APPENDICES

List of Appendices

APPENDIX A

Road Inventory Survey Form

APPENDIX A

Road Inventory Survey Form

Data Item				Data Input	Data Format
Link Code				ex) LA001	String (10 digits)
Class (Administrative)				"National Primary", "National Secondary", "National Tertiary", "Provincial Roads", "Municipal and City Roads", "Barangay Roads", "Expressways", "Bypasses", "Provincial", "Other"	String (30 digits)
Class (Functional)				ex) A: Class A, B: Class B, C: Class C. D: Class D, E: Class E, F: Other	String (1 digits)
Location	LGU (Metro Manila)/ Province Name			"Manila", "Pasay", "Makati", "Taguig", "Mandaluyong", "San Juan", "Quezon", "Caloocan", "Valenzuela", "Malabon", "Navotas", "Marikina", "Pasig", "Pateros", "Paranaque", "Muntinlupa", "Las Pinas", "Bulacan", "Cavite", "Laguna", "Rizal", "Other",	String (15 digits)
Management	Ownership			"MMDA", "DPWH", "LGU","DOTr", "Private", "Provincial", "Barangay", "Other"	String (10 digits)
	Maintenance			"MMDA", "DPWH", "LGU","DOTr", "Private", "Provincial", "Barangay", "Other"	String (10 digits)
Coordinate (Longitude, Latitude) *) Coordination system is 4326		Begin of Observation Point	Longitude	ex) 14.562519	Real (10digits and the 6th decimal places)
			Latitude	ex) 121.043057	
		End of Observation Point	Longitude	ex) 14.563837	
			Latitude	ex) 121.044271	
Observation Direction (1: Begin->End, 2: End->Begin)				ex) 1	Integer (1 digits)
Structure				O: Overpass/ U: Underpass/ B: Bridge/ T:Tunnel/ V:Viaduct/ X: Others	String (1 digits)
Length (m)				ex) 500	Integer (10 digits)
Right of Way	Total Width (m)			ex) 30.00	Real (6 digits and the 2nd decimal places)
	Sidewalk Width (1st direction) (m)			ex) 2.50	Real (6 digits and the 2nd decimal places)
	Carriageway Width (1st direction) (m)			ex) 10.00	Real (6 digits and the 2nd decimal places)
	Number of lane (1st direction)			ex) 2	Integer (2 digits)

Data Item		Data Input	Data Format
	Median (m)	ex) 5.00	Real (6 digits and the 2nd decimal places)
	Carriageway Width (2nd opposite direction) (m)	ex) 10	Real (the 2nd decimal places)
	Number of lane (2nd opposite direction)	ex) 2	Integer (2 digits)
	Sidewalk Width (2nd opposite direction) (m)	ex) 2.50	Real (6 digits and the 2nd decimal places)
Bridge	Structure	01 Beam, 02 Truss, 03 Cantilever, 04 Arch, 05 Tied Arch, 06 Suspension, 07 Cable-stayed, 99 Other.	String (2 digits)
	Year constructed	ex) 2000	Integer (4 digits)
	Length (m)	ex) 100	Integer (5 digits)
	Width (m)	ex) 3.50	Real (6 digits and the 2nd decimal places)
	Weight Limit (ton)	ex) 20.5	Real (6 digits and the 1nd decimal places)
	Maintenance Condition	ex) 1: poor 2: acceptable 3: good	Integer (1 digits)
Railway	Line	“LRT 1”, “LRT 2”, “MRT 3”, “PNR”	String (15 digits)
	Structure	“Elevated”, “At-grade”, “Underground”, “Other”	String (15 digits)
	Station Name	ex) Buendia	String (15 digits)
Safety Facilities	Pedestrian Crossing (Y: Yes/ N: No)	ex) Y	String (1 digits)
	Pedestrian Bridge (Y: Yes/ N: No)	ex) N	String (1 digits)
	Underground Passage (Y: Yes/ N: No)	ex) N	String (1 digits)
	Traffic Sign (Number)	ex) 2	Integer (3 digits)
	Street Light (Number)	ex) 3	Integer (3 digits)
	Street Tree (Y: Yes/ N: No)	ex) N	String (1 digits)
Dedicated Traffic Lane	Bus Lane (Number)	ex) 1	Integer (2 digits)
	Bus Lane Width (m)	ex) 5.00	Real (6 digits and the 2nd decimal places)
	Motorcycle Lane (Number)	ex) 1	Integer (2 digits)
	Motorcycle Lane Width (m)	ex) 2.00	Real (6 digits and the 2nd decimal places)
	Bicycle Lane (Number)	ex) 1	Integer (2 digits)
	Bicycle Lane Width (m)	ex) 2.00	Real (6 digits and the 2nd decimal places)
	Number of Lane of U-turn Slot (Number)	ex) 1	Integer (2 digits)

Data Item			Data Input	Data Format
	Length of U-turn Slot (m)		ex) 25.00	Real (6 digits and the 2nd decimal places)
Public Transport	PUJ Stop (Number)	On-street	ex) 1	Integer (2 digits)
		Off-street	ex) 1	Integer (2 digits)
	PUB Stop (Number)	On-street	ex) 1	Integer (2 digits)
		Off-street	ex) 1	Integer (2 digits)
Parking Facilities	On-Street Parking Slot (Number)	Number of parking	ex) 1	Integer (4 digits)
	Off-Street Parking Slot provided by Bldg.	Number of parking	ex) 30	Integer (4 digits)
		Facility Type	"Residence", "Commercial Institution", "Office/Bank", "Factory/Warehouse", "School/University", "Park/Recreational", "Medical/Welfare", "Religious/Social", "Wholesale/Retail shop", "Restaurant/Entertainment", "Other"	String (25 digits)
Traffic Regulation (if yes, please indicate time)	Speed Limit (km/ h)		ex) 40	Integer (3 digits)
	One-Way (N: No, if Yes, AM/PM Hour should be described)		ex) 6AM–9PM	String (9 digits)
	Prohibition (N: No, if Yes, AM/PM Hour should be described)		ex) N	String (9 digits)
	Truck Ban (N: No, if Yes, AM/PM Hour should be described)		ex) 6AM–9PM	String (9 digits)
	Parking Prohibition (N: No, if Yes, AM/PM Hour should be described)		ex) N	String (9 digits)
	Load/ Unload Prohibition (N: No, if Yes, AM/PM Hour should be described)		ex) 6AM–9PM	String (9 digits)
Road Maintenance	Sidewalk	Pavement Type	A: Asphalt, C: Cement/Concrete, G: Ground	String (1 digits)
		Condition	ex) 1: poor 2: acceptable 3: good	Integer (1 digits)
	Carriageway	Pavement Type	A: Asphalt, C: Cement/Concrete, G: Ground	String (10 digits)
		Condition	ex) 1: poor 2: acceptable 3: good	Integer (1 digits)
		Road Marking	ex) 1: poor 2: acceptable 3: good	Integer (1 digits)
Roadside Land Use	Commercial (roadside shop or small) (Y: Yes/ N: No)		ex) Y	String (1 digits)
	Commercial (medium or shopping mall) (Y: Yes/ N: No)		ex) N	String (1 digits)
	Industrial (Y: Yes/ N: No)		ex) Y	String (1 digits)
	Residential (Y: Yes/ N: No)		ex) Y	String (1 digits)

APPENDIX B

Traffic Signal Audit

APPENDIX B

Traffic Signal Audit

Traffic signal audit is a process that can be used to evaluate the effectiveness of the management of traffic signal and associated systems. The purpose of a traffic signal audit is to provide a mechanism to develop or improve the overall aspects of the existing traffic signal management program.

Its objective is to review the MMDA's traffic signal system design, procurement, operations, maintenance and safety practices and to formulate recommendations that might be taken to improve traffic management practices.

Please reply only to the questions that are directly related to your section. No reply is required for the questions that is out of scope of your section. Thank you.

1 Staffing for Signal System

1.1 Is there suitable number of number of staff for signal design, operation and maintenance?

1.2 Are the staff levels related to system size and complexity?

1.3 Does an operation staffing plan exist (number of staff for day time, night time, weekend, and holidays)?

1.4 Is a training program defined that ensures regular updates of staff skills?

2 System and Intersection Design

2.1 Is there a signal design manual that MMDA refers when a signal is designed?

2.2 Is there a criterion or guideline to apply actuated control?

2.3 Are there criteria to apply protected and permissive left turn?

2.4 Is there a standard layout of vehicle detector at intersection (lanes to install detector, distance from stop line, non-standard size loop, etc.)?

2.5 Does the intersection geometry design apply accessibility law (Batas Pambansa Blg. 344)?

2.6 Is there a guideline to the location of queue detectors?

2.7 Are double (and triple) turns used when required by exiting traffic patterns?

2.8 Is there a rule / guideline to group signals into a sub-area to apply same signal timing plan?

2.9 Is there a rule / guideline to install pedestrian pushbutton controlled signal?

2.10 Does the server system adopt redundant configuration to prevent the system from stoppage when a server stops operation?

2.11 Does the disk system adopt redundant configuration (RAID) to prevent the loss of data?

3 System and Controller Operation

3.1 Are signal optimization programs used for calculating signal timing and evaluating alternative phasing?z

3.2 Is the signal control mechanism such as traffic-responsive or traffic-adaptive control and permissive / protected left turn understood properly by the design and operation staff?

3.3 Is there a criterion to apply permissive or protected left turn?

3.4 Are field reviews of signal operations performed annually for all intersections?

3.5 Did the peak period field review reveal intersections with correctible operational problems, such as unused green time at congested intersections or blockages from left turn bays?

3.6 Did the off-peak and light traffic field reviews reveal correctible operational problems, such as excessive side street waiting times, inadequate pedestrian crossing time, unnecessarily long cycle lengths, inadequate progression?

3.7 Is timing with adjacent systems (Hermes vs. Cosmos) coordinated using a common time base?

3.8 Are the appropriate number of timing plans developed and scheduled for the traffic conditions existing at the controlled intersection?

3.9 Are plans available for use when both planned and unplanned unusual conditions (including weather) occur?

4 Safety

4.1 Are accident records reviewed annually to identify intersections at which safety could be improved through revised signal operations (protected turns, longer clearance intervals, etc.)?

4.2 Is there a policy for the calculation of vehicle clearance intervals that reflects differences in traffic characteristics at intersection approaches?

4.3 Is the clearance interval policy designed to identify and eliminate all potential dilemma zones?

4.4 Is there a policy for the calculation of pedestrian clearance intervals?

4.5 Is the policy consistently applied at all intersections?

4.6 Does the pedestrian clearance interval policy take into account intersections at which pedestrians have special needs (children, elderly, handicapped, etc.)?

5 System and Local Controller Maintenance

5.1 Is there a maintenance contract for the portion of the system for which DLP (defect liability period) has expired?

5.2 Alternatively, is the maintenance work done by in-house staff only?

5.3 Are system and intersection detectors operational at acceptable level (% of working detectors)?

5.4 Is the intersection operation observed at site and are adjustments made to reflect changes required due to the characteristics of the new equipment When new detection and control devices are installed?

5.5 Are signal heads and signs correctly aligned and positioned with the approaches they control?

5.6 Are pedestrian pushbuttons operational?

5.7 Is the operability of all equipment verified annually?

5.8 Is the communication network completely operational more than 90 percent of time?

5.9 Is there requirements about response time for maintenance personnel to be dispatched to the site?

5.10 Does the maintenance staff respond to critical failures within the time specified (30 minutes for example) of the trouble report?

5.11 Does the maintenance staff respond to all reported failures within the specified time (for example: two hours if reported during business hours, and within two hours of the beginning of the next business day if reported after normal business hour)?

5.12 When new detection and control devices are installed, are they tested prior to their use?

5.13 Is the log kept when abnormal operation and defective operation of signal is reported by traffic enforcer or general public?

5.14 Is the operability of all equipment that is connected to a Control Center automatically monitored and recorded on a continuing basis?

5.15 Is the spare parts inventory system established and managed?

5.16 Is the malfunction records of equipment and communication line reviewed periodically to identify underlying issues and develop improvement measures?

6 Documentation

6.1 Is signal timing, including all intervals, offsets, and controller settings available for all intersections in electronic form?

6.2 Is the as-built drawing available for all intersections in electronic form?

6.3 Are the route map, location of closure (junction box), and connection diagram available for fiber optic cable network?

6.4 Do the controller settings match the documentation at all intersections?

6.5 Are cabinet prints available both in the office and in the cabinet? Do they match each other as well as the equipment configuration in the cabinet?

6.6 Do schematics exist that document all wiring interconnects for the system? Do they match the field wiring and interconnects at all intersections?

6.7 Do timesheets exist for recording the activities of all field technicians?

6.8 Do the timesheets identify the locations at which work was performed, the equipment on which the work was performed and the type of work performed?

6.9 Is there an up-to-date equipment inventory that correctly identifies the location, make, model number and serial number of all equipment in the system (including spares)?

6.10 Does an historical database of traffic count information exist that can be used as input to traffic signal timing software?

6.11 Are turning movement counts collected and utilized in the development of signa timing? Are the turning movement count data kept in a systematic way?

6.12 Do maintenance agreements require performance monitoring and reporting?

6.13 Are standard documents used for bidding such as general conditions of contract, employer's requirements (specifications), bill of quantities, drawings?

6.14 Is there standards and guidelines for preparing intersection signal drawing?

7 Policies

7.1 Is there a well-defined policy for the calculation of pedestrian and vehicle clearance intervals?

7.2 Is there a policy in place for determining when concurrent and exclusive pedestrian displays can or should be used?

7.3 Are there written practices for intersection signal design?

7.4 Are there policies for maintenance response times that are correlated with the severity of the failures to be corrected?

7.5 Are specifications developed to guide the procurement of new traffic control devices? Do the specifications ensure interoperability?

7.6 Are policies in place to guide the signal timing according to roadway classification? (For example, signal timing on arterial routes will be designed to maximize throughput, minimize stops and promote progression.)

7.7 Are policies in place to guide the design of cycle lengths and provide for coordination?

7.8 Is there a policy for signal removal?

7.9 Is there a policy for the acceptable and appropriate quality of service that intersections are designed to operate as a function of intersection volume to capacity ratios?

8 Management

8.1 Are performance measures in use with which to evaluate signal system effectiveness and staff efficiency?

8.2 Are training programs funded to ensure that engineering and technician-level personnel are aware of the most recent developments in signal system equipment and operations?

8.3 Is there a publicized call-in number and Web site that the public can used to report malfunctions, ask questions and suggest operation improvements?

8.4 Do all personnel involved in signal system have a clear understanding of their job responsibilities?

8.5 Do all personnel involved in signal system feel that they are adequately trained to perform their responsibilities?

8.6 Are staff designated to monitor the operation of the traffic signal system and traffic conditions during peak hours?

8.7 Are staff designated to monitor the operation of the traffic signal system and traffic conditions at defined intervals during off-peak, weekends and nights?

8.8 Does the staff routinely communicate with elected and appointed officials, management and the public regarding system operation and benefits?

APPENDIX C

Questionnaire for Makati and Mandaluyong Cities

APPENDIX C

Questionnaire for Makati and Mandaluyong Cities

Traffic Management Projects and Activities

1. List down all ongoing and recently completed traffic management activities conducted by the LGU (Name, Year/Duration, Brief Description).
2. Does your LGU have a transport/traffic master plan? (Yes/No)
3. If Yes…
   a. How much of the plan has been implemented?
   b. How much is the full implementation of the plan expected to cost?
4. What does the LGU consider to be the top three barriers to effective traffic management within its jurisdiction? (e.g. lack of technical know-how, lack of budget, etc.)
5. What are the main areas of traffic enforcement that the LGU is focused on? Is there an existing guidebook/ordinance that lays out the LGU's enforcement rules?

Budget

6. How much does the LGU allocate for traffic management activities each year?
7. How are these funds sourced? (e.g. fines, external aid, general budget from IRA/RPT)
8. How much is collected from traffic fines each year? Do these traffic fines automatically accrue to traffic management activities or are they used for a different purpose?

Organizational Set-up and Capacity

9. What is the current organizational set-up of the LGU's traffic management unit? Who does it report to?
10. How large is the traffic management unit as a whole?
11. How many traffic enforcers does the LGU employ?
12. Please provide a breakdown of the current staffing around the following distinctions (%):
    a. Permanent vs. Casual
    b. Technical vs. Administrative
13. What positions is the LGU presently lacking? (e.g. transport planners, economists, engineers, enforcers, etc.)
14. What skillsets/capacities is the LGU presently lacking? Circle all that are applicable.

Planning	Project Design	Budgeting	Implementation	Enforcement
	Monitoring		Other (list below)	

Data and Technology

15. What data does the LGU collect and maintain databases for? How is data measure and how often are these data sets updated?
16. What are the success metrics for traffic management that the LGU tracks (e.g. number of apprehensions, average vehicular speed, number of bottlenecks, volume of people moved, etc.)? What are the corresponding rewards or consequences for meeting or failing to meet these success metrics, if any?
17. In what areas of traffic management does the LGU use technology? (e.g. non-contact apprehensions, traffic control center, etc.)

Inter-agency/LGU Collaboration

18. To what extent does the LGU coordinate with the MMDA?
    a. How often? (e.g. daily, weekly, monthly, etc.)
    b. In what area(s)? (e.g. ticketing, enforcement, etc.)
    c. Through what channel(s)? (e.g. direct, Metro Manila Council, I-ACT, etc.)

19. What is the main factor preventing greater coordination with neighboring LGUs?
20. Would the LGU be in favor of a unified ticketing system? If no, why not?
21. Is the LGU in favor of the proposal for a stronger MMDA (i.e. with regulatory powers) that may potentially overrule LGU autonomy?
    a. Why or why not?
    b. What powers/areas would the LGU be willing to concede to MMDA?
    c. What powers/areas would the LGU not be willing to concede to MMDA?

22. Is the LGU satisfied with current I-ACT operations? What can be improved?

Other Comments

Please list any other insights or comments pertaining to the current institutional arrangement of traffic management agencies—and how to improve it—that you would like to share below.

Requested Data

1. Current transport/traffic management plan being followed
2. Breakdown of LGU traffic management budget over the last 3 years (2016-2019) by:
    a. Revenue source
    b. Expenditure
3. Organizational chart of LGU traffic management unit
4. Penalty matrix for traffic violations
5. Latest traffic management ordinances issued by the LGU (2016-2019)

APPENDIX D

LGU Self-assessment Questionnaire

APPENDIX D

LGU Self-Assessment Survey Questionnaire

Table 1: Issues and Concerns in Transportation Planning and Traffic Management

Instructions: Please rate the following transport/traffic issues and concerns on a scale of 1 to 5, with 1 as minor and 5 as severe.

Issue / Concern	Rating	Remark, if any
1. Disorderly traffic flow at intersections		
2. Conflicts between local and through traffic		
3. Ineffective traffic flow schemes		
4. Lack of traffic signals		
5. Increasing use of automobiles		
6. Heavy trucks in urban center		
7. Limited road capacity		
8. Poor road hierarchy (e.g., no bypasses)		
9. Missing links in the urban highway network		
10. Poor road maintenance		
11. Inadequate traffic signage in the streets		
12. Lack of traffic enforcers		
13. Accidents (Road crashes)		
14. Reckless drivers		
15. Drunk/Drugged driving		
16. Lack of public awareness on traffic safety		
17. Lack of traffic safety education		
18. Dangerous crossings for pedestrians		
19. Poor sidewalk conditions		
20. Lack of pedestrian facilities (e.g., sidewalks, pedestrian crossing)		
21. Lack of facilities for the disabled/senior citizens		
22. Inadequate public transport		
23. Declining public transport ridership		
24. Disorderly boarding/alighting of public utility vehicles on streets		
25. Poor public transport services		
26. Lack of public transport management		
27. Overloaded public transport at peak hours		
28. Lack of waiting sheds for commuters		
29. High transport fares		
30. Operation of illegal/unorganized transport terminals		
31. Poor management of tricycles		
32. Need for bicycle and motorcycle lanes		
33. Lack of street lighting		
34. Air Pollution		
35. Noise pollution		
36. Unmanageable land development impacts on traffic		
37. Excessive and disorderly urban sprawl		
38. Weak project preparation and justification		
39. Difficulty in funding projects		
40. Difficulty in right-of-way acquisition		
41. Weak institutional capacity		
42. Presence of beggars and vendors in the streets		
43. Informal settlers along road right of way		
44. Flooding in the streets		
45. Presence of animals in the streets (e.g., dogs, etc.)		
46. Others (specify)		

Source: UP NCTS

Table 2: Availability of Transportation Planning and Traffic Engineering Equipment

Equipment / Tool Use	Yes/No	If Yes, Quantity	Remarks, if any
1. Traffic lights/signals (managed by city)			
2. CCTV system (closed circuit TV)			
3. Vehicles for traffic enforcers			
4. Tow trucks for stalled vehicles			
5. Ambulances to respond to accidents			
6. Communication system for traffic police			
7. Computers for planning use			
8. Emissions testing devices:			
9. Gas analyzer (mobile testing unit)			
10. Opacimeter (mobile testing unit)			
11. Breath analyzer			
12. Speed radar/gun			
13. Others, specify type			

Source: UP NCTS

Table 3: Availability of Transportation Planning and Traffic Engineering Software

Software Use	Yes/No	If Yes, Quantity	Remarks
Traffic Simulation			
Travel Demand Forecasting			
Geographic Information System (GIS)			
Traffic Accidents/Road Crash Analysis			
Others (specify)			

Source: UP NCTS

Table 4: Availability of Handbook, Literature, and Manuals on Transportation Planning and Traffic Engineering

Handbook / Literature / Manuals: Topic	Yes/No	Remarks
Highway Design		
Road Maintenance		
Traffic Engineering		
Transport Planning		
Land Use Planning		
Disaster Preparedness/ Rescue & Recovery		
Comprehensive Planning		
Others (Specify)		

Source: UP NCTS

Table 5: Availability of Transportation Planning and Traffic Engineering Databases

Database Item	Yes/No	Needs updating? Y/N	Remarks, if any
Population database (by barangay)			
Socio-economic database (by barangay)			
Natural conditions map			
Flood map			
Land use map (actual or existing conditions)			
Traffic flow records			
Origin-Destination database			
Road quality assessment inventory			
Public transport terminal inventory			
Public transport operator inventory			
Public transport route inventory			
Traffic signs and regulations inventory/map			
Parking space inventory			
Accidents/Road crash			
Air pollution records			
GIS-based maps of any of the above			
Organizations of jeepney drivers, tricycle drivers			
NGOs with transport as their advocacy/projects			
others (specify)			

Source: UP NCTS

Table 6: Availability of Transportation Planning and Traffic Engineering Tools

Tools	Yes/No	If Yes, year introduced	Remarks, if any
Traffic impact assessment (TIA) ordinance			
- if no, is the city planning to introduce TIA?			
Parking Management System			
Disaster risk reduction and management plan for the transport sector			
Environmental monitoring plan			

Source: UP NCTS

Table 7: Name of Unit/Department Responsible for Transportation Planning and Traffic Engineering

Please indicate the name of unit/department responsible for the following functions in your city:

Function	Department/Unit ('none' if non-existent)	No. of Technical Staff	Remarks, if any
Transport planning			
Urban planning			
Traffic engineering and management			
Highway engineering			
Road maintenance			
Public transport			
Traffic enforcement			
Traffic safety/ accident response			
Air pollution control			
Disaster preparedness & response			
Other related functions (pls. specify):			

Source: UP NCTS

Table 8: Annual Budget for Transportation Planning and Traffic Engineering[1]

Item	Budget	Remark, if any
Capital outlay		
Personnel		
Maintenance and other operating expenses		

[1] Including administration and projects.

Source: UP NCTS

Table 9: Funding Sources for Transportation Planning and Traffic Engineering Projects

Source	% of Amount	Remark, if any
Internal revenue allotment		
Borrowings		
Grants		
Internally sourced revenues		
Others		

Source: UP NCTS

Table 10: Level of Staff's Technical Knowledge in Transportation Planning and Preferred Training Topics

Score from 1 to 5 with 1 as highest priority and 5, not a priority.

Topic	Current Level (Pls check)			Preferred Topic for Training[1]	Remark, if any
	Good	Some	Limited		
Land Use and Transport Planning					
Travel Demand Forecasting					
Transport modeling using software, eg., Cube, Vissum, GIS, etc.					
Public Transport System Planning and Analysis					
Transportation System Evaluation					
Mobility Management					
Communications Plan					
Road Network Planning/Development					
Implementation Planning - prioritization, budgeting, etc.					
Others (specify)					

Source: UP NCTS

Table 11: Level of Staff's Technical Knowledge in Traffic Engineering and Management and Preferred Training Topics

Score from 1 to 5 with 1 as highest priority and 5, not a priority.

Topic	Current Level (PIs check)			Preferred Topic for Training[1]	Remark, if any
	Good	Some	Limited		
Traffic flow characteristics and Problem identification. Definition of traffic flow variables; capacity and level of service concepts; congestion; bottlenecks					
Traffic control devices (Traffic signs, pavement markings, markers, etc.)					
Data Collection (Traffic surveys; data processing and analysis, ITS applications, crowd sourcing, RFID)					
Intersection, corridor, sub-area design and control					
Geometric design of roads and intersections					
Road and intersection Capacity analysis					
Traffic Simulation					
Economic Evaluation					
Traffic Impact Assessment					
Road safety; blackspot analysis, road safety audit					
Traffic management and enforcement					
Others (specify)					

Source: UP NCTS

APPENDIX E

Longlist of Traffic Bottlenecks

APPENDIX E

Longlist of TBNs

Code	Coordinate	LGU	Intersection	Structure	INTType	No. of Legs	Signal	Crossing Conflict	PUV Stop	Section	Rad//Cir	Area	SevLOC	SevQL
CC03	14.6571388, 120.9840133	Caloocan	Epifanio Delos Santos Avenue - MacArthur Highway	At-Grade	A x A	4	0	4	1	6	C4,R9	Caloocan	A	1
CC05	14.6444224, 120.9835574	Caloocan	5th Avenue–Rizal Avenue Extension	At-grade	A x A	4	1	16	1	10	C3,R9	Caloocan	B	3
CC09	14.7560658, 121.0436717	Caloocan	Zabarte Road–Camarin Road	At-grade	A x A	4	0	16	1	2	R7,R8	0	B	2
CC12	14.7568824, 121.0536225	Caloocan	Camarin Road–Zapote/Ilang-ilang	At-grade	A x B	4	0	16	1	None	R8	0	A	2
CC13	14.7443744, 121.0347708	Caloocan	Camarin Road–Congressional Road	At-grade	A x B	4	1	16	0	None	R8	0	A	3
CC23	14.6508284, 120.9726037	Caloocan	A. Mabini Street–P. Burgos/10th Avenue	At-grade	A x C	3	0	16	1	None	0	Caloocan	B	6
CC24	14.6515458, 120.9838656	Caloocan	Rizal Avenue Extension–10th Avenue	At-grade	A x C	4	1	16	1	6	R9	Caloocan	A	2
CC28	14.6431501, 120.9835245	Caloocan	Rizal Avenue Extension–4th Avenue	At-grade	A x C	4	1	16	1	10	R9	Caloocan	B	3
CC29	14.6431245, 120.9752776	Caloocan	A. Mabini Street–4th Avenue	At-grade	A x C	3	0	3	1	None	0	Caloocan	B	2
CC32	14.6573575, 120.9901565	Caloocan	Epifanio Delos Santos Avenue–General Tinio Street	At-grade	A x C	3	0	0	1	None	C4	0	A	3
LP02	14.46586984, 120.9680289	Las Pinas	P. Diego Cera Avenue–Alabang-Zapote Road	Elevated	A x A	4	1	16	1	None	C8,R2	0	A	2
LP03	14.44455181, 120.9938738	Las Pinas	Alabang-Zapote Road–BF Resort Drive/CAA Avenue	At-grade	A x B	4	1	16	1	None	C8	0	B	4
LP05	14.42786474, 121.0224155	Las Pinas	Alabang-Zapote Road–Investment Drive/Victor Buencamino	At-grade	A x B	4	0	3	1	14	C8	0	A	2
LP09	14.47309357, 120.9765689	Las Pinas	P. Diego Cera Avenue–Naga Road	At-grade	A x B	4	0	8	1	12	R2	0	D	2
LP10	14.42811382, 121.0207461	Las Pinas	Alabang-Zapote Road–Concha Cruz Drive	At-grade	A x B	3	1	3	1	14	C8	0	B	3

Code	Coordinate	LGU	Intersection	Structure	INTType	No. of Legs	Signal	Crossing Conflict	PUV Stop	Section	Rad//Cir	Area	SevLOC	SevQL
LP13	14.44814762, 120.9848521	Las Pinas	Alabang-Zapote Road–Aria/Manila Times	At-grade	A x C	4	0	16	1	None	C8	0	A	2
LP16	14.43675019, 121.0068444	Las Pinas	Alabang-Zapote Road–Marcos Alvarez Avenue	At-grade	A x B	3	0	3	1	14	C8	0	C	4
LP18	14.45312397, 120.9758305	Las Pinas	Alabang-Zapote Road–Dona Manuela Avenue	At-grade	A x C	3	0	3	1	None	C8	0	A	2
MD01	14.58128896, 121.0535659	Mandaluyong	Epifanio Delos Santos Avenue (EDSA)–Shaw Boulevard	Elevated	A x A	4	1	16	1	19	C4,R5	0	D	2
MD02	14.59318403, 121.058478	Mandaluyong	Epifanio Delos Santos Avenue (EDSA)–Ortigas Avenue	Elevated	A x A	4	1	16	1	None	C4,R6	0	A	2
MD03	14.57242785, 121.0473535	Mandaluyong	Epifanio Delos Santos Avenue (EDSA)–Boni Avenue	Elevated	A x B	4	0	0	1	19	C4	0	B	4
MD06	14.58451556, 121.0557811	Mandaluyong	Epifanio Delos Santos Avenue (EDSA)–Dona Julia Vargas Avenue	At-grade	A x B	3	0	0	1	19	C4	0	B	3
MD08	14.59367364, 121.0269932	Mandaluyong	Shaw Boulevard/P. Sanchez–Gen. Kalentong	At-grade	A x B	4	1	16	1	23	R5	0	C	2
MK01	14.56147789, 121.0279216	Makati	Senator Gil Puyat Avenue/ Buendia Avenue–Makati Avenue	At-grade	A x B	4	1	16	1	18	0	Makati Pasay	C	6
MK02	14.56766019, 121.0468719	Makati	Epifanio Delos Santos Avenue (EDSA)–J.P. Rizal	Elevated	A x B	4	1	3	1	None	0	0	B	6
MK03	14.55981041, 121.0405872	Makati	Epifanio Delos Santos Avenue (EDSA)–Estrella	Elevated	A x A	3	0	0	1	19	C4	0	C	2
MK04	14.5621521, 121.0223594	Makati	Senator Gil Puyat Avenue/ Buendia Avenue–Nicanor T. Garcia	At-grade	A x C	3	1	3	1	18	0	Makati Pasay	B	2
MK05	14.55769145, 121.0382997	Makati	Epifanio Delos Santos Avenue (EDSA)–Kalayaan Avenue	Elevated	A x A	3	0	0	1	19	C4,R4	0	B	2
MK12	14.55690286, 121.0057207	Makati	Senator Gil Puyat Avenue/ Buendia Avenue–Filmore Street	At-grade	A x C	4	1	16	1	18	C3	Makati Pasay	B	2

Code	Coordinate	LGU	Intersection	Structure	INTType	No. of Legs	Signal	Crossing Conflict	PUV Stop	Section	Rad//Cir	Area	SevLOC	SevQL
MK14	14.54118523, 121.0183261	Makati	Epifanio Delos Santos Avenue (EDSA)–Chino Roces Avenue	Elevated	A x C	4	0	0	1	None	C4	0	A	3
MK23	14.5503714, 121.0293664	Makati	Epifanio Delos Santos Avenue (EDSA)–Ayala Avenue	Elevated	A x B	4	1	16	1	19	C4	Makati Pasay	B	2
MK24	14.54749395, 121.0260314	Makati	Epifanio Delos Santos Avenue (EDSA)–Antonio S. Arnaiz Avenue	At-grade	A x B	4	1	4	1	19	C4	Makati Pasay	C	3
MK25	14.55499459, 121.0348805	Makati	Epifanio Delos Santos Avenue (EDSA)–Senator Gil Puyat Avenue/ Buendia Avenue	Elevated	A x A	4	0	16	1	19	C4	Makati Pasay	C	3
MK27	14.56655256, 121.0236115	Makati	Kalayaan Avenue–Nicanor T. Garcia	At-grade	A x C	3	1	16	1	16	R4	Makati-Manila	B	2
MK28	14.55778393, 121.0075529	Makati	Osmena Highway–Senator Gil Puyat Avenue/ Buendia Avenue	Elevated	A x A	3	1	0	1	18	C3,R3	Makati Pasay	D	2
MK29	14.5741136, 121.0113111	Makati	Kalayaan Avenue–Zobel Roxas Street	At-grade	A x B	4	0	5	0	16	R4	Makati-Manila	C	2
MK32	14.575024, 121.0121544	Makati	Tejeron Street–Zobel Roxas Street/Delpan	At-grade	B x B	4	1	16	1	15	0	Makati-Manila	B	2
MK34	14.56133341, 121.0154968	Makati	Senator Gil Puyat Avenue/ Buendia Avenue–Ayala Avenue	At-grade	A x B	4	1	4	1	18	C3	Makati Pasay	B	2
MK35	14.55991808, 121.0117702	Makati	Senator Gil Puyat Avenue/ Buendia Avenue–Chino Roces Avenue	At-grade	A x C	4	1	16	1	18	C3	Makati Pasay	C	3
MK36	14.56431922, 121.0163155	Makati	South Avenue/Ayala Avenue Extension–Metropolitan Avenue	At-grade	A x B	4	1	16	1	None	C3	0	B	2
MK39	14.56768427, 121.0307389	Makati	J.P. Rizal–Makati Avenue	At-grade	B x B	4	1	16	1	None	0	0	B	2
MK40	14.55967195, 121.0304981	Makati	Senator Gil Puyat Avenue/ Buendia Avenue–Paseo de	At-grade	A x C	4	1	1	1	18	0	Makati Pasay	C	3

Code	Coordinate	LGU	Intersection	Structure	INTType	No. of Legs	Signal	Crossing Conflict	PUV Stop	Section	Rad//Cir	Area	SevLOC	SevQL
			Roxas											
MK50	14.5404049, 121.016819	Makati	Osmena Highway–Epifanio Delos Santos Avenue (EDSA)	Elevated	A x A	4	0	16	1	None	C4,R3	Makati Pasay	A	2
MK6	14.55523538, 121.0645941	Makati	Kalayaan Avenue–J.P. Rizal Extension	At-grade	A x B	4	1	5	1	21	R4	Makati-Pateros-Pasig-Taguig	B	2
MK8	14.55605407, 121.0631493	Makati	Carlos P. Garcia Avenue/C-5–Kalayaan Avenue	At-grade	A x A	4	0	0	1	22	C5,R4	Makati-Pateros-Pasig-Taguig	C	2
MN04	14.6180267, 120.9708252	Manila	Juan Luna Street–Tayuman St./ Capulong St.	At-grade	A x A	4	1	16	1	30	C2	Manila	C	3
MN08	14.6139016, 120.9887077	Manila	Lacson Ave.–Laon Laan St.	At-grade	A x A	5	1	19	1	32	C2,R8	Manila	D	1
MN09	14.6028723, 121.0159493	Manila	Magsaysay Blvd.–V. Mapa St.	At-grade	A x A	3	1	3	1	35	R5,R6	0	B	2
MN103	14.5776355, 121.0074231	Manila	Pasig Line–Agusto Francisco	At-grade	A x C	4	0	16	0	16	R4	0	C	2
MN104	14.5787477, 121.0012156	Manila	Pedro Gil St–Onyx	At-grade	A x C	3	0	3	0	48	R4	Makati-Manila	B	2
MN11	14.5642677, 120.9850984	Manila	Roxas Blvd.–President Quirino Ave	At-grade	A x A	3	1	3	1	42	C2,R1	Makati-Manila	B	3
MN110	14.5760923, 120.9883133	Manila	Taft Ave.–Pedro Gil St.	At-grade	A x C	4	1	5	1	None	R2	Makati-Manila	A	2
MN115	14.58947853, 121.0233118	Manila	New Panaderos Extension–Reverend Gregorio Aglipay St.	Elevated	B x B	5	1	16	1	24	0	0	B	2
MN121	14.6106107, 121.0047974	Manila	G. Tuazon St.–Leyte St.	At-grade	B x B	3	0	3	0	34	0	0	B	3
MN13	14.58292366, 120.9754907	Manila	Roxas Blvd./Bonifacio Dr.–Padre Burgos Ave./ Katigbak Dr.	At-grade	A x A	4	1	16	1	44	C1,R1	0	C	3
MN15	14.58589877, 120.9802031	Manila	Padre Burgos Ave.–Finance Rd.	At-grade	A x A	3	1	1	1	44	C1	0	B	1
MN16	14.5770632, 120.9970851	Manila	President Quirino Ave–Osmena Highway	Elevated	A x A	3	1	3	1	42	C2,R3	0	D	2
MN17	14.5787346, 120.9982548	Manila	President Quirino Ave–Pedro Gil St.	Elevated	A x A	5	1	7	0	42	C2,R4	Makati-Manila	C	2
MN23	14.6031249, 120.9850762	Manila	Quezon Blvd.–C.M. Recto Ave.	Elevated	A x A	4	0	0	1	38	C1	Manila	B	2

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MN24	14.60056026, 120.9815587	Manila	Rizal Ave - Ronquillo St.	At-grade	A x A	4	0	3	1	31	R9	Manila	B	2
MN25	14.6003004, 120.9909496	Manila	Legarda St.–C.M. Recto Ave./ E. Mendiola	At-grade	A x A	4	1	16	1	37	C1,R6	Manila	C	1
MN26	14.6021072, 120.9871549	Manila	C.M. Recto Ave.– Nicanor Reyes St.	At-grade	A x B	3	1	3	1	38	C1	Manila	B	2
MN30	14.5795334, 121.0048306	Manila	Pedro Gil St–Pasig Line	At-grade	A x A	3	0	3	0	16	R4	Makati-Manila	C	2
MN39	14.5733377, 120.9940904	Manila	President Quirino Ave– Singalong St.	At-grade	A x B	4	1	5	0	42	C2	Makati-Manila	C	3
MN41	14.5928559, 121.0015497	Manila	Quirino Ave–Jesus St./Paz Mendoza Guazon St.	At-grade	A x B	4	1	16	0	42	C2	Makati-Manila	B	2
MN42	14.615459, 120.9990606	Manila	Espana Blvd.– Blumentritt Extension	At-grade	A x B	4	1	16	1	None	R7	0	B	3
MN45	14.6025486, 121.0135124	Manila	Magsaysay Blvd.– Santol	At-grade	A x B	4	1	8	0	35	R6	0	C	2
MN46	14.6022536, 121.011767	Manila	Magsaysay Blvd.–Old Santa Mesa Road	At-grade	A x B	3	1	3	1	35	R6	0	B	2
MN49	14.6267021, 120.9733738	Manila	Juan Luna St.–Solis St./ Del Fierro St.	At-grade	A x B	4	1	8	1	None	0	0	B	1
MN53	14.5662703, 120.9883613	Manila	President Quirino Ave– Adriatico St.	At-grade	A x C	4	1	8	1	42	C2	Makati-Manila	B	2
MN68	14.5902088, 120.9856956	Manila	Ayala Blvd.–D. Romualdez St./ Natividad Lopez St.	At-grade	A x C	4	1	5	1	43	C1	0	B	1
MN70	14.6097716, 120.9861943	Manila	Alfonso Mendoza St.– Dapitan St.	At-grade	A x C	3	1	1	1	None	R8	Manila	B	2
MN71	14.6117603, 120.9863275	Manila	Alfonso Mendoza St.– Laon Laan St./ Alvarez St.	At-grade	A x A	4	1	8	1	None	R8	Manila	B	1
MN72	14.608519, 120.9938488	Manila	Lacson Ave.–Loyola St.	At-grade	A x C	4	1	5	1	32	C2	Manila	B	2
MN73	14.6017677, 120.9881517	Manila	C.M. Recto Ave.– Loyola St.	At-grade	A x C	4	1	16	0	38	C1	Manila	B	2
MN74	14.6102136, 120.9934611	Manila	Espana Blvd.–M. Earthshaw St.	At-grade	A x C	3	0	1	1	None	R7	Manila	C	2
MN75	14.6091033,	Manila	Lacson Ave.–M.	At-grade	A x B	4	0	0	0	32	C2	Manila	B	2

Code	Coordinate	LGU	Intersection	Structure	INTType	No. of Legs	Signal	Crossing Conflict	PUV Stop	Section	Rad//Cir	Area	SevLOC	SevQL
	120.9933062		Earthshaw St.											
MN76	14.6001265, 121.0168006	Manila	V. Mapa St.–Old Santa Mesa Road	At-grade	A x B	4	1	3	1	36	R5	0	C	2
MN77	14.6015647, 120.9926535	Manila	Legarda St.–Figueras St.	At-grade	A x C	3	1	3	1	37	R6	Manila	C	2
MN79	14.622796, 120.9830023	Manila	Rizal Ave–New Antipolo St.	At-grade	A x C	5	0	0	1	31	R9	Manila	B	1
MN80	14.6202651, 120.9715822	Manila	Juan Luna St–Raxabago St.	At-grade	A x C	4	1	16	1	30	0	Manila	B	1
MN81	14.6167498, 120.9773731	Manila	Abad Santos Ave.–Tayuman St.	At-grade	A x C	4	1	16	1	32	C2	Manila	C	1
MN83	14.6024636, 120.9674294	Manila	C.M. Recto Ave.–Asuncion St.	At-grade	A x C	4	0	16	0	None	C1	0	B	6
MN84	14.6160077, 120.9867039	Manila	Lacson Ave.–Alfonso Mendoza St./ Aragon St.	At-grade	A x C	4	1	8	1	32	C2	Manila	C	2
MN85	14.6171159, 120.9856861	Manila	Lacson Ave.–Tayuman St./	At-grade	A x A	4	0	16	0	32	C2	Manila	C	3
MN90	14.6128943, 120.9896628	Manila	Lacson Ave.–Dapitan St.	At-grade	A x C	4	1	5	1	32	C2	Manila	C	2
MN91	14.6161126, 120.9888305	Manila	Dimasalang St.–Maria Clara St.	At-grade	A x C	6	1	50	1	33	R8	Manila	B	2
MN92	14.6151154, 120.9877189	Manila	Lacson Ave.–Maria Clara St.	At-grade	A x C	4	1	5	1	32	C2	Manila	C	2
MN95	14.6319201, 120.9806659	Manila	Rizal Ave–Abad Santos Ave./ Hermosa St.	At-grade	A x C	4	1	10	1	10	R9	0	B	2
MN99	14.6204912, 120.9653703	Manila	Capulong St–Velasquez St	At-grade	A x C	4	0	16	0	28	C2	0	C	1
MR01	14.63566558, 121.097462	Marikina	Don Juan Sumulong Avenue–Shoe Avenue	At-Grade	A x B	4	1	16	1	None	0	0	C	2
MR02	14.64948698, 121.1020371	Marikina	J. P. Rizal–J. Molina Avenue	At-Grade	A x A	3	0	3	0	None	0	0	B	2
MR03	14.65319516, 121.1030966	Marikina	J. P. Rizal–Bagong Farmer's Avenue	At-Grade	A x B	3	1	3	1	None	0	0	B	2
MT03	14.38679409, 121.0451462	Muntinlupa	Manila South Road (National Road)–Susana Heights Rd.	At-grade	A x A	3	1	3	1	None	R3	0	A	5
MT07	14.4191564, 121.0501547	Muntinlupa	Ilaya St./Wawa Road–Montillano St.	At-grade	A x C	4	0	16	1	59	0	0	C	2
MT08	14.42275221,	Muntinlupa	Alabang-Zapote Rd.–	At-grade	A x B	4	1	16	1	None	C8	0	A	2

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	121.0367346		Filinvest Ave.											
MT09	14.39815943, 121.0459167	Muntinlupa	Manila South Road–Soldier Hills Village Main Road	At-grade	A x B	3	0	3	1	60	R3	0	B	3
MT12	14.44477655, 121.0505078	Muntinlupa	M.L. Quezon Avenue–Concepcion St	At-grade	A x C	3	0	3	1	57	0	0	B	2
MT16	14.37908878, 121.0517599	Muntinlupa	Arandia St.–E. Rodriguez Jr. Ave.	At-grade	A x C	3	0	3	0	61	0	0	C	2
MT17	14.3762635, 121.0471367	Muntinlupa	Manila South Road–E. Rodriguez Jr. Ave.	At-grade	A x C	3	0	3	1	None	R3	0	A	2
MT18	14.41007757, 121.0462323	Muntinlupa	Manila South Road–Bautista St./Pleasant Drive	At-grade	A x C	4	0	16	1	None	R3	0	A	3
MT19	14.39488467, 121.0505399	Muntinlupa	San Guillermo St.–Bruger St.	At-grade	A x C	3	0	3	0	59	0	0	B	2
MT20	14.41023108, 121.0500904	Muntinlupa	San Guillermo St.–Bautista St.	At-grade	A x C	4	0	16	0	59	0	0	C	2
MT21	14.39456361, 121.0448894	Muntinlupa	Manila South Road–Bruger	At-grade	A x C	3	0	3	1	60	R3	0	B	6
NV01	14.6392292, 120.9559855	Navotas	R-10–C-3/Bulungan Street	At-grade	A x A	4	0	16	1	None	C3,R10	0	B	1
NV04	14.6401225, 120.9571029	Navotas	C-3–North Bay Boulevard	At-grade	A x C	4	0	16	0	None	C3	0	A	2
PG02	14.5906377, 121.085406	Pasig	Ortigas Ave–Dr. Sixto Antonio Ave./Amang Rodriguez	Elevated	A x A	4	0	0	1	None	R6	0	A	4
PG03	14.58986112, 121.0797639	Pasig	Ortigas Ave–E. Rodriguez Jr. Ave.	Elevated	A x A	4	1	10	1	None	C5,R6	0	A	2
PG04	14.56611913, 121.0704694	Pasig	E. Rodriguez Jr. Ave–Pasig Boulevard/G. Santos	Elevated	A x A	4	1	8	0	83	C5	Makati-Pateros-Pasig-Taguig	B	2
PG06	14.55162352, 121.0744424	Pasig	Ramon Jabson–Elisco Road	At-grade	A x A	4	1	16	1	84	R4	Makati-Pateros-Pasig-Taguig	C	2
PG07	14.58870532, 121.0639199	Pasig	Ortigas Ave–Meralco Ave	At-grade	A x B	3	1	3	1	None	R6	0	B	2
PG08	14.57493208, 121.0610785	Pasig	Shaw Blvd–Meralco Ave	At-grade	A x B	3	1	3	1	25	R5	0	C	2
PG09	14.57632867,	Pasig	Shaw Blvd–Pioneer St	At-grade	A x B	4	1	16	1	25	R5	0	C	3

Code	Coordinate	LGU	Intersection	Structure	INTType	No. of Legs	Signal	Crossing Conflict	PUV Stop	Section	Rad//Cir	Area	SevLOC	SevQL
	121.0592485													
PG12	14.59028551, 121.0894618	Pasig	Ortgas Avenue Extension–C. Raymundo Ave.	At-grade	A x B	3	0	0	1	None	R6	0	A	2
PG15	14.58109633, 121.0832313	Pasig	Dr. Sixto Antonio Ave–Eagle Drive	At-grade	A x B	3	0	3	1	81	0	0	B	2
PG16	14.578255, 121.0814976	Pasig	Dr. Sixto Antonio Ave–Stella Maris	At-grade	A x C	3	0	3	1	81	0	0	B	2
PG17	14.55094248, 121.0815259	Pasig	Elisco Road–M Jimenez St./A.V. Cruz	At-grade	A x B	4	0	16	1	84	R4	Makati-Pateros-Pasig-Taguig	C	2
PG20	14.57743631, 121.0733589	Pasig	E. Rodriguez Jr. Ave–R. Lanuza Ave	At-grade	A x B	4	1	16	1	None	C5	0	B	3
PG23	14.578255, 121.0573704	Pasig	Shaw Blvd–San Miguel Ave./Sheridan St.	At-grade	A x C	4	1	16	1	25	R5	0	B	2
PG25	14.61871389, 121.0924777	Pasig	Marcos Highway–Amang Rodriguez Ave./ J.P. Rizal St.	At-grade	A x C	4	0	0	1	None	R6	0	A	3
PG27	14.58885582, 121.1036985	Pasig	Ortigas Avenue Extension–Riverside Drive	At-grade	A x C	3	0	3	1	79	R6	0	B	2
PG28	14.60277353, 121.0930074	Pasig	Tramo - Magsaysay	At-grade	A x C	4	0	3	0	78	0	0	B	3
PG33	14.575964, 121.084885999999	Pasig	C. Raymundo Ave.–F. Legaspi/Stella Maris	At-grade	B x B	3	1	16	0	None	0	0	A	4
PQ01	14.49220434, 120.9878299	Paranaque	Quirino Avenue - Kabihasnan	At-grade	A x A	4	1	16	1	66	C7,R2	0	C	3
PQ04	14.48626651, 120.9913581	Paranaque	Dr. Arcadio Santos Avenue–Old Sucat Road	At-grade	A x A	3	0	1	0	None	C7	0	B	2
PQ08	14.4750841, 121.0011296	Paranaque	Dr. Arcadio Santos Avenue–Angelina Canaynay Avenue	At-grade	A x B	3	1	3	1	71	C7	0	B	5
PQ11	14.51715563, 120.9963004	Paranaque	NAIA Road–Quirino Avenue	Elevated	A x A	4	1	16	1	53	R2	Pasay-Paranaque	B	3
PQ13	14.50439906, 120.9935608	Paranaque	Quirino Avenue–J.P. Rizal St./Dimatimbangan St.	At-grade	A x B	4	1	16	1	66	R2	0	C	2
PQ20	14.49615331,	Paranaque	C-5 Extension	At-grade	A x C	4	1	16	1	69	C5	0	C	4

Code	Coordinate	LGU	Intersection	Structure	INTType	No. of Legs	Signal	Crossing Conflict	PUV Stop	Section	Rad//Cir	Area	SevLOC	SevQL
	121.0002868		Road/Kaingin Road–Multinational Avenue											
PQ25	14.52708692, 120.9971566	Paranaque	Quirino Avenue–Airport Road	At-grade	A x C	4	1	5	1	53	R2	Pasay-Paranaque	B	2
PQ26	14.52725815, 120.9936036	Paranaque	Roxas Blvd.–Airport Road	At-grade	A x C	3	1	1	1	63	R1	Pasay-Paranaque	B	3
PY01	14.5539044, 120.9971585	Pasay	Taft Ave.–Senator Gil Puyat Ave.	At-grade	A x A	4	1	16	1	52	C3,R2	Pasay-Paranaque	C	2
PY03	14.5369905, 120.9926386	Pasay	EDSA–Roxas Boulevard	Elevated	A x A	4	1	16	1	76	C4,R1	Pasay-Paranaque	C	3
PY04	14.5375177, 121.0007001	Pasay	EDSA–Taft Avenue	At-grade	A x A	4	1	16	1	76	C4,R2	Pasay-Paranaque	D	4
PY08	14.5376272, 121.0032576	Pasay	EDSA–Aurora Boulevard	Elevated	A x B	3	0	0	0	76	C4	Pasay-Paranaque	C	2
PY09	14.5376242, 120.9957676	Pasay	EDSA–F.B. Harrison St.	At-grade	A x B	3	0	0	1	76	C4	Pasay-Paranaque	B	2
PY10	14.5476887, 120.9986181	Pasay	Taft Ave.–Antonio S. Arnaiz Ave	At-grade	A x A	4	1	16	1	52	R2	Pasay-Paranaque	C	2
PY15	14.52417603, 121.0249492	Pasay	Sales Road–SLEX West Service Road	Elevated	A x A	4	0	4	1	77	R3	0	C	2
PY20	14.5377766, 120.998294	Pasay	EDSA–Park Avenue	At-grade	A x C	3	0	0	1	76	C4	Pasay-Paranaque	C	1
QC01	14.65717892, 121.0003599	Quezon City	EDSA–Cloverleaf to A. Boniafacio Avenue NB	Elevated	A x A	3	0	0	1	None	C4,R8	0	A	6
QC03	14.7310889, 121.0473497	Quezon City	Quirino Highway–Commonwealth Avenue	At-Grade	A x A	3	1	3	1	None	R7	0	A	6
QC05	14.69282934, 121.0299443	Quezon City	Quirino Highway–Don Julio Gregorio	At-Grade	A x A	4	0	0	1	88	R8	0	B	6
QC06	14.69042143, 121.0278253	Quezon City	Mindanao Avenue–Quirino Highway	At-Grade	A x A	4	1	16	1	88	C5, R8	0	A	6
QC07	14.6678834, 121.0340377	Quezon City	Mindanao Avenue–Congressional Avenue	At-Grade	A x B	4	1	16	1	None	C5	0	B	6
QC108	14.65704781, 121.0242134	Quezon City	EDSA (NB)–Corregidor	At-Grade	A x C	3	0	0	1	96	C4	0	B	6
QC109	14.65594017, 121.0285958	Quezon City	EDSA (NB)–Misamis (SM North EDSA)	At-Grade	A x C	3	0	0	1	96	C4	0	B	6
QC11	14.63258345, 121.0186752	Quezon City	Quezon Avenue–Roosevelt Avenue	At-Grade	A x B	3	1	0	1	None	R7	0	A	3
QC110	14.65752939,	Quezon City	EDSA (SB)–Kaingin	At-Grade	A x C	3	0	0	1	None	C4	0	A	6

Code	Coordinate	LGU	Intersection	Structure	INTType	No. of Legs	Signal	Crossing Conflict	PUV Stop	Section	Rad//Cir	Area	SevLOC	SevQL
	121.0108736		Road											
QC115	14.63051265, 121.0110663	Quezon City	G. Araneta Avenue–Maria Clara St.	At-Grade	A x C	4	0	16	1	100	C3	0	B	4
QC117	14.62006232, 121.0595375	Quezon City	P. Tuazon Boulevad–15th Avenue	At-Grade	B x B	4	1	5	1	108	0	Cubao	B	2
QC118	14.6125978, 121.0627159	Quezon City	Col. Bonny Serrano Avenue–15th Avenue	At-Grade	B x B	4	1	8	1	None	0	Cubao	B	3
QC12	14.62824921, 121.0132815	Quezon City	Quezon Avenue–G. Araneta Avenue	At-Grade	A x A	4	1	16	1	100	C3,R7	0	B	2
QC13	14.6439128, 120.9938283	Quezon City	A. Bonifacio Avenue–5th Avenue/Sgt. Rivera Avenue	At-Grade	A x A	4	1	16	1	None	C3,R8	0	C	6
QC17	14.69307014, 121.070349	Quezon City	Republic Avenue–Sampaguita/Saint Anthony Street	At-Grade	A x A	4	0	16	0	None	0	0	B	1
QC19	14.66484944, 121.0699637	Quezon City	Commonwealth Avenue–Tandang Sora Avenue/Luzon Avenue	Elevated	A x A	4	0	0	1	None	C5,R7	0	A	4
QC20	14.63176476, 121.0781025	Quezon City	Marcos Highway–A. Bonifacio Avenue	At-Grade	A x B	3	0	0	1	None	R6	0	A	5
QC21	14.63157213, 121.074021	Quezon City	Katipunan Avenue–Aurora Boulevard/Marcos Highway	Elevated	A x A	4	1	16	1	None	C5,R6	0	B	2
QC22	14.62160338, 121.0501707	Quezon City	EDSA–Aurora Boulevard	Elevated	A x A	4	1	16	1	102	C4,R6	Cubao	C	3
QC23	14.63306503, 121.044777	Quezon City	EDSA–Timog Avenue	Elevated	A x B	4	1	6	1	102	C4	Cubao	A	2
QC24	14.64433405, 121.0376496	Quezon City	EDSA–Quezon Avenue	Elevated	A x A	4	1	16	1	96	C4,R7	0	C	3
QC25	14.6138439, 121.0348323	Quezon City	Aurora Boulevard–Gilmore Avenue	At-Grade	A x A	4	1	3	1	None	R6	0	A	2
QC26	14.60560885, 121.0187956	Quezon City	G. Araneta Avenue–Magsaysay Boulevard	At-Grade	A x A	4	1	16	1	35	C3	0	C	2
QC28	14.65473622, 121.054842	Quezon City	Commonwealth Avenue–University Avenue	At-Grade	A x C	3	0	8	1	None	R7	0	A	4
QC29	14.68178299, 121.0695965	Quezon City	Luzon Avenue–Diego Silang/Airforce	At-Grade	A x B	4	0	16	0	94	0	0	C	3
QC30	14.67197685, 121.068519	Quezon City	Congressional Avenue Extension–Luzon	At-Grade	A x B	3	0	0	1	94	C5	0	B	3

Code	Coordinate	LGU	Intersection	Structure	INTType	No. of Legs	Signal	Crossing Conflict	PUV Stop	Section	Rad//Cir	Area	SevLOC	SevQL
			Avenue											
QC31	14.64828302, 121.0743943	Quezon City	Katipunan Avenue–C. P. Garcia Avenue	At-Grade	A x B	3	1	1	0	None	C5	0	A	2
QC36	14.69302198, 121.0407799	Quezon City	Don Julio Gregorio–F. delos Santos/Gulod Road	At-Grade	A x B	4	0	16	0	None	0	0	C	3
QC37	14.71965345, 121.0211313	Quezon City	Gen. Luis–Katipunan Extension	At-Grade	A x B	3	0	3	1	3	C6	0	B	2
QC38	14.70067913, 121.0347601	Quezon City	Quirino Highway–Pablo dela Cruz	At-Grade	A x B	3	1	3	1	88	R8	0	B	6
QC41	14.63706216, 121.0259953	Quezon City	Quezon Avenue–Timog Avenue	At-Grade	A x B	4	1	16	1	None	R7	0	A	2
QC46	14.65555491, 121.0300406	Quezon City	EDSA–North Avenue	At-Grade	A x B	3	0	0	1	96	C4	0	B	6
QC49	14.60137695, 121.0792823	Quezon City	E. Rodriguez Jr. Avenue–Greenmeadows Avenue	At-Grade	A x B	3	1	3	1	113	C5	0	B	2
QC50	14.61090625, 121.0551551	Quezon City	EDSA–Santolan Road/Col. Bonny Serrano Avenue	Elevated	A x B	4	1	16	1	102	C4	Cubao	B	2
QC51	14.61768856, 121.0018159	Quezon City	Quezon Avenue/Espana Boulevard–E. Rodriguez Sr. Avenue	At-Grade	A x A	4	0	4	1	None	R7	0	B	2
QC53	14.7218906, 121.0386348	Quezon City	Gen. Luis–Buenamar Drive	At-Grade	A x B	3	0	0	1	86	C6	0	B	6
QC59	14.62482998, 121.0571055	Quezon City	Aurora Boulevard–15th Avenue	At-Grade	A x B	4	1	3	1	111	R6	Cubao	B	2
QC64	14.63056081, 121.0457883	Quezon City	EDSA–Kamuning Road/Kamias Road	Elevated	A x B	4	1	16	1	102	C4	Cubao	A	2
QC65	14.61610131, 121.0746351	Quezon City	E. Rodriguez Jr. Avenue (C-5)/FVR Road–C-5 Access Road	Elevated	A x B	3	1	3	1	112	C5	Cubao	B	2
QC67	14.61630598, 121.0524341	Quezon City	EDSA (Service Roads)–P. Tuazon Boulevard	At-Grade	A x B	4	1	16	1	102	C4	Cubao	C	2
QC69	14.69942702, 121.087397	Quezon City	Commonwealth Avenue (NB)–IBP Road	At-Grade	A x B	4	0	0	1	None	R7	0	A	3

Code	Coordinate	LGU	Intersection	Structure	INTType	No. of Legs	Signal	Crossing Conflict	PUV Stop	Section	Rad//Cir	Area	SevLOC	SevQL
QC72	14.67785215, 121.0831591	Quezon City	Commonwealth Avenue–Holy Spirit Drive	At-Grade	A x B	4	0	0	1	None	R7	0	A	6
QC75	14.61162862, 121.03594	Quezon City	Gilmore Avenue–N. Domingo	At-Grade	A x B	4	0	3	1	105	R6	0	B	2
QC77	14.62656368, 121.0605247	Quezon City	Aurora Boulevard–20th Avenue	At-Grade	A x C	3	1	0	1	111	R6	Cubao	B	2
QC78	14.62771947, 121.0632697	Quezon City	Aurora Boulevard–Anonas	At-Grade	A x C	3	1	3	1	111	R6	Cubao	B	2
QC84	14.71059972, 121.0611989	Quezon City	Commonwealth Avenue–Regalado Highway	At-Grade	A x C	3	1	3	1	None	R7	0	A	6
QC88	14.66407891, 121.0678448	Quezon City	Commonwealth Avenue (SB)–Tandang Sora Avenue	At-Grade	A x C	3	1	0	1	None	R7	0	A	6
QC95	14.66677576, 121.0074062	Quezon City	Quirino Highway–Sta. Quiteria Road	At-Grade	A x C	4	0	16	1	None	R8	0	A	6
QC97	14.64626038, 121.0409243	Quezon City	Quezon Avenue–Agham Road	At-Grade	A x C	4	1	16	1	97	R7	0	A	6
SJ01	14.60743886, 121.0392147	San Juan	Ortigas Ave–Santolan Road	At-grade	A x B	4	1	16	1	105	R6	0	A	2
SJ02	14.6009375, 121.0477869	San Juan	Ortigas Ave–Wilson	At-grade	A x C	4	1	20	1	115	R6	0	A	2
SJ03	14.60363436, 121.0216851	San Juan	Araneta Ave–N. Domingo	At-grade	A x B	3	1	3	0	None	C3	0	A	2
TG01	14.54045082, 121.0553236	Taguig	C5-McKinley Service Rd./ Carlos P. Garcia Ave.–Upper McKinley Rd	At-grade	A x A	3	1	3	1	116	C5	Makati-Pateros-Pasig-Taguig	C	2
TG04	14.4885684, 121.0609421	Taguig	Gen. Paulino Santos Ave./ Laguna Lake Highway–Manuel L. Quezon Avenue	At-grade	A x B	4	1	16	1	122	C6	0	C	2
TG05	14.51816963, 121.0733669	Taguig	Manuel L. Quezon Avenue–Seagull Avenue	At-grade	A x A	3	0	3	1	119	0	0	B	2
TG06	14.51688541, 121.0761601	Taguig	Laguna Lake Highwway–Seagull Avenue	At-grade	A x A	4	0	16	0	None	C6	0	C	2
TG07	14.53398761, 121.1005083	Taguig	Laguna Lake Highwway–Napindan	At-grade	A x A	3	0	0	0	117	C6	0	B	2

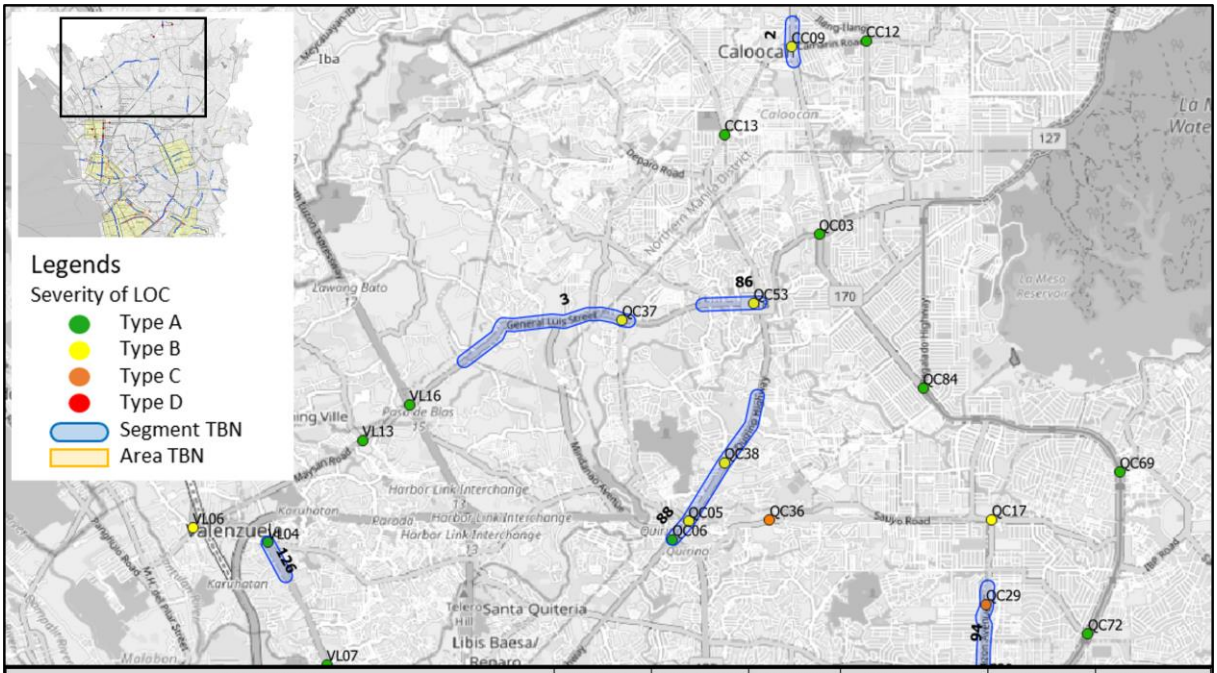
Code	Coordinate	LGU	Intersection	Structure	INTType	No. of Legs	Signal	Crossing Conflict	PUV Stop	Section	Rad//Cir	Area	SevLOC	SevQL
			Bridge Service Rd.											
TG08	14.53500817, 121.1013981	Taguig	Napindan Bridge Service Rd.–Napindan Local Rd.	At-grade	A x A	3	0	3	0	117	C6,R4	0	D	2
TG13	14.55085299, 121.0586947	Taguig	Carlos P. Garcia Avenue–32nd St	Elevated	A x B	3	0	0	1	22	C5	Makati-Pateros-Pasig-Taguig	B	3
TG14	14.52706284, 121.0743461	Taguig	J.P. Rizal–Felix Y. Manalo Street	At-grade	A x B	3	0	3	1	None	0	0	B	2
TG19	14.47826254, 121.0607816	Taguig	Manuel L. Quezon Avenue–Paso	At-grade	A x B	3	0	3	1	122	0	0	C	1
TG20	14.48778181, 121.0468799	Taguig	Gen. Paulino Santos Ave.–East Service Road	At-grade	A x C	3	0	2	1	None	C6,R3	0	B	6
TG21	14.53671856, 121.0987503	Taguig	Labao St.–Napindan Local Rd.	At-grade	A x A	3	0	3	1	117	R4	0	D	2
TG24	14.56053278, 121.0567202	Taguig	Kalayaan Ave–11th Ave	At-grade	A x C	3	0	0	1	21	R4	Makati-Pateros-Pasig-Taguig	B	2
TG35	14.53048207, 121.0577315	Taguig	C-5 Dagohoy Service Road–Cayetano Blvd.	At-grade	A x B	3	0	3	0	None	C5	Makati-Pateros-Pasig-Taguig	A	2
VL04	14.6899779, 120.9739367	Valenzuela	MacArthur Highway–Gen. T. De Leon (Karuhatan Road)/A. Pablo Street	At-grade	A x B	4	1	16	1	126	R9	0	A	6
VL06	14.6920104, 120.9639469	Valenzuela	Gov. Ignacio Santiago Road–Rincon Road	At-grade	A x B	4	0	8	0	None	C6,R9	0	B	6
VL07	14.6737596, 120.9817789	Valenzuela	MacArthur Highway–Pio Valenzuela	At-grade	A x B	3	1	3	0	None	R9	0	A	1
VL13	14.7036563, 120.986538	Valenzuela	Paso de Blas–T. Santiago	At-grade	A x B	3	0	3	0	None	C6	0	A	5
VL16	14.70840012, 120.9928277	Valenzuela	NLEX–Bagbaguin Road/Paso de Blas	Elevated	A x C	4	0	36	1	None	C6	0	A	4

APPENDIX F

Factors of Congestion on Segment Bottlenecks based on Site Observation

APPENDIX F

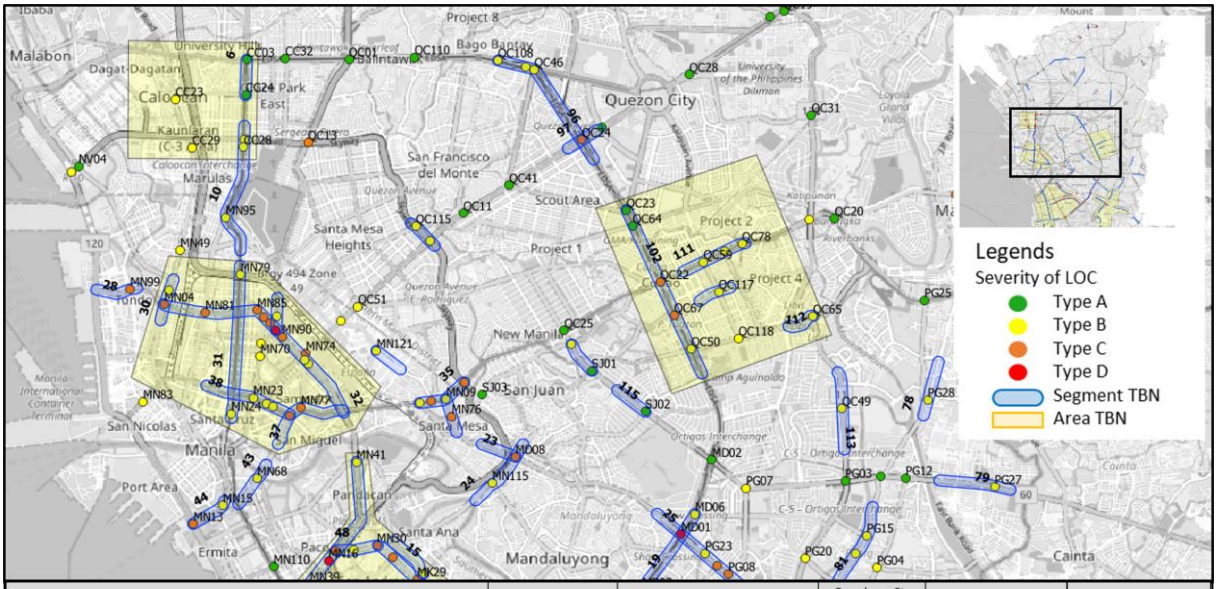
Factors of Congestion on Segment Bottlenecks Based on Site Observation



Segment Roads	Zabarte Rd	Gen. Luis St	Gen. Luis St	Quirino Hwy			Luzon Ave		MacArthur Hwy
TBNs Involved	CC09	QC37	QC53	QC38	QC05	QC06	QC29	QC30	VL04
Segment Code	2	3	86	88	88	88	94	94	126
Distance(km)	0.60	2.73	0.85	2.56			1.77		0.57
No. of TBN	1	1	1	3			2		1
Severity of Level of Congestion	B	B	B	B	B	A	C	B	A
Severity of Queue Length	2	2	6	6	6	6	3	3	6
Signal Type	1	1	1	3	1	3	1	1	3
FACTOR OF CONGESTION									
Lack of lanes	0	1	1	1	1	1	1	1	1
Insufficient road width	0	1	1	1	1	1	1	1	1
Wrong geometric layout	0	1	1	0	1	1	1	1	1
Inadequate corner cutting	0	1	1	1	1	0	1	1	1
Improper location of road facilities (road markings)	0	1	1	0	1	0	1	1	1
Inadequate traffic signal control (If No Signal)	0	1	1	0	1	0	0	1	0
Inadequate traffic signal control (If With Signal)	0	0	0	0	0	1	0	0	1
Bad visibility of traffic signal	0	0	0	0	0	0	0	0	0
No left-turn lane	0	1	0	1	0	1	1	1	0
Insufficient left-turn lane length	0	0	0	0	0	0	0	0	0
Conflict between left-turn and through movements	0	1	0	1	0	0	1	0	0
Right-turning vehicles blocking vehicles proceeding straight ahead	0	1	0	1	1	1	1	0	1
Improper stop line position	0	1	0	0	1	0	1	1	1
Improper channelization	0	0	0	0	0	0	0	0	0
Speed reduction due to large vehicle	0	0	0	1	1	1	0	1	1
Obstruction by motorcycles	0	1	1	1	1	1	1	1	1
Obstruction by bicycles	0	1	1	1	1	1	1	1	1
Obstruction by pedestrians	0	1	1	1	1	1	1	1	0
Stopped traffic at at-grade railway crossings	0	0	0	0	0	0	0	0	0
Traffic flow in/out from intersections and narrow streets	0	0	0	1	0	1	0	0	1
Traffic flow in/out from ICs at expressways	0	0	0	0	0	0	0	0	0
Speed reduction due to PUV stops	0	1	0	1	0	1	0	0	1
Speed reduction due to PUJ stops	1	1	1	1	1	1	0	0	1
Lane reduction with dedicated bus and priority lanes	0	0	0	1	1	1	0	1	0
Obstruction of travel by on-street parking	1	0	1	1	1	1	1	1	0
Excess traffic demand at intersections	0	0	1	0	1	0	0	0	1
Excess traffic demand at non-intersections	0	0	0	1	1	1	0	0	0
Concentration of traffic at specific times	1	1	1	1	1	1	1	1	1
Concentration of traffic on roadside facilities at specific times and periods	1	1	1	1	1	1	1	1	1
Concentration of traffic at specific periods during events or incidents	1	1	1	1	1	1	1	1	1
Lane blockage due to construction	0	0	0	0	0	0	0	1	0
Clogging with congestion downstream	1	0	1	1	1	1	0	0	1

Note: Segment codes that are highlighted are TBNs intersecting two segments.
Factor of Congestion present in a TBN has a value of 1, marked with red cells.

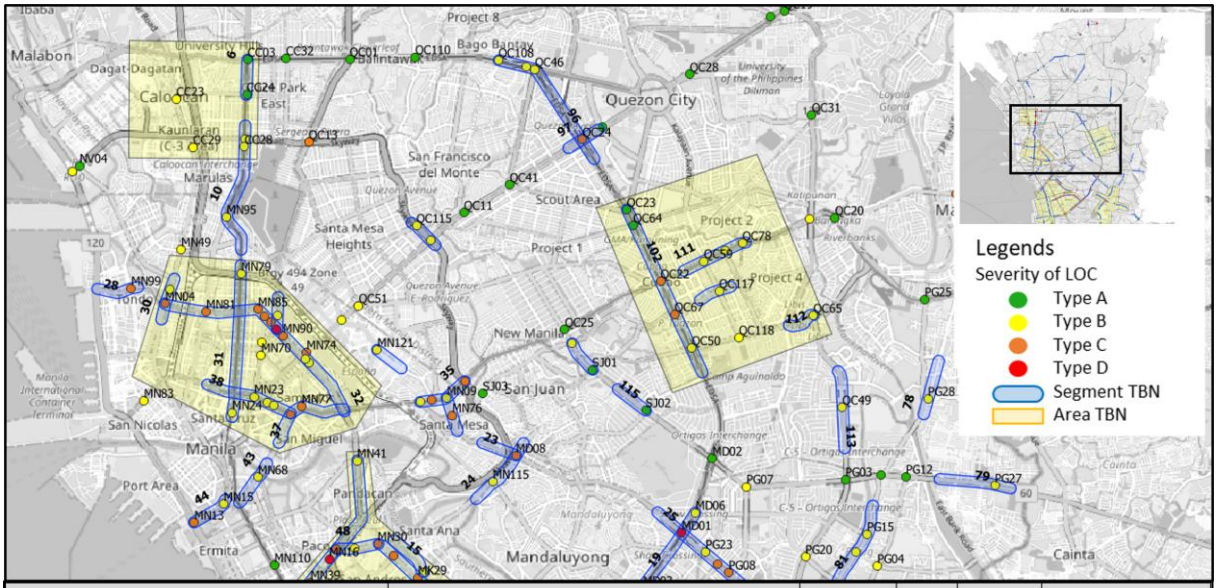
Figure F.1: Zabarte Rd., Gen Luis St., Quirino Hwy., Luzon Ave., McArthur Hwy.



Segment Roads	Rizal Ave		Rizal Ave			Capulong St-Pres. Quirino Ave	Juan Luna St-A. Mabini St		Rizal Ave	
TBNs Involved	CC03	CC24	CC05	CC28	MN95	MN99	MN80	MN04	MN79	MN24
Segment Code	6	6	10	10	10	28	30	30	31	31
Distance(km)	0.65		2.44			0.75	0.79		2.81	
No. of TBN	2		3			1	2		2	
Severity of Level of Congestion	A	A	B	B	B	C	B	C	B	B
Severity of Queue Length	1	2	3	3	2	1	1	3	1	2
Signal Type	1	3	3	3	3	1	3	3	1	1
FACTOR OF CONGESTION										
Lack of lanes	1	1	1	1	0	0	0	1	0	1
Insufficient road width	1	1	1	1	1	0	0	1	0	1
Wrong geometric layout	0	0	1	1	1	0	0	0	0	0
Inadequate corner cutting	0	1	1	1	1	0	0	0	0	0
Improper location of road facilities (road markings)	0	0	0	1	1	1	0	0	1	0
Inadequate traffic signal control (If No Signal)	0	0	0	0	0	1	0	0	1	0
Inadequate traffic signal control (If With Signal)	0	1	0	0	0	0	0	0	0	0
Bad visibility of traffic signal	0	1	0	0	0	0	0	0	0	0
No left-turn lane	1	1	1	1	1	1	0	0	1	0
Insufficient left-turn lane length	0	0	0	0	1	1	0	1	0	0
Conflict between left-turn and through movements	0	0	0	0	1	1	0	0	0	0
Right-turning vehicles blocking vehicles proceeding straight ahead	1	1	1	1	1	1	0	0	0	0
Improper stop line position	0	0	1	1	1	1	0	1	0	0
Improper channelization	0	0	0	0	0	0	0	0	0	0
Speed reduction due to large vehicle	1	1	1	0	1	1	1	0	0	0
Obstruction by motorcycles	1	1	1	1	1	1	1	1	1	1
Obstruction by bicycles	1	0	0	1	0	1	0	1	1	0
Obstruction by pedestrians	0	1	0	1	1	1	0	0	1	1
Stopped traffic at at-grade railway crossings	0	0	0	0	0	0	0	0	1	0
Traffic flow in/out from intersections and narrow streets	0	0	0	0	0	0	0	0	0	0
Traffic flow in/out from ICs at expressways	0	0	0	0	0	0	0	0	0	0
Speed reduction due to PUV stops	1	0	0	0	0	0	0	0	0	0
Speed reduction due to PUJ stops	1	1	1	1	1	0	1	0	0	0
Lane reduction with dedicated bus and priority lanes	1	0	0	1	0	0	0	0	0	0
Obstruction of travel by on-street parking	1	1	1	1	1	1	0	1	1	0
Excess traffic demand at intersections	0	1	1	0	0	0	0	1	0	0
Excess traffic demand at non-intersections	0	1	1	0	0	0	0	0	0	0
Concentration of traffic at specific times	1	1	1	1	1	0	0	0	0	0
Concentration of traffic on roadside facilities at specific times and periods	1	0	1	1	0	0	0	0	0	0
Concentration of traffic at specific periods during events or incidents	1	0	0	1	0	0	0	0	0	0
Lane blockage due to construction	0	1	1	1	0	0	0	0	0	0
Clogging with congestion downstream	0	1	1	0	0	0	0	0	0	0

Note: Segment codes that are highlighted are TBNs intersecting two segments.
Factor of Congestion present in a TBN has a value of 1, marked with red cells.

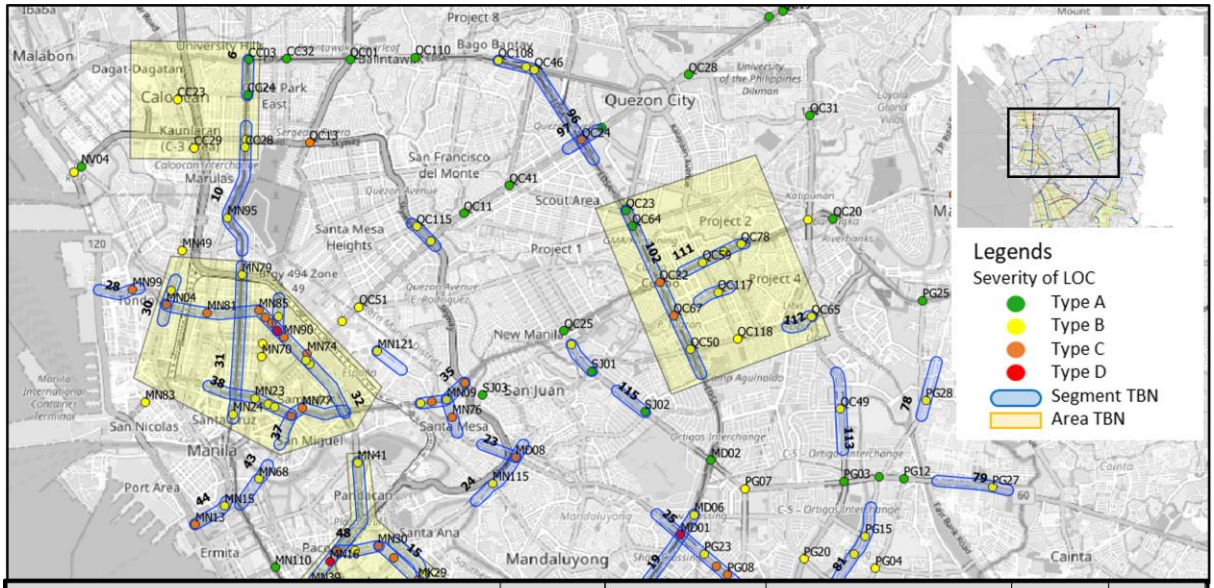
Figure F.2: Rizal Ave., Capulong St.-Pres. Quirino Ave., Juan Luna St.-A. Mabini St.



Segment Roads	Capulong St-Pres. Quirino Ave									Dimasalang Rd		Leyte St	Legarda St		C. M. Recto Ave			
TBNs Involved	MN04	MN81	MN85	MN84	MN92	MN08	MN90	MN75	MN72	MN08	MN91	MN121	MN77	MN25	MN23	MN26	MN73	MN25
Segment Code	30	32	32	32	32	32	32	32	32	32	33	34	37	37	38	38	38	37
Distance(km)	4.15									0.59		0.55	1.59		1.59			
No. of TBN	9									2		1	2		4			
Severity of Level of Congestion	C	C	C	C	C	D	C	B	B	D	B	B	C	C	B	B	B	C
Severity of Queue Length	3	1	3	2	2	1	2	2	2	1	2	3	2	1	2	2	2	1
Signal Type	3	3	1	3	3	3	3	1	3	3	3	1	3	3	2	3	3	3
FACTOR OF CONGESTION																		
Lack of lanes	1	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Insufficient road width	1	0	1	1	0	0	0	1	1	0	0	0	0	0	0	0	1	0
Wrong geometric layout	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Inadequate corner cutting	0	0	1	1	0	1	0	0	1	1	0	0	0	0	1	1	1	0
Improper location of road facilities (road markings)	0	0	1	1	0	0	0	0	0	0	0	1	0	0	0	1	1	0
Inadequate traffic signal control (If No Signal)	0	0	1	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0
Inadequate traffic signal control (If With Signal)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bad visibility of traffic signal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
No left-turn lane	0	0	0	1	0	1	0	0	1	1	0	0	1	0	0	1	0	0
Insufficient left-turn lane length	1	0	0	1	0	1	0	0	1	1	0	0	0	0	0	1	0	0
Conflict between left-turn and through movements	0	0	0	1	0	1	0	0	1	1	0	0	0	0	0	1	0	0
Right-turning vehicles blocking vehicles proceeding straight ahead	0	0	1	1	0	1	0	1	1	1	0	0	0	0	1	1	1	0
Improper stop line position	1	0	1	0	0	1	0	0	0	1	0	0	0	0	1	0	0	0
Improper channelization	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Speed reduction due to large vehicle	0	0	1	1	0	1	1	1	1	1	0	0	0	0	1	0	1	0
Obstruction by motorcycles	1	0	1	0	0	0	1	0	1	0	1	1	1	0	0	1	0	0
Obstruction by bicycles	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Obstruction by pedestrians	0	0	0	0	0	0	0	0	0	0	1	1	0	1	1	0	0	1
Stopped traffic at at-grade railway crossings	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Traffic flow in/out from intersections and narrow streets	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Traffic flow in/out from ICs at expressways	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Speed reduction due to PUV stops	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0	1
Speed reduction due to PUJ stops	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Lane reduction with dedicated bus and priority lanes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Obstruction of travel by on-street parking	1	0	1	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0
Excess traffic demand at intersections	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Excess traffic demand at non-intersections	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Concentration of traffic at specific times	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Concentration of traffic on roadside facilities at specific times and periods	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Concentration of traffic at specific periods during events or incidents	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lane blockage due to construction	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Clogging with congestion downstream	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Note: Segment codes that are highlighted are TBNs intersecting two segments.
Factor of Congestion present in a TBN has a value of 1, marked with red cells.

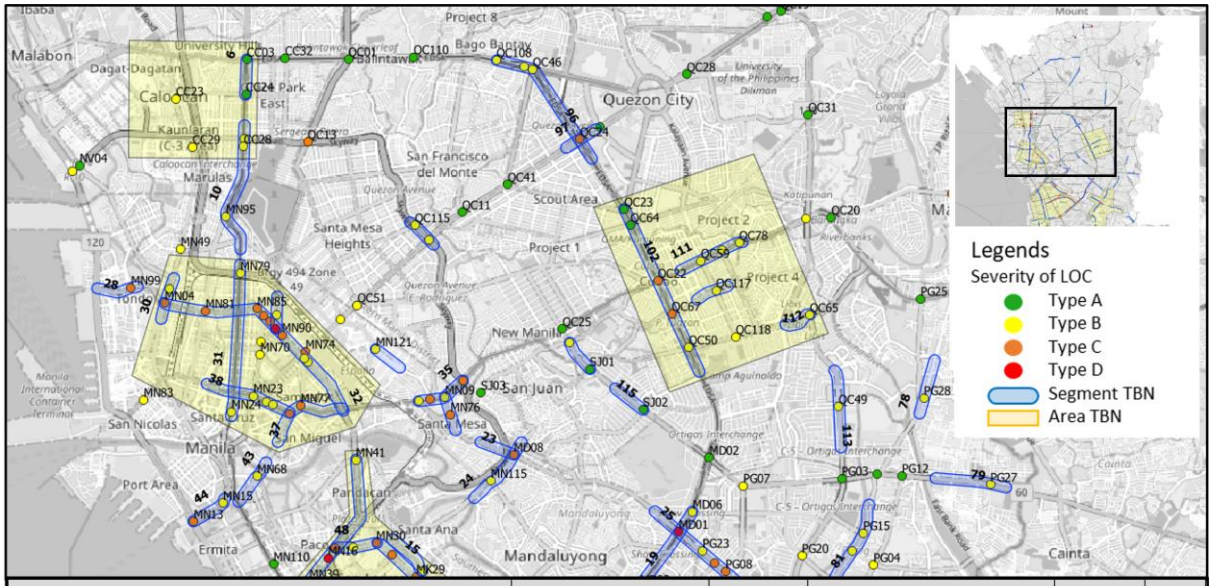
Figure F.3: Capulong St.-Pres. Quirino Ave., Dimasalang Rd., Leyte St., Legarda St., C. M. Recto Ave.



Segment Roads	P. Sanchez St	Gen Kalentong St		Aurora Blvd				V. Mapa		Gregorio Araneta Ave	
TBNs Involved	MD08	MD08	MN115	QC26	MN09	MN45	MN46	MN09	MN76	QC12	QC115
Segment Code	23	23	24	35	35	35	35	35	36	100	100
Distance(km)	0.64	1.35		0.92				0.64		0.59	
No. of TBN	1	2		4				2		2	
Severity of Level of Congestion	C	C	B	C	B	C	B	B	C	B	B
Severity of Queue Length	2	2	2	2	2	2	2	2	2	2	4
Signal Type	3	3	4	3	3	3	3	3	3	3	1
FACTOR OF CONGESTION											
Lack of lanes	0	0	0	0	0	0	0	0	0	0	1
Insufficient road width	0	0	0	0	0	0	0	0	0	0	0
Wrong geometric layout	0	0	0	0	0	0	0	0	0	0	0
Inadequate corner cutting	0	0	1	0	0	0	0	0	0	0	1
Improper location of road facilities (road markings)	0	0	0	0	0	1	1	0	0	0	0
Inadequate traffic signal control (If No Signal)	0	0	0	0	0	0	0	0	0	0	0
Inadequate traffic signal control (If With Signal)	0	0	0	0	0	0	0	0	0	0	0
Bad visibility of traffic signal	0	0	0	0	0	0	0	0	0	0	0
No left-turn lane	0	0	0	0	0	0	0	0	0	0	0
Insufficient left-turn lane length	0	0	0	0	0	0	0	0	0	0	0
Conflict between left-turn and through movements	0	0	0	0	0	0	0	0	0	0	0
Right-turning vehicles blocking vehicles proceeding straight ahead	0	0	0	0	0	0	0	0	0	0	0
Improper stop line position	0	0	0	0	0	0	0	0	0	0	0
Improper channelization	0	0	0	0	0	0	0	0	0	0	0
Speed reduction due to large vehicle	0	0	0	0	0	0	0	0	0	0	0
Obstruction by motorcycles	0	0	1	0	1	1	1	1	1	0	0
Obstruction by bicycles	0	0	0	0	0	0	0	0	0	0	1
Obstruction by pedestrians	0	0	1	0	1	0	0	1	0	0	0
Stopped traffic at at-grade railway crossings	0	0	0	0	0	0	0	0	0	0	0
Traffic flow in/out from intersections and narrow streets	0	0	0	0	0	0	1	0	0	0	0
Traffic flow in/out from ICs at expressways	0	0	0	0	0	0	0	0	0	0	0
Speed reduction due to PUV stops	0	0	0	0	0	0	1	0	0	0	0
Speed reduction due to PUJ stops	0	0	1	0	1	1	1	1	1	0	1
Lane reduction with dedicated bus and priority lanes	0	0	0	0	0	0	0	0	0	0	0
Obstruction of travel by on-street parking	0	0	0	0	0	0	0	0	0	0	1
Excess traffic demand at intersections	0	0	0	0	0	0	0	0	0	0	0
Excess traffic demand at non-intersections	0	0	0	0	0	0	0	0	0	0	0
Concentration of traffic at specific times	0	0	1	0	1	1	1	1	1	0	0
Concentration of traffic on roadside facilities at specific times and periods	0	0	0	0	0	0	0	0	0	0	0
Concentration of traffic at specific periods during events or incidents	0	0	0	0	0	0	0	0	0	0	0
Lane blockage due to construction	0	0	0	0	0	0	0	0	0	0	0
Clogging with congestion downstream	1	1	0	0	0	0	0	0	0	0	0

Note: Segment codes that are highlighted are TBNs intersecting two segments.
Factor of Congestion present in a TBN has a value of 1, marked with red cells.

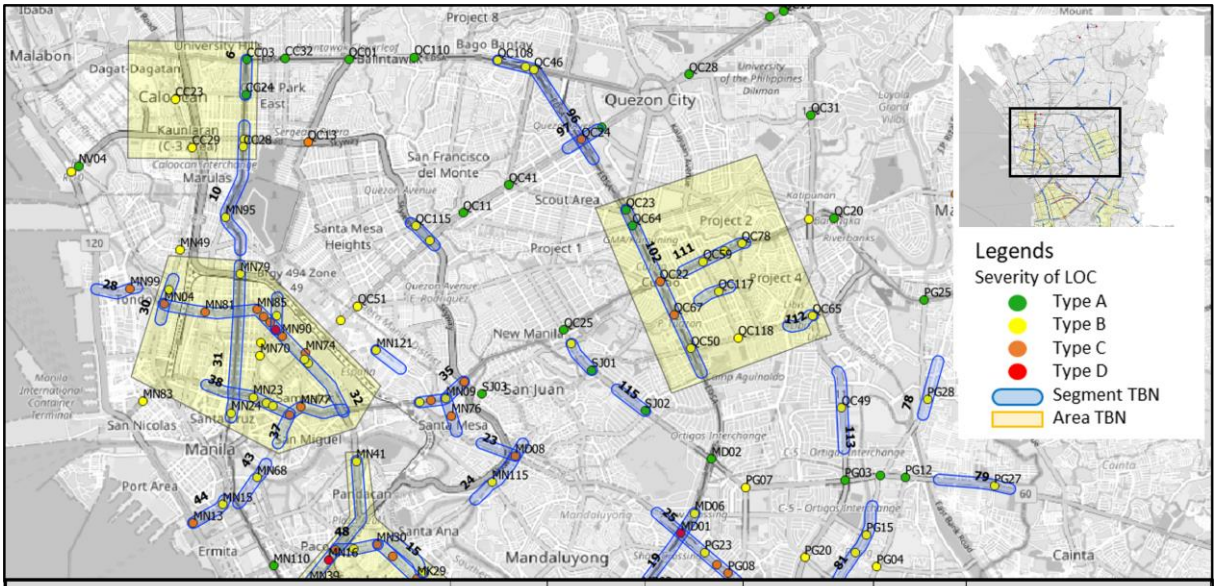
Figure F.4: P. Sanchez St., Gen. Kalentong St., Aurora Blvd., V. Mapa, Gregorio Araneta Ave.



Segment Roads	EDSA				Quezon Ave		EDSA					Ortigas Ave		Ortigas Ave
TBNs Involved	QC108	QC109	QC46	QC24	QC24	QC97	QC22	QC67	QC50	QC23	QC64	SJ01	QC75	SJ02
Segment Code	96	96	96	96	96	97	102	102	102	102	102	105	105	115
Distance(km)	2.63				0.64		3.29					0.61		0.64
No. of TBN	4				2		5					2		1
Severity of Level of Congestion	B	B	B	C	C	A	C	C	B	A	A	A	B	A
Severity of Queue Length	6	6	6	3	3	6	3	2	2	2	2	2	2	2
Signal Type	1	1	1	4	4	3	4	3	4	4	4	3	1	3
FACTOR OF CONGESTION														
Lack of lanes	1	1	1	1	1	1	0	0	0	0	0	0	0	0
Insufficient road width	1	1	1	1	1	1	0	0	0	0	0	0	0	0
Wrong geometric layout	0	0	0	1	1	0	0	0	0	0	0	0	0	0
Inadequate corner cutting	1	1	1	0	0	0	0	0	0	0	0	0	0	0
Improper location of road facilities (road markings)	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Inadequate traffic signal control (If No Signal)	0	1	1	0	0	0	0	0	0	0	0	0	0	0
Inadequate traffic signal control (If With Signal)	0	0	0	1	1	0	0	0	0	0	0	0	0	0
Bad visibility of traffic signal	0	0	0	0	0	0	0	0	0	0	0	0	0	0
No left-turn lane	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Insufficient left-turn lane length	0	0	0	1	1	0	0	0	0	0	0	0	0	0
Conflict between left-turn and through movements	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Right-turning vehicles blocking vehicles proceeding straight ahead	1	1	0	0	0	1	0	0	0	0	0	0	0	0
Improper stop line position	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Improper channelization	0	0	0	1	1	0	0	0	0	0	0	0	0	0
Speed reduction due to large vehicle	0	1	1	0	0	0	1	0	0	0	0	1	0	0
Obstruction by motorcycles	1	0	0	1	1	1	0	0	0	0	0	0	0	0
Obstruction by bicycles	1	0	0	0	0	1	0	0	0	0	0	0	0	0
Obstruction by pedestrians	1	0	0	1	1	1	0	0	0	0	0	0	0	0
Stopped traffic at at-grade railway crossings	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Traffic flow in/out from intersections and narrow streets	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Traffic flow in/out from ICs at expressways	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Speed reduction due to PUV stops	0	1	1	0	0	1	1	0	0	0	0	0	0	0
Speed reduction due to PUJ stops	0	0	1	1	1	1	0	0	0	0	0	0	0	0
Lane reduction with dedicated bus and priority lanes	1	1	1	1	1	1	0	0	0	0	0	0	0	0
Obstruction of travel by on-street parking	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Excess traffic demand at intersections	1	1	1	1	1	1	0	0	0	0	0	0	0	0
Excess traffic demand at non-intersections	1	1	1	1	1	1	0	0	0	0	0	0	0	0
Concentration of traffic at specific times	1	1	1	1	1	1	0	0	0	0	0	0	0	0
Concentration of traffic on roadside facilities at specific times and periods	1	1	1	1	1	1	0	0	0	0	0	0	0	0
Concentration of traffic at specific periods during events or incidents	1	1	1	1	1	1	0	0	0	0	0	0	0	0
Lane blockage due to construction	0	1	1	1	1	0	0	0	0	0	0	0	0	0
Clogging with congestion downstream	1	0	1	1	1	1	0	0	0	0	0	1	0	0

Note: Segment codes that are highlighted are TBNs intersecting two segments.
Factor of Congestion present in a TBN has a value of 1, marked with red cells.

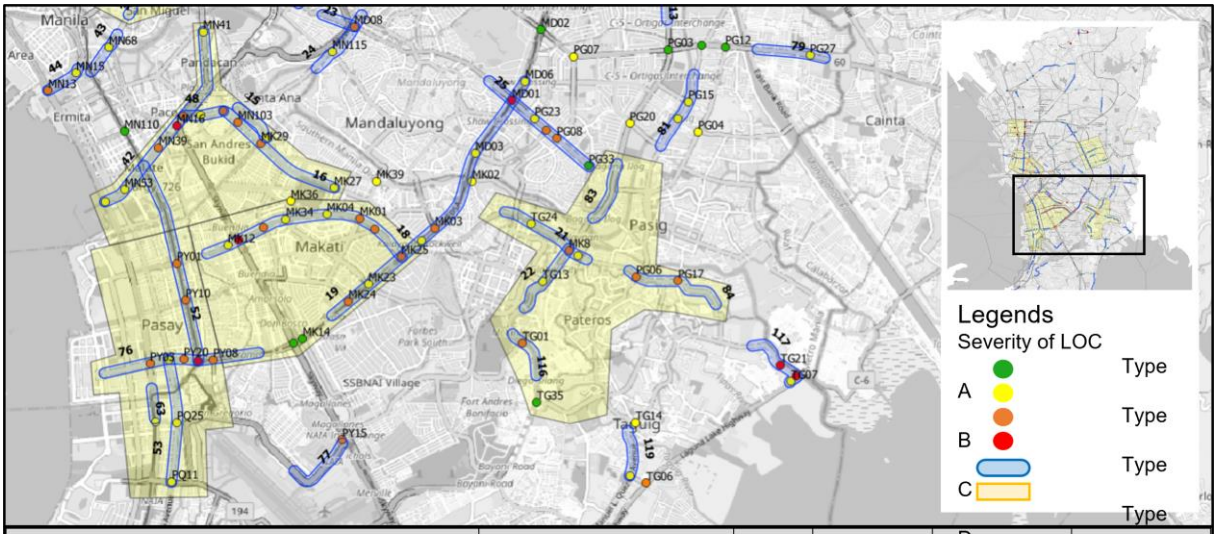
Figure F.5: EDSA, Quezon Ave., Ortigas Ave.



Segment Roads	E. Mariano Ave	Ortigas Ave Ext	P. Tuazon Blvd	Aurora Blvd			C5 Access Rd	Carlos P. Garcia Ave-E. Rodriguez Ave
TBNs Involved	PG28	PG27	QC117	QC59	QC77	QC78	QC65	QC49
Segment Code	78	79	108	111	111	111	112	113
Distance(km)	1.02	1.28	0.61	1.23			0.52	1.44
No. of TBN	1	1	1	3			1	1
Severity of Level of Congestion	B	B	B	B	B	B	B	B
Severity of Queue Length	3	2	2	2	2	2	2	2
Signal Type	1	1	3	3	3	3	4	3
FACTOR OF CONGESTION								
Lack of lanes	0	0	0	0	0	0	0	0
Insufficient road width	0	0	0	0	1	0	0	0
Wrong geometric layout	0	0	0	0	0	0	0	0
Inadequate corner cutting	0	0	0	0	0	0	0	0
Improper location of road facilities (road markings)	1	0	0	0	0	0	0	0
Inadequate traffic signal control (If No Signal)	0	0	0	0	0	0	0	0
Inadequate traffic signal control (If With Signal)	0	0	0	0	0	0	0	0
Bad visibility of traffic signal	0	0	0	0	0	0	0	0
No left-turn lane	0	0	0	0	0	0	0	0
Insufficient left-turn lane length	0	0	0	0	0	0	0	0
Conflict between left-turn and through movements	0	0	0	0	0	0	0	0
Right-turning vehicles blocking vehicles proceeding straight ahead	0	0	0	0	0	0	0	0
Improper stop line position	0	0	0	0	0	0	0	0
Improper channelization	0	0	0	0	0	0	0	0
Speed reduction due to large vehicle	0	0	0	0	0	0	0	0
Obstruction by motorcycles	0	0	0	0	0	0	0	0
Obstruction by bicycles	0	0	0	0	0	0	0	0
Obstruction by pedestrians	0	0	0	0	0	0	0	0
Stopped traffic at at-grade railway crossings	0	0	0	0	0	0	0	0
Traffic flow in/out from intersections and narrow streets	0	0	0	0	0	0	0	0
Traffic flow in/out from ICs at expressways	0	0	0	0	0	0	0	0
Speed reduction due to PUV stops	0	0	0	0	0	0	0	0
Speed reduction due to PUJ stops	0	0	0	0	0	0	0	0
Lane reduction with dedicated bus and priority lanes	0	0	0	0	0	0	0	0
Obstruction of travel by on-street parking	0	0	0	0	0	0	0	0
Excess traffic demand at intersections	0	0	0	0	0	0	0	0
Excess traffic demand at non-intersections	0	0	0	0	0	0	0	0
Concentration of traffic at specific times	0	0	0	0	0	0	0	0
Concentration of traffic on roadside facilities at specific times and periods	0	0	0	0	0	0	0	0
Concentration of traffic at specific periods during events or incidents	0	0	0	0	0	0	0	0
Lane blockage due to construction	0	0	0	0	0	0	0	0
Clogging with congestion downstream	1	0	0	0	0	0	0	0

Note: Segment codes that are highlighted are TBNs intersecting two segments.
Factor of Congestion present in a TBN has a value of 1, marked with red cells.

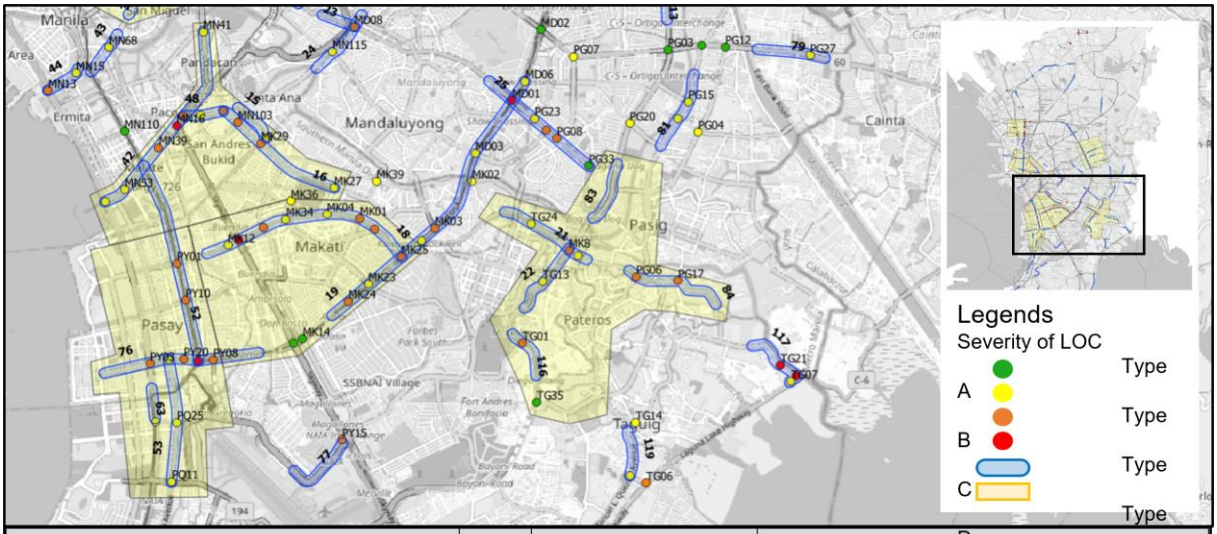
Figure F.6: E. Mariano Ave., Ortigas Ave. Ext., P. Tuazon Blvd., Aurora Blvd., C5 Access Rd., Carlos P. Garcia Ave.-E. Rodriguez Ave.



Segment Roads	Capulong St-Pres. Quirino Ave						Legarda St	P. Burgos Ave		Pedro Gil St			Taft Ave		
TBNs Involved	MN41	MN17	MN16	MN39	MN53	MN11	MN68	MN15	MN13	MN30	MN17	MN104	PY01	PY10	PY04
Segment Code	42	42	42	42	42	42	43	44	44	16	42	48	52	52	76
Distance(km)	4.05						0.88	0.72		1.75			3.93		
No. of TBN	6						1	2		3			3		
Severity of Level of Congestion	B	C	D	C	B	B	B	B	C	C	C	B	C	C	D
Severity of Queue Length	2	2	2	3	2	3	1	1	3	2	2	2	2	2	4
Signal Type	3	4	4	3	3	3	3	3	3	1	4	1	3	3	3
FACTOR OF CONGESTION															
Lack of lanes	1	1	0	0	0	0	0	0	0	0	1	1	0	0	1
Insufficient road width	1	1	0	1	1	0	0	0	0	1	1	1	0	0	1
Wrong geometric layout	0	0	0	0	1	0	0	0	0	1	0	1	0	0	1
Inadequate corner cutting	0	0	0	0	1	0	0	0	0	1	0	1	0	0	1
Improper location of road facilities (road markings)	0	0	0	1	0	0	0	1	0	1	0	1	0	1	1
Inadequate traffic signal control (If No Signal)	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0
Inadequate traffic signal control (If With Signal)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bad visibility of traffic signal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
No left-turn lane	0	0	0	0	1	1	0	1	0	1	0	1	0	0	1
Insufficient left-turn lane length	0	0	0	0	1	1	0	0	0	1	0	1	0	0	1
Conflict between left-turn and through movements	0	0	0	0	1	1	0	0	0	1	0	1	0	0	0
Right-turning vehicles blocking vehicles proceeding straight ahead	0	0	0	0	1	1	0	1	0	1	0	1	0	0	1
Improper stop line position	0	0	0	0	1	0	0	0	0	1	0	1	0	0	1
Improper channelization	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Speed reduction due to large vehicle	0	0	0	0	1	1	1	0	1	1	0	1	1	0	1
Obstruction by motorcycles	1	0	0	0	1	0	1	1	0	1	0	0	1	1	1
Obstruction by bicycles	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Obstruction by pedestrians	1	0	0	0	0	0	0	0	0	1	0	0	0	1	1
Stopped traffic at at-grade railway crossings	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0
Traffic flow in/out from intersections and narrow streets	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Traffic flow in/out from ICs at expressways	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Speed reduction due to PUV stops	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
Speed reduction due to PUJ stops	0	0	0	0	1	0	1	0	0	1	0	1	1	1	1
Lane reduction with dedicated bus and priority lanes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Obstruction of travel by on-street parking	0	0	0	0	0	0	0	0	0	1	0	1	0	1	1
Excess traffic demand at intersections	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Excess traffic demand at non-intersections	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Concentration of traffic at specific times	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
Concentration of traffic on roadside facilities at specific times and periods	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Concentration of traffic at specific periods during events or incidents	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Lane blockage due to construction	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Clogging with congestion downstream	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1

Note: Segment codes that are highlighted are TBNs intersecting two segments.
Factor of Congestion present in a TBN has a value of 1, marked with red cells.

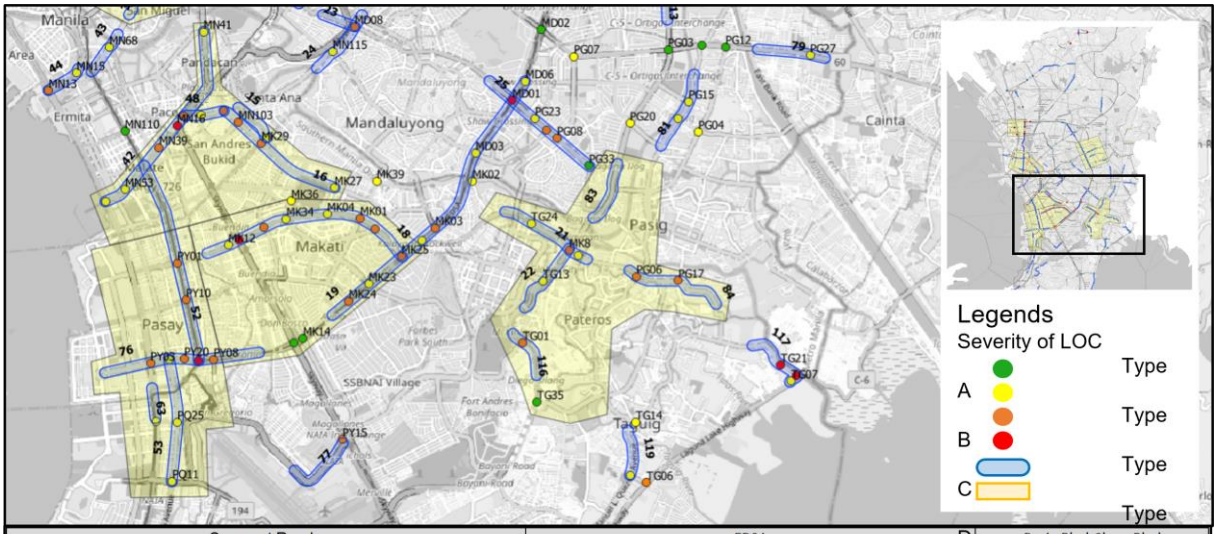
Figure F.7: Capulong St.-Pres. Quirino Ave., Legarda St., P. Burgos Ave., Pedro Gil St., Taft Ave.



Segment Roads	Tejeron St	Kalayaan Ave				Sen. Gil Puyat Ave							
TBNs Involved	MK32	MN30	MN103	MK29	MK27	MK01	MK04	MK12	MK28	MK24	MK35	MK40	MK25
Segment Code	15	16	16	16	16	18	18	18	18	18	18	19	19
Distance(km)	0.81	2.58											
No. of TBN	1	4				8							
Severity of Level of Congestion	B	C	C	C	B	C	B	B	D	B	C	C	C
Severity of Queue Length	2	2	2	2	2	6	2	2	2	2	3	3	3
Signal Type	3	1	1	1	3	3	3	3	4	3	3	3	2
FACTOR OF CONGESTION													
Lack of lanes	1	0	1	0	0	0	0	0	0	0	0	0	0
Insufficient road width	1	1	1	0	1	1	0	0	0	0	1	0	1
Wrong geometric layout	0	1	1	0	1	1	0	0	0	0	0	0	0
Inadequate corner cutting	1	1	1	0	1	1	1	0	0	0	1	0	0
Improper location of road facilities (road markings)	0	1	1	1	1	1	0	0	0	0	0	0	0
Inadequate traffic signal control (If No Signal)	0	1	1	1	0	0	0	0	0	0	0	0	0
Inadequate traffic signal control (If With Signal)	0	0	0	0	1	0	0	0	0	0	0	0	0
Bad visibility of traffic signal	0	0	0	0	1	0	0	0	0	0	0	0	0
No left-turn lane	0	1	1	0	1	1	1	0	1	0	0	1	0
Insufficient left-turn lane length	0	1	1	0	1	1	1	0	1	0	0	1	0
Conflict between left-turn and through movements	0	1	1	0	1	0	0	0	0	0	0	0	0
Right-turning vehicles blocking vehicles proceeding straight ahead	0	1	1	0	1	1	1	0	0	0	1	1	0
Improper stop line position	0	1	1	0	1	1	0	0	0	0	0	0	0
Improper channelization	0	0	0	0	0	1	0	0	0	0	0	0	0
Speed reduction due to large vehicle	1	1	1	0	0	0	0	0	0	0	0	0	0
Obstruction by motorcycles	1	1	0	1	1	1	1	1	0	1	1	1	1
Obstruction by bicycles	0	0	0	0	0	0	0	0	0	0	0	0	0
Obstruction by pedestrians	1	1	0	0	0	1	0	0	0	0	0	0	0
Stopped traffic at at-grade railway crossings	0	0	0	0	0	0	0	0	1	0	0	0	0
Traffic flow in/out from intersections and narrow streets	0	0	0	0	0	0	0	0	0	0	0	0	0
Traffic flow in/out from ICs at expressways	0	0	0	0	0	0	0	0	0	0	0	0	0
Speed reduction due to PUV stops	0	0	0	0	0	1	1	1	1	1	1	0	1
Speed reduction due to PUJ stops	1	1	1	0	1	1	1	1	1	1	1	1	0
Lane reduction with dedicated bus and priority lanes	0	0	0	0	0	0	0	0	0	0	0	0	1
Obstruction of travel by on-street parking	0	1	1	1	0	0	0	0	0	0	0	0	0
Excess traffic demand at intersections	0	0	0	0	1	1	0	0	0	0	1	1	0
Excess traffic demand at non-intersections	0	0	0	0	1	1	0	0	0	0	1	1	0
Concentration of traffic at specific times	1	0	0	0	1	1	0	0	0	1	1	1	0
Concentration of traffic on roadside facilities at specific times and periods	0	0	0	0	1	1	0	0	0	0	1	1	0
Concentration of traffic at specific periods during events or incidents	0	0	0	0	1	1	0	0	0	0	1	1	0
Lane blockage due to construction	0	0	1	0	0	0	0	0	0	0	1	0	0
Clogging with congestion downstream	0	0	0	0	0	0	0	0	0	0	0	0	0

Note: Segment codes that are highlighted are TBNs intersecting two segments.
Factor of Congestion present in a TBN has a value of 1, marked with red cells.

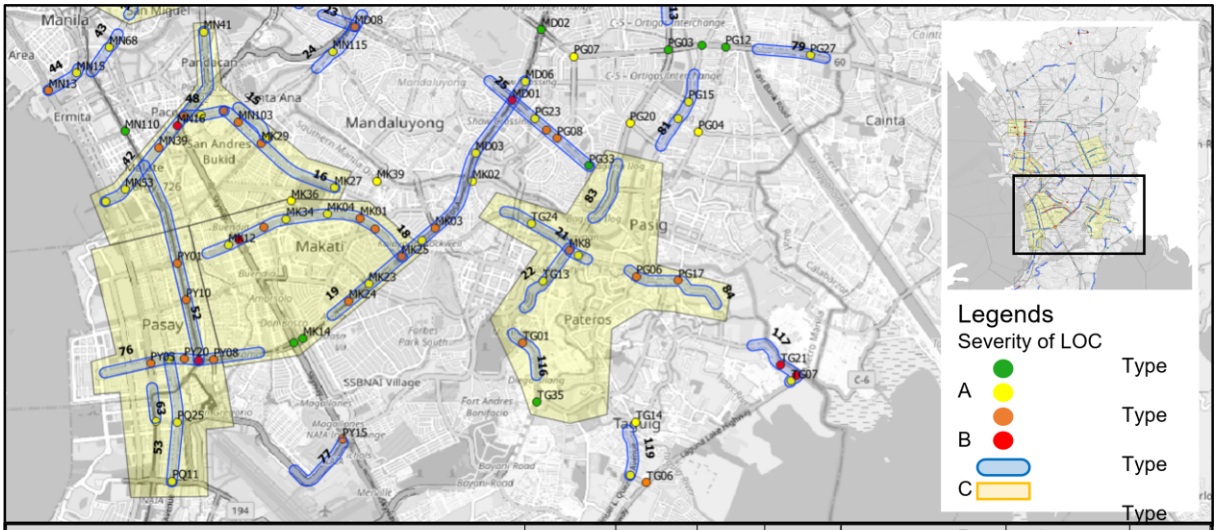
Figure F.8: Tejeron St., Kalayaan Ave., Sen. Gil Puyat Ave.



Segment Roads	EDSA								Pasig Blvd-Shaw Blvd			
TBNs Involved	MD01	MD03	MD06	MK03	MK05	MK23	MK24	MK25	MD01	PG23	PG08	PG08
Segment Code	19	19	19	19	19	19	19	19	19	25	25	25
Distance(km)	5.93								2.50			
No. of TBN	8								4			
Severity of Level of Congestion	D	B	B	C	B	B	C	C	D	B	C	C
Severity of Queue Length	2	4	3	2	2	2	3	3	2	2	3	2
Signal Type	4	2	1	2	2	4	3	2	4	3	3	3
FACTOR OF CONGESTION												
Lack of lanes	0	1	0	0	0	0	0	0	0	0	1	0
Insufficient road width	0	1	0	0	0	0	1	1	0	0	1	0
Wrong geometric layout	0	1	0	0	0	0	0	0	0	0	0	0
Inadequate corner cutting	0	1	0	0	0	0	1	0	0	0	0	0
Improper location of road facilities (road markings)	0	0	0	1	0	0	0	0	0	0	0	0
Inadequate traffic signal control (If No Signal)	0	0	0	0	0	0	0	0	0	0	0	0
Inadequate traffic signal control (If With Signal)	0	0	0	0	0	0	0	0	0	0	0	0
Bad visibility of traffic signal	0	0	0	0	0	0	0	0	0	0	0	0
No left-turn lane	0	0	0	0	0	0	1	0	0	0	1	0
Insufficient left-turn lane length	0	0	0	0	0	0	1	0	0	0	1	0
Conflict between left-turn and through movements	0	0	0	0	0	0	0	0	0	0	1	0
Right-turning vehicles blocking vehicles proceeding straight ahead	0	1	0	0	0	0	1	0	0	0	1	0
Improper stop line position	0	0	0	0	0	0	0	0	0	0	0	0
Improper channelization	0	0	0	0	0	0	0	0	0	0	0	0
Speed reduction due to large vehicle	0	0	0	0	0	0	0	0	0	0	0	0
Obstruction by motorcycles	0	0	0	1	0	1	1	1	0	0	0	0
Obstruction by bicycles	0	0	0	0	0	0	0	0	0	0	0	0
Obstruction by pedestrians	0	1	0	0	0	0	0	0	0	0	0	0
Stopped traffic at at-grade railway crossings	0	0	0	0	0	0	0	0	0	0	0	0
Traffic flow in/out from intersections and narrow streets	0	0	0	0	0	0	0	0	0	0	0	0
Traffic flow in/out from ICs at expressways	0	0	0	0	0	0	0	0	0	0	0	0
Speed reduction due to PUV stops	0	0	0	0	1	1	1	1	0	0	0	0
Speed reduction due to PUJ stops	0	0	0	0	0	1	0	0	0	0	0	0
Lane reduction with dedicated bus and priority lanes	0	0	1	1	0	1	1	1	0	0	0	0
Obstruction of travel by on-street parking	0	1	0	0	0	0	0	0	0	0	0	0
Excess traffic demand at intersections	0	0	0	0	0	0	1	0	0	0	1	0
Excess traffic demand at non-intersections	0	0	0	0	0	0	1	0	0	0	0	0
Concentration of traffic at specific times	0	0	0	0	0	1	1	0	0	0	0	0
Concentration of traffic on roadside facilities at specific times and periods	0	0	0	0	0	0	1	0	0	0	0	0
Concentration of traffic at specific periods during events or incidents	0	0	0	0	0	0	1	0	0	0	0	1
Lane blockage due to construction	0	0	0	0	0	1	0	0	0	0	0	0
Clogging with congestion downstream	1	1	1	0	0	0	0	0	1	0	1	0

Note: Segment codes that are highlighted are TBNs intersecting two segments.
Factor of Congestion present in a TBN has a value of 1, marked with red cells.

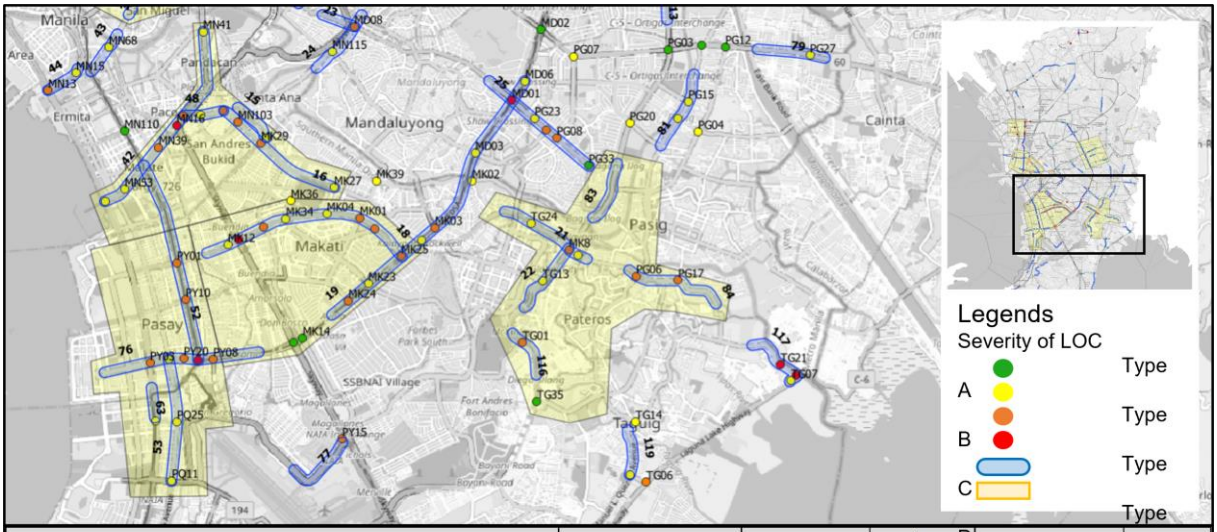
Figure F.9: EDSA, Pasig Blvd.-Shaw Blvd.



Segment Roads	Quirino Ave		Roxas Blvd	Sales Rd	Ortigas Ave Ext	Dr. Sixto Antonio Ave		Carlos P. Garcia Ave-E. Rodriguez Ave	Kalayaan Ave	
TBNs Involved	PQ25	PQ11	PQ26	PY15	PG27	PG15	PG16	PG04	PG17	PG06
Segment Code	53	53	63	77	79	81	81	83	84	84
Distance(km)	0.94		0.59	1.34	1.28	1.56		1.20	1.91	
No. of TBN	2		1	1	1	2		1	2	
Severity of Level of Congestion	B	B	B	C	B	B	B	B	C	C
Severity of Queue Length	2	3	3	2	2	2	2	2	2	2
Signal Type	3	4	3	2	1	1	1	4	1	3
FACTOR OF CONGESTION										
Lack of lanes	0	0	0	0	0	0	0	0	0	0
Insufficient road width	1	1	1	1	0	0	0	0	0	0
Wrong geometric layout	1	1	0	1	0	0	0	0	0	0
Inadequate corner cutting	1	1	1	1	0	0	0	0	0	0
Improper location of road facilities (road markings)	0	1	0	1	0	0	0	0	0	0
Inadequate traffic signal control (If No Signal)	0	0	0	1	0	0	0	0	0	0
Inadequate traffic signal control (If With Signal)	0	0	0	0	0	0	0	0	0	0
Bad visibility of traffic signal	0	1	0	0	0	0	0	0	0	0
No left-turn lane	1	1	1	1	0	0	0	0	0	0
Insufficient left-turn lane length	1	1	1	1	0	0	0	0	0	0
Conflict between left-turn and through movements	1	0	1	1	0	0	0	0	0	0
Right-turning vehicles blocking vehicles proceeding straight ahead	1	1	1	1	0	0	0	0	0	0
Improper stop line position	1	1	0	1	0	0	0	0	0	0
Improper channelization	0	1	0	1	0	0	0	0	0	0
Speed reduction due to large vehicle	0	1	1	1	0	0	0	0	0	0
Obstruction by motorcycles	0	1	1	1	0	0	0	0	0	0
Obstruction by bicycles	0	1	0	1	0	0	0	0	0	0
Obstruction by pedestrians	0	0	0	1	0	0	0	0	0	0
Stopped traffic at at-grade railway crossings	0	0	0	0	0	0	0	0	0	0
Traffic flow in/out from intersections and narrow streets	0	0	1	1	0	0	0	0	0	0
Traffic flow in/out from ICs at expressways	0	0	0	0	0	0	0	0	0	0
Speed reduction due to PUV stops	0	1	1	1	0	0	0	0	0	0
Speed reduction due to PUJ stops	1	1	1	1	0	0	0	0	0	0
Lane reduction with dedicated bus and priority lanes	0	0	0	0	0	0	0	0	0	0
Obstruction of travel by on-street parking	1	1	0	0	0	0	0	0	0	0
Excess traffic demand at intersections	0	0	0	0	0	0	0	0	0	0
Excess traffic demand at non-intersections	0	0	0	0	0	0	0	0	0	0
Concentration of traffic at specific times	0	1	0	1	0	0	0	0	0	0
Concentration of traffic on roadside facilities at specific times and periods	0	1	0	1	0	0	0	0	0	0
Concentration of traffic at specific periods during events or incidents	1	1	0	1	0	0	0	0	0	0
Lane blockage due to construction	0	1	1	0	0	0	0	0	0	0
Clogging with congestion downstream	0	0	0	0	0	0	0	0	0	0

Note: Segment codes that are highlighted are TBNs intersecting two segments.
Factor of Congestion present in a TBN has a value of 1, marked with red cells.

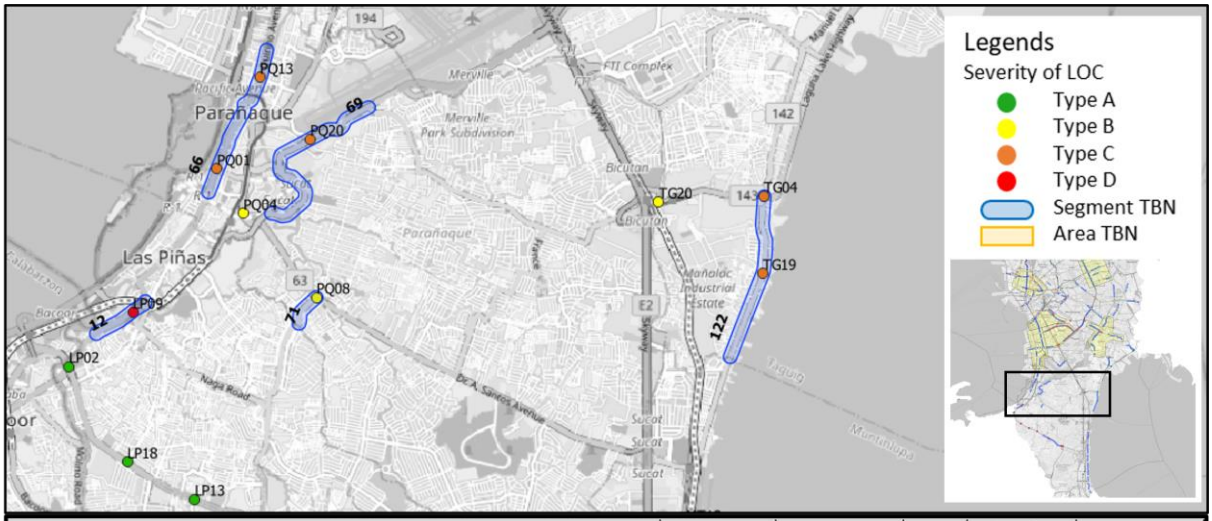
Figure F.10: Quirino Ave., Roxas Blvd., Sales Rd., Ortigas Ave. Ext., Dr. Sixto Antonio Ave., Carlos P. Garcia-E. Rodrigues Ave., Kalayaan Ave.



Segment Roads	Kalayaan Ave			Carlos P. Garcia Ave-E. Rodriguez Ave		Carlos P. Garcia Ave-E. Rodriguez Ave	Unnamed Rd			Manuel L. Quezon St
TBNs Involved	MK6	MK8	TG24	MK8	TG13	TG01	TG21	TG08	TG07	TG05
Segment Code	21	21	21	21	22	116	117	117	117	119
Distance(km)	1.82			1.47		0.99	1.33			0.89
No. of TBN	3			2		1	3			1
Severity of Level of Congestion	B	C	B	C	B	C	D	D	B	B
Severity of Queue Length	2	2	2	2	3	2	2	2	2	2
Signal Type	3	1	1	1	2	3	1	1	1	1
FACTOR OF CONGESTION										
Lack of lanes	0	0	0	0	0	0	1	0	1	1
Insufficient road width	0	0	0	0	0	0	1	0	1	1
Wrong geometric layout	0	0	0	0	0	0	1	0	1	0
Inadequate corner cutting	0	0	0	0	0	0	1	0	1	0
Improper location of road facilities (road markings)	1	0	0	0	0	0	1	1	1	0
Inadequate traffic signal control (If No Signal)	0	0	0	0	0	0	0	0	1	0
Inadequate traffic signal control (If With Signal)	0	0	0	0	0	0	0	0	0	0
Bad visibility of traffic signal	0	0	0	0	0	0	0	0	0	0
No left-turn lane	0	0	0	0	0	0	0	0	0	0
Insufficient left-turn lane length	0	0	0	0	0	0	1	0	0	0
Conflict between left-turn and through movements	0	0	0	0	0	0	1	0	0	0
Right-turning vehicles blocking vehicles proceeding straight ahead	0	0	0	0	0	0	1	0	0	0
Improper stop line position	0	0	0	0	0	0	1	1	0	0
Improper channelization	0	0	0	0	0	0	0	0	0	0
Speed reduction due to large vehicle	0	0	1	0	0	1	0	0	0	0
Obstruction by motorcycles	1	0	1	0	1	1	0	0	0	0
Obstruction by bicycles	0	0	0	0	1	0	0	0	0	0
Obstruction by pedestrians	1	0	0	0	0	0	1	0	0	0
Stopped traffic at at-grade railway crossings	0	0	0	0	0	0	0	0	0	0
Traffic flow in/out from intersections and narrow streets	0	0	0	0	0	0	0	0	1	1
Traffic flow in/out from ICs at expressways	0	0	0	0	0	0	0	0	0	0
Speed reduction due to PUV stops	0	0	1	0	0	0	0	0	0	0
Speed reduction due to PUJ stops	1	0	1	0	0	0	0	0	0	1
Lane reduction with dedicated bus and priority lanes	0	0	0	0	0	0	0	0	0	0
Obstruction of travel by on-street parking	1	0	1	0	0	0	1	1	1	1
Excess traffic demand at intersections	0	0	0	0	0	0	0	0	0	0
Excess traffic demand at non-intersections	0	0	0	0	0	0	0	0	0	0
Concentration of traffic at specific times	0	1	0	1	0	1	0	0	0	0
Concentration of traffic on roadside facilities at specific times and periods	0	0	0	0	0	1	0	0	0	0
Concentration of traffic at specific periods during events or incidents	0	1	0	1	0	1	0	0	0	0
Lane blockage due to construction	0	0	0	0	0	0	0	0	0	1
Clogging with congestion downstream	0	0	0	0	0	0	0	0	0	0

Note: Segment codes that are highlighted are TBNs intersecting two segments.
Factor of Congestion present in a TBN has a value of 1, marked with red cells.

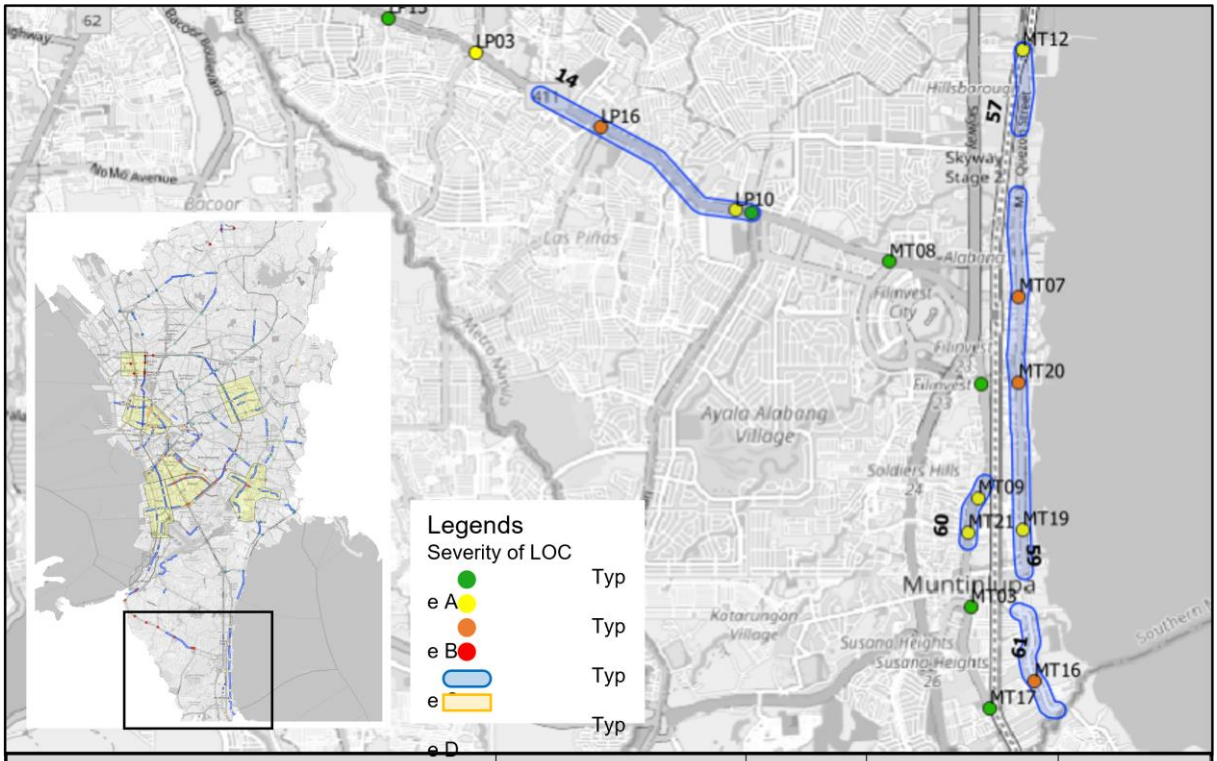
Figure F.11: Kalayaan Ave., Carlos P. Garcia-E. Rodriguez Ave., Unnamed Rd., Manuel L. Quezon St.



Segment Roads	P. Diego Cera Ave	Quirino Ave		C5 Rd Ext	Angelina Canaynay Ave	San Guillermo St	
TBNs Involved	LP09	PQ13	PQ01	PQ20	PQ08	TG04	TG19
Segment Code	12	66	66	69	71	122	122
Distance(km)	0.90	2.39		3.03	0.50	2.56	
No. of TBN	1	2		1	1	2	
Severity of Level of Congestion	D	C	C	C	B	C	C
Severity of Queue Length	2	2	3	4	5	2	1
Signal Type	1	3	3	3	3	3	1
FACTOR OF CONGESTION							
Lack of lanes	1	1	1	1	1	0	1
Insufficient road width	1	1	1	1	1	0	1
Wrong geometric layout	1	1	1	1	1	0	1
Inadequate corner cutting	1	1	1	1	1	0	1
Improper location of road facilities (road markings)	1	1	1	1	1	1	1
Inadequate traffic signal control (If No Signal)	1	0	0	0	0	0	1
Inadequate traffic signal control (If With Signal)	0	1	1	1	0	0	0
Bad visibility of traffic signal	0	1	0	1	0	0	0
No left-turn lane	1	1	1	1	1	0	1
Insufficient left-turn lane length	1	1	1	1	1	0	1
Conflict between left-turn and through movements	1	1	1	1	1	0	1
Right-turning vehicles blocking vehicles proceeding straight ahead	1	1	1	1	1	0	1
Improper stop line position	1	1	1	1	1	0	1
Improper channelization	0	0	0	0	0	0	0
Speed reduction due to large vehicle	1	1	1	1	1	0	1
Obstruction by motorcycles	1	1	1	1	1	1	1
Obstruction by bicycles	0	0	0	0	0	1	0
Obstruction by pedestrians	0	0	0	0	0	1	1
Stopped traffic at at-grade railway crossings	0	0	0	0	0	0	0
Traffic flow in/out from intersections and narrow streets	0	0	0	1	0	0	1
Traffic flow in/out from ICs at expressways	0	0	1	0	0	0	0
Speed reduction due to PUV stops	0	0	0	0	0	0	0
Speed reduction due to PUJ stops	1	1	1	1	1	0	1
Lane reduction with dedicated bus and priority lanes	0	0	0	0	0	0	0
Obstruction of travel by on-street parking	0	1	0	0	0	0	1
Excess traffic demand at intersections	0	0	1	1	0	0	1
Excess traffic demand at non-intersections	0	0	0	0	0	0	1
Concentration of traffic at specific times	0	0	1	1	1	0	1
Concentration of traffic on roadside facilities at specific times and periods	1	1	1	1	1	0	1
Concentration of traffic at specific periods during events or incidents	1	1	1	1	1	0	1
Lane blockage due to construction	0	0	1	0	0	0	0
Clogging with congestion downstream	0	0	0	0	0	0	0

Note: Segment codes that are highlighted are TBNs intersecting two segments.
Factor of Congestion present in a TBN has a value of 1, marked with red cells.

Figure F.12: P. Diego Cera Ave., Quirino Ave., C5 Rd. Ext., Angelina Canaynay Ave., San Guillermo St.



Segment Roads	gment TBN / a TBN	Se / Are	Alabang-Zapote Rd		San Guillermo St	San Guillermo St			National Rd	
TBNs Involved		LP05	LP10	LP16	MT12	MT07	MT20	MT19	MT09	MT21
Segment Code		14	14	14	57	59	59	59	60	60
Distance(km)		2.90			0.94	4.52			0.74	
No. of TBN		3			1	3			2	
Severity of Level of Congestion		A	B	C	B	C	C	B	B	B
Severity of Queue Length		2	3	4	2	2	2	2	3	6
Signal Type		1	3	1	1	1	1	1	1	1
FACTOR OF CONGESTION										
Lack of lanes		1	0	1	1	1	1	1	0	1
Insufficient road width		1	1	1	1	1	1	1	1	1
Wrong geometric layout		1	0	1	1	0	0	1	1	1
Inadequate corner cutting		1	1	1	1	1	1	1	1	1
Improper location of road facilities (road markings)		1	0	1	1	0	0	1	1	1
Inadequate traffic signal control (If No Signal)		1	0	1	1	0	0	1	1	1
Inadequate traffic signal control (If With Signal)		0	0	0	0	0	0	0	0	0
Bad visibility of traffic signal		0	0	0	0	0	0	0	0	0
No left-turn lane		1	1	1	1	0	0	0	1	1
Insufficient left-turn lane length		1	1	1	1	0	1	0	1	1
Conflict between left-turn and through movements		1	1	1	1	0	1	1	1	1
Right-turning vehicles blocking vehicles proceeding straight ahead		1	1	1	1	0	0	1	1	1
Improper stop line position		1	0	1	1	0	0	1	1	1
Improper channelization		1	0	0	0	0	0	0	0	0
Speed reduction due to large vehicle		1	1	1	1	0	0	1	1	1
Obstruction by motorcycles		1	1	1	1	1	1	1	1	1
Obstruction by bicycles		0	0	0	0	0	0	0	1	1
Obstruction by pedestrians		0	0	0	1	1	1	1	1	1
Stopped traffic at at-grade railway crossings		0	0	0	0	0	0	0	0	0
Traffic flow in/out from intersections and narrow streets		0	0	0	1	0	0	1	1	1
Traffic flow in/out from ICs at expressways		0	0	0	0	0	0	0	0	0
Speed reduction due to PUV stops		1	1	1	0	0	0	0	1	1
Speed reduction due to PUJ stops		1	1	1	1	1	0	0	1	1
Lane reduction with dedicated bus and priority lanes		0	0	0	0	0	0	0	1	1
Obstruction of travel by on-street parking		1	0	1	1	1	0	1	1	1
Excess traffic demand at intersections		0	0	1	0	0	0	1	1	1
Excess traffic demand at non-intersections		0	0	0	0	0	0	1	1	1
Concentration of traffic at specific times		1	1	1	1	0	0	1	1	1
Concentration of traffic on roadside facilities at specific times and periods		1	1	1	1	0	0	1	1	1
Concentration of traffic at specific periods during events or incidents		1	1	1	1	0	0	1	1	1
Lane blockage due to construction		0	0	0	0	1	0	0	0	0
Clogging with congestion downstream		0	0	0	0	0	0	0	0	1

Note: Segment codes that are highlighted are TBNs intersecting two segments.
Factor of Congestion present in a TBN has a value of 1, marked with red cells.

Figure F.13: Alabang-Zapote Rd., San Guillermo St., National Rd.

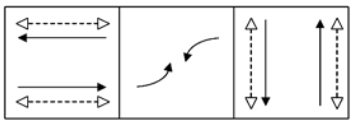
APPENDIX G

Concept Plans for 42 Priority Intersection Bottlenecks

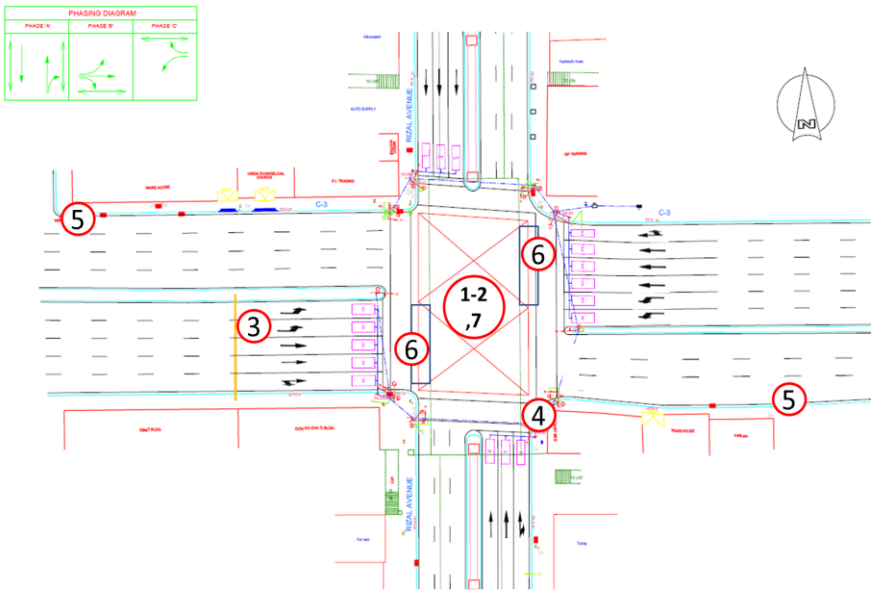
APPENDIX G

Concept Plans for 42 Priority Intersection Bottlenecks

1. Priority Intersection Bottlenecks

Code	CC05
Int. Name	Caloocan: 5th Avenue-Rizal Avenue Extension
Field Observations	1. Traffic congestion was observed during rush hour. 2. There are "No Truck Entry to Rizal Ave." signs but trucks still enter. 3. West approach: Left-most through lane aligns straight to the median of the receiving leg. 4. Far side pole and lantern for eastbound traffic was knocked down. 5. Far side traffic signals for EB and WB directions have limited visibility because of the LRT girder.
Related DPWH/ DoTr Projects	1. Rehabilitation/Reconstruction/ Upgrading of Damaged Paved Roads - C-3 Road - K0010+273 - K0010+778, (F.Y. 2023) 2. Rehabilitation/Reconstruction/ Upgrading of Damaged Paved Roads - C-3 Road - K0009+(-611) - K0009+(-055), (F.Y. 2023)
Recommended Traffic Management Measures by the JPT, MMDA, DPWH, and DoTr	1. Phase sequence review and update, if necessary. 2. Timing plan updating. 3. West approach left-most through lane should be left-turning as well. 4. Install mast arm to replace the knocked down pole. 5. PUV stops should be 50m away from the intersection along the recieving side of the leg. 6. Additional lantern on LRT. 7. Proposed phase sequence. 

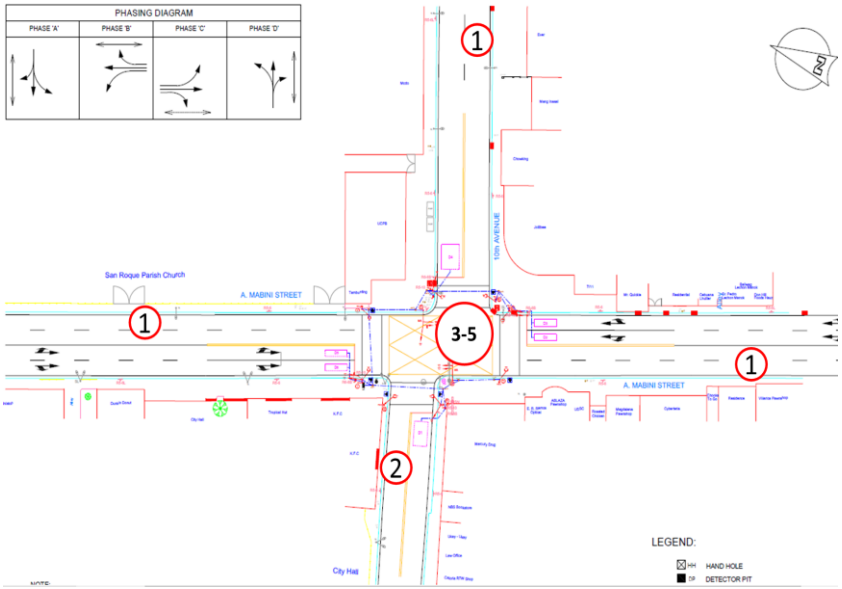
Map of Recommended Traffic Management Measures



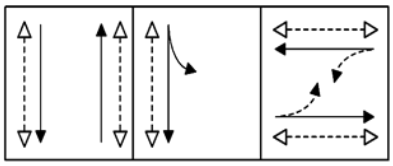
Note: The numbers on the figure correspond to the list of recommendation/s

Code	CC23
Int. Name	Caloocan: A. Mabini - P. Burgos
Field Observations	1. Traffic congestion was observed during rush hour. 2. Jeepney stops near the intersection impede through traffic. 3. Grab delivery drivers park on-street along north leg (10th Ave) receiving side. 4. Pedestrian push button is broken because of misuse.
Related DPWH/ DoTr Projects	Funded: 1. Rehabilitation/Reconstruction/ Upgrading of Damaged Paved Roads - A Mabini St - K0008+200 - K0009+000 (F.Y. 2023)
Recommended Traffic Management Measures by the JPT, MMDA, DPWH, and DoTr	1. Jeepney stops should be 50m from the intersection. 2. P. Burgos should be a one-way southbound (in coordination with the LGU as construction of city hall located northwest corner is on-going). 3. Pedestrian push button provided to be used for pedestrian phase. 4. Phase sequence must be modified and timing plan updated. 5. Stricter traffic law enforcement.

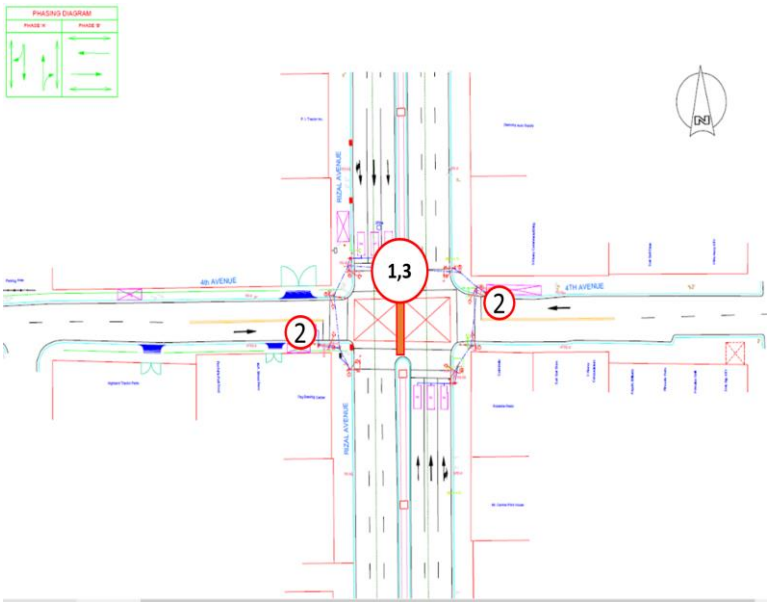
Map of Recommended Traffic Management Measures



Note: The numbers on the figure correspond to the list of recommendation/s

Code	CC28
Int. Name	Caloocan: Rizal Avenue Extension-4th Avenue
Field Observations	1. Traffic congestion was observed during rush hour. 2. Closed intersection. Probably to prevent intersection lockup by queue extended from C5. 3. Traffic signal is not operational. 4. Jeepney stop beside no loading and unloading sign. 5. Current damaged traffic signal has no capability to be actuated.
Related DPWH/ DoTr Projects	Funded: 1. Rehabilitation/Reconstruction/ Upgrading of Damaged Paved Roads - Rizal Ave Ext - K0008 + 367 - K0009+015 (F.Y. 2023)
Recommended Traffic Management Measures by the JPT, MMDA, DPWH, and DoTr	1. Activate signal with new phase sequence. 2. Actuation may be considered for 4th Ave. approaches. 3. Proposed phase sequence. 

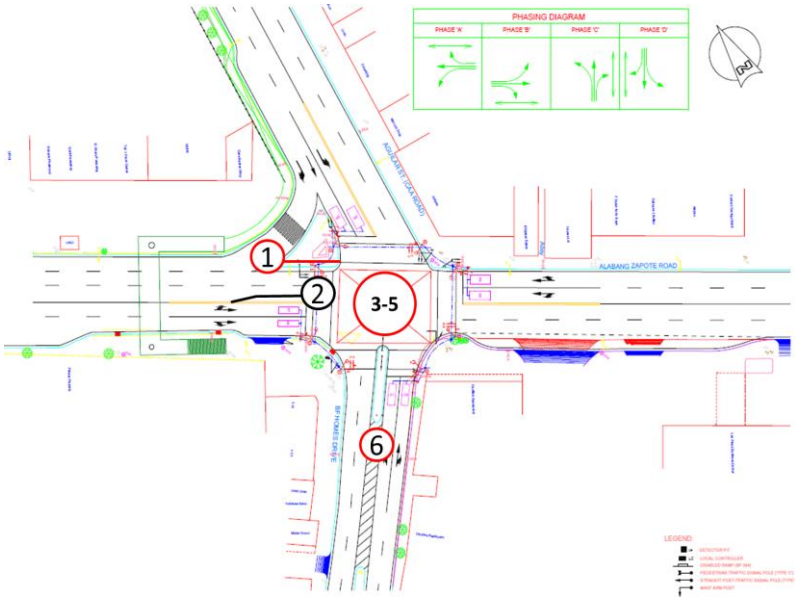
Map of Recommended Traffic Management Measures



Note: The numbers on the figure correspond to the list of recommendation/s

Code	LP03
Int. Name	Las Piñas: Alabang-Zapote Road - BF Resort Drive/CAA Avenue
Field Observations	1. Heavy Traffic. 2. Fading Pavement Markings. 3. Traffic signal is currently flashing. 4. Traffic enforcers currently manages traffic. 5. East leg receiving side used as LT lane during green time. 6. Uneven pavement at south approach.
Related DPWH/ DoTr Projects	Completed: 1. South Metro Manila Bike Lanes
Recommended Traffic Management Measures by the JPT, MMDA, DPWH, and DoTr	1. Edge of island along Alabang Zapote road to be set back to increase capacity. 2. Shift center line along the west approach. 3. Apply lead-lag left turn for east and west approaches. 4. Updated timing plan. 5. Proposed Interchange at Alabang-Zapote Rd.-CAA Rd. by DPWH. 6. Road Widening along BF Home Drive by DPWH.

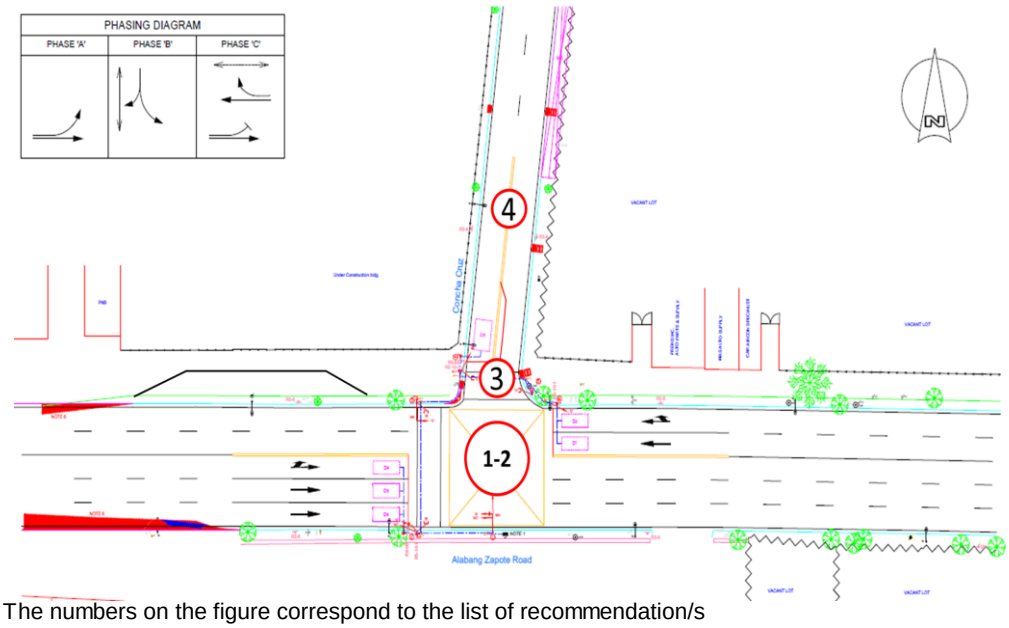
Map of Recommended Traffic Management Measures



Note: The numbers on the figure correspond to the list of recommendation/s

Code	LP10
Int. Name	Las Piñas: Alabang-Zapote Road-Concha Cruz Drive
Field Observations	1. Moderate Traffic. 2. Fading Pavement Markings 3. Heavy Traffic during 6 am to 8 am 4. Layby area from Village Square 5. The intersection belongs to a group of traffic signals together with Acacia Rd, Manolo Dr, and Madrigal Ave.
Related DPWH/ DoTr Projects	Completed: 1. South Metro Manila Bike Lanes
Recommended Traffic Management Measures by the JPT, MMDA, DPWH, and DoTr	1. Review of timing plan. 2. Pavement marking with new layout including bicycle lane. 3. Shift of north app. center line to provide two lanes (left turn + right turn) with staggered stop line. 4. Road widening along Concha Cruz Rd. by DPWH.

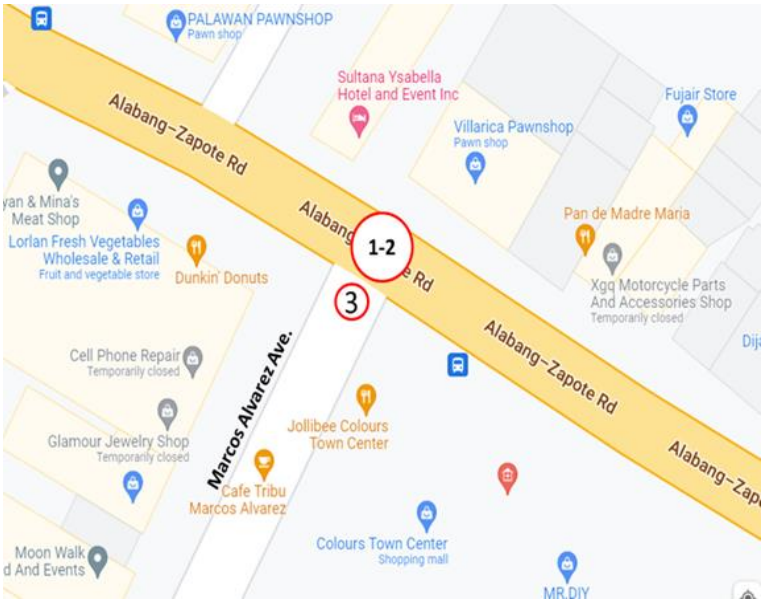
Map of Recommended Traffic Management Measures



Note: The numbers on the figure correspond to the list of recommendation/s

Code	LP16
Int. Name	Las Piñas: Alabang-Zapote Road-Marcos Alvarez Avenue
Field Observations	1. Heavy Traffic. 2. Fading Pavement Markings. 3. Jaywalking despite of having a footbridge. 4. Large volume of left turning vehicles from the east approach. 5. Long queue from west approach because of the movement conflict with east approach LT. 6. Las Pinas requested the signal to be flashing. 7. Entry and exit of vehicles to establishments impede traffic.
Related DPWH/ DoTr Projects	Completed: 1. South Metro Manila Bike Lanes
Recommended Traffic Management Measures by the JPT, MMDA, DPWH, and DoTr	1. Signalization with proper phasing and timing plan. 2. Pavement marking with new layout. 3. Two approach lanes on Marcos Alvarez Ave. with staggered stop line. 4. Alabang-Zapote Diversion Road Flyover from Alabang-Zapote (SM Southmall to Marcos. Alvarez Ave.) Las Piñas City by DPWH.

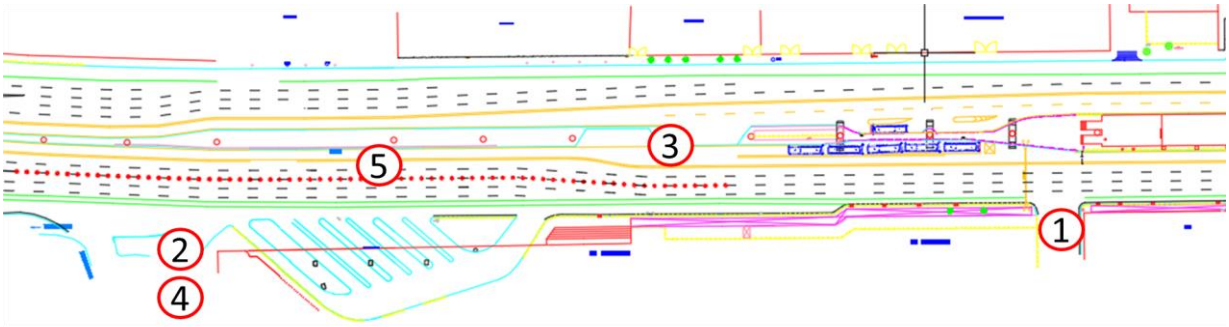
Map of Recommended Traffic Management Measures



Note: The numbers on the figure correspond to the list of recommendation/s

Code	MD06
Int. Name	Mandaluyong: EDSA - Doña Julia Vargas Avenue
Field Observations	1. Huge volume of traffic from EDSA 2. Turning vehicles from Julia Vargas disrupt flow of traffic going through. 3. Not possible for widening. 4. Provincial buses from this terminal turn right to Ortigas Ave. 5. Current bottleneck is diversion point at downstream (EDSA-ADB Access Rd). 6. As per our observation, this is not the start of congestion along EDSA. Congestion starts just before Ortigas intersection, where EDSA is divided into left turn (2 lanes), through (3 lanes with innermost bus lane and left turn 2 lane). 7. Traffic demand is not proportional to number of lanes and there are weaving movements of vehicles toward their choice of direction. This is the cause of congestion, which sometimes extend beyond Mega Mall. 8. Vehicles exiting ADB Rd. add merging conflict along EDSA.
Related DPWH/ DoTr Projects	Completed: 1. Bayanihan 2 Bike Lanes
Recommended Traffic Management Measures by the JPT, MMDA, DPWH, and DoTr	1. Close ADB Rd. to reduce intersection bottlenecks going to Ortigas (NB). 2. Divert vehicles exiting ADB Rd. to Julia Vargas Ave. 3. With proposed DPWH Project. (Preventive Maintenance: Asphalt Overlay) 4. Use of alternate route from Julia Vargas and vicinity to lessen the traffic flow. 5. Proposed plan layout of MMDA.

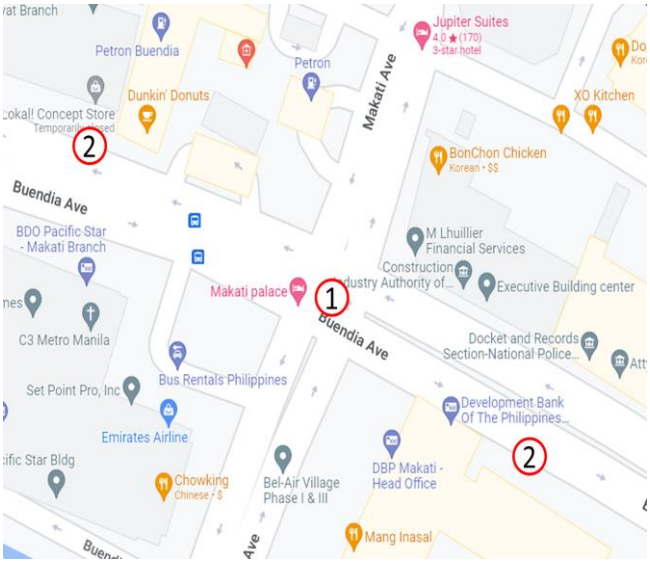
Map of Recommended Traffic Management Measures



Note: The numbers on the figure correspond to the list of recommendation/s

Code	MK01
Int. Name	Makati: Buendia Avenue - Makati Ave
Field Observations	1. Intersection is at a business district area, so congestion is expected. 2. Jeepney terminal along Buendia west leg receiving side. 3. Jeepney stops near the intersection along Buendia Ave.
Related DPWH/ DoTr Projects	Completed: 1. Bayanihan 2 Bike Lanes
Recommended Traffic Management Measures by the JPT, MMDA, DPWH, and DoTr	1. Adjust time-of-day plan and day-of-the-week plan to provide cycle length and split that commensurate with varying traffic demand. 2. MMDA-LGU coordination on jeepney terminals/stops.

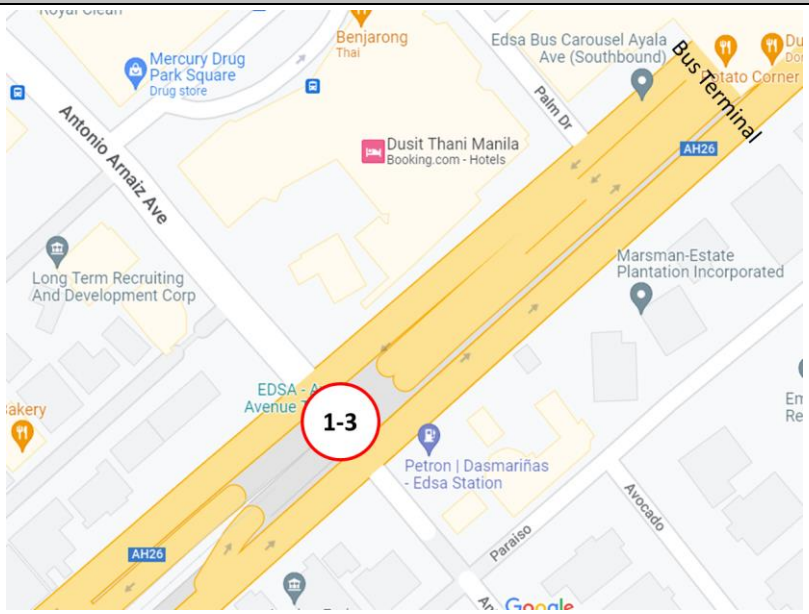
Map of Recommended Traffic Management Measures



Note: The numbers on the figure correspond to the list of recommendation/s

Code	MK24
Int. Name	Makati: EDSA - Antonio S. Arnaiz Avenue
Field Observations	1. Intersection is a gateway from the business district area, so congestion is expected. 2. Palm Dr. (east of the intersection along EDSA) was closed. 3. Bus terminal near the East approach along EDSA.
Related DPWH/ DoTr Projects	Completed: 1. Bayanihan 2 Bike Lanes
Recommended Traffic Management Measures by the JPT, MMDA, DPWH, and DoTr	1. Pavement marking with new layout. 2. Provide guide lane marking for LT traffic from EDSA south approach (2-lane left turn). 3. Proposed phase sequence (lead-lag left turn) for unbalance left turn traffic.

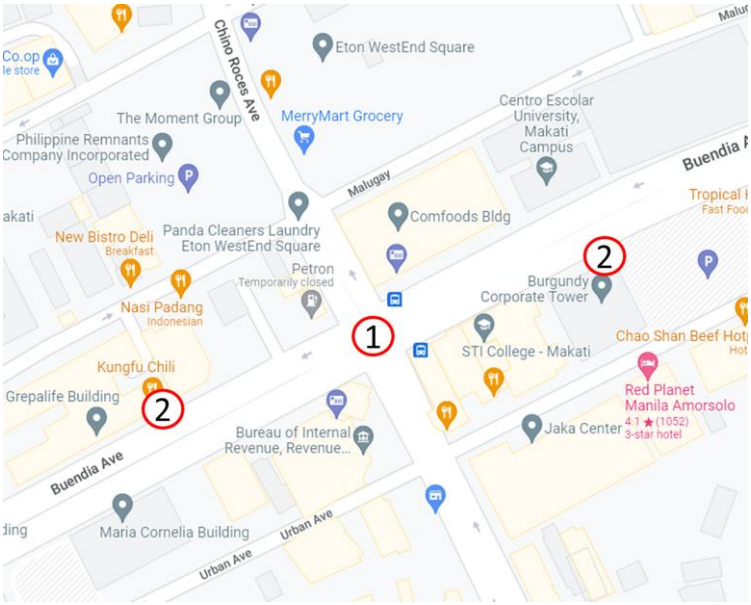
Map of Recommended Traffic Management Measures



Note: The numbers on the figure correspond to the list of recommendation/s

Code	MK35
Int. Name	Makati: Buendia Avenue - Chino Roces Avenue
Field Observations	1. Intersection is at a business district area, so congestion is expected. 2. Chino Roces north approach is under construction. 3. Jeepney terminal along Buendia west leg receiving side. 4. Jeepney stops near the intersection along Buendia Ave. 5. Signal cycle too long compared with traffic volume. 6. Large volume of through traffic from the south approach.
Related DPWH/ DoTr Projects	Ongoing: 1. Project along Chino Roces Avenue from Calatagan Creek towards Buendia Avenue Completed: 1. Bayanihan 2 Bike Lanes
Recommended Traffic Management Measures by the JPT, MMDA, DPWH, and DoTr	1. Adjust timing plan to cope with traffic demand. 2. MMDA-LGU coordination on jeepney terminals/stops.

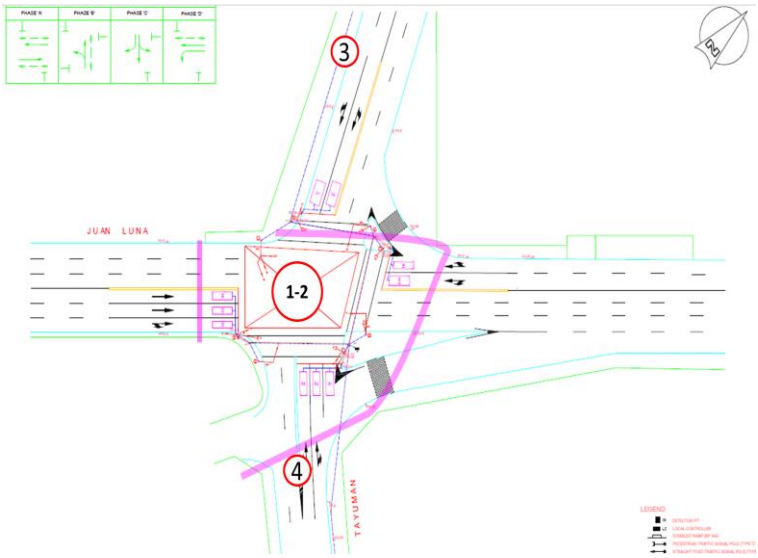
Map of Recommended Traffic Management Measures



Note: The numbers on the figure correspond to the list of recommendation/s

Code	MN04
Int. Name	Manila: Juan Luna Street-Tayuman St./ Capulong St.
Field Observations	1. Juan Luna St. - access road from Divisoria (Public market) to Caloocan and Nicanor Reyes - Caloocan to Divisoria. 2. Public Market bldgs. and Private Supermarket Bldg. located at the corners or almost corner of the intersections; deliveries of goods affects the flow of traffic; entraces and exits are located near the intersections. 3. Capulong St. is an access road of trailers and trucks going to and from port area; outer lanes at both sides are used as parking area; sidewalk obstructions are visible (used by vendors or establishments). 4. Tricycles and "Padyak" stations are located near the corners of intersections, which blocks visibility for merging motorists. 5. Pedestrians are still crossing the roads even though A pedestrian overpass is present.
Related DPWH/ DoTr Projects	Funded: 1. Asphalt Overlay at Juan Luna Street (FY 2022 GAA)
Recommended Traffic Management Measures by the JPT, MMDA, DPWH, and DoTr	1. Phase sequence review and update, if necessary. 2. Update timing plan. 3. Strict compliance and implementation of traffic rules and regulations; remove parked trucks, vehicles and obstructions. 4. Relocate terminals and loading stations.

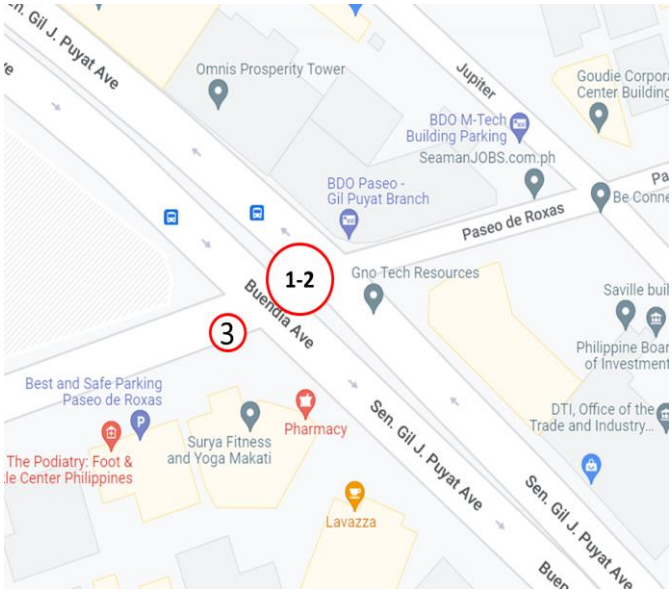
Map of Recommended Traffic Management Measures



Note: The numbers on the figure correspond to the list of recommendation/s

Code	MK40
Int. Name	Makati: Buendia Avenue - Paseo de Roxas
Field Observations	1. Intersection is at a business district area, so congestion is expected. 2. South approach: Large volume on RT movement. “No right turn on red” sign is provided but not observed. 3. Jeepney stops near the intersection along Buendia Ave.
Related DPWH/ DoTr Projects	Completed: 1. Bayanihan 2 Bike Lanes
Recommended Traffic Management Measures by the JPT, MMDA, DPWH, and DoTr	1. Adjust time-of-day plan and day-of-the-week plan to provide cycle length and split that commensurate with varying traffic demand. 2. Provide right turn arrow signal to Paseo. de Roxas west approach.

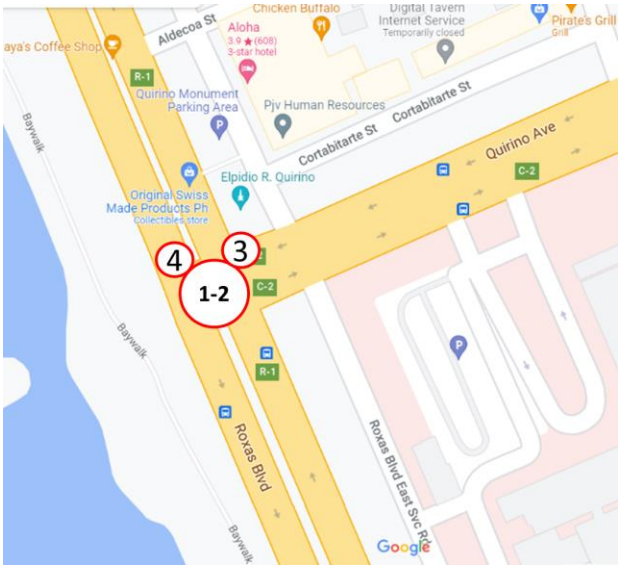
Map of Recommended Traffic Management Measures



Note: The numbers on the figure correspond to the list of recommendation/s

Code	MN11
Int. Name	Manila: Roxas Blvd.- President Quirino Ave
Field Observations	1. Green light for left-turning vehicles to Quirino is too short. 2. Many ambulance turn left from the north approach. 3. Road Re-Blocking project by DPWH at north leg service road. 4. Service Rd. NB flow is only right-turning. 5. Lacks zebra crossing for pedestrians going to the corner island (East approach). 6. Normally there are movements from main road to North leg service road
Related DPWH/ DoTr Projects	Ongoing: 1. Road Re-Blocking project by DPWH target completion is at the end of May 2022. 2. Bayanihan 2 Bike Lanes
Recommended Traffic Management Measures by the JPT, MMDA, DPWH, and DoTr	1. Phase sequence review and update, if necessary. 2. Timing plan updating. 3. Zebra crossing going to the East approach corner island. 4. Provide more time to North approach left turn movement.

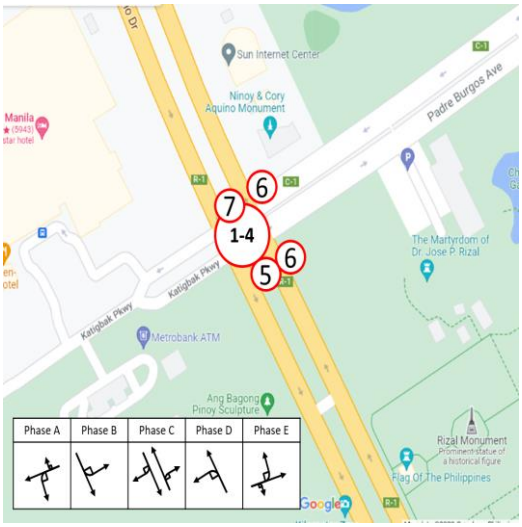
Map of Recommended Traffic Management Measures



Note: The numbers on the figure correspond to the list of recommendation/s

Code	MN13
Int. Name	Manila: Roxas Blvd - Padre Burgos Ave.
Field Observations	1. Left turn green light is too short even though two lanes were given since volume of trucks and PUJ's turning left from Bonifacio Drive to Padre Burgos is high. 2. Potholes in this intersection is a cause of delay. 3. Trucks from Padre Burgos to Bonifacio Drive turn right from east approach. 4. The circumstance worsened especially at the first month of the implementation of truck ban along Roxas Blvd started on January 15, 2022. As perceived, the 2 inner lanes becomes congested as the volume of trucks increases for the area of Finance Rd., Ayala Blvd., and San Marcelino St., which can no longer handle the influx of the trucks going to Skyway and other areas.
Related DPWH/ DoTr Projects	Funded: 1. Ongoing concrete laying Completed: 1. Bayanihan 2 Bike Lanes
Recommended Traffic Management Measures by the JPT, MMDA, DPWH, and DoTr	1. Level the intersection and fix potholes. 2. Phase sequence review and update, if necessary. 3. Timing plan updating. 4. Phase D can be actuated. 5. Provide pedestrian pushbutton for pedestrians crossing Roxas Blvd and shorten Phase D when there is no pedestrian request. 6. Allow right turn with care during red signal. 7. Recalibrate signal timeing using new data.

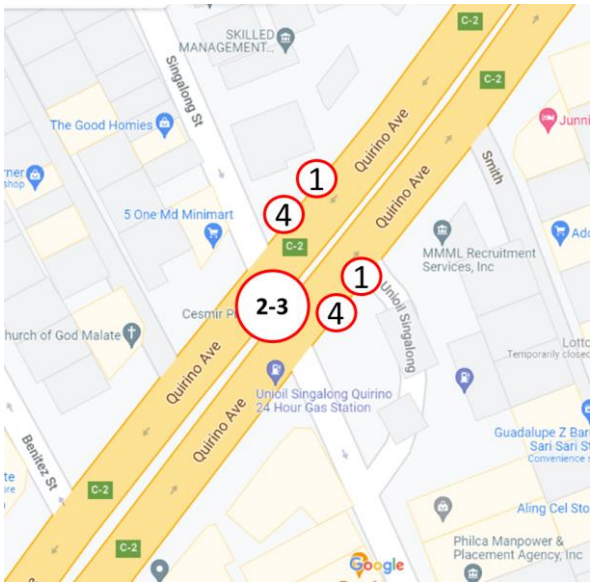
Map of Recommended Traffic Management Measures



Note: The numbers on the figure correspond to the list of recommendation/s

Code	MN39
Int. Name	Manila: President Quirino Ave-Singalong St.
Field Observations	1. Skyway ramp is currently under construction. 2. Signal is temporary removed and no traffic enforcers at the intersection. Same situation at the next intersection (Pres. Quirino – Angel Linao St.) as of Nov. 4, 2021. 3. Singalong St. is one-way towards the intersection. 4. Lack of construction site safety measures.
Related DPWH/ DoTr Projects	Ongoing: 1. Skyway ramp construction (c/o contractor)
Recommended Traffic Management Measures by the JPT, MMDA, DPWH, and DoTr	1. Implement construction site safety measures icluding cones, lights, and marchalls. 2. Temporary signal or traffic guide all the time. 3. Safe pedestrian path. 4. Warning sign, guide sign, lighting, fence, temporary pavement marking, etc.

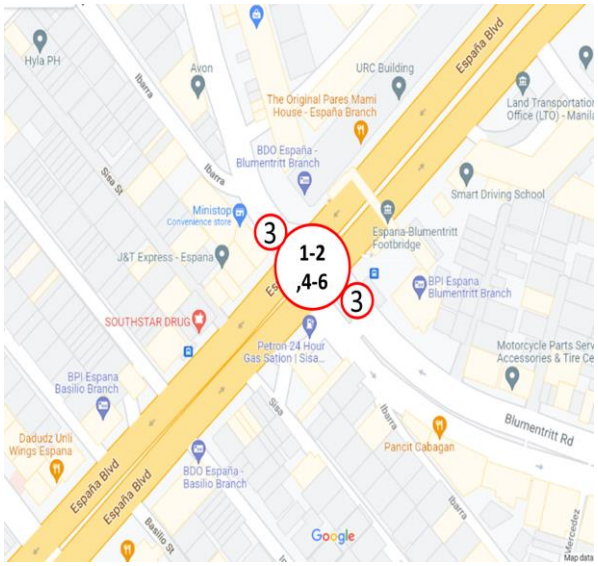
Map of Recommended Traffic Management Measures



Note: The numbers on the figure correspond to the list of recommendation/s

Code	MN42
Int. Name	Manila: España Blvd.-Blumentritt Extension
Field Observations	1. PUVs are loading and unloading near or at the intersections. 2. Blumentritt st. have outer lanes used as parkings; obstruction on sidewalks; tricycle terminal and loading stations were located beside the center island. 3. Gasoline station at the corner of the intersection - vehicles entering the station may affects the flow of traffic. 4. Ibarra St. - on-street parking; road re-blocking beside jeppney terminal; no pavement parking. 5. Jay walking despite having a footbridge. 6. Blumentritt Rd. green time is too long for its volume (as of Q1 2022). Volume on Ibarra is normally large, but vehicles are currently rerouted. Traffic signal is likely to be enough once the constructions is complete. 7. Local controller is at the next intersection (Espana-Maceda) controls both intersections. 8. Vehicle lantern for Blumentritt traffic are not operational for both side.
Related DPWH/ DoTr Projects	Completed: 1. Bayanihan 2 Bike Lanes
Recommended Traffic Management Measures by the JPT, MMDA, DPWH, and DoTr	1. Phase sequence review and update. 2. Timing plan updating. 3. Actuation control may be applied to Blumentritt sides. 4. Pavement marking on all approaches. (100 m from stop line for main street and 50 m for side street). 5. No crossing sign (R3-10) on Espana. 6. Stricter law enforcement.

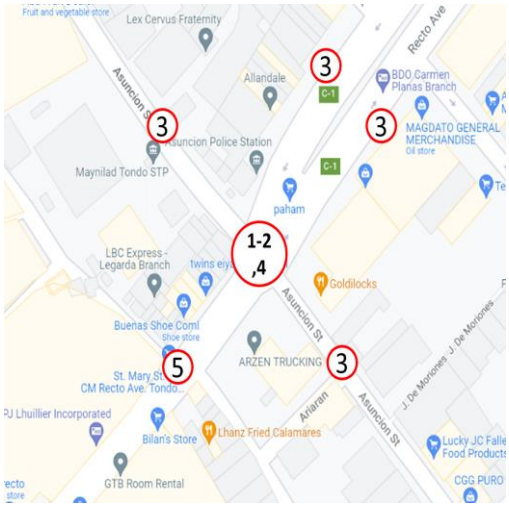
Map of Recommended Traffic Management Measures



Note: The numbers on the figure correspond to the list of recommendation/s

Code	MN83
Int. Name	Manila: C.M. Recto Ave. - Asuncion St.
Field Observations	1. Hundreds of meter before and after the intersection (C.M. Recto Avenue), as well as the intersecting streets are part of the wide area of public market; outer lanes are used as parking areas and unloadings o goods; obstruction and street vendors on carriage way and sidewalks are visible. 2. Pedestrian are crossing on all directions on the streets and intersection 3. PUVs and trucks load and unload near or at the intersection. The intersection serves as a U-turn slot. 4. East bound from the intersection is a dual carriageway width while westbound from the intersection is a single carriageway width. 5. Police station is located at the carriageway. 6. South leg of Recto Ave. has narrower carriage width. 7. The intersection lacks pavement markings.
Related DPWH/ DoTr Projects	Funded: 1. Reconstruction of Concrete Pavement along C.M. Recto Ave.
Recommended Traffic Management Measures by the JPT, MMDA, DPWH, and DoTr	1. Apply pavement marking to delineate passing lanes, loading / unloading zone and on-street vendor area. 2. Coordination with local authority is required. 3. Remove parked trucks, vehicles, vendors and other obstructions. 4. Strict compliance and implementation of traffic rules and regulations. 5. Consider Right of Way (ROW) acquisition from Asuncion to Delpan Service Rd.

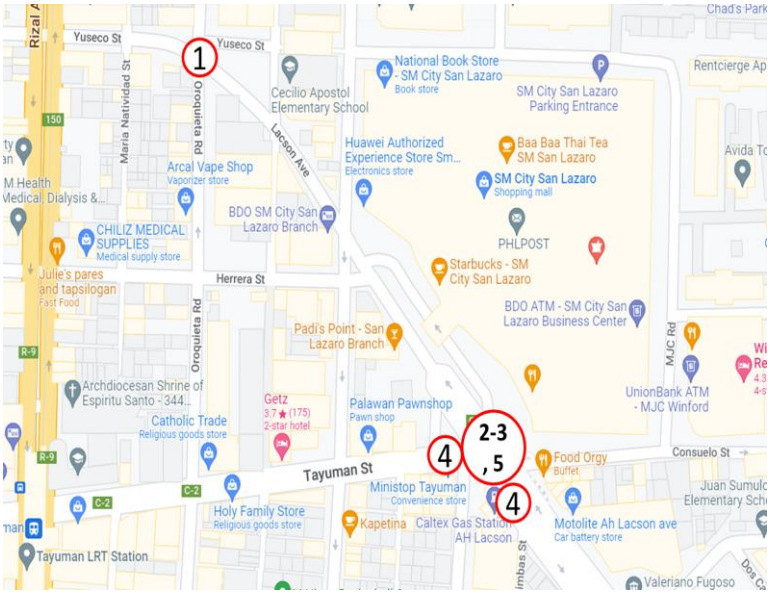
Map of Recommended Traffic Management Measures



Note: The numbers on the figure correspond to the list of recommendation/s

Code	MN85
Int. Name	Manila: Lacson Ave. - Tayuman St./Consuelo St
Field Observations	1. Shopping Mall is located at the corner of the intersection which affects the flow of traffic. 2. Concrete barrier separates northbund and southbound directions and blocks the intersection. 3. Tricycle and jeepney terminals and loading areas are located at the corners of the intersection. 4. There are parked vehicles and vendors at Tayuman St. near the intersection. 5. Pedestrians are still crossing the roads even though a pedestrian overpass is present. 6. Lacson Ave. intersections lack pavement markings.
Related DPWH/ DoTr Projects	
Recommended Traffic Management Measures by the JPT, MMDA, DPWH, and DoTr	1. Lane markings required at Lacson – Oroquieta Road and crossing streets. 2. No crossing sign (R3-10) at intersection. 3. Signalization to be studied by MMDA. 4. Consider relocation of loading areas. 5. Strict compliance and implementation of traffic rules and regulations.

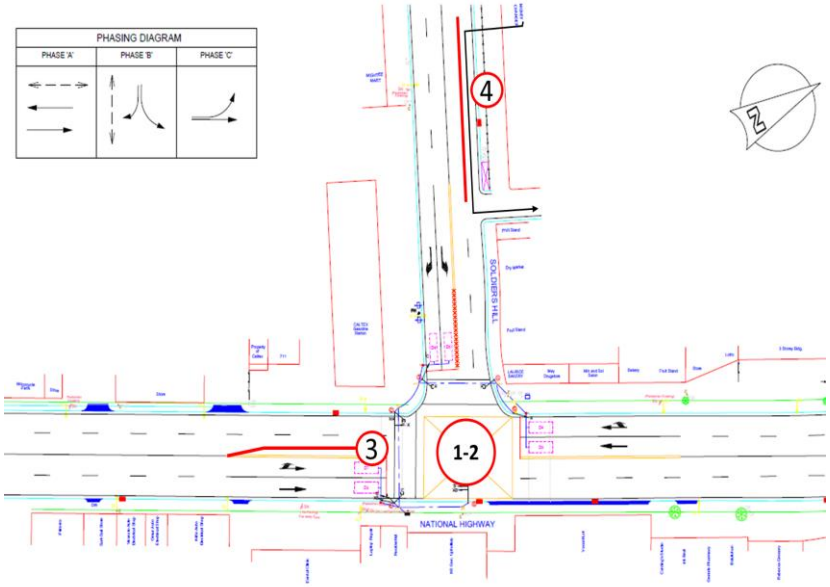
Map of Recommended Traffic Management Measures



Note: The numbers on the figure correspond to the list of recommendation/s

Code	MT09
Int. Name	Muntinlupa: Manila South Road-Soldier Hills Village Main Road
Field Observations	1. Long queues on both direction of Manila South Rd. because of accumulated delay from PUJs and other vehicles entering and leaving the corridor. 2. Once signalized and later removed due probably to saturated condition during peak hours and conflict with LT from south approach that cannot be banned. 3. North leg receiving side: Dedicated tricycle lane, that enter the lane in reverse direction, drop off / pick up passenger, make U-turn inside market and proceed to the west. 4. Pedestrian railings to prevent pedestrians from crossing from this corner.
Related DPWH/ DoTr Projects	
Recommended Traffic Management Measures by the JPT, MMDA, DPWH, and DoTr	1. Pavement marking with new layout 2. Coordinate traffic signal of intersections along National Rd. 3. Shift of west app. center line to provide space for through vehicle on inner lane to pass through LT vehicle waiting for a gap. 4. Reverse the circulation of tricycles at north leg receiving side.

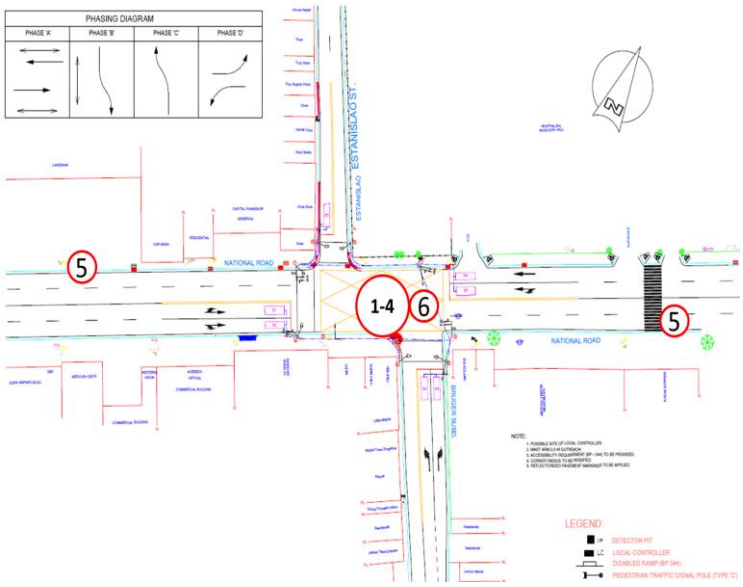
Map of Recommended Traffic Management Measures



Note: The numbers on the figure correspond to the list of recommendation/s

Code	MT21
Int. Name	Muntinlupa: Manila South Road - Bruger
Field Observations	1. Formerly signalized 2. Long queues on both direction of Manila South Rd. because of accumulated delay from PUJs and other vehicles entering and leaving the corridor 3. Tricycle terminal and on-street parking along Bruger Subd. Rd.
Related DPWH/ DoTr Projects	Funded: 1. Asphalt Overlay
Recommended Traffic Management Measures by the JPT, MMDA, DPWH, and DoTr	1. Re-install signal if warranted with proper phasing and timing plan. 2. Center line shift at intersection approach. 3. Pavement marking with proper layout. 4. Provide Traffic signs. 5. Jeepney stop should be 50m from the intersection. 6. Coordinate traffic signal of intersections along National Rd.

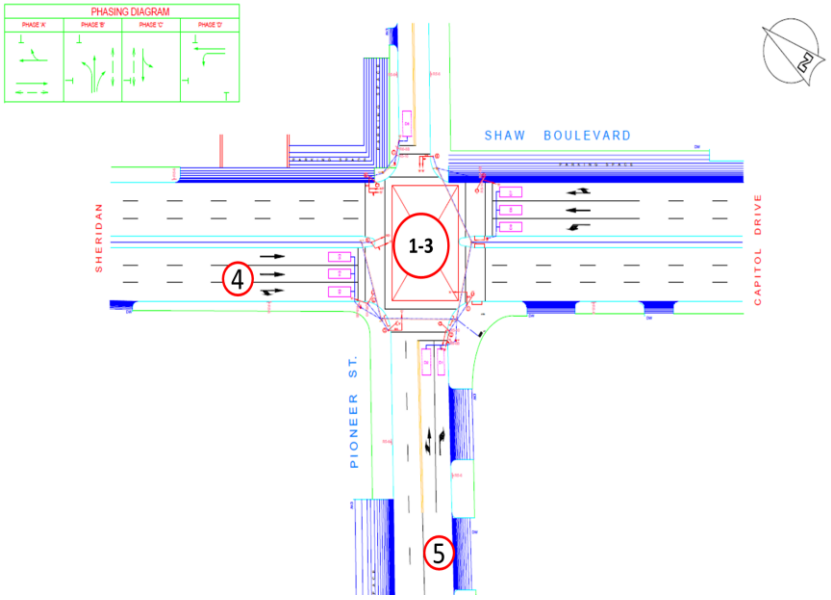
Map of Recommended Traffic Management Measures



Note: The numbers on the figure correspond to the list of recommendation/s

Code	PG09
Int. Name	Pasig: Shaw Blvd - Pioneer St
Field Observations	1. Huge volume of traffic from Shaw Boulevard and Pioneer St. 2. Turning vehicles disrupt flow of traffic going through. 3. Possible for Road Widening. 4. No traffic enforcer. 5. Signal timing does not match with traffic demand. 6. Green time of nearby intersection along Shaw Blvd. is not the same. 7. Pasig City operates the traffic signal. 8. Pedestrian signal is broken. 9. Queue from downstream along EB direction (Shaw Blvd), and SB direction (Pioneer).
Related DPWH/ DoTr Projects	Completed: 1. Bayanihan 2 Bike Lanes
Recommended Traffic Management Measures by the JPT, MMDA, DPWH, and DoTr	1. Review of phase sequence and timing plan. 2. Coordinate with neighboring signals. 3. Pavement marking with new layout. 4. Apply actuation control to north app. (Gen. Roxas). 5. Use of alternate route from Pioneer st. to lessen the traffic flow.

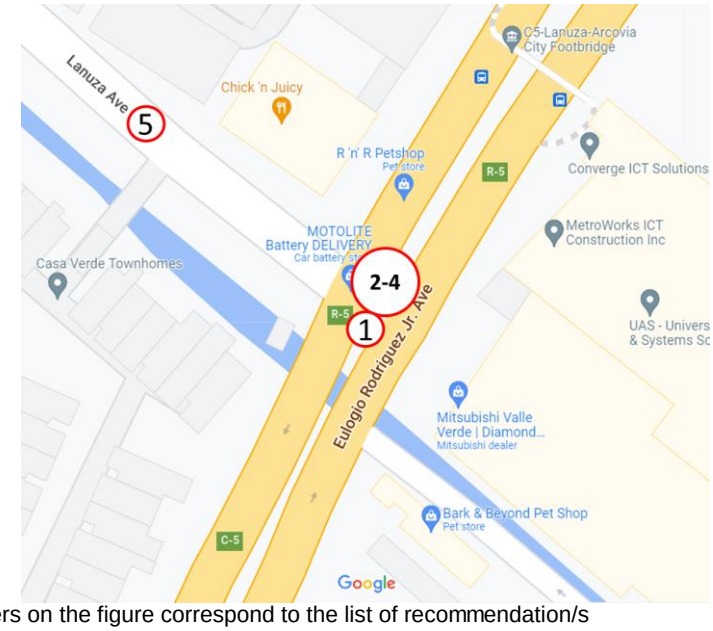
Map of Recommended Traffic Management Measures



Note: The numbers on the figure correspond to the list of recommendation/s

Code	PG20
Int. Name	Pasig: E. Rodriguez Jr. Ave-R. Lanuza Ave
Field Observations	1. Huge volume of traffic from C5 Southbound and from Lanuza. 2. Turning vehicles disrupt flow of traffic going through. 3. Not Possible for Road Widening. 4. Staggered intersection. 5. No through movement to P. Conducto St. Right turn only from Conducto St. 6. Activity from the commercial building on the EB direction affects vehicles on the right lane. 7. Not clear if 2 lane left turn at west approach is allowed or not.
Related DPWH/ DoTr Projects	Completed: 1. Bayanihan 2 Bike Lanes
Recommended Traffic Management Measures by the JPT, MMDA, DPWH, and DoTr	1. Remove barrier for NB direction and apply pavement marking. 2. Pavement marking with new layout. 3. Review phase sequence and modify if necessary. 4. Left turn green arrow at west approach not required. 5. Use of alternate route from Lanuza and vicinity to lessen the traffic flow.

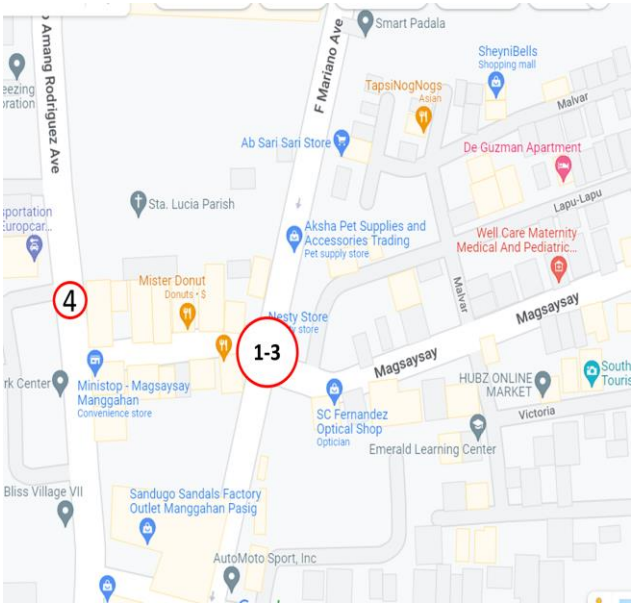
Map of Recommended Traffic Management Measures



Note: The numbers on the figure correspond to the list of recommendation/s

Code	PG28
Int. Name	Pasig: Tramo - Magsaysay
Field Observations	1. Tramo St is one-way towards South. 2. Magsaysay Rd leads to Felix Ave. that connects Marikina-Infanta Hwy. and Ortigas Ave. 3. No sidewalk, pedestrians are exposed to passing vehicles 4. Long queue along Tramo St. because of vehicles exiting A. Mabini St. accessing E. Rodriguez Ave. 5. Road construction by MMDA at F. Mariano Ave.
Related DPWH/ DoTr Projects	
Recommended Traffic Management Measures by the JPT, MMDA, DPWH, and DoTr	1. Carriageway edge line to delineate imaginary sidewalk. 2. Other pavement marking with proper layout. 3. Corner mirror at all intersections. 4. Improve major road so vehicles would shift there.

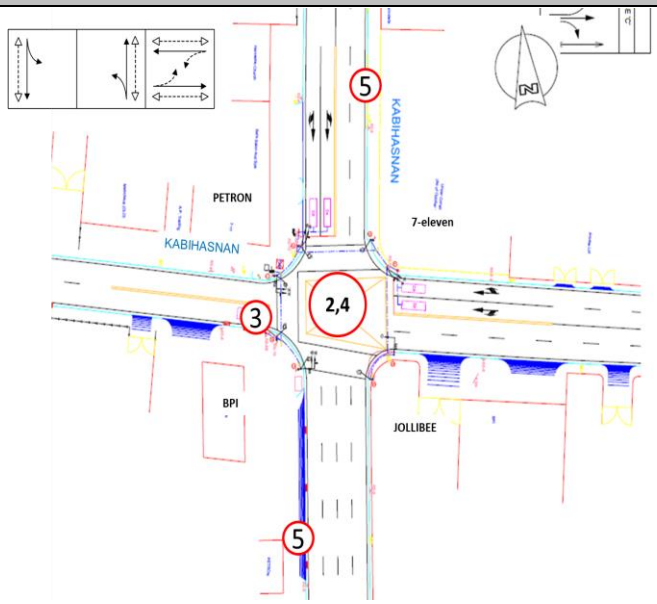
Map of Recommended Traffic Management Measures



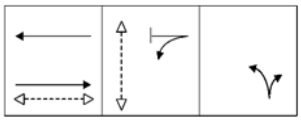
Note: The numbers on the figure correspond to the list of recommendation/s

Code	PQ01
Int. Name	Parañaque: Quirino Avenue - Kabihasnan
Field Observations	1. PUVs loading and unloading impede the flow of traffic. 2. Low volume from west approach coming from the service road. 3. Signal lantern for west approach installed but not working.
Related DPWH/ DoTr Projects	Funded: 1. Road Improvement along Kabihasnan (C.P. Garcia to Quirino Ave.)
Recommended Traffic Management Measures by the JPT, MMDA, DPWH, and DoTr	1. Prepare intersection drawing with correct geometry, direction, signal lantern layout and phase sequence. 2. Review and update phase sequence and timing plan. 3. West approach may be actuated. 4. Design and apply pavement marking. 5. MMDA-LGU coordination for loading and unloading areas.

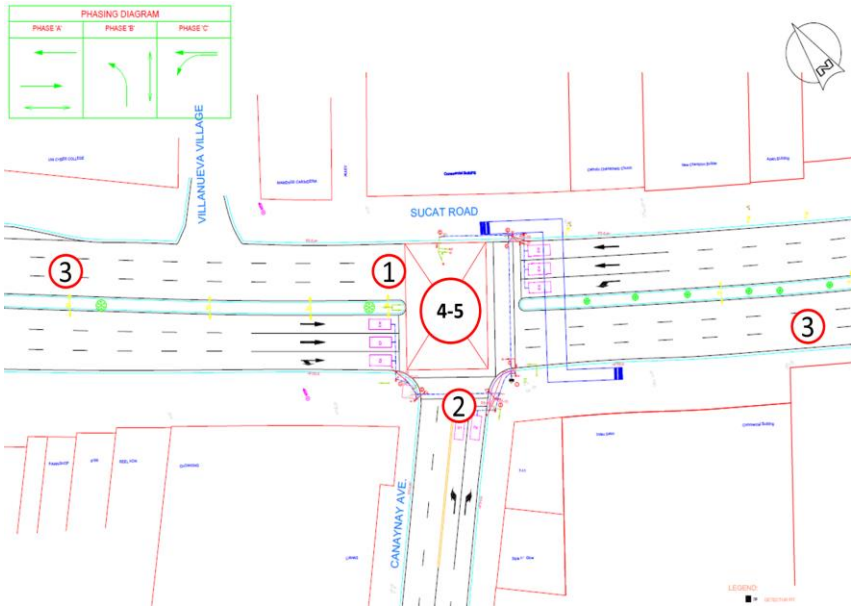
Map of Recommended Traffic Management Measures



Note: The numbers on the figure correspond to the list of recommendation/s

Code	PQ08
Int. Name	Parañaque: Dr. Arcadio Santos Avenue-Angelina Canaynay Ave
Field Observations	1. PUVs loading and unloading impede the flow of traffic. 2. Through movement cannot pass due to the queue from downstream Sucat Rd eastbound direction. through vehicles are trapped in the middle of the intersection. 3. Traffic Signal grouped with N. Lopez, San Antonio, President Ave.
Related DPWH/ DoTr Projects	Funded: 1. Asphalt overlay along Sucat Rd. Completed: 1. South Metro Manila Bike Lanes
Recommended Traffic Management Measures by the JPT, MMDA, DPWH, and DoTr	1. Consider relocating pedestrian crossing on west side and modify phase sequence shown below. 2. Apply actuation to left turn on east approach 3. Study the cause of congestion at downstream point and implement improvement measures if possible. 4. Pavement marking with new layout 5. Proposed Signal phasing 

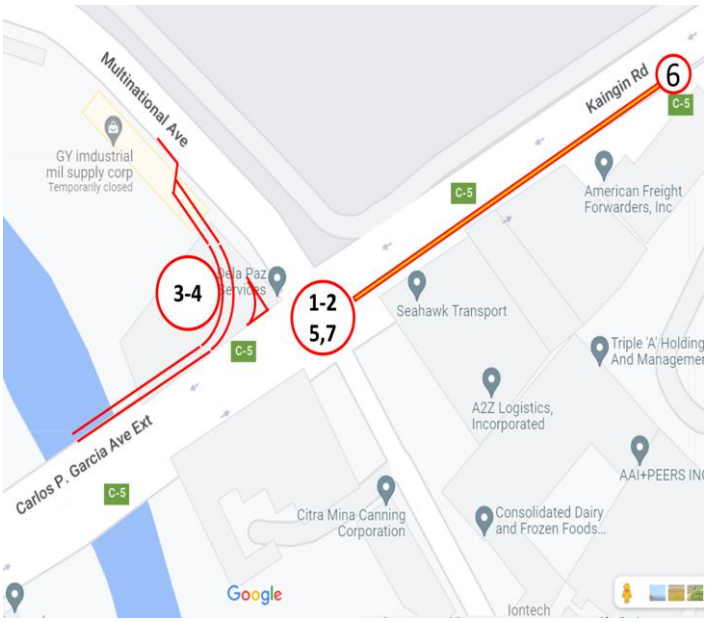
Map of Recommended Traffic Management Measures



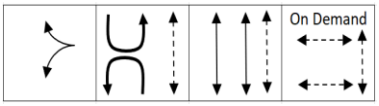
Note: The numbers on the figure correspond to the list of recommendation/s

Code	PQ20
Int. Name	Parañaque: C-5 Extension Road/Kaingin Road-Multinational Ave
Field Observations	1. Turning vehicles disrupt flow of traffic going through. 2. Potholes along/near/inside the intersection. 3. C5 Ext. west approach: Large left turning volume, motorcycles have large packages loaded on their vehicle. 4. C5 Ext. east approach receiving side: Queue from down stream due to potholes, narrower lane width, and curved road. 5. Managed by 2 traffic enforcers (Let all vehicles pass per leg/long red time for other legs). 6. Lacks lane marking. 7. Intersection is not leveled. 8. Long queues along C5 Ext. 9. Had Delta V controller installed before but due to DPWH road widening project, the traffic signal facilities were pulled out. July 21, 2020.
Related DPWH/ DoTr Projects	Proposed: 1. C5-Multinational Underpass (FS stage) 2. Road widening 280m from the east approach. Completed: 1. Road wideing at the intersection along C5 Ext.
Recommended Traffic Management Measures by the JPT, MMDA, DPWH, and DoTr	1. Signalization with appropriate phasing and timing plan. 2. Re-concrete intersection area leveled with approaches. 3. Buy land at north west corner area and apply geometric improvement of intersection. 4. Construct sidewalk along Multinational Ave. 5. Pavement marking with suitable layout 6. Planned road widening by DPWH 280m from the east approach. 7. Included in the proposed Phase VI. Traffic Signalization Project by MMDA.

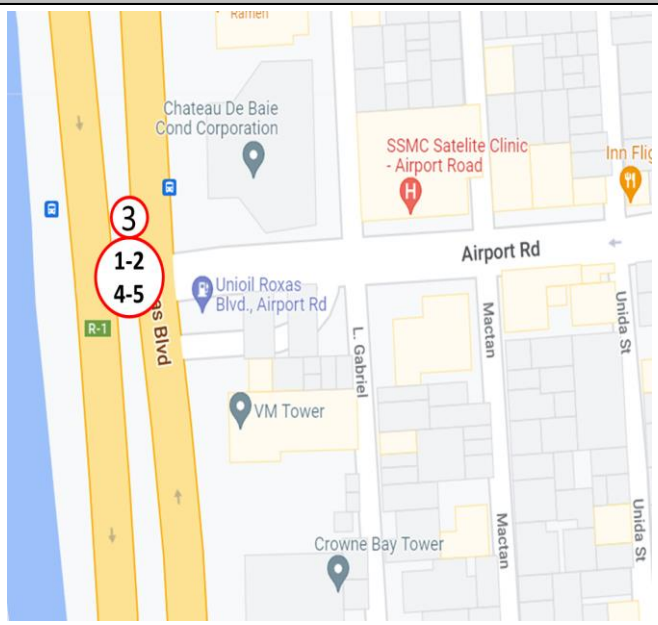
Map of Recommended Traffic Management Measures



Note: The numbers on the figure correspond to the list of recommendation/s

Code	PQ26
Int. Name	Parañaque: Roxas Blvd.- Airport Road
Field Observations	1. U-Turn is allowed from north app. but not allowed for south app. 2. Signal cycle too short compared with traffic volume. 3. Pedestrian signal not working. Pedestrian push button not working. A dedicated all red phase was given to pedestrians. U-Turn is being implemented. 4. South approach: Jeepney stop at the gas station and then turn right. 5. Airport Road is one-way westbound. 6. Traffic Enforcers manage traffic when queue at Airport Rd. reaches major intersections. They let the east approach and U-turn (SB) at the same time.
Related DPWH/ DoTr Projects	Completed: 1. Bayanihan 2 Bike Lanes
Recommended Traffic Management Measures by the JPT, MMDA, DPWH, and DoTr	1. Review and update phase sequence and timing plan. 2. Reactivate pedestrian pushbutton. 3. Consider allowing U-turn from south approach. 4. Pavement marking with proper layout. 5. Proposed phase sequence. 

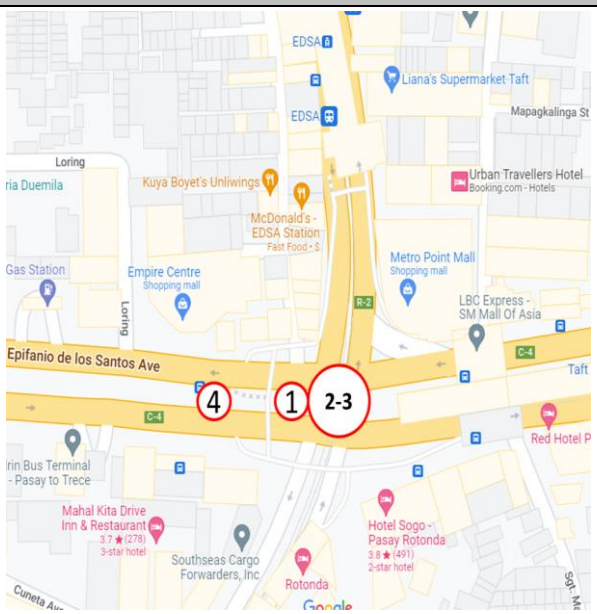
Map of Recommended Traffic Management Measures



Note: The numbers on the figure correspond to the list of recommendation/s

Code	PY04
Int. Name	Pasay: EDSA-Taft Avenue
Field Observations	1. Buses and jeepneys load/unload passenger causing traffic. 2. Terminal for buses and jeepneys were also observed within the vicinity. 3. West approach: Two left turn lanes merge into one lane due to LRT column. 4. West approach: EDSA Carousel bus stop moved here. Before it was on the east leg receiving side. 5. Pedicab terminal along EDSA. 6. Jeepney terminals at north leg receiving side empedes through and right-turn traffic. 7. EDSA Carousel bus stop at west leg. Private vehicles also use the bus lane as of 20220623. 8. East approach, west leg receiving side and north leg receiving side: Jeepney stop/terminal impede through traffic.
Related DPWH/ DoTr Projects	Completed: 1. Bayanihan 2 Bike Lanes
Recommended Traffic Management Measures by the JPT, MMDA, DPWH, and DoTr	1. Signalization at the intersection and between U-turn slot at the west approach and the busway. 2. Provide left turn lane guide marking to allow two lane left turn from west approach. 3. Pavement marking with proper layout. 4. Relocate bus terminals along busway line.

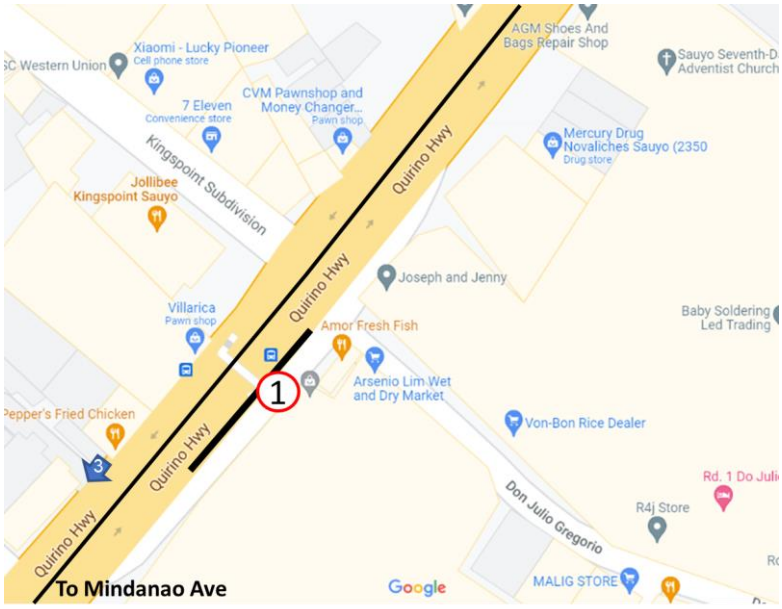
Map of Recommended Traffic Management Measures



Note: The numbers on the figure correspond to the list of recommendation/s

Code	QC05
Int. Name	Quezon City: Quirino Highway-Don Julio Gregorio
Field Observations	1. Concrete barrier at intersection. 2. Jeepney and bus stop impede through traffic 3. Service road used as parking rather than layby area. 4. Market area.
Related DPWH/ DoTr Projects	Funded: 1. Preventive/Routine Maintenance works. Completed: 1. Bayanihan 2 Bike Lanes
Recommended Traffic Management Measures by the JPT, MMDA, DPWH, and DoTr	1. Relocate some parked vehicles at layby area to giveway to loading and unloading PUVs.

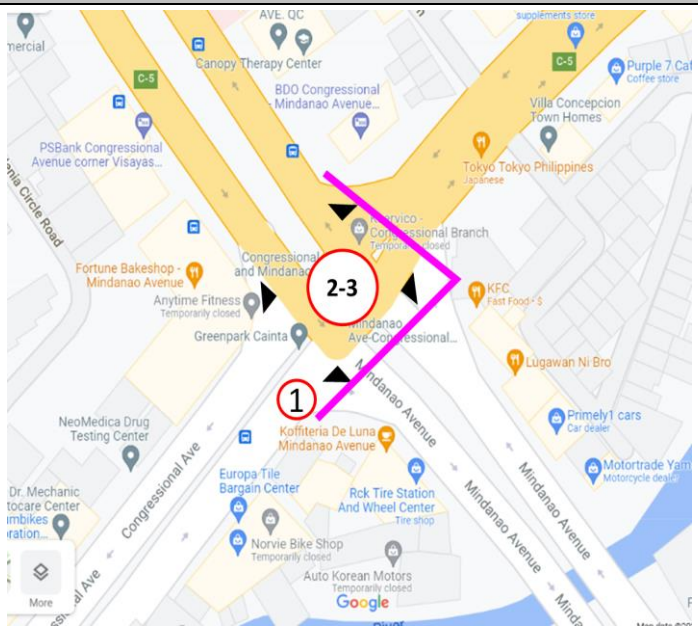
Map of Recommended Traffic Management Measures



Note: The numbers on the figure correspond to the list of recommendation/s

Code	QC07
Int. Name	Quezon City: Mindanao Avenue - Congressional Avenue
Field Observations	1. Truck route coming/going from/to NLEX. 2. Heavy volume of left-turning trucks at Congressional (south approach) and Mindanao Ave. (west approach). 3. No RTOR at Congressional (north approach but there is heavy RT volume of trucks 4. Long queues along Mindanao Ave
Related DPWH/ DoTr Projects	
Recommended Traffic Management Measures by the JPT, MMDA, DPWH, and DoTr	1. RTOR should be allowed from Congressional Ave to Mindanao Ave. northbound. 2. Pavement marking must be applied with new layout. 3. Signal phase and timing plan must be reviewed and updated taking consideration into heavy left turn from north approach.

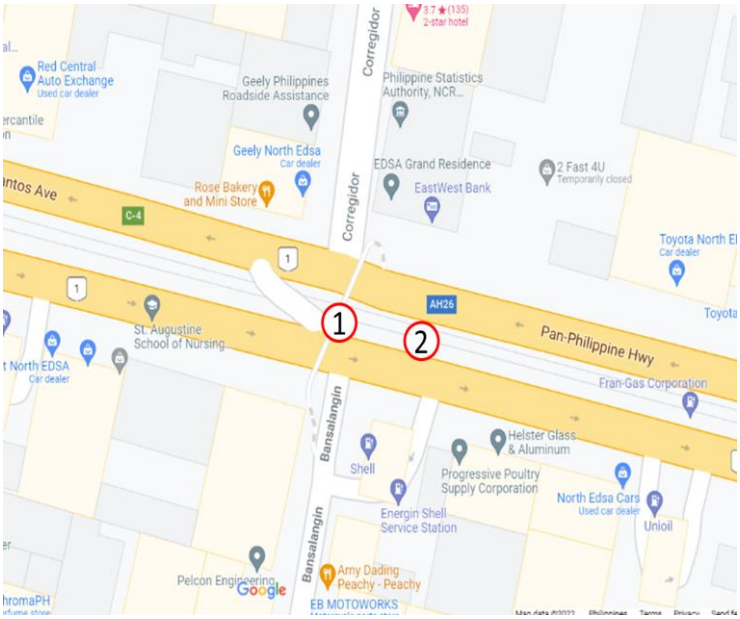
Map of Recommended Traffic Management Measures



Note: The numbers on the figure correspond to the list of recommendation/s

Code	QC108
Int. Name	Quezon City: EDSA (NB)-Corregidor
Field Observations	1. One of Detour to avoid EDSA Traffic. 2. Long queue of U-turning vehicles beside bus lane. 3. 2 lanes were dedicated for U-turn. 4. Controlled by traffic signal but no transit signal priority is applied. 5. U-turn volume of vehicles coming from Balintawak is heavier than the through volume (EB) during pm peak hours.
Related DPWH/ DoTr Projects	Completed: 1. Bayanihan 2 Bike Lanes
Recommended Traffic Management Measures by the JPT, MMDA, DPWH, and DoTr	1. Adopt transit signal priority at U-turn slot in front of Quezon City Academy. 2. Install bus detector on bus lane with proper distance from U-turn opening.

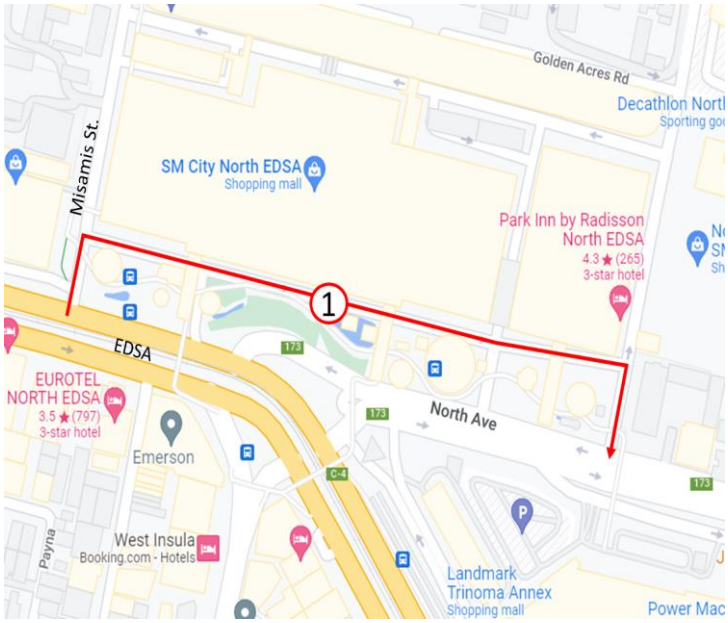
Map of Recommended Traffic Management Measures



Note: The numbers on the figure correspond to the list of recommendation/s

Code	QC109
Int. Name	Quezon City: EDSA (NB)-Misamis (SM North EDSA)
Field Observations	1. U-turn area of vehicle going to SM North. 2. Conflict with swerving vehicles coming from Misamis St. accessing the U-turn slot about 300m from Misamis St. 3. Construction of bus stop for EDSA carusel near Misamis St. 4. Misamis St to West EDSA: Sudden lane change by vehicles accessing the U-turn.
Related DPWH/ DoTr Projects	Completed: 1. Bayanihan 2 Bike Lanes
Recommended Traffic Management Measures by the JPT, MMDA, DPWH, and DoTr	1. Proposed circulation to prevent merging conflict due to vehicles exiting Misamis St. Misamis St. as entrance and SM North East Rd as exit.

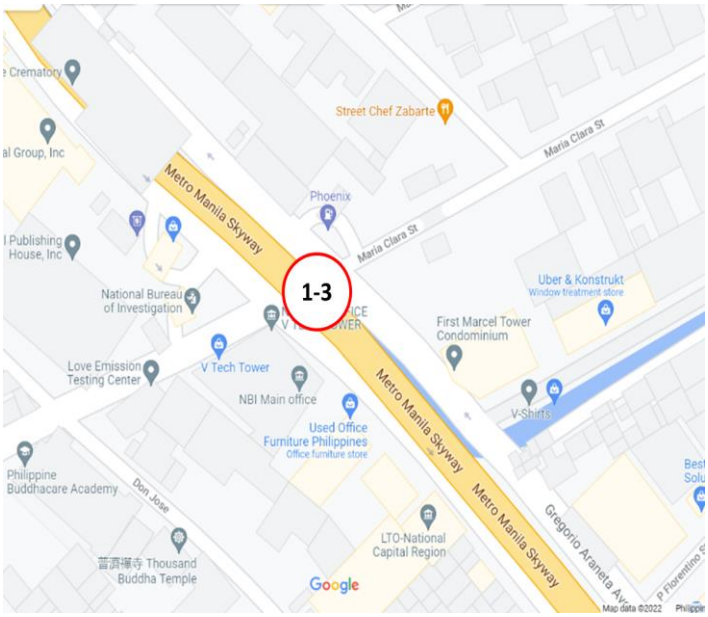
Map of Recommended Traffic Management Measures



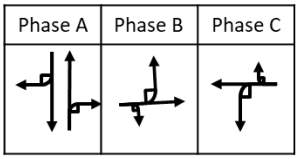
Note: The numbers on the figure correspond to the list of recommendation/s

Code	QC115
Int. Name	Quezon City: G. Araneta Avenue-Maria Clara St.
Field Observations	1. Truck route coming/going from/to NLEX. 2. Dedicated parking area under skyway. 3. Damaged pavement inside intersection (asphalt over concrete). 4. Hampered sight distance due to columns particularly for left turning traffic from south app. 5. Lacks pavement markings.
Related DPWH/ DoTr Projects	
Recommended Traffic Management Measures by the JPT, MMDA, DPWH, and DoTr	1. Signalization with Maria Clara east app. Actuated. Intersection is included in the traffic signalization project Phase VI by MMDA. 2. Re-pavement work at intersection and approaches. 3. Pavement marking with turning lane guide line inside intersection.

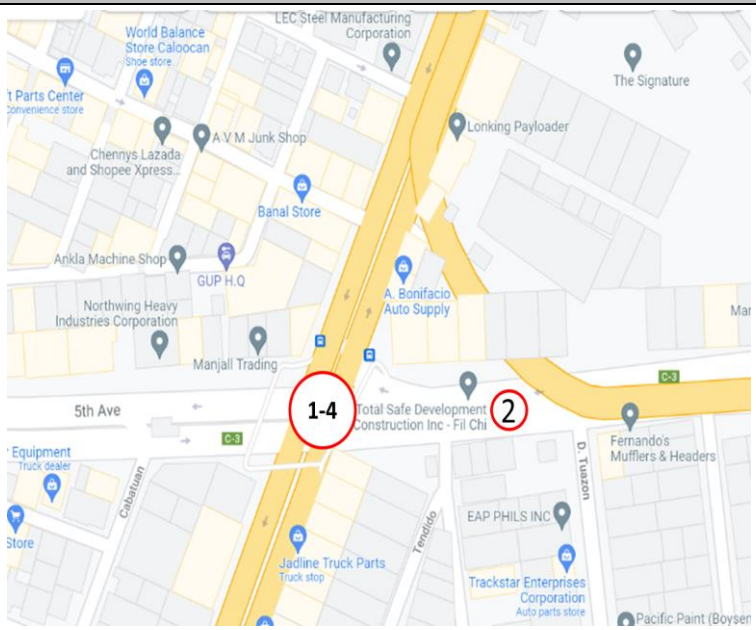
Map of Recommended Traffic Management Measures



Note: The numbers on the figure correspond to the list of recommendation/s

Code	QC13
Int. Name	Quezon City: A. Bonifacio Avenue-5th Avenue/Sgt. Rivera Ave
Field Observations	1. Truck route coming/going from/to NLEX. 2. Disconnected footbridge due to construction of Skyway. 3. Merging and diverging directions between Skyway columns are not clear. 4. Potholes at the intersection and its legs impede traffic. 5. Heavy truck volume.
Related DPWH/ DoTr Projects	Funded: 1. Preventive/Routine Maintenance works. Ongoing: 1. Skyway interchange construction (c/o Concessionaire)
Recommended Traffic Management Measures by the JPT, MMDA, DPWH, and DoTr	1. Re-pavement work at intersection and approaches. 2. Pavement marking with turning lane guide line inside intersection. 3. Re-construction of removed part of foot bridge. 4. Proposed phase sequence. 

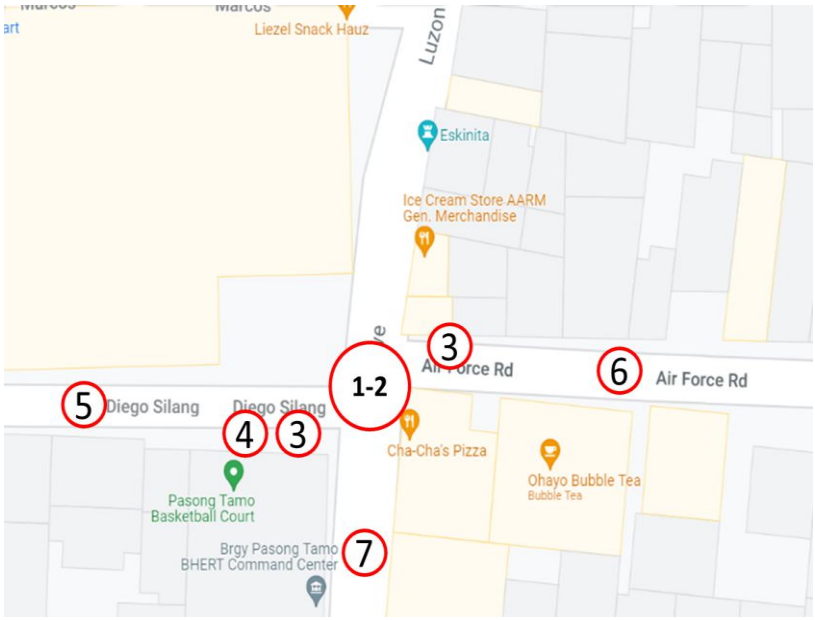
Map of Recommended Traffic Management Measures



Note: The numbers on the figure correspond to the list of recommendation/s

Code	QC29
Int. Name	Quezon City: Luzon Avenue - Diego Silang/Airforce
Field Observations	1. Truck route coming/going from/to NLEX. 2. Staggered intersection. 3. 1 lane per direction for all legs. 4. Street vendors occupy pedestrian walkway and road. 5. Lacks lane marking. 6. NLEX Segment 8.2 is set to be constructed along Luzon Ave. 7. Low volume along Diego Silang St. and Air Force Rd. 8. On-street parking along Diego Silang.
Related DPWH/ DoTr Projects	
Recommended Traffic Management Measures by the JPT, MMDA, DPWH, and DoTr	1. Pavement markings (Lane line, stop line at intersection, center line along Luzon Ave. if width is enough, etc.). 2. Imaginary sidewalk lane marking at the section where no sidewalk is provided. 3. Stop sign (R1-1) on Air Force Road and Diego Silang. 4. Relocate tricycle terminal to Diego Silang. 5. Diego Silang to be a one-way road (WB). 6. Air Force Rd to be a one-way road (WB). 7. Increase capacity along Luzon Ave in anticipation to NLEX Segment 8.2.

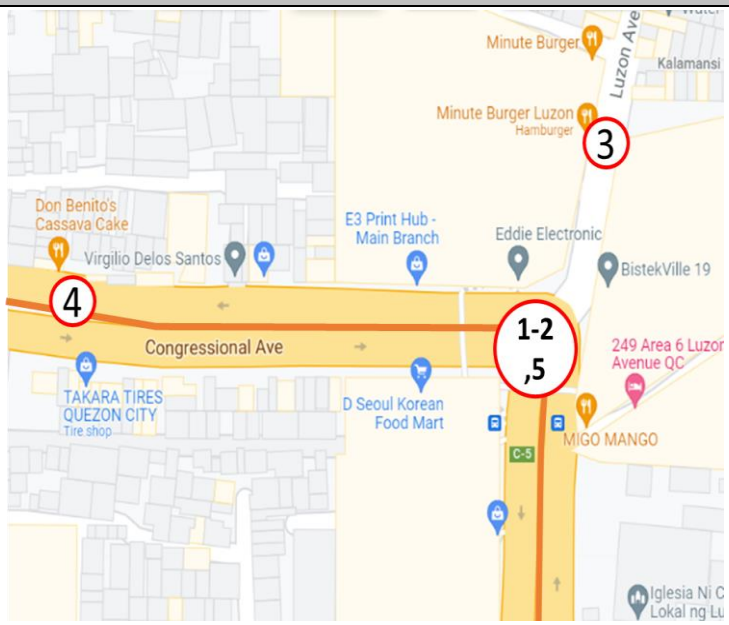
Map of Recommended Traffic Management Measures



Note: The numbers on the figure correspond to the list of recommendation/s

Code	QC30
Int. Name	Quezon City: Congressional Avenue Extension-Luzon Avenue
Field Observations	1. Truck route coming/going from/to NLEX. 2. U-turn slot at Congrassional Ave. Vehicle slow down to give way for U-turning vehicles. 3. Bus stop impedes through traffic along Crongressional Ave. (EB). 4. Tricycle terminal at Luzon Ave north leg receiving side. 5. Road-side parking at the intersection. 6. Closed intersection.
Related DPWH/ DoTr Projects	
Recommended Traffic Management Measures by the JPT, MMDA, DPWH, and DoTr	1. Imaginary triangle island by pavement marking to be provided at the intersection to guide traffic from south approach. 2. Reapplication of pavement markings. 3. Increase capacity along Luzon Ave north leg in anticipation for NLEX Segment 8.2. 4. Move the U-turn farther West. 5. LGU proposed to open the intersection.

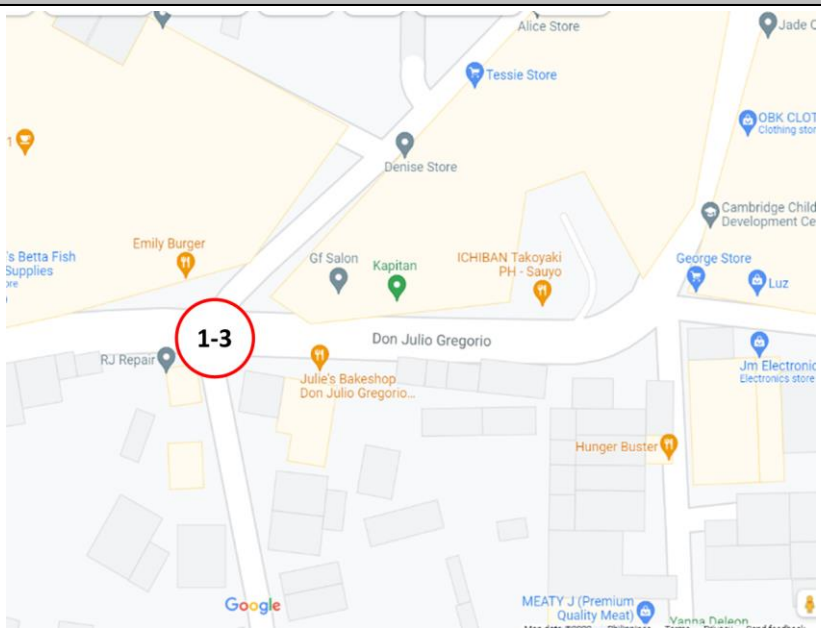
Map of Recommended Traffic Management Measures



Note: The numbers on the figure correspond to the list of recommendation/s

Code	QC36
Int. Name	Quezon City: Don Julio Gregorio-F. delos Santos/Gulod Road
Field Observations	1. Intersection area/highly populated area/subdivision area. 2. Potehole at south approach. 3. Island at north approach. 4. 1 lane per direction. 5. Long queue along Don Julio Gregorio during peak hour caused by trucks. 6. Lacks pavement markings. 7. No sidewalk along Don Julio Gregorio. 8. Don Julio Gregorio-Old Sauyo Rd, an intersection nearby, is too small for a truck route.
Related DPWH/ DoTr Projects	1. Local Road (Currently No Proposed Improvement as per DPWH Mandate)
Recommended Traffic Management Measures by the JPT, MMDA, DPWH, and DoTr	1. Pavement markings (imaginary sidewalk line, stop line at intersection, center line along the road with carriage width of 6.0 m for two ways or more such as Richland Ave. etc. 2. Stop sign (R1-1) on all side roads at intersection with Don Julio Gregorio. 3. Install curve mirror (corner mirror) at intersection with visibility issue.

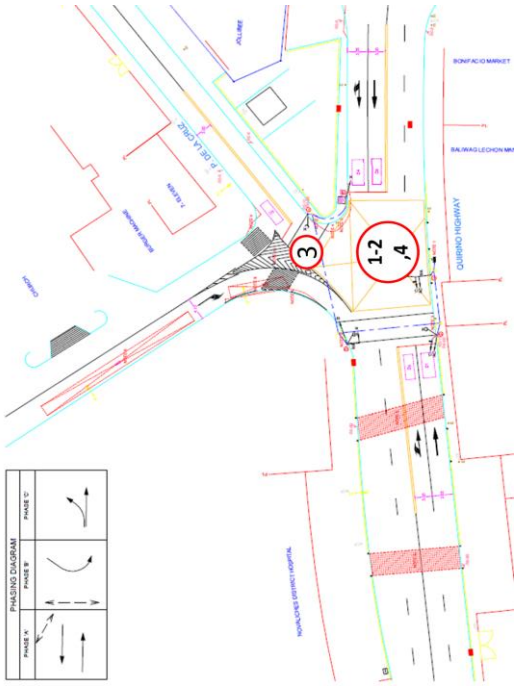
Map of Recommended Traffic Management Measures



Note: The numbers on the figure correspond to the list of recommendation/s

Code	QC38
Int. Name	Quezon City: Quirino Highway-Pablo dela Cruz
Field Observations	1. Highly populated area/subdivision area. 2. Currently flashing yellow. Requested Flashing by DPOS from DPWH controller. 3. Jeepney stops along Quirino Hwy impede through traffic. 4. Long queue caused by shockwave effect. 5. Low volume from P. Dela Cruz St.
Related DPWH/ DoTr Projects	Funded: 1. Preventive/Routine Maintenance works. Completed: 1. Bayanihan 2 Bike Lanes
Recommended Traffic Management Measures by the JPT, MMDA, DPWH, and DoTr	1. Signal phase and timing re-design. 2. Re-activation of signal after review of phasing and timing parameter. 3. Actuation on P. De la Cruz and provision of pedestrian pushbutton to cross Quirino Highway. 4. Pavement markings.

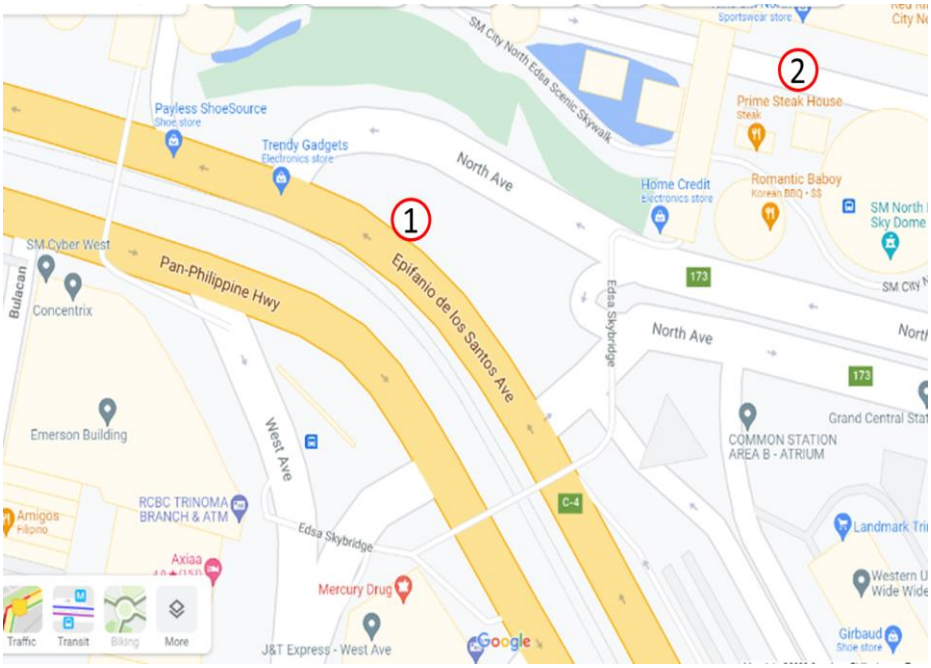
Map of Recommended Traffic Management Measures



Note: The numbers on the figure correspond to the list of recommendation/s

Code	QC46
Int. Name	Quezon City: EDSA - North Avenue
Field Observations	1. Affected by the on-going MRT-7 project. 2. Merging vehicles slow down at EDSA-North Ave. 3. Bus terminal nearby disturb traffic flow.
Related DPWH/ DoTr Projects	Completed: 1. Bayanihan 2 Bike Lanes
Recommended Traffic Management Measures by the JPT, MMDA, DPWH, and DoTr	1. Re-study alignments based on the final changes brought by the common station. 2. Proposed circulation to prevent merging conflict due to vehicles exiting Misamis St. Misamis St. as entrance and SM North East Rd as exit.

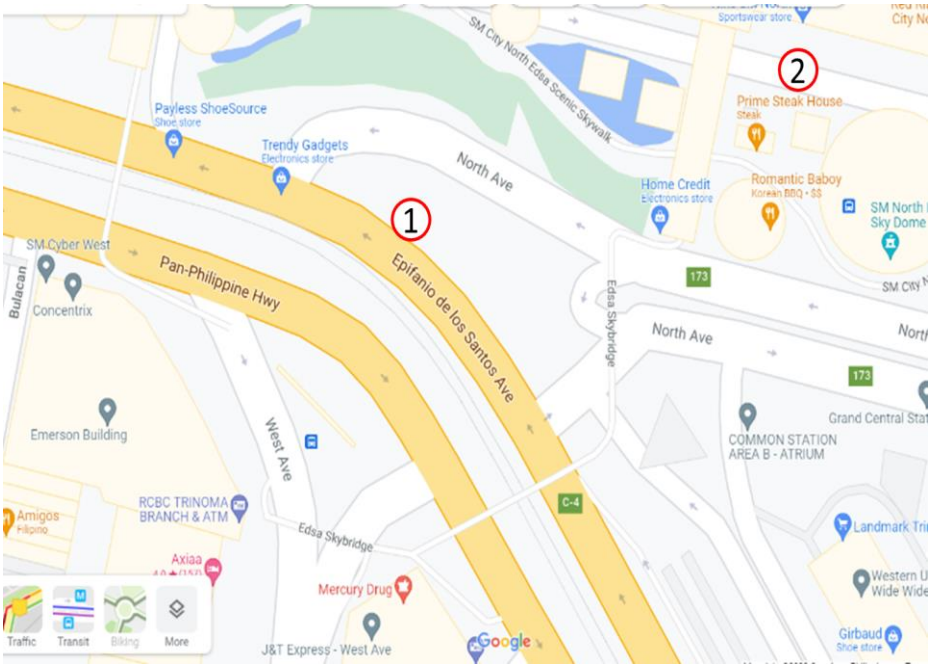
Map of Recommended Traffic Management Measures



Note: The numbers on the figure correspond to the list of recommendation/s

Code	QC53
Int. Name	Quezon City: Gen. Luis - Buenamar Drive
Field Observations	1. Area is surrounded by a market area. 2. Pedestrian railings to prevent crossing. 3. Staggered intersection.
Related DPWH/ DoTr Projects	Funded: 1. Preventive/Routine Maintenance works.
Recommended Traffic Management Measures by the JPT, MMDA, DPWH, and DoTr	1. Signal phase and timing re-design. Replace signal system (controller and lanterns) at Susana Road - General Luis with the signal that has time-of-day function. 2. Provide intersection box and pedestrian crossing on General Luis between Susan Road – Buenarmar Drive with flashing beacon. 3. Pavement markings.

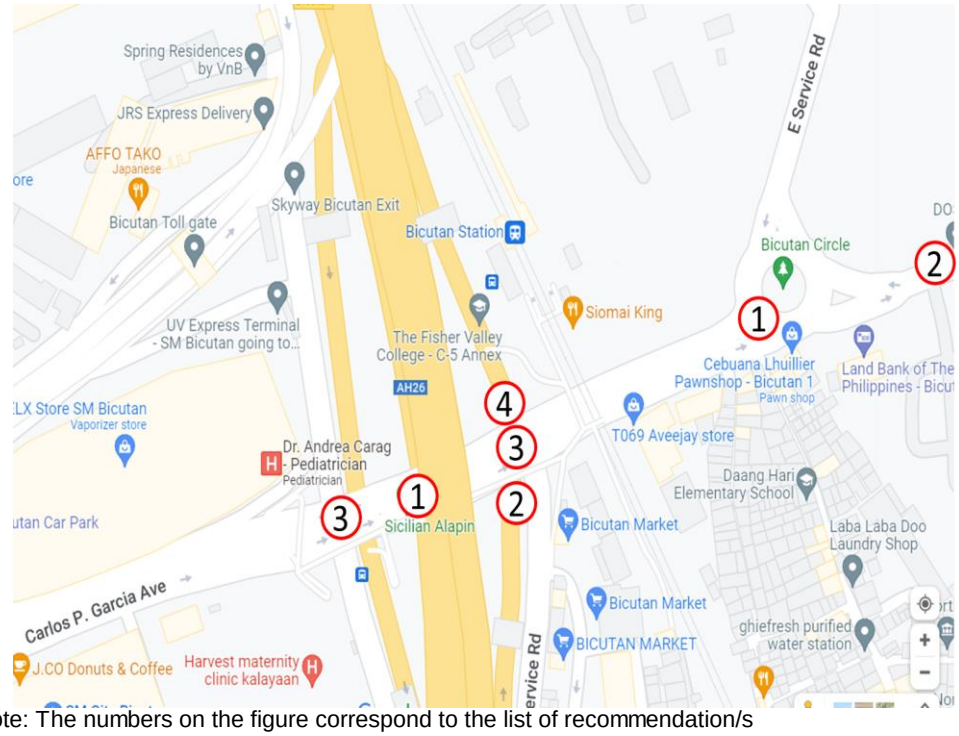
Map of Recommended Traffic Management Measures



Note: The numbers on the figure correspond to the list of recommendation/s

Code	TG20
Int. Name	Taguig: Gen. Paulino Santos Ave.-East Service Road
Field Observations	1. Traffic congestion Observed almost the whole day. 2. Minimal traffic volume to/from A. Bonifacio. 3. Many trucks take the NB service road to avoid paying toll fee. 4. Habal-habal (unregistered motorcycle taxi) are present near the intersection. Tricycle terminals on both sides of the east leg. 5. Railway crossing nearby the west approach. 6. Jeepney terminals on both sides of the NB Service Rd beside SLEX toll exit.
Related DPWH/ DoTr Projects	Funded: 1. Rehabilitation/Reconstruction/ Upgrading of Damaged Paved Roads - Tertiary Roads- Gov I Santiago St. - K0015 + (-197) - K0015 + 006, K0015 + (-644) - K0015 + (-197), K0015 + 006 - K0015 + 012 (F.Y. 2022)
Recommended Traffic Management Measures by the JPT, MMDA, DPWH, and DoTr	1. Pavement marking must be applied from the roundabout to SB Service Rd. 2. Jeepney and tricycle terminals must be clearly defined. 3. Coordination signal at intersections involving SLEX exits. 4. Island required at NB SLEX Entry.

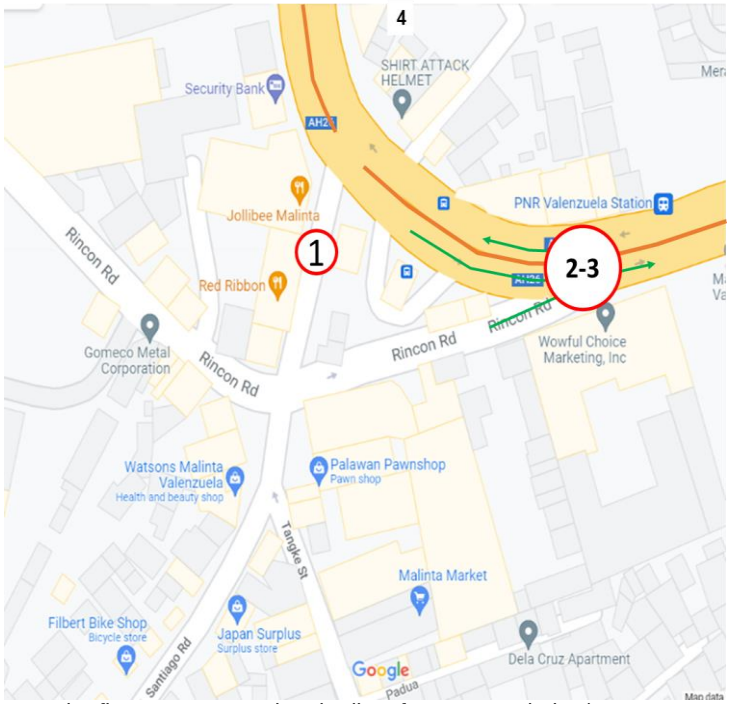
Map of Recommended Traffic Management Measures



Note: The numbers on the figure correspond to the list of recommendation/s

Code	VL06
Int. Name	Valenzuela: Gov. Ignacio Santiago Road-Rincon Road
Field Observations	1. RT vehicles from MacArthur Hwy cannot pass due to queuing along Santiago St. 2. Tricycle terminal along Santiago Rd. 3. Rincon Rd. East leg is one-way going to MacArthur Hwy. 4. The intersection has pedestrian railings to prevent crossing. 5. Large volume of trucks. 6. Congestion sometimes occurs from downstream point of Santiago Rd.
Related DPWH/ DoTr Projects	
Recommended Traffic Management Measures by the JPT, MMDA, DPWH, and DoTr	1. Santiago Rd. North leg: One-way road (SB). 2. Exiting vehicle (NB) can take Rincon Rd then U-turn. 3. Above proposal needs further study as left turn at end of Rincon Rd. is very sharp and needs additional lantern and signal timing modification.

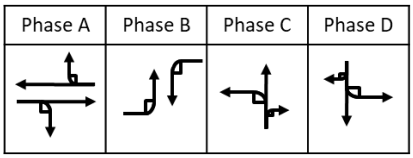
Map of Recommended Traffic Management Measures



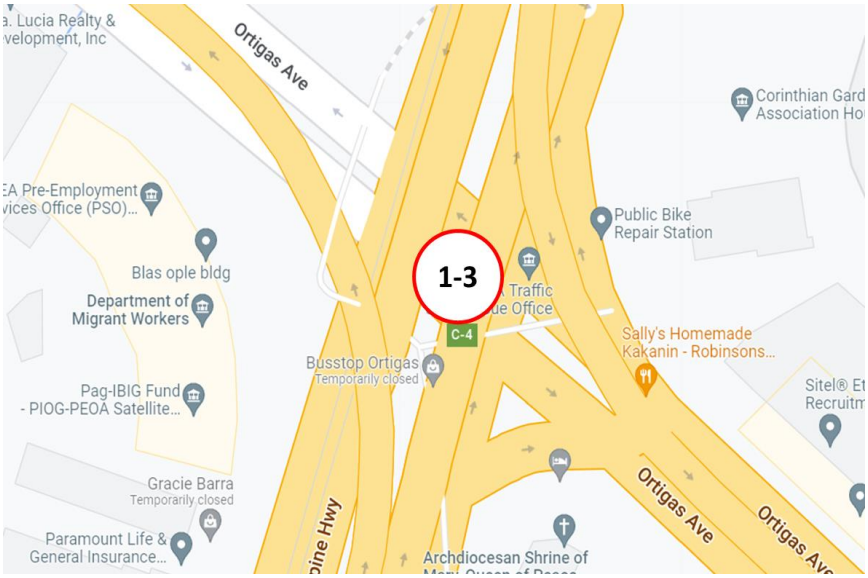
Note: The numbers on the figure correspond to the list of recommendation/s

2. Concept Plan for 3 Additional Intersections Near Bottlenecks

During the site inspection for the 42 major intersections, the JPT noticed that the downstream intersections of MD06, QC05, and QC115—these three are priority intersection TBNs—also have traffic issues that need to be addressed if the congestion at these priority intersections is to be resolved. Hence, concept plans were also prepared for these adjacent intersections.

Code	Near MD06
Int. Name	Mandaluyong: EDSA-Ortigas
Field Observations	1. Traffic is often guided by traffic enforcer following the traffic signal depending on congestion levels.
Related DPWH/ DoTr Projects	
Recommended Traffic Management Measures by the JPT, MMDA, DPWH, and DoTr	1. Review and update signal phase and timing plan. 2. Large intersection area and irregular movement direction require pavement marking inside intersection. 3. Consider the new phase sequence below (North ->). 

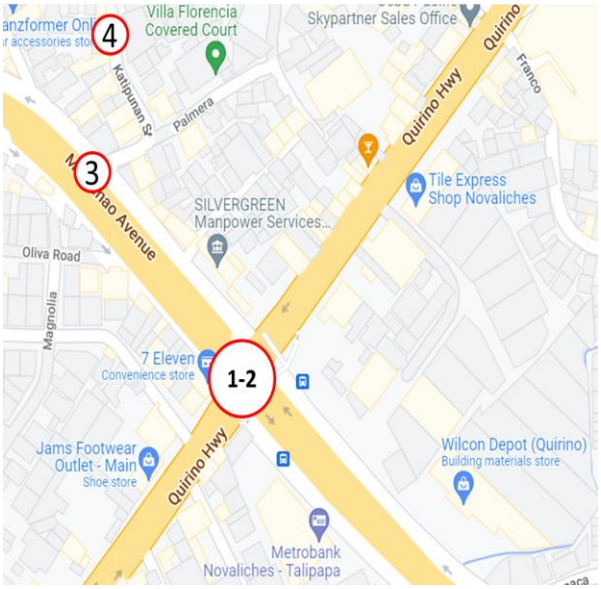
Map of Recommended Traffic Management Measures



Note: The numbers on the figure correspond to the list of recommendation/s

Code	Near QC05
Int. Name	Quezon City: Quirino Hwy-Mindanao Ave
Field Observations	1. Unnecessarily wide right turn lane with inadequate arrow markings (East approach). 2. Intersection has non-operational signal lanterns. 3. 2 Traffic enforcers manage the intersection. 4. Vehicles from east approach enter Palmera St. to access subdivisions causing congestion. 5. Corner cut on East approach U-turn movement is too sharp. 6. Expected MMSP Terminal on South-East side of the intersection.
Related DPWH/ DoTr Projects	
Recommended Traffic Management Measures by the JPT, MMDA, DPWH, and DoTr	1. Signal phase and timing re-design. 2. Appropriate pavement markings with proper design. 3. Install a corner mirror at intersection with Palmera St. 4. Propose improvement of Katipunan St. condition to LGU.

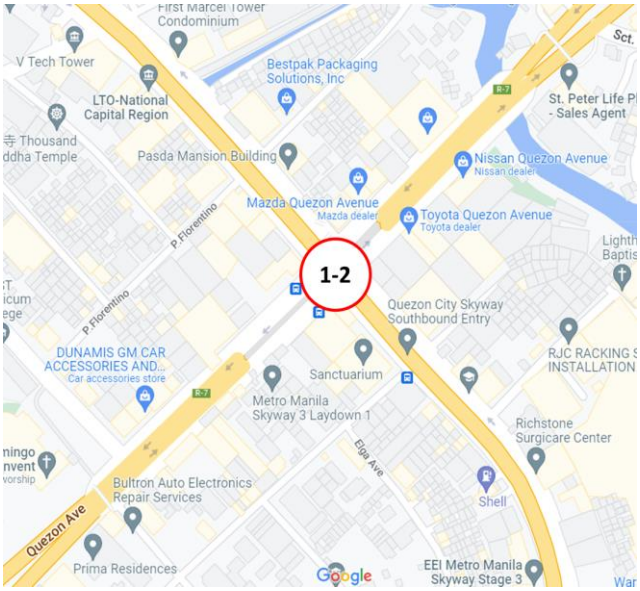
Map of Recommended Traffic Management Measures



Note: The numbers on the figure correspond to the list of recommendation/s

Code	Near QC115
Int. Name	Quezon City: Quezon Ave-G Araneta Ave
Field Observations	1. Footbridge is obstructed by sagging electrical wires. 2. Heavy volume of LT vehicles from North and East appproaches. 3. Donated RSIM controller (old traffic signal).
Related DPWH/ DoTr Projects	
Recommended Traffic Management Measures by the JPT, MMDA, DPWH, and DoTr	1. Signal re-timing and time-of-day plan review. 2. Pavement marking with proper design including turning lane guide line inside intersection.

Map of Recommended Traffic Management Measures



Note: The numbers on the figure correspond to the list of recommendation/s

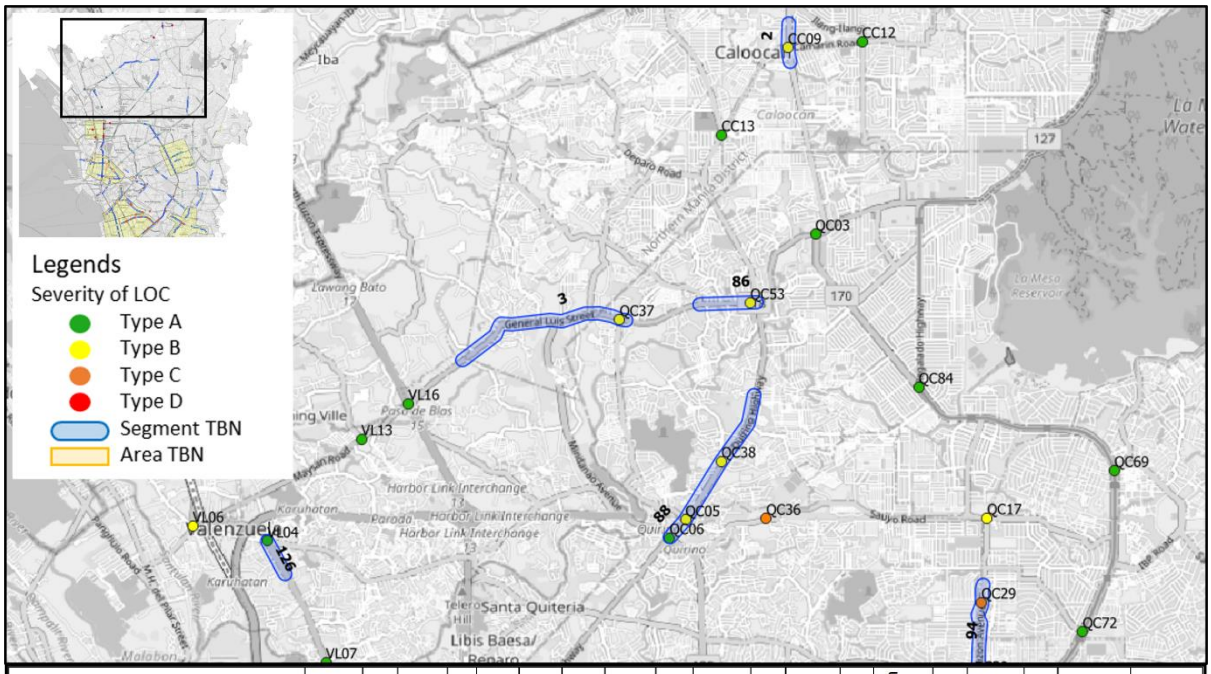
APPENDIX H

Preliminary Improvement Plans for Road Segment Bottlenecks

APPENDIX H

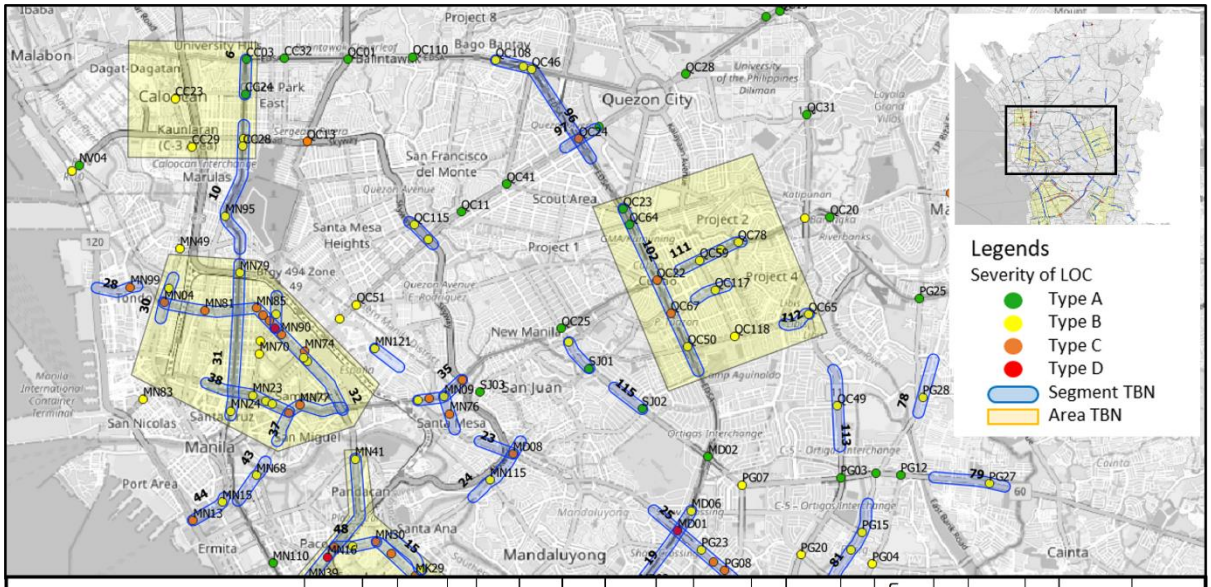
Preliminary Improvement Plans for Road Segment Bottlenecks

The 209 intersection bottlenecks (TBNs) are grouped into 64 segment TBNs and presented here by area. Each table shows the road segment names and their locations.



Segment Roads	TBNs Involved	Segment Code	Distance(km)	No. of TBN	Severity of Level of Congestion	Severity of Queue Length	Signal Type[1]	1. Intersection geometric improvement (within ROW)	2. Proper signage and marking	3. Improvement of safety facilities (pedestrian sidewalk, etc.)	4. Installation of new traffic signals	5. Appropriate signal operation and maintenance (phasing/ timing, etc.)	6. Introduction of signal coordination for corridors	7. Improvement of traffic information facilities such as guide signs	8. Review of traffic regulation for vehicular traffic	9. Parking management (Enhance enforcement, Guidance system, Secure parking space)	10. Review/Replacement of PUVs stop/route	11. Improvement of construction management（Enhance coordination on road diggings)	12. Intersection geometric improvement with conner cut
Zabarte Rd	CC09	2	0.60	1	B	2	1					✓	✓	✓		✓	✓		
Gen. Luis St	QC37	3	2.73	1	B	2	1		✓	✓	✓	✓		✓	✓		✓		✓
Gen. Luis St	QC53	86	0.85	1	B	6	1		✓	✓	✓	✓	✓	✓	✓	✓	✓		✓
Quirino Hwy	QC38	88	2.56	3	B	6	3		✓	✓		✓	✓	✓	✓	✓	✓		✓
	QC05	88			B	6	1		✓	✓	✓	✓	✓	✓	✓	✓	✓		✓
	QC06	88			A	6	3		✓	✓		✓	✓	✓	✓	✓	✓		
Luzon Ave	QC29	94	1.77	2	C	3	1		✓	✓		✓		✓	✓	✓			✓
	QC30	94			B	3	1		✓	✓	✓	✓		✓	✓	✓		✓	✓
MacArthur Hwy	VL04	126	0.57	1	A	6	3		✓			✓	✓	✓	✓		✓		✓

Note: A blank row represents an intersection TNB that is involved in 2 segments. These TBNs are recorded in one of the segments.
[1] 1 At grade Unsignalized, 2 Separated Unsignalized, 3 At grade Signalized, 4 Separated Signalized



Segment Roads	TBNs Involved	Segment Code	Distance(km)	No. of TBN	Severity of Level of Congestion	Severity of Queue Length	Signal Type[1]	1. Intersection geometric improvement (within ROW)	2. Proper signage and marking	3. Improvement of safety facilities (pedestrian sidewalk, etc.)	4. Installation of new traffic signals	5. Appropriate signal operation and maintenance (phasing/ timing, etc.)	6. Introduction of signal coordination for corridors	7. Improvement of traffic information facilities such as guide signs	8. Review of traffic regulation for vehicular traffic	9. Parking management (Enhance enforcement, Guidance system, Secure parking space)	10. Review/Replacement of PUVs stop/route	11. Improvement of construction management (Enhance coordination on road diggings)	12. Intersection geometric improvement with conner cut
Rizal Ave	CC03	6	0.65	2	A	1	1		✓			✓		✓	✓	✓	✓		
	CC24	6			A	2	3		✓	✓		✓	✓	✓	✓	✓	✓	✓	✓
Rizal Ave	CC05	10	2.44	3	B	3	3		✓			✓	✓	✓	✓	✓	✓	✓	✓
	CC28	10			B	3	3		✓	✓		✓		✓		✓	✓	✓	✓
	MN95	10			B	2	3	✓	✓	✓		✓		✓	✓	✓	✓		✓
P. Sanchez St	MD08	23	0.64	1	C	2	3					✓	✓						
Gen Kalentong St	MD08		1.35	2															
	MN115	24			B	2	4			✓		✓		✓			✓		✓
Capulong St-Pres. Quirino Ave	MN99	28	0.75	1	C	1	1	✓	✓	✓	✓	✓		✓	✓	✓			
Juan Luna St-A. Mabini St	MN80	30	0.79	2	B	1	3							✓	✓		✓		
	MN04																		
Rizal Ave	MN79	31	2.81	2	B	1	1		✓	✓	✓	✓		✓	✓	✓			
	MN24	31			B	2	1		✓	✓				✓					
Capulong St - Pres. Quirino Ave	MN04	30	4.15	9	C	3	3	✓	✓			✓		✓		✓			
	MN81	32			C	1	3												
	MN85	32			C	3	1	✓	✓		✓	✓		✓	✓	✓	✓	✓	✓
	MN84	32			C	2	3	✓	✓			✓			✓		✓		✓
	MN92	32			C	2	3										✓		
	MN08	32			D	1	3	✓	✓			✓			✓		✓		✓
	MN90	32			C	2	3							✓	✓		✓		
	MN75	32			B	2	1		✓		✓	✓			✓		✓		
	MN72	32			B	2	3	✓	✓			✓		✓	✓		✓		✓

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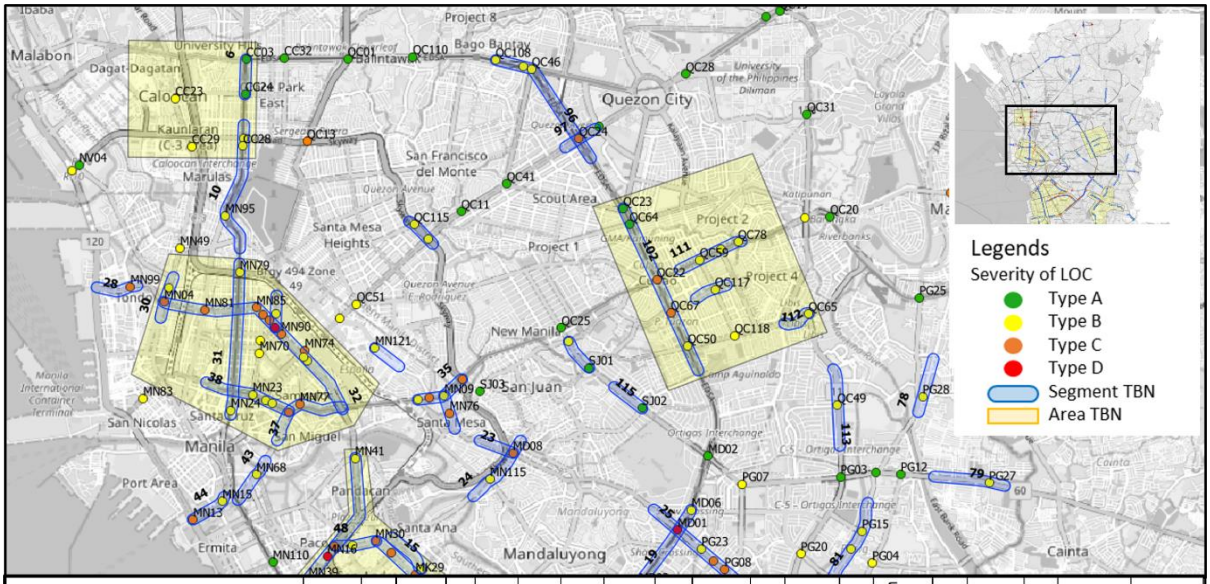

Segment Roads	TBNs Involved	Segment Code	Distance(km)	No. of TBN	Severity of Level of Congestion	Severity of Queue Length	Signal Type[1]	1. Intersection geometric improvement (within ROW)	2. Proper signage and marking	3. Improvement of safety facilities (pedestrian sidewalk, etc.)	4. Installation of new traffic signals	5. Appropriate signal operation and maintenance (phasing/ timing, etc.)	6. Introduction of signal coordination for corridors	7. Improvement of traffic information facilities such as guide signs	8. Review of traffic regulation for vehicular traffic	9. Parking management (Enhance enforcement, Guidance system, Secure parking space)	10. Review/Replacement of PUVs stop/route	11. Improvement of construction management（Enhance coordination on road diggings)	12. Intersection geometric improvement with conner cut
Dimasalang Rd	MN08		0.59	2															
	MN91	33			B	2	3			✓				✓		✓	✓		
Leyte St	MN121	34	0.55	1	B	3	1		✓	✓				✓			✓		
Aurora Blvd	QC26	35	0.92	4	C	2	3												
	MN09	35			B	2	3			✓		✓		✓			✓		
	MN45	35			C	2	3		✓			✓		✓			✓		
	MN46	35			B	2	3		✓			✓		✓	✓		✓		
V. Mapa	MN09		0.64	2															
	MN76	36			C	2	3					✓		✓			✓		
Legarda St	MN77	37	1.59	2	C	2	3		✓			✓		✓			✓		
	MN25	37			C	1	3			✓							✓		
C. M. Recto Ave	MN23	38	1.59	4	B	2	2		✓	✓	✓	✓		✓	✓	✓	✓		✓
	MN26	38			B	2	3	✓	✓			✓		✓	✓		✓		✓
	MN73	38			B	2	3		✓			✓			✓		✓		✓
	MN25																		
E. Mariano Ave	PG28	78	1.02	1	B	3	1		✓			✓	✓						
EDSA	QC108	96	2.63	4	B	6	1		✓	✓		✓	✓	✓		✓			✓
	QC109	96			B	6	1		✓		✓	✓		✓	✓		✓	✓	✓
	QC46	96			B	6	1		✓		✓	✓	✓	✓	✓		✓	✓	✓
	QC24	96			C	3	4	✓	✓	✓		✓	✓	✓	✓		✓	✓	
Quezon Ave	QC24		0.64	2															
	QC97	97			A	6	3		✓	✓		✓	✓	✓			✓		
Gregorio Araneta Ave	QC12	100	0.59	2	B	2	3												
	QC115	100			B	4	1		✓					✓		✓	✓		✓

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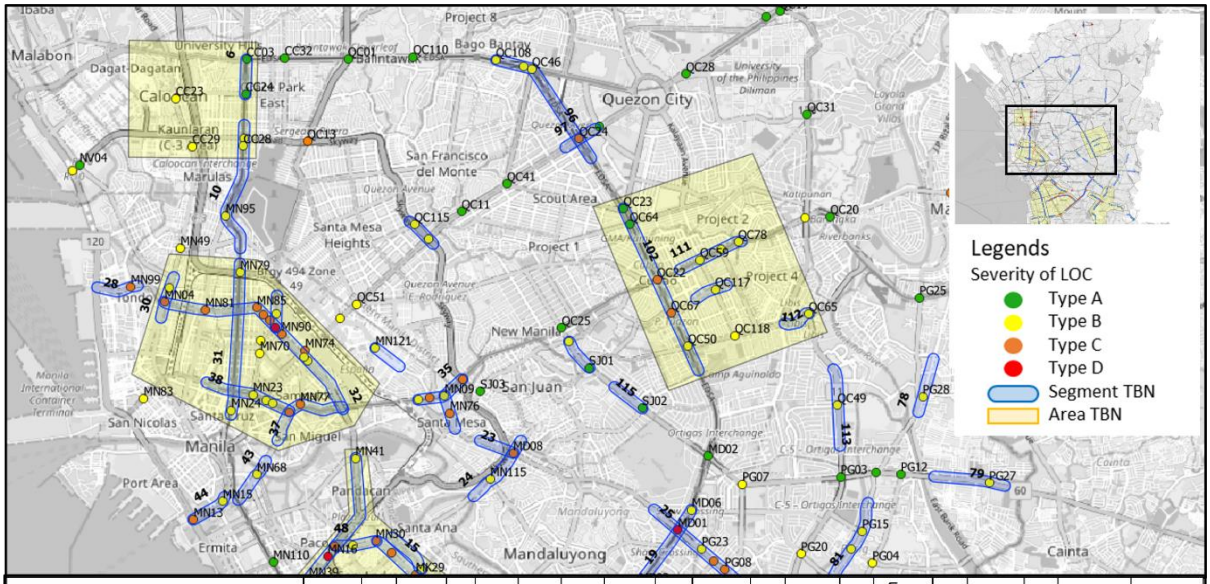

Segment Roads	TBNs Involved	Segment Code	Distance(km)	No. of TBN	Severity of Level of Congestion	Severity of Queue Length	Signal Type[1]	1. Intersection geometric improvement (within ROW)	2. Proper signage and marking	3. Improvement of safety facilities (pedestrian sidewalk, etc.)	4. Installation of new traffic signals	5. Appropriate signal operation and maintenance (phasing/ timing, etc.)	6. Introduction of signal coordination for corridors	7. Improvement of traffic information facilities such as guide signs	8. Review of traffic regulation for vehicular traffic	9. Parking management (Enhance enforcement, Guidance system, Secure parking space)	10. Review/Replacement of PUVs stop/route	11. Improvement of construction management（Enhance coordination on road diggings)	12. Intersection geometric improvement with conner cut
EDSA	QC22	102	3.29	5	C	3	4		✓			✓			✓		✓		
	QC67	102			C	2	3												
	QC50	102			B	2	4												
	QC23	102			A	2	4												
	QC64	102			A	2	4												
Ortigas Ave	SJ01	105	0.61	2	A	2	3					✓	✓		✓				
	QC75	105			B	2	1												
P. Tuazon Blvd	QC117	108	0.61	1	B	2	3												
Aurora Blvd	QC59	111	1.23	3	B	2	3												
	QC77	111			B	2	3		✓										
	QC78	111			B	2	3												
C5 Access Rd	QC65	112	0.52	1	B	2	4												
Carlos P. Garcia Ave - E. Rodriguez Ave (C5)	QC49	113	1.44	1	B	2	3												
Ortigas Ave	SJ02	115	0.64	1	A	2	3												

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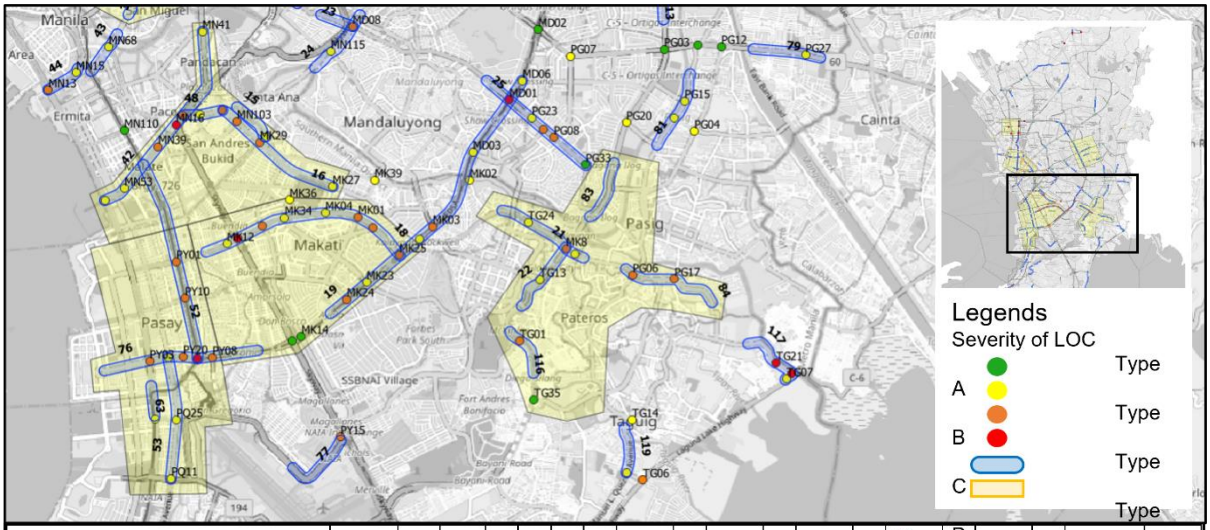

Segment Roads	TBNs Involved	Segment Code	Distance(km)	No. of TBN	Severity of Level of Congestion	Severity of Queue Length	Signal Type[1]	1. Intersection geometric improvement (within ROW)	2. Proper signage and marking	3. Improvement of safety facilities (pedestrian sidewalk, etc.)	4. Installation of new traffic signals	5. Appropriate signal operation and maintenance (phasing/ timing, etc.)	6. Introduction of signal coordination for corridors	7. Improvement of traffic information facilities such as guide signs	8. Review of traffic regulation for vehicular traffic	9. Parking management (Enhance enforcement, Guidance system, Secure parking space)	10. Review/Replacement of PUVs stop/route	11. Improvement of construction management (Enhance coordination on road diggings)	12. Intersection geometric improvement with conner cut	Segment TBN	Segment Area
Kalayaan Ave	MK6	21	1.82	3	B	2	3		✓	✓				✓		✓	✓				
	MK8																				
	TG24	21			B	2	1							✓	✓	✓	✓				
Carlos P. Garcia Ave - E. Rodriguez Ave (C5)	MK8	21	1.47	2	C	2	1					✓		✓							
	TG13	22			B	3	2							✓							
Pasig Blvd-Shaw Blvd	MD01		2.50	4																	
	PG23	25			B	2	3														
	PG09	25			C	3	3	✓	✓			✓	✓		✓						
	PG08	25			C	2	3							✓							
Capulong St - Pres. Quirino Ave	MN41	42	4.05	6	B	2	3		✓	✓				✓							
	MN17	42			C	2	4		✓												
	MN16	42			D	2	4					✓									
	MN39	42			C	3	3		✓												
	MN53	42			B	2	3	✓	✓			✓		✓	✓		✓			✓	
	MN11	42			B	3	3	✓	✓			✓			✓						
Legarda St	MN68	43	0.88	1	B	1	3							✓	✓		✓				
P. Burgos Ave	MN15	44	0.72	2	B	1	3		✓			✓		✓							
	MN13	44			C	3	3								✓						
Pedro Gil St	MN30		0.75	3																	
	MN17																				
	MN104	48			B	2	1	✓	✓		✓	✓		✓	✓	✓	✓			✓	
Taft Ave	PY01	52	3.93	3	C	2	3							✓	✓		✓				
	PY10	52			C	2	3		✓	✓				✓		✓	✓				
	PY04																				

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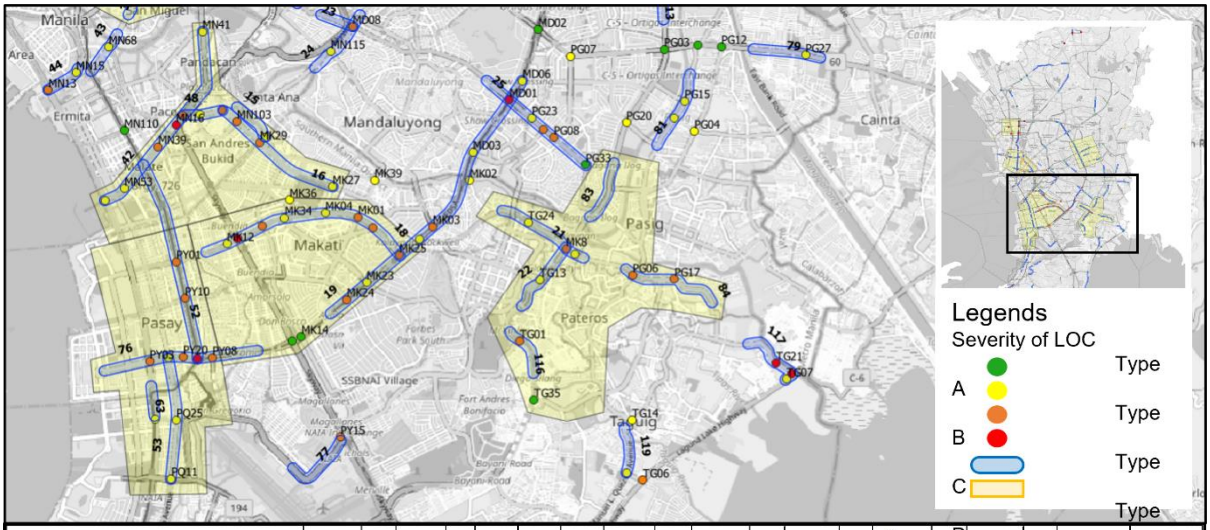

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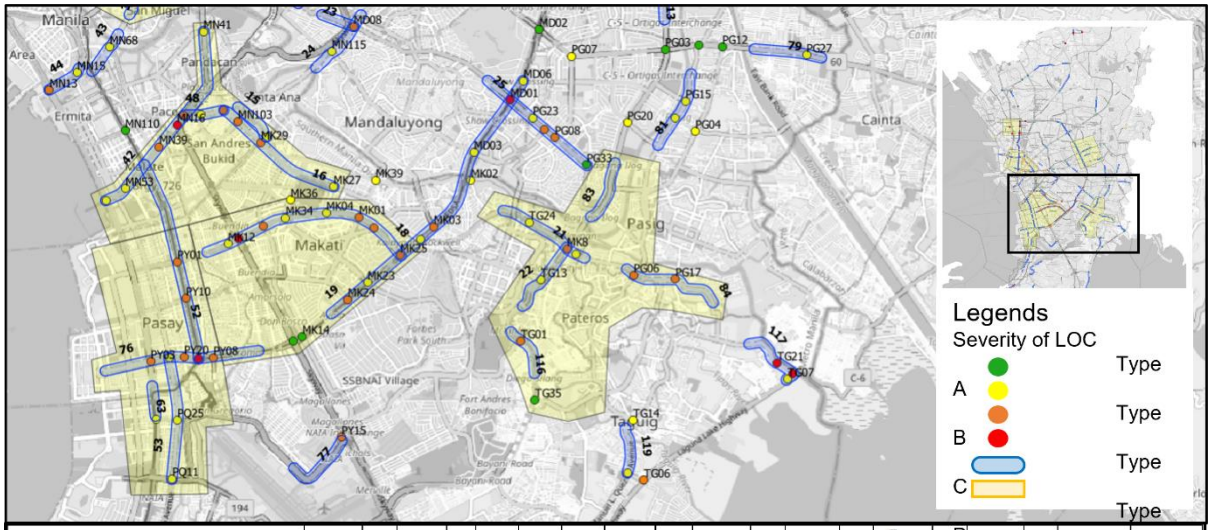
Tejeron St	MK32	15	0.81	1	B	2	3		✓	✓		✓		✓	✓		✓		✓
Kalayaan Ave	MN30	16	2.58	4	C	2	1	✓	✓	✓	✓	✓		✓	✓	✓	✓		✓
	MN103	16			C	2	1	✓	✓		✓	✓		✓	✓	✓	✓	✓	✓
	MK29	16			C	2	1		✓		✓			✓	✓	✓			
	MK27	16			B	2	3	✓	✓			✓		✓	✓		✓		✓
Sen. Gil Puyat Ave	MK01	18	4.13	8	C	6	3	✓	✓	✓		✓		✓			✓		✓
	MK04	18			B	2	3	✓	✓			✓		✓			✓		✓
	MK12	18			B	2	3							✓			✓		
	MK28	18			D	2	4	✓	✓			✓					✓		
	MK34	18			B	2	3					✓		✓			✓		
	MK35	18			C	3	3		✓			✓		✓			✓	✓	✓
	MK40	18			C	3	3	✓	✓			✓		✓			✓		
	MK25																		
EDSA	MD01	19	5.93	8	D	2	4					✓	✓						
	MD03	19			B	4	2		✓	✓		✓	✓	✓		✓			✓
	MD06	19			B	3	1		✓			✓	✓						
	MK03	19			C	2	2		✓					✓					
	MK05	19			B	2	2										✓		
	MK23	19			B	2	4		✓			✓		✓			✓	✓	
	MK24	19			C	3	3	✓	✓			✓		✓			✓		✓
	MK25	19			C	3	2		✓					✓			✓		

Note: A blank row represents an intersection TNB that is involved in 2 segments. These TBNs are recorded in one of the segments.
[1] 1 At grade Unsignalized, 2 Separated Unsignalized, 3 At grade Signalized, 4 Separated Signalized



Segment Roads	TBNs Involved	Segment Code	Distance(km)	No. of TBN	Severity of Level of Congestion	Severity of Queue Length	Signal Type[1]	1. Intersection geometric improvement (within ROW)	2. Proper signage and marking	3. Improvement of safety facilities (pedestrian sidewalk, etc.)	4. Installation of new traffic signals	5. Appropriate signal operation and maintenance (phasing/ timing, etc.)	6. Introduction of signal coordination for corridors	7. Improvement of traffic information facilities such as guide signs	8. Review of traffic regulation for vehicular traffic	9. Parking management (Enhance enforcement, Guidance system, Secure parking space)	10. Review/Replacement of PUVs stop/route	11. Improvement of construction management（Enhance coordination on road diggings)	12. Intersection geometric improvement with conner cut
Quirino Ave	PQ25	53	0.94	2	B	2	3	✓	✓			✓		✓	✓	✓	✓		✓
	PQ11	53			B	3	4	✓	✓			✓		✓	✓	✓	✓	✓	✓
Roxas Blvd	PQ26	63	0.59	1	B	3	3	✓	✓			✓		✓	✓		✓	✓	✓
EDSA	PY03	76	2.93	5	C	3	4			✓				✓		✓	✓		
	PY09	76			B	2	1		✓	✓	✓	✓		✓	✓	✓	✓		✓
	PY20	76			C	1	1		✓	✓	✓	✓			✓		✓		✓
	PY08	76			C	2	2		✓	✓		✓	✓		✓		✓		
	PY04	76			D	4	3	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓
Sales Rd	PY15	77	1.34	1	C	2	2	✓	✓	✓	✓	✓		✓	✓		✓		✓
Ortigas Ave Ext	PG27	79	1.28	1	B	2	1												
Dr. Sixto Antonio Ave	PG15	81	1.56	2	B	2	1												
	PG16	81			B	2	1												
Carlos P. Garcia Ave - E. Rodriguez Ave (C5)	PG04	83	1.20	1	B	2	4												
Kalayaan Ave	PG17	84	1.91	2	C	2	1												
	PG06	84			C	2	3												
Carlos P. Garcia Ave - E. Rodriguez Ave (C5)	TG01	116	0.99	1	C	2	3					✓		✓	✓				
Unnamed Rd	TG21	117	1.33	3	D	2	1	✓	✓	✓		✓		✓	✓	✓			✓
	TG08	117			D	2	1		✓					✓		✓			
	TG07	117			B	2	1		✓		✓			✓	✓	✓			✓
Manuel L. Quezon St	TG05	119	0.89	1	B	2	1		✓					✓	✓	✓	✓	✓	

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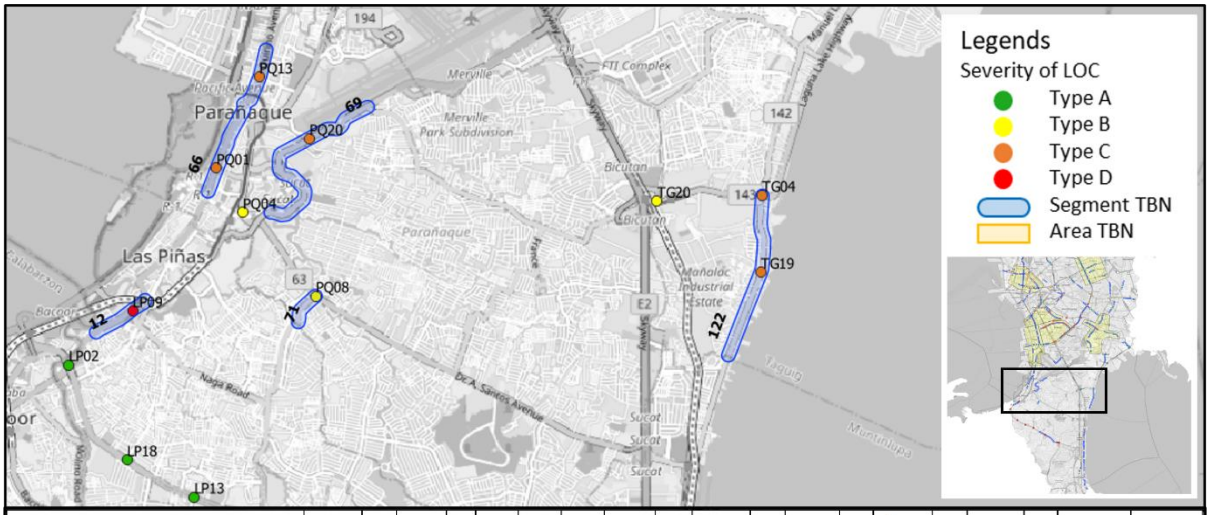
[1] 1 At grade Unsignalized, 2 Separated Unsignalized, 3 At grade Signalized, 4 Separated Signalized



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P. Deigo Cera Ave	LP09	12	0.90	1	D	2	1	✓	✓		✓	✓		✓	✓		✓		✓
Quirino Ave	PQ13	66	2.39	2	C	2	3	✓	✓			✓		✓	✓	✓	✓		✓
	PQ01	66			C	3	3	✓	✓			✓		✓	✓		✓	✓	✓
C5 Rd Ext	PQ20	69	3.03	1	C	4	3	✓	✓			✓		✓	✓		✓		✓
Angelina Canaynay Ave	PQ08	71	0.50	1	B	5	3	✓	✓			✓		✓	✓		✓		✓
San Guillermo St	TG04	122	2.56	2	C	2	3		✓	✓				✓					
	TG19	122			C	1	1	✓	✓	✓	✓	✓		✓	✓	✓	✓		✓

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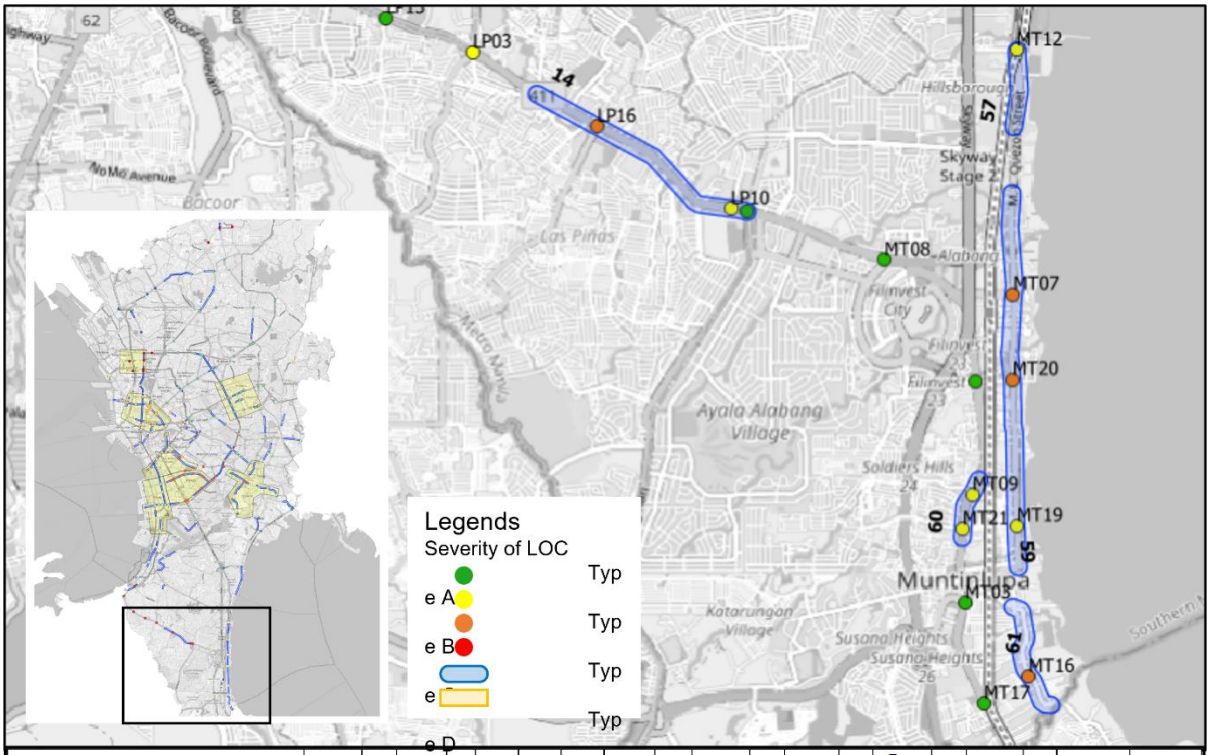

Segment Roads	TBNs Involved	Segment Code	Distance(km)	No. of TBN	Severity of Level of Congestion	Severity of Queue Length	Signal Type[1]	1. Intersection geometric improvement (Within ROW)	2. Proper signage and marking	3. Improvement of safety facilities (pedestrian sidewalk, etc.)	4. Installation of new traffic signals	5. Appropriate signal operation and maintenance (phasing/ timing, etc.)	6. Introduction of signal coordination for corridors	7. Improvement of traffic information facilities such as guide signs	8. Review of traffic regulation for vehicular traffic	9. Parking management (Enhance enforcement, Guidance system, Secure parking space)	10. Review/Replacement of PUVs stop/route	11. Improvement of construction management（Enhance coordination on road diggings)	12. Intersection geometric improvement with conner cut
Alabang-Zapote Rd	LP05	14	2.90	3	A	2	1	✓	✓		✓	✓		✓	✓	✓	✓		✓
	LP10	14			B	3	3	✓	✓			✓		✓	✓		✓		✓
	LP16	14			C	4	1	✓	✓		✓	✓		✓	✓	✓	✓		✓
San Guillermo St	MT12	57	0.94	1	B	2	1	✓	✓	✓	✓	✓		✓	✓	✓	✓		✓
San Guillermo St	MT07	59	4.52	3	C	2	1		✓	✓				✓		✓	✓	✓	✓
	MT20	59			C	2	1	✓	✓	✓		✓		✓	✓				✓
	MT19	59			B	2	1		✓	✓	✓	✓		✓	✓	✓			✓
National Rd	MT09	60	0.74	2	B	3	1	✓	✓	✓	✓	✓		✓	✓	✓	✓		✓
	MT21	60			B	6	1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓
Arandia St	MT16	61	1.39	1	C	2	1		✓	✓	✓	✓		✓	✓	✓			✓

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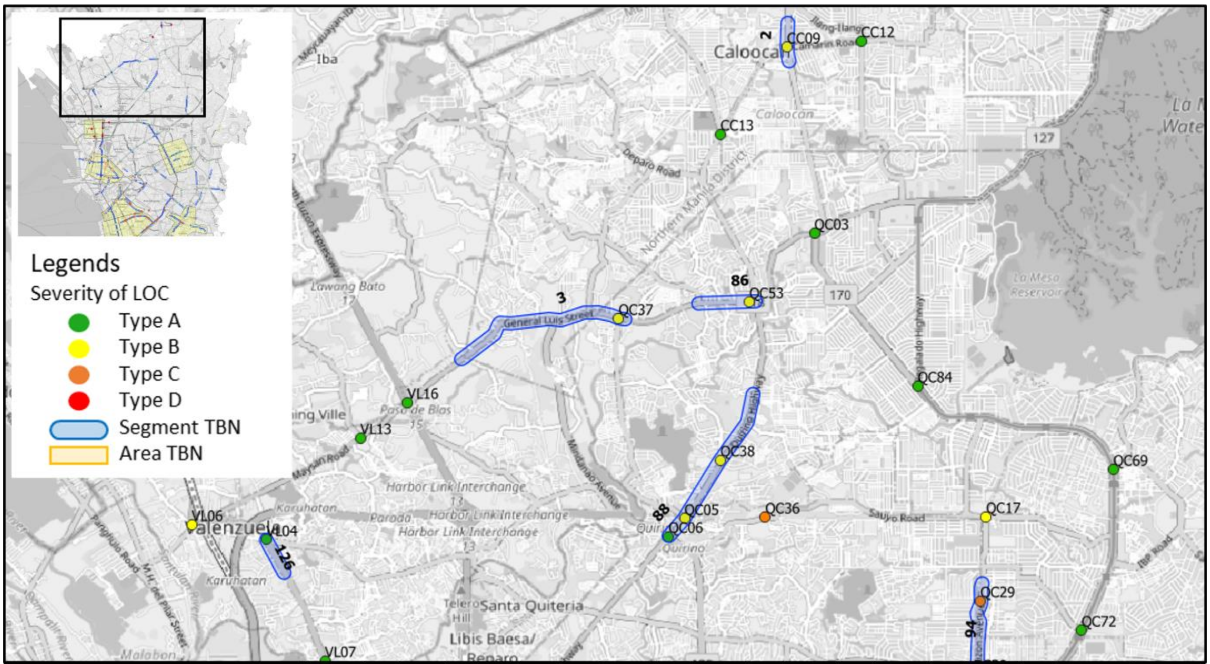

Segment Roads	TBNs Involved	Segment Code	Distance(km)	No. of TBN	Severity of Level of Congestion	Severity of Queue Length	Signal Type[1]	1. Intersection geometric improvement (within ROW)	2. Proper signage and marking	3. Improvement of safety facilities (pedestrian sidewalk, etc.)	4. Installation of new traffic signals	5. Appropriate signal operation and maintenance (phasing/ timing, etc.)	6. Introduction of signal coordination for corridors	7. Improvement of traffic information facilities such as guide signs	8. Review of traffic regulation for vehicular traffic	9. Parking management (Enhance enforcement, Guidance system, Secure parking space)	10. Review/Replacement of PUVs stop/route	11. Improvement of construction management（Enhance coordination on road diggings)	12. Intersection geometric improvement with conner cut
Zabarte Rd	CC09	2	0.60	1	B	2	1					✓	✓	✓		✓	✓		
Gen. Luis St	QC37	3	2.73	1	B	2	1		✓	✓	✓	✓		✓	✓		✓		✓
Gen. Luis St	QC53	86	0.85	1	B	6	1		✓	✓	✓	✓	✓	✓	✓	✓	✓		✓
Quirino Hwy	QC38	88	2.56	3	B	6	3		✓	✓		✓	✓	✓	✓	✓	✓		✓
	QC05	88			B	6	1		✓	✓	✓	✓	✓	✓	✓	✓	✓		✓
	QC06	88			A	6	3		✓	✓		✓	✓	✓	✓	✓	✓		
Luzon Ave	QC29	94	1.77	2	C	3	1		✓	✓		✓		✓	✓	✓			✓
	QC30	94			B	3	1		✓	✓	✓	✓		✓	✓	✓		✓	✓
MacArthur Hwy	VL04	126	0.57	1	A	6	3		✓			✓	✓	✓	✓		✓		✓

Note: A blank row represents an intersection TNB that is involved in 2 segments. These TBNs are recorded in one of the segments.

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APPENDIX I

Pilot Project No. 1

APPENDIX I

Pilot Project No.1: Traffic Management Improvement of Ortigas Avenue (Santolan Road–Connecticut Street) Phases 1 and 2

1 INTRODUCTION

1.1 Background

The simulation results of Case Study 2: Improvement of a Segment Bottleneck along a Corridor (Technical Report No.1) showed that traffic management measures, such as geometric improvement, proper regulation of traffic, optimized signal timing, and coordination of signals among intersections, could improve traffic conditions. In response to this positive result, MMDA and the JICA Project Team decided on the implementation of the proposed countermeasures at the actual site.

1.2 Objectives

The main purpose of the Pilot Project 1 is to apply the proposed countermeasures in Case Study 2. Case Study 2 to Pilot Project 1 shows the process of studying identified TBNs, proposing best fit countermeasures, executing the plans, and evaluating implemented projects, which are expected of the five-year action plan. Under these circumstances, this pilot project aims:

(i) To smoothen traffic flow and ensure road safety along the corridor;

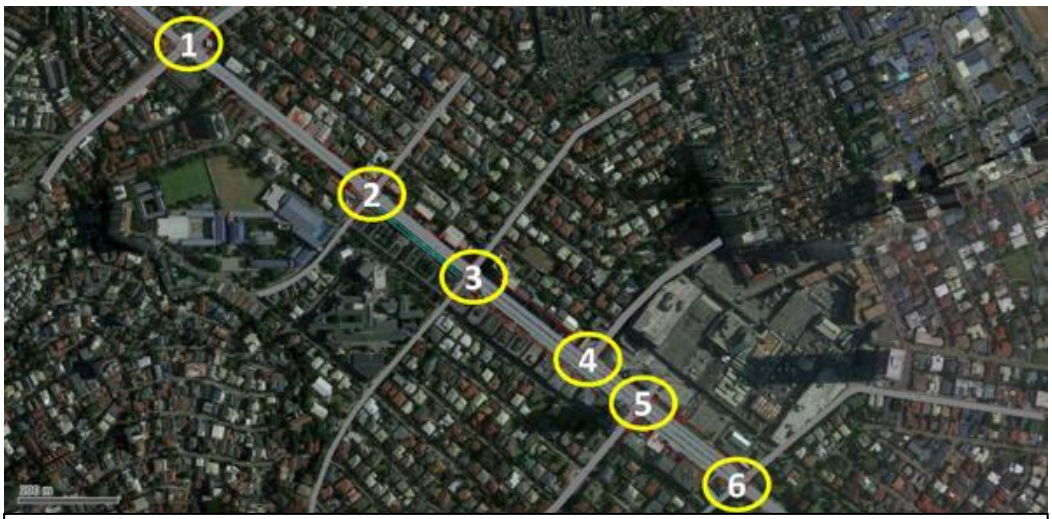
(ii) To verify the effectiveness of the improvement measures proposed by the case study;

(iii) To identify and settle any hindrance that may occur during the implementation; and

(iv) To enhance the implementation capacity of MMDA in traffic management.

1.3 Project Area

This pilot project is located in San Juan City along the corridor of Ortigas Avenue, covering six (6) intersections.



1. Ortigas Ave.–Santolan
2. Ortigas Ave.–Madison
3. Ortigas Ave.–Roosevelt
4. Ortigas Ave.–Club Filipino
5. Ortigas Ave.–Wilson
6. Ortigas Ave.–Connecticut

Source: JPT and Google map

Figure 1.1: Area of Pilot Project No. 1

2 SUMMARY OF PROPOSED INTERVENTIONS IN THE CASE STUDY 2 AND FOLLOW-UP STUDY

2.1 Summary of Proposed Interventions

When Metro Manila was under the general community quarantine due to the pandemic in year 2020, traffic flow was significantly different from the 2019 conditions which Case Study 2 examined. So, the proposed improvement plan, including the signal phase timing, was revised using 2020 traffic count. Also, since San Juan City introduced temporary bike and motorcycle lanes in 2020 to respond to the increase in their number, there was a need to reverify the improvement plan to study the safety of bike and motorcycle lane users.

In the follow-up study, the following interventions are proposed: (i) geometric improvement; (ii) review of lane configuration on Santolan Road NB; (iii) Relocation of the center line on the west approach of the Ortigas Avenue–Santolan Road intersection; (iv) optimization of signal phasing and revision of offset timing; and, (v) safety measures for bike lanes.

(1) Geometric Improvement

The triangular median island, which was a bottleneck at Ortigas Avenue–Club Filipino Drive intersection, is proposed to be removed to provide an additional left-turning lane for vehicles from the west approach.

Source: JPT

Figure 2.1: Geometric Improvement of Ortigas Avenue–Club Filipino Drive Intersection

(2) Review of Lane Configuration (Regulation) on Santolan Road NB

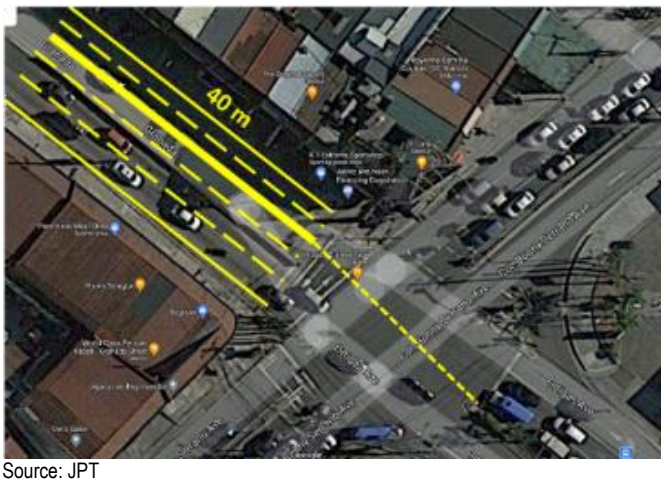
Based on the results of Case Study 2, which compared the two options on lane assignments at the innermost lane on the south approach, allocating the innermost lane for left-turn movement only yielded better results. This will be applied to Pilot Project 1. This geometric improvement is illustrated in Figure 2.2.

Source: JPT

Figure 2.2: Geometric Improvement on South Approach of Ortigas Avenue–Santolan Road

(3) Reallocation of Lanes on West Approach of Ortigas Avenue–Santolan Road Intersection

To increase the capacity of the west approach of Ortigas Avenue–Santolan Road intersection, the reallocation of the lanes is proposed. Since road widening is not an option due to its high cost, moving the plastic barriers—which separates the eastbound and westbound traffic—is proposed to widen the west approach from two to three lanes and to reduce the number of lanes of the west exit from three to two lanes. This solution increases the capacity of the west approach of the intersection, which can decrease the queue length and average vehicle delays. The reallocation of the lanes will only be up to 40 meters from the intersection, as illustrated in Figure 2.3.



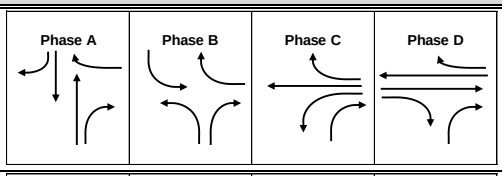
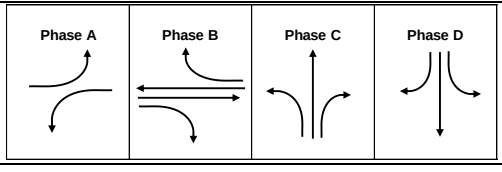
Source: JPT

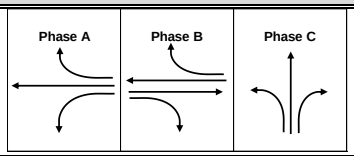
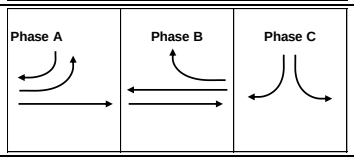
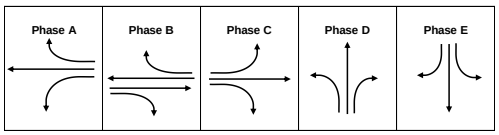
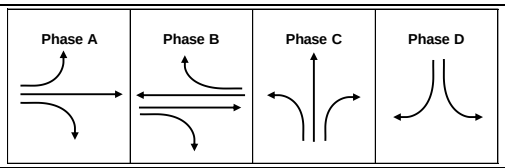
Figure 2.3: Geometric Improvement on West Approach of Ortigas Avenue–Santolan Road Intersection

(4) Optimization of Signal Phasing and Revision of Offset Timing

Existing traffic signal parameters at all intersections in the pilot project area have not been optimized because the traffic flow has changed gradually. In addition, the signal coordinating function of the ATC system has been applied to this section but not to match the offset timing between signals with actual traffic flow. Therefore, several optimization and coordination of the signal timing parameters for each intersection are proposed based on 2020 traffic counts. Through microsimulation using PTV VISTRO (a software that can compute signal parameters), the scenarios with a signal cycle time of 110 sec (Table 2.1) were verified as the best traffic signal control parameters under 2020 traffic conditions.

Table 2.1: Signal Timing Parameters Determined using Vistro and Capacity Analysis

Intersection	Phase		VISTRO	Capacity Analysis	
			(110 sec)	(190 sec)	(150 sec)
			Split (sec)		
Ortigas Avenue-Santolan Road		A	28	48	38
		B	22	36	29
		C	32	59	46
		D	28	47	37
		Cycle	**110**	**190**	**150**
Ortigas Avenue-Madison Street		A	17	13	11
		B	59	133	104
		C	17	23	18
		D	17	21	17
		Cycle	**110**	**190**	**150**

Intersection	Phase		VISTRO (110 sec)	Capacity Analysis (190 sec)	Capacity Analysis (150 sec)
			Split (sec)		
Ortigas Avenue-Roosevelt Street		A	17	21	17
		B	66	158	124
		C	27	11	9
		Cycle	**110**	**190**	**150**
Ortigas Avenue-Club Filipino Drive		A	45	55	44
		B	48	72	57
		C	17	63	49
		Cycle	**110**	**190**	**150**
Ortigas Avenue-Wilson Street		A	27	27	21
		B	30	32	26
		C	12	67	52
		D	26	49	39
		E	15	15	12
		Cycle	**110**	**190**	**150**
Ortigas Avenue-Connecticut Street		A	20	59	47
		B	53	97	76
		C	15		
		D	22	34	27
		Cycle	**110**	**190**	**150**

Source: JPT

Also, the offset timing presented in Table 2.2 was determined from VISTRO. This network object was drawn across the eastbound direction as priority flow to optimize the offset timing.

Table 2.2: Revised Offset Timings

Intersection	Offset (sec)	Intersection	Offset (sec)
Ortigas Avenue–Santolan Road	0	Ortigas Avenue–Club Filipino Drive	82
Ortigas Avenue–Madison Street	39	Ortigas Avenue–Wilson Street	5
Ortigas Avenue–Roosevelt Street	31	Ortigas Avenue–Connecticut Street	49

Source: JPT

Since the parameters were proposed based on the 2020 traffic count survey, when actual implementation, it must be revised based on the new traffic count after the completion of the geometric improvement.

(5) Safety Measures for Bike Lanes

In response to safety issues for the bike lane and motorcycle lane, the team reviewed the preliminary bike lanes installed by San Juan City and proposed improvement measures based on the Japanese bike lane environment and DPWH guidelines.

To enhance road safety for various road users, including that of bicycle users, the following principles are recommended:

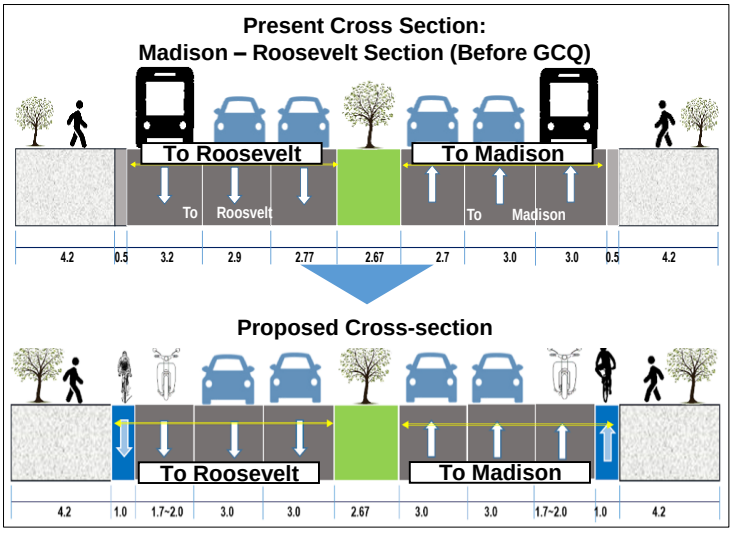
(I) The bike lane should secure a 1.0m or more width and should be placed on the most outer lane.

(II) If there are service roads, they should be utilized to secure capacity for traffic and ensure safety.

(III) The exclusive bike lane should be separated by bollards; and

(IV) If the road's traffic capacity cannot be maintained near an intersection, a shared lane without bollards but with arrow markings, should be introduced.

Figure 2.4 shows the proposed drawing of a cross-section with bike lanes.



Source: JPT

Figure 2.4: Proposed Cross-section of Pilot Project Area with Bike Lanes

Also, to ensure safety at sections with risks of conflicts, such as intersections and bus stops, safety measures are recommended as described below.

(a) **Intersection Layout with Arrow Markings**

(I) Allow appropriate separation and coexistence among pedestrians, bicyclists, and motorists at intersections;

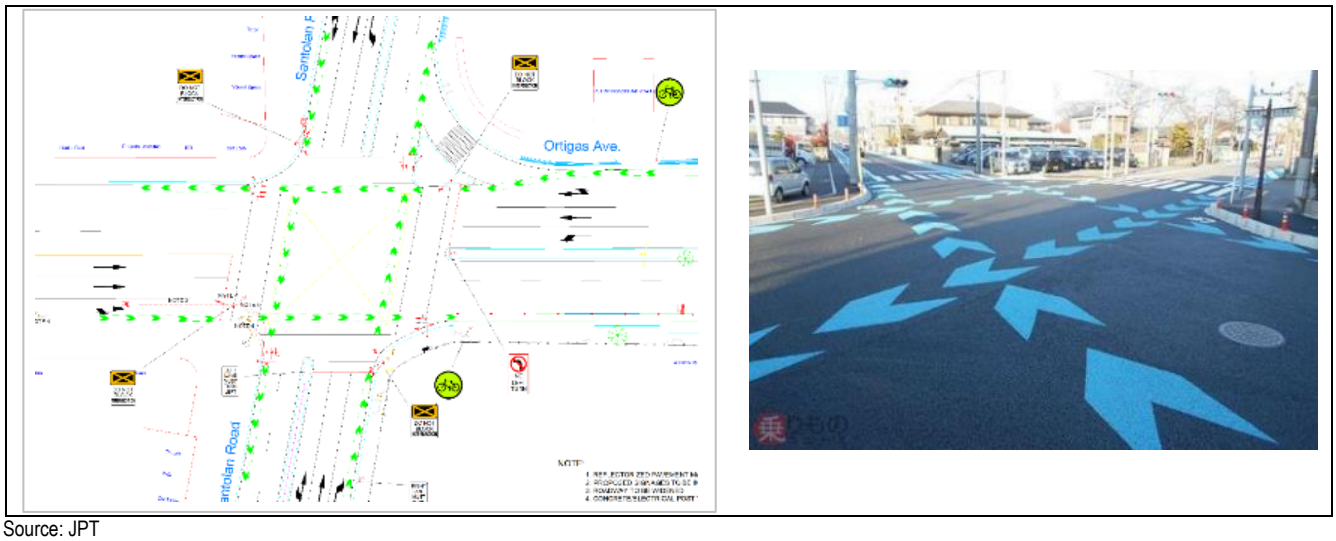
(II) Keep the lane in the intersection straight;

(III) Clarify the direction of traffic within an intersection;

(IV) Serve as safety measures against right turns (signal for bicycle, road marking)

(V) Securing stagnation space for two-step left turns of bicycle

Based on these principles, arrow pavement markings indicating bicycle lanes are proposed to clarify the traffic flow at an intersection, as illustrated in Figure 2.5.

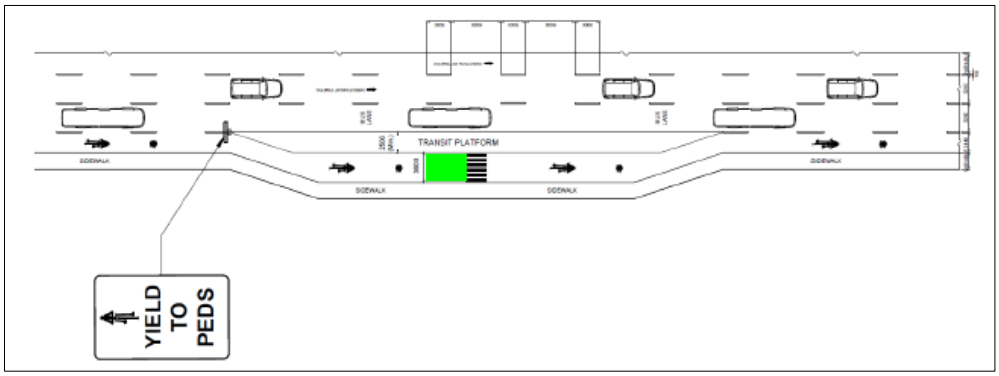


Source: JPT

Figure 2.5: Proposed Layout of Bike Lanes at Intersection and Sample Intersection in Japan

(b) **Improvement of PUB/PUJ Loading and Unloading Areas (Transit Platforms)**

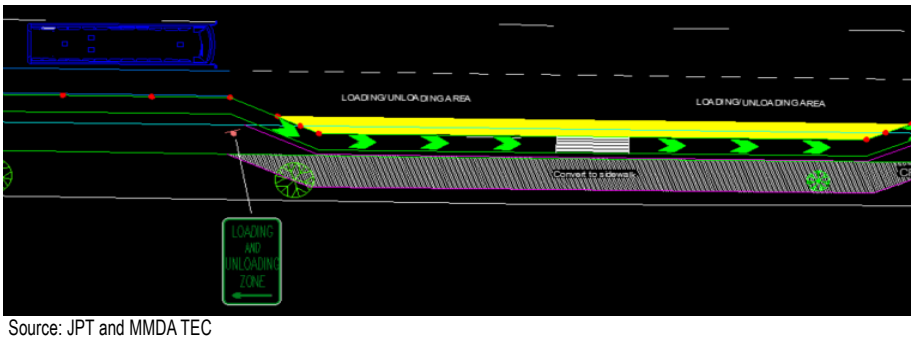
Improvement of PUB/PUJ loading and unloading areas (transit platforms) is proposed to prevent conflict between bicycles and passengers. Based on the "Guidelines on the Design of Bicycle Facilities Along National Roads," shifting the bike lane to the curbside to secure a transit platform and yield to pedestrians are recommended, as shown in Figure 2.6. If sufficient space is not available, it is recommended that pavement markings displaying bus bays be applied to warn cyclists that they are approaching a bus stop.



Source: DPWH Guidelines on the Design of Bicycle Facilities along National Roads

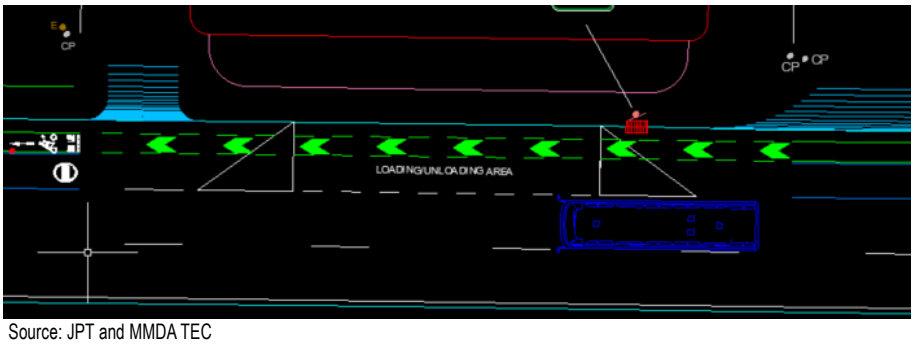
Figure 2.6: Sample of Transit Stop Loading and Unloading Bay (with Transit Platform) based on DPWH Guidelines

Two transit platforms, located between Santolan and Madison and between Madison and Club Filipino eastbound, are proposed in this pilot project. Also, two locations on the westbound are designed as straight bus bays.



Source: JPT and MMDA TEC

Figure 2.7: Proposed Loading and Unloading Bay with a Transit Platform at a Transit Stop



Source: JPT and MMDA TEC

Figure 2.8: Proposed Loading and Unloading Bay at a Transit Stop

2.2 Evaluation Results of the Desktop Study

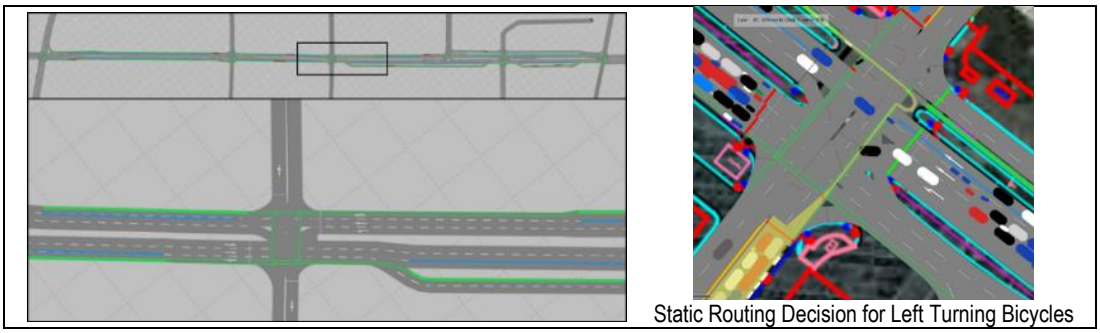
In the follow-up study, three alternative scenarios were set (Table 2.3).

Table 2.3: Summary of Proposed Scenarios in Case Study 2

Alternative Solution		Scenario		
		2	3	4
Geometric Improvements				
1	Removal of the triangular median island and add one lane for left turns at Club Filipino	✓	✓	✓
2	Left turn only at an innermost lane at the south approach of Santolan	✓	✓	✓
3	Reallocation of lanes at the west approach of Santolan			✓
4	Shared bicycle lanes	✓		
5	Exclusive bicycle and motorcycle lanes		✓	✓
Traffic Signal Control Option				
1	VISTRO (110-sec cycle length)	✓	✓	✓

Note. Scenario 1 is the base (existing). Other options of traffic signal control, including offset, were also analyzed (refer to Interim Report 2)
Source: JPT and MMDA TEC

In Scenarios 3 and 4, dedicated motorcycle and bicycle lanes were introduced. The road network in Scenario 3 is shown in Figure 2.9. Solid green lines indicate dedicated bike lanes, while green border lines near and at the intersection boxes signify shared bicycle lanes. Motorcycle lanes, represented as blue lines, were placed along the main road beside the bicycle lanes. Service roads were also utilized to divert bicycle traffic to a safer route. Cyclists also follow a two-step left-turning route as shown in Figure 2.9 for their safety. For the implementation stage, the application of these ideas was discussed with San Juan City and the DPWH.



Source: JPT and MMDA TEC

Figure 2.9: Scenario 3 Road Network

Key performance indicators (KPIs) were set to evaluate the situation in the existing corridor and the efficiency of the proposed alternatives. To examine the effects of the improvements to the whole network, the evaluation areas considered the corridor and its surrounding areas in the simulation model. Table 2.4 shows the KPIs, while Table 2.5 shows the results.

Table 2.4: Key Performance Indicators on Network Performance

KPI	Description
Total travel time (sec)	The total travel time of vehicles that have left the network (Veh Arrived) and vehicles that are still active (Veh Active).
Average travel time (sec/veh)	Ratio between the total travel time and the total number of vehicles.
Average delay (sec/veh)	Ratio between the total delay divided and the total number of vehicles.
Average travel speed (kph)	Ration between the total distance traveled and the total travel time.

Source: JPT

Table 2.5: KPI Results on Network Performance

KPI	Base	SC2	SC3	SC4
Total Travel Time (sec)	3,702,135	2,943,388	2,785,257	2,744,504
Vehicle Arrived (veh)	10,610	10,693	10,760	10,877
Vehicle Active (veh)	1,254	932	876	936
Ave. Travel Time (sec/veh)	388	330 (15.0%)	332 (14.5%)	320 (17.5%)
Ave. Delay (sec/veh)	223	162 (27.4%)	148 (33.7%)	140 (37.0%)
Ave. Speed (kph)	16.3	20.5 (26.1%)	21.7 (33.3%)	22.4 (37.7%)

*( ) shows the rate of improvement
Note. In the analysis, evaluation which is focused on the area along the corridor, was also analyzed. (Refer to Interim Report2)
Source: JPT and MMDA TEC

The MMDA CPT assisted in estimating the total cost of each improvement scenario. A summary of the estimated costs is presented in Table 2.6.

Table 2.6: Estimated Costs by Scenario

Estimated Cost (PHP)	SC2	SC3	SC4
First Cost	877,593	3,201,098	3,216,098
Indirect Cost (25% Mark-up)	219,398	800,275	804,025
Total VAT	116,639	450,100	450,254
Total Est. Cost	1,213,630	4,451,472	4,470,377
Rounded Total Est. Cost	1,214,000	4,452,000	4,471,000

Source: JPT and MMDA TEC

After computing the benefit-cost ratio (BCR) using corridor analysis, only Scenario 2 was evaluated as acceptable, considering the insignificant benefits from Scenario 3 and Scenario 4. This analysis shows the importance of determining the effect of improving the flow on and crossing the corridor on the network.

Table 2.7: Cost-Benefit Analysis of Network Performance

Scenarios	First Year						At Year 3				
	Benefit		Cost		Benefit-Cost Ratio (B/C)	Net Benefits (Php)	Benefit	Cost		Benefit-Cost Ratio (B/C) at Year 3	Net Benefits at Year 3 (Php)
	Travel time Saving (Php/year)	Total Benefits (Php/year)	First Cost (Php)	Total Cost (Php/year)			Cumulative Benefit (PHP) at Year 3	First Cost (Php)	Total Cummulative Cost (Php) at Year 3		
SC2	45,314,000	45,314,000	1,214,000	1,214,000	**37.3**	**44,100,000**	121,897,000	1,214,000	1,214,000	**100.4**	**120,683,000**
SC3	52,070,000	52,070,000	4,452,000	4,452,000	**11.7**	**47,618,000**	140,071,000	4,452,000	4,452,000	**31.5**	**135,619,000**
SC4	55,528,000	55,528,000	4,471,000	4,471,000	**12.4**	**51,057,000**	149,374,000	4,471,000	4,471,000	**33.4**	**144,903,000**

Source: JPT

Based on the analysis, Scenario 4 showed the highest travel time savings. However, Scenario 2 was found to have 3 times the BCR of Scenario 3 and Scenario 4. This difference is due to the smaller cost of Scenario 2, which only covers the geometric improvements proposed in the 2019 case study. Nonetheless, Scenario 4 provides a significant benefit that considers a safer road use for cyclists. Using the network performance results, the north and south legs of the intersections provided substantial contributions to travel time savings. Therefore, Scenario 4 was recommended based on the desk study.

3 IMPLEMENTATION OF TRAFFIC MANAGEMENT COUNTERMEASURES

Based on the proposed drawing and results of the desktop study, MMDA discussed with San Juan City and the DPWH to implement the proposed countermeasures at the actual site.

3.1 Discussion with Stakeholders

MMDA discussed with the city of San Juan the different interventions to improve traffic flow along Ortigas Avenue. The government officials positively consider proposed solutions that will alleviate the area's perennial traffic congestion. The proposed intervention includes the following:

(i) Geometric improvement at the intersection of Ortigas Avenue–Club Filipino, existing Santolan loading/unloading modification, and relocation of Madison and Roosevelt loading/unloading bay.

(ii) Realignment of the existing bike lane to utilize both service roads for the east and westbound of Ortigas Avenue.

(iii) San Juan City has several obstacles in the project implementation, one of which is the proposed intervention's funding allocation. With that said, MMDA allocated and provided funding for the project.

(iv) Prior to the project's implementation, the team did numerous site visits to ascertain any additional problems that would directly influence the project's execution.

(v) Additional tasks identified by the MMDA counterpart team included relocating existing traffic signal poles and lanterns on the channelized island at the intersection of Ortigas Avenue and Club Filipino, relocating a manhole on the median island, and modifying the modification the street lighting cable connection at the same intersection.

(vi) Additionally, the relocation of the existing waiting shed (bus shelter) at Santolan is essential due to the alteration of the existing loading bay. MMDA facilitated the transfer of the waiting shed.

(vii) During the lockdown, the project was completed in the fourth quarter of 2021. Before the project's implementation, the team reconvened with San Juan city to discuss the proposed changes for Ortigas Avenue. At that time, the Department of Public Works and Highway (DPWH) has already begun the implementation of their bike lane project in the National Capital Region. The MMDA counterpart team coordinated with them to see if the proposed realignment of the bike lane to utilize the service road for both eastbound and westbound Ortigas Avenue could be incorporated. However, the DPWH stated that they have already submitted the final design plan for Ortigas Avenue and would not change their design.

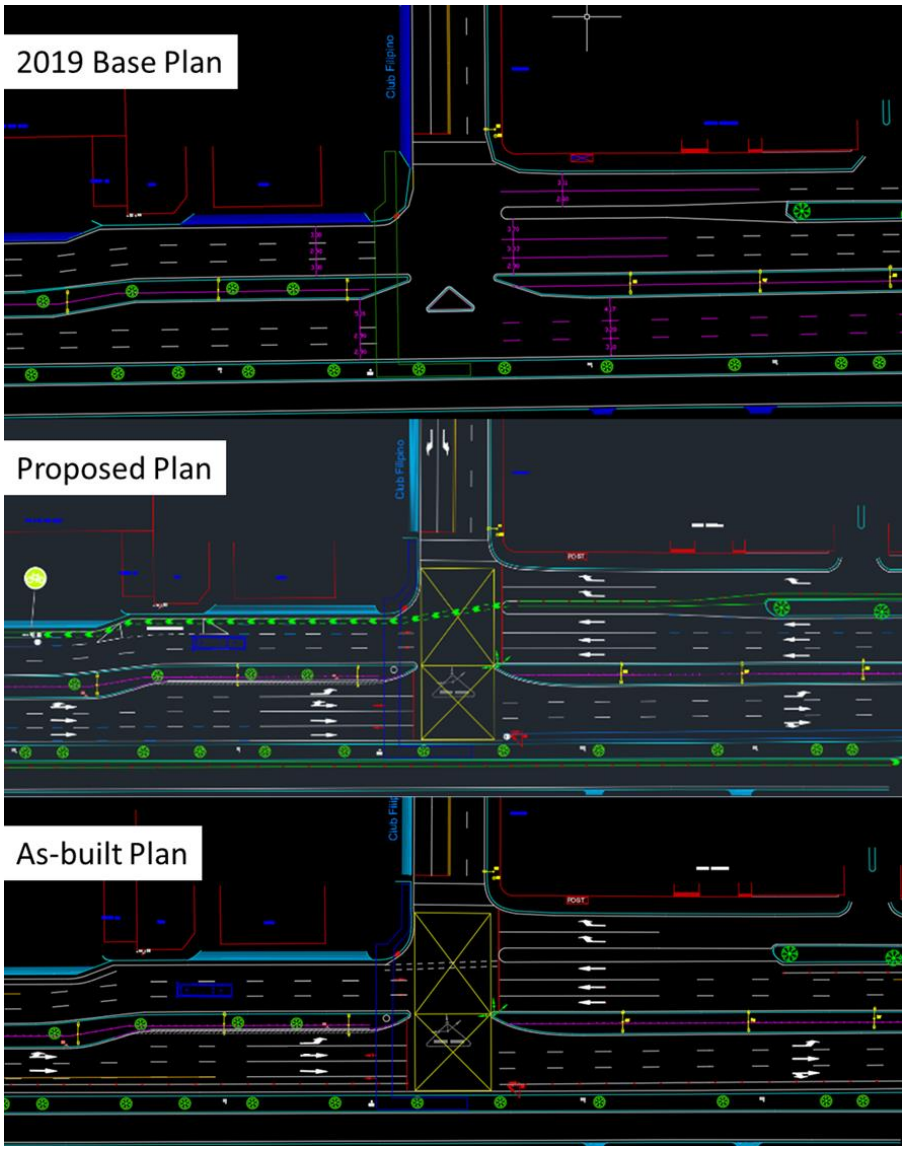
(viii) Lane realignment on Santolan's west approach was not implemented due to ongoing concerns about lane assignment and standard pavement marking design. This realignment will also confuse drivers unfamiliar with the scheme mentioned above.

3.2 Preparation of Modification Plan

Based on negotiation and discussion, the MMDA counterpart team modified the improvement plan as follows:

(a) **Geometric Improvement at the Intersection of Ortigas Avenue–Club Filipino:** The realignment of the bike lane on the service road along Ortigas Avenue was not incorporated into the DPWH's Final Plan. Additionally, the green road arrow was not adapted, as DPWH has its standard pavement design regarding bike lanes. The MMDA team successfully improved the intersection's geometry and added a left-turn lane leading to Club Filipino. Additionally, traffic posts and lanterns were added to aid motorists in navigating the area.

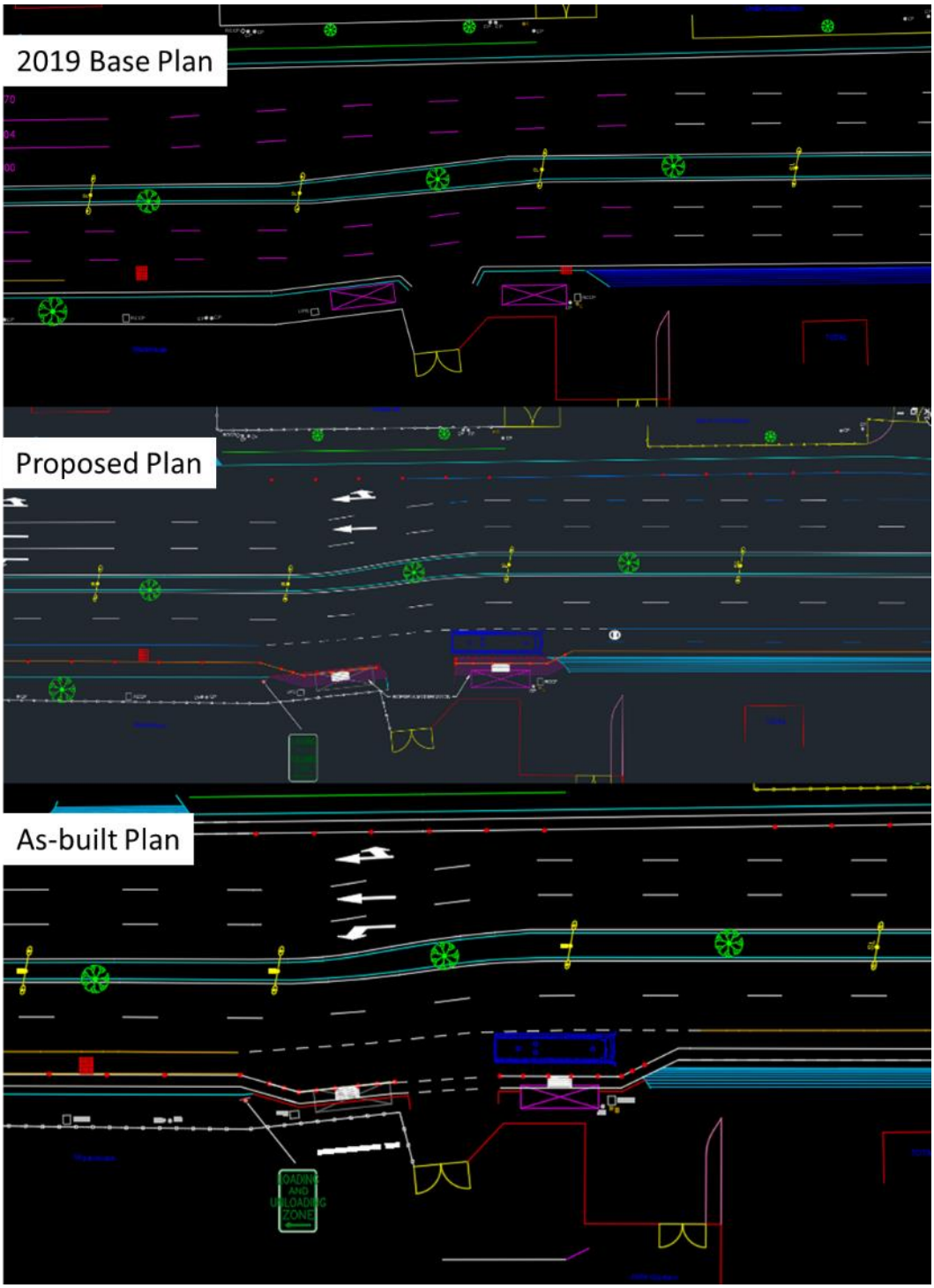
Although the proposed additional left-turning lane on the west approach aimed to provide more lanes for left-turning vehicles, the through movement (which has the higher volume) was observed to be impeded during the second phase. Thus, the LGU and MMDA decided to only have one (1) left-turning lane, two (2) through lanes, a motorcycle lane, and a bike lane.



Source: MMDA TEC

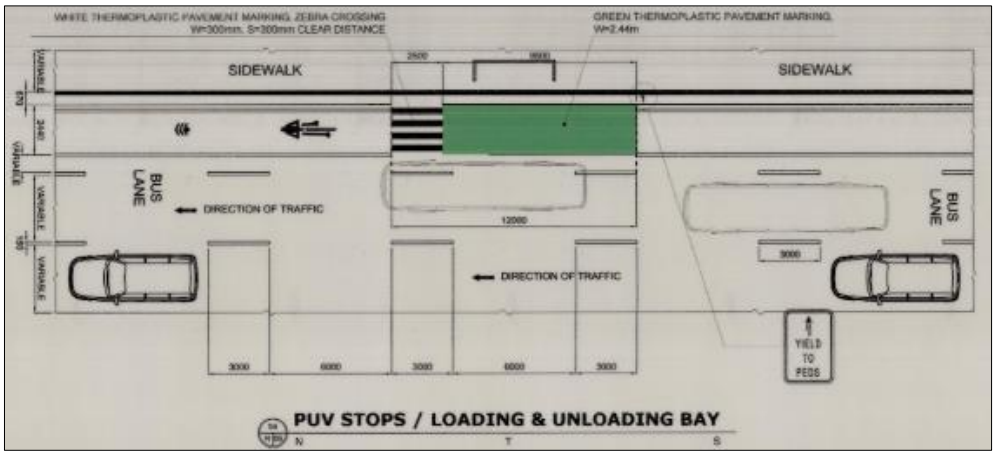
Figure 3.1: Drawing of a Modified Ortigas Avenue–Club Filipino Drive Intersection

(b) **Geometric Improvement at the Existing Santolan Loading/Unloading Bay:** The MMDA team made several changes to the initial concept. The team decided not to build a passenger platform to avoid interaction with other cars on the road due to limited available road space. To accommodate a full-size bus in one lane, the team revised and adapted the design plan of DPWH. Figure 3.2 shows the base plan, proposed plan, and as-built plan of the loading and unloading bay, while Figure 3.3 presents DPWH standard on overlapping bike lanes and PUV stop.



Source: MMDA TEC

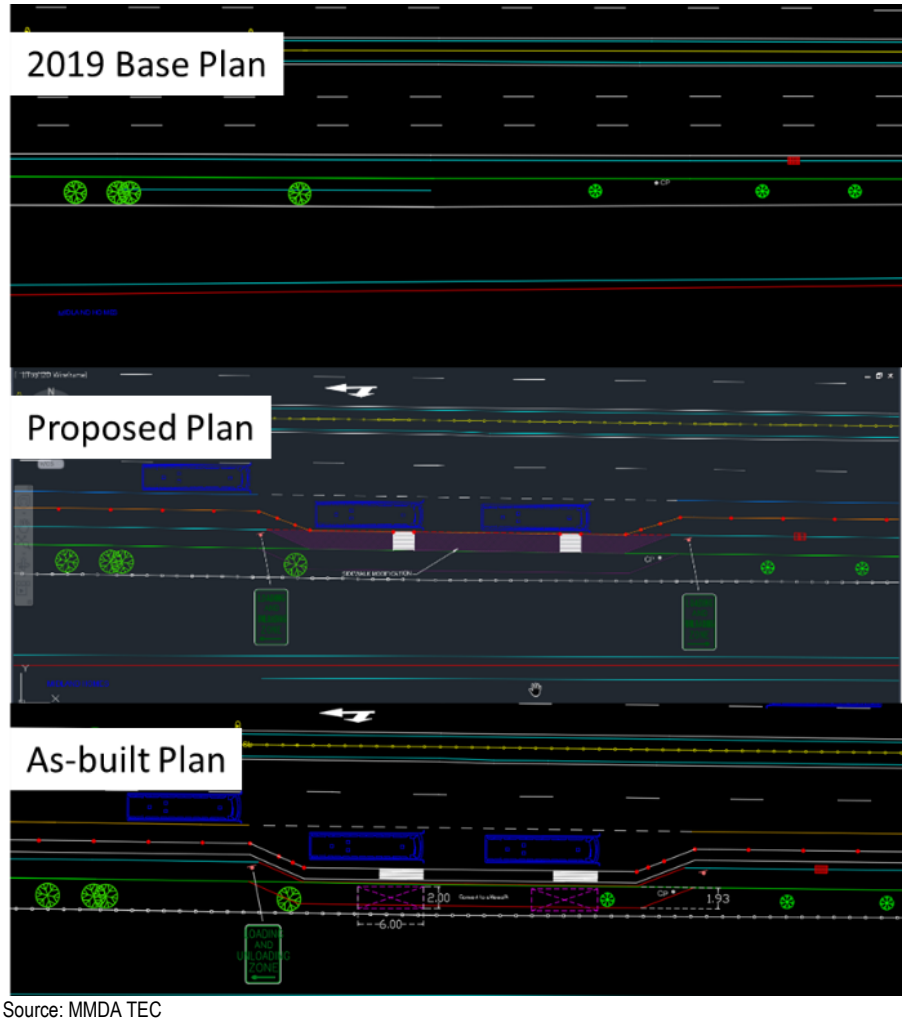
Figure 3.2: Drawing of a Modified Loading and Unloading Bay on Santolan Road



Source: DPWH

Figure 3.3: Design of PUV Stops in the DPWH Bicycle Design Standard

(c) **Relocation of Loading/Unloading Bays at Madison–Roosevelt:** Similar to the changes done on the Santolan loading/unloading bay, the Madison-Roosevelt loading/unloading bay underwent the same modification. As of this writing, the MMDA team, in coordination with San Juan LGU, has erected two (2) waiting sheds at the newly constructed loading/unloading bay.



Source: MMDA TEC

Figure 3.4: Drawing of a Modified Loading and Unloading Bay near Madison–Roosevelt Intersection

3.3 Implementation at the Site

(a) **Project Implementation at Ortigas Avenue–Club Filipino Drive IS:** The MMDA team relocated the affected traffic signal at the existing channelized island at Ortigas Avenue–Club Filipino. An additional task for the team is the relocation and modification of the existing street light wiring connection located at the median island near the intersection of Ortigas Avenue–Club Filipino.

Source: MMDA TEC and JPT

Figure 3.5: Before and After implementation at Approach of Ortigas Ave.–Club Filipino Drive IS

An unforeseen task for the team was the modification of drainage located at the median island where the proposed widening to provide an additional left turning lane was implemented.

Source: MMDA TEC

Figure 3.6: Picture of Modification of Existing Manhole

To provide additional space for left-turning vehicles, the team removed the existing channelized island to accommodate two (2) lanes for left-turning vehicles.

Source: MMDA TEC and JPT

Figure 3.7: Removal of Median Island at Ortigas Avenue–Club Filipino Drive Intersection

Originally, an additional left-turning lane, pavement marking re-application, and median island modification were completed for the intersection of Ortigas Avenue-Club Filipino Drive. However, the LGU and MMDA noticed that the left-turning vehicles waiting on the shared lane on the west approach was hindering the through volume, so they decided to implement through only movement beside the dedicated left-turning lane.

As a result, the modification increased the flow of the through movement, while the queuing on the left turn lane increased.

Source: MMDA TEC and JPT

Figure 3.8: Traffic Near Ortigas Avenue–Club Filipino Drive Intersection After Completion

The removal of the median island is completed, and additional poles and lanterns were installed at the intersection of Ortigas Avenue–Club Filipino Drive.

Source: MMDA TEC

Figure 3.9: Picture of Ortigas Avenue–Club Filipino Drive IS After Completion

(b) **Project Implementation of Santolan Loading/Unloading Bay:** The team spearheaded the relocation and modification of the existing waiting shed to give way for the proposed intervention at the Santolan loading/unloading bay.

Source: Google, MMDA TEC, and JPT

Figure 3.10: Construction of the Santolan Loading/Unloading Bay

Realignment of bike lane, modification of pavement markings, and relocation of existing bus shelter was completed at Santolan loading/unloading bay.

Source: MMDA TEC

Figure 3.11: Finished Santolan Loading/Unloading Bay

(c) **Project implementation of Madison-Roosevelt Loading/Unloading Bay:** Similar to the modifications made on the Santolan loading/unloading bay, the newly constructed Madison-Roosevelt loading/unloading bay utilized the same design concept. The loading bay is 30 meters long, which allows for simultaneous loading of two buses. San Juan assisted in procuring bollards and installing them strategically around the loading/unloading area to provide a physical barrier between motorized vehicles and bicycles.

Source: MMDA TEC and JPT

Figure 3.12: Construction of the Madison-Roosevelt Loading/Unloading Bay

Realignment of bike lanes, modification of pavement markings, and relocation of existing bus shelter were completed at Madison-Roosevelt loading/unloading bay.

Source: MMDA TEC

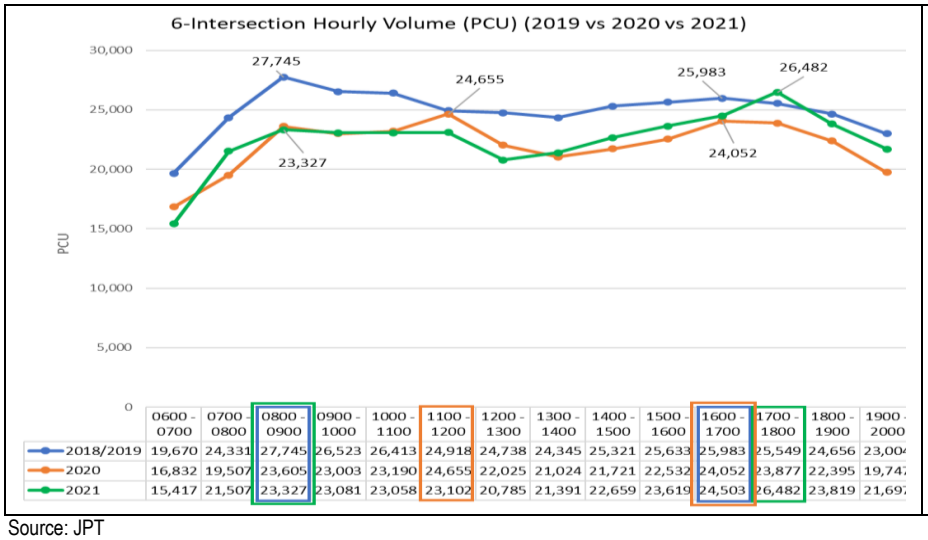
Figure 3.13: Finished Madison–Roosevelt Loading/Unloading Bay

3.4 Proposed Optimized New Signal Phase Parameters

In the peak of the pandemic situation, the national government updated the number of users for public transportation depending on infection status of the metro. MMDA also altered the regulation of the truck ban and number coding system. Traffic volume and modal share are affected time by time for the same reason.

After completing the physical solution, MMDA conducted a traffic count survey at six intersections along the project corridor.

Figure 3.14 shows the comparison of hourly traffic volume (PCU) in the project area among 2019, 2020, 2021. Figure 3.15 shows a comparison of vehicle composition at Ortigas–Santolan in 2019, 2020, 2021. The total PCU of six intersections during the pandemic in 2020 and 2021 is 10% lower than in 2018/2019. Also, peak hours in 2020 and 2021 are different from the 2019 data. It means signal phasing must adjust to match latest traffic volume and change peak hours.

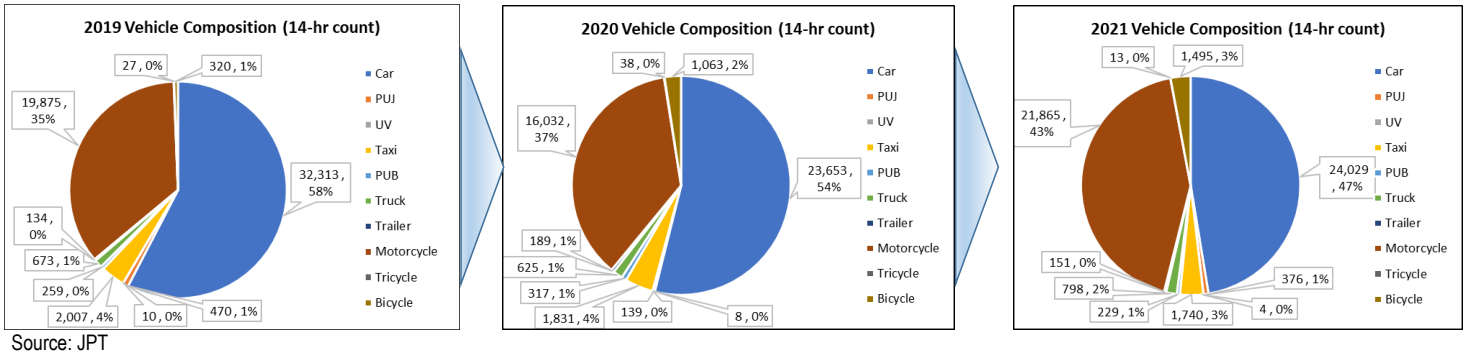


Time of Day	PCU		
	2018/2019	2020	2021
0600 - 0700	19,670	16,832	15,417
0700 - 0800	24,331	19,507	21,507
0800 - 0900	**27,745**	23,605	**23,327**
0900 - 1000	26,523	23,003	23,081
1000 - 1100	26,413	23,190	23,058
1100 - 1200	24,918	**24,655**	23,102
1200 - 1300	24,738	22,025	20,785
1300 - 1400	24,345	21,024	21,391
1400 - 1500	25,321	21,721	22,659
1500 - 1600	25,633	22,532	23,619
1600 - 1700	**25,983**	**24,052**	24,503
1700 - 1800	25,549	23,877	**26,482**
1800 - 1900	24,656	22,395	23,819
1900 - 2000	23,004	19,747	21,697
TOTAL	**348,829**	**308,165**	**314,447**
% Change			
2019 VS 2020	**-11.66%**		
2019 VS 2021	**-9.86%**		

Source: JPT

Figure 3.14: Comparison of Hourly Traffic Volume (PCU) in the Project Area Among 2019, 2020, 2021

Figure 3.15 shows a comparison of vehicle composition at Ortigas–Santolan in 2019, 2020, 2021. According to the data, the percentage of bicycle users increased in 2020 and was maintained in 2021. The rate of passenger cars decreased in 2020 and decreased further in 2021. The percentage of motorcycle users increased significantly in 2021. In the project area, dedicated motorcycle lanes were installed next to a dedicated bicycle lane.

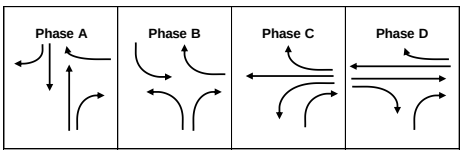
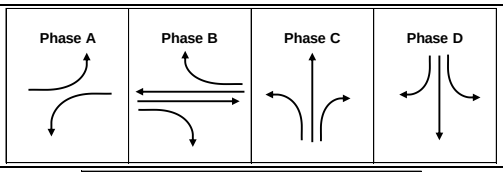
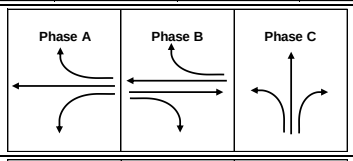
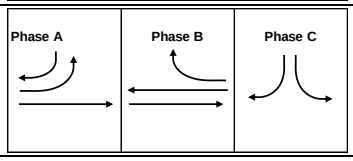
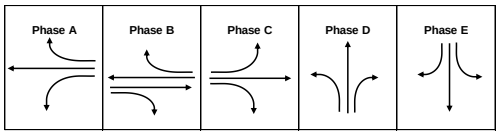
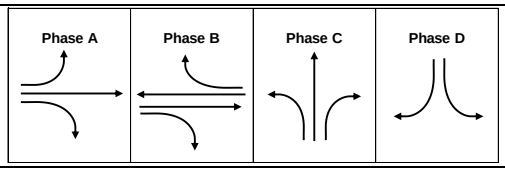


Source: JPT

Figure 3.15: Comparison of Vehicle Composition at Ortigas–Santolan in 2019–2021

Based on traffic count data, MMDA proposed suitable signal timing for 6 intersections by using VISTRO, a software to compute best signal timing to match traffic volume (Table 3.1).

Table 3.1: Proposed New Signal Phasing

Intersection	Phase		VISTRO AM (140 secs)	VISTRO PM (180 secs)
Ortigas–Santolan		A	32	66
		B	25	33
		C	46	45
		D	37	36
		Cycle	**140**	**180**
Ortigas–Madison		A	17	17
		B	88	115
		C	18	31
		D	17	17
		Cycle	**140**	**180**
Ortigas–Roosevelt		A	27	22
		B	86	131
		C	27	27
		Cycle	**140**	**140**
Ortigas–Club Filipino		A	29	40
		B	82	91
		C	29	49
		Cycle	**140**	**180**
Ortigas–Wilson		A	28	49
		B	54	65
		C	12	12
		D	26	34
		E	20	20
		Cycle	**140**	**180**
Ortigas–Connecticut		A	28	42
		B	75	87
		C	15	15
		D	22	36
		Cycle	**140**	**180**

Source: MMDA TEC

Also, the offset timing presented below was determined through VISTRO. This network object was drawn across the eastbound direction as priority flow in optimizing the offset timing. These proposed timing will be introduced on the site.

Table 3.2: Revised Offset Timing for Morning Peak Hour

Intersection	Offset (sec)	Intersection	Offset (sec)
Santolan	0	Club Filipino	27
Madison	81	Wilson	48
Roosevelt	71	Connecticut	98

Source: MMDA TEC

Table 3.3: Revised Offset Timing for Afternoon Peak Hour

Intersection	Offset (sec)	Intersection	Offset (sec)
Santolan	0	Club Filipino	70
Madison	94	Wilson	79
Roosevelt	66	Connecticut	164

Source: MMDA TEC

4 POST EVALUATION

4.1 Introduction

Upon implementation of the pilot project, effectiveness of the countermeasures was quantified using two (2) indicators, namely, travel speed and travel time. Space-time tables were exported from the Waze data dashboard and analyzed by segments.

The following parameters were extracted from the Waze data dashboard to visualize the impact of the countermeasures:

(i) 2019, February–April,

(ii) 2021, February–April,

(iii) 2022, February–April (Physical improvements), and

(iv) 2022, April–May (Physical improvements with signal retiming).

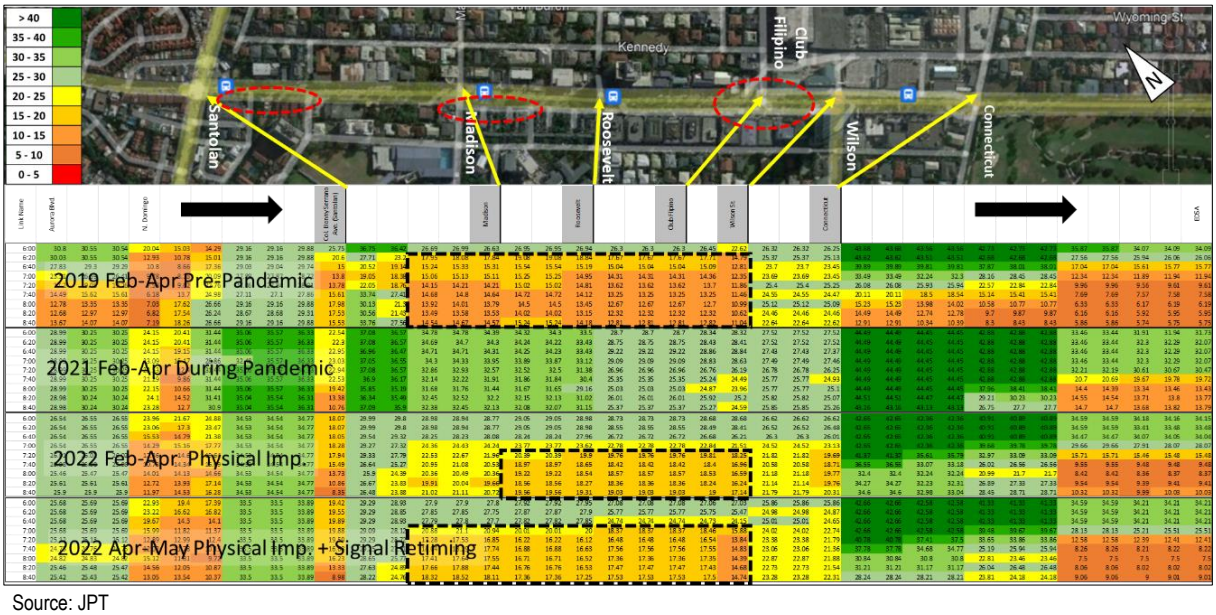
All data represent weekday travel speeds from 6:00am to 8:00pm. Dataset from R6AnxNB (Radial Road 6 Annex, northbound direction) and R6AnxSB (Radial Road 6 Annex, southbound direction) were utilized as raw data. Periods where physical improvements and signal retiming were also analyzed to know if the countermeasures complement each other or further adjustments are needed.

4.2 Key Performance Indicators

Intersections from Ortigas corridor were located in the dataset using the coordinates of their respective link segments. The space-time table starts from N. Domingo St. to EDSA. AM (6:00am–9:00am) and PM (4:00pm–7:00pm) peaks were placed side-by-side to easily see the change in traffic behavior over time.

(1) Travel Speed

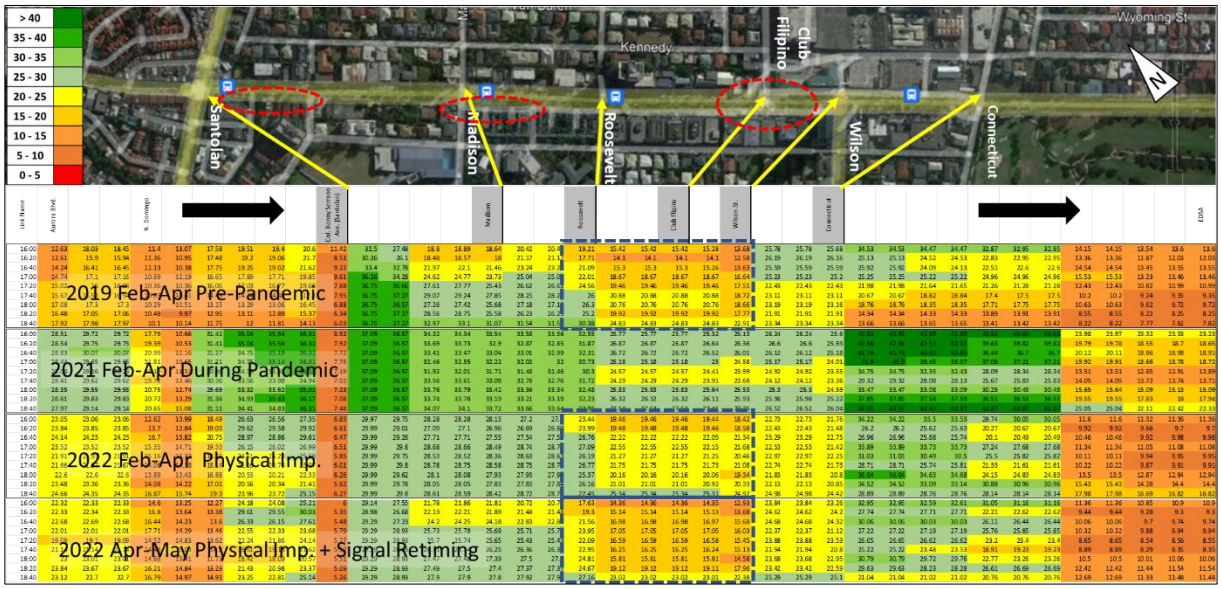
Travel speeds were color coded by increments of 5kph. Warmer-colored cells represent slower travel speeds while the Greener-colored cells represent faster travel speeds. Shown in Figure 4.1 to Figure 4.4 are the space-time table for travel speeds.



Source: JPT

Figure 4.1: Ortigas Ave. Travel Speed Comparison, AM Peak, SB/EB Direction

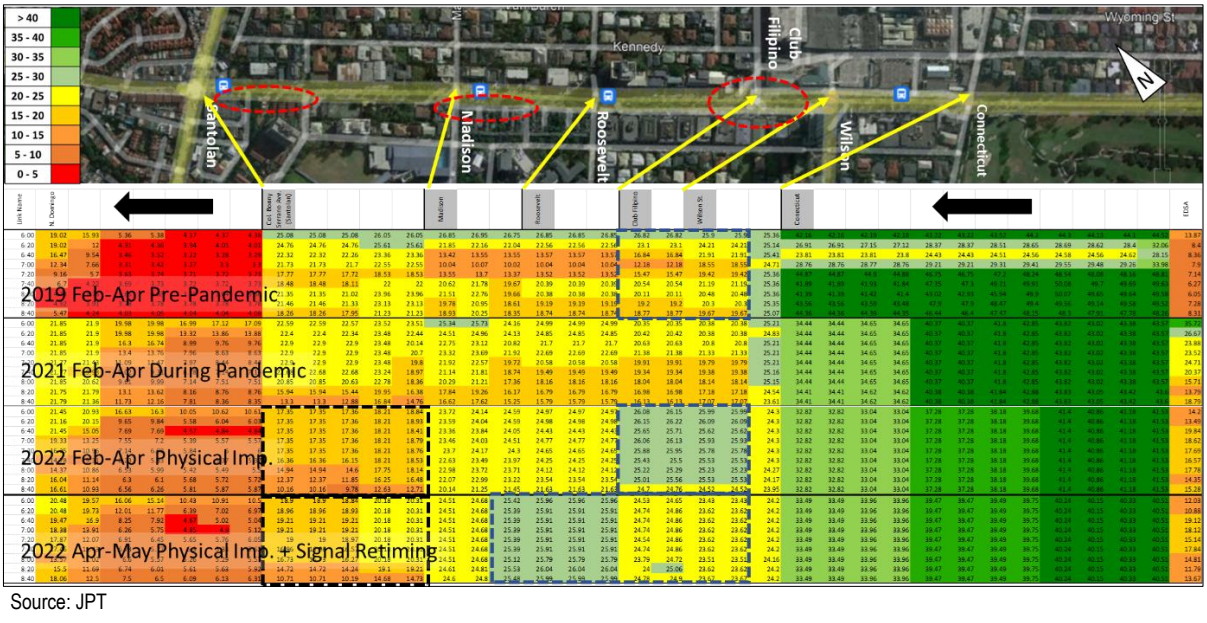
Shown above are travel speeds during the AM peak on the southbound/eastbound direction. It is evident that 2021 scenario has the highest travel speeds because of travel restrictions. It can also be observed that in Madison–Wilson and Connecticut–EDSA segments, slower travel speeds shifted from 6:20am to 7:00am. The table also implies that travel speeds from Santolan to Wilson decreased after retiming the traffic signal, making Wilson intersection a bottleneck. Generally, travel speeds from Santolan to Connecticut segment decreased, but traffic signal retiming needs recalibration.



Source: JPT

Figure 4.2: Ortigas Ave. Travel Speed Comparison, PM Peak, SB/EB Direction

Similar to Figure 5.1, 2021 scenario has the lowest travel speeds and traffic signal along the study area needs updating. Traffic bottleneck in Santolan (west approach) is also more evident in Figure 5.2.

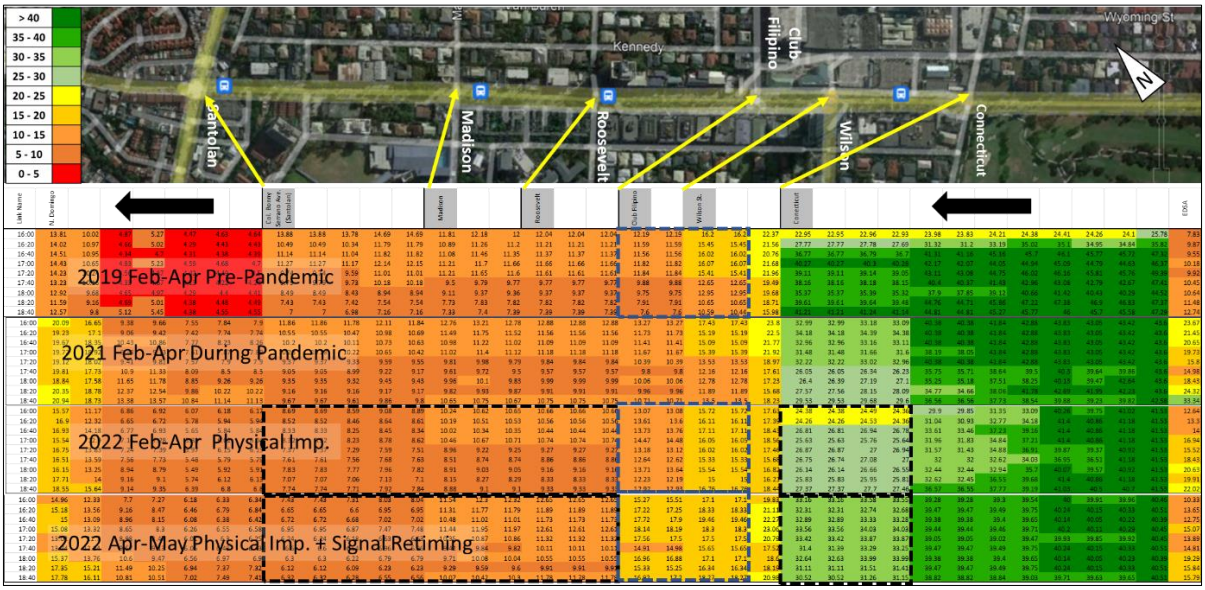


Source: JPT

Figure 4.3: Ortigas Ave. Travel Speed Comparison, AM Peak, NB/WB Direction

On the opposite direction, travel speeds between N. Domingo and Santolan have slow speeds during the AM peak (shown in Figure 4.3). While it is visible that travel speeds

increased after the physical improvements when approaching Santolan (NB/WB), travel speeds increased after applying the new signal timing for the NB/WB direction. Travel speeds also improved from Wilson to Roosevelt. Highest travel speeds can be seen from Wilson to Club Filipino after the physical improvements, and Club Filipino to Roosevelt after applying the new traffic signal.



Source: JPT

Figure 4.4: Ortigas Ave. Travel Speed Comparison, PM Peak, NB/WB Direction

Figure 4.4 shows travel speeds slightly decreased from Madison to Santolan after implementing the countermeasures. However, travel speeds from Connecticut to Club Filipino increased after traffic signal retiming.

(2) Travel Time

Travel time was computed by dividing the distance of the links by the travel speed data. Generally, the traffic flow in the northbound direction has higher travel time than the southbound. Moreover, warmer colors in 2019 data indicate the highest travel times, while 2021 data has the lowest travel time. Travel speeds have started to increase again even after applying the traffic signal adjustment. Thus, recalculation of optimum signal timing and phasing based on the updated volume count is necessary.

Table 4.1: Travel Time along Ortigas Corridor

Scenario	Distance(m)	3135.57		3271.31		Scenario	Distance(m)	3135.57		3271.31	
	Time Period (AM Peak)	SB Santolan–Connecticut		NB Connecticut–Santolan			Time Period (PM Peak)	SB Santolan–Connecticut		NB Connecticut –Santolan	
		sec	min	sec	min			sec	min	sec	min
2019	0600–0700	491.7	8.2	849.7	14.2	2019	1600–1700	625.9	10.4	980.4	16.3
2021		342.8	5.7	481.1	8.0	2021		429.4	7.2	763.2	12.7
2022 Physical Imp.		373.2	6.2	615.5	10.3	2022 Physical Imp.		607.1	10.1	937.9	15.6
2022 Signal Retiming		384.6	6.4	595.1	9.9	2022 Signal Retiming		661.2	11.0	902.6	15.0
2019	0700–0800	734.8	12.2	994.6	16.6	2019	1700–1800	636.9	10.6	978.9	16.3
2021		373.9	6.2	567.5	9.5	2021		488.6	8.1	834.6	13.9
2022 Physical Imp.		519.2	8.7	679.0	11.3	2022 Physical Imp.		601.3	10.0	964.0	16.1
2022 Signal Retiming		576.8	9.6	679.4	11.3	2022 Signal Retiming		682.9	11.4	925.1	15.4
2019	0800–0900	942.5	15.7	931.9	15.5	2019	1800–1900	756.7	12.6	1129.7	18.8
2021		458.0	7.6	626.1	10.4	2021		443.6	7.4	807.1	13.5
2022 Physical Imp.		636.2	10.6	725.3	12.1	2022 Physical Imp.		549.4	9.2	959.8	16.0
2022 Signal Retiming		690.0	11.5	700.3	11.7	2022 Signal Retiming		628.5	10.5	918.3	15.3

Source: JPT

4.3 Recommendation for Further Improvement

As part of the continued process of improving the Ortigas, San Juan corridor, Plan-Do-Check-Act (PDCA) method is recommended. In planning, the LGU and/or MMDA should conduct classified directional volume counts first. This shall determine the green time allocation per phase of every intersection. Planning also involves temporary traffic management schemes when conducting geometric improvements. After implementation, the traffic enforcers should report key observations on queuing and traffic flow. Finally, the LGU and/or MMDA shall act and modify countermeasures if necessary. Such modifications include traffic signal retiming, adjustment of lane configuration (at Santolan and Club Filipino), and additional geometric improvements.

5 APPLICATION OF AI-BASED TRAFFIC MONITORING

5.1 Introduction

As lessons learned from the previous result of the studies, traffic flow is changed due to reasons such as regulation, infrastructure development, and people movement. To maximize the mobility of all road users, it is essential to monitor traffic flow real time and implement a traffic management solution to provide smooth traffic. MMDA has conducted a traffic count survey, but the workforce is a limited resource making it impossible to monitor traffic on real-time basis.

For efficient operation of the intersection, its capacity must be utilized by applying the appropriate signal timings. The traffic demand on each approach must be measured, and signal timing must be adjusted for an optimal signal operation.

Traditionally, inductive loop vehicle detectors and ultrasonic vehicle detectors are used to measure the traffic flow parameters as these types of detectors are easy to install and operate. However, their sensing area is limited to a fixed small area. Therefore, many detectors are required to measure queue length to grasp the area-wide traffic conditions. In addition, maintenance of the loop coil is often an issue because it is vulnerable to the harsh site conditions which are common in Metro Manila. About half of the 2,000 loop detectors installed in Metro Manila are damaged and not functioning at the moment.

The current technology on video signal processing and artificial intelligence has made it possible to recognize individual vehicles and classify them into predefined categories. However, the process is affected by many factors such as occlusion of vehicles, weather condition, and low brightness of vehicles in the night, etc. In order to apply the image vehicle detector technology to traffic control, it must provide reliable traffic data regardless of traffic condition, weather, time of day and other factors.

Traffic volume data is one of the data sources required to plan comprehensive traffic management measures. Currently, traffic volume data is collected manually by surveyors' onsite. If an automated traffic volume counting system is submitted, traffic data can be constantly available that can enable research and planning and evaluate countermeasures.

A pilot project applying video Image processing technology by using Artificial Intelligence has been proposed at a section of Ortigas Avenue between the Santolan intersection and Connecticut Intersection. It uses the effectiveness of image vehicle detectors to the vehicle counting and speed measurement and eventually to signal control.

(1) Objectives

The pilot project intended to evaluate the usefulness of image processing technology of the videos taken by the detector installed at or near the intersection: The objectives of the pilot project are:

(i) To test and evaluate the accuracy of image vehicle detector system under various conditions;

(ii) To study and develop the data processing procedure of the image vehicle detector system most suitable for the use by the signal control system, and

(iii) To study the possibility of utilizing a continuous traffic count data collected by the image vehicle detector in traffic management and other applications.

(2) Pilot Project Site

The pilot project was conducted at Ortigas Avenue between Santolan and Connecticut. There are six signals along this section as shown in the map. These signals are operated online under 'MMDA's area traffic control system. The system is Hermes, provided by Indra. For traffic monitoring, video cameras were installed at the intersections of Santolan (2 unit) and Connecticut (2 units) for traffic monitoring and surveillance by the area traffic control system.

Source: JPT

Figure 5.1: Installed Locations for the CCTV System

5.2 Implementation of Vehicle Detection System

(1) Installation of Network Camera:

The pilot project consists of two (2) parts; shooting of video and processing of video images. Finally, traffic volume will be classified. These processes have been carried out online in real-time in this project.

Two video camera sets were installed at each of two intersections, Ortigas–Santolan and Ortigas–Connecticut. These intersections were selected as they are located at the end of the section, and the traffic volume is higher between these two intersections. Two (2) sets were installed at each intersection at the diagonal position, and a total of four (4) sets were newly installed. The video camera was mounted on the existing pole. The site survey was necessary to confirm the availability and suitability of the existing poles for the video camera.

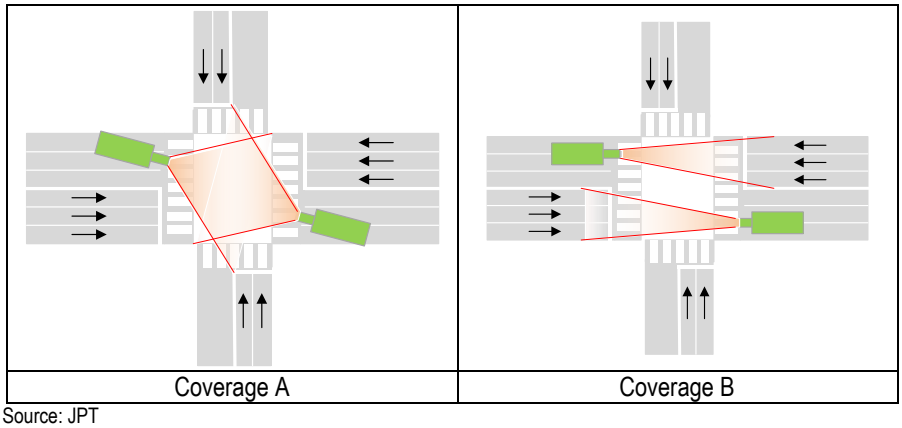
(2) Coverage Area of Cameras

The pilot project consists of two angles with different camera angles and coverage areas. The camera is directed to the intersection approach, while it will cover the inside of the intersection in the second stage. In both cases, all four video camera units are used (two cameras at an intersection), and the coverage area is modified by the PTZ function of the camera.

- **Coverage A:** One video camera covers one intersection approach. It counts and classifies the vehicles approaching the intersection into the specified vehicle types. Two approaches of opposite directions along the main road will be covered at an intersection.
- **Coverage B:** The camera will cover the inside area of the intersection. It will count and classify the vehicles entering the intersection from two intersecting approaches. Classification will be made by approach and directional movements (through, right turn, and left turn) separately. It is expected that vehicles from two intersecting directions will not stay in the intersection simultaneously.

Source: JPT

Figure 5.2: Pictures of Installed Cameras



Source: JPT

Figure 5.3: Coverage Area

(3) Requirement of Function

The functions of the vehicle detection system are listed in Figure 5.1.

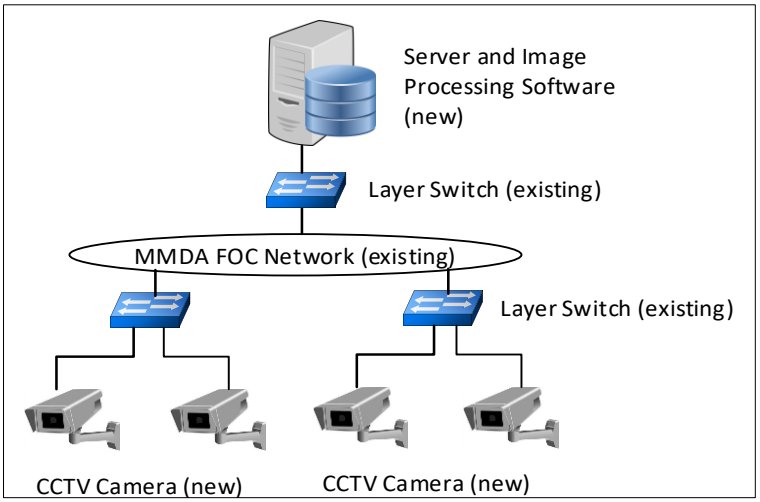
Table 5.1: Camera Functions

Item		Description	Remark
Traffic counting	Intersection approach	One camera covers max. three (3) lanes on the approach and perform vehicle classification separately for each lane	Traffic flow is toward the intersection, and vehicles leaving the intersection is not covered.
	Intersection inside	One camera covers three (3) directions inside the intersection from two (2) approaches separately	Right turn, through, and left-turn movements separately from two intersection approaches. U-turn is included in the left turn.
Counting accuracy		90% or higher	Under all conditions of occlusion, rain, fog, night time, street lighting and other adverse conditions, in which vehicles can be classified by human eye.
Vehicle classification		Passenger car/van, middle size truck/bus, large truck/bus, motorcycle, bicycle	

Source: JPT

(4) System Configuration

The proposed vehicle counting and classification system consists of the video camera at the intersection, an image processing server with image processing software at the Command and Control Center, and a data transmission system using MMDA's existing fiber optic cable network, connecting CCTV cameras and the server, as shown in Figure 5.4.



Source: JPT

Figure 5.4: System Configuration

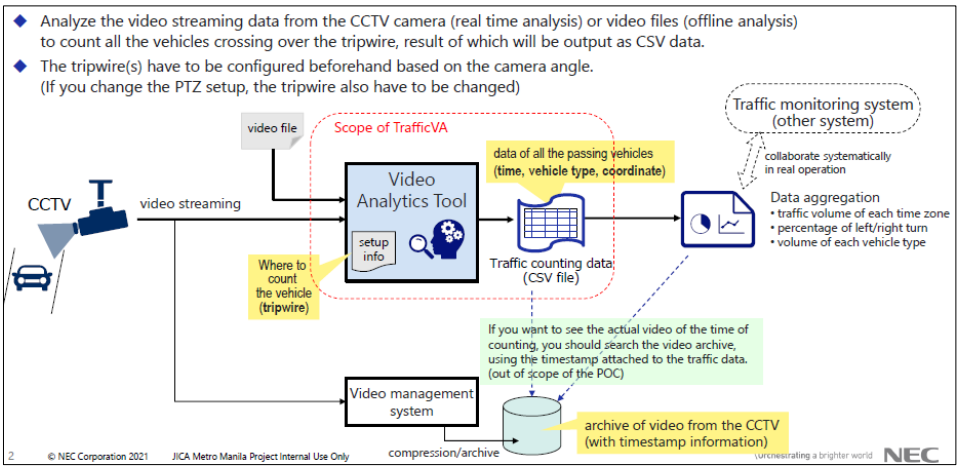
(a) **Consideration of Conditions:** To establish the system shown in Table 5.2, the following items were considered:

Table 5.2: Installation Requirements

Item	Requirement	Remark
Network	Existing MMDA network	Permission from MMDA to be sought
Protocol	iPv4/v6, FTP, HTTP, SNMP, etc.	Adopt the protocol used by the existing system
Power supply	AC 240 V	To be provided from the power receiving point for local controller through PoE.
Installation location	Existing signal mast arm	Mast arm locations to be confirmed.
Installation height	H >= 6.0 meters	Height of arm of the existing mast arm is about 6m.

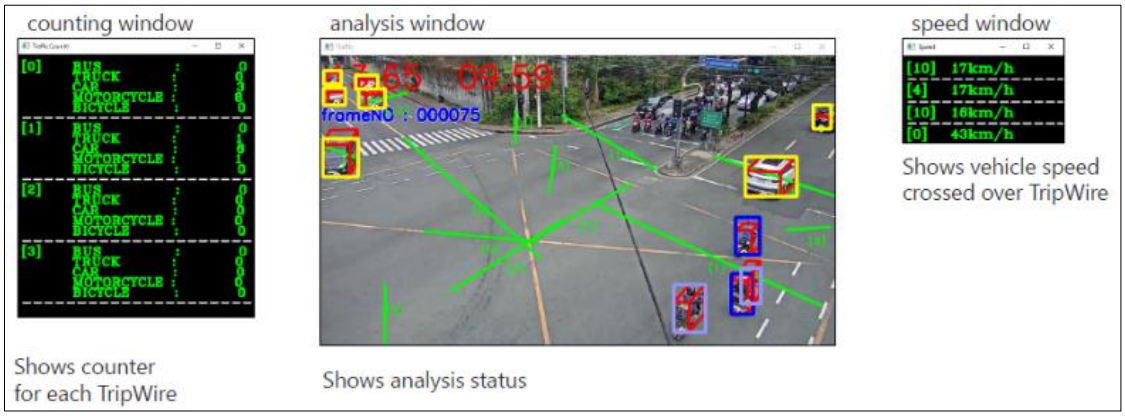
Note: PoE: Power on Ethernet that provides power over the Ethernet cable.
Source: JPT

(b) **Image Detection System:** In this project, AI image processing software developed by Japanese manufacturers was customized to adopt vehicle types in the Philippines. This software can analyze the video streaming data from the CCTV camera (real-time analysis) or video files (offline analysis) to count all the vehicles crossing over the tripwire. The result will be retrieved as CSV data. The tripwire(s) have to be configured beforehand based on the camera angle (If the PTZ setup is changed, the tripwire also has to be changed.).



Source: JPT

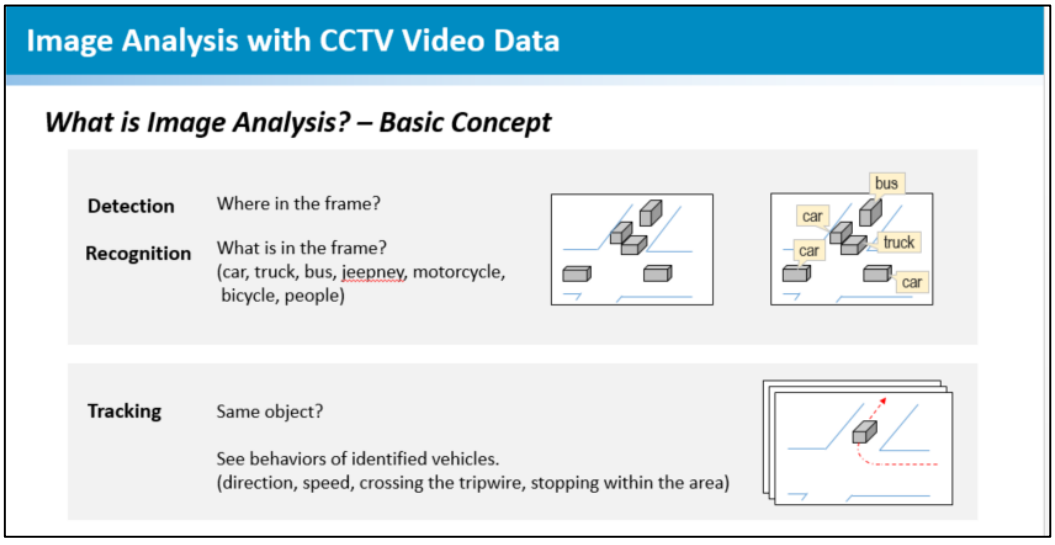
Figure 5.5: AI Vehicle Detection System

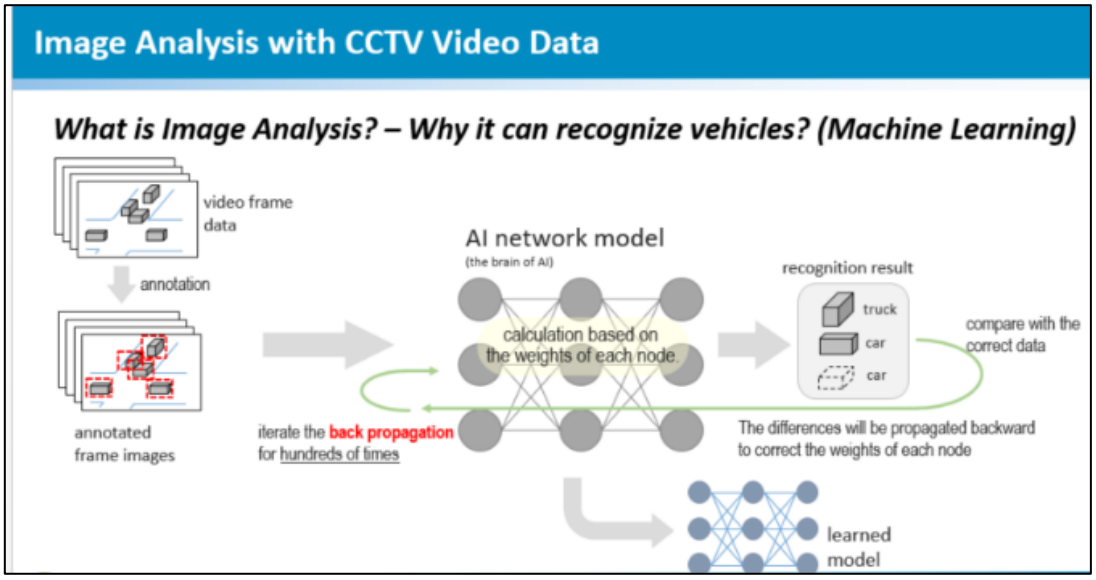


Source: JPT

Figure 5.6: Interface of AI Vehicle Detection System

AI image analysis technology can detect vehicles and vehicle types based on a trained model (dictionary) developed by giving annotations to vehicles and vehicle types in frame images of a pre-registered video in advance and repeatedly training the AI to memorize such information.



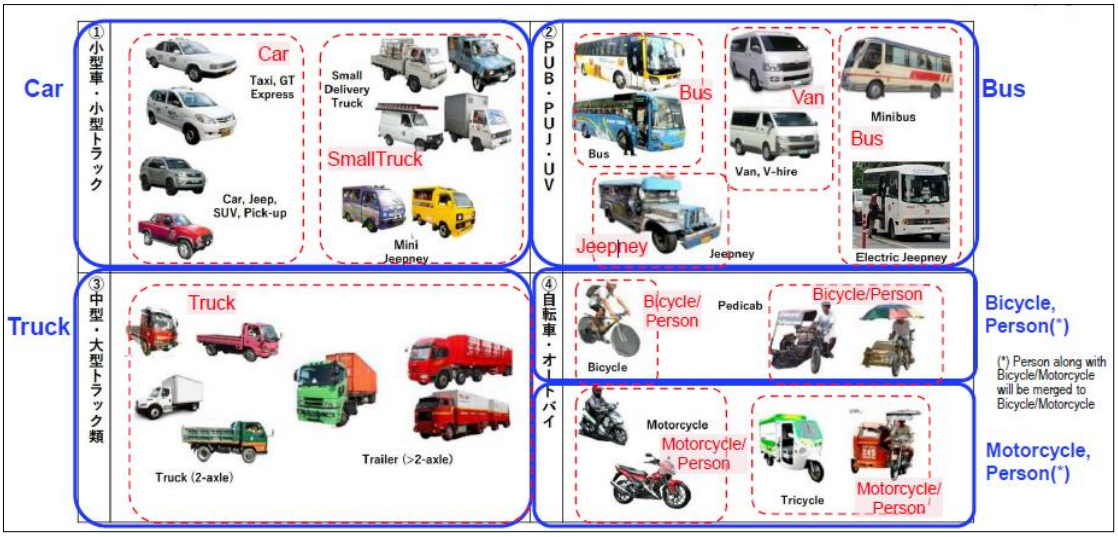


Source: JPT

Figure 5.7: Mechanism of AI Image Analysis Technology

(5) Calibration

The image processing software developed was customized to adopt vehicle types in the Philippines by machine learning with the preparation of dictionary. The software can identify four main vehicle classes and 11 vehicle types, as shown in Figure 5.8.

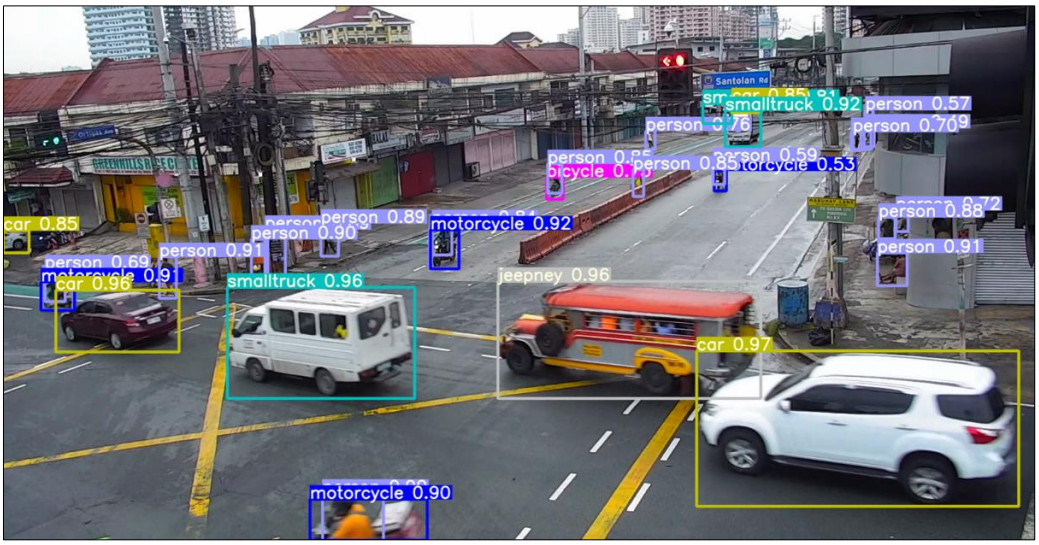


Source: JPT

Figure 5.8: Vehicle Types Recognized by the System

(6) Implementation of Software

After offline tests are conducted shown in Figure 5.9, the pilot implementation was done from 1st March, 2022 to 30th August, 2022.



Source: JPT

Figure 5.9: Offline Test of Image Recognition

crossing angle in degree (counter clockwise from 3 o'clock direction)

score (confidence value) of recognition

TripWire No. | time of crossing TripWire | Frame No. | speed(km/h) | class | recognized type | coordinates | unique id of the vehicle

WireNo	Year	Month	Day	Hour	Min	Sec	Millisec	Frame	Direction	Velocity	ObjectClass	Type	Score	CenterX	CenterY	ObjectId
1	2021	11	23	18	16	42	880	11	57	34.7	bike	motorcycle	0.92989	1777	652	21
11	2021	11	23	18	16	43	440	18	59	34.2	bike	motorcycle	0.89962	1873	506	21
12	2021	11	23	18	16	43	920	24	146	40.8	car	car	0.95092	180	169	39
12	2021	11	23	18	16	44	960	37	154	41.9	car	car	0.95136	286	145	31
11	2021	11	23	18	16	47	40	63	43	43	car	car	0.96659	1685	444	7390
11	2021	11	23	18	16	48	480	81	47	35.1	bike	motorcycle	0.85395	1764	470	11898
11	2021	11	23	18	16	48	560	82	52	26.9	bike	motorcycle	0.88748	1862	502	10076

Source: JPT

Figure 5.10: Output in CVS Format

5.3 Verification of AI image recognition results

(1) Verification Method

The accuracy of the traffic volume survey results from AI image recognition was verified by comparing the results of image recognition on a specific day at a specific time with the results of visual survey (assume it is a true value) on the same day and at the same time.

(2) Target of Verification

The following the traffic volume survey at the intersection of Connecticut-Ortigas Ave. is targeted to verification.

- Directional traffic volume (Car) at the intersection
- Cross-sectional traffic volume (Car) at the cross-section
- Directional traffic volume by vehicle type

(3) Calculation of Accuracy

- Directional traffic volume (Car) at the intersection
- Cross-sectional traffic volume (Car) at the cross-section

  A point to be noted in the accuracy verification is that if the true value of the manual survey results is 100 vehicles and the machine survey results are also 100 vehicles, then facially, the accuracy is 100%.

  However, there are cases in which the machine survey results count vehicles even though no vehicle has passed (over-detection) and cases in which no vehicles are counted even though a vehicle has passed (under-detection).

  Therefore, the Recall (reproduction rate) is calculated to observe the degree of under-detection, and the Precision (conformance rate) is calculated to observe the degree of over-detection.

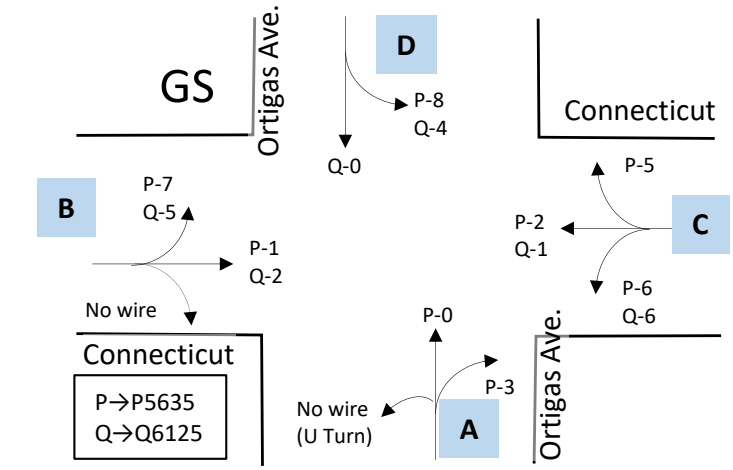
- Directional traffic volume by vehicle type

  In general, there are concerns about the effects of direct sunlight entering the camera and the shadows of surrounding buildings, plants, and other objects as factors that may reduce the accuracy of image recognition. Therefore, for this accuracy verification, three time periods are targeted for the verification: morning (8:00s), evening (17:00s), and daytime (13:00s), when the angle of incidence of sunlight changes. The five-minute data for each period of time is verified and harmonically averaged to confirm the accuracy of the traffic volume by vehicle type.

(4) Verification Results

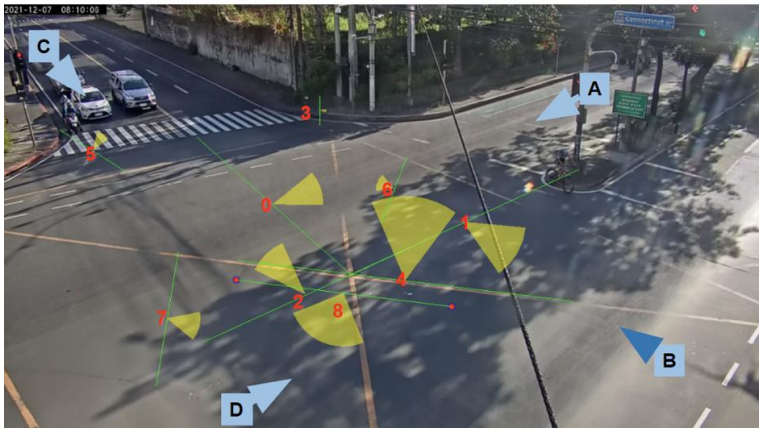
- **Directional traffic volume at the intersection**

  The following are the results of the verification of the traffic volume by direction. Figure 5.11 shows the direction of traffic flow at the intersection. Figure 5.12 and Figure 5.13 show the locations of the trip wires. Then, the verification result of directional traffic volume at the intersection is shown Figure 5.14.



Source: JPT

Figure 5.11: Directional Guide Map



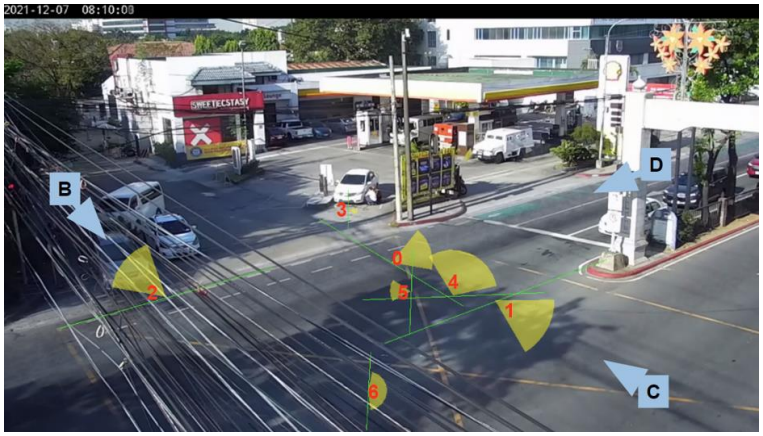
Source: JPT

Figure 5.12: P5635 Angle of View

Table 5.3: Comparison of Volume Counts between Manual and System Detection at P5635 Camera

	Manual Count										System Detection									
	Total	T0	T1	T2	T3	T4	T5	T6	T7	T8	Total	T0	T1	T2	T3	T4	T5	T6	T7	T8
bicycle	19	10	2	0	5	0	2	0	0	0	17	8	2	0	5	0	2	0	0	0
bus	4	3	0	0	1	0	0	0	0	0	4	3	0	0	1	0	0	0	0	0
car	106	52	2	0	13	0	14	4	1	20	106	52	2	0	13	0	14	4	1	20
jeepney	2	2	0	0	0	0	0	0	0	0	2	2	0	0	0	0	0	0	0	0
motorcycle	126	88	3	0	17	0	11	2	1	4	124	88	3	0	17	0	10	2	1	3
smalltruck	7	5	1	0	0	0	0	0	0	1	7	5	1	0	0	0	0	0	0	1
truck	7	4	0	0	0	0	0	1	1	1	7	4	0	0	0	0	0	1	1	1
van	2	2	0	0	0	0	0	0	0	0	2	2	0	0	0	0	0	0	0	0
Total	273	166	8	0	36	0	27	7	3	26	269	164	8	0	36	0	26	7	3	25

Note. P5635 is camera name. T is Trip Wire
Source: JPT



Source: JPT

Figure 5.13: Q6125 Angle of View

Table 5.4: Comparison of Volume Counts between Manual and System Detection at Q6125 Camera

	Manual Count										System Detection									
	Total	T0	T1	T2	T3	T4	T5	T6	T7	T8	Total	T0	T1	T2	T3	T4	T5	T6	T7	T8
bicycle	9	7	0	2	0	0	0	0	0	0	7	7	0	0	0	0	0	0	0	0
bus	3	3	0	0	0	0	0	0	0	0	3	3	0	0	0	0	0	0	0	0
car	98	73	0	2	0	20	1	2	0	0	95	73	0	1	0	20	1	0	0	0
jeepney	2	2	0	0	0	0	0	0	0	0	2	2	0	0	0	0	0	0	0	0
motorcycle	71	63	0	4	0	3	1	0	0	0	44	38	0	2	0	3	1	0	0	0
smalltruck	10	8	0	1	0	1	0	0	0	0	10	8	0	1	0	1	0	0	0	0
truck	3	2	0	0	0	0	0	1	0	0	2	2	0	0	0	0	0	0	0	0
van	6	6	0	0	0	0	0	0	0	0	6	6	0	0	0	0	0	0	0	0
Total	202	164	0	9	0	24	2	3	0	0	169	139	0	4	0	24	2	0	0	0

Note. Q6125 camera name. T is Trip Wire
Source: JPT

The Recall (as the degree of under-detection) is 90.2%, and the Precision (as the degree of over-detection) is 99.6%.

All of them have an accuracy of more than 90%. The results show that while under-detections are less than 10%, over-detections are less than 1%, indicating that detection with high accuracy is possible.

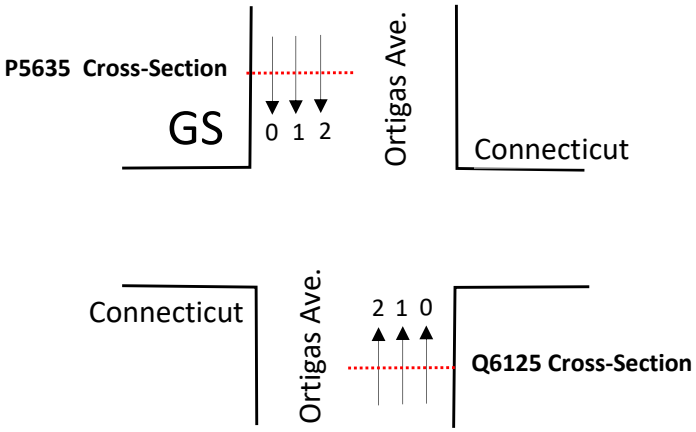
Table 5.5: Result of Recall / Precision (at Intersection)

Site	Recalll	Precision
P5635 Angle of View	97.8%	99.3%
Q6125 Angle of View	83.7%	100.0%
Harmonic Average	90.2%	99.6%

Note. P5635 and Q6125 are camera name.
Source: JPT

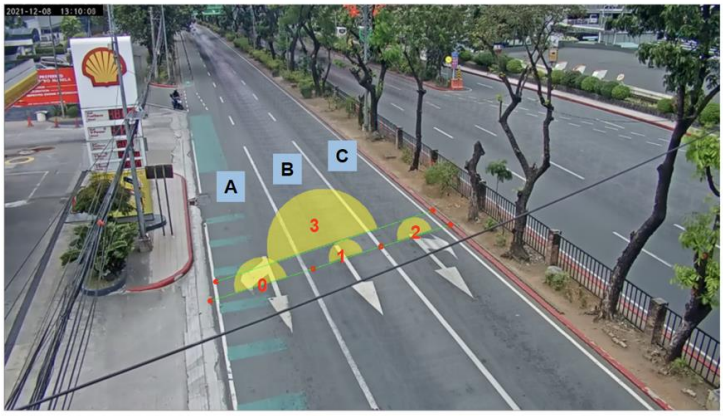
- **Cross-sectional traffic volume at the cross-section**

The following are the results of the verification of the cross-sectional traffic volume at the single street. Figure 5.14 shows the direction of traffic flow. Figure 5.15 and Figure 5.16 show the locations of the trip wires. Then, the verification result of directional traffic volume at the intersection is shown



Source: JPT

Figure 5.14: Directional Guide Map



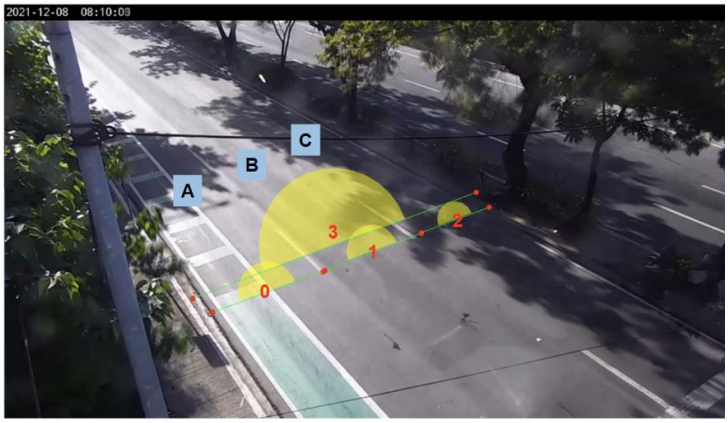
Source: JPT

Figure 5.15: P5635 Cross-Section (Inflow)

Table 5.6: Comparison of Volume Counts between Manual and System Detection at P5635 Camera (Inflow)

	Manual Count										System Detection									
	Total	T0	T1	T2	T3	T4	T5	T6	T7	T8	Total	T0	T1	T2	T3	T4	T5	T6	T7	T8
bicycle	8	4	0	0	4	0	0	0	0	0	8	4	0	0	4	0	0	0	0	0
bus	4	1	1	0	2	0	0	0	0	0	2	0	1	0	1	0	0	0	0	0
car	90	5	33	7	45	0	0	0	0	0	89	5	33	7	44	0	0	0	0	0
jeepney	2	1	0	0	1	0	0	0	0	0	2	1	0	0	1	0	0	0	0	0
motorcycle	48	12	6	6	24	0	0	0	0	0	40	11	6	4	19	0	0	0	0	0
smalltruck	4	0	2	0	2	0	0	0	0	0	4	0	2	0	2	0	0	0	0	0
truck	12	0	4	2	6	0	0	0	0	0	12	1	3	2	6	0	0	0	0	0
van	2	0	1	0	1	0	0	0	0	0	2	0	1	0	1	0	0	0	0	0
Total	170	23	47	15	85	0	0	0	0	0	159	22	46	13	78	0	0	0	0	0

Note. P5635 is camera name. T is Trip Wire
Source: JPT



Source: JPT

Figure 5.16: Q6125 Cross-Section (Inflow)

Table 5.7: Comparison of Volume Counts between Manual and System Detection at Q6125 Camera (Inflow)

	Manual Count										System Detection									
	Total	T0	T1	T2	T3	T4	T5	T6	T7	T8	Total	T0	T1	T2	T3	T4	T5	T6	T7	T8
bicycle	9	7	0	2	0	0	0	0	0	0	7	7	0	0	0	0	0	0	0	0
bus	3	3	0	0	0	0	0	0	0	0	3	3	0	0	0	0	0	0	0	0
car	98	73	0	2	0	20	1	2	0	0	95	73	0	1	0	20	1	0	0	0
jeepney	2	2	0	0	0	0	0	0	0	0	2	2	0	0	0	0	0	0	0	0
motorcycle	71	63	0	4	0	3	1	0	0	0	44	38	0	2	0	3	1	0	0	0
smalltruck	10	8	0	1	0	1	0	0	0	0	10	8	0	1	0	1	0	0	0	0
truck	3	2	0	0	0	0	0	1	0	0	2	2	0	0	0	0	0	0	0	0
van	6	6	0	0	0	0	0	0	0	0	6	6	0	0	0	0	0	0	0	0
Total	202	164	0	9	0	24	2	3	0	0	169	139	0	4	0	24	2	0	0	0

Note. Q6125 is camera name. T is Trip Wire
Source: JPT

The Recall (as the degree of under-detection) is 85.6%, and the Precision (as the degree of over-detection) is 99.3%.

The accuracy of Recall (undetected) is lower than the accuracy in cross-sectional traffic, but the accuracy of Precision (over-detected) is less than 1%, which is comparable to the accuracy in directional traffic.

Table 5.8: Result of Recall / Precision (at Inflow)

Site	Recalll	Precision
P5635 Cross-Section	92.4%	98.7%
Q6125 Cross-Section	79.7%	100.0%
Harmonic Average	85.6%	99.3%

Note. P5635 and Q6125 are camera name
Source: JPT

- **Directional traffic volume by type of object**

The results of the accuracy verification of directional traffic volume by vehicle type harmonically averaged for the total of three time periods of morning, noon, and evening, are shown in Table 5.9.

Car and Bus have an accuracy of more than 90%, and especially Car has an accuracy of more than 98%.

On the other hand, Truck, Motorcycle, and Bicycle are less than 90% accurate, especially Truck and Bicycle are less than 80% accurate.

Table 5.9: Result of Accuracy by Vehicle Type

Vehicle Type	car	truck	bus	Motor cycle	bicycle
Morning 5min	98.0%	90.0%	87.5%	82.7%	92.0%
Afternoon 5min	96.9%	75.0%	93.3%	84.3%	50.0%
Evening 5min	100.0%	66.7%	93.8%	89.2%	97.9%
Average 5min	98.3%	76.1%	91.4%	85.3%	73.0%

Source: JPT

5.4 Issues and Points to Note

Although AI image recognition can count vehicles with a certain degree of accuracy, it is also true that there is a margin of error.

To improve accuracy, it is also important to acquire high quality images. Low visibility reduces the accuracy of AI image recognition, just as it does with the human eye.

Based on this pilot project, the following issues are founded.

- **Lack of AI learning**
- **Angle of view of CCTV cameras**
- **Changes in traffic flow due to LGU enforcers**

(1) Lack of AI Learning

AI Image recognition is certainly an improvement in recognition accuracy in a variety of environments compared to previous image recognition technologies without AI. However, it is not sufficiently accurate when it is not in the proper learning of images.

In AI image recognition, it is extremely important to learn the "appearance" of various vehicles on the road. The "appearance" depends on the position from which the vehicle is viewed, i.e., the location of the CCTV camera, and depends on the effects of sunlight.

- **Influence by shadow:**

  It is common that shadows of trees and buildings appear on the road at some time of a day, which lead to AI image analysis's misidentifications of vehicles or persons to be counted.

  Figure 5.17 is an example. In the left photo, there are no shadows on the road surface. On the other hand, in the right photo, there is a shadow of a tree on the road surface. In such cases, AI image recognition may not be able to recognize cars and motorcycles accurately. To prevent such negative effects, more "appearance" images of each vehicle should be acquired and learned.

No shadow effect (cloudy, daytime)

With shadow effect (sunny, early morning)

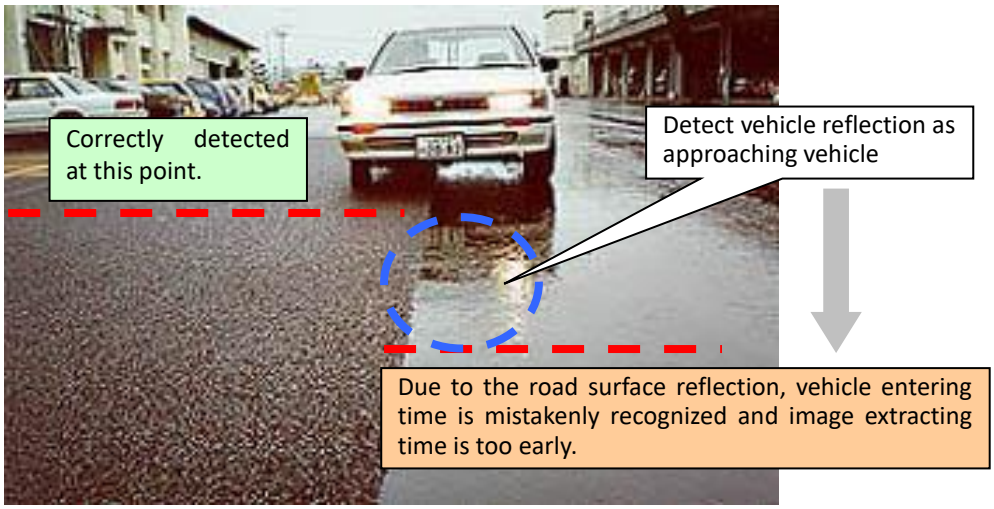
Source: JPT

Figure 5.17: Example of Effects of Shadows of Surrounding Objects

- **Road Surface Reflection (especially at night and rain) :**

  AI image recognition performs object recognition based on the features and movements of objects (e.g., cars, motorcycles, bicycles) in the video. As shown in Figure 5.18 a car or headlight may be reflected on the road surface, resulting in misrecognition of the object's size and timing of its passage.

  In traffic volume measurement, a measurement line called a trip wire is set and vehicles passing through the trip wire are detected to measure traffic volume and passing time, but in cases like Figure 5.18, the passing timing may be wrong.



Source: JPT

Figure 5.18: Example of Effects of Road Surface Reflection

Figure 5.19 shows an image of the Santolan intersection at Ortigas Ave. during a wet night, when the road surface is wet, and cars and headlights are reflected on the road surface. The camera lens is also covered with water droplets.

Thus, it should be noted that measurement accuracy may be relatively low during rainy weather at night.

Source: JPT

Figure 5.19: Image at Night Time and in Rainy Weather at Santolan

(2) Angle of View of CCTV Cameras

- **Effects of Occlusion**

  Passenger cars are not the only vehicles on the road. There are also large vehicles such as trucks and buses, motorcycles, and bicycles.

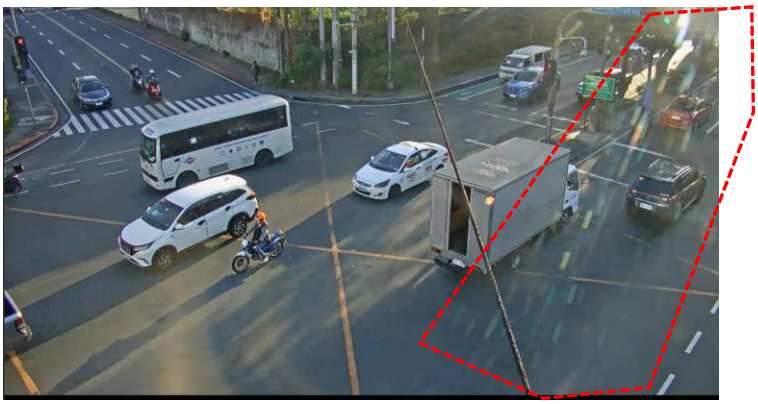
  As shown in Figure 5.20, small vehicles and motorcycles may not be visible due to the presence of large buses. In this case, large buses can be recognized, but hidden vehicles (especially motorcycles) may not.

Source: JPT

Figure 5.20: Examples of the effects of occlusion

- **Sunlight into the camera**

  Sunlight coming into the camera can also cause the camera to fail to obtain an appropriate image. In Figure 5.21, sunlight is coming into the CCTV camera, causing it to fail to properly capture the appearance of the vehicle from the upper right side.



Source: JPT

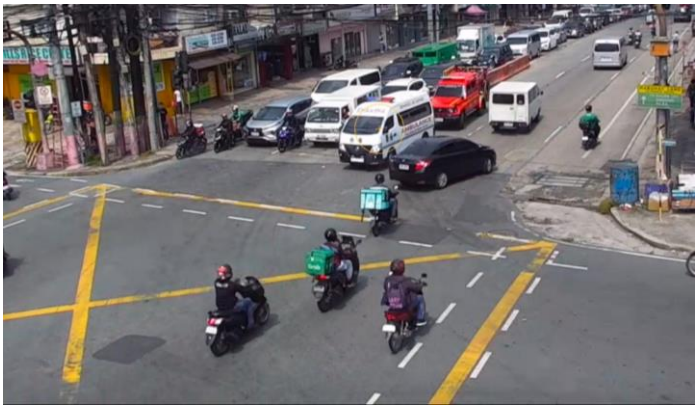
Figure 5.21: Sunlight into the camera

As a countermeasure, although there are some restrictions on the location of the camera, it is advisable to raise the installation height as high as possible and to take pictures at an angle of view close to directly above the CCTV camera.

(3) Changes in Traffic Flow due to Enforcers / Road Maintenance

Traffic flow counting in image recognition counts vehicles that have passed through a trip wire set in the angle of view. The passing judgment is made when the "center point of appearance" of a vehicle passes through the trip wire. In other words, even if a partial passage of a vehicle occurs, if the "center point of appearance" is not on the trip wire, the vehicle is not counted. Sometimes, enforcer controls traffic flow, opposite direction as shown in the left photo in Figure 5.22.

When such control occurs, the vehicle trajectory of the traffic flow will change. In such cases, as shown in the right photo in Figure 5.22, the normal vehicle trajectory is a light blue line, but if the vehicle trajectory changes as shown in the red line due to the Enforcer or Road Maintenance, the vehicle does not pass on the Trip Wire and is not counted.



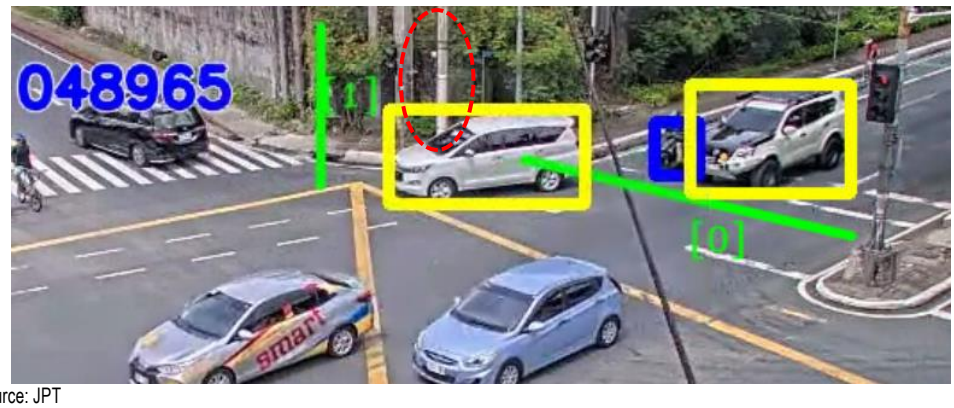
Source: JPT

Source: JPT

Figure 5.22: Changes in Traffic Flow Guided by Enforcers

The method of counting vehicles using a trip wire is extremely inaccurate when the trajectory of the traffic flow changes. Naturally, the same thing happens if the angle of view changes slightly.

In Figure 5.23, the Trip Wire circled by the red dotted line is shifted to the upper left due to the change in the angle of view. As a result, right-turning vehicles may not be counted correctly.



Source: JPT

Figure 5.23: Changes in Traffic Flow Guided by Enforcers

5.5 Improvement of Accuracy

(1) Setting the Angle of View to Capture the Proper Image Whenever Possible

AI image recognition can count vehicles with a certain accuracy, but it is also true that there are errors. To improve accuracy, it is also important to acquire high quality video. If visibility is low, AI image recognition will be less accurate, just as it is with the human eye.

It is not easy to set the angle of view from a high position, close to the top, and still be able to capture the traffic flow. In addition, as in Metro Manila, where overhead telephone and electric lines are stretched over the roads as like Figure 5.24

.

Source: JPT

Figure 5.24: View Obstruction by Overhead ires

Therefore, the angle of view and Trip Wire settings should be optimized as much as possible through repeated setup, evaluation verification, and review.

While PTZ cameras have the advantage of being able to change the angle of view remotely, it is also advisable to periodically evaluate, verify, and review the settings because the angle of view may change due to operational errors, mechanical errors, or other factors.

(2) Acquisition of Learning Data and Regular Review of Learning

The advantage of AI image analysis is that it is not necessary to manually facilitate a large amount of learning images but learning data is very important for improving accuracy. As mentioned above, the images taken differ depending on various surrounding environments and CCTV installation conditions, therefore it is necessary to acquire and prepare learning data manually and visually, absolutely. If an AI image analysis device is purchased and installed without careful consideration, accuracy will not be ensured.

In addition, to be possible to distinguish between motorcycles, bicycle and new mobility mode such as electric kickboards, it is also necessary to acquire and prepare learning data on a regular basic and to carry out review of learning. It should be noted that it is essential for AI to grow in the same way as humans and improve detection accuracy by continuously performing such learning work.

5.6 Use Cases of AI Image Technologies

Right now, MMDA have a plan to introduce a vehicle detection system (VDS), traffic signal enforcement system (TSES), speed violation enforcement system (SVES) which use AI image recognition (machines learning). There is very limited transportation data available for transportation planning and traffic management in Metro Manila. Such available traffic data is collected manually in each project on a specific day only, which is not constantly collected. Meanwhile, CCTV cameras are becoming affordable in recent years and MMDA has already installed 200 CCTV cameras in Metro Manila but just viewing manually. When install such kind of technologies, it is essential to understand characteristics of each use case and advantage and weak points. Use cases, data visualization and data protection are summarized as follows.

(1) Improvement and Upgrade of Traffic Management

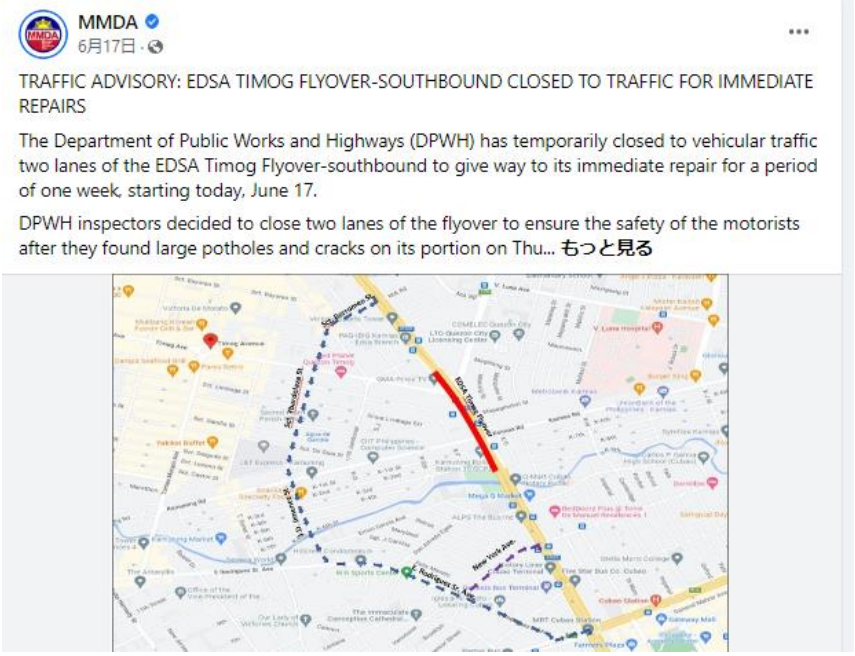
AI image recognition on the collected video image data from CCTV cameras will make it possible to monitor the traffic volume constantly. Furthermore, real-time analysis will enable timely and effective traffic management, law enforcement and disaster control while utilization of accumulated data will enable well-planned traffic guidance as shown in Table 5.10.

Table 5.10: Use Cases of Image Analysis Data Utilization

Traffic Management Field	Use Case (Purpose)	Department of MMDA that utilizes data	Necessity of Real-time analysis
Traffic Management/ Traffic Guidance	• Detection of incidents and traffic accidents • Traffic guidance (Traffic restrictions on an event day, road cloure)	• TEC • Metrobase	YES
Traffic Enforcement	• Automatic detection of traffic violation (No-contact apprehension) • Detection of on-street parking • Apprehension of illegal parking by jeepneys	• TDO	YES
Traffic Congestion Measurement	• Input data for Intersection Improvement • Review of signal phase • Detour plan for events and constructions	• TEC	NO
Traffic Information Provision	• Information provision with variable message signs • Input data for application that provides transportation information	• TEC • Metrobase	YES
Traffic Control in Disasters	• Grasping safe routes in case of disasters (flooding)	• TDO	YES

Source JPT

It should be noted that the customization and calibration of AI dictionary by vehicle type is necessary for conducting traffic count by vehicle types, since there are unique vehicles such as jeepney and tricycle in the Philippines.



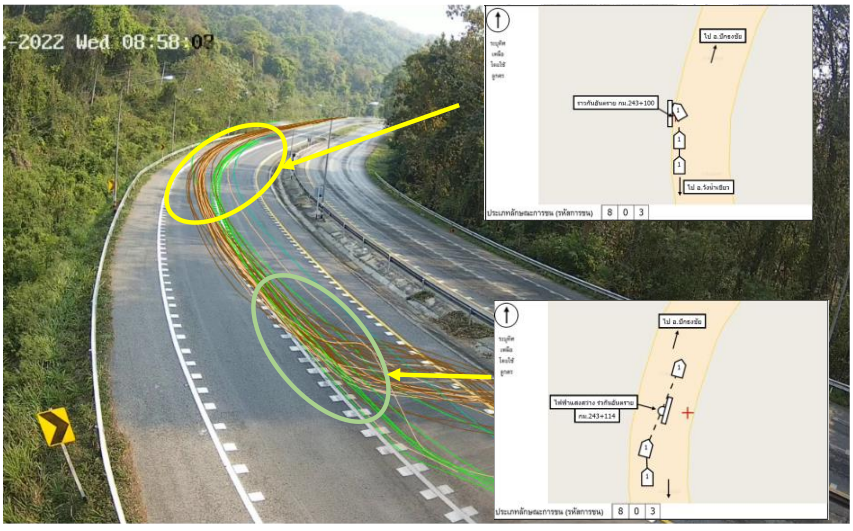
Source: MMDA Facebook

Figure 5.25: Traffic Advisory by SNS (Road Closure due to Road Construction/Maintenance)

(2) Road Safety Improvement

According to Metro Manila Accident Reporting and Analysis System (MMRAS), In 2019, there were 126,556 road crash cases and 394 fatalities in Metro Manila. Traffic accidents triggers traffic congestions and give negative impacts on the socio economy.

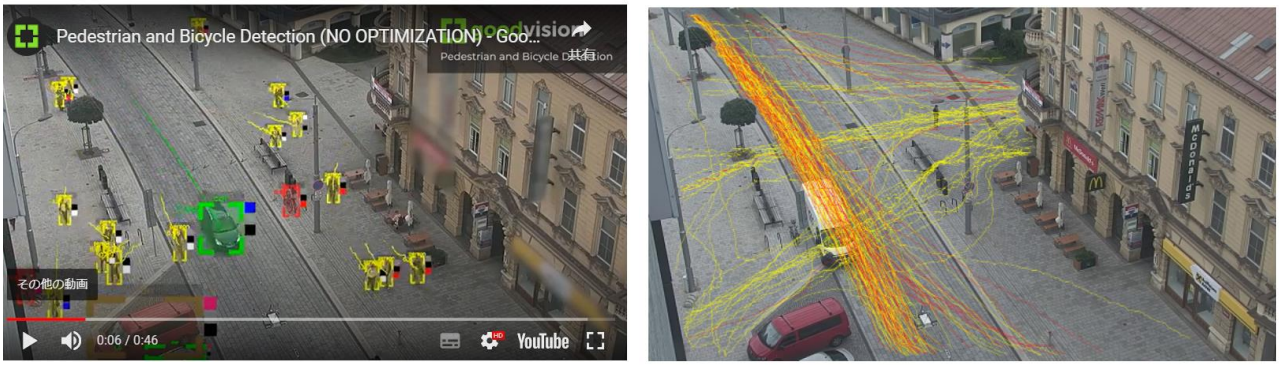
The major cause of traffic accidents are considered to be driving behaviors, however, it is difficult to identify causes attributed to the specific location from traffic accident investigation report and site investigation. Figure 5.26 shows vehicle trajectories, observe lane departures in sharp curve area where is accident black spots. AI image analysis enables constant monitoring, which makes it possible to identify factors that may lead to accidents and make countermeasures in advance.



Source: JICA The Project On Capacity Improvement For Road Traffic Safety Institutions And Implementation In The Kingdom Of Thailand

Figure 5.26: Driving Behavior Observation with Image Analysis

Also AI image recognition can detect pedestrian behavior as shown in Figure 5.27. If there are many jaywalking area, it helps to consider engineering and enforcement countermeasures.



Source: Good Vision

Figure 5.27: Trajectory of Pedestrian Crossing Analyzed by AI Image Recognition

(3) Utilization for Road Transportation and Urban Planning

It is possible to grasp the traffic flow at each intersection by vehicle type, by direction as hourly data, daily data and monthly data by accumulating image analysis data. These data will be utilized as input data for road transportation and urban planning. Furthermore, it is possible to quantitatively determine the effectiveness of countermeasures by comparing data between before and after implementation of road improvements and traffic management measures.

(4) Visualization of AI Image Analysis

It is important for policy makers and decision makers who are not expert technicians to understand the usefulness of the collected data in order to improve the environment for continuous and sustainable data collection and to obtain investment decisions. Therefore, it is important that the materials resulting from image analysis can be explained to policy makers and local residents in an easy-to-understand manner through visualization.

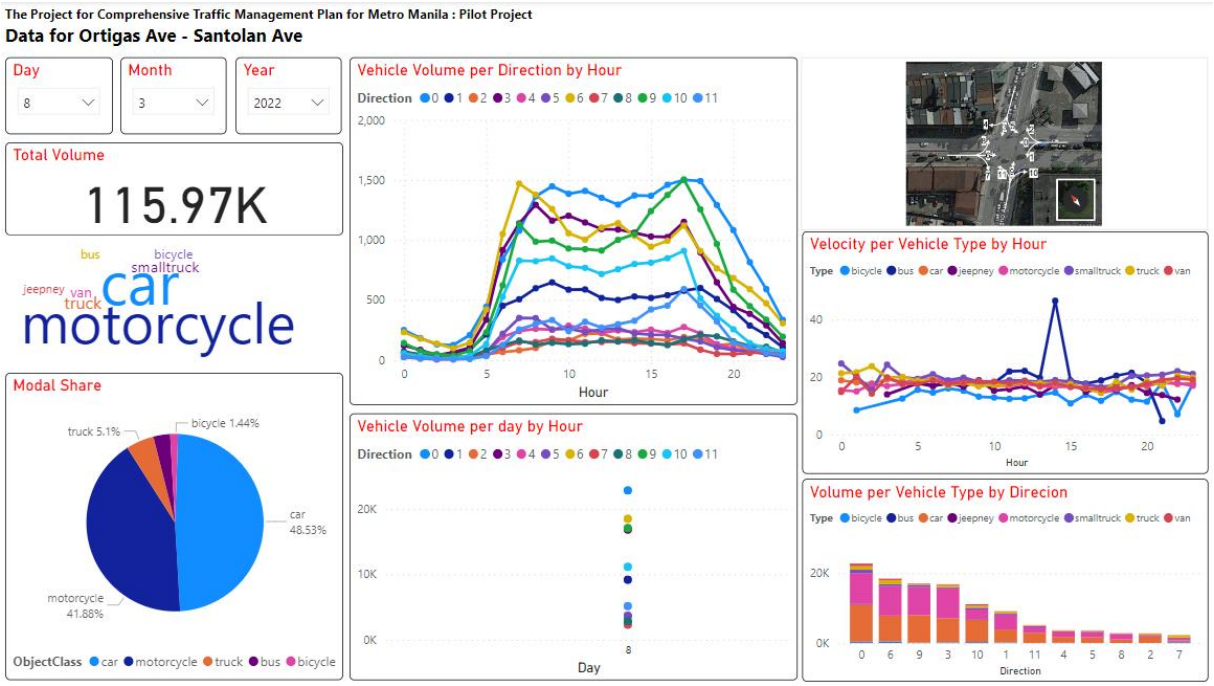
In Source JPT

Figure 5.28, Power BI (Business Intelligence) (Microsoft product), one of the visualization tools, is utilized to visualize and display the results of this pilot project including traffic volume percentage by vehicle type, traffic volume by direction by time of day, average speed by vehicle type by time of day, and traffic volume by vehicle type by direction, all at once.

In addition, the left-middle area in the figure, displays the traffic volume at the intersection in the size of the letters of the vehicle type name using a method called “Infographics”.

The Dashboard information can be changed by selecting the year and month in the upper left corner, and the data to be displayed can also be automatically changed by selecting the target from the graph legend.

Preparing a dashboard with such a BI tool in advance will enable grasping the local traffic situation constantly and it is essential to utilize it for signal design and infrastructure development decisions.



Source JPT

Figure 5.28: Example of Visualization using Power BI

(5) Protection of Personal Information Data

The Philippines has a law dealing with personal data, the Data Privacy Act 10173, which was enacted in 2012, and entities handling personal data must comply with its provisions.

The National Transport Policy requires compliance with the Data Privacy Act. The policy states: “A database system for transport-related data shall be established and maintained by the DOTr for all government agencies, data repositories, research institutions and members of the academe, particularly those that are involved in the collection and management of transport-related data.” Therefore, it is expected that transportation data will be used in various fields.

(6) Location and Installation of CCTV Cameras

The appropriate location for CCTV camera depends on what kind of data is needed and what the use case is. Table 5.11 shows the preferred camera locations and installation by expected use case.

Table 5.11: Preferred Camera Locations by Expected Use Case

Traffic Management Sectors	Use Case	Need for Real-time Performance	Preferred Installation Location
Traffic Management and Guidance	✓ Incident and traffic accident detection ✓ Traffic advisory	Yes	- Traffic accident hotspots - At around annual events
Traffic Enforcement	✓ Automated traffic violation detection (No-Contact Apprehension) ✓ On-street parking detection ✓ PUJ enforcement of illegal parking	Yes	- Areas with many traffic violations and illegal on-street parking
Traffic Congestion Countermeasures	✓ Input data for intersection improvement studies ✓ Review of signal control ✓ Study of detours and routes during various events and construction	No	- Junction of Major corridor - Traffic bottleneck - Turnaround point during construction
Traffic Information Provision	✓ Provision of information on VMS ✓ Input data for traffic information provision application	Yes	- Junction of Major corridor
Traffic Guidance during Disasters	✓ Assessing the availability of roads due to disasters (flooding)	Yes	- Candidate locations for road closures due to disasters

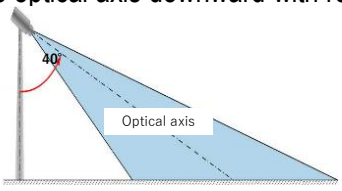
Source JPT

As mentioned earlier, the accuracy of AI image analysis is largely dependent on the CCTV camera's installation position and its angle of view. Source JPT

Figure 5.29 shows the desired installation of CCTV cameras to improve the accuracy of image analysis, based on the results of this Study. Depending on the size of the intersection, an installation height of 6 to 8 m is likely to result in an angle of view with less occlusion.

Recommended video streaming configuration

- 15FPS / non-interlace
- Minimum resolution depends on the size of the vehicle in the video.
  It should be at least 100pixel.
  (Usually, it does not have to be FULL HD(1920x1080). Half HD(960x540) can work)
- Basically AE (Auto Exposure) should be enabled.
  If count/recognition result does not seem good, you can consider to adjust maximum shutter speed to 1/2000 or 1/1000 depending on the light conditions in night time and also the performance of the camera itself.
- The camera should be installed at an angle of 40 ° with the optical axis downward with respect to the vertical



Source JPT

Figure 5.29: Recommendation of CCTV Installation for Improving Accuracy of AI Image Analysis

APPENDIX J

Pilot Project #2: Strengthening of the Traffic Management Capacity of Local Government Units in Metro Manila

APPENDIX J
Pilot Project No.2: Strengthening of the Traffic Management Capacity of Local Government Units in Metro Manila

On 19 November 2020 during the joint conduct of the 2nd Joint Coordination Committee (JCC) and Technical Working Group meetings, the JCC approved the implementation of three pilot projects during the course of the CTMP Project. In general, these pilot projects, which are listed below, aimed to enhance the MMDA's and the local government units' (LGUs) implementation capacity through a series of activities, from planning, implementation to evaluation and verification.

(ii) Pilot Project No.1: Improvement of Ortigas Avenue (Santolan Road–Connecticut Street);

(iii) Pilot Project No.2: Capacity building of LGUs; and

(iv) Pilot Project No.3: Database building.

This appendix provides a brief profile of the second pilot project. A separate technical report is provided which shows the deliverables of this pilot project.

1) Rationale for the Pilot Project

In the CTMP Project, it was found that it would be vital to develop and enhance the traffic management capacity of LGUs because of the following reasons:

(i) Traffic congestion at a bottleneck on a primary road is not an isolated matter that concerns that particular location only but is often interrelated with the traffic situation in other bottlenecks. As it was proven in the questionnaire surveys conducted among Metro Manila's LGUs and the case studies of LGU-identified traffic bottlenecks, the performance of lower-class roads influence that of higher-class roads which the MMDA and the LGUs manage;

(ii) The traffic management capacities of LGUs are often insufficient in many aspects, such as in human resources, technology, facilities, financial resources, and other institutional arrangements. These gaps between and within MMDA and the LGUs amplify traffic issues; and

(iii) Traffic problems in Metro Manila are interconnected and must therefore be resolved through a uniform and coordinated policy to the extent possible. To effectively plan and implement the five-year traffic management plan, which this Project will prepare, coordination with the MMDA and LGUs, and a shared understanding of issues and measures are essential.

This pilot project, an online training in traffic management provided by the U.P. National Center for Transportation Studies (UP NCTS), intended to focus on the technical knowledge and capacities of the traffic management personnel of Metro Manila LGUs but was opened to the personnel from other counterpart agencies as well. The specific objectives of this pilot project are as follows:

(i) To promote a common understanding of the situation, issues, and solutions related to traffic management in Metro Manila, particularly traffic congestion, based on data and scientific planning methodologies;

(ii) To strengthen inter-agency coordination in traffic management planning and plan implementation among MMDA and LGUs; and

(iii) To prepare teaching materials for the online lectures and training based on consultations with the LGUs and MMDA regarding their actual needs.

2) LGU Self-assessment Survey Questionnaire

In relation to the third objective mentioned above, the JICA Project Team (JPT) conducted a self-assessment survey among LGUs to have a better understanding of their needs and preferences and to guide the development of a training program on transportation planning and traffic engineering more suited to the needs of LGUs; MMDA's preferences took a backseat for this pilot project.

(a) **Objective:** The purpose of the survey is to determine the LGUs' strengths and weaknesses in different aspects (technical knowledge, equipment, manuals, and literature, etc.) which boost or hinder the performance of their tasks related to transportation planning and traffic engineering. Specifically, it aimed to identify the training needs of the LGUs (and MMDA) and to guide the formulation of a training program. The survey consisted of five parts: namely: (i) issues and concerns; (ii) availability of transportation and traffic equipment (software, database and records, reference materials or manuals, transportation planning and tools, etc.); (iii) existence of a unit/department responsible for transportation/traffic-related functions and number of technical staff; (4) annual budget (capital outlay, personnel, internal revenue, borrowings, grants, and internally sourced revenues); and (5) knowledge in transportation planning, in traffic engineering and management (TEAM), as well as their preferred topics.

(b) **Respondents:** The survey was answered by 48 respondents form the LGUs and five from MMDA (Table 1).

(c) **Level of Knowledge and Training Needs:** The level of knowledge of the respondents in the different areas and tracks of transportation planning and traffic engineering and management was assessed in three self-perception ratings: limited, some, and good. The responses were then converted to 0, 1, and 2, respectively, to quantify results. The training needs and the preferred topic of the respondents were also determined using a scale of 1 (highest priority) to 5 (lowest priority).

The survey among the LGUs showed the highest average score of 1.26—or most knowledge and experience—in transportation implementation, in particular, project prioritization, budgeting, etc. This was followed by communications planning (1.10) and land use and transportation planning (0.96). These results complement earlier findings that most LGUs have communications devices/tools and land use maps. On the other hand, transportation modeling using software (0.42), travel demand forecasting (0.65), and transportation system evaluation (0.82) recorded the lowest scores.

In terms of preferred training topics under transportation planning, transportation modeling using software (1.93) was the most preferred topic, followed by land use and transportation planning (1.94) and implementation planning (prioritization, budgeting, etc.) (1.98). Transportation modeling using software was the topic the respondents have the least knowledge of and the most preferred topic for training. Despite the indication of a high level of knowledge on implementation planning (prioritization, budgeting, etc.), this topic still ranked among the most preferred for training.

Regarding traffic engineering and management, knowledge on traffic management and enforcement were the topics with the highest average score (1.37), followed by traffic flow characteristics (1.13) and traffic impact assessment (0.94). These results also complemented earlier findings that most of the LGU and MMDA staff were dedicated to traffic enforcement. Meanwhile, the responses to traffic simulation (0.78), economic

evaluation (0.80), and data collection (0.82) recorded the lowest average scores.

Traffic management and enforcement (1.88) ranked as the most preferred topic for training, followed by traffic flow characteristics (1.95) and traffic impact assessment (1.97). Unlike in transportation planning where the most preferred topics for training were those in which the respondents had the least knowledge of, the topics that were deemed to be the respondents' strengths were still the most preferred training topics regarding traffic engineering and management. This could be due to the respondents' awareness that more knowledge could be learned through training.

3) Training Schedule

To meet the objectives of Pilot Project No.2, a training program, consisting of 11 modules, was developed. The training program started on 16 November 2021 and was initially scheduled to finish in February 2022 for a total of 19 days. However, due to the sudden surge in COVID-19 cases, the training program was suspended for two weeks. The program resumed on 3 February 2022 and was completed on 8 March 2022. Table 2 shows the final schedule of the training program.

Table 2: Schedule of the Training Program

Day	Date	Activity
1	16 November 2021	Opening Program, Orientation on the Capacity Building Program and Orientation on the use of Slack
2	23 November 2021	Modules 1 and 2
3	25 November 2021	Modules 3 and 4
4	2 December 2021	Modules 3 and 4
5	7 December 2021	Modules 3 and 4
6	9 December 2021	Module 2
7	14 December 2021	Modules 5 and 7
8	16 December 2021	Modules 5 and 7
9	11 January 2022	Modules 5 and 7
10	13 January 2022	Modules 5 and 7
11	3 February 2022	Modules 6 and 8
12	8 February 2022	Modules 6 and 8
13	10 February 2022	Modules 6 and 8
14	15 February 2022	Modules 6 and 8
15	17 February 2022	Module 6
16	22 February 2022	Modules 9 and 10
17	1 March 2022	Modules 9 and 10
18	3 March 2022	Module 10
19	8 March 2022	Module 11

Source: UP NCTS

4) Methodology

The UP NCTS training team, led by Dr. Ricardo Sigua and comprising local experts in transportation planning, traffic management, and traffic simulation, conducted the training program online via the Zoom platform. The training team used Slack, a messaging application which allows sharing of electronic files, in this case, presentation materials, submission of assignments, and practices by the participants, among other files.

Each lecture was usually followed by a discussion/question and answer session and a workshop/practicum. The participants posted questions on the Zoom chat panel or were asked directly to the resource person who answered the questions live.

5) Training Program

The table below shows the contents of each training module, as well as the objectives and duration.

Table 0.3: Contents of the Training Modules

Module No.	Module Title & Description	Learning Objective	No. of Hours
1	**Introduction on Strengthening of the Traffic Management Capacity of Local Government Units** This module covers the: (i) introduction of this pilot project, including objectives, scope, implementation schedule, and expected outputs; (ii) current traffic issues including traffic congestion; and (iii) basic understanding of traffic engineering and management in transportation planning.	• Know the objectives, scope, implementation schedule, and expected outputs of the capacity building (pilot project). • Have a common understanding of the situation, issues, and solutions related to traffic management in Metro Manila, particularly traffic congestion, based on data and scientific planning methodologies.	Lecture: 3
2	**Identification of Roads for Traffic Management** This module covers the: (i) selection of urban roads and road facilities for which LGUs are responsible for traffic management, (ii) classification of Metro Manila roads according to function, and (iii) digitalization of the road network by LGU and discussion on the elements of roads to initially prepare the LGU road inventory.	• Know the classification of Metro Manila roads according to function. • Understand the procedure of the selection of urban roads and road facilities for which LGUs are responsible for traffic management. • Be able to perform digitalization of the road network by LGU. • Know the different elements of roads to be included in an LGU road inventory.	Lecture: 2 Workshop: 7
3	**Definition and Identification of Traffic Congestion and Bottlenecks** This module covers the: (i) definition and promotion of a shared understanding of traffic congestion and bottlenecks in Metro Manila, (ii) analysis of traffic flow characteristics and problem identification, (iii) definition of road/intersection capacity and level of service, and (iv) identification of traffic bottlenecks.	• Understand traffic variables used in describing traffic flow. • Be able to perform basic traffic flow analysis about road/intersection capacity and level of service. • Understand traffic phenomena/events such as the occurrence of congestion and bottlenecks. • Identify factors contributing to congestion or the formation of bottlenecks.	Lecture: 4
4	**Traffic Control Devices** This module covers the: (i) role of traffic control devices currently introduced in Metro Manila such as traffic signals, various ICT tools, new traffic signs, traffic signals and ICT devices, markings, etc.; (ii) conditions and technical standards for application; and (iii) impact of traffic control.	• Identify the role of traffic control devices currently introduced in Metro Manila. • Be familiar with the Philippines and international standard road signs and pavement markings. • Pinpoint and identify traffic safety facilities being used on the roads.	Lecture: 4
5	**Intersection Design and Control** This module covers the: (i) typology of intersections, (ii) identification of elements/factors affecting intersection capacity, (iii) proposals on the inventory of intersections for assessment and identification of traffic bottlenecks, (vi) physical improvement measures, and (v) overview of issues on intersection traffic control and management.	• Understand the issues on the design and control of intersections and traffic management. • Be able to identify physical improvement measures in addressing the issues.	Lecture: 7 Practicum: 5

Module No.	Module Title & Description	Learning Objective	No. of Hours
6	**Corridor and Area Traffic Management** This module covers the: (i) identification of traffic problems that must be attended to as a corridor or area, and (ii) alternative solutions and coordination with the MMDA on such issues as roadside parking, one-way traffic, truck ban, PUV/PUJ stops, vendors, pedestrians, and bike lanes, among others.	• Be able to identify traffic problems along a corridor or area. • Be able to identify alternative solutions to improve traffic flow along a corridor or within an area.	Lecture: 4 Practicum/ Workshop: 5
7	**Traffic Simulation** This module covers the: (i) theories, possibility of, and constraints in simulation models; (ii) microsimulation of intersections; (iii) microsimulation of sub-areas; and (iv) possibility and constraints to traffic simulation.	• Be able to simulate intersections, areas, or localized networks to determine the impact of traffic management schemes on traffic flow.	Lecture: 6 Practicum: 8
8	**Transportation Impact Assessment** This covers the: (i) existing design guidelines, (ii) alternative improvement measures, and (iii) solutions to typical bottlenecks in Metro Manila.	• Know and be aware of transport/traffic impacts of proposed projects or developments. • Understand the possible role of TIA in alleviating urban traffic problems due to projects. • Learn about the fundamental scope of work and analysis involved in TIA.	Lecture: 12
9	**Road Safety** This module covers the: (i) methodologies of traffic impact assessment, (ii) key performance indicators, and (iii) case studies.	• Be able to analyze road crash data. • Be able to identify black spots. • Be able to identify countermeasures towards improving road safety.	Lecture: 5
10	**Need for Comprehensive Urban Transport Plan by Local Government Units** This module covers the: (i) availability of traffic accident data and their analysis, (ii) assessment of current traffic safety measures in Metro Manila, and (iii) experience of other cities in the world.	• Understand the key concepts and analytical methods in urban transport planning. • Appreciate the need for a comprehensive urban transport plan at the LGU level and the importance of aligning it with a Metro Manila-wide urban transport plan. • Review existing transportation data and models developed for Metro Manila including the 2010 High Standard Highway and its update, 2015 MUCEP, and 2014 Roadmap Study and its update. • Develop practical knowledge and skills in implementing the basic four-step transportation model using Cube, a travel demand modeling software.	Lecture: 5 Practicum: 16
11	**Wrap-up** This module covers the: (i) transportation/traffic characteristics and issues facing LGUs, (ii) scope of comprehensive transportation planning in LGUs, and (iii) role of traffic management in transportation planning.		Panel Discussion: 3
Opening Program, Pre-test, Post-test, Evaluation, Closing Program and Graduation			5

Source: UP NCTS

6) Participants

Participants to the training program are from the 17 Metro Manila LGUs, from transportation-related government agencies (DPWH, DOTr, and MMDA), and the local technical staff from the JICA Project Team. Table 4 provides a summary of the number of participants by LGU / agency. Of the 53 participants, 49 satisfactorily completed the course, while the rest were awarded with certificates of completion and attendance.

Based on the evaluation of the training by the participants, it would seem that there was a preference for a more detailed training in other modules such as traffic impact assessment and traffic management planning, among others.

Table 4: Number of Participants

LGU / Agency	No. of Participants
1. Caloocan	3
2. Las Pinas	2
3. Makati	5
4. Malabon	3
5. Mandaluyong	5
6. Manila	2
7. Marikina	2
8. Muntinlupa	4
9. Navotas	2
10. Paranaque	1
11. Pasay	2
12. Pasig	4
13. Pateros	1
14. Quezon City	6
15. San Juan	4
16. Taguig	4
17. Valenzuela	3
18. DPWH	5
19. DOTr	6
20. MMDA	28
21. Project Staff	4
Total	**96**

Source: UP NCTS

7) Deliverables

To reach a wider audience, the training team stored the teaching materials in audio-visual format, PowerPoint, and Word. These are shown in Technical Report No. 9.

APPENDIX K

Pilot Project No.3: Development of a Traffic Management Database

APPENDIX K

Pilot Project No.3: Development of a Traffic Management Database

1 BACKGROUND AND OBJECTIVE

The CTMP Project confirmed that there is insufficient data related to roads and traffic, and that it will benefit MMDA and the LGUs if a comprehensive database is established to help in traffic management planning.

1.1 Objectives

This pilot project has the following objectives:

(i) To define the concept of a comprehensive database that will contribute to the overall traffic management in Metro Manila and help establish cooperation among MMDA, LGUs, DPWH, and DOTr in traffic management planning;

(ii) To create a database on basic data necessary for traffic management, focusing on roads in which MMDA should be responsible for; and

(iii) For the JICA Project Team to make recommendations on the institutional and technical requirements of updating this database since the database to be created in this project needs to be updated periodically after the completion of the project and will need supplementary studies

1.2 Activities

To cooperate with DOTr, DPWH, MMDA, LGUs, CPT meetings had been held to explain the database concept, database utilization, and methodology of database development. Pilot Project 3 activities are described below.

(1) Meetings for Database development

Table 1.1: Activities of the Pilot Project

CPT Meeting No.	Date	Description
104	April 16, 2020	• Waze dashboard update
114	July 2, 2020	• Updates on the dashboard
123	September 17, 2021	• Concept, benefits, utilization of database • About the data ""primary"" and "secondary" database which compose the database. Data items such as the basic information, road geometry elements, infrastructure, regulatory, among others, are introduced. • Inventory database and survey methodology
128	October 15, 2021	• Discussion of AIM (Asian Institute of Management) MS Data Science Capstone and TSOMD Proposal • AIM (Asian Institute of Management) MS Data Science Capstone Project by MMDA and TSOMD Proposal • Discussion of AI database
129	October 29, 2021	• Concept of corridor database and data preparation, how to utilize the database for traffic management.
132	November 26, 2021	• Updates on the Waze dashboard and demonstration of the Web App Dashboard. • Discussion of the continuous database maintenance (Waze)
135	December 20, 2021	• Progress of inventory database development. • The structure of the primary, secondary, and the data that consists of inventory survey, among others.

CPT Meeting No.	Date	Description
		• Relationship with macroscopic demand forecast. • The detailed methodology and examples that reflect on the traffic management plan from using the database. • The detailed item lists of primary inventory data.
141	March 4, 2022	• Formation of the database development in MMDA and related agencies
142	March 11, 2022	• Introduction of inventory survey by SRDP • Inventory survey methodology, data items, data structures, etc.
143	March 18, 2022	• Visualization of result of inventory survey • Presentation of the physical information of the road facility based on inventory survey, and the orientation of analysis based on it are explained.
145	April 1 2022	• New Corridor Sheet Format and Road Inventory Database • The changes in the corridor analysis sheet format, and the orientation of analysis based on them are explained.
Individual	April 29, 2022	• Training for Corridor Analysis • Based on corridor analysis sheet, methodology of the development is explained. • Asked MMDA to update the inventory survey data and corridor analysis sheets
147	May 6, 2022	• Confirmation progress of Corridor analysis sheets by MMDA
148	May 20, 2022	• Confirmation progress of Corridor analysis sheets by MMDA
150	June 29,2022	• Updates on corridor analysis sheets
151	July 15, 2022	• Updates on corridor analysis sheets • Orientation on Strategy 8
Individual	August 10, 2022	• The introduction of Database development
Individual	September 28, 30, 2022	• Database training

Source: JPT

(2) Database Training

The database training was conducted on September 28, 30, 2022which focused on the bottle neck database, corridor database, Waze dashboard, inventory survey, enforcer opinion survey, and active transport. The agenda is shown below.

Table 1.2: Schedule for Database Training

Date	Day	Topics	Description	Hrs	Time
Sep 28 Wednesday 8:30am-3:00pm Venue: 2F Manila City Room	1	Introduction	Objectives, Topic Outline, Outputs, Definition of terms	0.17	8:30am–8:40am
		Road Classification	Classifying Class A, B, C, and D Roads	0.33	8:40am–9:00am
		Road Inventory	Identifying and measuring attributes	0.5	9:00am–9:30am
		Corridor Profile	Dividing the corridor, grouping the segments, inputting data into Excel, taking map photos, and compiling into a PPT file	2	9:30am–11:30am
		Lunch Break			11:30am–12:30pm
		Corridor Database	Loading the style files, using the layout manager in QGIS, and compiling into a PPT file	2	12:30pm–2:30pm
		Waze Travel Speed Dashboard	Explaining the dashboard and exporting CSV files	0.5	2:30pm–3:00pm
		Determination of LOC Criterion	Determining speed ranges and LOCs per road class		
Sep 30 Friday 8:30am-3:00pm Venue: 2F	2	Waze Travel Speed Data (LOC Map)	Converting Speed data to LOC and loading it in QGIS	2	8:30am–10:30am
		Identification of TBNs (Intersection,	Identifying TBNs based on criteria per category and naming them	0.5	10:30am–11:00am

Date	Day	Topics	Description	Hrs	Time
Manila City Room		Segment, Area)			
		Data Collection	Describing the TBNs' location, geometry, volume, speed, queue, and factors of congestion; Filling out the datasheets; and long-listing TBNs	1	11:00am-12:00nn
		Lunch Break			12:00nn-1:00pm
		MS Access	Encoding and editing TBN longlist	0.5	1:00pm-1:30pm
		Prioritizing Major Intersection TBNs	Determining severity of LOC and queue length	0.25	1:30pm-2:00pm
		Factors of Congestion & Countermeasures	Identifying FOCs and countermeasures	0.25	
		Space-Time Table	Visualizing space-time table in Excel and QGIS	0.5	2:00pm-2:30pm
		Wrapping up	Finalizing workshop outputs	0.5	2:30pm-3:00pm
Oct14 CPT Meeting	3	Presentation	Presenting trainees' outputs	2	9:00am-11:00am
		Closing Remarks		1	11:00am-12:00nn
		Awarding of Certificates			

Source: JPT

1.3 Current Situation

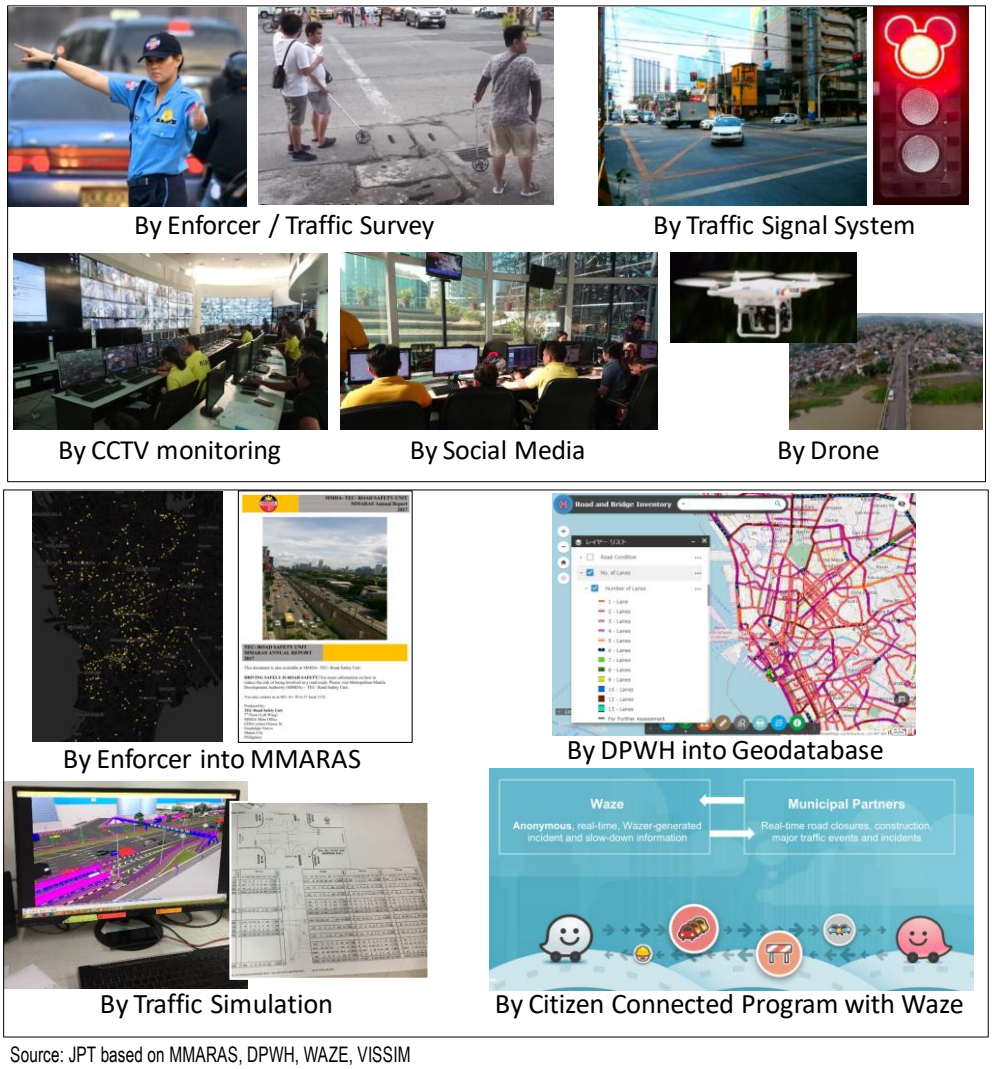
Before starting the study, the MMDA required specific data such as traffic survey data, traffic counter data, intersection plan, and road facility layout since these are used for signal introduction and road and intersection improvement.

The traffic survey result data is stored at each department in charge after the road improvement / intersection improvement, signal introduction / improvement and measurement are conducted by the vehicle detectors. After which, these data can be used as needed. However, it must also be noted that the observation items, observation hourly time, and seasonal timing of the data are not same. Regardless of the variety of traffic analysis using these data, the consistency is still not enough. Moreover, when the data is stored in Microsoft Excel and managed by the department in charge, these are not shared with other departments.

The traffic counter data is collected by the MMDA-controlled transportation facility improvement project. The project plans to introduce and/or replace new detectors since half of these are already not operating. Furthermore, some lane data are applied to all lanes. Intersection plan and road facility layout map data are created by implementing projects wherein the MMDA-managed roads have stored drawing data based on the implementation of the past projects.

As for the latest traffic conditions and traffic regulations, information is collected onsite by the staff through a telephone, and there are many items that are not left in the records to be kept. In addition, the situation onsite is changing day by day, and it is unclear what the other related organizations (DPWH, DOTr, companies, etc.) and departments are doing in a specific road. For this reason, it is sometimes unclear where the discussion with MMDA is based on.

MMDA contracted with the Waze of citizen connected program, which can collect and use Waze speed data. However, the data is not being used for current MMDA works and is only collected, not stored. Hence, the data is not utilized much.



Source: JPT based on MMARAS, DPWH, WAZE, VISSIM

Figure 1.1: Types of Data Held by MMDA

When the data is used as described from the previous section, it is collected and analyzed for business execution depending on the direct instructions from the supervisor. It is also carried out within a predetermined range rather than for higher purposes. For this reason, the data collection and results are done for internal use only, according to the supervisors in the section. This makes it difficult for the entire organization to collaborate to other sections and create new ideas based on the data and knowledge management

1.4 Corresponding Future Transportation Plans

Currently in the Philippines, roadmap 2 (Supplementary Survey on Transport Roadmap Creation Support Study for Sustainable Development of Metro Manila, 2019) and local transportation plan, Build! Build! Build policy, are being considered. Based on the counterpart information, large-scale highway construction and public transportation will be constructed. NS Connector Expressway and Skyway Stage 3 will be built in 2021 and MRT7 and North-South Commuter Line (Malolos-Tutuban) will follow in 2023. Furthermore, the common stations, LRT1, MRT3, MRT7, will also be connected to the North Avenue Station. When such large-scale transportation facilities are constructed, the congestion on existing roads will be reduced, while the traffic concentration will occur at highway interchanges. The public transportation will also be concentrated at the construction site of the new station. Since the existing traffic will significantly change, there is a possibility that a place

recognized as a bottleneck will not be congested, and the traffic may concentrate in an area where it was not congested before. By constantly monitoring the current traffic situation, it is possible to recognize changes in traffic jams and their new locations, and immediately resolve the traffic bottlenecks. As a result, this will reduce any economic loss due to traffic jams. In addition, it is important to carry out traffic management by deciding priority points for traffic jams that are expected to occur in the future.

Furthermore, in the future action plans that the MMDA will formulate, it is necessary to consider the planning of traffic measures that has not been dealt with, so far, and to take into consideration the other aspects related to traffic planning.

1.5 Existing Database

MMDA will handle the following data where almost all are managed under related department of regular work. Since there is no comprehensive database, the utilization for traffic management planning is limited.

Table 1.3: Existing Database

Categories	No.	Database Name	Typical kind of Data	Department in Charge
Planning / Designing	1	Traffic Survey Count	Traffic Movement Count, Pedestrian Count and travel time	Traffic Engineering Center (TEC)
	2	Design and plans	Pavement marking design, traffic signal design and traffic signages	
	3	Road Diggings	Permits and schedule for excavation and roadworks	
	4	Volume-Capacity Ratio and Level of Service (LOS)	V/C ratio of intersections and its corresponding LOS	
	5	Vissim and Vistro	Simulation results and formulation of phasing and timing parameters	
	6	Completed list of MMDA footbridges	Date of construction and actual number of pedestrians using the footbridge (Before and after)	
	7	Bus Management Dispatch System (BMDS)	Date/Time of Dispatch, Route, Name of Driver, Birth date, License Number Company Name, Plate Number, Hourly Dispatched Report, Dispatched Count Report, Apprehension Inquiry, Status	Bus Management Dispatch System
	8	Operation and monitoring of traffic signal	Existing phasing and timing of traffic lights	Metrobase - TEC
	9	Computer Aided Dispatch	Incident monitoring report, Metrocall 136 logs	
	10	Digifort	Video recordings	
	11	NUUO	Video recordings	
	12	ShoreTel	Voice call recordings	
	13	Metro Manila Accident Reporting Analysis System (MMARAS)	Location of Accident, Classification, Weather Situation, Collision Type, Details of Vehicles involved	Road Safety Unit
	14	Effective Flood Control Operation System (EFCOS)	Rain Fall, Water Level, Gate Operations, Location	Flood Control Information Center
	15	Metropolitan Road Rules Enforcement System (MRRES)	Last Name, First Name, Birthdate, License Number, Plate Number, Place of Apprehension, Date of Apprehension, Type of Violation, Ticket Number	Traffic Ticket Management Division
Other organizations	16	MMDA- LTO Interconnectivity (Driver)	Last Name, First Name, Birthdate, License Number, Plate Number, Place of Apprehension, Date of Apprehension, Type of Violation, Ticket Number	Traffic Ticket Management Division
	17	MMDA- LTO Interconnectivity (Plate Number)	Last Name, First Name, Birthdate, License Number, Plate Number, Date of Apprehension, Type of Violation, Ticket Number	Traffic Ticket Management Division
	18	No Contact Apprehension Policy (NCAP)	License Number, Plate No., Location, Violation	No-contact Apprehension Policy

Source: JPT

1.6 Identified Issues

Because of the issues described above, MMDA has departments that carry out a series of processes from planning to maintenance, such as the Planning Department, Engineering Department, Traffic Regulation Department, Data Management Department, Vissim Simulation Department, and Maintenance Management Department. In order to improve the current traffic management capabilities, the first step is to identify the congestion bottlenecks to be addressed by the MMDA, as well as the countermeasures, traffic management policies, effect measurement, and the follow-up after implementation. In the current situation, it is necessary to create a mechanism that allows the entire organization to cooperate.

For this purpose, a database that collects information of departments currently scattered in the MMDA must be necessary and shared throughout the MMDA. In the next step of formulating an action plan within MMDA, it is crucial to create not only bottleneck congestion countermeasures but also a wide range of policies that will leads to new traffic management policies and traffic plans. Cooperation with other organizations such as DPWH, DOTr and LGUs, road users and private companies is also necessary. For this reason, it is an urgent task to consolidate data with a view to data sharing of other organizations, and to build a database system that collects data to be shared and explained with other organizations by performing MMDA operations.

1.7 Database Concept

The requirements for the development of database are the following.

(i) The databases which will be used for regular work should be collected and updated continously. These will be called the “Primary data”. Utilizable data for planning is preferable rather than raw data.

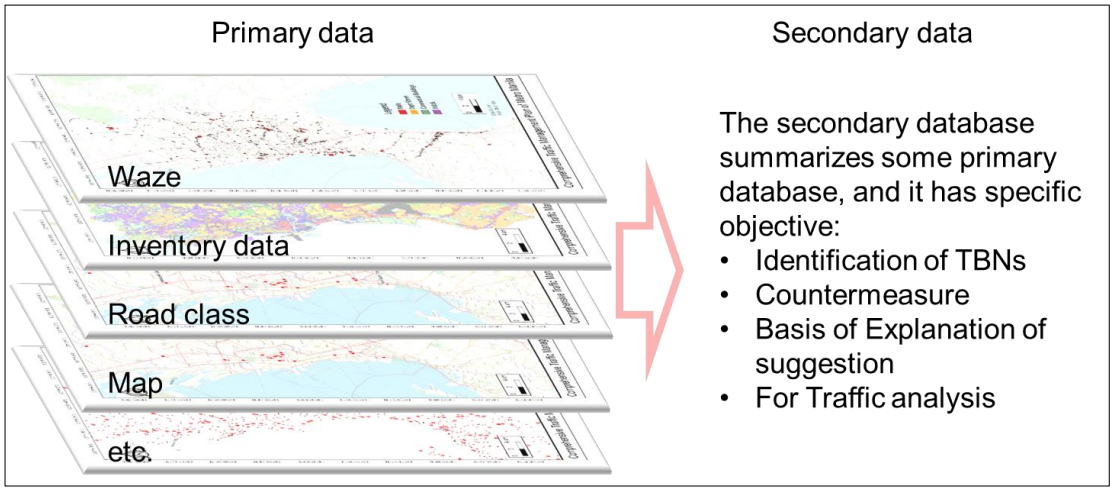
(ii) The databases which will be used for a specific objective, e.g. identification of bottleneck etc., should be developed and updated continously. The database can be utilized for the planning side and will be called the “Secondary database”

(iii) These databases can be checked on the GIS system wherein the material based on data can be sharable and evidensable for the planning side.

The concept figure is shown below. The platform based on GIS and the above database can be shared with others, if necessary, and can strengthen the coordination within MMDA and inter agencies. For example, traffic volume, opinion survey by enforcers, and Waze data are collected for the identification bottle neck work. The reason of congestion and the evidence of countermeasures can be shared within MMDA so that, the identification of the reason of congestion or the efficient countermeasures can be analyzed more deeply.

Primary Data to be Collected Regularly and Institutionalized:	Secondary Data to be Processed for Specific Purposes
• Road inventory of all classes of Roads • Congestion level: Waze Dashboard • Traffic volume counts (vehicles, pedestrians) • Traffic accidents data • Environment data: CO_2, SPM, NO_X • Flood condition data • Large-scale development • Roadside parking	• Identification of TBNs • Signal retiming • Traffic regulation/ control and enforcement • Identification of black spots • Traffic circulation / rerouting • Others depending on needs

* Red: Real-time data in future -> Historical data for planning



Source: JPT

Figure 1.2: Database Concept

2 PRIMARY DATABASE

The primary database is a single data, and it should be updated regularly. The list of data is shown in Table 2.1. These primary data are used for the secondary database or regular works. The list of data below should be changed by MMDA in the future, if necessary.

Table 2.1: Primary Data

Primary Data	Update Frequency	Tentative Main Responsibility	Status
• Road inventory of all classes of Roads	Annual Every time there is a new/ upgraded road	TBD	JPT will hand over the prototype to MMDA
• Congestion level: Waze Dashboard	Annual	TBD	JPT will hand over to MMDA
• Traffic volume counts (vehicles, pedestrians)	Annual 2 times / year preferable	TBD	TBD
• Traffic accidents data	Annual	PNP, Road Safety Unit Waze	TBD
• Environment data: CO2, SPM, NOX	Annual	TBD in MMDA DENR etc.	TBD
• Flood condition data	Annual	TBD in MMDA Waze Mines and Geosciences, DENR	TBD
• Large-scale development	Annual	OAGMP	TBD
• Roadside parking	Annual	TBD in MMDA LGU, etc.	TBD
• Enforcer Opinion Data	Annual	TEC	TBD
• Public transport information • LPTRP	Regularly	TBD in MMDA DOTr/ LTFRB	TBD

Source: JPT

2.1 Road Inventory of All Classes of Roads

The road inventory data includes the physical information of a road facility. Mapilliary, a road-user view service which can see street-level images, can be used to input the data that can calculate the situation based on the road network made from Open Street Map data. In this study, the survey works is covered by outsourcing. After which, MMDA should update the inventory surveyed data for the new and updated road section annually.

(1) Inventory Data for Road Section

An inventory data for road class A to E for traffic management classification is suggested in this study. Although the DPWH has a similar database, it is not for traffic management since the available road class information is limited and the data items are only restricted to other agencies. Hence, a new inventory database is necessary. The inventory data has two types: the section and intersection type. This study will hand over the section type only. Since there are various traffic management organizations, the coordination of LGU, DPWH, and expressway companies is necessary to develop the data from class A to E.

See technical report on “Inventory data”, for the details of the inventory data.

(2) Inventory Data for Intersection

Inventory data for intersection is shown in the table below. The intersection inventory data is assumed to be stored in each link connecting the intersection. Data items which are similar with the section inventory data, the traffic facilities near the signals and intersections, and lanes and pedestrian facilities are also included.

Table 2.2: Intersection Inventory Survey Data Items

Data Items			Example	Format
Node Code			ex) NA001	String (10 digits)
Leg No			ex) 1	Integer (2 digits)
Connected link Code			ex) LA001	String (10 digits)
Type of Intersection	Structure (P: Plain, U: Underpass, F: Flyover)		ex) P	String (1 digits)
	Interchange (Yes/ No)		ex) Yes	String (1 digits)
	Total Legs (Number)		ex) 4	Integer (2 digits)
	Pavement Type (A: Asphalt, C: Cement/Concrete, G: Ground)		ex) A	String (1 digits)
	Pavement condition (1: poor 2: acceptable 3: good)		ex) 1	Integer (1 digits)
Railway	Line		"LRT 1", "LRT 2", "MRT 3", "PNR"	String (15 digits)
	Structure (N: None, E: Elevated/ G: At grade)		ex) E	String (1 digits)
	Station		ex) Buendia	String (15 digits)
Approx. Size of Intersection (m2)			ex) 30.00	Real (6 digits and the 2nd decimal places)
Begin of Observation Point	Longitude		ex) 14.562519	Real (10digits and the 6th decimal places)
	Latitude		ex) 121.043057	
End of Observation Point	Longitude		ex) 14.563837	
	Latitude		ex) 121.044271	
Intersection point (1: Begin Node, 2: End Node)			ex) 1	Integer (1 digits)
Cross-Section	Total Width (m)		ex) 30.00	Real (6 digits and the 2nd decimal places)
	Sidewalk Width (1st direction) (m)		ex) 2.50	Real (6 digits and the 2nd decimal places)
	Bike lane Width (1st direction) (m)		ex) 0.00	Real (6 digits and the 2nd decimal places)
	Carriageway Width (1st direction) (m)		ex) 10.00	Real (6 digits and the 2nd decimal places)
	Number of lane (1st direction)		ex) 2	Integer (2 digits)
	Median (m)		ex) 5.00	Real (6 digits and the 2nd decimal places)
	Carriageway Width (2nd opposite direction) (m)		ex) 10.00	Real (6 digits and the 2nd decimal places)
	Bike lane Width (1st direction) (m)		ex) 0.00	Real (6 digits and the 2nd decimal places)
	Sidewalk Width (2nd opposite direction) (m)		ex) 2.50	Real (6 digits and the 2nd decimal places)
	Number of lane (2nd opposite direction)		ex) 2	Integer (2 digits)
Traffic Signal	System (Name of manufacturer)		ex) Company A	String (15 digits)
	Year Installed		ex) 1999	Integer (4 digits)
	Retiming-year		ex) 1999	Integer (4 digits)
	Future Improvement Plan (Yes/ No)		ex) Y	String (1 digits)
	ICT Equipment (Yes/ No)		ex) Y	String (1 digits)
	Pedestrian (Yes/ No)		ex) Y	String (1 digits)
Lane Arrangement	Lane Marking Condition (1: poor 2: acceptable 3: good)		ex) 1	Integer (1 digits)
	Left-Turn Marking (Yes/ No)		ex) Y	String (1 digits)
	Right-Turn Marking (Yes/ No)		ex) Y	String (1 digits)
	Exclusive Left-Turn lane (Yes/ No)		ex) N	String (1 digits)
	Exclusive Right-Turn lane (Yes/ No)		ex) N	String (1 digits)
Pedestrian Facilities	Bridges (Yes/ No)		ex) Y	String (1 digits)
	Crossings (Yes/ No)		ex) Y	String (1 digits)
	Signals (Yes/ No)		ex) Y	String (1 digits)
Public Transport	Bus Stop (Number)	with Shelter	ex) 1	Integer (2 digits)
		without Shelter	ex) 1	Integer (2 digits)
	PUJ Stop (Number)	On-street	ex) 1	Integer (4 digits)
		Off-street	ex) 1	Integer (4 digits)

Data Items			Example	Format
	PUB Stop (Number)	On-street	ex) 1	Integer (4 digits)
		Off-street	ex) 1	Integer (4 digits)
Traffic regulation	PUV Loading/ Unloading (Yes/ No)		ex) Y	String (1 digits)
	Parking Prohibition (N: No, if Yes, AM/PM Hour should be described)		ex) N	String (1 digits)
	Load/ Unload Prohibition (N: No, if Yes, AM/PM Hour should be describe)		ex) 6AM–9PM	String (9 digits)
Roadside Land Use	Commercial (roadside shop or small) (Y: Yes/ N: No)		ex) Y	String (1 digits)
	Commercial (medium or shopping mall) (Y: Yes/ N: No)		ex) N	String (1 digits)
	Industrial (Y: Yes/ N: No)		ex) Y	String (1 digits)
	Residential (Y: Yes/ N: No)		ex) Y	String (1 digits)
	Hospitals (Y: Yes/ N: No)		ex) N	String (1 digits)
	Schools (Y: Yes/ N: No)		ex) N	String (1 digits)
	Entry/ Exit of Buildings (Yes/ No)		ex) N	String (1 digits)

Source: JPT

2.2 Waze Dashboard

The Waze speed data is stored. The data from Waze dashboard is necessary for the raw data, which MMDA can get through outsourcing. The data can be collected regularly and the congestion information can be used for a variety of traffic management works. If the other agencies have the approval from the MMDA, they can also see the Waze dashboard. It is an important tool to implement in the traffic management of the whole Metro Manila.

See technical report “Waze Data Dashboard and User Manual”. It shows the details of the inventory data.

2.3 Traffic Volume Counts (Vehicles, Pedestrians, etc.)

The traffic count data is stored. Vehicles, pedestrian, non-motorized transport, and all land transportation should be covered. It is also important not only for the project area, but also for the road sections and intersections, it is important that the data collection must be conducted constantly to know the variety of indices, congestion loss, climate change gas emission vehicle-km easily. Based on these, a variety of evaluation will be available like active transport, new project, visualization of traffic management, and congestion management.

(1) Vehicle Counting Data

Vehicle traffic count is necessary to know how much the volume is in Metro Manila. Currently, the traffic count location is changed because it is being conducted in a project. Therefore, the time series fluctuation and traffic situation cannot be understood comprehensively. In the long run, the installation of the AI camera is expected to automatically count the volume. These devices contribute in monitoring the traffic situation and evaluating traffic management. The sites of traffic counting are classified into two types, the section volume and the intersection movement counting. These are used for the following objectives.

(i) To evaluate the traffic policies and compare the before and after results;

(ii) To compare the traffic indices of the traffic on the day of an event, seasonal fluctuation, and special situations (election, special holiday etc.);

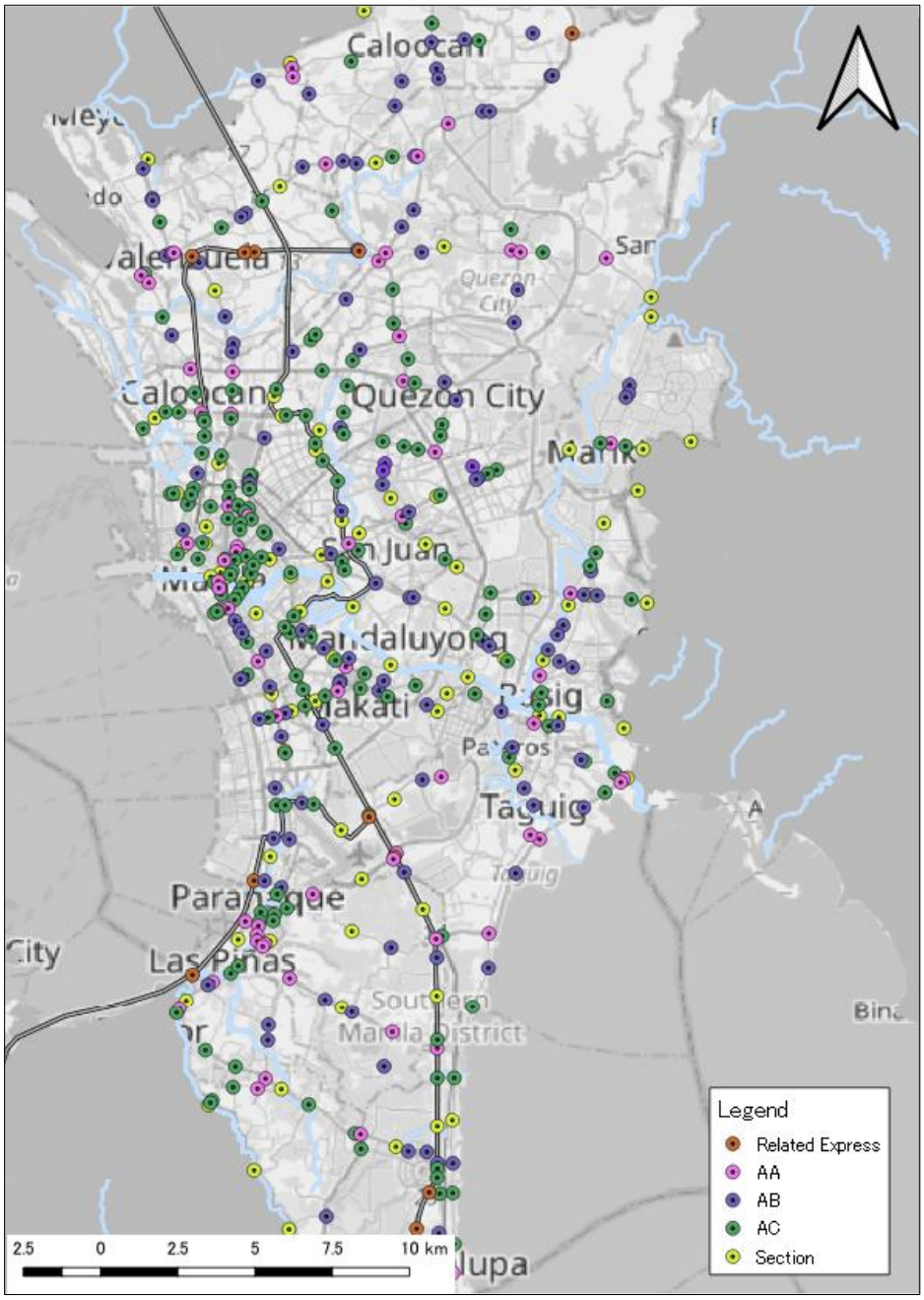
(iii) To determine the traffic indices to know the time series tendency for traffic congestion loss, congestion, and CO2;

(iv) To measure the estimated congestion;

(v) To calculate the congestion loss; and

(vi) To improve the accuracy of traffic model (macroscopic/ microscopic) for the evaluation of the project

A Class A road, as the study suggested, is expanded from the current situation. Therefore, the traffic monitoring locations should also be expanded the same way. Assuming there are automated traffic count locations at the intersection crossing class A, the 461 locations shown in Figure 2.1 are estimated. The locations should be prioritized in the installation, and in the first step, the database and management system of the traffic counted data is necessary.



Source: JPT

Figure 2.1: Vehicle Traffic Count Site (Draft)

(2) Pedestrian Traffic Data

In 2022, active transport is a modern strategy to conduct a traffic policy due to the spread

of COVID-19. The active transport picked up the modal shift to pedestrian and bicycle. These non-motorized vehicles are high demand for short trip length, residential roads, and public transportation nodes. However, the database of these modes is only for limited use. The current situation, issues, countermeasures, and the evaluation of the project are necessary for pedestrian counting and data analysis.

2.4 Traffic Accidents Data

The traffic accident information is stored. Generally, the reason of accident, type of injury or death, accident case, location (longitude, latitude), transport mode, etc. are collected. However, only some parts of the data are gathered in the current situation. If available, the countermeasures to reduce the number of accidents can be utilized for the planning of traffic safety.

Currently, MMRAS database stores traffic accident data in MMDA and an annual report is developed for related accidents. However, the database doesn't record the exact location of the accident and the detailed reason. These cannot be used to suggest the countermeasures.

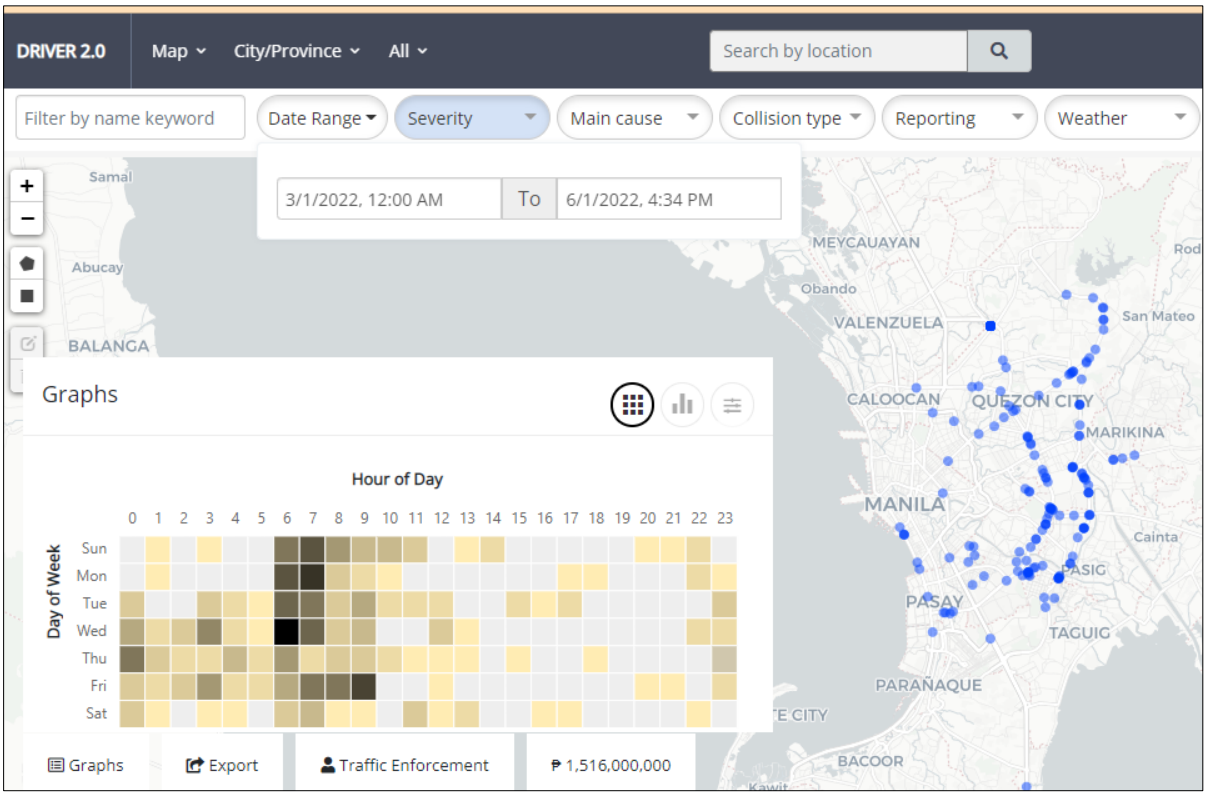
Therefore, upgrading of MMRAS system is necessary. Based on it, the utilization of the accident data should be confirmed. It needs other related agencies, budget, accident analysis, and suggestions of countermeasures. These works could contribute to the improvement of traffic safety facility in Strategy 6.

The figure below shows the DRIVER data which can specify the black spots. The figure can also indicate the time distribution and place distribution. Listed below are the following analyses that can be done using GIS data.

(i) Understanding the reason of accident-prone location;

(ii) Accident characteristics of traffic speed and physical facilities; and

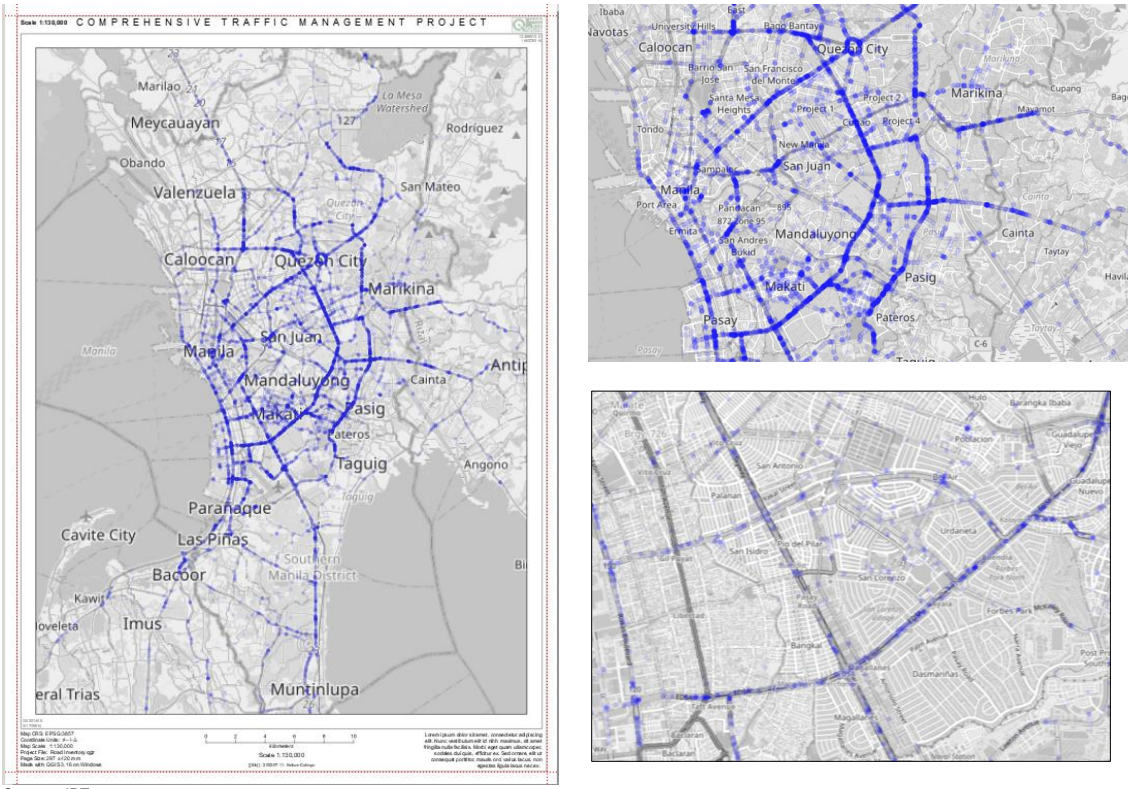
(iii) Effect of enforcement, verification of reduction of accident with/without traffic facilities (e.g., signal, pedestrian walkway, separation between vehicle and pedestrian, etc.)



Source: DRIVER

Figure 2.2: Black Spots Data Based on the DRIVER

Waze data can also get the post event data of the accident. Accident post data are the accidents that the road users confirmed and posted. The location with many posted data indicate that the accident attracts many road users, but the accident data can be recorded in one data with the reason of accident, meaningful is different from the accident data. However, the data can utilize the location. For example, a key area for accident countermeasures can be used during the improvement of MMARAS system.



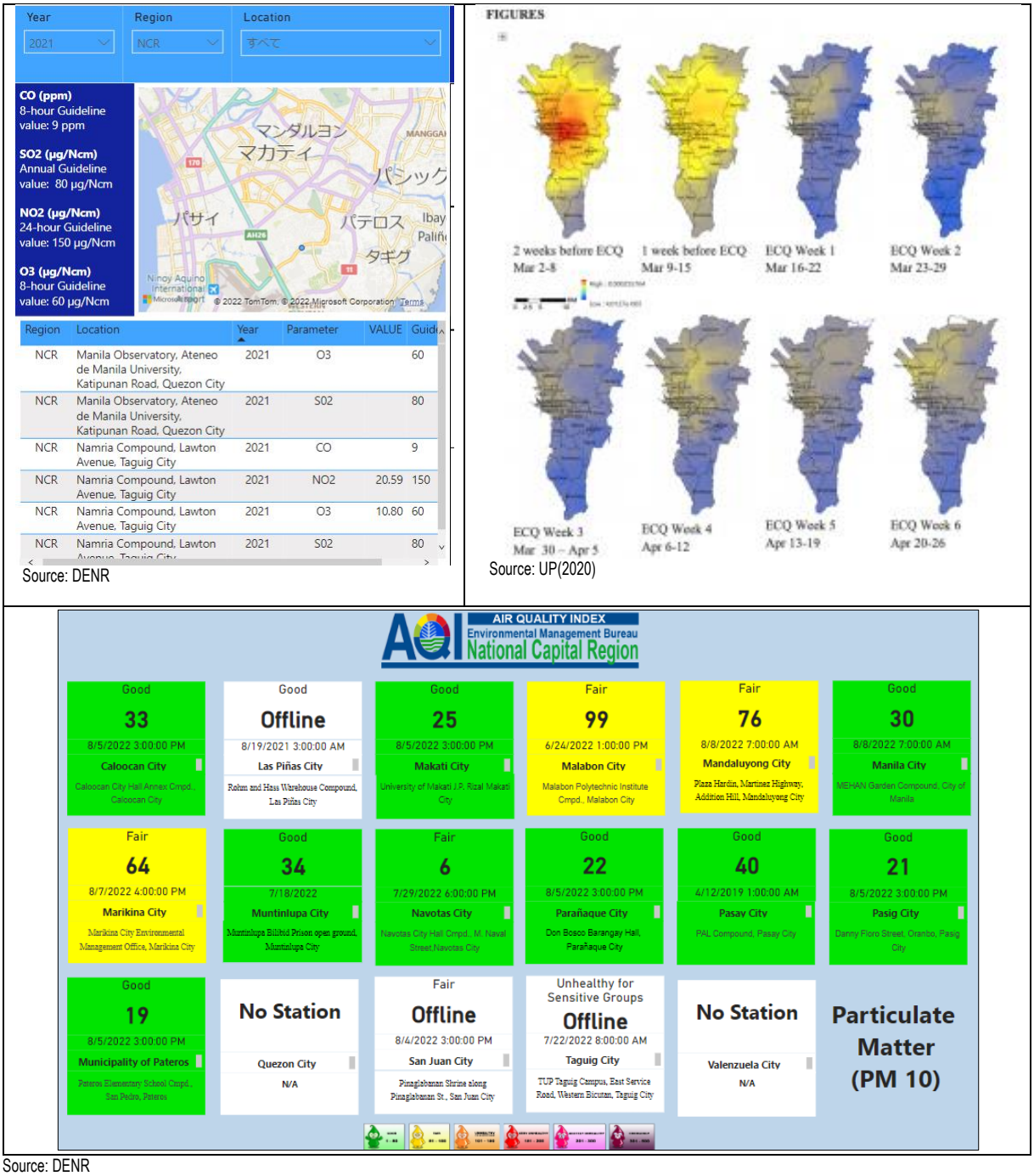
Source: JPT

Figure 2.3: Accident Posted Data for 1st January, 2019 to 15th

2.5 Environment Data (CO2, SPM, NOX)

The concern for the environmental aspect is increasing. However, in Metro Manila, there is not enough data to measure the factors used in evaluating the environment aspect, etc. Therefore, a database in the future must be required.

The climate change-related data in Metro Manila is not detailed so these data cannot be used to describe the relationship between the environmental data and the traffic management aspect. Currently, the MMDA doesn't regularly monitor these environmental data independently. These are managed by DENR-EMB wherein they are monitoring the air quality level from 11 sites and the indices are published on the web site. The monitoring of environmental data is important in learning the impact of transportation project especially since the interest in climate change is increasing, and related the agencies are expected to collect the data.



Source: DENR

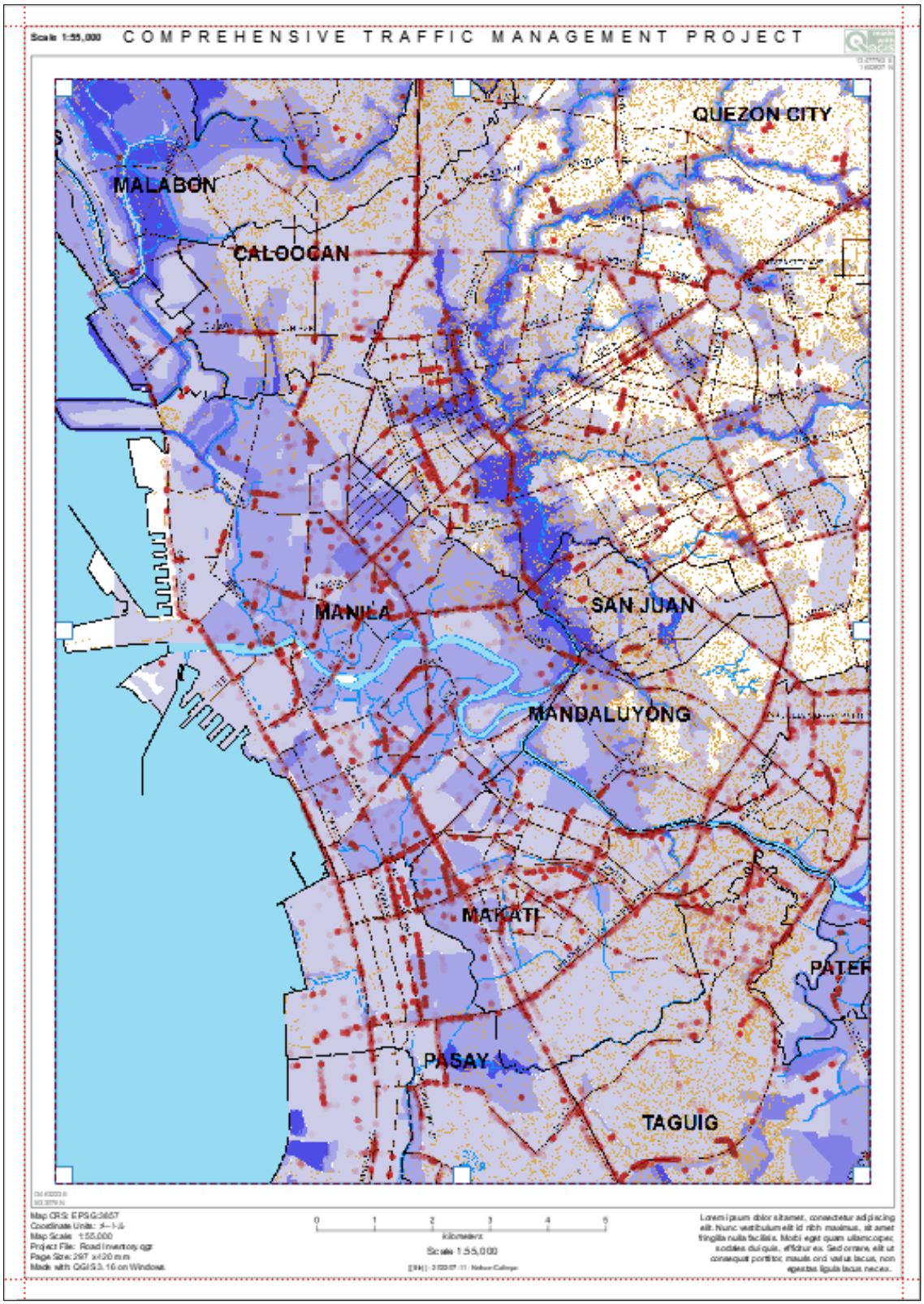
Figure 2.4: Air Quality Data

2.6 Flood Condition Data

There are many flood areas in Metro Manila and it generates the closure of sections resulting to the unavailability of pedestrian movement. For these corresponding sections, traffic enforcers assist in passing, but this solution is not that effective. Regarding general disasters, the estimation cost, evaluation project, and check the efficiency to be corresponding before/during/after of such disaster have many improvements.

Although the flood condition data is not available currently, the Waze data can generate the posted data as a Weather Hazard which includes the exact locations. The data is posted when the user sees the hazard posted, high dense areas attract more road users, and

which can also have a large effect. Since getting the flood data would take much time, during it , the MMDA can utilize these posted data, and the planning to reduce the flood area and the traffic management under the flood can be planned.



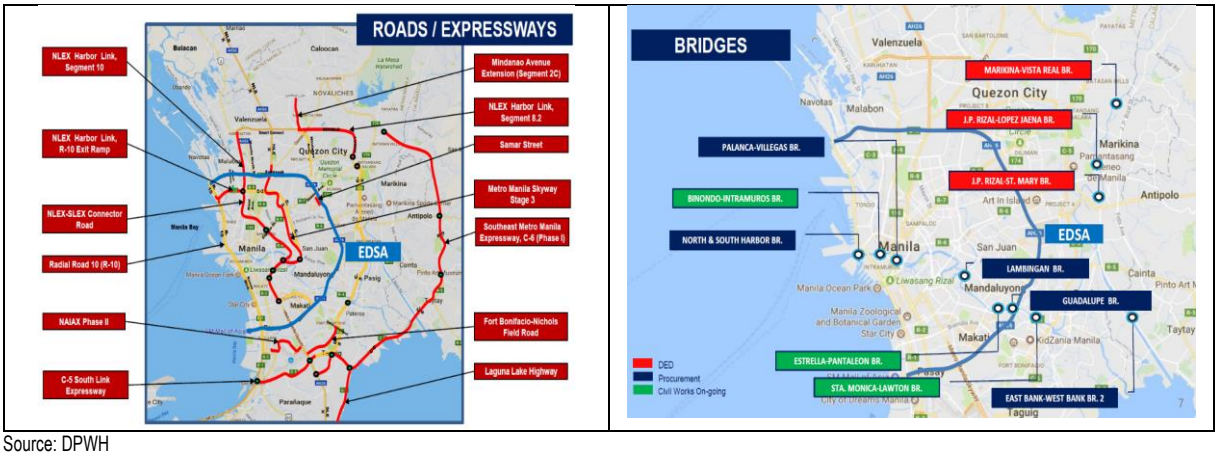
Source: Hazard data, Mines and Geosciences Bureau (MGB) (2013), Waze (2019 data)

Figure 2.5: Water Hazard (Blue) and Waze Weather Hazard Post Data (Red)

2.7 Large-scale Development

In the future, Build! Build! Build! Program should be implemented to ease the traffic congestion. Once the total effect is confirmed, the local congestion is generated. If an existing signal setting is not optimized after the project implementation, it should also be improved based on the project information. The progress of a large-scale development information is provided from a list or a ppt based, but this cannot provide information on how the traffic situation will change and what must be adjusted in the signal settings. The project owner should provide such information and the MMDA must consider the necessity of traffic management changes based on the information.

After a large-scale development project, the owner should work on the traffic management around the area, but the changed traffic situation can also influence other areas. Therefore, MMDA and the LGU need to adjust the traffic regulation and signal setting in their area based on these changes. In easing the new congestion, the large-scale development cost should also allot several percent for the additional traffic management cost for MMDA and the LGU by several percent.



Source: DPWH

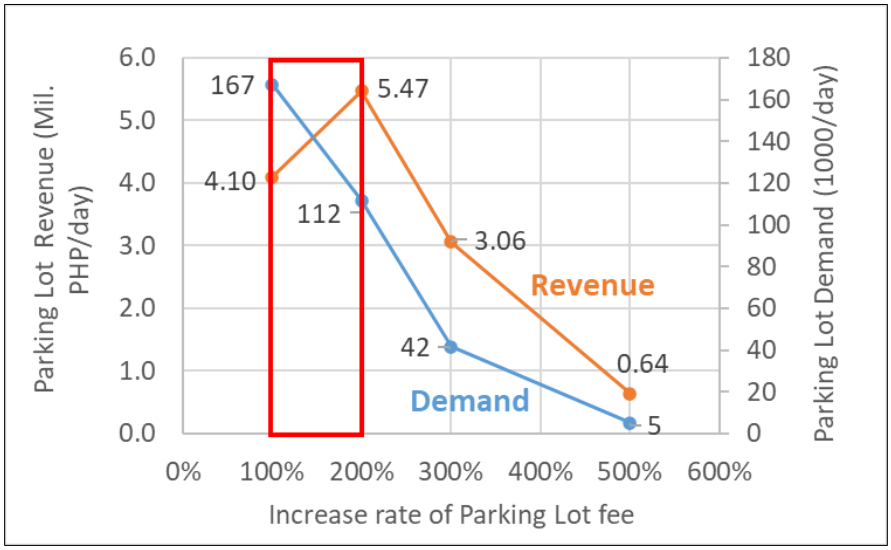
Figure 2.6: Large-scale Development Information

2.8 Roadside Parking

Currently, there are a lot of on street parking on Class C, D, and E roads which reduces the road capacity. To be more efficient, a confirmation is necessary to check the parking situations on the targeted roads. For Class C and priority roads, it would be better to prohibit illegal parking, and encourage the drivers to park in other areas. In considering the prohibition of on street parking, stricter on-street parking regulations, stiffer penalties for violators, more strategic parking fee increase or decrease, proper rerouting of vacant parking space, and minimum parking lot constructions are all necessary. On street parking information, regulation information, construction of parking facilities, side road for parking and moving the parking facilities are also crucial for the planning. The inventory survey includes some items.

The figure below shows the parking demand and revenue from parking lot fees with increasing ratio based on the MUCEP data. Although the latest survey is necessary, the figure indicates the demand increases in accordance with the cheaper fee, but the revenue is less than 200% of the increasing fee. It also indicates that the parking fee can increase up to 200% for private cars and motorcycles, which is when the revenue is at maximum. The additional revenue can be used for the improvement of parking service, e.g., expansion

of parking space, parking building construction, and installation of parking spaces.



Source: JPT based on MUCEP (2012)

Figure 2.7: Parking lot Revenue and Demand

2.9 Enforcer Opinion Survey Data

An enforcer opinion survey was conducted in this project, the bottleneck database used it to identify the traffic bottlenecks. The interviews include the causes of traffic congestion, traffic situation, and the countermeasures. The bottlenecks extracted from these interviews are called potential bottlenecks, and these are verified with the traffic congestion in Waze.

Please see the Manual on the bottleneck database in technical report.

Table 2.3: A Part of Enforcer Opinion Survey

Congestion Situation				
	Approach (toward)	**Vehicle Queue Length**	**Spill over from downstream intersection**	**Spill over to upstrear intersection**
D1	Taft South	02 Moderate : over 300m to 500m	Yes	No
D2	Taft North	02 Moderate : over 300m to 500m	No	No
D3	A. Arnaiz West	None	Yes	No
D4	A. Arnaiz East	02 Moderate : over 300m to 500m	Yes	No
D5				

Checklist for Factor of Congestion (intersection)								
1:STRONGLY AGREE, 2:AGREE, 3:DISAGREE								
Factor item	Checkpoint	Factor of Congestion	D1	D2	D3	D4	D5
Road infrastructure	Number of lanes	Lack of number of lanes	1	3	1	1	
		Insufficient road width	2	3	2	2	
	Intersection layout	Wrong geometric intersection layout	3	1	3	3	
		Inadequate corner cutting	1	2	1	1	
		Improper location of road facilities (road markings)	2	3	2	2	
Traffic regulation	Signal timing	Inadequate of traffic signal control	1	1	1	1	
		Bad visibility of traffic signal	1	2	1	1	
	Right-turning or oncoming vehicles	No left-turn lane	1	1	1	1	
		Insufficient left-turn lane length	1	2	1	1	
		Conflict between a left-turning car and an oncoming straight car	1	3	1	1	
	Left-turning vehicles	Right-turning vehicles blocking vehicles proceeding straight ahead	1	1	1	1	
		Improper stop line position	1	2	1	1	
		Improper channelization	1	3	1	1	
Traffic situation	Large vehicle	Speed reduction due to large vehicle	1	1	1	1	
		Obstruction by motorcycles	1	2	1	1	
		Obstruction by bicycles	1	1	1	1	
		Obstruction by pedestrian	1	2	1	1	
Environment of Roadside and intersection	Railway Crossing	Stopping traffic at railway crossing	1	3	1	1	
	Driveway from roadside shop	Traffic flow in/out from intersections and narrow streets	1	1	1	1	
		Traffic flow in/out from IC at expressway	1	2	1	1	
	PUJ, PUV	Speed reduction due to PUV stop	1	3	1	1	
		Speed reduction due to PUJ stop	1	1	1	1	
		Lane reduction with dedicated bus and priority lanes	1	2	2	1	
	On-street parking	Obstruction of travel by on-street parking	1	1	3	1	
Traffic Demand	Over capacity	Excess traffic capacity at intersections	1	1	1	1	
		Excess traffic capacity at non-intersections	1	2	2	1	
	Concentrated traffic	Concentration of traffic at specific time	1	3	1	1	
		Concentration of traffic on roadside facilities at specific times and periods	1	1	1	1	
		Concentration of traffic during specific periods during events or incidents	1	2	1	1	
Others	Construction	Lane blockage due to construction	1	1	1	1	
	Clogging of downstream	Clogging with congestion of downstream	1	2	1	1	
	Free Comment (if any)	Due to traffic accident, tenporaly congestion occurs					

Source: JPT

3 SECONDARY DATABASE

Secondary database is the dataset incorporating some primary data. The secondary data is used for specific objectives as described from the strategies, e.g., identification of traffic bottleneck.

Table 3.1: Secondary Database List

No.	Name	Specific Objective	Primary Data	Update Frequency	Lead Section	Status
1	Bottleneck DB	To identify the corridor bottleneck issues, and countermeasure	• Waze • Enforcer Opinion survey • Traffic count survey	Annual	DB Task force (TEC, TSOMD, and OAGMP)	JPT will hand over to MMDA
2	Corridor DB (Corridor analysis sheets and Corridor Profile)	To identify the intersection bottleneck issues, and countermeasure	• Demand forecast • Waze • Inventory survey • Traffic count survey	Annual	DB Task force (TEC, TSOMD, and OAGMP)	JPT will hand over to MMDA
3	Traffic safety DB	To identify the issues from traffic safety aspect	• Demand forecast • Waze • Inventory survey • Accident data • Other data.	Annual	TBD	TBD
4	Environment DB	To identify the issues from Environmental aspect	• Demand forecast • Waze • Traffic survey • Environmental data • Other data.	Annual	TBD	TBD
5	Flood management DB	To identify the issues from Flood management aspect	• Demand forecast • Waze • Inventory survey • Flood condition data • Other data.	Annual	TBD	TBD

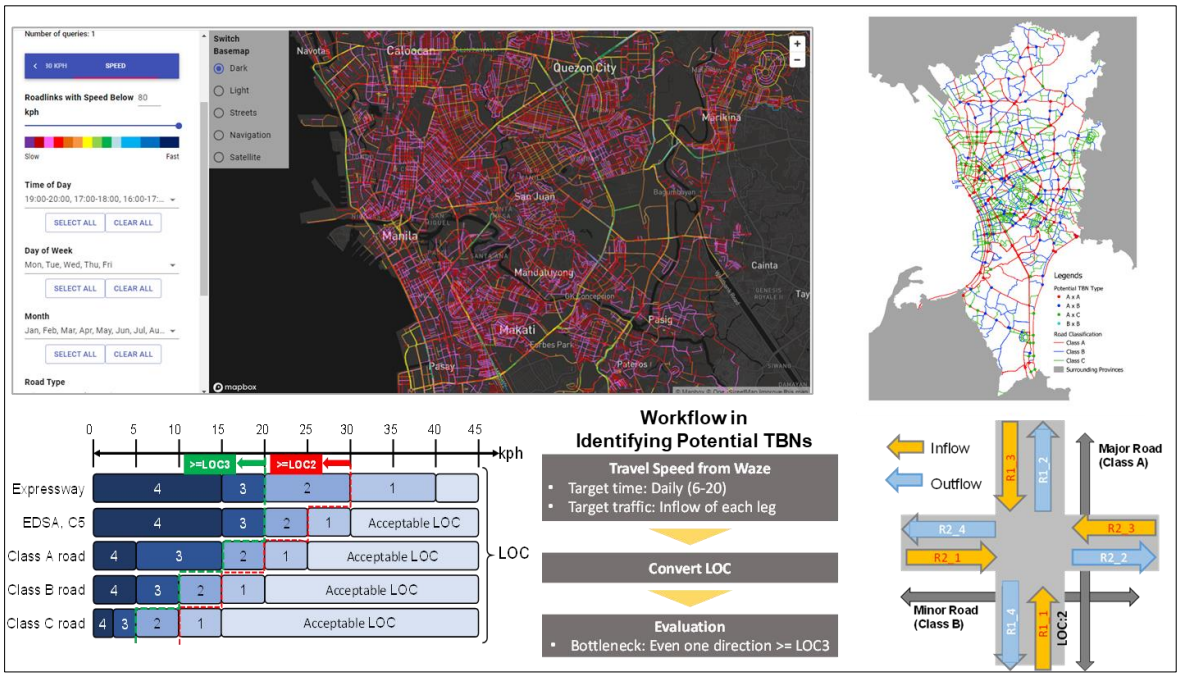
Source: JPT

The discussion below describes the overview of secondary database.

3.1 Bottleneck Database

The Bottleneck database was developed based on the traffic volume, enforcer opinion survey and Waze data. It can be used for the identification of major traffic bottlenecks, and their countermeasures. These identifications are based on data, so it contributes to the justification of the decision. MMDA should analyze the Waze data every year for the identification of traffic bottlenecks and the monitoring and evaluation of the effectiveness of countermeasures.

See technical report “The manual on the Bottleneck database”. It shows the details of the database.



Source: JPT

Figure 3.1: Bottleneck Database

3.2 Corridor Database

Corridor database was developed based on the traffic demand result, traffic count survey, Waze data, and inventory data. The Corridor database has 2 kinds: 1) Corridor analysis sheet, and 2) Corridor profile. It also includes both the demand and the supply side.

The demand side is based on the demand forecast result and traffic count survey. Although the project uses the demand forecast result, the replacement with traffic survey data is assumed in the future because the traffic count data is more accurate.

The supply side information is based on the inventory data. From the inspection of corridors, there are many inconsistent sections such as the road widths, bike lanes, and pedestrians. For example, inconsistent road width tends to generate bottlenecks. This kind of finding can be used for the improvement of corridors.

The Corridor profile shows the summarized information and the selected important issues from the corridor bottleneck analysis sheets.

1) Corridor Bottleneck Analysis Sheet

The Corridor Bottleneck Analysis sheets were developed to identify traffic issues and the corresponding countermeasures for traffic management. The information included in the sheets are Waze travel speeds, road and traffic facilities based on the inventory survey, and traffic bottleneck intersection information based on the opinion of MMDA traffic enforcers. However, the road sections need to be checked manually in order to remain consistent with the inventory survey data. This manual will instruct the users on how to increase the quality of the corridor bottleneck analysis sheets to identify the traffic issues (FOC, Table 3.2) and countermeasure more accurately. Ultimately, this will be for the benefit of related agencies, especially in securing the budget for the implementation of the proposed countermeasures.

Please see technical report “Manual on corridor bottleneck analysis sheet”.

Table 3.2: Factors of Congestion

Aspect		Factor of Congestion
Road Infrastructure	Number of Lanes	Insufficient number of lanes
		Insufficient road width
	Intersection Layout	Wrong geometric intersection layout
		Inappropriate for center point of intersection
		Inadequate corner cutting
		Improper location of road facilities (road markings)
	Road Alignment	Sharp curve
		Gradient change point (sag point)
		Steep slope
	Tunnels, Underpass	Entrance of underpass
Traffic Control and Regulation	Signal Timing	Inadequate traffic control (in case of without traffic signal)
		Inadequate traffic signal control (in case of with traffic signal)
		Poor visibility of traffic signal
	Left-turning or oncoming Vehicles	No left-turn lane
		Insufficient left-turn lane length
		Conflict between a left-turning car and an oncoming through car
	Right-turning Vehicles	Right-turning vehicles blocking vehicles proceeding through ahead
		Improper stop line location
		Improper channelization
	Traffic Sign	Improper / lack of traffic sign or inadequate location
Traffic Characteristic	Conflict by Specific Traffic	Speed reduction due to large vehicle
		Motorcycle is obstructed by other modes
		Bike is obstructed by other modes
		Inadequate pedestrian facilities
Environment of Roadside and Intersection	Railway Crossing	Stopping traffic at railway crossing
	Bridge Section	Difference in cross-sectional configuration between bridge and approaches
		Concentration of traffic on bridges
	Traffic Flow from/to Roadside Land Use, Connecting Streets, etc.	Traffic flow in/out at driveway along road side shop
		Traffic flow in/out from intersections and narrow streets
		Traffic flow into/out from at expressway interchange
	PUJ, PUB	Speed reduction due to PUV stop
		Speed reduction due to PUJ stop
		Lane reduction with dedicated bus and priority lanes
	On-street Parking	Obstruction of movement by on-street parking
Traffic Demand	Exceeding Capacity	Excess traffic demand at intersections
		Excess traffic demand at non-intersections
	Concentrated Traffic	Concentration of traffic at specific time
		Concentration of traffic on roadside establishment at specific times and periods
		Concentration of traffic during specific periods during events or incidents
Others	Construction Work	Lane blockage due to construction
	Clogging of Downstream	Clogging with congestion of downstream

Source: JPT

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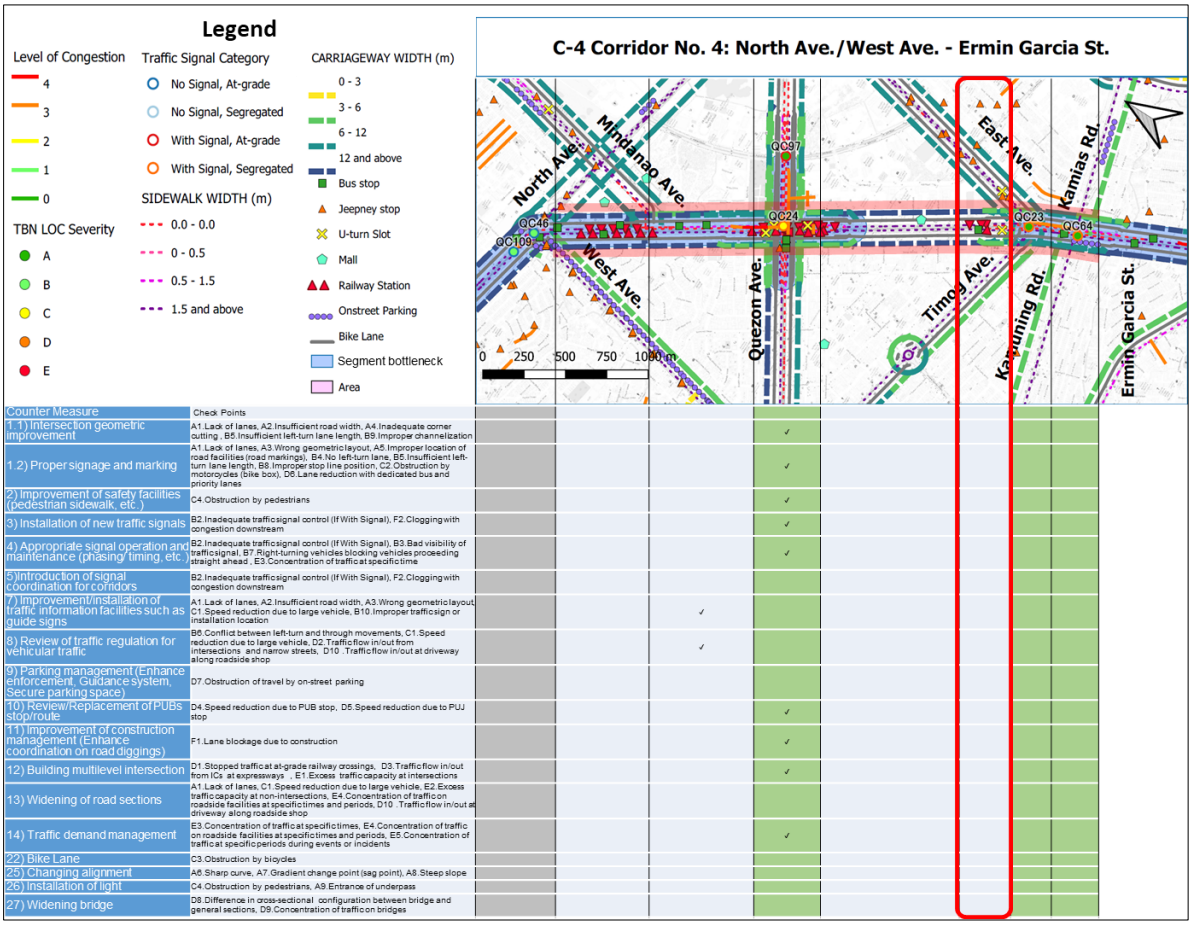


Source: JPT

Figure 3.2: Sample Corridor Sheet

2) Corridor Profile

Based on corridor analysis sheets, the Corridor profile was developed by extracting the important points. Based on the data, the Corridor profile gives the opportunity to find the consistency easily, and it can suggest the locations of the following:

(i) Narrow road width/lane;

(ii) Bottleneck for pedestrian (Active transport);

(iii) Areas with not enough streetlight;

(iv) Areas with poor Road marking; and

(v) Characteristics of the corridor

Please see technical report “Manual on corridor Profile”.

Corridor Profile and Analysis (C1: Mel Lopez Blvd. – Legarda St.)

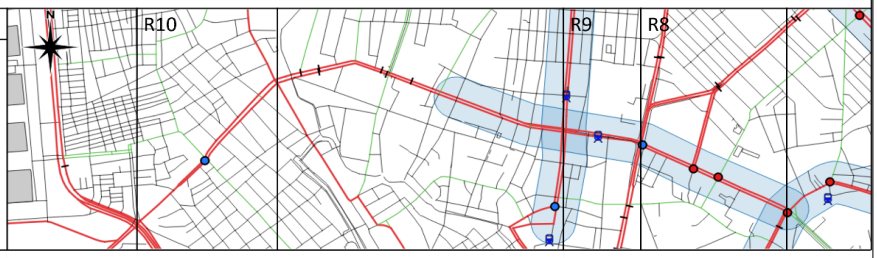
Location and General

Road Type

Legend

Road Class
Expressway — A — C
B — D,E
RailwayStation
Pedestrian Bridge
Segment Bottleneck

TBN Signal Category
No Signal — With Signal



Infrastructure and Facilities

Road Section No.				1	2	3	4
Road Section Length (m)				879	1483	423	701
Road width (m)				24.7	24.7	24.1	23.7
Direction1(Rightward)	Carriageway	Width(m)(Min-Ave.-Max)		6 - 9.2 - 12	6 - 9.2 - 12	6 - 8.1 - 9	9 - 9 - 9
		No. Lanes		2 - 3.1 - 4	2 - 3.1 - 4	2 - 2.6 - 3	3 - 3 - 3
		Pavement(%)(Poor/Fair/Good)		0/100/0	0/100/0	0/100/0	0/100/0
	Bike lane	Width(m)(Min-Ave.-Max)		0 - 0 - 0	0 - 0.2 - 2	0 - 0 - 0	0 - 1.3 - 2
		Bikability					
	Sidewalk	Width(m)(Min-Ave.-Max)		1.6 - 1.6 - 1.6	0 - 1.9 -		
		Pavement(%)(Poor/Fair/Good)		0/100/0	0/100/		
		Walkability					
	Road marking(%)(Poor/Fair/Good)			46/54/0	0/100/		
	No. of Streetlights per km			56.89	41.13		
	Busway	Width(m)		0.00	0.00		
		Segregated		0.00	0.00		
Median	Median	Availability		4.73	6.48		
		U-turn		0.00	0.00		
	Pedestrian Bridge			N	Y (parti		
	MRT/LRT			-	LRT 2		
Direction2(Leftward)	Carriageway	Width(m)(Min-Ave.-Max)		6 - 10.8 - 15	9 - 9 -		
		No. Lanes(Min-Ave.-Max)		2 - 3.6 - 5	3 - 3 -		
		Pavement(%)(Poor/Fair/Good)		11/89/0	0/100/		
	Bike lane	Width(m)(Min-Ave.-Max)		0 - 0 - 0	0.3 - 0 -		
		Bikability		0.00	15.80		
	Sidewalk	Width(m)(Min-Ave.-Max)		0 - 1.5 - 2	0 - 1.9 -		
		Pavement(%)(Poor/Fair/Good)		0/100/0	0/100/		
		Walkability		80.00	96.60	100.00	98.70
	Road marking(%)(Poor/Fair/Good)			37/63/0	0/100/0	0/100/0	0/100/0
	No. of Streetlights per km			54.87	50.57	31.09	33.21
	Busway	Width(m)		0.00	0.00	0.00	0.00
		Segregated		0.00	0.00	0.00	0.00
Pedestrian Crossing (At-grade)		Total					
		With Signal					
No. of Intersections		Total					
		T-junction					
Estimated Traffic Capacity (000PCU/day)				13.20	39.60	39.60	39.60
Traffic Demand Characteristics							
AADT		No.(000)		10.23	21.47	56.04	43.20
		PCU(000)		8.61	23.35	44.69	38.65
Travel speed (kph/6hr-20hr)		Rightward		15.34	18.07	17.62	17.92
		Leftward		15.26	15.00	12.16	12.15
Traffic characteristics		% of PUV		52.30	32.10	60.70	16.00
		% of truck		1.10	4.40	2.10	4.10
		% of MC		7.90	17.20	9.40	14.00

Data items:
- Length
- Road width
- Carriageway lane/width/pavement
- Sidewalk width/pavement/walkability
- Road marking condition
- Streetlight
- Busway width/segregated
- Median width/U-turn
- Pedestrian bridge
- MRT/LRT
- Intersection No./type
- Capacity
- AADT
- Speed(waze)
- % of PUV/ truck/ Motor bike

Source: JPT

Figure 3.3: Corridor Profile

Based on the profile, the traffic issues based on physical facility aspect can be identified, and the following are the fundamental information to be considered for the improvements following below:

Table 3.3: Physical Issues and Improvements Facilities

Physical issues	Improvements Facilities
Low speed and narrow width	Consider widening the road
Narrow sidewalk width and many pedestrians	Widen and improve sidewalks
Not enough streetlights	Installation of additional lights
Inconsistencies in upstream and downstream side	Widening of road, carriageway, and sidewalk or increase in no. of lanes
Few road markings	Install additional
Poor sidewalk conditions	Improve sidewalk
No bike lane and no sidewalk	Consider installing bike lane and sidewalk
Inconsistencies in each corridor (large gap)	Sections should be uniform

Source: JPT

3.3 The Draft of Traffic Safety DB

Accident database would be based on the accident data, traffic volume data, inventory data, and Waze data. In the first step, the accident data is necessary to analyze the black spots and understand the tendency is important as described below:

(i) Speed range;

(ii) Vehicle type and non-motorized transport mode;

(iii) Road facility type (lane, marking, exclusive lane, walkway, lane marking etc.);

(iv) Reason;

(v) Road class and crossing road class;

(vi) Road administrative.

(vii) Death and injury; and

(viii) Intersection type

If the common category is found, the reason can now be verified. Changes in the design policy or traffic safety strategy should be suggested and individual and serious and problems should be identified and improved urgently. The improvement countermeasures can be considered based from the following:

(i) Physical separation between pedestrian and vehicles;

(ii) Pedestrian network construction;

(iii) Speed control facilities (traffic sign, hump, road width, etc.);

(iv) Secure the Sight;

(v) Review of road design, and; etc.

3.4 The Draft of Environment DB

The Environment database would be based on the environmental data (CO2, SPM, and NOx etc.), traffic volume data, inventory data, and Waze data. Currently, for the environmental aspect, these are the following issues in Metro Manila:

(i) No data for emission (or fuel consumption) in each speed range and vehicle type (old data is existing, but the vehicles have updated recently). It is important to measure the emission amount.

(ii) The estimation of the baseline amount of the emission and the analysis of the current situation.

(iii) Analysis of the project impact based on (i)

(iv) There is no CO2 emission data for climate change effect is nothing.

These kinds of the data can be used for the following development:

(i) Monitoring the environmental matter, analyzing and estimating the relationship between the traffic situation and the environmental aspect, and estimating

(ii) Evaluation of green facilities development project based on the current emission

(iii) Estimation of the impact of demand management (Large vehicle regulation, road pricing, parking regulation, etc.)

3.5 The Draft of Flood Management DB

Flood management database would be developed based on Demand forecast data, Waze data, traffic count data, and flood condition data. It can be used for the traffic management countermeasures and can be easily shared with other related agencies. Because the data can identify exact flood areas, it is stored as the evidence information. These are following issues from the flood aspect:

(i) Flood basic data does not exist (Where, when, how long, how level)

(ii) The economic loss of flood on the transport field cannot be measured and nobody knows how much the enforcement contributes.

(iii) Coordination with LGU is not enough with regards to flooding to plan for a more efficient traffic situation.

(iv) Impact on Pedestrian movement, public/private transportation cannot be known.

The development of flood management is utilized for following:

(i) Understanding the current situation and the importance of flood and traffic management

(ii) The planning sectors assign the staff to ease the congestion and encourage the rerouting to avoid the area with ITS based on the information.

(iii) Provide the rerouting information to enforcers to carry out a more efficient traffic management

(iv) Based on the database, MMDA can show a part of the justification for the traffic management and can suggest to the LGU and other related agencies on how to improve the infrastructures to reduce the generated flood in the area.

(v) Provide information to the driver, LGU, private company etc. about the road closure promptly

(vi) Transport network construction considering redundancy

3.6 Real Time Data for Traffic Management Works

Real time data is important to know the current situation and the corresponding urgent matter based on it. If some data items can be provided in real time, the utilization is shown below.

Table 3.4: Real Time Data

Data	Description	Support for
Congestion level (Waze etc.)	It can be utilized for various traffic management plans.	• Traffic information provision • Rerouting information • Dispatch the enforcer without camera • Coordination with related agencies
Traffic volume	Basic data for traffic management and transportation planning It can be utilized for various works (Consideration/ prioritization/ evaluation etc.)	• Enforcement validation • Signal validation • Publish the amount of congestion loss promptly • Know the various fluctuation (hourly, month, seasonal, special holiday, etc.)
Traffic accident	It can be utilized for a more efficient traffic processing	• Rerouting Information promptly • Coordination with enforcement and related agencies
Flood condition	It can be utilized for urgent countermeasures	• Traffic information provision • Rerouting information • Urgent corresponding against disaster

Source: JPT

4 PLANNING DATABASE DEVELOPMENT AND ENHANCEMENT OF COORDINATION

Draft Final report shows the following matters that must be discussed within MMDA and the related agencies:

(i) Database Task Force is established in MMDA wherein they will lead the development, operation, and management of comprehensive traffic management database in Metro Manila.

(ii) Updates on bottleneck and corridor database for the identification of bottleneck and traffic management planning based on the granted database from JPT. These database updates also include the inventory, Waze data, and necessary surveys. In the future, the database will be developed in (iii).

(iii) The database development and utilization possibilities in the Table 4.1 should be identified and considered for the traffic management planning. It includes the utilization of other transportation related agencies information (e.g., public transportations)

(iv) To formulate a comprehensive traffic management database system and obtain a consensus among the MMDA and other related organizations.

This chapter shows the draft contents of project contents.

4.1 Establish a Taskforce on Traffic Management Database in MMDA

1) Establishment of Taskforce

In order to follow the database objectives from the use of the database, the rules of the existing data collection and management should be changed, and the common team should manage them. Because the project base and section base management are the same as before, such that the data is not shared with other sections, there are many cases that changing personnel cut the handover work from pretender to new person. It means pretender works is stopped including technical matters. Therefore, establishing the common sector, task force, data collection management, system management, operation, and engineering for traffic management database is necessary.

The task force oversees the tasks below.

Table 4.1: The task for Database Task Force

Aspect	Description
System	• Development of the brief document about the Task Force objective, members, tasks (This table) • Decide what Primary and Secondary database, and record them • Decide a representative person(s), and section for Primary and Secondary database, and record them • Decide the authority that the sectors/ related agencies can use and share the database, and record them • Request a representative person(s) to development/ update the manual for methodologies of 1) data collection, 2) development, 3) management
Data Collection	• Request sectors to prepare the Manuals for data collection methodologies to secure the consistency data quality and check them. Only primary and Secondary database only • Encourage to use the other data from other related agencies, e.g., environmental data, land use data, detailed accident data etc.
Management	• Check the database location • Check the performance to update the database. If the section delay to update, report to senior colleague and encourage to improve

Aspect	Description
	• Verification of data integrity • Check whether use of database is appropriate or not, following rule or not.
Operation	• Find the possibility to use the database for traffic management plan or works • Consider the coordination with other related agencies • Encourage to use the database for MMDA works • Check the person in charge, whether the task is followed in the rules, encourage to follow them
Engineering	• Encourage to discuss the ICT technologies availabilities about database, e.g., AI Camera, violation apprehension, DX technologies • Consider the utilizing the database for traffic management • In corporate from technical Assistance from NTCS and ODA experts about the data analysis based on the database for traffic management. Traffic safety DB, Flood management DB etc. should be targeted.

Source: JPT

MMDA is establishing the Task Force this year. The members can be changed in accordance with their contribution to the database for traffic management or social responsibilities. Regarding the coordination with related agencies, data sending, and project/ plan/ strategy should be discussed based on the data.

2) Preparation of Necessary Tools Including Software, Equipment and Human Resource in MMDA

The budget for purchasing the new device and human resources is not enough. The preparation to supplement them is necessary. The budget needs to be requested from the government and the human resources for specific works need to be outsourced from other section. One of the ideas is that, since the additional traffic management works will be added after the large-scale infrastructure construction, that development should add a few percentage of the total amount for the changes in the whole of traffic management.

4.2 Update Secondary Database

1) Bottleneck Database and Corridor Database Update

The prototype databases developed in this study, were composed of two levels. The first level is Primary data which will be collected regularly and will also be institutionalized. The secondary data which will be processed for specific purposes will be based on the Primary data and the supplemental data, if necessary. Primary database will be based on Road Inventory and Waze data dashboard, enforcer opinion survey, traffic count survey, and the secondary database. Bottleneck database and corridor database should be updated to carry out Projects 1 and 3.

Please see the technical report regarding the methodology in updating of traffic bottleneck and corridor database and the Primary data.

4.3 Design Comprehensive Traffic Management Database System

1) Review of Existing Database

Since JPT focuses on the identification of bottlenecks, this study developed the bottleneck and corridor database. However, other traffic related management databases also exist. Therefore, it is necessary to find a way to use the existing data for traffic management purposes and analysis studies (e.g., accidents black spots). This must also consider other available data, e.g., flood condition, air pollution, road-side parking, construction work, land use, and so on.

Common data platform development with all the public organizations, in coordination with other related agencies would be able to generate new type of data. The use of these kinds of data and the data analysis based on them are necessary. This consideration might need new technologies and it would be better if there will be coordination between MMDA, NCTS, and international consultants.

Based on the result, the comprehensive traffic management databases are defined.

2) To formulate Alternative Comprehensive Traffic Management Database Systems to Obtain Consensus Among MMDA and Other Related Agencies

After the definition of comprehensive traffic management database above, the database structure and system would obtain the consensus of the development and cooperative development of database in the stakeholder meeting. The following are the discussion items:

(i) Understanding of the objective of the development of database and common goal;
(ii) Traffic management road classification and coverage;
(iii) Database structure and development and data provision from stakeholders; and
(iv) Cooperative development of database with other related agencies

4.4 Formulate Comprehensive Traffic Management Database Systems

1) Operation and Maintenance of the Database which it Meets the Needs of the Related Departments Timely and Properly

The operation, management, and conflicts on the traffic management are carried out based on Table 2.1 and Table 3.1. The necessary data should be collected from the related agencies and other sections in MMDA.

2) To Make Necessary Adjustments Between the Existing and the New System of MMDA and Other Related Agencies

The project suggests that the MMDA should cover Class A and B roads, while LGUs should cover Class C, D, and E. For a better coordination with LGUs, the responsibility coverage, data consolidation, data share, maintenance etc., should be dispatched.

3) Encourage and Assist Other Related Agencies to Integrate MMDA's Traffic Management Database System

When LGU and other related agencies develop the databases (e.g., inventory survey, traffic count survey, enforcer opinion survey), the task force can lead the tasks. The task force can provide support for the following tasks:

(i) Review of traffic management data, including relevant ministries and agencies, regarding permanent bottleneck removal;
(ii) Role sharing with relevant ministries and agencies for database development to be applied to the traffic management industry; and
(iii) Database operation and management

Preferably, there should be a collaboration between MMDA and other related agencies in the establishment of database task force for the Database development formation.

APPENDIX L

Study Trips in Japan

APPENDIX L

Part A: 1st Study Trip to Japan

1 TRAINING PROGRAM OVERVIEW

1.1 Training Program Name

Traffic Management Planning

1.2 Training Program Period

26 January 2020–6 February 2020

1.3 Trainees

11 members from MMDA as shown in Table 1.1.

Table 1.1: List of the Trainees

No.	Name	Designation	Affiliation
1.	Ms. Arlene N. Parafina	Project Evaluation Officer III	Office of the Asst. Gen. Manager for Planning
2.	Mr. Lou Martin Tabilog	Computer Operator II	Office of the Asst. Gen. Manager for Planning
3.	Engr. Ryan Tacbad	Engineer III	Office of the Asst. Gen. Manager for Operations
4.	Mr. Vincent Joel Recio	Computer Programmer II	Office of the Asst. Gen. Manager for Operations
5.	Mr. Steve Ovett Antonio	Engineer III	Office of the Asst. Gen. Manager for Operations
6.	Ms. Nimfa Espela	Project Evaluation Officer II	Office of the Asst. Gen. Manager for Operations
7.	Engr. Jemima Ann Ado	Engineer II	Office of the Asst. Gen. Manager for Operations
8.	Mr. Anthony Raymond Tuazon	Special Operations Officer II	Office of the Asst. Gen. Manager for Operations
9.	Mr. Dennis Marcos	Traffic Discipline Officer III	Office of the Asst. Gen. Manager for Operations
10.	Mr. Jeffrey Torres	Traffic Operations Officer II	Office of the Asst. Gen. Manager for Operations
11	Mr. John Paul Manalo	Computer Programmer II	Office of the Chairman

Source: JPT

2 TRAINING PROGRAM CONTENTS

2.1 Project Description

1) Project Background

In 2015, Metro Manila had a population of 12.87 million, and that figure is increasing at 1.7% a year. While the concentration is denser in the central areas of Metro Manila, the rate of suburbanization in the surrounding areas is also picking up. In addition, the number of registered vehicles has risen at 24.6% compared to 2016. For these reasons, traffic congestion in Metro Manila has become a major political and social problem. According to the "Formulation of Transportation Development Roadmap to Support Sustainable Development of Metropolitan Manila and Its Surrounding Areas," which was conducted in 2014 with the support of JICA, the cost of transportation to the people in Metro Manila was PHP2.4 billion a day, and if no action would be taken, the cost was estimated to balloon to PHP6 billion by 2030.

Therefore, it is essential to solve traffic and transportation problems through a comprehensive action that has both hard and soft aspects, such as road and railway network, and a comprehensive traffic management plan, respectively, to support future economic development. Under such circumstances, the Japanese government was requested to conduct "The Project for Comprehensive Traffic Management Plan for Metro Manila." In September 2018, the Record of Discussion was signed between the Japan International Cooperation Agency (JICA) and the Metropolitan Manila Development Authority (MMDA) to implement this technical cooperation.

2) Project Objectives and Expected Outputs

"The Project for Comprehensive Traffic Management Plan for Metro Manila" aims to formulate a comprehensive traffic management plan for the road sector in Metro Manila to manage traffic demand and increase traffic capacity, thereby improving mobility, connectivity, traffic environment, and safety. In doing so, the project will identify congested points, analyze the causes based on quantitative and scientific data, and formulate a comprehensive traffic management plan focusing on developing the capacity of institutions and personnel to plan, implement, evaluate, and improve traffic management measures.

The project is expected to achieve the following outputs:

(i) Data-driven identification of major traffic bottlenecks in Metro Manila and their detailed characteristics based on quantitative analysis;

(ii) Setting of the traffic management goal to pursue in five years and formulation of the MMDA's five-year action plan based on an analysis of the collected data and which will include the improvement measures for each major traffic bottleneck; and

(iii) Implementation of selected improvement measures and applying the lessons to finalize the five-year action plan so that the knowledge on comprehensive traffic management planning, implementation of traffic management (TM) measures, evaluation, and improvement is transferred to the personnel of the counterpart organizations.

3) Project Area

The project covers the 17 local government units (LGUs) comprising Metro Manila, i.e., the cities of Quezon, Manila, Caloocan, Pasig, Valenzuela, Taguig, Las Piñas, Parañaque,

Makati, Marikina, Muntinlupa, Pasay, Malabon, Mandaluyong, San Juan, and Navotas, and the municipality of Pateros, especially the roads managed by the MMDA.

4) Organization Involved in the Project

While the main counterpart in the project is the MMDA, the JICA Project Team will also coordinate with the other member organizations of the Joint Coordination Committee (JCC) and the Technical Working Group (TWG) to implement the project smoothly. These organizations are identified in the figure below.

JCC (Joint Coordination Committee)

Chairperson (Project Director)	Undersecretary of MMDA	
Vice Chairperson (Deputy Project Director)	Assistant Secretary of MMDA	
Member	Philippines	•MMDA: Relevant Directors •Representatives of Relevant Departments DPWH, DOTr, NEDA and LGUs
	Japan	•Embassy of Japan •Chief Representative of JICA Philippine Office •JICA Experts •Members of JICA Missions
Provisional Member	Representatives of LTO, LTFRB, DICT, DENR and Others	

TWG (Technical Working Group)

Chairperson (Project Director)	Director for Planning, MMDA	
Vice Chairperson (Deputy Project Director)	Director for Operation, MMDA Director for Financing and Administration, MMDA	
Member	Philippines	•Division Chief of MMDA: Personnal of Planning Personnal of Operation Personnal of Finance and Administration Personnal of Legal Department Personnal of Traffic Engineering Office Personnal of Flood Control and Sewerage Management Office •Representatives of Other Departments: DPWH, DOTr, NEDA and LGUs
	Japan	•Representative of JICA Philippine Office •JICA Experts •Members of JICA Missions
Provisional Member	Chiefs of LTO, LTFRB, DICT, DENR and Other Offices Concerned	

CWG (Counterpart Working Group)

The staff of Planning Office of MMDA leads the members from related office of C/P organizations as a team leader.

Source: JPT

Figure 2.1: Project Implementation Structure

2.2 Training Program

1) Training Purposes

Study trips to Japan aim to deepen participant's understanding of the following three points through lectures and site visits related to traffic management in Japan. For the first study trip, the training objectives are as follows: (1) Identify traffic bottlenecks based on quantitative data, elucidate the causes and make countermeasures. (2) Formulate an action plan for several years and update it regularly. (3) Implement measures based on the action plan and evaluate and improve them. To fulfill these training objectives, lectures and site visit were conducted with the following considerations:

(i) Understand how to define traffic congestion, how to extract traffic bottlenecks, and how to have a common understanding among institutions.

(ii) Understand how traffic management data is collected.

(iii) Know how to create and operate a traffic management database and the examples of collaboration between government agencies and private organizations.

(iv) Understand how to reproduce the current situation, analyze the cause of traffic congestion, examine countermeasures and evaluate cost and impact by simulation using VISSIM and STRADA.

(v) Know the practical cases of ICT / ITS related to traffic management.

(vi) Understand what coordination should be made among central governments, local governments and private organizations in the process of developing urban transport policies. (Council structure, division of roles of each organization, budget division, etc.)

(vii) Understand how to proceed with the process of data collection and analysis, planning, implementing and monitoring measures, and how information is shared within the organization.

(viii) Understand how to create an internal manual for the particularly important matters above-mentioned.

(ix) Learn about application cases of automatic traffic data collection using image processing technology of Japanese private companies.

(x) Know the latest technology related to traffic management in Japan.

2) Overview of Site Visits and Lectures

The dates, locations, contents of site visits and lectures, etc. are shown in Table 2.1.

Table 2.1: Training Schedule

No.	Date	Organization	Theme	Content of Lectures and Site Visits
1	Jan. 27th	Ministry of Land, Infrastructure, Transport and Tourism (MLIT)	[Lecture] Effects of Road Maintenance	• Economic Effects of Road Maintenance • Effects of Ordinary Road Maintenance • Effects of Ring Road Maintenance in Urban Area • Effects of Expressway Maintenance
2			[Lecture] Road Transportation Management in Urban Area (Congestion Countermeasures)	• Current Situation of Traffic Congestion in Japan • Countermeasures on Traffic Congestion • Countermeasure by Roadside Facilities • Application of New Technology to Traffic Congestion
3	Jan. 28th	Chiba Pref. Police	[Lecture and Site Visit] Activities of Chiba Pref. Police on Traffic	• Organization and roles of Chiba Pref. Police • Prevention of Traffic Accidents • Traffic Command Center

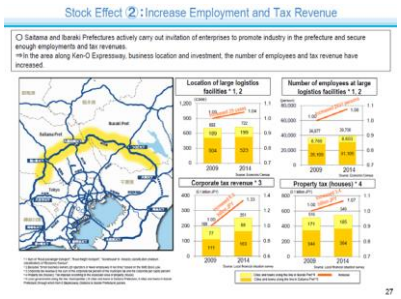
No.	Date	Organization	Theme	Content of Lectures and Site Visits
			Management	• Communication Control Center
4		Kawasaki City Government	[Lecture] Traffic and Transportation Policies in Kawasaki City	• Urban Development Master Plan • Comprehensive Urban Transportation Plan • Current Situation and Characteristics of Transportation in Kawasaki City • Projects based on Comprehensive Urban Transportation Plan • Key Countermeasures on Traffic Issues in Kawasaki City
5			[Site Visit] Facilities around JR Kawasaki Station	• Bicycle Pushing and Walking zone • Cooperative Cargo Handling Area • Bus Priority Lane • Bath Bay • Universal Designed Taxi • Automatic Bicycle Parking Lot, etc.
6	Jan. 29th	Iwane Laboratories, Ltd.	[Lecture] Road Traffic Management by 3D Visualization Technology	• Mobile Mapping System • Customized Software System Development • Artificial Intelligence (AI) by Machine learning
7		VICS Center	[Lecture] Vehicle Information and Communication System (VICS)	• System Development and Operation related to Collection, Processing, Editing and Transmission of Road Traffic Information
8		PTV Group Japan Ltd.	[Lecture] Solution by the software related to Traffic Analysis, Hands-on training on VISSIM	• Transportation Software • VISSIM Features • Basic Usage of VISSIM
9				• Application of VISSIM (for professionals)
10		Japan Railways (JR) East	[Site Visit] Multi Modal Hub (Shinjuku Bus Terminal)	• Functioning as a Traffic Node and Multi Modal Hub • Introduction of facilities in Shinjuku Bus Terminal
11	Jan. 30th	Metropolitan Expressway Company Ltd.	[Lecture and Site Visit] Tokyo Metropolitan Expressway	• Business Outline of Metropolitan Expressway Co., Ltd. • Traffic Congestion Countermeasures on the Metropolitan Expressway
12				• Introduction of Yamate Tunnel, Escort Light, Ohashi JCT and Rainbow Bridge
13				• Operation of Traffic Command Center
14				• Operation of Motorcycle Patrol Group and Meguro Sky Garden
15	Jan. 31st	Institute of Industrial Science, The University of Tokyo	[Lecture] The Latest science and technology related to Road Traffic Management	• Bottlenecks, Congestion and general Countermeasures from a Traffic Engineering Perspective • Introduction of the Latest Trends in Worldwide Traffic Management Studies
16		NEC Corporation	[Lecture] Application of Image Recognition Technology to Road Traffic Management	• Technologies and Services related to Automatic Traffic Volume Count and Detection of Violating vehicles by Using Cameras
17		ZERO-SUM, LTD.	[Lecture] Application of ITS to Road Traffic Management	• Automotive ITS Technology • Smart Road Solution by Using Road ITS Technology • Traffic Information Transmission System • V2X (Emergency Vehicle Priority System) • Introduction of Traffic Management ITS in India

No.	Date	Organization	Theme	Content of Lectures and Site Visits
18	Feb. 2nd	Mobility Design KOBO Inc.	[Lecture and Site Visit] Practical Case Study on VISSIM	• Reproduction of the Current Situation, Factor Analysis of Traffic Congestion, Study of Countermeasures, Evaluation of Cost and Impact by VISSIM
19	Feb. 3rd			• Case Study: Intersection Improvement and Traffic Signal Adjustment at intersection in Yamanakako Village
20	Feb. 4th	Nagoya Electric Works Co., Ltd.	[Lecture and Site Visit] Application of ITS to Road Traffic Management	• Variable-message Sign (VMS) system and Mobile VMS • Maintenance Training and Mobile VMS in Bosnia Herzegovina and Sri Lanka • Introduction of Blinks • ITS services in India
21	Feb. 4th	Toyota City Government	[Lecture] Traffic and Transportation Policies in Toyota City	• Traffic Town Action Plan • Public Transportation Basic Plan
22	Feb. 5th	Toyota City Government	[Site Visit] Facilities around Aichi Loop Line, Shin-Toyota Station and Meitetsu Toyotashi Station	• City Center Environment Plan • City Center Future Design • Station Plaza Development Plan
23		Toyota Eco-ful Town	[Site Visit] Activities of Toyot Eco-ful Town for Low Carbon Society	• Activities of Toyota City for Sustainable Development Goals (SDGs) • Introduction of Hydrogen Vehicles • Introduction of Hydrogen Station • Introduction of Smart House

Source: JPT

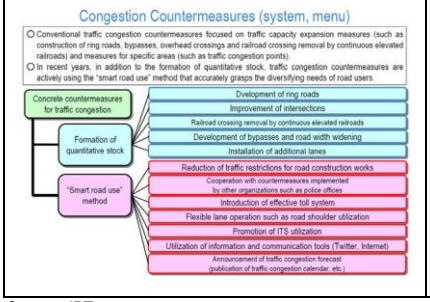
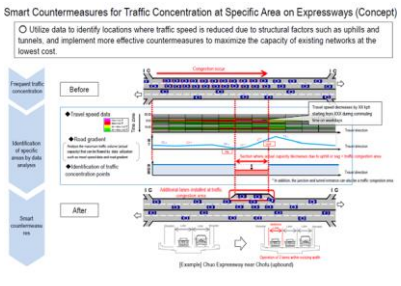
3 CONTENTS OF SITE VISITS AND LECTURES

Table 3.1: January 27, 2020

Lecture	Effects of Road Maintenance
Overview and Trainees' Impressions	The lecture included the economic effects of road maintenance, the effects of ordinary road maintenance, the effects of ring road maintenance in an urban area, effects of expressway maintenance. The following questions were raised by the trainees. What is the jurisdiction of the authorities involved in identifying areas of traffic accident concentration? Under what entity's jurisdiction is the identification of traffic accident concentration areas? How does the Ministry of Land, Infrastructure, Transport and Tourism provide leadership in joint committees with local residents? How is land acquisition for infrastructure development handled? How does the Ministry of Land, Infrastructure, Transport and Tourism coordinate the construction of highways with the private sector? What is the road construction process like?
		

Source: JPT

Table 3.2:

Lecture	Road Transportation Management in Urban Area (Congestion Countermeasures)
Overview and Trainees' Impressions	• The lecture included the current situation of traffic congestion in Japan, countermeasures on traffic congestion, countermeasure by roadside facilities, application of new technology to traffic congestion • The following questions were raised by the trainees. - How automated is the collection of traffic volume data? - How accurate is the automatic collection of traffic volume data? - What indicators are most frequently used to measure traffic congestion? - Has the toll price adjustment been effective in reducing traffic concentration? - How many traffic counters are needed to automatically collect traffic volumes by direction at one intersection? - What is the incentive to install ETC? - Does the measurement accuracy of traffic counters decrease with weather conditions? - Will localized traffic congestion countermeasures, such as those at a single intersection, simply postpone the problem (i.e., move it to the next intersection)?
		

Source: JPT

Table 3.3: January 28, 2020

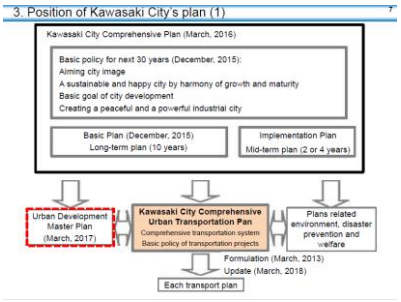
Lecture and Site Visit	Activities of Chiba Pref. Police on Traffic Management
Overview and Trainees' Impressions	• The lecture and site visit included the organization and roles of Chiba Pref. Police, prevention of traffic accidents, traffic command center, communication control center. • The following questions were raised by the trainees? - How many staff members are stationed at a traffic control center at any given time? - How are traffic signals that are not connected to the traffic control center controlled? How are traffic signals that are not connected to the traffic control center controlled? - Traffic congestion information obtained from traffic congestion sensors installed on the roads in your jurisdiction is displayed on a monitor at the traffic control center. How often is this information updated?

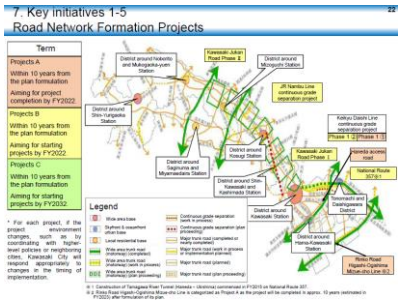


Source: JPT

Table 3.4:

Lecture	Traffic and Transportation Policies in Kawasaki City
Overview and Trainees' Impressions	• The lecture included an urban development master plan, a comprehensive urban transportation plan, the current situation and characteristics of transportation in Kawasaki City, projects based on a comprehensive urban transportation plan, and key countermeasures for traffic issues in Kawasaki City. • The following questions were raised by the trainees. - How are universal cabs different from regular cabs? - Why are they promoting the undergrounding of rail lines? - Why not elevated tracks? - How are the standards and maintenance of bike lanes being promoted? - How often is the comprehensive plan updated? - What kind of cooperation does Kawasaki City provide to railroad operators? - What steps were taken to introduce the hydrangea train as a regional transportation system? - Why is the percentage of public transportation use so high in Kawasaki City? - What measures are taken against on-street parking?





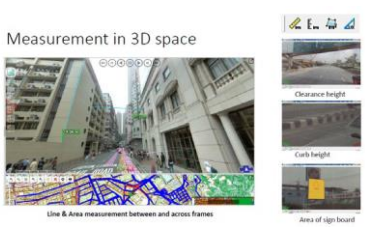
Source: JPT

Table 3.5:

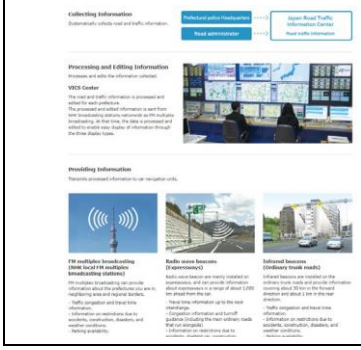
Site Visit	Facilities around JR Kawasaki Station	
Overview	• The site visit included a bicycle pushing and walking zone, cooperative cargo handling area, bus priority lane, bath bay, universal designed taxi, automatic bicycle parking lot, etc.	
		
Bicycle Pushing and Walking Zone	Bath Bay	Automatic Bicycle Parking Facility
		
Cooperative Cargo Handling Area	Bicycle Parking on the Sidewalk (1)	Bicycle Parking on the Sidewalk (2)

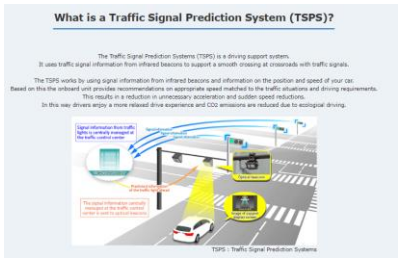
Source: JPT

Table 3.6: January 29, 2020

Lecture	Road Traffic Management by 3D Visualization Technology
Overview and Trainees' Impressions	• The lecture included Mobile Mapping System, customized software System development, artificial intelligence (AI) by machine learning. • The following questions were raised by the trainees. - Can mapping systems be applied to traffic simulation? - How much time is required to create a 3D map using the mapping system? - What is the data size of the 3D map? - Is the camera itself used for the mapping system available for sale? How much does it cost? - How is it different from Google Streetview? - How accurate are the cameras? - How do you update the 3D map data? - Do you already have a business partner in the Philippines?
		
Lecture	**Vehicle Information and Communication System (VICS)**	

Lecture	Road Traffic Management by 3D Visualization Technology
Overview and Trainees' Impressions	• The lecture included system development and operation related to collection, processing, editing and transmission of road traffic information • The following questions were raised by the trainees. - Will VICS Center be providing road traffic information via the Internet? - What equipment and organization will be needed to operate in the Philippines? - Are VICS centers private sector or public sector? - What are the funding options?

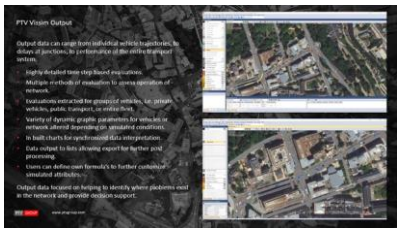




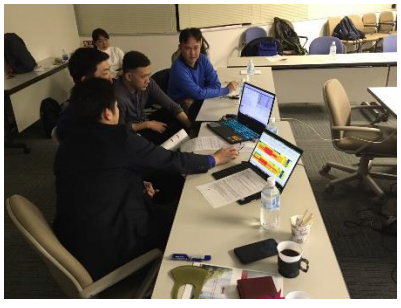
Source: JPT

Table 3.7:

Lecture	Solution by the software related to Traffic Analysis
Overview and Trainees' Impressions	• The lecture included the transportation software, VISSIM features, basic usage of VISSIM. • The following questions were raised by the trainees. - What kind of calibration is needed to get the most out of Vissim? - What are the benefits of running a Vissim simulation before a social experiment?



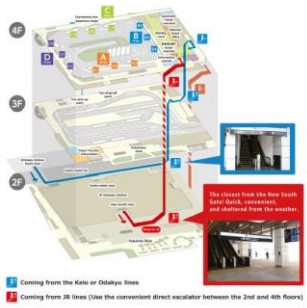
Lecture	Hands-on Training on VISSIM
Overview	• The lecture was given in a hands-on format to three trainees who work with Vissim at MMDA on a daily basis. The trainees had their own files from MMDA at hand, and based on the lecturer's advice, they modified the parameters necessary to reproduce the current situation. • The trainees also received advice on modifying the parameters of the intersection improvement plans that they had prepared in the case study so that they could be evaluated accurately after the fact.



Source: JPT

Table 3.8:

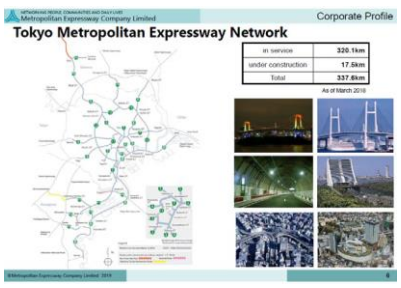
Site Visit	Multi Modal Hub (Shinjuku Bus Terminal)
Overview and Trainees' Impressions	• The lecture was given in a hands-on format to three trainees who work with Vissim at MMDA on a daily basis. The trainees had their own files from MMDA at hand, and based on the lecturer's advice, they modified the parameters necessary to reproduce the current situation. • The trainees also received advice on modifying the parameters of the intersection improvement plans that they had prepared in the case study so that they could be evaluated accurately after the fact. • During the site visit, the trainees were briefed on how the construction of Basta Shinjuku will improve access between buses and other modes of transportation, ensure the safety of pedestrians and bus, cab, and train users, and eliminate traffic congestion waiting for passengers. And the facilities on each floor of Basta Shinjuku and how to use them were explained. • The following questions were raised by the trainees. - How many bus routes are there? - How many bus operators are there? - What is the business scheme?

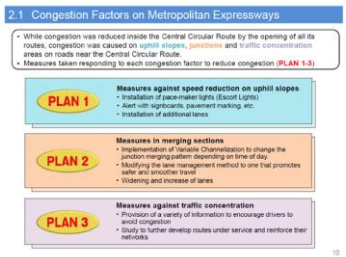


Source: JPT

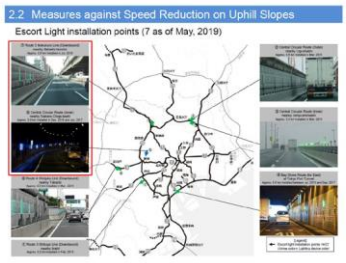
Table 3.9: January 30, 2020

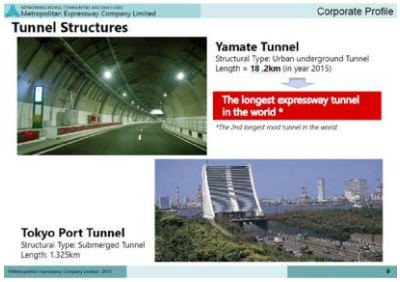
Lecture	Business of Tokyo Metropolitan Expressway
Overview	• The lecture included business outline of Metropolitan Expressway Co., Ltd. and traffic congestion countermeasures on the Metropolitan Expressway

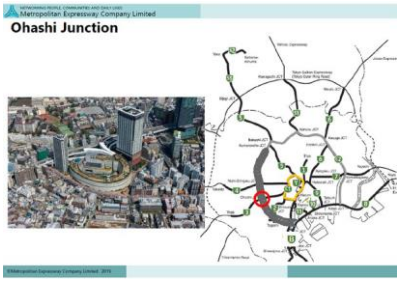




Site Visit	Trial Ride of Tokyo Metropolitan Expressway
Overview	• The site visit included introduction of Yamate Tunnel, Escort Light, Ohashi JCT and Rainbow Bridge.

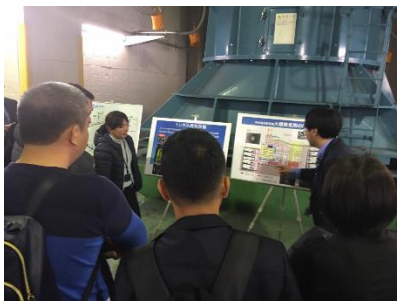






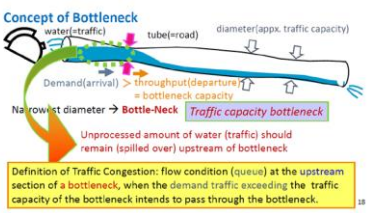
Source: JPT

Table 3.10:

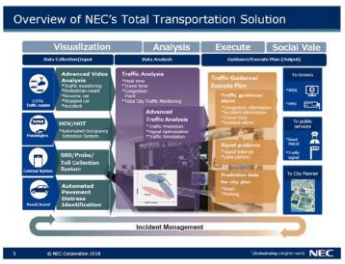
Site Visit	Traffic Command Center
Overview and Trainees' Impressions	• The site visit included operation of Traffic Command Center. • The following questions were raised by the trainees. - What days are the busiest? - How is the map legend on the display determined? - How many lanes are there on a typical Metropolitan Expressway?
	
Site Visit	**Motorcycle Patrol Group and Meguro Sky Garden**
Overview and Trainees' Impressions	• The site visit included operation of Motorcycle Patrol Group and Meguro Sky Garden. • The following questions were raised by the trainees. - Do bike patrols also respond to emergency services in the event of an accident? - When there is an accident in a tunnel, the entrance is physically closed with a bar. What happens to the cars that come before the bars?
	 

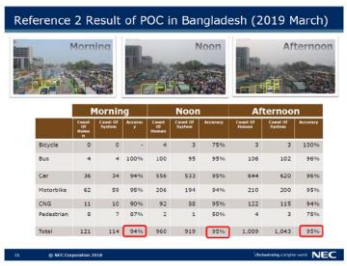
Source: JPT

Table 3.11: January 31, 2020

Lecture	The Latest Science and Technology related to Road Traffic Management
Overview and Trainees' Impressions	• The lecture included bottlenecks, congestion and general countermeasures from a traffic engineering perspective, introduction of the latest trends in worldwide traffic management studies. • The following questions were raised by the trainees. - How to predict traffic congestion? - How do we prevent congestion? - What kind of data is needed for congestion control?
		
Lecture	**Application of Image Recognition Technology to Road Traffic Management**

Lecture	The Latest Science and Technology related to Road Traffic Management
Overview and Trainees' Impressions	• The lecture included technologies and services related to automatic traffic volume count and detection of violating vehicles by using cameras. • The following questions were raised by the trainees. - What is the price? - How accurate is it in bad weather? - Can existing cameras be used? - What is the accuracy level? - Is it adaptable for jeepney detection?

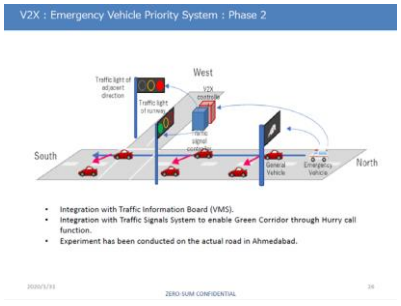




Source: JPT

Table 3.12:

Lecture	Application of ITS to Road Traffic Management
Overview and Trainees' Impressions	• The lecture included automotive ITS technology, smart road solution by using road ITS technology, traffic information transmission system, V2X (Emergency Vehicle Priority System), introduction of traffic management ITS in India. • The following questions were raised by the trainees. - Can't we use it on roads that are already crowded? - Isn't it dangerous to have advertisements displayed all the time? - How are they communicating? - Can V2X be implemented using existing infrastructure?

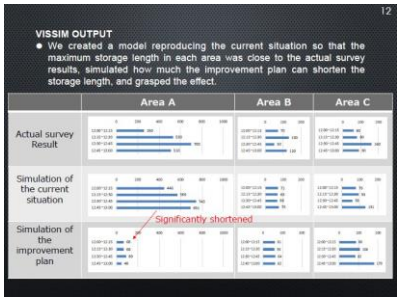


Source: JPT

Table 3.13: February 3, 2020

Lecture and Site Visit	Practical Case Study on VISSIM
Overview and Trainees' Impressions	• The lecture included reproduction of the current situation, factor analysis of traffic congestion, study of countermeasures, evaluation of cost and impact by VISSIM, intersection improvement and traffic signal adjustment at intersection in Yamanakako Village. • The following questions were raised by the trainees. - What data needs to be collected to recreate the existing conditions? - What base map is being used? - Have the dwell times of cars at the stations been measured? - How many minutes of traffic should be measured at the intersections? - Have the signal indications been changed?

Lecture and Site Visit	Practical Case Study on VISSIM
	- If the police change the signal indications, how do they optimize the signal indications? - Can VISSIM alone derive the optimal intersection geometry, traffic flow, and signal indications? - What indicators are used to evaluate the project?



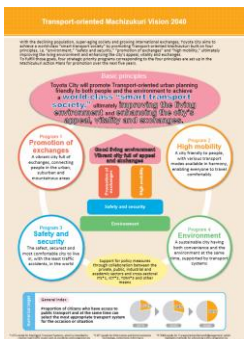

Source: JPT

Table 3.14: February 4, 2020

Site Visit	Application of ITS to Road Traffic Management
Overview and Trainees' Impressions	• The lecture included variable-message sign (VMS) system and mobile VMS, maintenance training and mobile VMS in Bosnia Herzegovina and Sri Lanka, introduction of Blinks, ITS services in India. • The following questions were raised by the trainees. - Do you have a business partner in Philippines? - Which products and services should we implement to address the situation in Metro Manila?

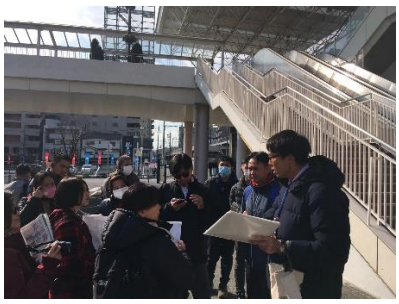


Lecture	Traffic and Transportation Policies in Toyota City
Overview and Trainees' Impressions	• The lecture included Traffic Town Action Plan, Public Transportation Basic Plan. • The following questions were raised by the trainees. - If bus operating subsidies are paid to private bus operators, how are the profits of private bus operators calculated? - Are there any private bus companies that run in the black even without payment of operating subsidies?



Source: JPT

Table 3.15: February 5, 2020

Site Visit	Facilities around Aichi Loop Line, Shin-Toyota Station and Meitetsu Toyotashi Station
Overview and Trainees' Impressions	• The site visit included City Center Environment Plan, City Center Future Design, Station Plaza Development Plan. • The following questions were raised by the trainees. - How do you consult with residents' organizations in the surrounding area? - Who will decide the rules for the use of the plaza in front of the station? - What is the division of roles between the public and private sectors with regard to the cost burden of station-front development and the increase in revenues associated with improved convenience?
		
Site Visit	**Activities of Toyota Eco-ful Town for Low Carbon Society**
Overview and Trainees' Impressions	• The site visit included activities of Toyota City for Sustainable Development Goals (SDGs), the introduction of hydrogen vehicles, the introduction of a hydrogen station, the introduction of a Smart House. • The following questions were raised by the trainees. - How many hydrogen stations are there throughout Japan? - How expensive are hydrogen vehicles compared to gasoline-powered vehicles? - What is the penetration rate of hydrogen vehicles? - Are there any incentives for buyers to purchase hydrogen vehicles? - How expensive are smart houses compared to ordinary houses? - How will smart houses provide electricity during bad weather?
		

Source: JPT

Table 3.16: February 6, 2020

Lecture	Wrap-up Meeting
Lecturer	**JICA Project Team**
Overview and Trainees' Impressions	• To summarize the findings from this training, the following three points should be emphasized. 1. Shift from manual to automation • One of the most impressive pieces of knowledge gained through this training was that various Japanese private companies have state-of-the-art technologies and services to solve and alleviate traffic congestion. • These private firms have maximized their performance by localizing their technologies and services to the target areas. • Living in a highly developed city like Metro Manila, where traffic congestion is more complex and severe, one would think that it would be extremely difficult to solve this problem manually without the support of advanced technologies such as those mentioned above.

Lecture	Wrap-up Meeting
	• However, the lecture showed that without the proper knowledge to use this so-called advanced technology, all efforts to implement it, including time and money, would be wasted or not fully effective. • In other words, we learned that in order to properly provide solutions, it is essential to first understand the nature of the current issues. 2. Importance of PDCA Cycle • The lecture also demonstrated the importance of pre- and post-project surveys and estimation of future traffic volumes. • The trainees were able to discuss the derivation of cost-effectiveness ratios using Vissim and the methods for comparative analysis and evaluation of the impact of multiple congestion control proposals on traffic conditions. 3. Role of governmental agencies • The lectures in Toyota City and Kawasaki City presented the systematic formulation and implementation process and methods related to appropriate urban planning that considers the convenience of all road users, such as pedestrian facilities, bicycle facilities, intersections, signals, parking, shoulder safety, and road lighting. • In addition, a lecture at the Ministry of Land, Infrastructure, Transport and Tourism showed the differences in traffic management methods for rural and urban arterial roads. • The lectures also emphasized the desirability of working to reduce problems along routes and networks as a whole, rather than focusing on independent problem areas when targeting specific areas.

Source: JPT

Part B: 2nd Study Trip to Japan

1 TRAINING PROGRAM OVERVIEW

1.1 Training Program Name

Traffic Management and Intelligence Transport System (ITS)

1.2 Training Program Period

October 25, 2022 ~ November 2, 2022

1.3 Trainees

10 members from MMDA as shown in Table 1.1.

Table 1.1: List of the Trainees

No.	Title	Name	Designation	Affiliation
1.	Mr.	Mark Edmon C. Navarro I	OIC	Office of the Assistant General Manager for Planning
2.	Mr.	Michael Gison	Director III	Physical Planning and Spatial Development Service
3.	Ms.	Neomie Recio	Director III	Traffic Engineering Center
4.	Mr.	Victor Maria Nuñez	Director III	Traffic Discipline Office for Enforcementt
5.	Ms.	Milagros Silvestre	Director II	Management Information System Staff
6.	Ms.	Sharon Gentalian	Director II	Public Affairs Staff
7.	Mr.	Francisco Jr. Pesino	Head	Traffic Signal Operations & Maintenance Division
8.	Ms.	Rianne Mae Bautista	Attorney IV	Legal and Legislative Affairs Staff
9.	Ms.	Monica Marie M. Mateo	Planning Officer II	Urban Development Division
10.	Mr.	Christian Gel M. Javier	Planning Officer III	Plans and Programs Formulation Division

Source: JPT

1.4 Training Accompanying Personnel

The training accompanying personnel are as follows.

(i) JICA training administrator & interpreter: Ms. Yoko Tange

(ii) JICA Project Team: Mr. Tsuyoshi Matsunuma (Deputy team leader & Traffic survey specialist)

Mr. Shinji Terawaki (Project coordinator & Pilot project implementor)

(iii) ALMEC Corporation Manila Office: Ms. Karen Hulleza Luna

2 TRAINING PROGRAM CONTENTS

2.1 Project Description

1) Project Background

In 2015, Metro Manila had a population of 12.87 million, and that figure is increasing at 1.7% a year. While the concentration is denser in the central areas of Metro Manila, the rate of suburbanization in the surrounding areas is also picking up. In addition, the number of registered vehicles has risen at 24.6% compared to 2016. For these reasons, traffic congestion in Metro Manila has become a major political and social problem. According to the “Formulation of Transportation Development Roadmap to Support Sustainable Development of Metropolitan Manila and Its Surrounding Areas,” which was conducted in 2014 with the support of JICA, the cost of transportation to the people in Metro Manila was PHP2.4 billion a day, and if no action would be taken, the cost was estimated to balloon to PHP6 billion by 2030.

Therefore, it is essential to solve traffic and transportation problems through a comprehensive action that has both hard and soft aspects, such as road and railway network, and a comprehensive traffic management plan, respectively, to support future economic development. Under such circumstances, the Japanese government was requested to conduct “The Project for Comprehensive Traffic Management Plan for Metro Manila.” In September 2018, the Record of Discussion was signed between the Japan International Cooperation Agency (JICA) and the Metropolitan Manila Development Authority (MMDA) to implement this technical cooperation.

2) Project Objectives and Expected Outputs

“The Project for Comprehensive Traffic Management Plan for Metro Manila” aims to formulate a comprehensive traffic management plan for the road sector in Metro Manila to manage traffic demand and increase traffic capacity, thereby improving mobility, connectivity, traffic environment, and safety. In doing so, the project will identify congested points, analyze the causes based on quantitative and scientific data, and formulate a comprehensive traffic management plan focusing on developing the capacity of institutions and personnel to plan, implement, evaluate, and improve traffic management measures.

The project is expected to achieve the following outputs:

(i) Data-driven identification of major traffic bottlenecks in Metro Manila and their detailed characteristics based on quantitative analysis;

(ii) Setting of the traffic management goal to pursue in five years and formulation of the MMDA's five-year action plan based on an analysis of the collected data and which will include the improvement measures for each major traffic bottleneck; and

(iii) Implementation of selected improvement measures and applying the lessons to finalize the five-year action plan so that the knowledge on comprehensive traffic management planning, implementation of traffic management (TM) measures, evaluation, and improvement is transferred to the personnel of the counterpart organizations.

3) Project Area

The project covers the 17 local government units (LGUs) comprising Metro Manila, i.e., the cities of Quezon, Manila, Caloocan, Pasig, Valenzuela, Taguig, Las Piñas, Parañaque,

Makati, Marikina, Muntinlupa, Pasay, Malabon, Mandaluyong, San Juan, and Navotas, and the municipality of Pateros, especially the roads managed by the MMDA.

4) Organization Involved in the Project

While the main counterpart in the project is the MMDA, the JICA Project Team will also coordinate with the other member organizations of the Joint Coordination Committee (JCC) and the Technical Working Group (TWG) to implement the project smoothly. These organizations are identified in the figure below.

JCC (Joint Coordination Committee)		
Chairperson (Project Director)	Undersecretary of MMDA	
Vice Chairperson (Deputy Project Director)	Assistant Secretary of MMDA	
Member	Philippines	•MMDA: Relevant Directors •Representatives of Relevant Departments DPWH, DOTr, NEDA and LGUs
	Japan	•Embassy of Japan •Chief Representative of JICA Philippine Office •JICA Experts •Members of JICA Missions
Provisional Member	Representatives of LTO, LTFRB, DICT, DENR and Others	

TWG (Technical Working Group)		
Chairperson (Project Director)	Director for Planning, MMDA	
Vice Chairperson (Deputy Project Director)	Director for Operation, MMDA Director for Financing and Administration, MMDA	
Member	Philippines	•Division Chief of MMDA: Personnal of Planning Personnal of Operation Personnal of Finance and Administration Personnal of Legal Department Personnal of Traffic Engineering Office Personnal of Flood Control and Sewerage Management Office •Representatives of Other Departments: DPWH, DOTr, NEDA and LGUs
	Japan	•Representative of JICA Philippine Office •JICA Experts •Members of JICA Missions
Provisional Member	Chiefs of LTO, LTFRB, DICT, DENR and Other Offices Concerned	

CWG (Counterpart Working Group)
The staff of Planning Office of MMDA leads the members from related office of C/P organizations as a team leader.

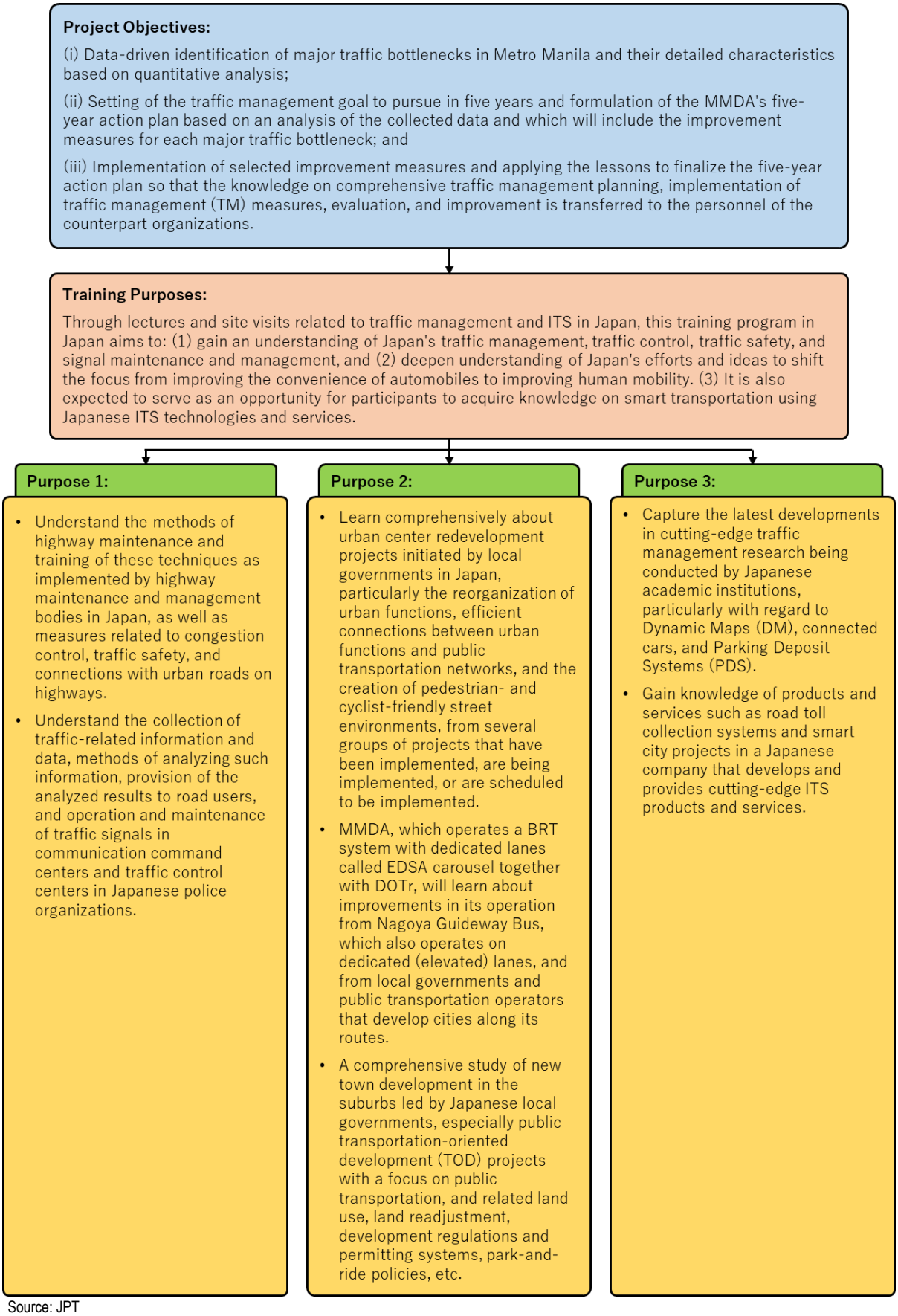
Source: JPT

Figure 2.1: Project Implementation Structure

2.2 Training Program

1) Training Purposes

Through lectures and site visits related to traffic management and ITS in Japan, this training program in Japan aims to: (i) gain an understanding of Japan's traffic management, traffic control, traffic safety, and signal maintenance and management, and (ii) deepen understanding of Japan's efforts and ideas to shift the focus from improving the convenience of automobiles to improving human mobility. (iii) It is also expected to serve as an opportunity for participants to acquire knowledge on smart transportation using Japanese ITS technologies and services.



Source: JPT

Figure 2.2: Overall Training Concept

2) Training Contents

In order to fulfill the above training purposes, lectures and site visits were conducted on the following items

(i) Understand the methods of highway maintenance and training of these techniques as implemented by highway maintenance and management bodies in Japan, as well as measures related to congestion control, traffic safety, and connections with urban roads on highways.

Understand the collection of traffic-related information and data, methods of analyzing such information, provision of the analyzed results to road users, and operation and maintenance of traffic signals in communication command centers and traffic control centers in Japanese police organizations.

(ii) Capture the latest developments in cutting-edge traffic management research being conducted by Japanese academic institutions, particularly with regard to Dynamic Maps (DM), connected cars, and Parking Deposit Systems (PDS).

(iii) MMDA, which operates a BRT system with dedicated lanes called EDSA carousel together with DOTr, will learn about improvements in its operation from Nagoya Guideway Bus, which also operates on dedicated (elevated) lanes, and from local governments and public transportation operators that develop cities along its routes.

(iv) Gain knowledge of products and services such as road toll collection systems and smart city projects in a Japanese company that develops and provides cutting-edge ITS products and services.

(v) Learn comprehensively about urban center redevelopment projects initiated by local governments in Japan, particularly the reorganization of urban functions, efficient connections between urban functions and public transportation networks, and the creation of pedestrian- and cyclist-friendly street environments, from several groups of projects that have been implemented, are being implemented, or are scheduled to be implemented.

A comprehensive study of new town development in the suburbs led by Japanese local governments, especially public transportation-oriented development (TOD) projects with a focus on public transportation, and related land use, land readjustment, development regulations and permitting systems, park-and-ride policies, etc.

3) Overview of Site Visits and Lectures

The dates, locations, contents of site visits and lectures, etc. are shown in Table 2.1.

Table 2.1: Training Schedule

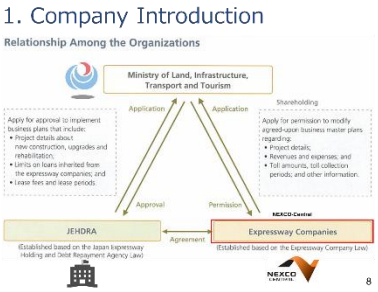
No	Date Location	Contents of Site Visits and Lectures	Lecturers, Place of Site Visits	Places to Stay
1	Gifu Oct. 27	(Lecture) Good operation of expressways, including traffic congestion countermeasures and traffic safety measures on expressways	Mr. Hisaya Hirose Central Nippon Expressway Company Limited	Nagoya
2		(Site Visit) Highway maintenance and management and training methods for these techniques	Mr. Hiroshi Miura Central Nippon Highway Engineering Nagoya Co., Ltd. @ E-MAC Technical Training Center	

No	Date Location	Contents of Site Visits and Lectures	Lecturers, Place of Site Visits	Places to Stay
3	Nagoya Oct. 27	(Site Visit) Collection of traffic-related information and data, methods of analyzing such information, provision of the analyzed results to road users, and operation and maintenance of traffic signals by police organizations	Mr. Koji Yamamoto Aichi Prefectural Police HQ @Communication Control Room, Traffic Command Center	
4	Nagoya Oct. 28	(Lecture) State-of-the-art traffic management research, especially Dynamic Maps (DM), Connected Car, Parking Deposit System (PDS)	Prof. Dr. Takayuki Morikawa Global Research Institute for Mobility in Society Research Leader, Mobility Innovation Center, Nagoya University	Nagoya
5		(Lecture and site visit) Operation of Nagoya Guideway Buses in elevated dedicated lanes by local governments and public transportation operators, and implementation of urban development projects along the bus route	Mr. Ryoji Sayase Nagoya GuideWay-Bus Co., Ltd. Mr. Atsushi Fukuda Housing and Urban Development Bureau, Nagoya City @ Trial ride of Nagoya Guideway Bus	
6	Kobe Oct. 31	(Lecture and site visit) State-of-the-art ITS products and services by private companies, especially road toll collection systems and smart city projects	Mr. Yoshifumi Hayakawa Mr. Takashi Kouyama Mitsubishi Heavy Industries Machinery Systems, Ltd. @ Kobe Factory	Kobe
7	Kobe Oct. 31	(Lecture and site visit) Urban center redevelopment projects initiated by local governments, especially reorganization of urban functions, the efficient connection of urban functions and public transportation networks, and creation of pedestrian- and bicycle-friendly street environments	Mr. Katsushi Suzuki Planning and Coordination Bureau, Kobe City Mr. Keigo Hamada Kobe Residential Management Authority @ Kobe Sannomiya Area	
8	Kobe Nov. 1	(Lecture and site visit) New town development in suburbs led by local governments, especially public transportation-oriented development (TOD) projects with a focus on public transportation, and related land use, land readjustment, development regulations and permitting systems, and park-and-ride policies	Mr. Keigo Hamada Kobe Residential Management Authority @ Seishin New Town, Trial ride of Kobe Municipal Subway, Highways, Akashi Kaikyo Bridge	Kobe
9	Kobe Nov. 2	• Wrap-up meeting	JICA, JICA Project Team	Kobe

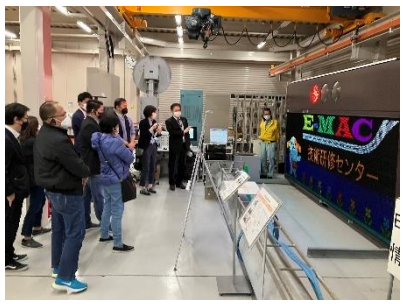
Source: JPT

3 CONTENTS OF SITE VISITS AND LECTURES

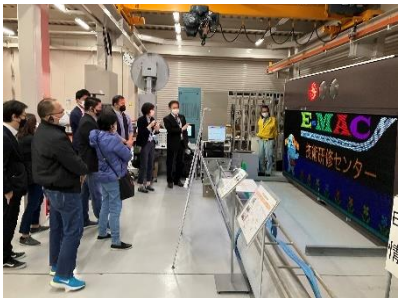
Table 3.1: October 27, 2022

Lecture	Expressway Business of Central Nippon Expressway Company Limited		
Lecturer	**Mr. Hisaya Hirose, Central Nippon Expressway Company Limited**		
Overview and Trainees' Impressions	• The lecture included an explanation of the good operation of expressways, including traffic congestion countermeasures and traffic safety measures on expressways. • There was much interest in the scope of responsibility and authority for expressway ownership and maintenance, the division of roles with other authorities, the functionality and implementation costs of ETC systems in achieving efficiency in toll collection, and public consultation when constructing new expressways.		
		
Lecture	Division of roles among related entities	Workflow for new expressway construction	

Source: JPT

Site Visit	E-MAC Technical Training Center, Central Nippon Highway Engineering Nagoya Co., Ltd.		
Explainer	**Mr. Hiroshi Miura, Central Nippon Highway Engineering Nagoya Co., Ltd.**		
Overview and Trainees' Impressions	• During the site visit, the trainees experienced and learned about highway maintenance and management and training methods for these techniques through the facilities of the E-MAC Technical Training Center. • In Metro Manila, there is no nationwide uniform manual or guideline for how to respond to actual traffic accidents or damage to facilities caused by disasters on expressways. In addition, there is no facility that can provide comprehensive learning in terms of passing on response methods and improving standards, so for the trainees, the establishment of a facility by the road administrator for the purpose of training in operation and maintenance management was a surprise in itself.		
			
Variable-message sign (VMS)	Reproduction of accident response in a tunnel	Experience in Concrete Pounding Inspection	
Site Visit	**Communication Control Room, Traffic Command Center, Aichi Prefectural Police HQ**		
Explainer	**Mr. Koji Yamamoto, Aichi Prefectural Police HQ**		
Overview and Trainees' Impressions	• The site visit included the collection of traffic-related information and data, methods of analyzing such information, provision of the analyzed results to road users, and operation and maintenance of traffic signals by the police organization.		

Site Visit	E-MAC Technical Training Center, Central Nippon Highway Engineering Nagoya Co., Ltd.
Explainer	Mr. Hiroshi Miura, Central Nippon Highway Engineering Nagoya Co., Ltd.
Overview and Trainees' Impressions	• During the site visit, the trainees experienced and learned about highway maintenance and management and training methods for these techniques through the facilities of the E-MAC Technical Training Center. • In Metro Manila, there is no nationwide uniform manual or guideline for how to respond to actual traffic accidents or damage to facilities caused by disasters on expressways. In addition, there is no facility that can provide comprehensive learning in terms of passing on response methods and improving standards, so for the trainees, the establishment of a facility by the road administrator for the purpose of training in operation and maintenance management was a surprise in itself.



Variable-message sign (VMS)

Reproduction of accident response in a tunnel

Experience in Concrete Pounding Inspection

Site Visit	Communication Control Room, Traffic Command Center, Aichi Prefectural Police HQ
Explainer	Mr. Koji Yamamoto, Aichi Prefectural Police HQ
	• In Metro Manila, traffic controllers are not police, but MMDA enforcement officers delegated by the Land Transportation Office (LTO), and the site visit was conducted with an interest in traffic control and emergency response. • The trainees were interested not only in the technical aspects of the centers and cameras used to collect traffic-related information and data, as well as the types and specifications of traffic signals and their diffusion rates, but also in the operational aspects, such as the deployment of enforcement officers, emergency response, and necessary personnel, organization, and systems.

Communication Control Room

Traffic Command Center

Explanation of Police Services

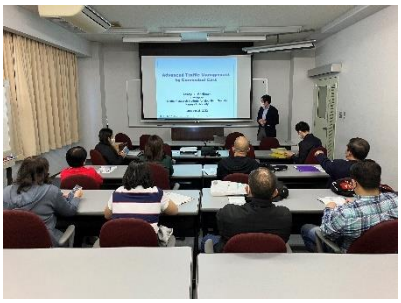
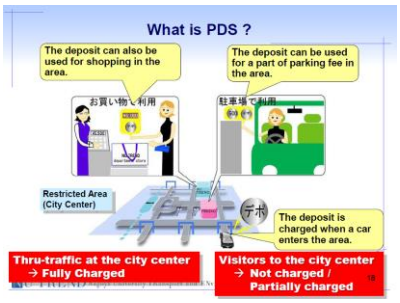
* Since photography is prohibited in the Communication Control Center and Traffic Command Center for security reasons, photographs of these facilities are taken from the Aichi Prefectural Police website.

Source: JPT

Table 3.2: October 28, 2022

Lecture	State-of-the-Art Traffic Management Research, Especially Dynamic Maps (DM), Connected Car, Parking Deposit System (PDS)
Lecturer	Prof. Dr. Takayuki Morikawa, Global Research Institute for Mobility in Society Research Leader, Mobility Innovation Center, Nagoya University
Overview and Trainees' Impressions	• The lecture included an overview of the history of ITS and mobility, multiple technologies (Dynamic Map (DM), Connected Car) that have been developed in CASE (C: Connected, A: Autonomous, S: Serviced, E: Electric), the keyword for the next generation of automobile transportation, as well as the Parking Deposit System (PDS) as a solution for road pricing, which has difficult social demand characteristics.

Lecture	State-of-the-Art Traffic Management Research, Especially Dynamic Maps (DM), Connected Car, Parking Deposit System (PDS)
	• In the 5-year action plan, continuous updating of the traffic management database and its use in measures to reduce traffic congestion is positioned as one of the strategies, and there was much interest in the Dynamic Map (DM), which consists of multiple data layers, with specific technical requirements and a timeline for its realization. • The parking deposit system (PDS) was discussed as an alternative idea to road pricing that has not progressed well in Metro Manila, taking social acceptability into consideration, and the challenges of gaining consensus from many stakeholders on the feasibility of introducing the system in Metro Manila's CBD.

		
Lecture	Concept of Dynamic Map	Concept of Parking Deposit System

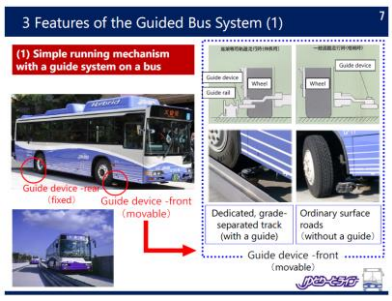
Source: JPT

Table 3.3:

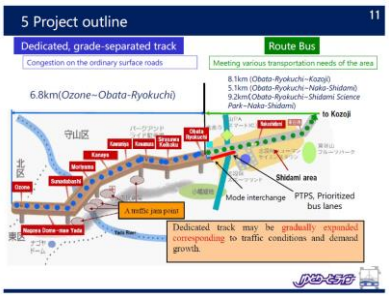
Lecture and Site Visit	Business of Nagoya GuideWay-Bus Co., Ltd. Command Center, Maintenance facility, and bus fleet of Nagoya Guideway Bus
Lecturer and Explainer	Mr. Ryoji Sayase, Nagoya GuideWay-Bus Co., Ltd. Mr. Atsushi Fukuda, Housing and Urban Development Bureau, Nagoya City
Overview and Trainees' Impressions	• In the lecture, Nagoya City and Nagoya Guideway Bus Company, a public transportation operator, explained the operation of the Nagoya Guideway Bus, which runs in an elevated dedicated lane, and the urban development projects along the route. During the site visit, the participants visited the Nagoya Guideway Bus control center and maintenance facility and were briefed on the specifications of the bus fleet. • In Metro Manila, the implementation of capacity restrictions on public transportation in the Covid-19 Pandemic has significantly reduced the transportation capacity of MRT1, which operates along the EDSA. In response, a BRT system with dedicated lanes, known as the EDSA carousel, was urgently introduced to cover the reduction in transportation capacity, but new issues arose, such as traffic processing at intersections and the flow line connecting stops and sidewalks, which made it inconvenient for passengers to board and alight. • There was much interest in the background to the introduction of the Nagoya Guideway Bus, a new concept with elevated bus lanes (some of which run on a flat surface), and the effects of its introduction (reduced traffic congestion, increased number of users, etc.).

		
Guideway Bus at Osone Bus Station	Explanation of service routes and timetables	Explanation of bus vehicles at the maintenance facility

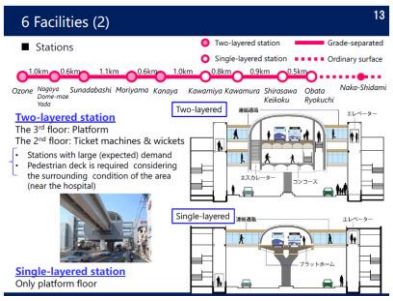
Lecture and Site Visit	Business of Nagoya GuideWay-Bus Co., Ltd. Command Center, Maintenance facility, and bus fleet of Nagoya Guideway Bus



Features of Guideway bus fleet



Characteristics of routes in operation and the surrounding area



Cross-sectional structure of a station in an elevated section

Source: JPT

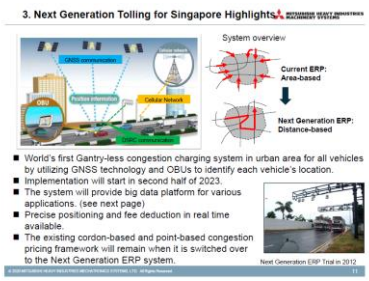
Table 3.4: October 31, 2022

Lecture and Site Visit	State-of-the-Art ITS Products and Services, Especially Road Toll Collection Systems and Smart City Projects Kobe Factory at Mitsubishi Heavy Industries Machinery Systems, Ltd.
Lecturer and Explainer	Mr. Yoshifumi Hayakawa, Mr. Takashi Kouyama, Mitsubishi Heavy Industries Machinery Systems, Ltd.
Overview and Trainees' Impressions	• In the lecture, Mitsubishi Heavy Industries Machinery Systems, Ltd. explained its cutting-edge ITS products and services, especially road toll collection systems and smart city projects. • During the site visit, the machines and systems that make up the ETC system, the stable supply, and quality control system in the production line, and examples of actual applications of the ETC system at sites where the system has been installed were explained. • In Metro Manila, traffic congestion and traffic accidents are caused not only by road operations at highway entrances, exits, mergers, and turnouts, but also by delays due to toll collection failures caused by analog systems and poorly maintained ETC systems. • Therefore, many specific questions related to the introduction of the system, such as the advantages of the ETC system manufactured by Mitsubishi Heavy Industries Machinery Systems, Ltd. compared to its competitors, its market share in Japan and around the world, and the cost of introducing the system was found.

Lecture

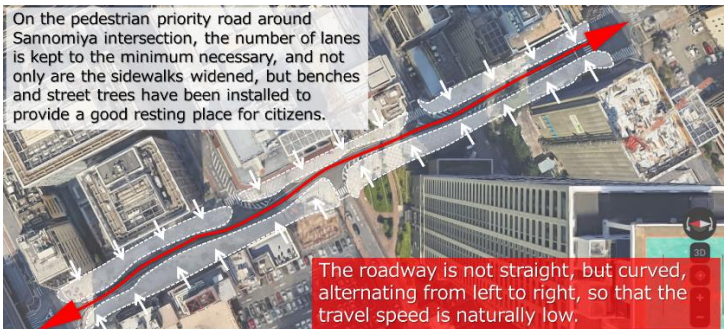
Explanation of ETC system components

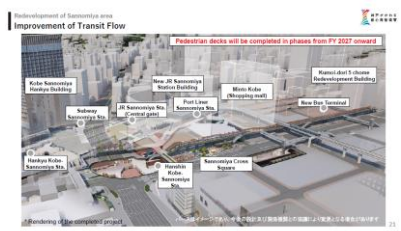
Explanation of quality control in manufacturing

Lecture and Site Visit	State-of-the-Art ITS Products and Services, Especially Road Toll Collection Systems and Smart City Projects Kobe Factory at Mitsubishi Heavy Industries Machinery Systems, Ltd.	
		
Road Pricing System in Singapore	Next-generation Electronic Road Pricing (ERP)	Application of next-generation ERP to big data utilization

Source: JPT

Table 3.5:

Lecture and Site Visit	Urban Center Redevelopment Projects Initiated by Local Government Kobe Sannomiya Area	
Lecturer and Explainer	Mr. Katsushi Suzuki, Planning and Coordination Bureau, Kobe City Mr. Keigo Hamada, Kobe Residential Management Authority	
Overview and Trainees' Impressions	• The lecture covered redevelopment projects in the city center of Kobe City called Sannomiya led by the local government, Kobe City, specifically the reorganization of urban functions, efficient connections between urban functions and the public transportation network, and the creation of pedestrian- and bicycle-friendly street environments. • During the site visit, various projects that have been implemented, are being implemented, or are planned to be implemented in the Sannomiya area were covered. As for buildings, the trainees confirmed with the lecturers the administrative services (city hall, cultural activities, exercise, recreation, etc.), commercial services (shopping mall, hotel, etc.), and transportation services (bus terminal) that are planned to be housed. • Many practical questions were asked about whether road users would agree and cooperate with the restrictions placed on private traffic in the Sannomiya area, which is in the heart of the city, and how traffic would be handled for the amount of traffic that could not use the roads in the Sannomiya area. • To respond these questions, various countermeasures made by Kobe City were explained. In these countermeasures, the following items are included; the social experiments repeatedly conducted under various condition settings to minimize the obstruction of traffic flow, measures being taken to distinguish between through traffic and internal traffic, and operating lanes and design intersections in such a way as to encourage detour of through traffic.	
		
Benches and street trees installed on the sidewalk	Various measures for pedestrian priority roads in city centers	

Lecture and Site Visit	Urban Center Redevelopment Projects Initiated by Local Government Kobe Sannomiya Area	
		
Continuous pedestrian deck centered on Sannomiya Intersection	Station Square (&3PARK) installed in front of JR Sannomiya Station	Sankita Street designated as a HOKOMICHI*

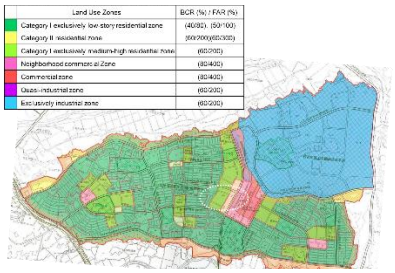
* HOKOMICHI: The Road Law was revised on November 25, 2020 to establish a system of roads for enhancing pedestrian convenience (commonly known as "HOKOMICHI"). This system has made it possible to use road space for various purposes and to utilize road space for the revitalization of the city.

Source: JPT

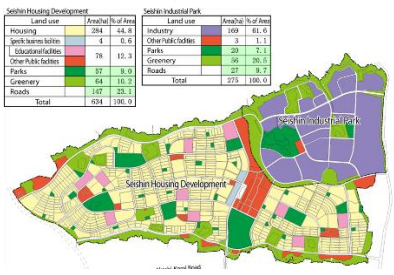
Table 3.6: November 1, 2022

Lecture and Site Visit	New Town Development in Suburbs Led by Local Government Seishin New Town, Trial ride of Kobe Municipal Subway, Highways, Akashi Kaikyo Bridge	
Lecturer and Explainer	Mr. Keigo Hamada, Kobe Residential Management Authority	
Overview and Trainees' Impressions	• The lecture provided a comprehensive explanation of new town development in the suburbs of Kobe City led by the local government, Kobe City, particularly the public transportation-oriented development (TOD) project with public transportation as its main focus, and related land use, land readjustment, development regulations and permission system, and park-and-ride policies. • During the site visit, the trainees first overviewed the layout of the plots and facilities (stations, schools, urban infrastructure facilities, etc.) in the new town while traveling by bus, and then confirmed the specifications of the facilities around the station (P&R facilities, bicycle parking facilities, pedestrian deck, etc.) on foot from Seishin Chuo Station on the Kobe Municipal Subway. In addition, a trial ride on the Kobe Municipal Subway was taken and the connection between the new town and the neighboring city center of Kobe City and Awaji Island via the expressway was confirmed. • Since Seishin New Town used to be agricultural land, there was much interest in institutional innovations such as land use conversion, urban development regulations, building height restrictions that maintain a favorable living environment within the new town, and maintenance of urban infrastructure, as well as the engineering of development costs.	
		
Terminal station of Kobe Municipal Subway (Seishin-chuo Station)	Redevelopment of public facilities & high-rise residential complexes near the station	Ward office buildings and P&R facilities near the station

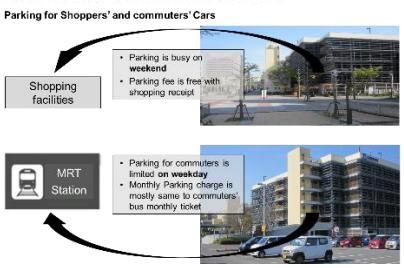
Lecture and Site Visit	New Town Development in Suburbs Led by Local Government Seishin New Town, Trial ride of Kobe Municipal Subway, Highways, Akashi Kaikyo Bridge



FAR Regulations in Within Seishin New Town



Land use in Seishin New Town



P&R facility operations changed on different days of the week

Source: JPT

Table 3.7: November 2, 2022

Lecture	Wrap-up Meeting
Lecturer	**JICA, JICA Project Team**
Overview and Trainees' Impressions	• The project developed a comprehensive traffic management plan for Metro Manila, with MMDA as the implementing agency. • In implementing the above-mentioned comprehensive traffic management plan, this training course provided trainees with an understanding of the structure and division of roles of the Japanese government regarding traffic management, as well as a look at the actual traffic management facilities, road improvement projects, and urban development and integrated transportation infrastructure. • In addition, lectures and site visits were conducted on ITS products and services provided by Japanese private companies that contribute to traffic management, as well as cutting-edge traffic management research being conducted at academic institutions, with the aim of providing MMDA with hints for future implementation of comprehensive traffic management plans. • At the Wrap-up Meeting, the trainees agreed that Japan's automated collection, analysis, and provision of road traffic information to road users have made people's lives more efficient, that these processes are the same for public transportation and highways, and that if similar operations can be realized in Metro Manila, the lives of Metro Manila residents will be more productive. - In this training course, with the exception of the lecture at Nagoya University, which discussed future developments, all training items were structured so that the trainees visited the sites discussed in the lecture after the lecture, and the trainees commented that they could easily visualize the implementation in Metro Manila because they were able to observe in the afternoon what they had learned in the classroom. - Throughout the entire session, many questions were raised about ITS products and services, as well as public transportation-based new town development (TOD), indicating the high level of interest among the trainees. • Many of the trainees asked practical questions about ITS products and services, not only about functionality but also about operational difficulties and implementation and operating costs. • With regard to TOD, there were many specific questions about how the city is guiding appropriate development by introducing a highly accurate public transportation system in an area that was once used for agriculture, thereby creating a good living and commuting environment despite its distance from the city center.

Source: JPT

APPENDIX L

Study Trips in Japan

APPENDIX L

Part A: 1st Study Trip to Japan

1 TRAINING PROGRAM OVERVIEW

1.1 Training Program Name

Traffic Management Planning

1.2 Training Program Period

26 January 2020–6 February 2020

1.3 Trainees

11 members from MMDA as shown in Table 1.1.

Table 1.1: List of the Trainees

No.	Name	Designation	Affiliation
1.	Ms. Arlene N. Parafina	Project Evaluation Officer III	Office of the Asst. Gen. Manager for Planning
2.	Mr. Lou Martin Tabilog	Computer Operator II	Office of the Asst. Gen. Manager for Planning
3.	Engr. Ryan Tacbad	Engineer III	Office of the Asst. Gen. Manager for Operations
4.	Mr. Vincent Joel Recio	Computer Programmer II	Office of the Asst. Gen. Manager for Operations
5.	Mr. Steve Ovett Antonio	Engineer III	Office of the Asst. Gen. Manager for Operations
6.	Ms. Nimfa Espela	Project Evaluation Officer II	Office of the Asst. Gen. Manager for Operations
7.	Engr. Jemima Ann Ado	Engineer II	Office of the Asst. Gen. Manager for Operations
8.	Mr. Anthony Raymond Tuazon	Special Operations Officer II	Office of the Asst. Gen. Manager for Operations
9.	Mr. Dennis Marcos	Traffic Discipline Officer III	Office of the Asst. Gen. Manager for Operations
10.	Mr. Jeffrey Torres	Traffic Operations Officer II	Office of the Asst. Gen. Manager for Operations
11	Mr. John Paul Manalo	Computer Programmer II	Office of the Chairman

Source: JPT

2 TRAINING PROGRAM CONTENTS

2.1 Project Description

1) Project Background

In 2015, Metro Manila had a population of 12.87 million, and that figure is increasing at 1.7% a year. While the concentration is denser in the central areas of Metro Manila, the rate of suburbanization in the surrounding areas is also picking up. In addition, the number of registered vehicles has risen at 24.6% compared to 2016. For these reasons, traffic congestion in Metro Manila has become a major political and social problem. According to the "Formulation of Transportation Development Roadmap to Support Sustainable Development of Metropolitan Manila and Its Surrounding Areas," which was conducted in 2014 with the support of JICA, the cost of transportation to the people in Metro Manila was PHP2.4 billion a day, and if no action would be taken, the cost was estimated to balloon to PHP6 billion by 2030.

Therefore, it is essential to solve traffic and transportation problems through a comprehensive action that has both hard and soft aspects, such as road and railway network, and a comprehensive traffic management plan, respectively, to support future economic development. Under such circumstances, the Japanese government was requested to conduct "The Project for Comprehensive Traffic Management Plan for Metro Manila." In September 2018, the Record of Discussion was signed between the Japan International Cooperation Agency (JICA) and the Metropolitan Manila Development Authority (MMDA) to implement this technical cooperation.

2) Project Objectives and Expected Outputs

"The Project for Comprehensive Traffic Management Plan for Metro Manila" aims to formulate a comprehensive traffic management plan for the road sector in Metro Manila to manage traffic demand and increase traffic capacity, thereby improving mobility, connectivity, traffic environment, and safety. In doing so, the project will identify congested points, analyze the causes based on quantitative and scientific data, and formulate a comprehensive traffic management plan focusing on developing the capacity of institutions and personnel to plan, implement, evaluate, and improve traffic management measures.

The project is expected to achieve the following outputs:

(i) Data-driven identification of major traffic bottlenecks in Metro Manila and their detailed characteristics based on quantitative analysis;

(ii) Setting of the traffic management goal to pursue in five years and formulation of the MMDA's five-year action plan based on an analysis of the collected data and which will include the improvement measures for each major traffic bottleneck; and

(iii) Implementation of selected improvement measures and applying the lessons to finalize the five-year action plan so that the knowledge on comprehensive traffic management planning, implementation of traffic management (TM) measures, evaluation, and improvement is transferred to the personnel of the counterpart organizations.

3) Project Area

The project covers the 17 local government units (LGUs) comprising Metro Manila, i.e., the cities of Quezon, Manila, Caloocan, Pasig, Valenzuela, Taguig, Las Piñas, Parañaque,

Makati, Marikina, Muntinlupa, Pasay, Malabon, Mandaluyong, San Juan, and Navotas, and the municipality of Pateros, especially the roads managed by the MMDA.

4) Organization Involved in the Project

While the main counterpart in the project is the MMDA, the JICA Project Team will also coordinate with the other member organizations of the Joint Coordination Committee (JCC) and the Technical Working Group (TWG) to implement the project smoothly. These organizations are identified in the figure below.

JCC (Joint Coordination Committee)		
Chairperson (Project Director)	Undersecretary of MMDA	
Vice Chairperson (Deputy Project Director)	Assistant Secretary of MMDA	
Member	Philippines	•MMDA: Relevant Directors •Representatives of Relevant Departments DPWH, DOTr, NEDA and LGUs
	Japan	•Embassy of Japan •Chief Representative of JICA Philippine Office •JICA Experts •Members of JICA Missions
Provisional Member	Representatives of LTO, LTFRB, DICT, DENR and Others	

TWG (Technical Working Group)		
Chairperson (Project Director)	Director for Planning, MMDA	
Vice Chairperson (Deputy Project Director)	Director for Operation, MMDA Director for Financing and Administration, MMDA	
Member	Philippines	•Division Chief of MMDA: Personnal of Planning Personnal of Operation Personnal of Finance and Administration Personnal of Legal Department Personnal of Traffic Engineering Office Personnal of Flood Control and Sewerage Management Office •Representatives of Other Departments: DPWH, DOTr, NEDA and LGUs
	Japan	•Representative of JICA Philippine Office •JICA Experts •Members of JICA Missions
Provisional Member	Chiefs of LTO, LTFRB, DICT, DENR and Other Offices Concerned	

CWG (Counterpart Working Group)
The staff of Planning Office of MMDA leads the members from related office of C/P organizations as a team leader.

Source: JPT

Figure 2.1: Project Implementation Structure

2.2 Training Program

1) Training Purposes

Study trips to Japan aim to deepen participant's understanding of the following three points through lectures and site visits related to traffic management in Japan. For the first study trip, the training objectives are as follows: (1) Identify traffic bottlenecks based on quantitative data, elucidate the causes and make countermeasures. (2) Formulate an action plan for several years and update it regularly. (3) Implement measures based on the action plan and evaluate and improve them. To fulfill these training objectives, lectures and site visit were conducted with the following considerations:

(i) Understand how to define traffic congestion, how to extract traffic bottlenecks, and how to have a common understanding among institutions.

(ii) Understand how traffic management data is collected.

(iii) Know how to create and operate a traffic management database and the examples of collaboration between government agencies and private organizations.

(iv) Understand how to reproduce the current situation, analyze the cause of traffic congestion, examine countermeasures and evaluate cost and impact by simulation using VISSIM and STRADA.

(v) Know the practical cases of ICT / ITS related to traffic management.

(vi) Understand what coordination should be made among central governments, local governments and private organizations in the process of developing urban transport policies. (Council structure, division of roles of each organization, budget division, etc.)

(vii) Understand how to proceed with the process of data collection and analysis, planning, implementing and monitoring measures, and how information is shared within the organization.

(viii) Understand how to create an internal manual for the particularly important matters above-mentioned.

(ix) Learn about application cases of automatic traffic data collection using image processing technology of Japanese private companies.

(x) Know the latest technology related to traffic management in Japan.

2) Overview of Site Visits and Lectures

The dates, locations, contents of site visits and lectures, etc. are shown in Table 2.1.

Table 2.1: Training Schedule

No.	Date	Organization	Theme	Content of Lectures and Site Visits
1	Jan. 27th	Ministry of Land, Infrastructure, Transport and Tourism (MLIT)	[Lecture] Effects of Road Maintenance	• Economic Effects of Road Maintenance • Effects of Ordinary Road Maintenance • Effects of Ring Road Maintenance in Urban Area • Effects of Expressway Maintenance
2			[Lecture] Road Transportation Management in Urban Area (Congestion Countermeasures)	• Current Situation of Traffic Congestion in Japan • Countermeasures on Traffic Congestion • Countermeasure by Roadside Facilities • Application of New Technology to Traffic Congestion
3	Jan. 28th	Chiba Pref. Police	[Lecture and Site Visit] Activities of Chiba Pref. Police on Traffic	• Organization and roles of Chiba Pref. Police • Prevention of Traffic Accidents • Traffic Command Center

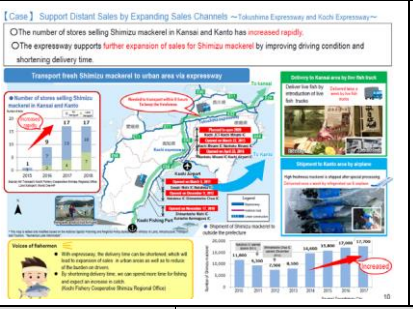
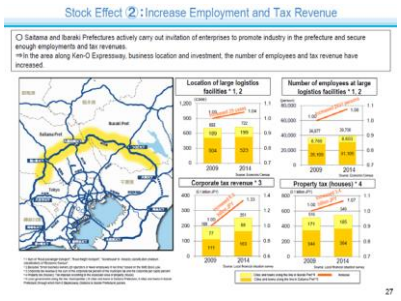
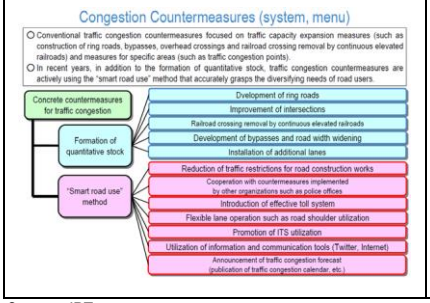
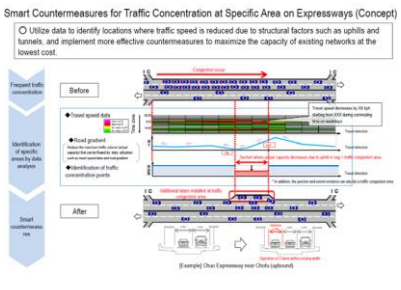
No.	Date	Organization	Theme	Content of Lectures and Site Visits
			Management	• Communication Control Center
4		Kawasaki City Government	[Lecture] Traffic and Transportation Policies in Kawasaki City	• Urban Development Master Plan • Comprehensive Urban Transportation Plan • Current Situation and Characteristics of Transportation in Kawasaki City • Projects based on Comprehensive Urban Transportation Plan • Key Countermeasures on Traffic Issues in Kawasaki City
5			[Site Visit] Facilities around JR Kawasaki Station	• Bicycle Pushing and Walking zone • Cooperative Cargo Handling Area • Bus Priority Lane • Bath Bay • Universal Designed Taxi • Automatic Bicycle Parking Lot, etc.
6	Jan. 29th	Iwane Laboratories, Ltd.	[Lecture] Road Traffic Management by 3D Visualization Technology	• Mobile Mapping System • Customized Software System Development • Artificial Intelligence (AI) by Machine learning
7		VICS Center	[Lecture] Vehicle Information and Communication System (VICS)	• System Development and Operation related to Collection, Processing, Editing and Transmission of Road Traffic Information
8		PTV Group Japan Ltd.	[Lecture] Solution by the software related to Traffic Analysis, Hands-on training on VISSIM	• Transportation Software • VISSIM Features • Basic Usage of VISSIM
9				• Application of VISSIM (for professionals)
10		Japan Railways (JR) East	[Site Visit] Multi Modal Hub (Shinjuku Bus Terminal)	• Functioning as a Traffic Node and Multi Modal Hub • Introduction of facilities in Shinjuku Bus Terminal
11	Jan. 30th	Metropolitan Expressway Company Ltd.	[Lecture and Site Visit] Tokyo Metropolitan Expressway	• Business Outline of Metropolitan Expressway Co., Ltd. • Traffic Congestion Countermeasures on the Metropolitan Expressway
12				• Introduction of Yamate Tunnel, Escort Light, Ohashi JCT and Rainbow Bridge
13				• Operation of Traffic Command Center
14				• Operation of Motorcycle Patrol Group and Meguro Sky Garden
15	Jan. 31st	Institute of Industrial Science, The University of Tokyo	[Lecture] The Latest science and technology related to Road Traffic Management	• Bottlenecks, Congestion and general Countermeasures from a Traffic Engineering Perspective • Introduction of the Latest Trends in Worldwide Traffic Management Studies
16		NEC Corporation	[Lecture] Application of Image Recognition Technology to Road Traffic Management	• Technologies and Services related to Automatic Traffic Volume Count and Detection of Violating vehicles by Using Cameras
17		ZERO-SUM, LTD.	[Lecture] Application of ITS to Road Traffic Management	• Automotive ITS Technology • Smart Road Solution by Using Road ITS Technology • Traffic Information Transmission System • V2X (Emergency Vehicle Priority System) • Introduction of Traffic Management ITS in India

No.	Date	Organization	Theme	Content of Lectures and Site Visits
18	Feb. 2nd	Mobility Design KOBO Inc.	[Lecture and Site Visit] Practical Case Study on VISSIM	• Reproduction of the Current Situation, Factor Analysis of Traffic Congestion, Study of Countermeasures, Evaluation of Cost and Impact by VISSIM
19	Feb. 3rd			• Case Study: Intersection Improvement and Traffic Signal Adjustment at intersection in Yamanakako Village
20	Feb. 4th	Nagoya Electric Works Co., Ltd.	[Lecture and Site Visit] Application of ITS to Road Traffic Management	• Variable-message Sign (VMS) system and Mobile VMS • Maintenance Training and Mobile VMS in Bosnia Herzegovina and Sri Lanka • Introduction of Blinks • ITS services in India
21	Feb. 4th	Toyota City Government	[Lecture] Traffic and Transportation Policies in Toyota City	• Traffic Town Action Plan • Public Transportation Basic Plan
22	Feb. 5th	Toyota City Government	[Site Visit] Facilities around Aichi Loop Line, Shin-Toyota Station and Meitetsu Toyotashi Station	• City Center Environment Plan • City Center Future Design • Station Plaza Development Plan
23		Toyota Eco-ful Town	[Site Visit] Activities of Toyot Eco-ful Town for Low Carbon Society	• Activities of Toyota City for Sustainable Development Goals (SDGs) • Introduction of Hydrogen Vehicles • Introduction of Hydrogen Station • Introduction of Smart House

Source: JPT

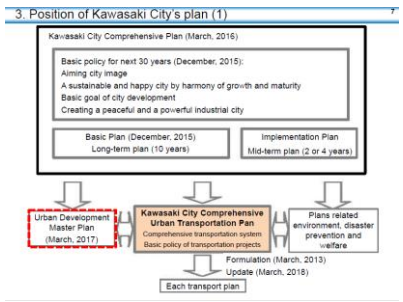
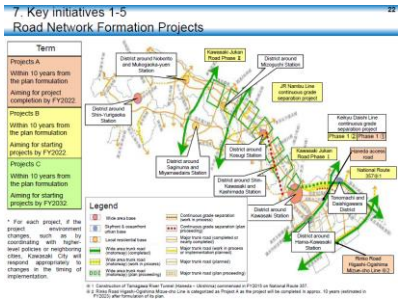
3 CONTENTS OF SITE VISITS AND LECTURES

Table 3.1: January 27, 2020

Lecture	Effects of Road Maintenance
Overview and Trainees' Impressions	The lecture included the economic effects of road maintenance, the effects of ordinary road maintenance, the effects of ring road maintenance in an urban area, effects of expressway maintenance. The following questions were raised by the trainees. What is the jurisdiction of the authorities involved in identifying areas of traffic accident concentration? Under what entity's jurisdiction is the identification of traffic accident concentration areas? How does the Ministry of Land, Infrastructure, Transport and Tourism provide leadership in joint committees with local residents? How is land acquisition for infrastructure development handled? How does the Ministry of Land, Infrastructure, Transport and Tourism coordinate the construction of highways with the private sector? What is the road construction process like?
		
Lecture	**Road Transportation Management in Urban Area (Congestion Countermeasures)**
Overview and Trainees' Impressions	• The lecture included the current situation of traffic congestion in Japan, countermeasures on traffic congestion, countermeasure by roadside facilities, application of new technology to traffic congestion • The following questions were raised by the trainees. - How automated is the collection of traffic volume data? - How accurate is the automatic collection of traffic volume data? - What indicators are most frequently used to measure traffic congestion? - Has the toll price adjustment been effective in reducing traffic concentration? - How many traffic counters are needed to automatically collect traffic volumes by direction at one intersection? - What is the incentive to install ETC? - Does the measurement accuracy of traffic counters decrease with weather conditions? - Will localized traffic congestion countermeasures, such as those at a single intersection, simply postpone the problem (i.e., move it to the next intersection)?
		

Source: JPT

Table 3.2: January 28, 2020_1

Lecture and Site Visit	Activities of Chiba Pref. Police on Traffic Management
Overview and Trainees' Impressions	• The lecture and site visit included the organization and roles of Chiba Pref. Police, prevention of traffic accidents, traffic command center, communication control center. • The following questions were raised by the trainees? - How many staff members are stationed at a traffic control center at any given time? - How are traffic signals that are not connected to the traffic control center controlled? How are traffic signals that are not connected to the traffic control center controlled? - Traffic congestion information obtained from traffic congestion sensors installed on the roads in your jurisdiction is displayed on a monitor at the traffic control center. How often is this information updated?
	
	
Lecture	**Traffic and Transportation Policies in Kawasaki City**
Overview and Trainees' Impressions	• The lecture included an urban development master plan, a comprehensive urban transportation plan, the current situation and characteristics of transportation in Kawasaki City, projects based on a comprehensive urban transportation plan, and key countermeasures for traffic issues in Kawasaki City. • The following questions were raised by the trainees. - How are universal cabs different from regular cabs? - Why are they promoting the undergrounding of rail lines? - Why not elevated tracks? - How are the standards and maintenance of bike lanes being promoted? - How often is the comprehensive plan updated? - What kind of cooperation does Kawasaki City provide to railroad operators? - What steps were taken to introduce the hydrangea train as a regional transportation system? - Why is the percentage of public transportation use so high in Kawasaki City? - What measures are taken against on-street parking?
	
	

Source: JPT

Table 3.3: January 28, 2020_2

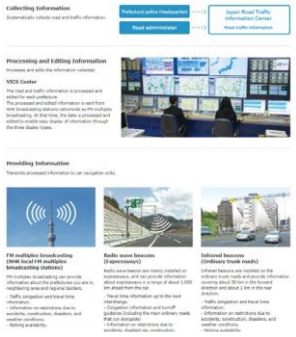
Site Visit	Facilities around JR Kawasaki Station	
Overview	• The site visit included a bicycle pushing and walking zone, cooperative cargo handling area, bus priority lane, bath bay, universal designed taxi, automatic bicycle parking lot, etc.	
		
Bicycle Pushing and Walking Zone	Bath Bay	Automatic Bicycle Parking Facility
		
Cooperative Cargo Handling Area	Bicycle Parking on the Sidewalk (1)	Bicycle Parking on the Sidewalk (2)

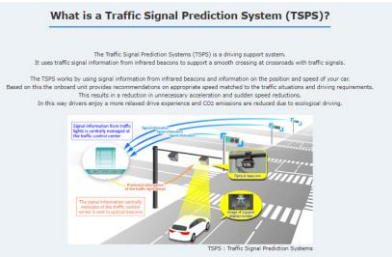
Source: JPT

Table 3.4: January 29, 2020

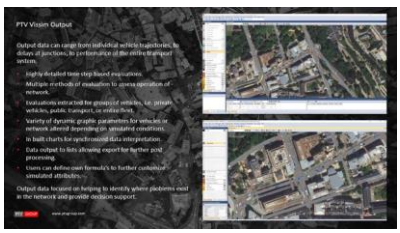
Lecture	Road Traffic Management by 3D Visualization Technology
Overview and Trainees' Impressions	• The lecture included Mobile Mapping System, customized software System development, artificial intelligence (AI) by machine learning. • The following questions were raised by the trainees. - Can mapping systems be applied to traffic simulation? - How much time is required to create a 3D map using the mapping system? - What is the data size of the 3D map? - Is the camera itself used for the mapping system available for sale? How much does it cost? - How is it different from Google Streetview? - How accurate are the cameras? - How do you update the 3D map data? - Do you already have a business partner in the Philippines?

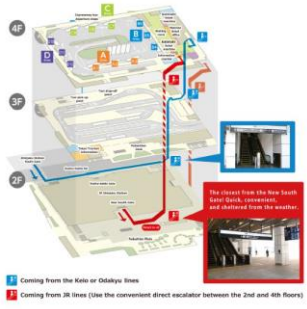
Lecture	Vehicle Information and Communication System (VICS)
Overview and Trainees' Impressions	• The lecture included system development and operation related to collection, processing, editing and transmission of road traffic information • The following questions were raised by the trainees. - Will VICS Center be providing road traffic information via the Internet? - What equipment and organization will be needed to operate in the Philippines? - What equipment and organization will be needed to operate in the Philippines? - Are VICS centers private sector or public sector? - What are the funding options?





Lecture	Solution by the software related to Traffic Analysis
Overview and Trainees' Impressions	• The lecture included the transportation software, VISSIM features, basic usage of VISSIM. • The following questions were raised by the trainees. - What kind of calibration is needed to get the most out of Vissim? - What are the benefits of running a Vissim simulation before a social experiment?

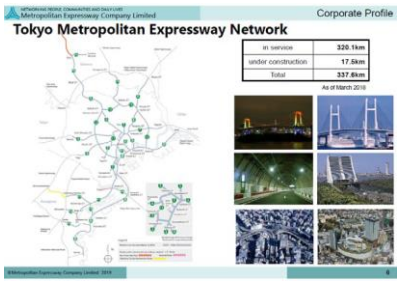


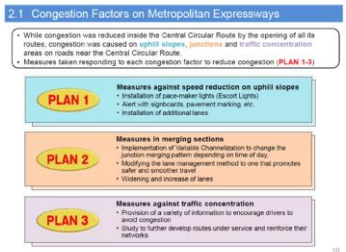
Lecture	Road Traffic Management by 3D Visualization Technology
Lecture	**Hands-on Training on VISSIM**
Overview	• The lecture was given in a hands-on format to three trainees who work with Vissim at MMDA on a daily basis. The trainees had their own files from MMDA at hand, and based on the lecturer's advice, they modified the parameters necessary to reproduce the current situation. • The trainees also received advice on modifying the parameters of the intersection improvement plans that they had prepared in the case study so that they could be evaluated accurately after the fact.
	
Site Visit	**Multi Modal Hub (Shinjuku Bus Terminal)**
Overview and Trainees' Impressions	• The lecture was given in a hands-on format to three trainees who work with Vissim at MMDA on a daily basis. The trainees had their own files from MMDA at hand, and based on the lecturer's advice, they modified the parameters necessary to reproduce the current situation. • The trainees also received advice on modifying the parameters of the intersection improvement plans that they had prepared in the case study so that they could be evaluated accurately after the fact. • During the site visit, the trainees were briefed on how the construction of Basta Shinjuku will improve access between buses and other modes of transportation, ensure the safety of pedestrians and bus, cab, and train users, and eliminate traffic congestion waiting for passengers. And the facilities on each floor of Basta Shinjuku and how to use them were explained. • The following questions were raised by the trainees. - How many bus routes are there? - How many bus operators are there? - What is the business scheme?
	
	

Source: JPT

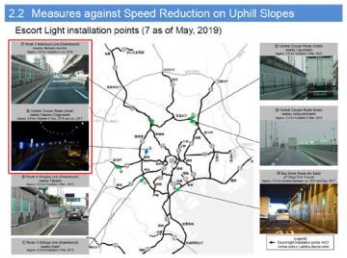
Table 3.5: January 30, 2020

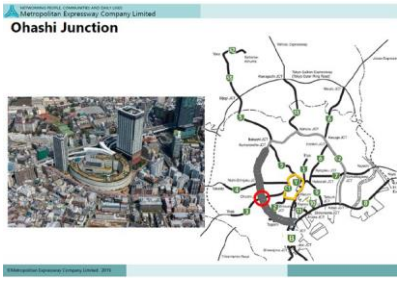
Lecture	Business of Tokyo Metropolitan Expressway
Overview	• The lecture included business outline of Metropolitan Expressway Co., Ltd. and traffic congestion countermeasures on the Metropolitan Expressway





Site Visit	Trial Ride of Tokyo Metropolitan Expressway
Overview	• The site visit included introduction of Yamate Tunnel, Escort Light, Ohashi JCT and Rainbow Bridge.

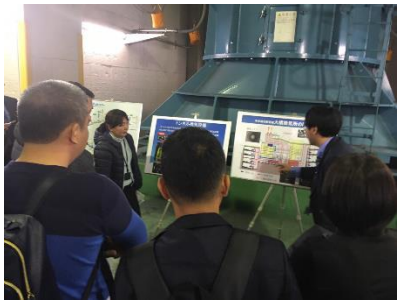




Site Visit	Traffic Command Center
Overview and Trainees' Impressions	• The site visit included operation of Traffic Command Center. • The following questions were raised by the trainees. - What days are the busiest? - How is the map legend on the display determined? - How many lanes are there on a typical Metropolitan Expressway?

Site Visit	Motorcycle Patrol Group and Meguro Sky Garden
Overview and Trainees' Impressions	• The site visit included operation of Motorcycle Patrol Group and Meguro Sky Garden. • The following questions were raised by the trainees. - Do bike patrols also respond to emergency services in the event of an accident? - When there is an accident in a tunnel, the entrance is physically closed with a bar. What happens to the cars that come before the bars?

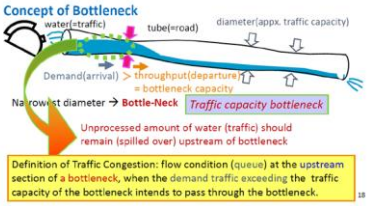
Lecture	Business of Tokyo Metropolitan Expressway



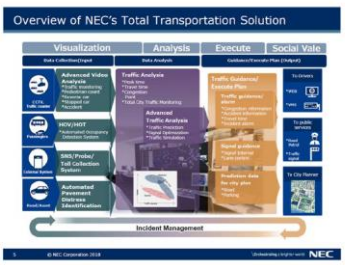
Source: JPT

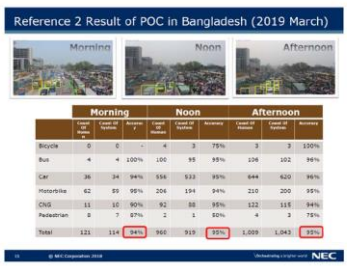
Table 3.6: January 31, 2020

Lecture	The Latest Science and Technology related to Road Traffic Management
Overview and Trainees' Impressions	• The lecture included bottlenecks, congestion and general countermeasures from a traffic engineering perspective, introduction of the latest trends in worldwide traffic management studies. • The following questions were raised by the trainees. - How to predict traffic congestion? - How do we prevent congestion? - What kind of data is needed for congestion control?



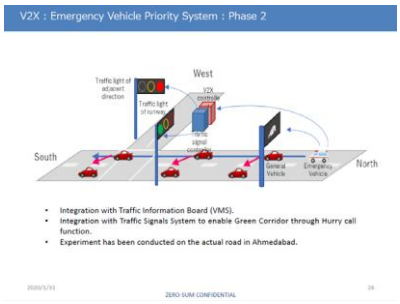
Lecture	Application of Image Recognition Technology to Road Traffic Management
Overview and Trainees' Impressions	• The lecture included technologies and services related to automatic traffic volume count and detection of violating vehicles by using cameras. • The following questions were raised by the trainees. - What is the price? - How accurate is it in bad weather? - Can existing cameras be used? - What is the accuracy level? - Is it adaptable for jeepney detection?





Source: JPT

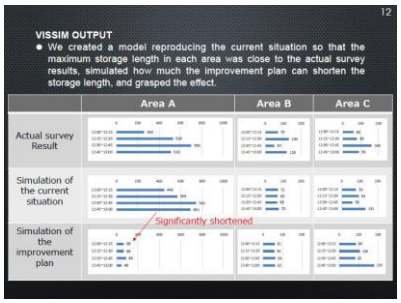
Lecture	Application of ITS to Road Traffic Management
Overview and Trainees' Impressions	• The lecture included automotive ITS technology, smart road solution by using road ITS technology, traffic information transmission system, V2X (Emergency Vehicle Priority System), introduction of traffic management ITS in India. • The following questions were raised by the trainees. - Can't we use it on roads that are already crowded? - Isn't it dangerous to have advertisements displayed all the time? - How are they communicating? - Can V2X be implemented using existing infrastructure?



Source: JPT

Table 3.7: February 3, 2020

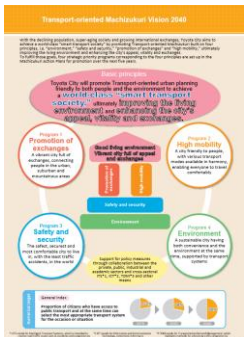
Lecture and Site Visit	Practical Case Study on VISSIM
Overview and Trainees' Impressions	• The lecture included reproduction of the current situation, factor analysis of traffic congestion, study of countermeasures, evaluation of cost and impact by VISSIM, intersection improvement and traffic signal adjustment at intersection in Yamanakako Village. • The following questions were raised by the trainees. - What data needs to be collected to recreate the existing conditions? - What base map is being used? - Have the dwell times of cars at the stations been measured? - How many minutes of traffic should be measured at the intersections? - Have the signal indications been changed? - If the police change the signal indications, how do they optimize the signal indications? - Can VISSIM alone derive the optimal intersection geometry, traffic flow, and signal indications? - What indicators are used to evaluate the project?



Source: JPT

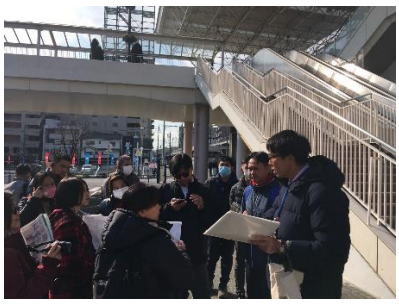
Table 3.8: February 4, 2020

Site Visit	Application of ITS to Road Traffic Management
Overview and Trainees' Impressions	• The lecture included variable-message sign (VMS) system and mobile VMS, maintenance training and mobile VMS in Bosnia Herzegovina and Sri Lanka, introduction of Blinks, ITS services in India. • The following questions were raised by the trainees. - Do you have a business partner in Philippines? - Which products and services should we implement to address the situation in Metro Manila?
	

Lecture	**Traffic and Transportation Policies in Toyota City**
Overview and Trainees' Impressions	• The lecture included Traffic Town Action Plan, Public Transportation Basic Plan. • The following questions were raised by the trainees. - If bus operating subsidies are paid to private bus operators, how are the profits of private bus operators calculated? - Are there any private bus companies that run in the black even without payment of operating subsidies?
	


Source: JPT

Table 3.9: February 5, 2020

Site Visit	Facilities around Aichi Loop Line, Shin-Toyota Station and Meitetsu Toyotashi Station
Overview and Trainees' Impressions	• The site visit included City Center Environment Plan, City Center Future Design, Station Plaza Development Plan. • The following questions were raised by the trainees. - How do you consult with residents' organizations in the surrounding area? - Who will decide the rules for the use of the plaza in front of the station? - What is the division of roles between the public and private sectors with regard to the cost burden of station-front development and the increase in revenues associated with improved convenience?
	
	
Site Visit	**Activities of Toyota Eco-ful Town for Low Carbon Society**
Overview and Trainees' Impressions	• The site visit included activities of Toyota City for Sustainable Development Goals (SDGs), the introduction of hydrogen vehicles, the introduction of a hydrogen station, the introduction of a Smart House. • The following questions were raised by the trainees. - How many hydrogen stations are there throughout Japan? - How expensive are hydrogen vehicles compared to gasoline-powered vehicles? - What is the penetration rate of hydrogen vehicles? - Are there any incentives for buyers to purchase hydrogen vehicles? - How expensive are smart houses compared to ordinary houses? - How will smart houses provide electricity during bad weather?
	
	

Source: JPT

Table 3.10: February 6, 2020

Lecture	Wrap-up Meeting
Lecturer	**JICA Project Team**
Overview and Trainees' Impressions	• To summarize the findings from this training, the following three points should be emphasized. 1. Shift from manual to automation • One of the most impressive pieces of knowledge gained through this training was that various Japanese private companies have state-of-the-art technologies and services to solve and alleviate traffic congestion. • These private firms have maximized their performance by localizing their technologies and services to the target areas. • Living in a highly developed city like Metro Manila, where traffic congestion is more complex and severe, one would think that it would be extremely difficult to solve this problem manually without the support of advanced technologies such as those mentioned above. • However, the lecture showed that without the proper knowledge to use this so-called advanced technology, all efforts to implement it, including time and money, would be wasted or not fully effective. • In other words, we learned that in order to properly provide solutions, it is essential to first understand the nature of the current issues. 2. Importance of PDCA Cycle • The lecture also demonstrated the importance of pre- and post-project surveys and estimation of future traffic volumes. • The trainees were able to discuss the derivation of cost-effectiveness ratios using Vissim and the methods for comparative analysis and evaluation of the impact of multiple congestion control proposals on traffic conditions. 3. Role of governmental agencies • The lectures in Toyota City and Kawasaki City presented the systematic formulation and implementation process and methods related to appropriate urban planning that considers the convenience of all road users, such as pedestrian facilities, bicycle facilities, intersections, signals, parking, shoulder safety, and road lighting. • In addition, a lecture at the Ministry of Land, Infrastructure, Transport and Tourism showed the differences in traffic management methods for rural and urban arterial roads. • The lectures also emphasized the desirability of working to reduce problems along routes and networks as a whole, rather than focusing on independent problem areas when targeting specific areas.

Source: JPT

Part B: 2nd Study Trip to Japan

1 TRAINING PROGRAM OVERVIEW

1.1 Training Program Name

Traffic Management and Intelligence Transport System (ITS)

1.2 Training Program Period

October 25, 2022 ~ November 2, 2022

1.3 Trainees

10 members from MMDA as shown in Table 1.1.

Table 1.1: List of the Trainees

No.	Title	Name	Designation	Affiliation
1.	Mr.	Mark Edmon C. Navarro I	OIC	Office of the Assistant General Manager for Planning
2.	Mr.	Michael Gison	Director III	Physical Planning and Spatial Development Service
3.	Ms.	Neomie Recio	Director III	Traffic Engineering Center
4.	Mr.	Victor Maria Nuñez	Director III	Traffic Discipline Office for Enforcementt
5.	Ms.	Milagros Silvestre	Director II	Management Information System Staff
6.	Ms.	Sharon Gentalian	Director II	Public Affairs Staff
7.	Mr.	Francisco Jr. Pesino	Head	Traffic Signal Operations & Maintenance Division
8.	Ms.	Rianne Mae Bautista	Attorney IV	Legal and Legislative Affairs Staff
9.	Ms.	Monica Marie M. Mateo	Planning Officer II	Urban Development Division
10.	Mr.	Christian Gel M. Javier	Planning Officer III	Plans and Programs Formulation Division

Source: JPT

1.4 Training Accompanying Personnel

The training accompanying personnel are as follows.

(i) JICA training administrator & interpreter: Ms. Yoko Tange

(ii) JICA Project Team: Mr. Tsuyoshi Matsunuma (Deputy team leader & Traffic survey specialist)

Mr. Shinji Terawaki (Project coordinator & Pilot project implementor)

(iii) ALMEC Corporation Manila Office: Ms. Karen Hulleza Luna

2 TRAINING PROGRAM CONTENTS

2.1 Project Description

1) Project Background

In 2015, Metro Manila had a population of 12.87 million, and that figure is increasing at 1.7% a year. While the concentration is denser in the central areas of Metro Manila, the rate of suburbanization in the surrounding areas is also picking up. In addition, the number of registered vehicles has risen at 24.6% compared to 2016. For these reasons, traffic congestion in Metro Manila has become a major political and social problem. According to the "Formulation of Transportation Development Roadmap to Support Sustainable Development of Metropolitan Manila and Its Surrounding Areas," which was conducted in 2014 with the support of JICA, the cost of transportation to the people in Metro Manila was PHP2.4 billion a day, and if no action would be taken, the cost was estimated to balloon to PHP6 billion by 2030.

Therefore, it is essential to solve traffic and transportation problems through a comprehensive action that has both hard and soft aspects, such as road and railway network, and a comprehensive traffic management plan, respectively, to support future economic development. Under such circumstances, the Japanese government was requested to conduct "The Project for Comprehensive Traffic Management Plan for Metro Manila." In September 2018, the Record of Discussion was signed between the Japan International Cooperation Agency (JICA) and the Metropolitan Manila Development Authority (MMDA) to implement this technical cooperation.

2) Project Objectives and Expected Outputs

"The Project for Comprehensive Traffic Management Plan for Metro Manila" aims to formulate a comprehensive traffic management plan for the road sector in Metro Manila to manage traffic demand and increase traffic capacity, thereby improving mobility, connectivity, traffic environment, and safety. In doing so, the project will identify congested points, analyze the causes based on quantitative and scientific data, and formulate a comprehensive traffic management plan focusing on developing the capacity of institutions and personnel to plan, implement, evaluate, and improve traffic management measures.

The project is expected to achieve the following outputs:

(i) Data-driven identification of major traffic bottlenecks in Metro Manila and their detailed characteristics based on quantitative analysis;

(ii) Setting of the traffic management goal to pursue in five years and formulation of the MMDA's five-year action plan based on an analysis of the collected data and which will include the improvement measures for each major traffic bottleneck; and

(iii) Implementation of selected improvement measures and applying the lessons to finalize the five-year action plan so that the knowledge on comprehensive traffic management planning, implementation of traffic management (TM) measures, evaluation, and improvement is transferred to the personnel of the counterpart organizations.

3) Project Area

The project covers the 17 local government units (LGUs) comprising Metro Manila, i.e., the cities of Quezon, Manila, Caloocan, Pasig, Valenzuela, Taguig, Las Piñas, Parañaque,

Makati, Marikina, Muntinlupa, Pasay, Malabon, Mandaluyong, San Juan, and Navotas, and the municipality of Pateros, especially the roads managed by the MMDA.

4) Organization Involved in the Project

While the main counterpart in the project is the MMDA, the JICA Project Team will also coordinate with the other member organizations of the Joint Coordination Committee (JCC) and the Technical Working Group (TWG) to implement the project smoothly. These organizations are identified in the figure below.

JCC (Joint Coordination Committee)		
Chairperson (Project Director)	Undersecretary of MMDA	
Vice Chairperson (Deputy Project Director)	Assistant Secretary of MMDA	
Member	Philippines	•MMDA: Relevant Directors •Representatives of Relevant Departments DPWH, DOTr, NEDA and LGUs
	Japan	•Embassy of Japan •Chief Representative of JICA Philippine Office •JICA Experts •Members of JICA Missions
Provisional Member	Representatives of LTO, LTFRB, DICT, DENR and Others	

TWG (Technical Working Group)		
Chairperson (Project Director)	Director for Planning, MMDA	
Vice Chairperson (Deputy Project Director)	Director for Operation, MMDA Director for Financing and Administration, MMDA	
Member	Philippines	•Division Chief of MMDA: Personnal of Planning Personnal of Operation Personnal of Finance and Administration Personnal of Legal Department Personnal of Traffic Engineering Office Personnal of Flood Control and Sewerage Management Office •Representatives of Other Departments: DPWH, DOTr, NEDA and LGUs
	Japan	•Representative of JICA Philippine Office •JICA Experts •Members of JICA Missions
Provisional Member	Chiefs of LTO, LTFRB, DICT, DENR and Other Offices Concerned	

CWG (Counterpart Working Group)
The staff of Planning Office of MMDA leads the members from related office of C/P organizations as a team leader.

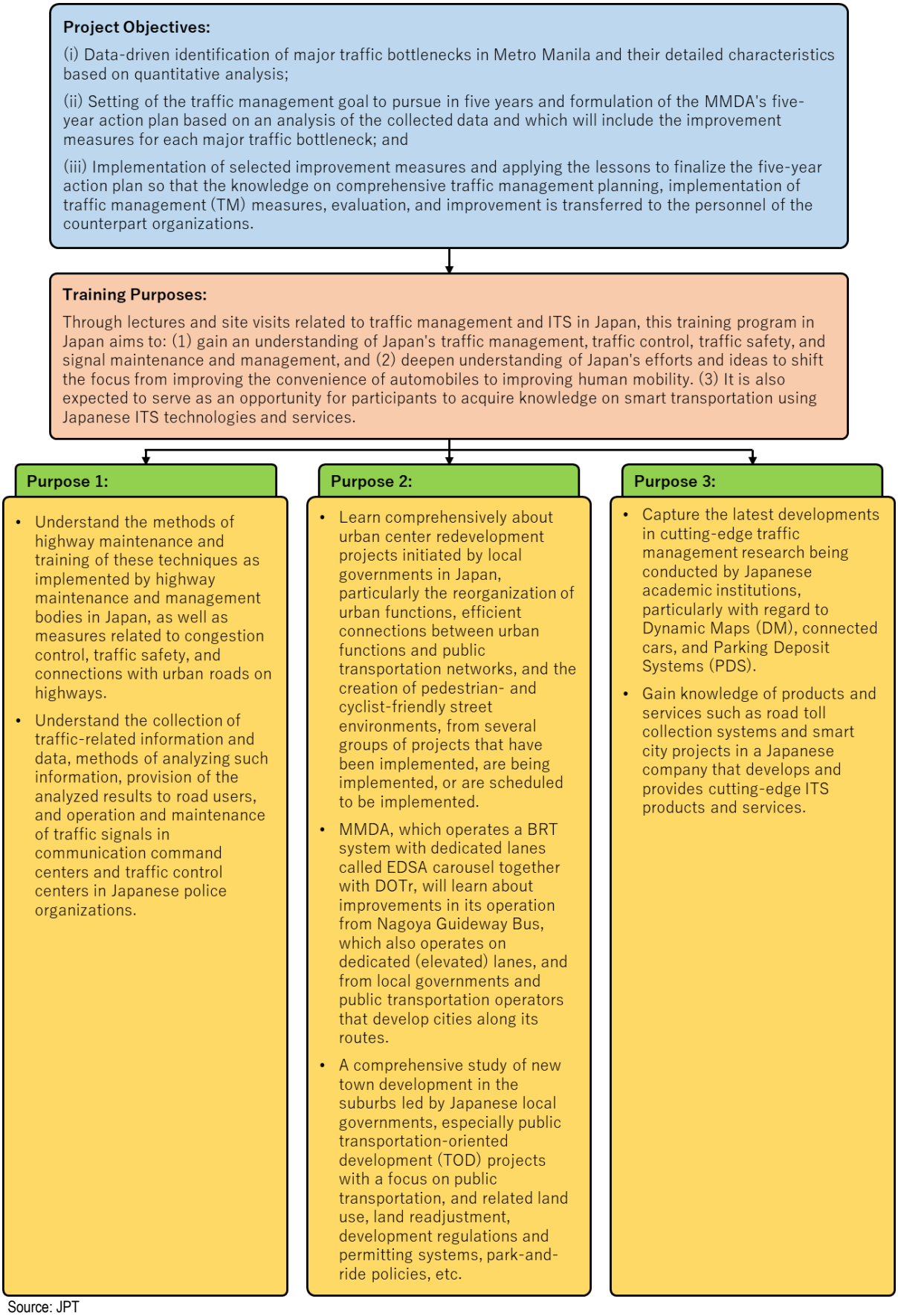
Source: JPT

Figure 2.1: Project Implementation Structure

2.2 Training Program

1) Training Purposes

Through lectures and site visits related to traffic management and ITS in Japan, this training program in Japan aims to: (i) gain an understanding of Japan's traffic management, traffic control, traffic safety, and signal maintenance and management, and (ii) deepen understanding of Japan's efforts and ideas to shift the focus from improving the convenience of automobiles to improving human mobility. (iii) It is also expected to serve as an opportunity for participants to acquire knowledge on smart transportation using Japanese ITS technologies and services.



Source: JPT

Figure 2.2: Overall Training Concept

2) Training Contents

In order to fulfill the above training purposes, lectures and site visits were conducted on the following items

(i) Understand the methods of highway maintenance and training of these techniques as implemented by highway maintenance and management bodies in Japan, as well as measures related to congestion control, traffic safety, and connections with urban roads on highways.

Understand the collection of traffic-related information and data, methods of analyzing such information, provision of the analyzed results to road users, and operation and maintenance of traffic signals in communication command centers and traffic control centers in Japanese police organizations.

(ii) Capture the latest developments in cutting-edge traffic management research being conducted by Japanese academic institutions, particularly with regard to Dynamic Maps (DM), connected cars, and Parking Deposit Systems (PDS).

(iii) MMDA, which operates a BRT system with dedicated lanes called EDSA carousel together with DOTr, will learn about improvements in its operation from Nagoya Guideway Bus, which also operates on dedicated (elevated) lanes, and from local governments and public transportation operators that develop cities along its routes.

(iv) Gain knowledge of products and services such as road toll collection systems and smart city projects in a Japanese company that develops and provides cutting-edge ITS products and services.

(v) Learn comprehensively about urban center redevelopment projects initiated by local governments in Japan, particularly the reorganization of urban functions, efficient connections between urban functions and public transportation networks, and the creation of pedestrian- and cyclist-friendly street environments, from several groups of projects that have been implemented, are being implemented, or are scheduled to be implemented.

A comprehensive study of new town development in the suburbs led by Japanese local governments, especially public transportation-oriented development (TOD) projects with a focus on public transportation, and related land use, land readjustment, development regulations and permitting systems, park-and-ride policies, etc.

3) Overview of Site Visits and Lectures

The dates, locations, contents of site visits and lectures, etc. are shown in Table 2.1.

Table 2.1: Training Schedule

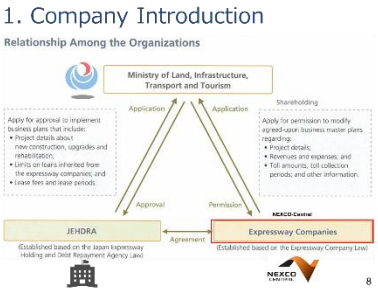
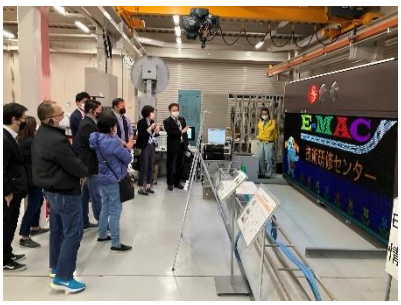
No	Date Location	Contents of Site Visits and Lectures	Lecturers, Place of Site Visits	Places to Stay
1	Gifu Oct. 27	(Lecture) Good operation of expressways, including traffic congestion countermeasures and traffic safety measures on expressways	Mr. Hisaya Hirose Central Nippon Expressway Company Limited	Nagoya
2		(Site Visit) Highway maintenance and management and training methods for these techniques	Mr. Hiroshi Miura Central Nippon Highway Engineering Nagoya Co., Ltd. @ E-MAC Technical Training Center	

No	Date Location	Contents of Site Visits and Lectures	Lecturers, Place of Site Visits	Places to Stay
3	Nagoya Oct. 27	(Site Visit) Collection of traffic-related information and data, methods of analyzing such information, provision of the analyzed results to road users, and operation and maintenance of traffic signals by police organizations	Mr. Koji Yamamoto Aichi Prefectural Police HQ @Communication Control Room, Traffic Command Center	
4	Nagoya Oct. 28	(Lecture) State-of-the-art traffic management research, especially Dynamic Maps (DM), Connected Car, Parking Deposit System (PDS)	Prof. Dr. Takayuki Morikawa Global Research Institute for Mobility in Society Research Leader, Mobility Innovation Center, Nagoya University	Nagoya
5		(Lecture and site visit) Operation of Nagoya Guideway Buses in elevated dedicated lanes by local governments and public transportation operators, and implementation of urban development projects along the bus route	Mr. Ryoji Sayase Nagoya GuideWay-Bus Co., Ltd. Mr. Atsushi Fukuda Housing and Urban Development Bureau, Nagoya City @ Trial ride of Nagoya Guideway Bus	
6	Kobe Oct. 31	(Lecture and site visit) State-of-the-art ITS products and services by private companies, especially road toll collection systems and smart city projects	Mr. Yoshifumi Hayakawa Mr. Takashi Kouyama Mitsubishi Heavy Industries Machinery Systems, Ltd. @ Kobe Factory	Kobe
7	Kobe Oct. 31	(Lecture and site visit) Urban center redevelopment projects initiated by local governments, especially reorganization of urban functions, the efficient connection of urban functions and public transportation networks, and creation of pedestrian- and bicycle-friendly street environments	Mr. Katsushi Suzuki Planning and Coordination Bureau, Kobe City Mr. Keigo Hamada Kobe Residential Management Authority @ Kobe Sannomiya Area	
8	Kobe Nov. 1	(Lecture and site visit) New town development in suburbs led by local governments, especially public transportation-oriented development (TOD) projects with a focus on public transportation, and related land use, land readjustment, development regulations and permitting systems, and park-and-ride policies	Mr. Keigo Hamada Kobe Residential Management Authority @ Seishin New Town, Trial ride of Kobe Municipal Subway, Highways, Akashi Kaikyo Bridge	Kobe
9	Kobe Nov. 2	• Wrap-up meeting	JICA, JICA Project Team	Kobe

Source: JPT

3 CONTENTS OF SITE VISITS AND LECTURES

Table 3.1: October 27, 2022

Lecture	**Expressway Business of Central Nippon Expressway Company Limited**		
Lecturer	**Mr. Hisaya Hirose, Central Nippon Expressway Company Limited**		
Overview and Trainees' Impressions	• The lecture included an explanation of the good operation of expressways, including traffic congestion countermeasures and traffic safety measures on expressways. • There was much interest in the scope of responsibility and authority for expressway ownership and maintenance, the division of roles with other authorities, the functionality and implementation costs of ETC systems in achieving efficiency in toll collection, and public consultation when constructing new expressways.		
			
Lecture	Division of roles among related entities	Workflow for new expressway construction	
Site Visit	**E-MAC Technical Training Center, Central Nippon Highway Engineering Nagoya Co., Ltd.**		
Explainer	**Mr. Hiroshi Miura, Central Nippon Highway Engineering Nagoya Co., Ltd.**		
Overview and Trainees' Impressions	• During the site visit, the trainees experienced and learned about highway maintenance and management and training methods for these techniques through the facilities of the E-MAC Technical Training Center. • In Metro Manila, there is no nationwide uniform manual or guideline for how to respond to actual traffic accidents or damage to facilities caused by disasters on expressways. In addition, there is no facility that can provide comprehensive learning in terms of passing on response methods and improving standards, so for the trainees, the establishment of a facility by the road administrator for the purpose of training in operation and maintenance management was a surprise in itself.		
			
Variable-message sign (VMS)	Reproduction of accident response in a tunnel	Experience in Concrete Pounding Inspection	
Site Visit	**Communication Control Room, Traffic Command Center, Aichi Prefectural Police HQ**		
Explainer	**Mr. Koji Yamamoto, Aichi Prefectural Police HQ**		
Overview and Trainees' Impressions	• The site visit included the collection of traffic-related information and data, methods of analyzing such information, provision of the analyzed results to road users, and operation and maintenance of traffic signals by the police organization. • In Metro Manila, traffic controllers are not police, but MMDA enforcement officers delegated by the Land Transportation Office (LTO), and the site visit was conducted with an interest in traffic control and emergency response.		

Lecture	Expressway Business of Central Nippon Expressway Company Limited
	• The trainees were interested not only in the technical aspects of the centers and cameras used to collect traffic-related information and data, as well as the types and specifications of traffic signals and their diffusion rates, but also in the operational aspects, such as the deployment of enforcement officers, emergency response, and necessary personnel, organization, and systems.

Communication Control Room

Traffic Command Center

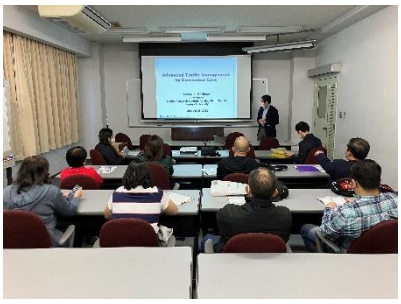
Explanation of Police Services

* Since photography is prohibited in the Communication Control Center and Traffic Command Center for security reasons, photographs of these facilities are taken from the Aichi Prefectural Police website.

Source: JPT

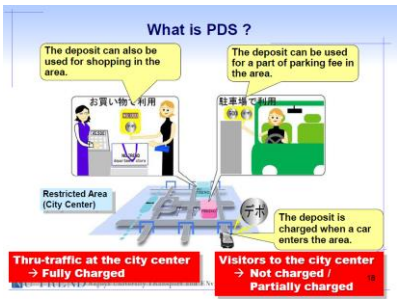
Table 3.2: October 28, 2022

Lecture	State-of-the-Art Traffic Management Research, Especially Dynamic Maps (DM), Connected Car, Parking Deposit System (PDS)
Lecturer	Prof. Dr. Takayuki Morikawa, Global Research Institute for Mobility in Society Research Leader, Mobility Innovation Center, Nagoya University
Overview and Trainees' Impressions	• The lecture included an overview of the history of ITS and mobility, multiple technologies (Dynamic Map (DM), Connected Car) that have been developed in CASE (C: Connected, A: Autonomous, S: Serviced, E: Electric), the keyword for the next generation of automobile transportation, as well as the Parking Deposit System (PDS) as a solution for road pricing, which has difficult social demand characteristics. • In the 5-year action plan, continuous updating of the traffic management database and its use in measures to reduce traffic congestion is positioned as one of the strategies, and there was much interest in the Dynamic Map (DM), which consists of multiple data layers, with specific technical requirements and a timeline for its realization. • The parking deposit system (PDS) was discussed as an alternative idea to road pricing that has not progressed well in Metro Manila, taking social acceptability into consideration, and the challenges of gaining consensus from many stakeholders on the feasibility of introducing the system in Metro Manila's CBD.



Lecture

Concept of Dynamic Map



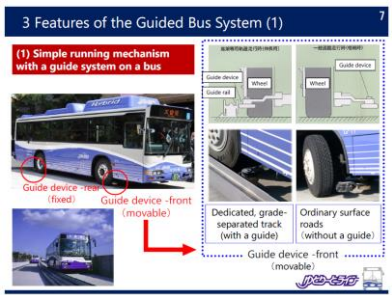
Concept of Parking Deposit System

Lecture and Site Visit	Business of Nagoya GuideWay-Bus Co., Ltd. Command Center, Maintenance facility, and bus fleet of Nagoya Guideway Bus
Lecturer and Explainer	Mr. Ryoji Sayase, Nagoya GuideWay-Bus Co., Ltd. Mr. Atsushi Fukuda, Housing and Urban Development Bureau, Nagoya City
Overview and Trainees' Impressions	• In the lecture, Nagoya City and Nagoya Guideway Bus Company, a public transportation operator, explained the operation of the Nagoya Guideway Bus, which runs in an elevated dedicated lane, and the urban development projects along the route. During the site visit, the participants visited the Nagoya Guideway Bus control center and maintenance facility and were briefed on the specifications of the bus fleet. • In Metro Manila, the implementation of capacity restrictions on public transportation in the Covid-19 Pandemic has significantly reduced the transportation capacity of MRT1, which operates along the EDSA. In response, a BRT system with dedicated lanes, known as the EDSA carousel, was urgently introduced to cover the reduction in transportation capacity, but new issues arose, such as traffic processing at intersections and the flow line connecting stops and sidewalks, which made it inconvenient for passengers to board and alight. • There was much interest in the background to the introduction of the Nagoya Guideway Bus, a new concept with elevated bus lanes (some of which run on a flat surface), and the effects of its introduction (reduced traffic congestion, increased number of users, etc.).

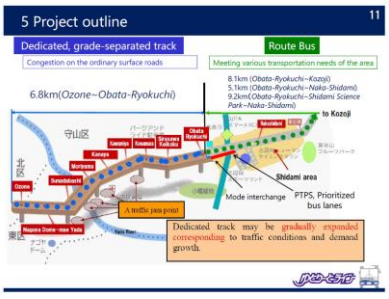
Guideway Bus at Osone Bus Station

Explanation of service routes and timetables

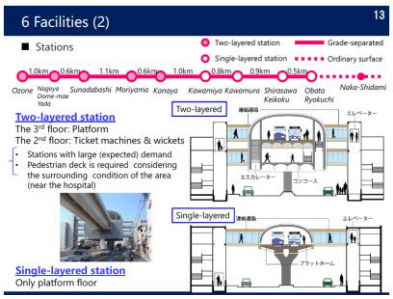
Explanation of bus vehicles at the maintenance facility



Features of Guideway bus fleet



Characteristics of routes in operation and the surrounding area

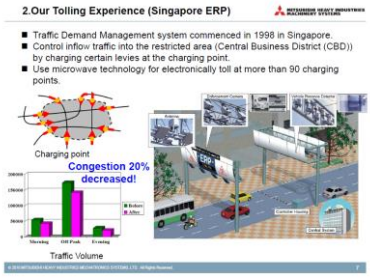
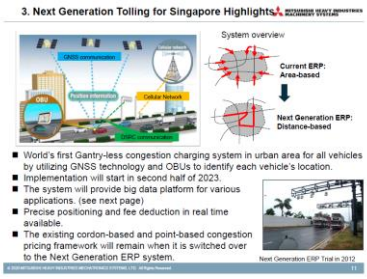


Cross-sectional structure of a station in an elevated section

Source: JPT

Table 3.3: October 31, 2022_1

Lecture and Site Visit	**State-of-the-Art ITS Products and Services, Especially Road Toll Collection Systems and Smart City Projects Kobe Factory at Mitsubishi Heavy Industries Machinery Systems, Ltd.**
Lecturer and Explainer	**Mr. Yoshifumi Hayakawa, Mr. Takashi Kouyama, Mitsubishi Heavy Industries Machinery Systems, Ltd.**
Overview and Trainees' Impressions	• In the lecture, Mitsubishi Heavy Industries Machinery Systems, Ltd. explained its cutting-edge ITS products and services, especially road toll collection systems and smart city projects. • During the site visit, the machines and systems that make up the ETC system, the stable supply, and quality control system in the production line, and examples of actual applications of the ETC system at sites where the system has been installed were explained. • In Metro Manila, traffic congestion and traffic accidents are caused not only by road operations at highway entrances, exits, mergers, and turnouts, but also by delays due to toll collection failures caused by analog systems and poorly maintained ETC systems. • Therefore, many specific questions related to the introduction of the system, such as the advantages of the ETC system manufactured by Mitsubishi Heavy Industries Machinery Systems, Ltd. compared to its competitors, its market share in Japan and around the world, and the cost of introducing the system was found.

		
Lecture	Explanation of ETC system components	Explanation of quality control in manufacturing
		
Road Pricing System in Singapore	Next-generation Electronic Road Pricing (ERP)	Application of next-generation ERP to big data utilization

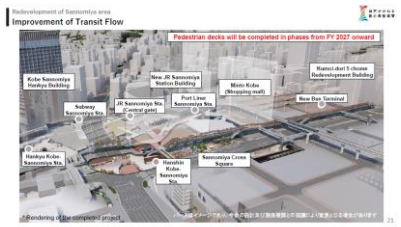
Source: JPT

Table 3.4: October 31, 2022_2

Lecture and Site Visit	Urban Center Redevelopment Projects Initiated by Local Government Kobe Sannomiya Area
Lecturer and Explainer	Mr. Katsushi Suzuki, Planning and Coordination Bureau, Kobe City Mr. Keigo Hamada, Kobe Residential Management Authority
Overview and Trainees' Impressions	• The lecture covered redevelopment projects in the city center of Kobe City called Sannomiya led by the local government, Kobe City, specifically the reorganization of urban functions, efficient connections between urban functions and the public transportation network, and the creation of pedestrian- and bicycle-friendly street environments. • During the site visit, various projects that have been implemented, are being implemented, or are planned to be implemented in the Sannomiya area were covered. As for buildings, the trainees confirmed with the lecturers the administrative services (city hall, cultural activities, exercise, recreation, etc.), commercial services (shopping mall, hotel, etc.), and transportation services (bus terminal) that are planned to be housed. • Many practical questions were asked about whether road users would agree and cooperate with the restrictions placed on private traffic in the Sannomiya area, which is in the heart of the city, and how traffic would be handled for the amount of traffic that could not use the roads in the Sannomiya area. • To respond these questions, various countermeasures made by Kobe City were explained. In these countermeasures, the following items are included; the social experiments repeatedly conducted under various condition settings to minimize the obstruction of traffic flow, measures being taken to distinguish between through traffic and internal traffic, and operating lanes and design intersections in such a way as to encourage detour of through traffic.

Benches and street trees installed on the sidewalk

Various measures for pedestrian priority roads in city centers



Continuous pedestrian deck centered on Sannomiya Intersection

Station Square (&3PARK) installed in front of JR Sannomiya Station

Sankita Street designated as a HOKOMICHI*

* HOKOMICHI: The Road Law was revised on November 25, 2020 to establish a system of roads for enhancing pedestrian convenience (commonly known as "HOKOMICHI"). This system has made it possible to use road space for various purposes and to utilize road space for the revitalization of the city.

Source: JPT

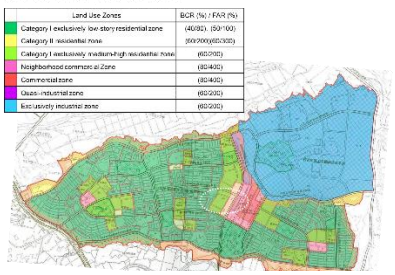
Table 3.5: November 1, 2022

Lecture and Site Visit	New Town Development in Suburbs Led by Local Government Seishin New Town, Trial ride of Kobe Municipal Subway, Highways, Akashi Kaikyo Bridge
Lecturer and Explainer	**Mr. Keigo Hamada, Kobe Residential Management Authority**
Overview and Trainees' Impressions	• The lecture provided a comprehensive explanation of new town development in the suburbs of Kobe City led by the local government, Kobe City, particularly the public transportation-oriented development (TOD) project with public transportation as its main focus, and related land use, land readjustment, development regulations and permission system, and park-and-ride policies. • During the site visit, the trainees first overviewed the layout of the plots and facilities (stations, schools, urban infrastructure facilities, etc.) in the new town while traveling by bus, and then confirmed the specifications of the facilities around the station (P&R facilities, bicycle parking facilities, pedestrian deck, etc.) on foot from Seishin Chuo Station on the Kobe Municipal Subway. In addition, a trial ride on the Kobe Municipal Subway was taken and the connection between the new town and the neighboring city center of Kobe City and Awaji Island via the expressway was confirmed. • Since Seishin New Town used to be agricultural land, there was much interest in institutional innovations such as land use conversion, urban development regulations, building height restrictions that maintain a favorable living environment within the new town, and maintenance of urban infrastructure, as well as the engineering of development costs.

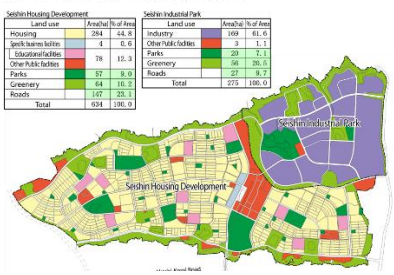
Terminal station of Kobe Municipal Subway (Seishin-chuo Station)

Redevelopment of public facilities & high-rise residential complexes near the station

Ward office buildings and P&R facilities near the station



FAR Regulations in Within Seishin New Town



Land use in Seishin New Town

P&R facility operations changed on different days of the week

Source: JPT

Table 3.6: November 2, 2022

Lecture	Wrap-up Meeting
Lecturer	**JICA, JICA Project Team**
Overview and Trainees' Impressions	• The project developed a comprehensive traffic management plan for Metro Manila, with MMDA as the implementing agency. • In implementing the above-mentioned comprehensive traffic management plan, this training course provided trainees with an understanding of the structure and division of roles of the Japanese government regarding traffic management, as well as a look at the actual traffic management facilities, road improvement projects, and urban development and integrated transportation infrastructure. • In addition, lectures and site visits were conducted on ITS products and services provided by Japanese private companies that contribute to traffic management, as well as cutting-edge traffic management research being conducted at academic institutions, with the aim of providing MMDA with hints for future implementation of comprehensive traffic management plans. • At the Wrap-up Meeting, the trainees agreed that Japan's automated collection, analysis, and provision of road traffic information to road users have made people's lives more efficient, that these processes are the same for public transportation and highways, and that if similar operations can be realized in Metro Manila, the lives of Metro Manila residents will be more productive. - In this training course, with the exception of the lecture at Nagoya University, which discussed future developments, all training items were structured so that the trainees visited the sites discussed in the lecture after the lecture, and the trainees commented that they could easily visualize the implementation in Metro Manila because they were able to observe in the afternoon what they had learned in the classroom. - Throughout the entire session, many questions were raised about ITS products and services, as well as public transportation-based new town development (TOD), indicating the high level of interest among the trainees. • Many of the trainees asked practical questions about ITS products and services, not only about functionality but also about operational difficulties and implementation and operating costs. • With regard to TOD, there were many specific questions about how the city is guiding appropriate development by introducing a highly accurate public transportation system in an area that was once used for agriculture, thereby creating a good living and commuting environment despite its distance from the city center.

Source: JPT