density in 2015 (persons/ha)	Urban Drainage Discharge Ratio
Poblacion	153.0	72.6%
Talomo	44.7	69.8%
Agdao	172.5	88.2%
Buhangin	30.3	57.3%
Bunawan	22.7	45.9%
Paquibato	-	55.9%
Baguio	-	36.0%
Calinan	3.6	19.8%
Marilog	-	43.8%
Toril	7.8	49.6%
Tugbok	8.0	50.0%

Source: IM4Davao Team



Source: IM4Davao Team

Figure 15.3.6 Relation Between Population Density and Urban Drainage Discharge Ratio

15.52 The installation cost of the sewer water collecting pipe per hectare was estimated based on existing data. Three sample sites in the Agdao district were set to determine the required length of the sewer water collection pipelines per hectare (Table 15.3.16). The area and the length of the required sewer water collecting pipeline in the sample sites were measured using Google Earth maps.

15.53 On other hand, construction cost of the sewer water collecting pipe per 1 meter of pipe with a diameter of 250 mm was calculated to be JPY109,000/m based on Japanese

data. Assuming the price level and exchange rate of the Philippines to be 0.6, PHP1.00 = JPY2.00, the unit cost of the sewer water collection pipe will be PHP32,700/m.

Table 15.3.16 Area and Length of Sewer Water Collecting Pipes in 3 Agdao Sample Areas

Sample Area	Area and Required Pipe Length
	6.1ha, L=1,933m , 327m/ha
	5.9ha L=1,882m, 319m/ha
	5.9h, L=2,260m, 383m/ha
Total A=6.1+5.9+5.9=17.9ha, L=1933+1882+2260=6075m 6075/17.9=340m/ha	

Source: IM4Davao Team

15.54 Based on the above results, the necessary cost of the water collecting pipes per hectare is PHP11,118,000/ha.

15.55 Table 15.3.17 shows the construction cost for sewer water collection system in each sewerage treatment area, computed as [(1)*(2)*(1-(3))=(4)].

Table 15.3.17 Construction Cost for Sewer Water Collection System

Area	(1) Zone Area (CLUP, ha)	(2) Unit Cost (1000PHP/ha)	(3) Present Installation Ratio	(4) Cost (million PHP)
A	1,693	11,118	85.8%	2,667
B	2,370	11,118	58.6%	10,903
C	5,798	11,118	56.0%	28,355
D	4,672	11,118	54.2%	23,771

Area	(1) Zone Area (CLUP, ha)	(2) Unit Cost (1000PHP/ha)	(3) Present Installation Ratio	(4) Cost (million PHP)
E	3,219	11,118	44.5%	19,872
F	4,285	11,118	49.4%	24,122
Total	22,037	-	-	109,690

Source: IM4Davao Team

15.4 Measures Other Than the Sewerage System

15.56 Areas with a population density of less than 40 persons/ha—those that are not sewerage system target areas—occupy about 90% of the city, but the population density of those areas are as small as 3.8 persons/ha (Table 15.4.1).

Table 15.4.1 Comparison of Sewerage Area and Other Than Sewerage Area

Item	Area (ha)		Population in 2045		Population Density (person/ha)
Total area	223,062.9	100.0%	3,285,400	100.0%	14.7
Sewerage area	22,037.4	9.9%	2,521,444	76.7%	114.4
Other than Sewerage area	201,025.441	90.1%	763,956	23.3%	3.8

Source: IM4Davao Team

15.57 For these other than sewerage areas, introduction of proper management of the septic tank system is recommended. As discussed in the previous sections, the proposed measures in DCWD's study[6] on septage management in 2013 should continue to be implemented.

[6] Septage Management Project Feasibility Study, Davao City Water District, June 2013.

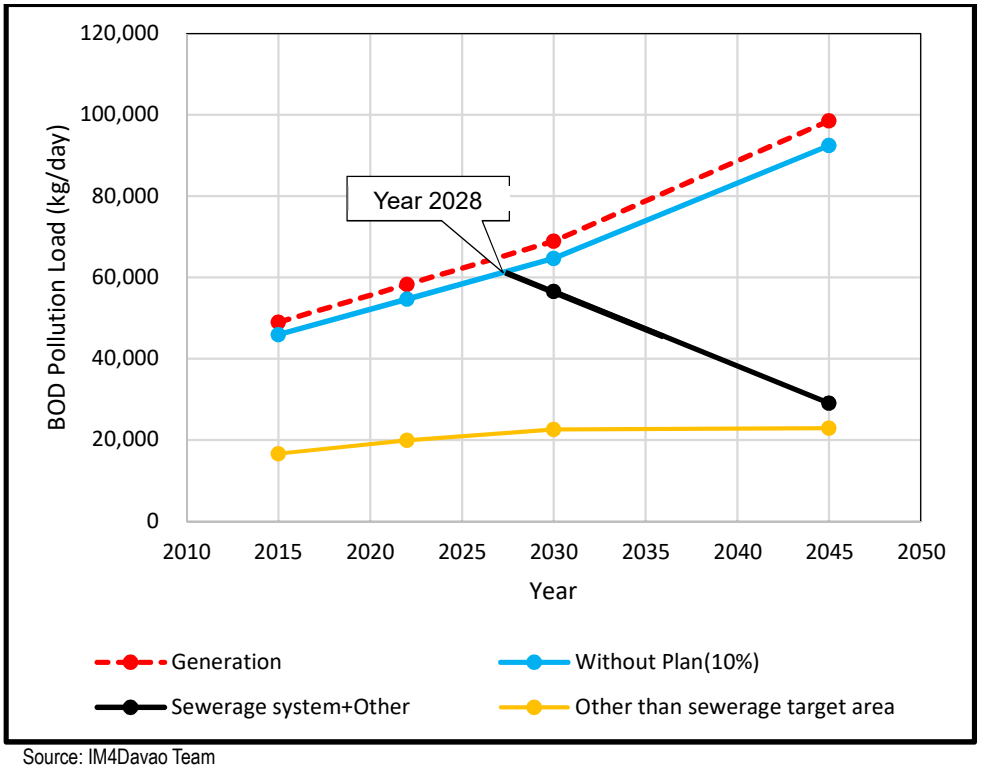
15.5 Future BOD Discharge Amount

15.58 The IM4Davao Team estimated the BOD generation and discharge amount in the years 2015, 2022, 2030, and 2045 taking into account the sewerage implementation plan (Figure 15.5.1) and conditions in other than sewerage target areas (Table 15.5.1).

Table 15.5.1 Future BOD Generation and Discharge Amount

		Year			
		2015	2022	2030	2045
BOD Generation amount		48,990	58,311	68,964	98,562
BOD discharge amount (kg/day)	1. Without Plan (10%*)	45,952	54,696	64,688	92,451
	2. From Sewerage System area	30,313	36,016	35,379	7,564
	3. From Other than Sewerage Target area	15,640	18,679	21,203	21,498
	Sum of 2. and 3.	45,952	54,696	56,582	29,062
* Assumed septic tank BOD removal ratio: 10%					

Source: IM4Davao Team



Source: IM4Davao Team

Figure 15.5.1 Future BOD Generation and Discharge Amount

15.59 Sewage treatment will start in Area A by 2030 and will be sequentially expanded until 2045. The amount of BOD discharge to public water will dramatically decrease during this period.

15.60 BOD discharge from the sewage treatment area in 2045 will be 7,564 kg/day, the amount of BOD discharge not from the sewage treatment area will be 21,498 kg/day, and the total BOD discharge amount will be 29,062 kg/day. This is 63% of the 45,952 kg/day of BOD discharge amount in 2015.

15.6 Management Improvement

15.61 The department responsible for implementing the sewerage project has not been decided at the time of this writing. When Davao City starts the sewerage project, it is necessary to designate the implementing department. For now, the city should identify the implementing department's necessary functions. The IM4Davao Team examined its minimum necessary functions, as listed in Table 15.6.1.

Table 15.6.1 Minimum Functions of Responsible Department for the Sewerage Project

Item	Function
Sewerage Planning Department	
Planning and Coordination Unit	Planning and coordination of sewerage system planning, management and maintenance of sewer pipeline, and related coordination activities
Sewerage Works Promotion Unit	Sewerage works operation planning, investigation of sewerage works technologies
Sewer Pipeline Department	
Sewer Pipeline Maintenance Unit	Sewer pipeline maintenance, sewer ledger, and promotion of connection from home to sewer pipeline
Sewer Pipeline Installation Unit	Design and construction of sewer pipeline
Sewerage Facility Department	
Sewerage Facility Maintenance Unit	Planning and inspection of operation and maintenance of sewerage treatment plant, pumping station and related facilities
Sewerage Treatment Plant Unit	Operation and maintenance of sewerage treatment plant
Sewerage Water Quality Unit	Water quality survey and analysis for sewerage treatment plant
Construction of Sewerage Treatment Plant Unit	Design and construction of sewerage treatment plant (civil works)
Sewerage Equipment Unit	Design and construction of sewerage treatment plant (machinery and equipment)

Source: IM4Davao Team

15.62 DCWD is currently preparing the preliminaries for the implementation of the septage treatment system project, which promotes the optimization of septic tank management. Preliminary works include the establishment and execution of a MOA between the City Government and DCWD, in conformance with the CO No. 0363-10. If this project will be pursued, the pollutant amount discharged from septic tank to public water will be reduced to the maximum of 1/5 as compared to the present level.

15.63 When septage treatment facilities are installed in a densely populated area, sufficient environmental measures including odor countermeasures are necessary so as not to impair the surrounding environment.

15.64 Implementation of the sewerage project requires significant investment and improvement of the capacity of the project implementation entity. Strengthening the capacity of the responsible agency in formulating and implementing the sewerage plan is important in parallel with implementation of septage treatment system project. Therefore, JICA's technical assistance can be tapped to strengthen such implementation capacity. Table 15.6.2 lists the necessary actions and capacities of sewerage departments of Davao City from 2018 to 2022, which is the preparation period for construction of the sewerage system.

Table 15.6.2 Necessary Actions and Capacities for Construction of Sewerage System (for the first component)

Year	Action	Necessary Capacities of Davao City
2018	Establishing execution body	
2019	Formulation of sewer system master plan	Planning capacity in the following aspects: • Project coordination • Field survey (geography and geological conditions) • Validation of target year and target areas • Set up planned outside water level • Sewerage treatment and disposal planning • Sewerage discharge planning • Facilities (sewer line, pumping station and treatment plant) configuration and contents planning • Sludge treatment and disposal planning • Project execution planning • Cost estimation • Financial planning • Organization and institutional planning • Selection of priority project(s) • Project evaluation
2020	Execution of feasibility study for priority project(s)	
2021	Prepare basic design and detailed design	Design capacity in the following aspects: • Project coordination • Sewer line • Treatment process engineering • Civil engineering and architecture • Machine and equipment engineering • Electric equipment engineering • Cost estimation • Preparation of tender documents
2022	Tender	
2023 to 2027	Construction works	• Project coordination • Safety control • Project supervision • Schedule control • Quality control

Source: IM4Davao Team

15.7 Summary of Projects

15.65 Summary of projects are shown in Table 15.7.1 to Table 15.7.3.

Table 15.7.1 Summary of Davao City Sewerage Management Project

Item	Content	
Name of the Project	Davao City Sewerage Management Project	
Executing Body	Davao City Government/DCWD	
Implementation Schedule	2018 to 2045	
Required Budget	Construction of sewerage system	PHP99,073 million
	Operation and maintenace for sewerage system	PHP1,712 million/year
	Construction of sewer water collection system (just for reference---not included in the project)	PHP109,690 million

Source: IM4Davao Team

Table 15.7.2 Summary of Davao City Septage Management Program

Item	Content	
Name of the Project	Davao City Septage Management Program	
Executing Body	Davao City Government/ DCWD	
Implementation Schedule	2018 to 2025	
Required Budget	Capital cost	PHP408 million
	Operation and maintenace cost	PHP71.5million/year

Source: IM4Davao Team

Table 15.7.3 Summary of Formulation of Sewerage Management Master Plan and Exection of Feasibility Study in Davao City (T/A)

Item	Content	
Name of the Project	Formulation of Sewerage Management Master Plan and Exection of Feasibility Study in Davao City (T/A)	
Executing Body	Davao City Government/ DCWD	
Implementation Schedule	2019 to 2020	
Required Budget	Capital cost (Japanese expert: 50 mm)	JPY300 million

Source: IM4Davao Team