付属資料集

付属資料A
- *A-1：交通調査結果*
- *A-2：追加交通調査結果*

付属資料B：対象地域の地質状況

付属資料C：推奨路線案の平面・縦断線形

付属資料D
- *D-1：代替オプションのスコーピング案*
- *D-2：自然環境及び社会環境の現況*
- *D-3：環境社会配慮調査のTOR案*
- *D-4：ステークホルダー協議会記録*

付属資料E：施工済み構造物の転用可能性

付属資料F：協議記録

付属資料G：収集資料一覧

付属資料 A

頁

1 TRAFFIC SURVEYS

1.1 Survey Items

The following surveys were conducted for MacArthur Highway, North Luzon Expressway (NLEX) and Clark International Airport.

- Vehicular traffic count;
- Vehicle occupancy;
- Roadside interview

1.2 Survey Method

1.2.1 Vehicular Traffic Count

Vehicular traffic count was made to get the traffic volume by hour, vehicle type, and direction. The survey duration was 18 hours for some stations and 24 hours for other stations. The survey form used is shown in **Appendix A.**

1.2.2 Vehicle Occupancy

For the vehicle occupancy survey, traffic counters recorded the number of passengers chosen at random by hour, vehicle type, and direction. The survey duration was also 18 hours or 24 hours. For NLEX, this survey was conducted only at entrance sides. The survey form used is shown in **Appendix A**.

1.2.3 Roadside Interview

Three types of roadside interview were conducted. One was interview with private mode passengers including taxi passengers. The second one was interview with public mode passengers and the third one was interview with public mode drivers.

For private mode passengers data on, trip origin and destination, trip purpose, occupancy, home address of interviewee were gathered. For public mode passengers data on, trip origin and destination, trip purpose, home address of interviewee were gathered, as well as, besides total fare paid from origin to destination. For public drivers data on, number of passengers and seating capacity, route of origin and destination were gathered. The survey duration was also for 18 hours or 24 hours. For NLEX, the survey was also conducted at entrance side only. The survey form used is shown in **Appendix A**.

1.3 Vehicle Classification

The surveyed vehicles are classified into 5 types as shown **Figure 1.3-1**. Vehicle type was not subjected to occupancy survey and roadside interview. The survey form used is shown in **Appendix A**.

Vehicle Type 1: Sedan, SUV, Pick-up, Taxi, Airport Taxi

Vehicle Type 2: Private or Public Van (seats 8+)

Vehicle Type 3: AUV-Public FX/Jeepney

Vehicle Type 4: All Buses

Vehicle Type 5: Others.

Figure 1.3-1Vehicle Classification

1.4 Survey Location

Survey locations are shown in Figure 1.4-1. There are two (2) survey sites for MacArthur Highway and eighteen (18) survey sites for NLEX and one (1) survey site for Clark airport.

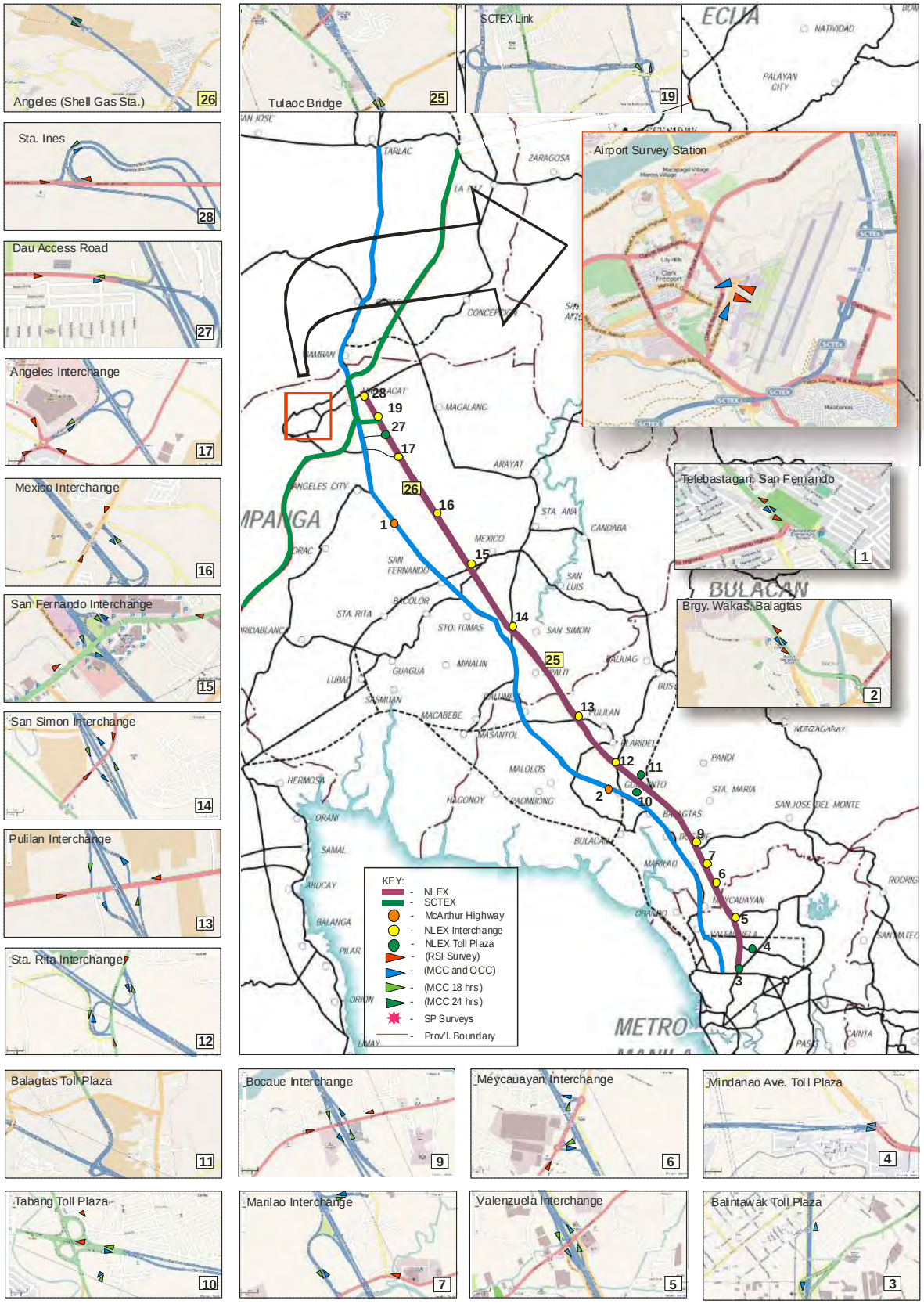


Figure 1.4-1 Survey Locations

1.5 Survey Duration and Survey Day and Date

Survey duration and survey date are shown in Table 1.5-1. For most of the survey sites, the duration was 18-hours, from 5am to 11pm. At the bridges in Angeles and Clark Airport survey duration was 24 hours from 5am to 5am of the next day. The survey was conducted from October 12 to 30.

Table 1.5-1 Survey Duration by Each Survey Site

Road Name	Station Code	Station Name	Entrance /Exit	Direction	Survey Duration			Survey	
					MCC	VOC	RSI	Day	Date
MacArthur Highway	1	Telabastagan, San Fernando Pamp.	-	Southbound	18	18	18	Friday	10/12/12
				Northbound	18	18	18	Friday	10/12/12
	2	Bgy. Wakas Bocaue, Bulacan	-	Southbound	18	18	18	Wednesday	10/17/12
				Northbound	18	18	18	Wednesday	10/17/12
NLEX	3	Balintawak Toll	-	Southbound	18	18		Thursday	10/25/12
				Northbound	18	18	-	Thursday	10/25/12
	4	Mindanao Ave. Toll	Entrance	-	18	18	-	Thursday	10/25/12
			Exit		18	18	-	Thursday	10/25/12
	5	Valenzuela IC	Entrance	Southbound	18	18	18	Thursday	10/25/12
				Northbound	18	18	18	Thursday	10/25/12
			Exit	Southbound	18	18	18	Thursday	10/25/12
				Northbound	18	18	18	Thursday	10/25/12
	6	Meycauayan IC	Entrance	Southbound	18	18	18	Monday	10/29/12
				Northbound	18	18	18	Monday	10/29/12
			Exit	Southbound	18	18	18	Monday	10/29/12
				Northbound	18	18	18	Monday	10/29/12
	7	Marilao IC	Entrance	Southbound	18	18	18	Monday	10/29/12
				Northbound	18	18	18	Monday	10/29/12
			Exit	Southbound	18	18	18	Monday	10/29/12
				Northbound	18	18	18	Monday	10/29/12
	9	Bocaue IC	Entrance	Southbound	18	18	18	Monday	10/29/12
				Northbound	18	18	18	Monday	10/29/12
			Exit	Southbound	18	18	18	Monday	10/22/12
				Northbound	18	18	18	Monday	10/22/12
	10	Tabang Toll	Entrance	-	18	18	18	Friday	10/19/12
			Exit		18	18	18	Friday	10/19/12
	11	Balagtas Toll	Entrance	-	18	18	18	Monday	10/22/12
			Exit		18	18	18	Monday	10/22/12
	12	Sta. Rita IC	Entrance	Southbound	18	18	18	Monday	10/22/12
				Northbound	18	18	18	Monday	10/22/12
			Exit	Southbound	18	18	18	Monday	10/22/12
				Northbound	18	18	18	Monday	10/22/12
	13	Pulilan IC	Entrance	Southbound	18	18	18	Friday	10/19/12
				Northbound	18	18	18	Friday	10/19/12
			Exit	Southbound	18	18	18	Friday	10/19/12
				Northbound	18	18	18	Friday	10/19/12
	14	San Simon IC	Entrance	Southbound	18	18	18	Monday	10/22/12
				Northbound	18	18	18	Monday	10/22/12
			Exit	Southbound	18	18	18	Monday	10/22/12
				Northbound	18	18	18	Monday	10/22/12
	15	San Fernando IC	Entrance	Southbound	18	18	18	Monday	10/29/12
				Northbound	18	18	18	Monday	10/29/12
			Exit	Southbound	18	18	18	Monday	10/29/12
				Northbound	18	18	18	Monday	10/29/12
	16	Mexico IC	Entrance	-	18	18	18	Tuesday	10/30/12
			Exit		18	18	18	Tuesday	10/30/12
	17	Angeles IC	Entrance	-	18	18	18	Tuesday	10/30/12
			Exit		18	18	18	Tuesday	10/30/12
	25	Bridge at Apalit	-	Southbound	18	18	18	Monday	10/29/12
	26	Bridge at Angeles		Northbound	24	24	18	Tuesday	10/30/12
	27	Dau Access Road	Entrance	-	18	18	18	Tuesday	10/30/12
			Exit		18	18	18	Tuesday	10/30/12
	28	Sta. Ines Access Road	Entrance	Southbound	18	18	18	Tuesday	10/30/12
				Northbound	18	18	18	Tuesday	10/30/12
			Exit	Southbound	18	18	18	Tuesday	10/30/12
				Northbound	18	18	18	Tuesday	10/30/12
Clark airport	24	Clark airport entrance	Entrance		18	18	18		
			Exit		18	18	18		

1.6 Incident During Survey

In the roadside interview survey (RIS) for several periods during the day, no vehicle samples could be interviewed due to reasons in the table below. No incidents occurred which affected the traffic counts surveys, except for Station 5 at NLEX, Valenzuela Interchange (as shown below).

Table 1.6-1: Incidents' Report

Station Code	Station Description	Direction	Time	Reasons
1	MacArthur Highway, Telabastagan, San Fernando, Pampanga	Southbound and Northbound	0500 - 0600	Traffic enforcers not yet in the vicinity
		Northbound	1200 - 1400	Traffic enforcers took lunch
		Southbound and Northbound	2100 - 2300	Vehicle drivers refused to be interviewed
2	MacArthur Highway, Bgy. Wakas, Bocaue, Bulacan	Southbound and Northbound	0500 - 0600	Traffic enforcers not yet on site
5	NLEX, Valenzuela Interchange (Inbound to NLEX)	Southbound	2200 - 2300	Heavy rain
		Northbound	0500 - 0600	No enforcers yet
		Northbound	1900 - 2100	Heavy rain
			2200 - 2300	Heavy rain
6	NLEX, Meycauayan Interchange (Inbound to NLEX)	Southbound and Northbound	2200 - 2300	Motorists refused to be interviewed
7	NLEX, Marilao Interchange (Inbound to NLEX)	Northbound	0500 - 0700	No enforcers on site
		Southbound	2100 - 2300	Motorists refused to be interviewed
9	NLEX, Bocaue Interchange (Inbound to NLEX)	Southbound and Northbound	0500 - 0600	Traffic enforcers not yet in the area
		Northbound	0600 - 0700	Traffic enforcers not yet in the area
11	NLEX, Balagtas Toll (Between MacArthur and Tabang Toll)	Southbound and Northbound	0500 - 0600	No Traffic enforcers yet in the area
		Southbound and Northbound	2200 - 2300	Motorists refused to be interviewed

Cont…Table 1.6-1

Station Code	Station Description	Direction	Time	Reasons
12	NLEX, Sta. Rita Interchange (Inbound to NLEX)	Southbound and Northbound	0500 - 0600	Traffic enforcers not yet in the area
		Southbound And Northbound	2200 - 23600	Motorists refused to be interviewed
		Northbound	2100 - 2200	Motorists refused to be interviewed
13	NLEX, Pulilan Interchange (Pulilan to NLEX)	Southbound and Northbound	0500 - 0600	Traffic enforcers not yet in the area
		Southbound and Northbound	2200 - 2300	Motorists refused to be interviewed
14	NLEX, San Simon Interchange (Inbound to NLEX)	Southbound	0500 - 0600	Traffic enforcers not yet in the area
		Southbound and Northbound	2100 - 2300	Motorists refused to be interviewed
15	NLEX, San Fernando Interchange (Inbound to NLEX)	Northbound	0500 - 0600	Traffic enforcers not yet in the area
		Northbound	2000 - 2200	Motorists refused to be interviewed
		Southbound and Northbound	2200 - 2300	Motorists refused to be interviewed
16	NLEX, Mexico Interchange (Before Angeles Toll)	Southbound In and Northbound In	0500 - 0600	Traffic enforcers not yet in the area
		Southbound and Northbound	2200 - 2300	Motorists refused to be interviewed

1.7 Summary of Survey Result

1.7.1 Traffic Count

Traffic count results by hour and site, direction are shown Table 1.7-1.and detailed survey results are shown in **Appendix B**.

Table 1.7-1 Summary of Traffic Count Result

Road Name	Station Code	Station Name	Entrance /Exit	Direction	Traffic Count 18 hours (veh)	Traffic Count 24 hours (veh)
MacArthur Highway	1	Telabastagan, San Fernando Pampanga	-	Southbound	14,004	-
				Northbound	13,710	-
				Total	27,714	-
	2	Bgy. Wakas Bocaue, Bulacan	-	Southbound	5,972	-
				Northbound	6,228	-
				Total	12,200	-
NLEX	3	Balintawak Toll	-	Southbound	33,142	-
				Northbound	37,336	-
				Total	70,478	-
	4	Mindanao Ave. Toll	Entrance	-	12,320	-
			Exit		12,044	-
			Total		24,364	-
	5	Valenzuela IC	Entrance	Southbound	9,238	-
				Northbound	3,551	-
				Total	12,789	-
			Exit	Southbound	3,894	-
				Northbound	5,804	-
				Total	9,698	-
			Total	Southbound	13,132	-
				Northbound	9,335	-
				Total	22,467	-
	6	Meycauayan IC	Entrance	Southbound	7,866	-
				Northbound	6,097	-
				Total	13,963	-
			Exit	Southbound	888	-
				Northbound	2,507	-
				Total	3,395	-
			Total	Southbound	8,754	-
				Northbound	8,604	-
				Total	17,358	-
	7	Marilao IC	Entrance	Southbound	4,437	-
				Northbound	1,200	-
				Total	5,637	-
			Exit	Southbound	1,231	-
				Northbound	4,538	-
				Total	5,769	-
			Total	Southbound	5,667	-
				Northbound	5,738	-
				Total	11,405	-
	9	Bocaue IC	Entrance	Southbound	4,528	-
				Northbound	2,993	-
				Total	7,521	-
			Exit	Southbound	2,900	-
				Northbound	4,106	-
				Total	7,006	-
			Total	Southbound	7,428	-
				Northbound	7,099	-
				Total	14,527	-
	10	Tabang Toll	Entrance	-	8,050	-
			Exit		7,640	-
			Total		15,690	-
	11	Balagtas Toll	Entrance	-	4,681	-
			Exit		4,939	-
			Total		9,620	-
	12	Sta. Rita IC	Entrance	Southbound	1,948	-

Road Name	Station Code	Station Name	Entrance /Exit	Direction	Traffic Count 18 hours (veh)	Traffic Count 24 hours (veh)
				Northbound	1,032	-
				Total	2,980	-
			Exit	Southbound	1,593	-
				Northbound	1,788	-
				Total	3,381	-
			Total	Southbound	3,541	-
				Northbound	2,820	-
				Total	6,361	-
	13	Pulilan IC	Entrance	Southbound	1,788	-
				Northbound	2,163	-
				Total	3,951	-
			Exit	Southbound	2,100	-
				Northbound	1,775	-
				Total	3,875	-
			Total	Southbound	3,888	-
				Northbound	3,938	-
				Total	7,826	-
	14	San Simon IC	Entrance	Southbound	2,763	-
				Northbound	1,577	-
				Total	4,340	-
			Exit	Southbound	1,701	-
				Northbound	2,012	-
				Total	3,713	-
			Total	Southbound	4,464	-
				Northbound	3,589	-
				Total	8,053	-
	15	San Fernando IC	Entrance	Southbound	7,953	-
				Northbound	2,742	-
				Total	10,695	-
			Exit	Southbound	2,913	-
				Northbound	6,986	-
				Total	9,899	-
			Total	Southbound	10,866	-
				Northbound	9,728	-
				Total	20,594	-
	16	Mexico IC	Entrance	-	1,552	-
			Exit		1,379	-
			Total		2,931	-
	17	Angeles IC	Entrance	-	4,644	-
			Exit		4,174	-
			Total		8,818	-
	19	Dau IC	Entrance		5,742	-
			Exit		6,534	-
			Total		12,276	-
	25	Bridge at Apalit	-	Southbound	21,029	-
				Northbound	20,654	-
				Total	41,683	-
	26	Bridge at Angeles	-	Southbound	-	15,537
				Northbound	-	17,980
				Total	-	33,517
	27	Dau Access Road	Entrance	-	4,580	-
			Exit		4,260	-
			Total		8,840	-
	28	Sta. Ines Access Road	Entrance	Southbound	1,888	-
				Northbound	1,423	-
				Total	3,311	-
			Exit	Southbound	1,466	-
				Northbound	1,728	-
				Total	3,194	-
			Total	Southbound	3,354	-
				Northbound	3,151	-
				Total	6,505	-
Clark airport	24	Clark Airport	Entrance	-	-	2,280
			Exit		-	2,215
			Total		-	4,495

1.7.2 Vehicle Occupancy Count

The average vehicle occupancy of each type vehicle by hour and site, direction are shown Table 1.7-2 and detailed survey results are shown in Appendix B

Table 1.7-2 Summary of Vehicle Occupancy Count Result

Road Name	Station Code	Station Name	Entrance /Exit	Direction	Car	Private or public Van	AUV -public FX/ Jeepney	All Buses
MacArthur Highway	1	Telabastagan, San Fernando Pampanga	-	Southbound	1.73	2.74	8.75	30.5
				Northbound	1.59	2.54	6.79	16.56
				Both	1.64	2.62	7.78	18.11
	2	Bgy. Wakas, Bocaue, Bulacan	-	Southbound	1.81	2.57	9.35	0.00
				Northbound	1.73	2.57	7.26	1.67
				Both	1.76	2.57	8.25	1.67
NLEX	3	Balintawak Toll	-	Southbound	1.80	9.44	18.46	48.44
				Northbound	2.11	5.49	15.17	21.47
				Both	1.95	7.52	16.75	33.41
	4	Mindanao Ave. Toll	Entrance	-	1.88	2.92	16.64	51.29
			Exit		1.44	2.40	0.00	33.02
			Both		1.67	2.65	16.64	45.44
	5	Valenzuela IC	Entrance	Southbound	1.48	2.71	17.46	56.14
				Northbound	1.69	3.09	10.56	21.54
				Both	1.51	2.83	14.73	52.52
	6	Meycauayan IC	Entrance	Southbound	1.46	4.86	14.73	28.90
				Northbound	1.57	2.82	12.49	12.47
				Both	1.50	3.81	13.78	24.00
	7	Marilao IC	Entrance	Southbound	2.00	3.60	20.97	54.84
				Northbound	1.47	2.11	17.51	41.56
				Both	1.82	3.39	19.75	53.87
	9	Bocaue IC	Entrance	Southbound	1.57	4.20	17.51	51.07
				Northbound	1.86	4.90	21.84	36.61
				Both	1.71	4.49	19.69	48.64
	10	Tabang Toll	Entrance	-	1.44	8.83	23.02	38.93
	11	Balagtas Toll	Entrance	-	1.63	3.70	18.36	30.23
	12	Sta. Rita IC	Entrance	Southbound	1.90	5.14	6.00	50.26
				Northbound	1.92	8.35	14.67	13.29
				Both	1.91	5.90	8.36	49.51
	13	Pulilan IC	Entrance	Southbound	1.89	6.08	8.10	11.78
				Northbound	2.12	5.27	6.45	14.54
				Both	2.01	5.69	7.60	14.08
	14	San Simon IC	Entrance	Southbound	1.72	2.33	0.00	40.27
				Northbound	1.73	4.10	16.87	24.19
				Both	1.72	2.75	16.87	38.73
	15	San Fernando IC	Entrance	Southbound	1.83	4.33	12.18	35.94
				Northbound	1.76	4.92	24.42	30.56
				Both	1.81	4.42	18.17	35.45
	16	Mexico IC	Entrance	Southbound	1.68	2.58	10.00	0.00
				Northbound	1.42	1.92	15.00	60.00
				Both	1.56	2.27	11.21	60.00
	17	Angeles IC	Entrance	-	1.43	1.60	17.40	39.08
	27	Dau Access Road	Entrance	-	1.70	5.31	22.24	30.99
	28	Sta. Ines Access Road	Entrance	Southbound	1.84	3.36	0.00	56.78
				Northbound	1.58	2.39	16.61	29.32
				Both	1.75	3.03	16.61	34.70
Clark Airport	24	Clark airport	Entrance		2.30	3.40	7.02	8.75
			Exit		1.86	2.70	6.02	9.35
			Both		2.07	3.09	6.55	9.05

1.7.3 Roadside Interview

Vehicle sample rate of each type vehicle by hour and site, direction is shown Table 1.7-3.and detailed survey results are shown in **Appendix B**.

Table 1.7-3 Summary of Roadside Interview Result

Road Name	Station Code	Station Name	Entrance /Exit	Direction	Car (%)	Private or Public Van (%)	AUV -Public FX/ Jeepney (%)	All Buses (%)
MacArthur Highway	1	Telabastagan, San Fernando Pamp.	-	Southbound	4.1	2.3	2.4	5.6
				Northbound	2.5	0.7	2.8	12.5
				Both	3.3	1.2	2.6	9.1
	2	Bgy. Wakas Bocaue, Bulacan	-	Southbound	15.4	7.6	6.8	0.0
				Northbound	6.1	5.6	6.7	0.0
				Both	10.8	6.6	6.7	0.0
NLEX	3	Balintawak Toll	-	Southbound	No RIS Conducted			
				Northbound				
				Both				
	4	Mindanao Ave. Toll	Entrance	-	No RIS Conducted			
			Exit					
			Both					
	5	Valenzuela IC	Entrance	Southbound	4.4	2.0	15.6	11.0
				Northbound	8.7	3.7	1.6	0.0
				Both	6.6	2.8	8.6	11.0
	6	Meycauayan IC	Entrance	Southbound	9.5	5.8	6.0	0.0
				Northbound	7.3	0.5	4.7	0.0
				Both	8.4	3.2	5.4	0.0
	7	Marilao IC	Entrance	Southbound	17.0	6.8	3.9	27.1
				Northbound	14.3	6.3	3.0	-
				Both	15.6	13.1	3.4	27.1
	9	Bocaue IC	Entrance	Southbound	21.7	6.3	22.9	8.7
				Northbound	15.4	8.8	10.7	-
				Both	18.6	7.6	16.8	8.7
	10	Tabang Toll	Entrance	-	5.3	2.4	23.6	10.6
	11	Balagtas Toll	Entrance	-	5.0	24.8	40.9	33.3
	12	Sta. Rita IC	Entrance	Southbound	19.1	24.8	100.0	0.0
				Northbound	10.6	49.2	100.0	0.0
				Both	14.8	37.0	100.0	0.0
	13	Pulilan IC	Entrance	Southbound	18.7	17.9	100.0	0.0
				Northbound	19.0	20.2	18.2	0.0
				Both	18.8	19.0	59.1	0.0
	14	San Simon IC	Entrance	Southbound	30.0	3.2	-	25.2
				Northbound	19.6	11.7	28.1	33.3
				Both	24.8	7.4	28.1	29.2
	15	San Fernando IC	Entrance	Southbound	3.5	1.7	0.3	8.6
				Northbound	1.6	2.6	3.7	30.7
				Both	2.6	2.2	2.0	19.6
	16	Mexico IC	Entrance	-	29.1	15.2	-	-
	17	Angeles IC	Entrance	-	18.9	1.2	37.3	31.0
	27	Dau Access Road	Entrance	-	12.8	7.3	9.5	13.5
	28	Sta. Ines Access Road	Entrance	-	45.8	24.2	27.1	4.7
Clark Airport	24	Clark Airport	Entrance		4.3	-	-	-

2 AIRPORT SURVEYS

2.1 Survey Items

The following items were obtained from this survey:

- Flight list with number of passengers
- Number of airport workers

2.2 Survey Method

Departing passengers, airport workers and well-wishers were interviewed at passenger terminals in NAIA and Clark, on sampling basis, using the interview forms shown in **Appendix A**.

2.3 Survey Result

Summary tables are shown in **Appendix B**.

2.3.1 NAIA Flight List With Number of Passengers

The flight data for NAIA terminals 1, 2, 3 and 4 are shown in Tables 2.1 to 2.12.

Table 2.1: NAIA Terminal 1 Flight Data - Arrival

Date	No.	Flight No.	Routing	Total Pax
Oct-24	1	OZ 705	PUS	74
	2	JQ 79	DRW	143
	3	CI 711	KHH	54
	4	QR 648	DOH	232
	5	CI 701	TPE	116
	6	CX 907	HKG	262
	7	3K 761	SIN	129
	8	KE 621	ICN	182
	9	GF 154	BAH	249
	10	OZ 701	ICN	231
	11	CZ 3091	CAN	68
	12	CX 901	HKG	277
	13	BR 271	TPE	167
	14	TG 620	BKK	202
	15	SV 872	JED	285
	16	SQ 910	SIN	260
	17	JL 741	NRT	115
	18	MH 704	KUL	143
	19	EY 424	AUH	407
	20	CI 703	TPE	129
	21	SQ 912	SIN	160
	22	SV 860	RUH	338
	23	KU 411	KWI	191
	24	QR 646	DOH	374
	25	EK 332	DXB	431
	26	CX 919	HKG	276
	27	GF 156	BAH	250
	28	MH 802	KUL	54

No.	Flight No.	Routing	Total Pax
29	SQ 916	SIN	108
30	HA 455	HON	192
31	KL 807	AMS/TPE	193
32	CZ 397	CAN	84
33	CX 903	HKG	269
34	QF 019	SYD	121
35	KA 931	HKG	44
36	3K 765	SIN	141
37	SQ 918	SIN	230
38	UA 183	GUM	152
39	MH 804	KUL	93
40	TR 2726	SIN	DLYD
41	JQ 78	NRT	173
42	JL 745	NRT	236
43	CZ 377	PEK/XMN	123
44	EK 334	DXB	428
45	KE 623	ICN	241
46	DL 173	JFK/NRT	376
47	CX 913	HKG	177
48	EY 428	AUH	403
49	AR 644	DOH	224
50	UA 193	ROR	98
51	OZ 703	ICN	160
52	7C 2301	ICN	101
53	DL 629	DTW/NGO	354
54	BI 689	BWN	79
55	CX 905	HKG	161

Table 2.2: NAIA Terminal 1 Flight Data - Departure

Date	No.	Flight No.	Dest'n	Total Pax	No.	Flight No.	Destination	Total Pax
Oct-24	1	OZ 706	PUS	90	29	SQ 919	SIN	144
	2	CX 904	HKG	337	30	CX 918	HKG	270
	3	CA 180	PEK	127	31	SV 871	RUH	340
	4	DL 630	NGO/DTW	-	32	QR 647	DOH	325
	5	JQ 79	NRT	148	33	EK 333	DXB	276
	6	BI 682	BWN	108	34	MH 803	KUL	88
	7	MH 805	KUL	61	35	GF 157	BAH	235
	8	DL 172	NRT/JFK	375	36	SQ 921	SIN	228
	9	SQ 915	SIN	147	37	EY 423	AUH	389
	10	CZ 378	XMN/PEK	129	38	CZ 398	CAN	62
	11	JL 746	NRT	211	39	KL 808	TPE/AMS	175
	12	CI 712	KHH	102	40	CX 902	HKG	244
	13	3K 762	SIN	143	41	HA 456	HON	212
	14	CI 702	TPE	170	42	QF 020	SYD	210
	15	QR 649	DOH	232	43	KA 932	HKG	132
	16	CX 906	HKG	318	44	3K 766	SIN	147
	17	GF 155	BAH	221	45	QA 192	ROR	138
	18	CZ 3092	CAN	119	46	TR 2727	SIN	DLYD
	19	KE 622	ICN	129	47	JQ 78	DRW	DLYD
	20	CX 900	HKG	251	48	KU 412	KWI	220
	21	OZ 702	ICN	104	49	QA 184	GUM	155
	22	DR 272	TPE	120	50	KE 624	ICN	212
	23	TG 621	BKK	297	51	OZ 704	ICN	168
	24	SQ 917	SIN	131	52	EK 335	DXB	399
	25	JL 742	NRT	129	53	EY 421	AUH	396
	26	SV 869	DMM	320	54	QR 645	DOH	224
	27	MH 705	KUL	82	55	7C 2302	ICN	101
	28	CI 704	TPE	72				

Table 2.3: NAIA Terminal 2 Flight Data - International Arrival

Date	No.	Flight no.	Origin	Total Pax	No.	Flight no.	Origin	Total Pax
23-Oct	1	PR311	Hongkong	99	13	PR753	Bangkok	51
	2	PR506	Singapore	133	14	PR502	Singapore	105
	3	PR107	Las Vegas	210	15	PR319	Hongkong	120
	4	PR105	San Francisco	273	16	PR210	Melbourne	118
	5	PR103	Los Angeles	333	17	PR359	Beijing	66
	6	PR111	Guam	118	18	PR731	Bangkok	184
	7	PR467	Incheon	150	19	PR508	Singapore	96
	8	PR427	Nagoya	122	20	PR899	Taipei	88
	9	PR407	Kansai	148	21	PR307	Hongkong	205
	10	PR431	Narita	136	22	PR331	Xiamen	99
	11	PR301	Hongkong	144	23	PR337	Shanghai	105
	12	PR592	Saigon	72	24	PR469	Incheon	121

Table 2.4: NAIA Terminal 2 Flight Data - International Departure

Date	No.	Flight No.	Destination	Total Pax	No.	Flight No.	Destination	Total Pax
23-Oct	1	PR896	Taipei	109	12	PR468	Incheon	101
	2	PR511	Singapore	154	13	PR432	Narita	179
	3	PR358	Beijing	90	14	PR501	Singapore	117
	4	PR591	Saigon	79	15	PR106	Las Vegas	178
	5	PR300	Hongkong	214	16	PR310	Hongkong	155
	6	PR507	Singapore	126	17	PR732	Bangkok	155
	7	PR730	Bangkok	221	18	PR102	Los Angeles	216
	8	PR438	Nagoya	144	19	PR503	Singapore	110
	9	PR318	Hongkong	140	20	PR104	San Francisco	151
	10	PR336	Shanghai	82	21	PR535	Jakarta	110
	11	PR306	Hongkong	239	22	PR466	Incheon	133

Table 2.5: NAIA Terminal 2 Flight Data – Domestic Arrival

Date	No.	Flight No.	Origin	Total Pax	No.	Flight No.	Origin	Total Pax
23-Oct	1	PR132	Bacolod	142	23	PR812	Davao	341
	2	PR140	Iloilo	124	24	PR478	Butuan	118
	3	PR190	Roxas	97	25	PR144	Iloilo	129
	4	PR844	Cebu	136	26	PR324	Kalibo	-
	5	PR124	Zamboanga	107	27	PR240	Kalibo	-
	6	PR278	Legazpi	89	28	PR294	Dumaguete	81
	7	PR820	Davao	145	29	PR858	Cebu	147
	8	PR282	Cagayan	129	30	PR158	Bacolod	154
	9	PR292	Dumaguete	77	31	PR186	Cagayan	119
	10	PR848	Cebu	237	32	PR178	Tagbilaran	140
	11	PR196	P. Princesa	105	33	PR198	P. Princesa	106
	12	PR134	Bacolod	144	34	PR284	Cagayan	91
	13	PR142	Iloilo	130	35	PR850	Cebu	286
	14	PR454	Gensan	196	36	PR326	Kalibo	-
	15	PR322	Kalibo	-	37	PR394	Tacloban	117
	16	PR168	Dipolog	86	38	PR136	Bacolod	135
	17	PR176	Tagbilaran	122	39	PR824	Davao	241
	18	PR392	Tacloban	126	40	PR126	Zamboanga	91
	19	PR854	Cebu	244	41	PR146	Iloilo	104
	20	PR227	Laoag	115	42	PR864	Cebu	138
	21	PR184	Cagayan	144	43	PR874	Cebu	117
	22	PR188	Cotabato	98	44	PR822	Davao	88

Table 2.6: NAIA Terminal 2 Flight Data – Domestic Departure

Date	No.	Flight No.	Destination	Total Pax	No.	Flight No.	Destination	Total Pax
23-Oct	1	PR819	Davao	127	23	PR226	Laoag	99
	2	PR131	Bacolod	110	24	PR477	Butuan	107
	3	PR123	Zamboanga	109	25	PR857	Cebu	156
	4	PR139	Iloilo	88	26	PR143	Iloilo	110
	5	PR843	Cebu	257	27	PR185	Cagayan	115
	6	PR189	Roxas	88	28	PR323	Kalibo	80
	7	PR281	Cagayan	140	29	PR293	Dumaguete	81
	8	PR277	Legazpi	139	30	PR157	Bacolod	120
	9	PR847	Cebu	300	31	PR283	Cagayan	94
	10	PR453	Gensan	216	32	PR393	Tacloban	99
	11	PR291	Dumaguete	73	33	PR849	Cebu	276
	12	PR195	P. Princesa	141	34	PR177	Tagbilaran	141
	13	PR133	Bacolod	137	35	PR197	P.Princesa	85
	14	PR141	Iloilo	119	36	PR325	Kalibo	52
	15	PR321	Kalibo	95	37	PR813	Davao	261
	16	PR187	Cotabato	97	38	PR125	Zamboanga	93
	17	PR175	Tagbilaran	133	39	PR135	Bacolod	128
	18	PR167	Dipolog	105	40	PR145	Iloilo	111
	19	PR853	Cebu	288	41	PR863	Cebu	135
	20	PR183	Cagayan	148	42	PR873	Cebu	118
	21	PR391	Tacloban	109	43	PR821	Davao	128
	22	PR811	Davao	390	44	PR855	Cebu	86

Table 2.7: NAIA Terminal 3 Flight Data – International Arrival

Date	No.	Flight No.	Origin	Total Pax	No.	Flight No.	Origin	Total Pax
24-Oct	1	2P258	REP	144	14	5J502	KUL	111
	2	2P801	SIN	148	15	5J673	PEK	84
	3	2P876	KUL	87	16	5J679	PVG	88
	4	5J109	HKG	115	17	5J734	BKI	91
	5	5J111	HKG	140	18	5J745	HAN	99
	6	5J119	HKG	128	19	5J752	SGN	61
	7	5J143	HKG	149	20	5J800	SIN	152
	8	5J191	ICN	58	21	5J802	SIN	155
	9	5J195	ICN	119	22	5J804	SIN	161
	10	5J311	TPE	133	23	5J806	SIN	167
	11	5J363	MFM	91	24	5J932	BKK	112
	12	5J410	BWM	66	25	NH949	NRT	209
	13	5J500	KUL	118	26	Z2885	ICN	121

Table 2.8: NAIA Terminal 3 Flight Data – International Departure

Date	No.	Flight No.	Destination	Total Pax	No.	Flight No.	Destination	Total Pax
24-Oct	1	2P800	SIN	130	13	5J501	KUL	137
	2	5J108	HKG	162	14	5J678	PVG	101
	3	5J110	HKG	161	15	5J751	SGN	136
	4	5J118	HKG	140	16	5J759	CGK	119
	5	5J142	HKG	170	17	5J799	SIN	163
	6	5J184	PUS	96	18	5J803	SIN	160
	7	5J190	ICN	109	19	5J805	SIN	158
	8	5J194	ICN	104	20	5J931	BKK	158
	9	5J288	CAN	124	21	NH950	NRT	209
	10	5J310	TPE	139	22	Z2018	PVG	31
	11	5J362	MFM	107	23	Z2884	ICN	132
	12	5J499	KUL	152				

Table 2.9: NAIA Terminal 3 Flight Data - Domestic Arrival

Date	No.	Flight No.	Origin	Total Pax	No.	Flight No.	Origin	Total Pax
24-Oct	1	2P015	TUG	64	57	5J384	CGY	138
	2	2P022	MBT	55	58	5J386	CGY	177
	3	2P030	CRM	68	59	5J390	CGY	163
	4	2P032	USU	48	60	5J392	CGY	155
	5	2P034	USU	51	61	5J396	CGY	165
	6	2P040	MPH	40	62	5J405	LAO	51
	7	2P042	SJI	54	63	5J450	ILO	122
	8	2P046	MPH	31	64	5J452	ILO	162
	9	2P048	MPH	0	65	5J454	ILO	174
	10	2P052	MPH	29	66	5J456	ILO	153
	11	2P056	MPH	29	67	5J458	ILO	160
	12	2P062	MPH	78	68	5J460	ILO	160
	13	2P066	SUG	0	69	5J474	BCD	181
	14	2P072	MPH	54	70	5J476	BCD	170
	15	2P074	MPH	28	71	5J478	BCD	145
	16	2P076	MPH	45	72	5J480	BCD	171
	17	2P078	MPH	0	73	5J482	BCD	122
	18	2P082	KLO	131	74	5J505	TUG	153
	19	2P092	CYP	63	75	5J514	SJI	150
	20	2P264	WNP	71	76	5J522	WNP	57
	21	2P266	WNP	76	77	5J532	USU	58
	22	2P388	LAO	78	78	5J540	USU	47
	23	2P870	CGY	152	79	5J552	CEB	144
	24	2P910	BCD	148	80	5J554	CEB	122
	25	2P914	BCD	157	81	5J556	CEB	52
	26	2P926	LGP	119	82	5J560	CEB	157
	27	2P928	CEB	156	83	5J562	CEB	171
	28	2P929	CEB	152	84	5J564	CEB	153
	29	2P931	CEB	147	85	5J566	CEB	122
	30	2P934	CEB	153	86	5J570	CEB	164
	31	2P940	OZC	158	87	5J572	CEB	138
	32	2P942	PPS	149	88	5J574	CEB	142
	33	2P944	PPS	137	89	5J578	CEB	134
	34	2P948	PPS	167	90	5J580	CEB	151
	35	2P952	ILO	150	91	5J582	CEB	144
	36	2P954	ILO	160	92	5J586	CEB	134
	37	2P958	TAG	146	93	5J618	TAG	146
	38	2P960	CBO	153	94	5J626	DGT	106
	39	2P966	CGY	164	95	5J628	DGT	113
	40	2P970	KLO	143	96	5J630	DGT	130
	41	2P978	TAC	144	97	5J638	PPS	159
	42	2P982	DVO	133	98	5J640	PPS	159
	43	2P984	DVO	140	99	5J644	PPS	176
	44	2P988	DVO	133	100	5J652	TAC	172
	45	2P990	GES	146	101	5J654	TAC	0
	46	2P994	ZAM	129	102	5J658	TAC	0
	47	2P998	ZAM	148	103	5J660	TAC	0
	48	5J197	CYZ	107	104	5J704	DPL	146
	49	5J324	LGP	120	105	5J772	PAG	143
	50	5J326	LGP	119	106	5J782	OZC	174
	51	5J328	LGP	141	107	5J786	BXU	0
	52	5J336	KLO	0	108	5J788	BXU	0
	53	5J340	KLO	0	109	5J852	ZAM	162
	54	5J346	KLO	70	110	5J856	ZAM	144
	55	5J374	RXS	172	111	5J888	CBO	183
	56	5J382	CGY	154	112	5J892	MPH	7

Cont…Table 2.9

Date	No.	Flight No.	Origin	Total Pax	No.	Flight No.	Origin	Total Pax
24-Oct	113	5J894	MPH	12	123	5J920	MPH	144
	114	5J896	MPH	16	124	5J960	DVO	151
	115	5J898	MPH	11	125	5J962	DVO	171
	116	5J900	MPH	22	126	5J964	DVO	162
	117	5J902	MPH	17	127	5J968	DVO	179
	118	5J906	MPH	12	128	5J970	DVO	181
	119	5J908	MPH	10	129	5J972	DVO	176
	120	5J910	MPH	20	130	5J974	DVO	175
	121	5J912	MPH	15	131	5J992	GES	174
	122	5J914	MPH	17	132	5J996	GES	168

Table 2.10: NAIA Terminal 3 Flight Data - Domestic Departure

Date	No.	Flight no.	Origin	Total Pax	No.	Flight no.	Origin	Total Pax
24-Oct	1	2P 104	TUG	53	50	5J 325	LGP	119
	2	2P 021	MBT	31	51	5J 327	LGP	134
	3	2P 029	CRM	76	52	5J 339	KLO	144
	4	2P 031	USU	48	53	5J 345	KLO	67
	5	2P 033	USU	53	54	5J 353	KLO	-
	6	2P 039	MPH	25	55	5J 355	KLO	-
	7	2P 041	SJI	49	56	5J 373	RXS	166
	8	2P 045	MPH	37	57	5J 381	CGY	169
	9	2P 047	MPH	21	58	5J 383	CGY	160
	10	2P 051	MPH	44	59	5J 385	CGY	181
	11	2P 055	MPH	25	60	5J 389	CGY	184
	12	2P 061	MPH	25	61	5J 391	CGY	149
	13	2P 065	SUG	-	62	5J 395	CGY	177
	14	2P 071	MPH	38	63	5J 404	LAO	66
	15	2P 073	MPH	29	64	5J 449	ILO	169
	16	2P 075	MPH	38	65	5J 451	ILO	166
	17	2P 077	MPH	-	66	5J 453	ILO	170
	18	2P 081	KLO	92	67	5J 455	ILO	180
	19	2P 091	CYP	66	68	5J 457	ILO	169
	20	2P 263	WNP	66	69	5J 459	ILO	173
	21	2P 265	WNP	67	70	5J 473	BCD	169
	22	2P 387	LAO	56	71	5J 475	BCD	156
	23	2P 869	CGY	162	72	5J 477	BCD	150
	24	2P 909	BCD	162	73	5J 479	BCD	166
	25	2P 913	BCD	165	74	5J 481	BCD	153
	26	2P 924	CEB	163	75	5J 504	TUG	137
	27	2P 925	LGP	129	76	5J 513	SJI	136
	28	2P 927	CEB	132	77	5J 521	WNP	49
	29	2P 930	CEB	170	78	5J 531	USU	65
	30	2P 933	CEB	165	79	5J 539	USU	59
	31	2P 939	OZC	157	80	5J 551	CEB	156
	32	2P 941	PPS	160	81	5J 553	CEB	170
	33	2P 943	PPS	146	82	5J 557	CEB	63
	34	2P 947	PPS	159	83	5J 559	CEB	163
	35	29 951	ILO	164	84	5J 561	CEB	145
	36	29 953	1LO	153	85	5J 563	CEB	174
	37	2P 957	TAG	164	86	5J 565	CEB	152
	38	2P 959	CBO	155	87	5J 569	CEB	159
	39	29 965	CGY	166	88	5J 571	CEB	147
	40	29 969	KLO	139	89	5J 573	CEB	151
	41	2P 977	TAC	153	90	5J 577	CEB	161
	42	2P 981	DVO	169	91	5J 581	CEB	158
	43	2P 983	DVO	163	92	5J 587	CEB	147

Date	No.	Flight no.	Origin	Total Pax	No.	Flight no.	Origin	Total Pax
	44	2P 987	DVO	164	93	5J 617	TAG	138
	45	2P 989	GES	169	94	5J 625	DGT	137
	46	2P 993	ZAM	164	95	5J 627	DGT	139
	47	2P 997	ZAM	158	96	5J 629	DGT	131
	48	5J 196	CYZ	152	97	5J 637	PPS	150
	49	5J 323	LGP	168	98	5J 639	PPS	167
	99	5J 643	PPS	161	116	5J 899	MPH	61
	100	5J 651	TAC	173	117	5J 901	MPH	57
	101	5J 653	TAC	-	118	5J 905	MPH	65
	102	5J 657	TAC	-	119	5J 907	MPH	47
	103	5J 659	TAC	144	120	5J 909	MPH	51
	104	5J 703	DPL	156	121	5J 911	MPH	64
	105	5J 771	PAG	151	122	5J 913	MPH	54
	106	5J 781	OZC	164	123	5J 919	MPH	43
	107	5J 785	BXU	-	124	5J 959	DVO	175
	108	5J 787	BXU	-	125	5J 961	DVO	175
	109	5J 851	ZAM	165	126	5J 963	DVO	172
	110	5J 855	ZAM	160	127	5J 965	DVO	176
	111	5J 887	CBO	149	128	5J 969	DVO	166
	112	5J 891	MPH	51	129	5J 971	DVO	174
	113	5J 893	MPH	44	130	5J 973	DVO	171
	114	5J 895	MPH	48	131	5J 991	GES	169
	115	5J 897	MPH	42	132	5J 995	GES	164

Table 2.11: NAIA Terminal 4 Flight Data – Domestic Arrival

Date	No.	Flight No.	Origin	Total Pax	No.	Flight No.	Origin	Total Pax
24-Oct	1	Z2 105	CRK	40	19	Z2 221	LGP	76
	2	Z2 313	ILO	126	20	Z2 203	MRQ	42
	3	Z2 361	CEB	94	21	DG 7025	DVO	74
	4	Z2 321	TAC	129	22	DG 7007	CEB	68
	5	Z2 261	MBT	44	23	Z2 353	TAG	171
	6	Z2 391	DVO	129	24	Z2 273	KLO	116
	7	DG 7003	CEB	64	25	DG 7063	PPS	107
	8	Z2 427	PPS	66	26	Z2 413	USU	33
	9	DG 7073	ILO	130	27	Z2 385	CEB	87
	10	Z2 309	KLO	123	28	DG 7083	BCD	171
	11	Z2 351	TAG	152	29	Z2 421	PPS	88
	12	Z2 423	PPS	125	30	Z2 311	ILO	115
	13	Z2 411	USU	38	31	DG 7057	KLO	115
	14	Z2 381	CEB	68	32	DG 7015	CEB	91
	15	DG 7045	TAC	118	33	DG 7029	DVO	87
	16	Z2 373	KLO	134	34	Z2 383	CEB	89
	17	Z2 303	KLO	109	35	Z2 393	DVO	108
	18	DG 7005	CEB	68	36	Z2 301	KLO	89

Table 2.12: NAIA Terminal 4 Flight Data – Domestic Departure

Date	No.	Flight No.	Destination	Total Pax	No.	Flight No.	Destination	Total Pax
24-Oct	1	Z2 360	CEB	111	19	Z2 300	KLO	111
	2	Z2 390	DVO	156	20	Z2 202	MRQ	34
	3	Z2 312	ILO	118	21	DG 7006	CEB	87
	4	Z2 320	TAC	129	22	Z2 272	KLO	107
	5	Z2 260	MBT	51	23	DG 7062	PPS	125
	6	DG 7002	CEB	92	24	DG 7082	BCD	124
	7	Z2 426	PPS	107	25	Z2 412	USU	54
	8	DG 7072	ILO	115	26	Z2 384	CEB	138
	9	Z2 422	PPS	134	27	Z2 420	PPS	131
	10	Z2 308	KLO	102	28	Z2 310	ILO	157
	11	Z2 350	TAG	165	29	Z2 274	KLO	103
	12	Z2 380	CEB	110	30	DG 7056	KLO	55
	13	Z2 410	USU	56	31	DG 7028	DVO	122
	14	DG 7004	TAC	97	32	Z2 392	DVO	149
	15	DG 7024	DVO	128	33	DG 7014	CEB	115
	16	DG 7004	CEB	81	34	Z2 382	CEB	143
	17	Z2 220	LGP	88	35	Z2 352	TAG	163
	18	Z2 322	TAC	105				

2.3.2 Clark Airport Flight List With Number of Passengers

The flight data for Clark International Airport are shown in Tables 2.13 to 2.16.

Table 2.13: Clark Airport Flight Data – International Arrival

Date	No.	Flight No.	Origin	Total Pax	No.	Flight No.	Origin	Total Pax
19-Oct	1	OZ 707	Incheon	167	10	2P780	Hongkong	82
	2	KA373	Hongkong	65	11	DG7929	Hongkong	122
	3	AK1438	Kuala Lumpur	137	12	PQ7311	Macau	107
	4	PQ7306	Hongkong	84	13	DG7213	Bangkok	100
	5	5J149	Hongkong	94	14	PQ7456	Kuala Lumpur	89
	6	DG7925	Hongkong	64	15	5J371	Macau	102
	7	DG7793	Singapore	132	16	OZ 707	Incheon	134
	8	AK6264	Kota Kinabalu	93	17	LJ003	Incheon	156
	9	5J538	Singapore	98				

Table 2.14: Clark Airport Flight Data – International Departure

Date	No.	Flight No.	Destination	Total Pax	No.	Flight No.	Destination	Total Pax
19-Oct	1	OZ 708	Incheon	61	9	AK6265	Kota Kinabalu	32
	2	5J150	Hongkong	125	10	DG 7212	Bangkok	133
	3	PQ7305	Hongkong	121	11	2P779	Hongkong	98
	4	DG7924	Hongkong	135	12	PQ7310	Macau	75
	5	DG 7792	Singapore	81	13	5J370	Macau	125
	6	KA376	Hongkong	133	14	DG7928	Hongkong	101
	7	AK1439	Kuala Lumpur	110	15	OZ 708	Incheon	96
	8	PQ7015	Singapore	142	16	LJ004	Incheon	135

Table 2.15: Clark Airport Flight Data – Domestic Arrival

Date	No.	Flight No.	Origin	Total Pax	No.	Flight No.	Origin	Total Pax
19-Oct	1	1	PQ7002	Kalibo	5	5	DG7403	Kalibo
	2	2	2P770	Cebu	6	6	2P774	Kalibo
	3	3	PQ7024	Davao	7	7	PQ7006	Kalibo
	4	4	PQ7016	Kalibo	8	8	5J608	Cebu

Table 2.16: Clark Airport Flight Data – Domestic Departure

Date	No.	Flight No.	Destination	Total Pax	No.	Flight No.	Destination	Total Pax
19-Oct	1	PQ7001	Kalibo	108	6	PQ7005	Kalibo	74
	2	2P769	Cebu	118	7	2P773	Kalibo	147
	3	PQ7023	Davao	83	8	5J609	Cebu	120
	4	DG7402	Kalibo	123	9	2P771	Davao	124
	5	PQ7455	Davao	134				

2.3.3 Number of Workers

2.3.3.1 Ninoy Aquino International Airport

The numbers of employees worked at NAIA Terminals 1, 2, 3 and 4 is shown in Table 2.17.

Table 2.17: Airport Workers Data

Type of Workers	Terminal 1	Terminal 2	Terminal 3	Terminal 4	Total	Data Source
MIAA Organic - Employees	866	163	59	33	**1,121**	MIAA Office
Non-Organic Employees	300	304	468	116	**1,188**	MIAA Office
Janitorial	60	80	366	20	**526**	MIAA Office
Airline Employees	366	1236	1030	85	**2,717**	Airline Offices
Police	100	40	33	11	**184**	Police Airport Office
Security Guards	90	120	66	22	**298**	Security Airport Office
TOTAL	**1782**	**1943**	**2022**	**287**	**6,034**	

Note: Non-Organic composed of Immigration, customs, contractors/subcontractor and concessionaries of MIAA as of October 2012

2.3.3.2 Clark International Airport

The numbers of employees worked at Clark Airport Terminal is shown in Table 2.18.

Table 2.18: Airport Workers Data (Clark Airport)

Type of Employees	Number	Data Source
Organic	347	CIAC
Non-Organic	56	CIAC
Janitorial	-	N.A
Police	-	N.A
Security	-	N.A
Airline Employees	-	N.A
Total	403	

Note: Non-Organic is composed of contractors/subcontractors and concessionaires of CIAC as of October 2012

3 ON-BOARD BUS SURVEY

3.1 Survey Items

The following items were observed during the on-board survey of buses:

- Passenger trip information (e.g., origin and destination, purpose, mode etc.)
- Bus Information (e.g., route origin and destination, number of passengers, seating capacity etc.)

3.2 Survey Method

Two types of interviews were conducted, one for public mode passengers and the others was for public mode drivers.

For public mode passengers, trip origin and destination, trip purpose, home address of interviewee, total fare paid from origin to destination were gathered. For public drivers, data on number of passengers and seating capacity, route origin and destination were gathered. The survey duration was 14 hours. Survey form used is shown in **Appendix A**.

3.3 Surveyed Bus Routes

Surveyed bus routes are shown in Figures 3.3-1 to 3.3-4.

3.4 Survey Days

The survey was conducted on 29th and 30th of October and 3rd of November 2012.

3.5 Survey Result

The numbers of buses surveyed and number of passengers interviewed are shown in Tables 3.3-1 to 3.3-4.

Figure 3.3-1 Surveyed Bus Routes in Bulacan Area

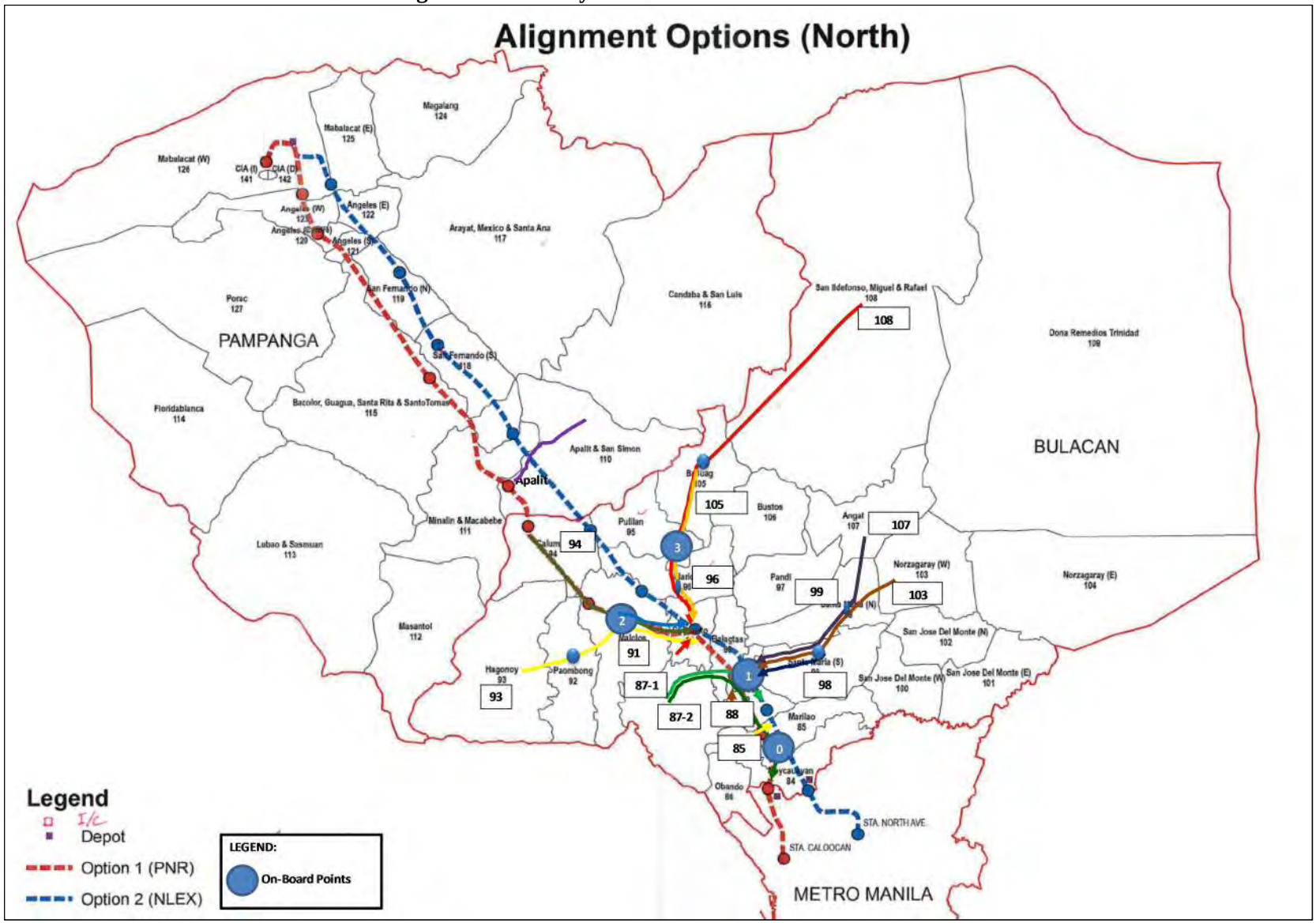


Figure 3.3-2 Surveyed Bus Routes in Pampanga Area

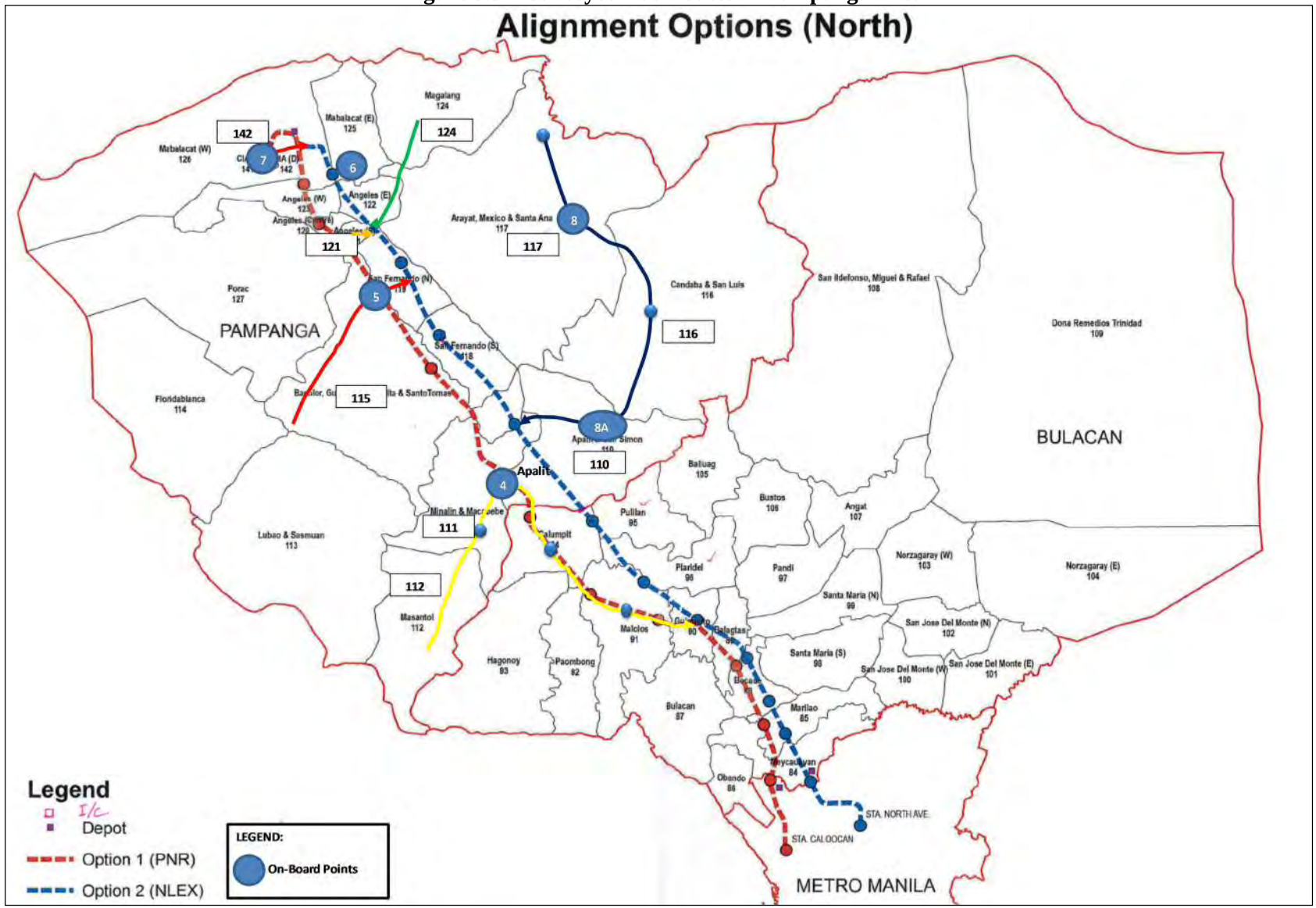


Figure 3.3-3 Surveyed Bus Routes in Other Region 3 Areas

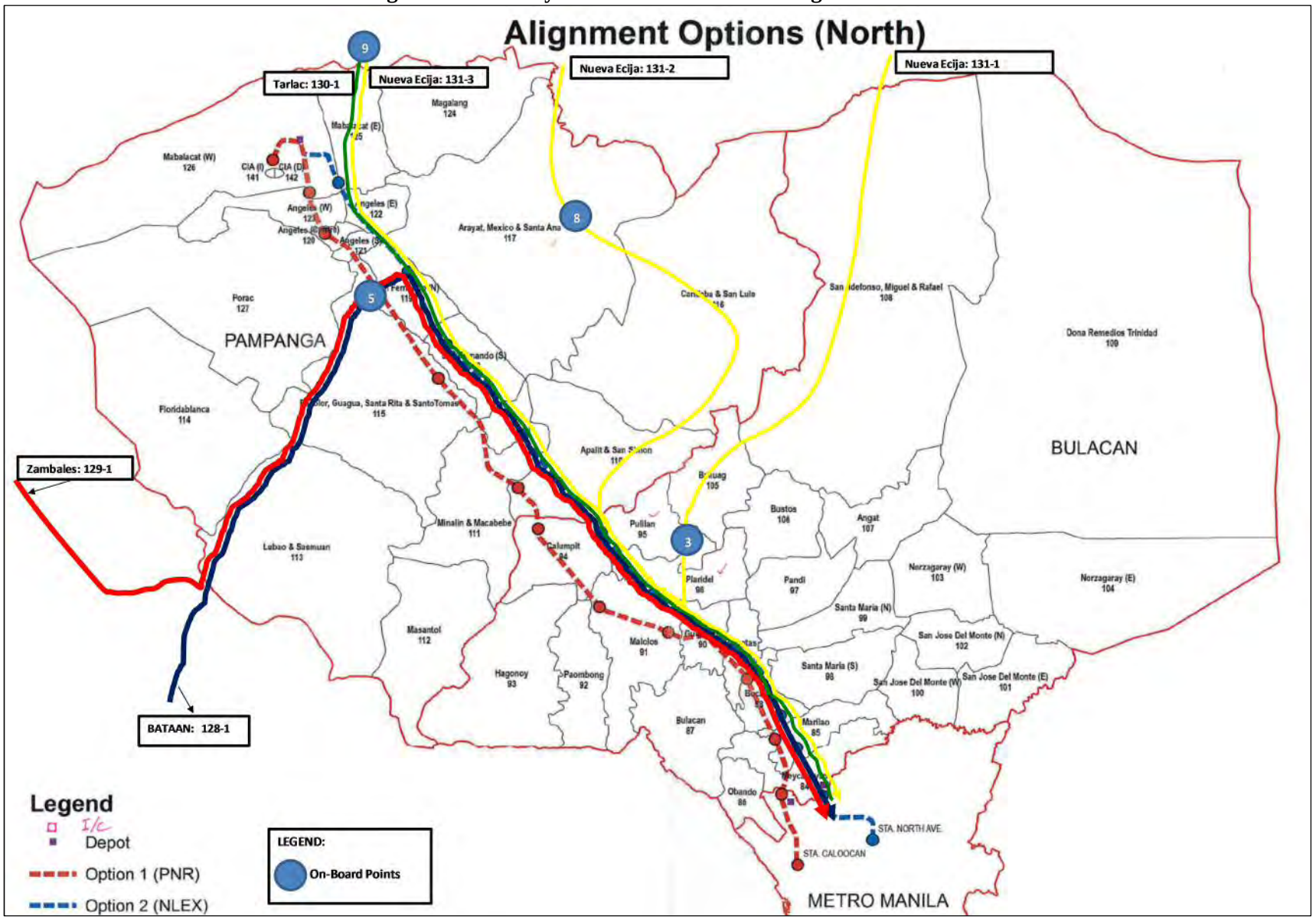


Figure 3.3-4 Surveyed Bus Routes in Region 1, 2 and CAR Areas

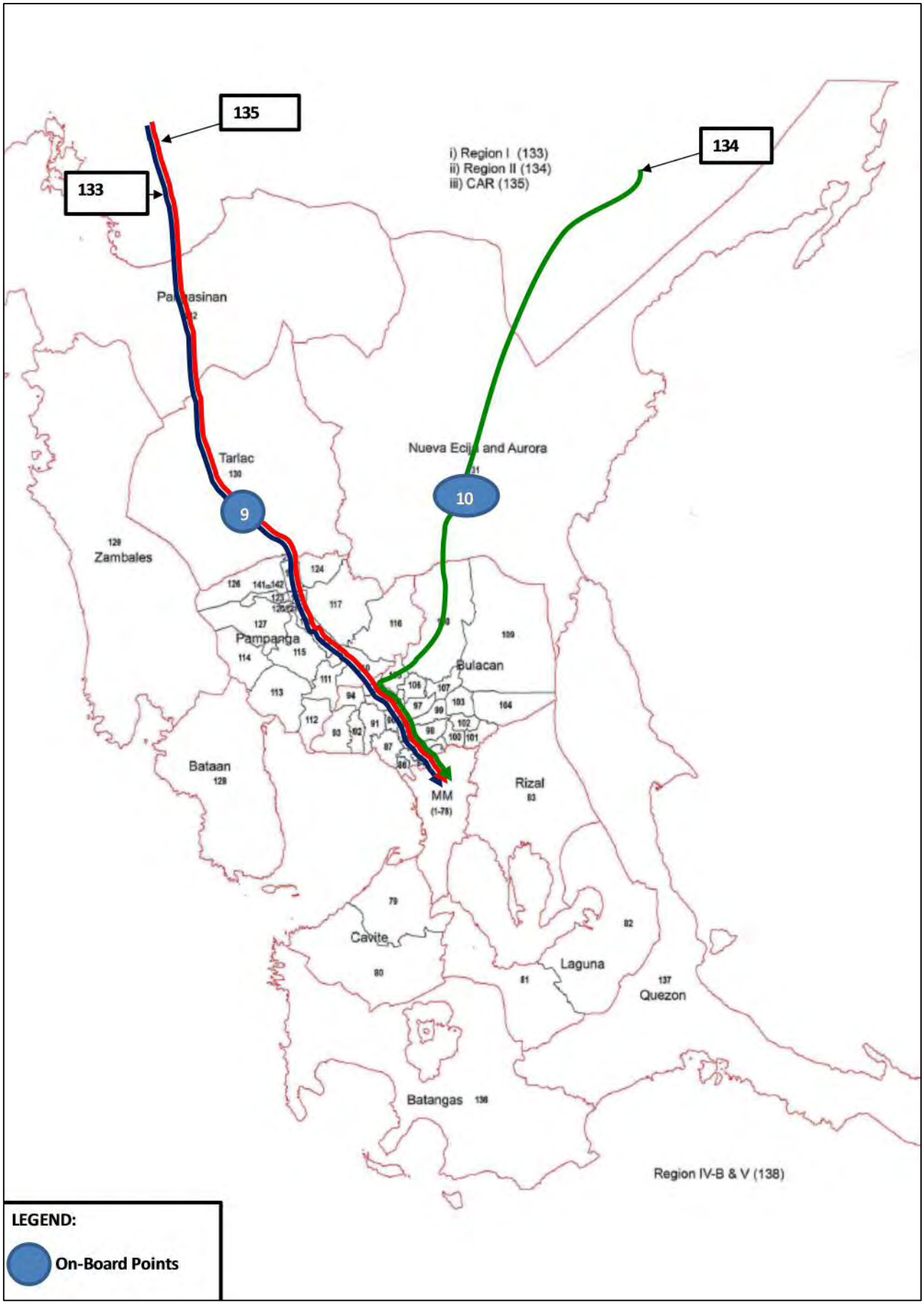


Table 3.3-1: Bus Routes Surveyed in Bulacan Area

ORIGIN			DESTINATION	Number of Buses Surveyed	Number of Passengers Interviewed
Region	Province	City/Municipality			
3	Bulacan	Marilao	Muntinlupa City	1	10
3	Bulacan	Bulacan	Quezon City	2	20
3	Bulacan	Bulacan	Manila City	6	62
3	Bulacan	Balagtas	Manila City	7	70
3	Bulacan	Malolos	Quezon City	3	30
3	Bulacan	Hagonoy	Pasay City	7	70
3	Bulacan	Hagonoy	Quezon City	3	46
3	Bulacan	Calumpit	Caloocan City	2	20
3	Bulacan	Pulilan	Quezon City	4	40
3	Bulacan	Plaridel	Quezon City	4	40
3	Bulacan	Santa Maria	Quezon City	3	28
3	Bulacan	San Jose del Monte	Manila City (Sta. Cruz)	3	40
3	Bulacan	Baliwag	Pasay City	2	20
3	Bulacan	Baliwag	Quezon City	9	96
3	Bulacan	Baliwag	Caloocan City	4	40
3	Bulacan	Angat	Manila City	8	80
3	Bulacan	San Miguel	Manila City	4	40
3	Bulacan	San Miguel	Caloocan City	4	40
3	Bulacan	San Rafael	Caloocan City	4	40
TOTAL				80	832

Table 3.3-2: Bus Routes Surveyed in Pampanga Area

ORIGIN			DESTINATION	Number of Buses Surveyed	Number of Passengers Interviewed
Region	Province	City/Municipality			
3	Pampanga	Apalit	Manila City	2	14
3	Pampanga	Apalit	Pasay City	6	44
3	Pampanga	Apalit	Caloocan City	3	32
3	Pampanga	Apalit	Caloocan City	4	28
3	Pampanga	Masantol	Manila City	3	16
3	Pampanga	Guagua	Caloocan City	2	31
3	Pampanga	Guagua	Manila City	18	181
3	Pampanga	Guagua	Cavite City	1	7
3	Pampanga	Candaba	Quezon City	4	28
3	Pampanga	Arayat	Caloocan City	5	54
3	Pampanga	San Fernando	Manila City	5	50
3	Pampanga	San Fernando	Pasay City	12	165
3	Pampanga	San Fernando	Quezon City	10	100
3	Pampanga	San Fernando	Caloocan City	6	76
3	Pampanga	Angeles	Manila City	1	10
3	Pampanga	Angeles	Quezon City	1	6
3	Pampanga	Angeles	Caloocan City	7	42
3	Pampanga	Mabalacat (Dau)	Pasay City	8	46
TOTAL				98	930

Table 3.3-3: Bus Routes Surveyed in Other Region 3 Areas

ORIGIN			DESTINATION	Number of Buses Surveyed	No. of Passengers Interviewed
Region	Province	City/Municipality			
3	Bataan	Balanga	Manila City	5	34
3	Bataan	Balanga	Pasay City	5	30
3	Bataan	Balanga	Quezon City	16	178
3	Bataan	Mariveles	Manila City	6	42
3	Bataan	Mariveles	Pasay City	5	18
3	Bataan	Mariveles	Quezon City	9	70
3	Zambales	Iba	Manila City	2	7
3	Zambales	Olongapo	Quezon City	1	10
3	Zambales	Olongapo City	Caloocan City	11	104
3	Zambales	Olongapo City	Pasay City	5	46
3	Zambales	Sta Cruz	Quezon City	1	10
3	Zambales	Olongapo City	Manila City	2	18
3	Tarlac	Tarlac	Manila City	3	24
3	Tarlac	Tarlac	Pasay City	2	20
3	Tarlac	Tarlac	Pasay City	5	48
3	Tarlac	Tarlac	Quezon City	4	38
3	Nueva Ecija,	Cabanatuan City	Caloocan City	2	20
3	Nueva Ecija,	Cabanatuan City	Pasay City	1	10
3	Nueva Ecija,	Cabanatuan City	Quezon City	12	112
3	Nueva Ecija,	Cabiao	Caloocan City	2	28
3	Nueva Ecija,	San Isidro	Caloocan City	24	242
TOTAL				123	1,109

Table 3.3-4: Bus Routes Surveyed in Regions 1, 2 and CAR Areas

ORIGIN			DESTINATION	Number of Buses Surveyed	No. of Passengers Interviewed
Region	Province	City/Municipality			
1	Pangasinan	Alaminos	Quezon City	10	106
1	Pangasinan	Anda	Quezon City	1	6
1	Pangasinan	Bolinao	Quezon City	1	12
1	Pangasinan	Bolinao	Pasay City	2	22
1	Pangasinan	Dagupan City	Manila City	1	14
1	Pangasinan	Dagupan City	Pasay City	9	86
1	Pangasinan	Dagupan City	Quezon City	29	294
1	Pangasinan	Lingayen	Quezon City	2	14
1	Pangasinan	Lingayen	Pasay City	1	14
1	Pangasinan	San Carlos City	Pasay City	6	70
1	Pangasinan	San Carlos City	Quezon City	6	68
1	Pangasinan	San Nicolas	Quezon City	1	12
1	Pangasinan	Urbiztundo	Quezon City	1	10
1	Pangasinan	Agno	Pasay City	1	10
1	Pangasinan	Alaminos-	Pasay City	2	20
1	Pangasinan	Anda	Pasay City	3	28
1	Pangasinan	San Fabian	Pasay City	1	10
1	Pangasinan	Tayug-	Pasay City	1	10
1	Pangasinan	Tayug-	Quezon City	1	10
1	Ilocos Norte	Laoag City	Manila City	4	26
1	Ilocos Sur	Candon	Manila City	3	17
1	Ilocos Sur	Vigan	Manila City	2	11
1	La Union	San Fernando	Pasay City	4	34
CAR	Cagayan	Tuguegarao	Manila City	14	310
CAR	Benguet	Baguio City	Manila City	2	26
CAR	Benguet	Baguio City	Pasay City	7	80
CAR	Benguet	Baguio City	Quezon City	5	38
CAR	Benguet	Baguio City	Mariveles	1	26
TOTAL				121	1,384

4 STATED PREFERENCE SURVEY

4.1 Survey Items

The following items were observed at MacArthur and NLEX, NAIA, Clark Airport, and provincial buses plying Northern Luzon.

4.2 Survey Method

Stated Preference (SP) survey interview was undertaken to gather information of socio-economic profile of passengers and trip information including trip origin and destination, mode, and willingness to pay. This survey was conducted at MacArthur Highway, NLEX, NAIA and Clark Airport and on provincial buses plying to Northern Luzon. For MacArthur and NLEX, private car users were interviewed at roadsides. For NAIA and Clark Airport, passengers and well-wishers were interviewed at each airport terminal. In addition, airport workers were also interviewed from NAIA and Clark airport offices. On board bus passengers' interviews were conducted at the same time the bus drivers were also interviewed. Each SP survey form is Appendix A.

4.3 Survey Location and Surveyed Bus Routes

Survey locations are shown in Figures 3.3-1 to 3.3-4 in Chapter 3. Surveyed bus routes are same with on board bus survey.

4.4 Survey Day and Duration

Each survey site's survey day and duration are shown in Table 4.4-1

Table 4.4-1 Survey Day and Duration

Type	Site	Survey Date	Survey Duration (Hrs)
MacArthur Highway	Petron (NB)	10/22/12	14
	Petron (SB)	10/22/12	14
NLEX	Petron (NB)	10/22/12	14
	Petron (SB)	10/22/12	14
Clark airport	Terminal 1	10/19/12	24
NAIA	Terminal 1	10/23/12	24
	Terminal 2	10/23/12	24
	Terminal 3	10/24/12	24
	Terminal 4	10/24/12	24
On Board Bus Survey	Selected areas	10/30/12 10/31/12 11/03/12	14 14 14

4.5 Survey Result

Number of samples by type and sample site is shown in Table 4.5-1.

Table 4.5-1 Survey Result

Type	Site	Total No. of Samples
MacArthur Highway	Petron (NB)	110
	Petron (SB)	88
NLEX	Petron (NB)	251
	Petron (SB)	148
Clark Airport	Terminal 1	416
NAIA	Terminal 1	425
	Terminal 2	451
	Terminal 3	451
	Terminal 4	199
On-Board Bus Survey	Selected areas	422

Summary tables are shown in **Appendix B**.

5 JOURNEY TIME SURVEY

5.1 Survey Items

The following items were observed at each survey station:

- Travel information on certain road sections: time of departure and arrival (start and end points of route)

5.2 Survey Method

This survey was conducted using the "floating car method", which requires the survey vehicle to keep the same position in the traffic flow; for example, if the survey vehicle is overtaken by other vehicles, it should overtake the same number of vehicles. The survey form is shown in Appendix A. In addition GPS data were also taken to analyze details regarding travel speed.

5.3 Survey Route and Duration

Three routes were selected for this survey. One was between Clark Airport and Mindanao Avenue, and the other was between Clark Airport and Balintawak using NLEX. The third route was between EDSA and Clark Airport via MacArthur Highway. Route details are shown in Figure 5.3-1.

Three (3) cars were allocated for NLEX route. One started in Balintawak and Clark Airport and ended in Clark Airport, then back to Balintawak via Mindanao Avenue. After reaching Mindanao Avenue, the survey vehicle went back to Clark Airport and back to Balintawak. This routine was continued for 17 hours. The second car started from Clark Airport then proceeded to Mindanao Avenue, and then went back to Clark Airport. This routine was continued for 18 hours. The third car started from Balintawak and survey was for 19 hours.

Two (2) cars are allocated for MacArthur Highway, one starts from Clark Airport and other started from EDSA. This survey is also continued for 14 or18 hours.

Table 5.3-1 Survey route & duration

Route	Section	Survey duration
NLEX	Clark airport to Mindanao Avenue Clark airport to Balintawak	3 cars for 17 -19 Hours
MacArthur Highway	Clark airport to EDSA	2 cars for 14-18 Hours

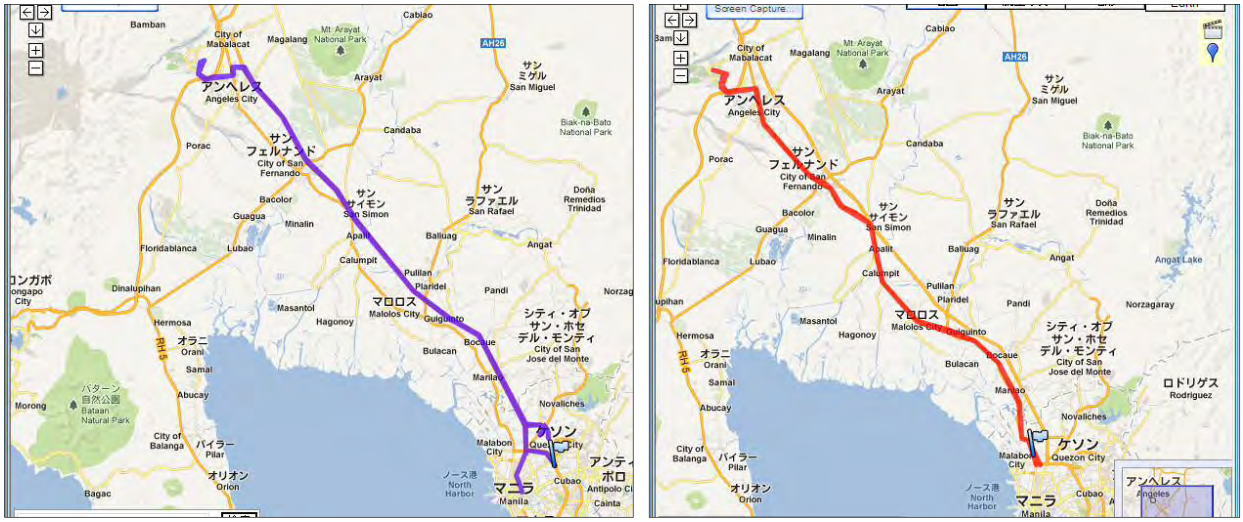


Figure 5.3-1 Survey Routes

5.4 Survey Result

5.4.1 NLEX Route

The survey .result for NLEX route is shown in Table 5.4-1.The average travel speed between Clark Airport and Mindanao Ave is about 60km/h and the average travel speed between Clark Airport and Balintawak is also about 60km/h. Travel speed at each point is shown Figure 5.4-1 and 5.4-2. In most points, travel speeds are over 60km/h.

Table 5.4-1 Survey Result for NLEX Route

No.	Date	Day	Direction		Departure Time	Arrival Time	Travel Time	Distance (km)	Travel Speed (Km/hr)
			From	To					
1	10/17/12	Wednesday	Clark Airport	Mindanao Ave	06:54:08	08:18:20	01:24:12	83	59
2	10/17/12	Wednesday	Clark Airport	Mindanao Ave	08:53:47	09:53:47	01:26:12		58
3	10/17/12	Wednesday	Clark Airport	Mindanao Ave	10:46:33	12:09:01	01:22:28		60
4	10/17/12	Wednesday	Clark Airport	Mindanao Ave	14:07:18	15:30:22	01:23:04		60
5	10/17/12	Wednesday	Clark Airport	Mindanao Ave	16:16:35	17:50:57	01:34:22		53
6	10/17/12	Wednesday	Clark Airport	Mindanao Ave	18:29:10	20:14:04	01:44:54		47
7	10/17/12	Wednesday	Clark Airport	Mindanao Ave	23:38:01	00:54:59	01:16:58		65
8	10/17/12	Wednesday	Mindanao Ave	Clark Airport	08:26:30	09:52:50	01:26:20		58
9	10/17/12	Wednesday	Mindanao Ave	Clark Airport	12:00:43	13:22:20	01:21:37		61
10	10/17/12	Wednesday	Mindanao Ave	Clark Airport	12:24:20	13:42:55	01:18:35		63
11	10/17/12	Wednesday	Mindanao Ave	Clark Airport	15:57:04	17:27:10	01:30:06		55
12	10/17/12	Wednesday	Mindanao Ave	Clark Airport	21:01:37	22:22:04	01:20:27		62
13	10/17/12	Wednesday	Mindanao Ave	Clark Airport	21:02:13	22:21:25	01:19:12		63
14	10/17/12	Wednesday	Clark Airport	Balintawak	06:00:00	07:22:18	01:22:18	85	62
15	10/17/12	Wednesday	Clark Airport	Balintawak	09:33:33	10:57:48	01:24:15		61
16	10/17/12	Wednesday	Clark Airport	Balintawak	13:22:20	14:47:11	01:24:51		60
17	10/17/12	Wednesday	Clark Airport	Balintawak	13:26:40	14:52:09	01:25:29		60
18	10/17/12	Wednesday	Clark Airport	Balintawak	16:43:05	18:22:43	01:39:38		51
19	10/17/12	Wednesday	Clark Airport	Balintawak	20:54:23	22:26:24	01:32:01		55
20	10/17/12	Wednesday	Clark Airport	Balintawak	22:22:04	23:45:42	01:23:38		61
21	10/17/12	Wednesday	Balintawak	Clark Airport	07:00:30	08:27:35	01:27:05		59
22	10/17/12	Wednesday	Balintawak	Clark Airport	07:53:24	09:15:58	01:22:34		62
23	10/17/12	Wednesday	Balintawak	Clark Airport	10:57:48	12:19:32	01:21:44		62
24	10/17/12	Wednesday	Balintawak	Clark Airport	14:48:47	16:16:35	01:27:48		58
25	10/17/12	Wednesday	Balintawak	Clark Airport	15:16:37	16:41:55	01:25:18		60
26	10/17/12	Wednesday	Balintawak	Clark Airport	18:22:43	19:49:38	01:26:55		59
27	10/17/12	Wednesday	Balintawak	Clark Airport	23:45:35	01:14:00	01:28:29		58

Direction		Average Travel Time	Distance (km)	Travel Speed (Km/hr)
From	To			
EDSA	Mindanao Ave.	01:27:27	83	57
Mindanao Ave	Clark Airport	01:22:43		60
Clark Airport	Balintawak	01:27:27	85	58
Balintawak	Clark Airport	01:25:42		60

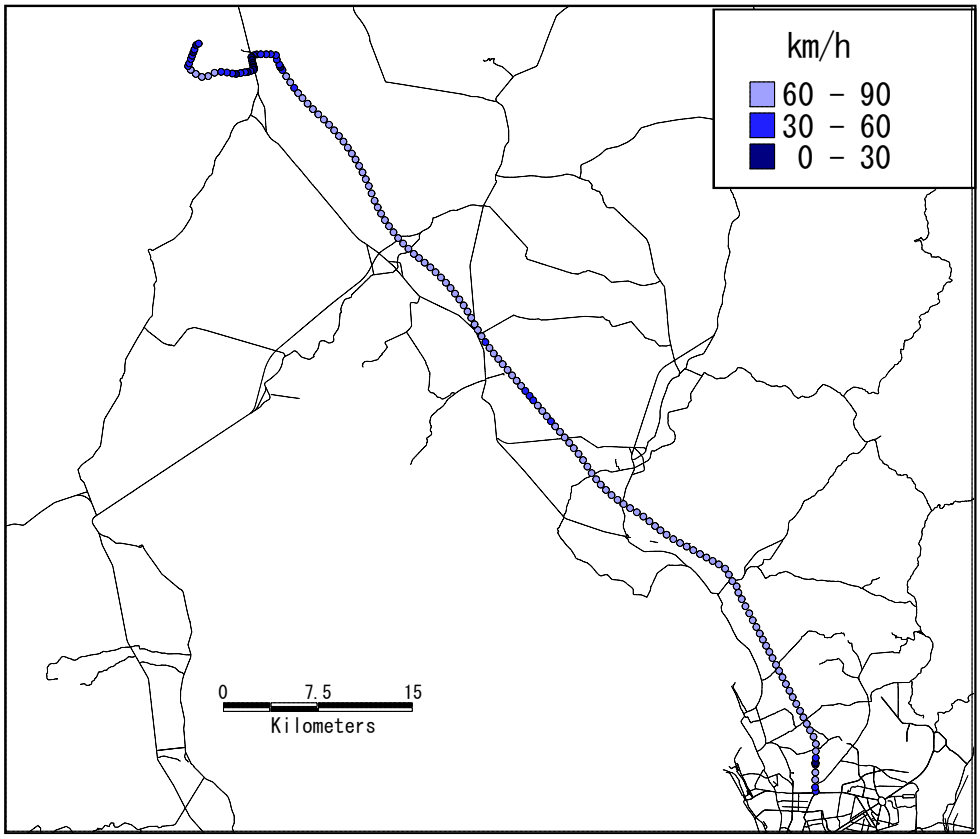


Figure 5.4-1 Travel Speed at Each Point from Balintawak to Clark Airport (7:00-8:27)

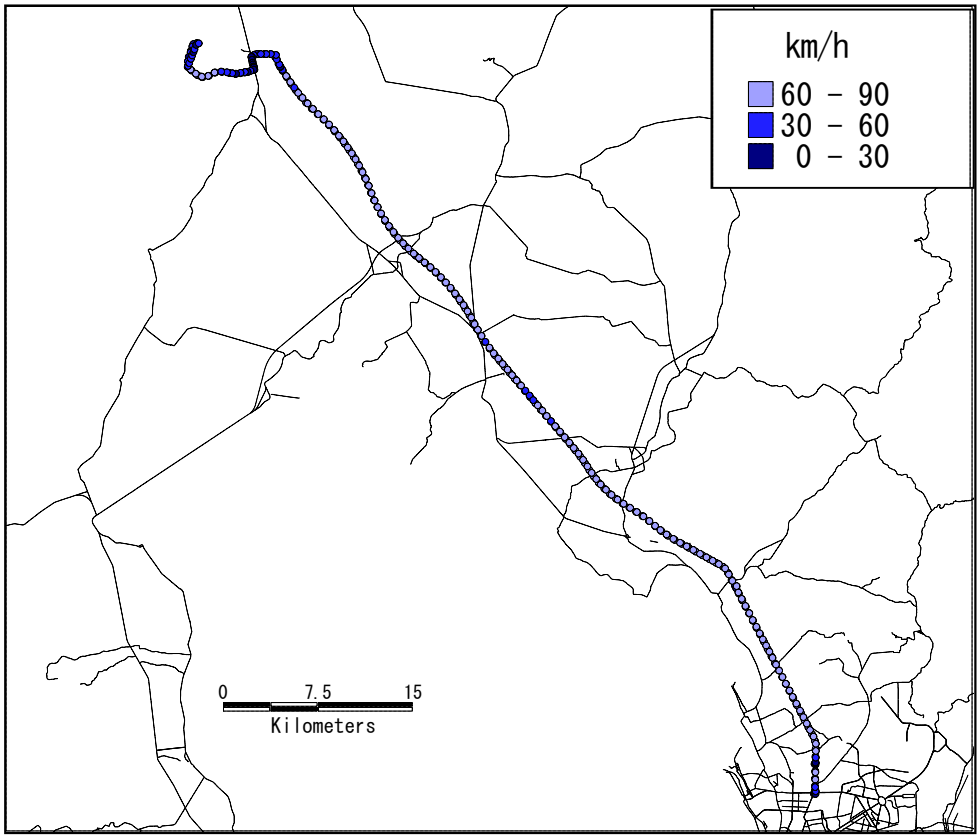


Figure 5.4-2 Travel Speed at Each Point from Clark Airport to Balintawak (6:00-7:22)

5.4.2 MacArthur Route

The survey .result for MacArthur route is shown in Table 5.4-2. The average travel speed between Clark airport and EDSA is about 25km/h. Travel speed at each point is shown Figure 5.4-3 and 5.4-4. In most points travel speed are about 15-45 km/h.

Table 5.5-1 Survey Result for MacArthur Route

No.	Date	Day	Direction		Departure (Time)	Arrival (Time)	Travel (Time)	Distance (km)	Travel Speed (Km/hr)
			From	To					
1	10/24/12	Thursday	EDSA	Clark Airport	06:18:36	09:14:24	02:55:48	86	29
2	10/24/12	Thursday	EDSA	Clark Airport	10:07:43	13:39:03	03:31:20		24
3	10/19/12	Friday	EDSA	Clark Airport	11:50:18	15:20:20	03:30:02		25
4	10/24/12	Thursday	EDSA	Clark Airport	13:52:19	17:46:23	03:54:04		22
5	10/19/12	Friday	EDSA	Clark Airport	21:42:45	00:16:54	02:34:09		33
6	10/24/12	Thursday	Clark Airport	EDSA	06:20:44	09:21:36	03:00:52		29
7	10/24/12	Thursday	Clark Airport	EDSA	10:11:12	13:25:56	03:14:44		26
8	10/19/12	Friday	Clark Airport	EDSA	16:45:54	20:33:57	3:48:03		23
9	10/25/12	Thursday	Clark Airport	EDSA	17:46:23	20:48:35	03:02:12		28

Direction		Average Travel Time	Distance (km)	Travel Speed (Km/hr)
From	To			
EDSA	Clark Airport	03:17:05	86	26
Clark Airport	EDSA	03:25:07		25

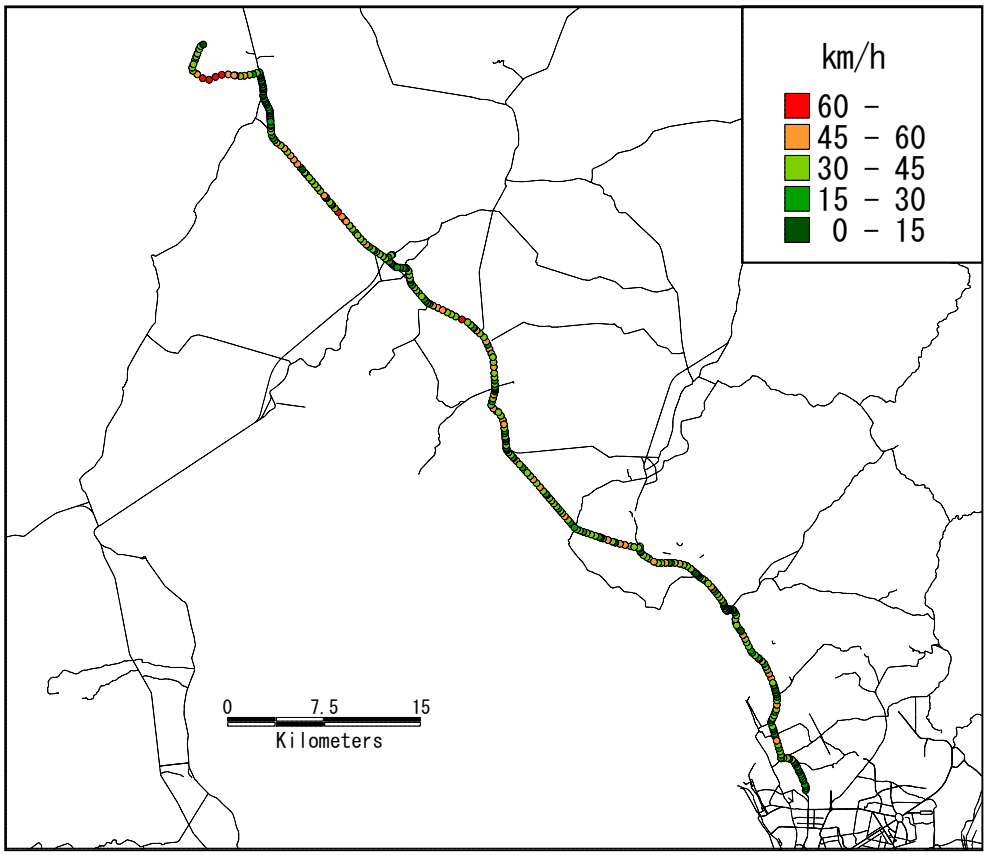


Figure 5.4-3 Travel Speed at Each Point from EDSA to Clark Airport (6:18-9:14)

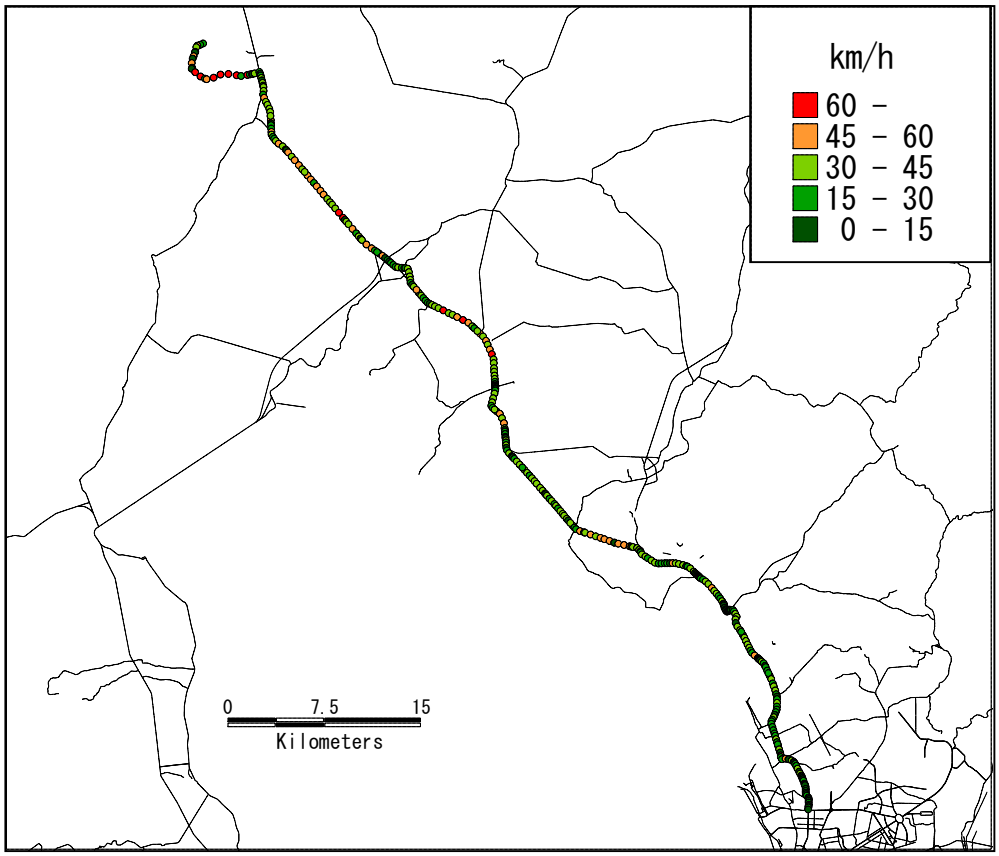


Figure 5.4-4 Travel Speed at Each Point from Clark Airport to EDSA (6:20-9:21)

1 Introduction

A high-investment project such as a railway line needs a project preparation study in order to establish its viability. One important input to the study is an estimate of the possible passenger transport demand that will use the service. Such estimate needs information on current passenger demand trends as well as vehicle traffic volumes along the proposed alignment of the service.

This proposal describes the scope of work and the corresponding cost of services for the traffic surveys to be undertaken, in connection with the project.

2 Survey Methodology

The traffic count and occupancy surveys were conducted in the south of FTI/NAIA areas focusing on the SLEX/ Skyway Corridor. The surveys conducted are:

1. Manual Classified Vehicle Counts on Skyway, SLEX and Service Roads; and
2. Vehicle Occupancy Counts at selected survey points of (1) above in the inbound (towards Metro Manila) direction only.

2.1 Survey Location and Duration

The surveys were conducted at the locations shown in Table 2.1, for a period of 18 hours from 05:00 to 23:00 on Tuesday, 23 April 2013 and Thursday, 25 April 2013. Traffic volumes were counted in both northbound and southbound directions. The vehicle occupancy survey was conducted for a period of 12 hours from 06:00 to 18:00 hours on the same day with the traffic count.

Figures 2.1 and 2.2 show the overall location of the stations while Table 2.1 presents the survey schedule of each station while

2.2 Vehicle Types Recorded

The surveys were conducted manually in both directions of travel. All vehicles (100% sample) passing a survey station were counted. For high volume roads manual counters were used. Data were recorded in 30-minute intervals. Table 2.2 shows the vehicle type classification and vehicle occupancy sampling method.

Figure 2.1: Location of Survey Stations (SLEX & Service Roads)

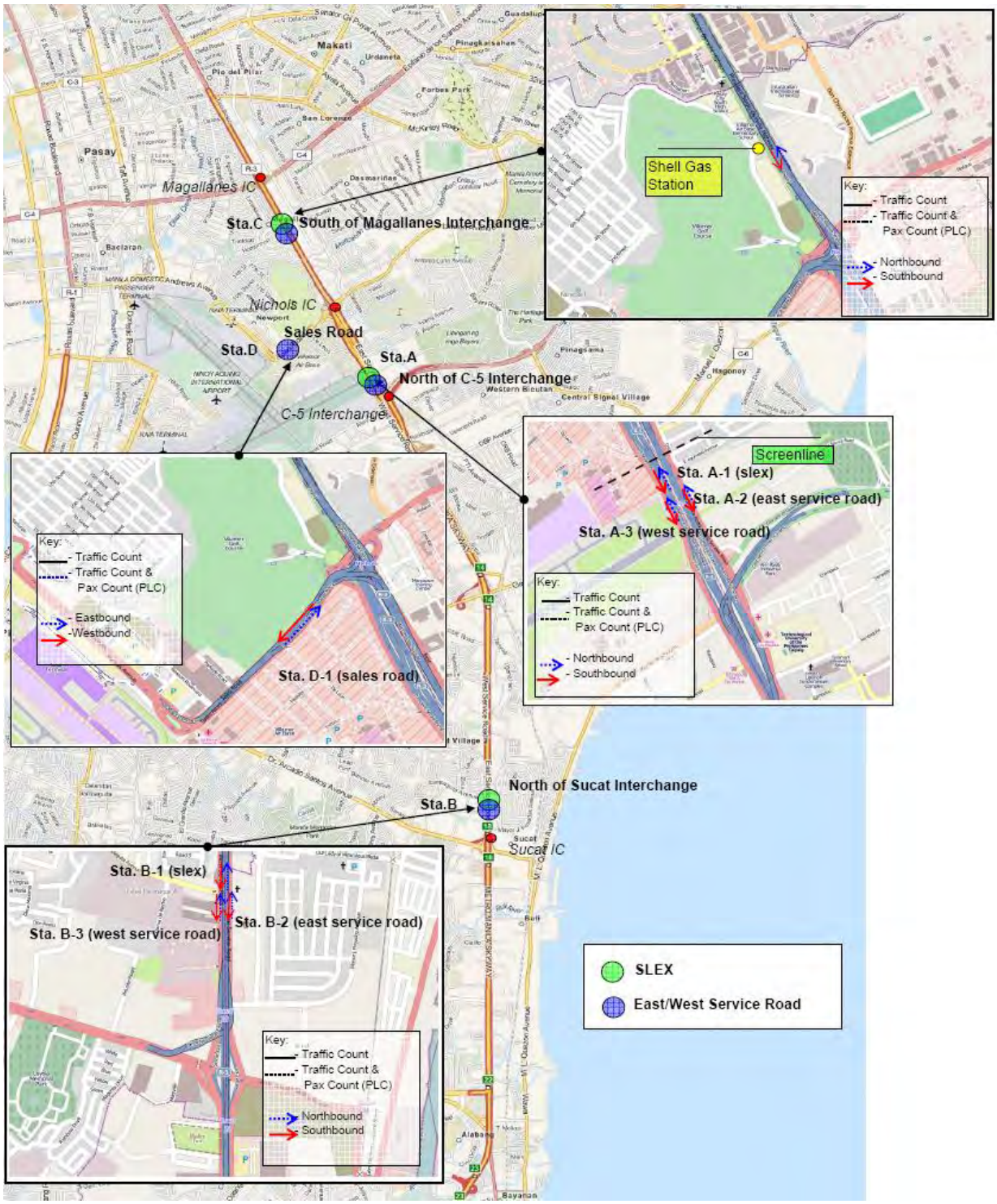


Figure 2.2: Location of Survey Stations (Skyway)

Table 2.1: Location of Survey Stations and Schedule

Station	Station Name/Location	Type of Surveys	Directions	Tuesday (April 23)		Thursday (April 25)		Survey Duration
				AM Shift	PM Shift	AM Shift	PM Shift	
Sta. A-1	SLEX (Screenline)	Traffic Counting	NB			√	√	24 Hrs
			SB			√	√	24 Hrs
		Vehicle Occupancy	NB			√	√	12 Hrs
Sta. A-2	East Service Road (Screenline)	Traffic Counting	NB			√	√	24 Hrs
			SB			√	√	24 Hrs
		Vehicle Occupancy	NB			√	√	12 Hrs
Sta. A-3	West Service Road (Screenline)	Traffic Counting	NB			√	√	24 Hrs
			SB			√	√	24 Hrs
		Vehicle Occupancy	NB			√	√	12 Hrs
Sta. B-1	SLEX	Traffic Counting	NB	√	√			18 Hrs
			SB	√	√			18 Hrs
		Vehicle Occupancy	NB	√	√			12 Hrs
Sta. B-2	East Service Road	Traffic Counting	NB	√	√			18 Hrs
			SB	√	√			18 Hrs
		Vehicle Occupancy	NB	√	√			12 Hrs
Sta. B-3	West Service Road	Traffic Counting	NB	√	√			18 Hrs
			SB	√	√			18 Hrs
		Vehicle Occupancy	NB	√	√			12 Hrs
Sta. C-1	SLEX	Traffic Counting	NB			√	√	24 Hrs
			SB			√	√	24 Hrs
Sta. D-1	Sales Road	Traffic Counting	EB	√	√			18 Hrs
			WB	√	√			18 Hrs
		Vehicle Occupancy	NB	√	√			12 Hrs
Sta. S-1	Skyway Arnaiz Entry/ Exit Ramps	Traffic Counting	NB			√	√	18 Hrs
			SB			√	√	18 Hrs
		Vehicle Occupancy	NB			√	√	12 Hrs
Sta. S-2	Skyway Sales Road Entry/ Exit Ramps	Traffic Counting	NB			√	√	18 Hrs
			SB			√	√	18 Hrs
		Vehicle Occupancy	NB			√	√	12 Hrs
Sta. S-3	Skyway North of C-5 (Screenline)	Traffic Counting	NB			√	√	24 Hrs
			SB			√	√	24 Hrs
Sta. S-4	Skyway Bicutan Entry/ Exit Ramps	Traffic Counting	NB			√	√	18 Hrs
			SB			√	√	18 Hrs
		Vehicle Occupancy	NB			√	√	12 Hrs
Sta. S-5	Skyway Sucat Entry/ Exit Ramps	Traffic Counting	NB			√	√	18 Hrs
			SB			√	√	18 Hrs
		Vehicle Occupancy	NB			√	√	12 Hrs
Sta. S-6	Skyway Hillsborough Entry/ Exit Ramps	Traffic Counting	NB			√	√	18 Hrs
			SB			√	√	18 Hrs
		Vehicle Occupancy	NB			√	√	12 Hrs
Sta. S-7	Skyway Alabang Entry/ Exit Ramps	Traffic Counting	NB			√	√	18 Hrs
			SB			√	√	18 Hrs
		Vehicle Occupancy	NB			√	√	12 Hrs

Table 2.2: Vehicle Type Classification and Vehicle Occupancy Recorded

No.	Vehicle Type Description	Vehicle Occupancy
1	Private Car/ Sedan/ SUV/ Open Back Pickup (single or twin cabin) and Taxi / Airport Taxi	All Occupants Including Driver (minimum 10% sample)
2	Private or Public Van, AUV & FX (Seats 8 to 18)	All Occupants Excluding Driver (minimum 10% sample)
3	All Sizes of Jeepney	All Occupants Excluding Driver (minimum 10% sample)
4	Public Bus	All Occupants Excluding Driver (minimum 10% sample)
5	Delivery vehicles, 2-Axle trucks, 2+ or more Axle Trucks / Goods Vehicles, Container Trucks/ Other Vehicles like construction, Concrete Mixer/ Military, Police, Fire Engines ***(No Occupancy Survey)***	**Not Required**

Vehicle Occupancy was recorded for at least 10% of all passing vehicles in the northbound direction (towards Metro Manila), for four (4) vehicle types in 30- minute intervals. In case of buses, bus seating capacity and % occupancy was recorded and later converted to the actual on-board passengers depending on bus capacity. Where a vehicle had dark windows, surveyor recorded occupancy of a similar size vehicle with clear windows. The occupancy surveys were conducted during day light hours from 6:00 to 18:00 (12-hours).

2.3 Survey Staffing

Adequate survey staffing is essential for quality and accuracy of data. In view of this, no person counted more than one lane and 2 vehicle types at any one time. For vehicle occupancy surveys, one surveyor was deployed for not more than two vehicle types. No staff surveyed for more than 45 minutes in each hour. No staff worked for more than one 9-hour shift.

Annex B shows the survey forms used for the survey.

3 Survey Results

Summary tables of all surveys conducted are presented here. Detailed data are shown in the subsection below.

3.1 VEHICLE COUNT SURVEY

Table 3.1-2 to 3.1.16 shows the traffic volume by direction, by vehicle type for all stations. The tables are arranged, as summarized below. The survey results are shown in **Annex A**.

Table 3.1-1: Summary of Traffic Count Data

Station Code	Station Name	Duration	Northbound (On-Ramp)	Southbound (Off-Ramp)	Total
Sta. A-1	SLEX (North of C-5 Access Ramp)	24-Hrs	28,873	32,815	61,688
Sta. A-2	East Service Road (Screenline)	24-Hrs	25,573	16,573	42,268
Sta. A-3	West Service Road (Screenline)	24-Hrs	15,937	12,160	28,097
Sta. B-1	SLEX	18-Hrs	36,740	44,614	81,354
Sta. B-2	East Service Road	18-Hrs	4,989	3,966	8,955
Sta. B-3	West Service Road	18-Hrs	7,153	9,368	16,521
Sta. C-1	SLEX	24-Hrs	58,692	55,738	114,430
Sta. D-1	Sales Road	18-Hrs	22,774	25,564	48,338
Sta. S-1	Skyway - Arnaiz (Entry/Exit Ramps)	18-Hrs	(10,727)	(10,361)	21,088
Sta. S-2	Skyway -Sales Road (Entry/Exit Ramps)	18-Hrs	(15,340)	(15,293)	30,633
Sta. S-3	Skyway - North of C-5 (Screenline)	24-Hrs	24,487	23,491	47,978
Sta. S-4	Skyway - Bicutan Entry/Exit Ramps	18-Hrs	(4,323)	(5,683)	10,008
Sta. S-5	Skyway - Sucat Entry/Exit Ramps	18-Hrs	(5,140)	(3,872)	9,012
Sta. S-6	Skyway - Hillsborough Entry/Exit Ramps	18-Hrs	(9,887)	(8,046)	17,933
Sta. S-7	Skyway Alabang Entry/Exit Ramps	18-Hrs	(5,364)	(4,993)	10,337

Table 3.1-2: Manual Classified Count: Station A-1: SLEX (North of C-5 Access Ramp)

Station Code: A-1
Station Name: SLEX (North of C-5 Access Ramp)
Date: 04/25/2013
Weather: Fine

	NORTHBOUND						SOUTHBOUND					
Time Period	Private Car/Sedan/SUV/Pick-Up/Jeep (Owner Type)/Taxi/Airport Taxi	Private or Public Van (Seats 8 to 19)	Jeepney (Seats 20+)	ALL BUSES	Delivery Veh./All Trucks/Special Vehicles	Total	Private Car/Sedan/SUV/Pick-Up/Jeep (Owner Type)/Taxi/Airport Taxi	Private or Public Van (Seats 8 to 19)	Jeepney (Seats 20+)	ALL BUSES	Delivery Veh./All Trucks/Special Vehicles	Total
05:00 - 05:30	164	43	7	61	117	392	146	57	18	53	225	499
05:30 - 06:00	344	67	19	105	76	611	233	101	34	85	271	724
06:00 - 06:30	498	87	17	125	65	792	423	115	63	97	134	832
06:30 - 07:00	599	92	26	112	48	877	589	118	83	94	93	977
07:00 - 07:30	707	79	28	101	47	962	498	160	94	91	104	947
07:30 - 08:00	578	85	22	89	73	847	502	160	95	83	75	915
08:00 - 08:30	485	86	20	66	57	714	486	146	96	90	81	899
08:30 - 09:00	429	88	3	65	51	636	519	133	93	102	109	956
09:00 - 09:30	370	102	9	61	91	633	518	146	83	94	124	965
09:30 - 10:00	374	90	11	44	123	642	506	173	67	104	183	1,033
10:00 - 10:30	392	77	8	53	264	794	339	121	31	58	184	733
10:30 - 11:00	419	77	10	38	206	750	395	126	31	63	232	847
11:00 - 11:30	406	101	7	49	236	799	399	146	25	67	224	861
11:30 - 12:00	338	72	5	38	156	609	384	134	28	74	238	858
12:00 - 12:30	372	59	1	42	150	624	410	143	22	58	219	852
12:30 - 13:00	367	61	1	43	133	605	405	120	29	70	198	822
13:00 - 13:30	337	80	3	63	173	656	420	122	25	77	164	808
13:30 - 14:00	398	91	9	62	195	755	503	114	28	63	146	854
14:00 - 14:30	570	104	4	60	199	937	382	85	17	61	133	678
14:30 - 15:00	568	132	6	71	208	985	478	95	17	77	166	833
15:00 - 15:30	547	151	8	89	264	1,059	478	137	30	81	196	922
15:30 - 16:00	415	106	6	65	180	772	322	66	35	51	112	586
16:00 - 16:30	430	103	7	69	142	751	420	112	33	64	88	717
16:30 - 17:00	498	143	9	73	127	850	417	108	25	63	103	716
17:00 - 17:30	520	122	11	81	95	829	400	102	33	66	97	698
17:30 - 18:00	511	137	18	91	97	854	479	152	38	77	58	804
18:00 - 18:30	418	128	16	80	104	746	471	114	35	124	65	809
18:30 - 19:00	458	120	18	59	65	720	458	33	43	13	51	598
19:00 - 19:30	397	131	13	83	98	722	338	152	29	63	63	645
19:30 - 20:00	302	111	8	92	70	583	389	73	26	86	70	644
20:00 - 20:30	268	99	10	92	50	519	397	78	21	89	47	632
20:30 - 21:00	240	69	6	73	60	448	413	93	38	73	79	696
21:00 - 21:30	273	66	3	69	148	559	375	75	27	85	29	591
21:30 - 22:00	209	42	2	41	238	532	432	69	32	87	76	696
22:00 - 22:30	211	33	1	57	338	640	460	84	26	48	83	701
22:30 - 23:00	263	64	1	56	234	618	317	37	32	35	92	513
23:00 - 23:30	108	43	1	41	118	311	253	59	19	39	398	768
23:30 - 00:00	181	39	1	29	98	348	275	47	23	34	267	646
00:00 - 00:30	79	44	2	29	106	260	204	48	20	22	190	484
00:30 - 01:00	74	18	0	23	90	205	176	13	13	18	169	389
01:00 - 01:30	72	22	0	12	110	216	174	30	20	14	234	472
01:30 - 02:00	46	13	0	14	97	170	66	12	10	17	42	147
02:00 - 02:30	48	17	0	20	93	178	81	23	13	14	129	260
02:30 - 03:00	42	17	1	30	108	198	80	34	10	14	62	200
03:00 - 03:30	53	19	2	44	110	228	78	29	15	15	245	382
03:30 - 04:00	50	37	1	43	112	243	89	32	11	32	184	348
04:00 - 04:30	84	38	1	60	139	322	128	32	14	36	218	428
04:30 - 05:00	105	45	3	75	144	372	98	51	7	63	211	430
Total	**15,617**	**3,650**	**365**	**2,938**	**6,303**	**28,873**	**16,803**	**4,410**	**1,657**	**2,984**	**6,961**	**32,815**

See Location Map below:

Figure 3.1-1: Location Map: Station A-1: SLEX (North of C-5 Access Ramp)

Sta. A - North of C-5 Ramp

Table 3.1-3: Manual Classified Count: Station A-2: East Service Road

Station Code: A-2
Station Name: East Service Road
Date: 04/25/2013
Weather: Fine

	NORTHBOUND						SOUTHBOUND					
Time Period	Private Car/Sedan/SUV/Pick-Up/ Jeep (Owner Type)/Taxi/Air	Private or Public Van (Seats 8 to 19)	Jeepney (Seats 20+)	ALL BUSES	Delivery Veh./ All Trucks/ Special Vehicles	Total	Private Car/Sedan/SUV/Pick-Up/ Jeep (Owner Type)/Taxi/Airport Taxi	Private or Public Van (Seats 8 to 19)	Jeepney (Seats 20+)	ALL BUSES	Delivery Veh./ All Trucks/ Special Vehicles	Total
05:00 - 05:30	80	30	93	7	46	256	53	8	12	2	35	110
05:30 - 06:00	269	30	93	20	88	500	146	30	55	17	48	296
06:00 - 06:30	403	50	120	19	71	663	203	41	74	15	54	387
06:30 - 07:00	496	44	117	14	56	727	205	87	97	15	54	458
07:00 - 07:30	501	52	127	13	47	740	169	42	100	7	46	364
07:30 - 08:00	557	55	129	13	51	805	181	42	91	11	41	366
08:00 - 08:30	566	57	120	11	68	822	259	35	97	18	62	471
08:30 - 09:00	481	59	80	7	74	701	122	40	86	8	56	312
09:00 - 09:30	639	81	77	11	107	915	271	50	92	23	55	491
09:30 - 10:00	574	72	79	12	122	859	164	50	86	13	96	409
10:00 - 10:30	502	77	79	14	136	808	143	52	81	10	128	414
10:30 - 11:00	504	58	64	8	131	765	152	56	73	14	120	415
11:00 - 11:30	499	57	69	11	129	765	129	45	53	5	130	362
11:30 - 12:00	423	57	56	9	121	666	175	47	67	10	142	441
12:00 - 12:30	292	44	69	6	106	517	211	46	60	5	116	438
12:30 - 13:00	408	63	83	7	94	655	164	40	72	4	104	384
13:00 - 13:30	401	60	63	5	104	633	172	37	75	37	116	437
13:30 - 14:00	366	62	63	15	113	619	246	39	63	9	97	454
14:00 - 14:30	420	74	66	15	113	688	197	30	47	6	91	371
14:30 - 15:00	368	64	63	7	131	633	281	32	47	9	82	451
15:00 - 15:30	449	76	72	11	139	747	211	36	43	8	69	367
15:30 - 16:00	393	49	69	18	99	628	314	41	47	5	78	485
16:00 - 16:30	380	79	80	14	91	644	201	45	56	8	62	372
16:30 - 17:00	456	50	96	15	74	691	219	39	50	8	44	360
17:00 - 17:30	399	53	98	11	75	636	220	55	78	13	50	416
17:30 - 18:00	391	44	88	13	60	596	289	42	86	12	48	477
18:00 - 18:30	404	62	113	19	64	662	315	58	82	14	60	529
18:30 - 19:00	394	56	102	10	55	617	232	46	54	27	57	416
19:00 - 19:30	343	46	81	14	66	550	269	35	76	10	33	423
19:30 - 20:00	343	55	84	14	62	558	265	35	78	10	39	427
20:00 - 20:30	294	52	88	23	61	518	259	32	55	12	41	399
20:30 - 21:00	305	47	62	14	57	485	240	21	36	9	30	336
21:00 - 21:30	226	39	50	13	55	383	245	45	59	7	40	396
21:30 - 22:00	231	33	49	10	65	388	205	3	45	12	40	305
22:00 - 22:30	209	31	39	11	96	386	230	2	17	4	37	290
22:30 - 23:00	159	12	34	3	125	333	106	4	13	8	45	176
23:00 - 23:30	146	13	29	5	83	276	202	15	49	23	194	483
23:30 - 00:00	143	31	25	5	75	279	161	13	24	11	137	346
00:00 - 00:30	144	13	15	6	71	249	137	19	18	15	126	315
00:30 - 01:00	119	11	21	2	87	240	121	9	5	13	87	235
01:00 - 01:30	75	10	17	3	98	203	110	10	6	2	41	169
01:30 - 02:00	48	13	19	4	74	158	66	3	6	6	35	116
02:00 - 02:30	133	16	15	3	101	268	69	6	10	5	54	144
02:30 - 03:00	105	18	17	5	95	240	69	8	24	11	44	156
03:00 - 03:30	105	13	20	12	91	241	66	4	12	3	65	150
03:30 - 04:00	98	22	27	21	94	262	49	3	15	2	86	155
04:00 - 04:30	112	29	29	15	100	285	47	3	16	3	180	249
04:30 - 05:00	121	39	45	25	83	313	68	2	18	3	81	172
Total	**15,474**	**2,158**	**3,194**	**543**	**4,204**	**25,573**	**8,628**	**1,483**	**2,506**	**502**	**3,576**	**16,695**

See Location Map below:

Figure 3.1-2: Location Map: Station A-2: East Service Road

Sta. A - North of C-5 Ramp

Table 3.1-4: Manual Classified Count: Station A-3: West Service Road

Station Code: A-3
Station Name: West Service Road
Date: 04/25/2013
Weather: Fine

	NORTHBOUND						SOUTHBOUND					
Time Period	Private Car/Sedan/SUV/Pick-Up/ Jeep (Owner Type)/Taxi/Airport Taxi	Private or Public Van (Seats 8 to 19)	Jeepney (Seats 20+)	ALL BUSES	Delivery Veh./ All Trucks/ Special Vehicles	Total	Private Car/Sedan/SUV/Pick-Up/ Jeep (Owner Type)/Taxi/Airport Taxi	Private or Public Van (Seats 8 to 19)	Jeepney (Seats 20+)	ALL BUSES	Delivery Veh./ All Trucks/ Special Vehicles	Total
05:00 - 05:30	104	45	20	1	44	214	97	35	23	0	29	184
05:30 - 06:00	199	58	41	1	39	338	103	35	29	1	28	196
06:00 - 06:30	318	139	52	0	43	552	1	1	1	0	1	4
06:30 - 07:00	327	176	56	0	30	589	0	0	0	0	0	0
07:00 - 07:30	458	188	55	0	47	748	0	0	0	0	0	0
07:30 - 08:00	486	165	44	1	23	719	0	0	0	0	0	0
08:00 - 08:30	408	131	41	0	43	623	0	0	0	0	0	0
08:30 - 09:00	320	89	30	0	39	478	0	0	0	0	0	0
09:00 - 09:30	312	132	28	0	40	512	0	0	0	0	0	0
09:30 - 10:00	261	91	33	0	70	455	52	40	19	0	20	131
10:00 - 10:30	230	95	24	0	33	382	157	70	43	0	37	307
10:30 - 11:00	239	103	26	1	56	425	144	70	19	0	46	279
11:00 - 11:30	230	107	29	0	58	424	140	83	37	0	45	305
11:30 - 12:00	192	81	25	0	22	320	150	82	26	0	43	301
12:00 - 12:30	186	111	30	0	45	372	178	85	29	0	37	329
12:30 - 13:00	237	100	33	0	37	407	173	49	28	0	37	287
13:00 - 13:30	258	109	25	0	42	434	163	66	32	1	40	302
13:30 - 14:00	215	113	25	0	45	398	174	62	23	0	41	300
14:00 - 14:30	232	123	24	0	42	421	145	57	16	0	30	248
14:30 - 15:00	212	109	33	0	51	405	190	69	19	0	47	325
15:00 - 15:30	185	99	28	0	46	358	172	99	24	0	25	320
15:30 - 16:00	168	125	20	0	44	357	212	85	24	2	40	363
16:00 - 16:30	149	107	23	0	29	308	174	86	24	0	30	314
16:30 - 17:00	180	108	35	0	29	352	217	83	19	0	23	342
17:00 - 17:30	203	119	38	0	30	390	230	71	18	0	20	339
17:30 - 18:00	217	107	44	0	30	398	335	106	21	0	25	487
18:00 - 18:30	161	89	43	0	24	317	289	104	30	0	15	438
18:30 - 19:00	173	83	40	0	22	318	334	105	28	0	26	493
19:00 - 19:30	159	66	32	0	25	282	272	102	29	0	13	416
19:30 - 20:00	140	69	37	0	18	264	342	84	21	0	30	477
20:00 - 20:30	132	69	36	0	30	267	259	83	23	0	23	388
20:30 - 21:00	122	38	29	0	34	223	350	80	28	0	25	483
21:00 - 21:30	151	59	28	0	31	269	331	76	25	1	25	458
21:30 - 22:00	132	41	21	0	37	231	293	59	28	0	22	402
22:00 - 22:30	139	41	19	2	36	237	221	35	22	0	26	304
22:30 - 23:00	170	35	19	2	37	263	102	8	8	0	30	148
23:00 - 23:30	103	29	12	0	42	186	303	67	16	0	55	441
23:30 - 00:00	138	34	11	0	60	243	172	25	14	0	42	253
00:00 - 00:30	92	23	8	0	36	159	180	38	7	0	41	266
00:30 - 01:00	103	26	9	0	34	172	191	23	9	1	39	263
01:00 - 01:30	81	23	9	0	37	150	149	18	6	0	44	217
01:30 - 02:00	63	8	5	0	31	107	100	8	14	0	39	161
02:00 - 02:30	57	8	4	0	43	112	124	25	6	0	33	188
02:30 - 03:00	60	19	5	0	40	124	86	18	7	0	50	161
03:00 - 03:30	53	22	6	0	39	120	71	15	4	0	39	129
03:30 - 04:00	59	25	8	0	44	136	67	15	8	0	30	120
04:00 - 04:30	65	25	11	0	50	151	70	18	6	0	39	133
04:30 - 05:00	112	38	23	2	52	227	87	24	16	0	31	158
Total	**8,991**	**3,800**	**1,277**	**10**	**1,859**	**15,937**	**7,600**	**2,364**	**829**	**6**	**1,361**	**12,160**

See Location Map below:

Figure 3.1-3: Location Map: Station A-3: West Service Road

Sta. A - North of C-5 Ramp

Table 3.1-5: Manual Classified Count: Station B-1: SLEX (between Bicutan and Sucat Interchanges)

Station Code: B-1
Station Name: SLEX (Bet. Bicutan IC and Sucat IC)
Date: 04/23/2013
Weather: Fine

Time Period	NORTHBOUND						SOUTHBOUND					
	Private Car/Sedan/SUV/Pick-Up/Jeep (Owner Type)/Taxi/Airport Taxi	Private or Public Van (Seats 8 to 19)	Jeepney (Seats 20+)	ALL BUSES	Delivery Veh./All Trucks/Special Vehicles	Total	Private Car/Sedan/SUV/Pick-Up/Jeep (Owner Type)/Taxi/Airport Taxi	Private or Public Van (Seats 8 to 19)	Jeepney (Seats 20+)	ALL BUSES	Delivery Veh./All Trucks/Special Vehicles	Total
05:00 - 06:00	547	51	25	208	249	1,080	475	346	31	206	726	1,784
06:00 - 07:00	1,040	211	28	231	108	1,618	1,233	769	57	341	362	2,762
07:00 - 08:00	1,547	208	33	104	105	1,997	1,197	793	54	102	200	2,346
08:00 - 09:00	1,290	177	25	179	110	1,781	1,515	514	76	153	205	2,463
09:00 - 10:00	1,435	281	9	178	316	2,219	1,313	703	53	152	341	2,562
10:00 - 11:00	1,202	215	12	97	728	2,254	1,282	474	45	160	520	2,481
11:00 - 12:00	1,145	115	6	94	631	1,991	1,123	500	43	134	621	2,421
12:00 - 13:00	1,050	176	11	118	473	1,828	1,179	367	35	150	477	2,208
13:00 - 14:00	1,345	119	9	143	389	2,005	1,454	473	32	136	387	2,482
14:00 - 15:00	1,612	225	8	130	550	2,525	1,609	262	31	149	445	2,496
15:00 - 16:00	1,426	259	6	150	578	2,419	1,621	271	36	152	399	2,479
16:00 - 17:00	1,706	353	12	168	429	2,668	1,728	341	21	182	452	2,724
17:00 - 18:00	1,770	355	15	187	328	2,655	2,165	323	114	203	192	2,997
18:00 - 19:00	1,610	277	27	182	290	2,386	2,302	278	88	183	109	2,960
19:00 - 20:00	1,485	288	23	179	250	2,225	3,186	226	47	158	112	3,729
20:00 - 21:00	947	198	24	182	285	1,636	1,772	170	51	195	131	2,319
21:00 - 22:00	889	198	18	130	680	1,915	1,235	100	44	144	199	1,722
22:00 - 23:00	634	101	7	103	693	1,538	1,048	63	20	97	451	1,679
Total	**22,680**	**3,807**	**298**	**2,763**	**7,192**	**36,740**	**27,437**	**6,973**	**878**	**2,997**	**6,329**	**44,614**

See Location Map below:

Figure 3.1-4: Location Map: Station B-1: SLEX (between Bicutan and Sucat Interchanges)

Sta. B - North of Sucat Interchange

Table 3.1-6: Manual Classified Count: Station B-2: East Service Road

Station Code: B-2
Station Name: East Service Road
Date: 04/23/2013
Weather: Fine

Time Period	NORTHBOUND						SOUTHBOUND					
	Private Car/Sedan/SUV/Pick-Up/Jeep (Owner Type)/Taxi/Airport Taxi	Private or Public Van (Seats 8 to 19)	Jeepney (Seats 20+)	ALL BUSES	Delivery Veh./All Trucks/Special Vehicles	Total	Private Car/Sedan/SUV/Pick-Up/Jeep (Owner Type)/Taxi/Airport Taxi	Private or Public Van (Seats 8 to 19)	Jeepney (Seats 20+)	ALL BUSES	Delivery Veh./All Trucks/Special Vehicles	Total
05:00 - 06:00	38	22	79	0	49	188	23	17	92	0	19	151
06:00 - 07:00	77	45	138	0	36	296	37	30	102	0	9	178
07:00 - 08:00	103	43	124	2	50	322	45	23	127	0	19	214
08:00 - 09:00	98	37	118	0	59	312	65	34	97	0	25	221
09:00 - 10:00	69	33	90	0	76	268	70	31	75	0	37	213
10:00 - 11:00	52	23	86	0	110	271	44	37	73	0	41	195
11:00 - 12:00	66	31	99	0	106	302	41	35	66	0	47	189
12:00 - 13:00	82	27	89	1	110	309	50	28	87	0	67	232
13:00 - 14:00	67	35	79	0	83	264	51	63	83	0	75	272
14:00 - 15:00	110	40	108	0	107	365	56	36	69	0	82	243
15:00 - 16:00	54	40	111	0	93	298	59	31	79	0	76	245
16:00 - 17:00	64	33	94	0	84	275	86	38	100	1	54	279
17:00 - 18:00	68	40	117	0	50	275	107	43	113	1	46	310
18:00 - 19:00	58	32	123	0	29	242	84	21	80	0	27	212
19:00 - 20:00	42	47	113	2	37	241	75	21	110	0	25	231
20:00 - 21:00	56	25	103	0	36	220	62	31	112	0	26	231
21:00 - 22:00	49	26	71	0	57	203	56	21	81	0	21	179
22:00 - 23:00	56	78	86	0	118	338	45	23	73	0	30	171
Total	**1,209**	**657**	**1,828**	**5**	**1,290**	**4,989**	**1,056**	**563**	**1,619**	**2**	**726**	**3,966**

See Location Map below:

Figure 3.1-5: Location Map: Station B-2: East Service Road

Sta. B - North of Sucat Interchange

Table 3.1-7: Manual Classified Count: Station B-3: West Service Road

Station Code: B-3
Station Name: West Service Road
Date: 04/23/2013
Weather: Fine

Time Period	NORTHBOUND						SOUTHBOUND					
	Private Car/Sedan/SUV/Pick-Up/Jeep (Owner Type)/Taxi/Airport Taxi	Private or Public Van (Seats 8 to 19)	Jeepney (Seats 20+)	ALL BUSES	Delivery Veh./All Trucks/Special Vehicles	Total	Private Car/Sedan/SUV/Pick-Up/Jeep (Owner Type)/Taxi/Airport Taxi	Private or Public Van (Seats 8 to 19)	Jeepney (Seats 20+)	ALL BUSES	Delivery Veh./All Trucks/Special Vehicles	Total
05:00 - 06:00	195	40	97	1	121	454	285	34	71	2	153	545
06:00 - 07:00	271	69	88	1	68	497	382	38	109	0	112	641
07:00 - 08:00	283	35	92	1	72	483	277	32	105	4	51	469
08:00 - 09:00	285	44	113	0	74	516	252	48	104	1	73	478
09:00 - 10:00	275	42	69	1	96	483	244	62	78	0	69	453
10:00 - 11:00	190	37	49	0	98	374	285	51	58	0	148	542
11:00 - 12:00	185	36	47	0	91	359	248	60	65	0	144	517
12:00 - 13:00	169	29	65	0	67	330	227	44	61	0	183	515
13:00 - 14:00	170	44	69	0	108	391	212	56	52	3	125	448
14:00 - 15:00	178	38	55	0	141	412	230	47	47	0	140	464
15:00 - 16:00	170	31	75	2	94	372	255	46	61	3	112	477
16:00 - 17:00	187	39	88	0	67	381	259	47	82	2	142	532
17:00 - 18:00	191	32	97	1	68	389	340	42	84	0	108	574
18:00 - 19:00	212	32	92	2	60	398	418	33	71	1	72	595
19:00 - 20:00	167	30	89	0	44	330	417	33	83	2	80	615
20:00 - 21:00	151	31	69	1	65	317	393	43	67	1	97	601
21:00 - 22:00	181	29	58	0	102	370	329	21	62	1	69	482
22:00 - 23:00	128	15	40	0	114	297	252	26	45	0	97	420
Total	**3,588**	**653**	**1,352**	**10**	**1,550**	**7,153**	**5,305**	**763**	**1,305**	**20**	**1,975**	**9,368**

See Location Map below:

Figure 3.1-6: Location Map: Station B-3: West Service Road

Sta. B - North of Sucat Interchange

Table 3.1-8: Manual Classified Count: Station C-1: SLEX (North of Nichols Interchange)

Station Code: C-1
Station Name: SLEX (North of Nichols IC)
Date: 04/25/2013
Weather: Fine

	NORTHBOUND						SOUTHBOUND					
Time Period	Private Car/Sedan/SUV/Pick-Up/Jeep (Owner Type)/Taxi/Airport Taxi	Private or Public Van (Seats 8 to 19)	Jeepney (Seats 20+)	ALL BUSES	Delivery Veh./All Trucks/Special Vehicles	Total	Private Car/Sedan/SUV/Pick-Up/Jeep (Owner Type)/Taxi/Airport Taxi	Private or Public Van (Seats 8 to 19)	Jeepney (Seats 20+)	ALL BUSES	Delivery Veh./All Trucks/Special Vehicles	Total
05:00 - 05:30	445	105	72	79	196	897	361	138	80	75	319	973
05:30 - 06:00	667	245	167	183	252	1,514	542	206	119	113	319	1,299
06:00 - 06:30	657	245	130	109	154	1,295	486	178	144	87	159	1,054
06:30 - 07:00	985	366	170	163	170	1,854	629	267	140	130	106	1,272
07:00 - 07:30	702	270	135	102	126	1,335	650	204	145	76	111	1,186
07:30 - 08:00	682	270	90	100	84	1,226	773	204	219	114	111	1,421
08:00 - 08:30	353	222	74	76	95	820	678	237	131	100	124	1,270
08:30 - 09:00	474	227	82	84	124	991	692	182	156	96	140	1,266
09:00 - 09:30	566	230	57	80	154	1,087	659	242	146	121	163	1,331
09:30 - 10:00	641	233	91	68	276	1,309	676	272	142	100	244	1,434
10:00 - 10:30	799	459	108	56	411	1,833	667	209	139	76	347	1,438
10:30 - 11:00	826	419	136	50	359	1,790	703	232	104	76	382	1,497
11:00 - 11:30	486	270	92	35	301	1,184	712	284	105	77	367	1,545
11:30 - 12:00	420	194	69	49	254	986	645	207	98	90	369	1,409
12:00 - 12:30	699	282	94	50	279	1,404	733	189	93	71	334	1,420
12:30 - 13:00	700	387	123	54	267	1,531	743	170	112	78	330	1,433
13:00 - 13:30	741	262	83	68	270	1,424	719	356	119	84	300	1,578
13:30 - 14:00	715	167	87	72	337	1,378	839	317	115	68	240	1,579
14:00 - 14:30	1,224	404	191	80	320	2,219	734	160	67	73	256	1,290
14:30 - 15:00	1,143	395	107	75	321	2,041	885	212	98	79	261	1,535
15:00 - 15:30	993	467	113	97	367	2,037	896	198	84	85	240	1,503
15:30 - 16:00	984	472	102	90	320	1,968	781	172	108	65	159	1,285
16:00 - 16:30	963	371	98	88	239	1,759	694	246	99	74	138	1,251
16:30 - 17:00	683	186	134	89	208	1,300	686	293	90	79	140	1,288
17:00 - 17:30	729	354	142	84	175	1,484	719	164	101	75	130	1,189
17:30 - 18:00	1,012	303	119	116	165	1,715	827	196	125	81	100	1,329
18:00 - 18:30	790	281	129	94	171	1,465	780	172	114	71	88	1,225
18:30 - 19:00	672	295	130	83	147	1,327	777	147	113	95	92	1,224
19:00 - 19:30	868	231	87	93	143	1,422	749	145	125	73	78	1,170
19:30 - 20:00	982	185	94	98	127	1,486	679	211	104	94	99	1,187
20:00 - 20:30	893	173	137	116	136	1,455	659	242	104	103	97	1,205
20:30 - 21:00	674	146	71	78	84	1,053	625	173	96	76	61	1,031
21:00 - 21:30	739	89	53	76	158	1,115	749	156	96	103	91	1,195
21:30 - 22:00	604	139	70	70	305	1,188	767	209	105	98	118	1,297
22:00 - 22:30	495	141	36	83	436	1,191	761	200	79	63	209	1,312
22:30 - 23:00	385	53	53	44	344	879	388	57	46	54	172	717
23:00 - 23:30	460	66	64	52	322	964	392	73	52	58	582	1,157
23:30 - 00:00	417	96	31	36	190	770	499	72	49	47	361	1,028
00:00 - 00:30	291	93	28	24	179	615	496	66	41	41	269	913
00:30 - 01:00	280	108	32	26	188	634	361	69	35	40	236	741
01:00 - 01:30	310	75	21	21	189	616	351	51	42	16	185	645
01:30 - 02:00	205	58	21	22	218	524	266	73	36	25	203	603
02:00 - 02:30	168	47	18	16	205	454	276	42	36	21	195	570
02:30 - 03:00	188	68	28	38	225	547	265	49	33	21	246	614
03:00 - 03:30	148	54	28	47	194	471	246	58	26	18	244	592
03:30 - 04:00	209	112	43	49	187	600	256	70	41	38	292	697
04:00 - 04:30	224	125	36	76	275	736	239	74	47	45	304	709
04:30 - 05:00	222	133	60	106	278	799	269	96	56	60	350	831
Total	**29,513**	**10,573**	**4,136**	**3,545**	**10,925**	**58,692**	**28,979**	**8,240**	**4,555**	**3,503**	**10,461**	**55,738**

See Location Map below:

Figure 3.1-7: Location Map: Station C-1: SLEX (North of Nichols Interchange)

Sta. C - North of Nichols Interchange

Table 3.1-9: Manual Classified Count: Station D-1: Sales Road

Station Code: D-1
Station Name: Sales Road
Date: 04/23/2013
Weather: Fine

Time Period	NORTHBOUND						SOUTHBOUND					
	Private Car/Sedan/SUV/Pick-Up/Jeep (Owner Type)/Taxi/Airport Taxi	Private or Public Van (Seats 8 to 19)	Jeepney (Seats 20+)	ALL BUSES	Delivery Veh./All Trucks/Special Vehicles	Total	Private Car/Sedan/SUV/Pick-Up/Jeep (Owner Type)/Taxi/Airport Taxi	Private or Public Van (Seats 8 to 19)	Jeepney (Seats 20+)	ALL BUSES	Delivery Veh./All Trucks/Special Vehicles	Total
05:00 - 06:00	767	271	21	9	116	1,184	883	470	33	8	87	1,481
06:00 - 07:00	601	319	46	10	58	1,034	908	424	36	3	57	1,428
07:00 - 08:00	516	482	56	4	43	1,101	1,034	349	59	5	77	1,524
08:00 - 09:00	364	521	40	2	60	987	1,131	289	7	3	97	1,527
09:00 - 10:00	257	486	25	4	72	844	1,049	186	1	1	108	1,345
10:00 - 11:00	664	400	66	5	174	1,309	1,002	547	18	5	157	1,729
11:00 - 12:00	616	573	41	1	122	1,353	1,065	240	19	3	137	1,464
12:00 - 13:00	751	214	73	6	114	1,158	1,086	436	17	3	132	1,674
13:00 - 14:00	770	400	35	0	151	1,356	933	448	23	3	127	1,534
14:00 - 15:00	859	246	35	0	160	1,300	995	532	29	1	178	1,735
15:00 - 16:00	975	398	43	1	114	1,531	819	247	38	1	108	1,213
16:00 - 17:00	974	335	40	1	93	1,443	855	427	39	2	77	1,400
17:00 - 18:00	1,152	361	49	2	86	1,650	812	488	44	3	74	1,421
18:00 - 19:00	1,003	299	39	2	63	1,406	775	377	29	1	37	1,219
19:00 - 20:00	951	362	34	5	67	1,419	772	309	27	3	64	1,175
20:00 - 21:00	850	279	33	4	66	1,232	869	349	21	6	56	1,301
21:00 - 22:00	945	290	25	4	85	1,349	815	347	18	4	62	1,246
22:00 - 23:00	804	237	10	1	66	1,118	732	347	10	3	56	1,148
Total	**13,819**	**6,473**	**711**	**61**	**1,710**	**22,774**	**16,535**	**6,812**	**468**	**58**	**1,691**	**25,564**

See Location Map below:

Figure 3.1-8: Location Map: Station D-1: Sales Road

Sta. D - Sales Road (At-grade)

Table 3.1-10: Manual Classified Count: Station S-1: Skyway - Arnaiz Entry/Exit Ramps

Station Code: S-1
Station Name: Skyway Arnaiz Entry/Exit Ramps
Date: 04/25/2013
Weather: Fine

Time Period	OFF-RAMP						ON-RAMP					
	Private Car/Sedan/SUV/Pick-Up/Jeep (Owner Type)/Taxi/Airport Taxi	Private or Public Van (Seats 8 to 19)	Jeepney (Seats 20+)	ALL BUSES	Delivery Veh./All Trucks/Special Vehicles	Total	Private Car/Sedan/SUV/Pick-Up/Jeep (Owner Type)/Taxi/Airport Taxi	Private or Public Van (Seats 8 to 19)	Jeepney (Seats 20+)	ALL BUSES	Delivery Veh./All Trucks/Special Vehicles	Total
05:00 - 06:00	83	4	0	0	0	87	95	6	0	1	1	103
06:00 - 07:00	524	73	0	0	0	597	273	32	0	0	0	305
07:00 - 08:00	1,418	212	0	1	6	1,637	284	72	0	2	2	360
08:00 - 09:00	1,562	174	0	0	1	1,737	310	66	0	0	2	378
09:00 - 10:00	1,158	123	0	0	9	1,290	348	46	0	0	4	398
10:00 - 11:00	587	62	0	0	5	654	330	26	0	0	5	361
11:00 - 12:00	486	66	0	0	5	557	318	34	0	0	7	359
12:00 - 13:00	332	38	0	0	2	372	362	30	0	0	3	395
13:00 - 14:00	346	38	0	0	5	389	373	39	2	1	5	420
14:00 - 15:00	353	54	0	0	11	418	374	45	0	0	6	425
15:00 - 16:00	325	22	0	0	2	349	554	45	0	0	7	606
16:00 - 17:00	351	44	0	0	10	405	541	75	0	0	5	621
17:00 - 18:00	391	51	0	0	8	450	926	119	1	1	4	1,051
18:00 - 19:00	491	75	0	1	9	576	1,093	147	1	2	3	1,246
19:00 - 20:00	419	92	0	0	2	513	1,110	127	0	0	1	1,238
20:00 - 21:00	296	64	0	0	6	366	689	68	0	0	4	761
21:00 - 22:00	175	18	0	0	1	194	794	73	0	0	3	870
22:00 - 23:00	124	11	0	0	1	136	442	22	0	0	0	464
Total	**9,421**	**1,221**	**0**	**2**	**83**	**10,727**	**9,216**	**1,072**	**4**	**7**	**62**	**10,361**

See Location Map below:

Figure 3.1-9: Location Map: Station S-1: Skyway - Arnaiz Entry/Exit Ramps

Sta. S-1 - Skyway Arnaiz Entry/Exit Ramps

Table 3.1-11: Manual Classified Count: Station S-2: Skyway - Sales Road Entry/Exit Ramps

Station Code: S-2
Station Name: Skyway Sales Road Entry/Exit Ramps
Date: 04/25/2013
Weather: Fine

Time Period	ON-RAMP						OFF-RAMP					
	Private Car/Sedan/SUV/Pick-Up/Jeep (Owner Type)/Taxi/Airport Taxi	Private or Public Van (Seats 8 to 19)	Jeepney (Seats 20+)	ALL BUSES	Delivery Veh./All Trucks/Special Vehicles	Total	Private Car/Sedan/SUV/Pick-Up/Jeep (Owner Type)/Taxi/Airport Taxi	Private or Public Van (Seats 8 to 19)	Jeepney (Seats 20+)	ALL BUSES	Delivery Veh./All Trucks/Special Vehicles	Total
05:00 - 06:00	207	169	0	3	8	387	240	137	0	18	5	400
06:00 - 07:00	306	312	0	2	11	631	302	240	0	27	8	577
07:00 - 08:00	751	438	0	2	11	1,202	364	278	3	15	9	669
08:00 - 09:00	756	407	1	0	8	1,172	443	328	1	12	11	795
09:00 - 10:00	602	385	1	0	33	1,021	475	340	0	9	20	844
10:00 - 11:00	503	337	0	0	34	874	432	350	0	13	18	813
11:00 - 12:00	479	332	0	2	31	844	431	388	0	7	18	844
12:00 - 13:00	436	315	1	0	15	767	465	282	0	8	15	770
13:00 - 14:00	392	315	0	1	16	724	473	356	2	14	20	865
14:00 - 15:00	319	345	1	1	32	698	535	401	6	10	27	979
15:00 - 16:00	415	364	0	1	23	803	500	395	6	5	13	919
16:00 - 17:00	410	371	0	1	19	801	572	398	1	7	8	986
17:00 - 18:00	575	561	0	4	23	1,163	559	480	0	4	17	1,060
18:00 - 19:00	475	435	1	3	9	923	625	484	0	7	19	1,135
19:00 - 20:00	753	369	1	1	7	1,131	501	498	0	3	17	1,019
20:00 - 21:00	401	334	4	0	10	749	581	420	1	4	22	1,028
21:00 - 22:00	237	221	0	2	6	466	457	453	0	6	19	935
22:00 - 23:00	631	342	1	2	8	984	359	281	0	7	8	655
Total	**8,648**	**6,352**	**11**	**25**	**304**	**15,340**	**8,314**	**6,509**	**20**	**176**	**274**	**15,293**

See Location Map below:

Figure 3.1-10: Location Map: Station S-2: Skyway - Sales Road Entry/Exit Ramps

Sta. S-2 - Skyway Sales Road Entry/Exit Ramps

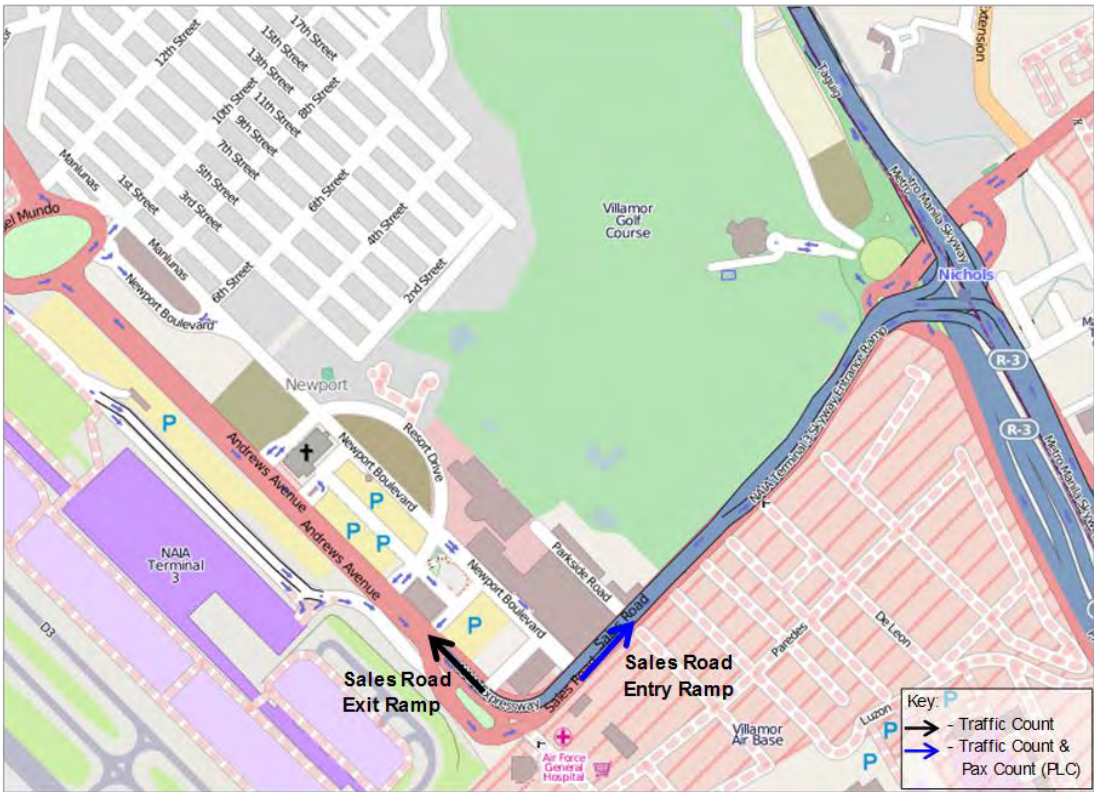


Table 3.1-12: Manual Classified Count: Station S-3: Skyway-North of C-5 (Screenline)

Station Code: S-3
Station Name: Skyway North of C-5 (Screenline)
Date: 04/25/2013
Weather: Fine

	NORTHBOUND (AT-GRADE)						SOUTHBOUND (AT-GRADE)					
Time Period	Private Car/Sedan/SUV/Pick-Up/ Jeep (Owner Type)/Taxi/Airport Taxi	Private or Public Van (Seats 8 to 19)	Jeepney (Seats 20+)	ALL BUSES	Delivery Veh./ All Trucks/ Special Vehicles	Total	Private Car/Sedan/SUV/Pick-Up/ Jeep (Owner Type)/Taxi/Airport Taxi	Private or Public Van (Seats 8 to 19)	Jeepney (Seats 20+)	ALL BUSES	Delivery Veh./ All Trucks/ Special Vehicles	Total
05:00 - 05:30	92	8	3	28	6	137	68	13	0	15	7	103
05:30 - 06:00	183	14	8	46	8	259	114	24	1	26	12	177
06:00 - 06:30	383	62	17	65	10	537	224	25	0	36	8	293
06:30 - 07:00	681	97	15	74	8	875	307	30	1	35	6	379
07:00 - 07:30	942	176	18	73	7	1,216	304	32	0	35	9	380
07:30 - 08:00	1,351	219	27	77	5	1,679	294	52	0	26	4	376
08:00 - 08:30	1,251	164	30	70	5	1,520	292	53	1	28	8	382
08:30 - 09:00	1,164	164	28	58	12	1,426	346	69	1	44	3	463
09:00 - 09:30	883	116	35	49	13	1,096	392	56	0	38	8	494
09:30 - 10:00	684	119	9	29	5	846	306	51	2	39	12	410
10:00 - 10:30	741	129	9	55	20	954	284	39	1	33	7	364
10:30 - 11:00	609	89	6	35	14	753	290	65	3	39	16	413
11:00 - 11:30	695	91	7	26	12	831	422	32	2	45	18	519
11:30 - 12:00	511	67	9	39	10	636	395	42	10	39	24	510
12:00 - 12:30	342	54	10	20	5	431	339	56	7	32	21	455
12:30 - 13:00	480	58	15	28	8	589	362	27	6	32	27	454
13:00 - 13:30	472	65	9	34	23	603	297	19	2	16	8	342
13:30 - 14:00	537	80	6	40	17	680	336	60	7	26	13	442
14:00 - 14:30	542	67	9	36	25	679	400	53	10	24	19	506
14:30 - 15:00	513	87	9	42	20	671	412	60	7	28	11	518
15:00 - 15:30	471	63	9	32	19	594	475	56	7	27	12	577
15:30 - 16:00	408	85	4	28	15	540	501	64	6	38	17	626
16:00 - 16:30	437	64	6	35	15	557	512	69	10	26	16	633
16:30 - 17:00	436	69	7	30	15	557	550	54	7	20	10	641
17:00 - 17:30	390	70	6	33	16	515	645	55	11	32	9	752
17:30 - 18:00	392	70	7	18	8	495	686	79	9	34	12	820
18:00 - 18:30	434	81	10	26	15	566	958	104	15	46	13	1,136
18:30 - 19:00	502	99	11	29	11	652	988	83	12	54	10	1,147
19:00 - 19:30	439	91	15	33	8	586	866	89	13	43	15	1,026
19:30 - 20:00	370	71	14	29	21	505	969	113	14	58	17	1,171
20:00 - 20:30	300	47	10	22	8	387	902	101	9	59	14	1,085
20:30 - 21:00	260	39	6	22	6	333	749	71	8	39	12	879
21:00 - 21:30	247	35	8	18	3	311	792	96	6	41	12	947
21:30 - 22:00	220	29	7	20	5	281	724	71	8	39	15	857
22:00 - 22:30	182	32	3	23	3	243	632	43	1	32	10	718
22:30 - 23:00	121	14	1	8	3	147	597	38	3	22	2	662
23:00 - 23:30	103	14	2	9	3	131	592	62	6	22	6	688
23:30 - 00:00	90	8	1	7	4	110	223	18	3	13	3	260
00:00 - 00:30	68	6	0	4	7	85	180	8	2	13	5	208
00:30 - 01:00	50	8	0	2	2	62	133	17	0	11	1	162
01:00 - 01:30	43	3	1	3	3	53	98	10	0	5	1	114
01:30 - 02:00	25	4	0	1	0	30	64	2	0	2	1	69
02:00 - 02:30	25	7	0	6	0	38	61	2	0	5	3	71
02:30 - 03:00	27	4	0	4	1	36	45	3	1	4	1	54
03:00 - 03:30	20	2	0	4	2	28	33	3	0	6	2	44
03:30 - 04:00	48	7	0	10	0	65	43	6	1	4	4	58
04:00 - 04:30	52	8	0	10	1	71	39	7	0	6	0	52
04:30 - 05:00	64	9	2	12	4	91	44	1	0	5	4	54
Total	**19,280**	**2,965**	**409**	**1,402**	**431**	**24,487**	**19,285**	**2,183**	**213**	**1,342**	**468**	**23,491**

See Location Map below:

Figure 3.1-11: Location Map: Station S-3: Skyway-North of C-5 (Screenline)

Sta. S-3 - Skyway North of C-5 (Screenline)

Table 3.1-13: Manual Classified Count: Station S-4: Skyway-Bicutan Entry/Exit Ramps

Station Code: S-4
Station Name: Skyway Bicutan Entry/Exit Ramps
Date: 04/25/2013
Weather: Fine

	ON-RAMP						OFF-RAMP					
Time Period	Private Car/Sedan/SUV/Pick-Up/Jeep (Owner Type)/Taxi/Airport Taxi	Private or Public Van (Seats 8 to 19)	Jeepney (Seats 20+)	ALL BUSES	Delivery Veh./All Trucks/Special Vehicles	Total	Private Car/Sedan/SUV/Pick-Up/Jeep (Owner Type)/Taxi/Airport Taxi	Private or Public Van (Seats 8 to 19)	Jeepney (Seats 20+)	ALL BUSES	Delivery Veh./All Trucks/Special Vehicles	Total
05:00 - 06:00	62	5	6	1	1	75	42	6	5	1	11	65
06:00 - 07:00	274	44	21	6	5	350	51	16	3	1	6	77
07:00 - 08:00	601	97	39	3	6	746	99	61	7	0	2	169
08:00 - 09:00	672	79	49	3	4	807	117	55	1	0	1	174
09:00 - 10:00	333	51	20	5	6	415	101	36	3	0	10	150
10:00 - 11:00	219	31	13	2	5	270	128	35	3	0	10	176
11:00 - 12:00	180	22	9	0	2	213	150	23	11	0	6	190
12:00 - 13:00	141	20	29	1	7	198	180	30	10	0	9	229
13:00 - 14:00	100	24	12	1	7	144	162	19	10	1	6	198
14:00 - 15:00	96	27	12	2	3	140	199	18	8	0	11	236
15:00 - 16:00	93	21	7	0	3	124	177	28	10	0	7	222
16:00 - 17:00	90	27	9	0	7	133	281	20	15	1	13	330
17:00 - 18:00	91	28	15	0	4	138	441	46	30	0	11	528
18:00 - 19:00	165	27	15	1	0	208	541	70	40	1	8	660
19:00 - 20:00	108	22	13	0	6	149	545	77	31	0	8	661
20:00 - 21:00	72	11	10	1	2	96	536	63	15	0	10	624
21:00 - 22:00	56	4	8	1	0	69	515	44	7	0	6	572
22:00 - 23:00	42	5	1	1	1	50	404	11	3	1	3	422
Total	**3,395**	**545**	**288**	**28**	**69**	**4,325**	**4,669**	**658**	**212**	**6**	**138**	**5,683**

See Location Map below:

Figure 3.1-12: Location Map: Station S-4: Skyway Bicutan Entry/Exit Ramps

Sta. S-4 - Skyway Bicutan Entry/Exit Ramps

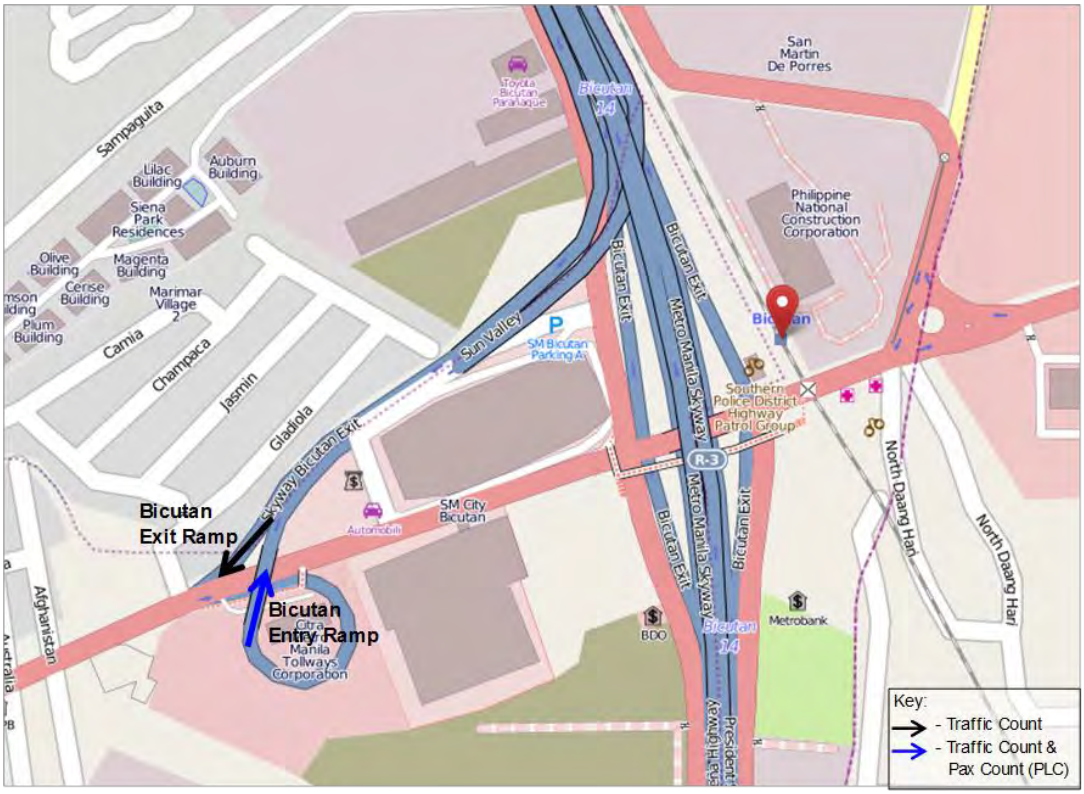


Table 3.1-14: Manual Classified Count: Station S-5: Skyway-Sucat Entry/Exit Ramps

Station Code: S-5
Station Name: Skyway Sucat Entry/Exit Ramps
Date: 04/25/2013
Weather: Fine

	ON-RAMP						OFF-RAMP					
Time Period	Private Car/Sedan/SUV/Pick-Up/Jeep (Owner Type)/Taxi/Airport Taxi	Private or Public Van (Seats 8 to 19)	Jeepney (Seats 20+)	ALL BUSES	Delivery Veh./All Trucks/Special Vehicles	Total	Private Car/Sedan/SUV/Pick-Up/Jeep (Owner Type)/Taxi/Airport Taxi	Private or Public Van (Seats 8 to 19)	Jeepney (Seats 20+)	ALL BUSES	Delivery Veh./All Trucks/Special Vehicles	Total
05:00 - 06:00	72	8	0	0	3	83	14	8	0	1	1	24
06:00 - 07:00	284	27	3	0	3	317	31	12	0	2	0	45
07:00 - 08:00	850	94	6	0	4	954	29	3	0	0	1	33
08:00 - 09:00	600	40	3	0	3	646	74	17	0	0	6	97
09:00 - 10:00	423	34	3	0	7	467	62	16	0	0	2	80
10:00 - 11:00	354	40	3	1	8	406	109	16	0	0	6	131
11:00 - 12:00	232	40	1	0	2	275	105	11	0	0	2	118
12:00 - 13:00	194	20	0	0	3	217	109	29	0	0	8	146
13:00 - 14:00	179	14	0	0	4	197	122	28	0	0	7	157
14:00 - 15:00	234	36	0	0	11	281	150	17	4	1	8	180
15:00 - 16:00	188	23	0	0	4	215	191	14	0	0	5	210
16:00 - 17:00	208	30	0	0	0	238	194	18	0	0	4	216
17:00 - 18:00	184	22	1	0	4	211	352	48	4	0	8	412
18:00 - 19:00	188	12	0	0	0	200	372	72	2	2	4	452
19:00 - 20:00	151	11	0	0	0	162	358	66	2	0	7	433
20:00 - 21:00	100	14	0	2	0	116	337	68	1	1	4	411
21:00 - 22:00	79	8	0	0	0	87	355	38	0	0	2	395
22:00 - 23:00	61	7	0	0	0	68	299	31	0	1	1	332
Total	**4,581**	**480**	**20**	**3**	**56**	**5,140**	**3,263**	**512**	**13**	**8**	**76**	**3,872**

See Location Map below:

Figure 3.1-13: Location Map: Station S-5: Skyway-Sucat Entry/Exit Ramps

Sta. S-5 - Skyway Sucat Entry/Exit Ramps

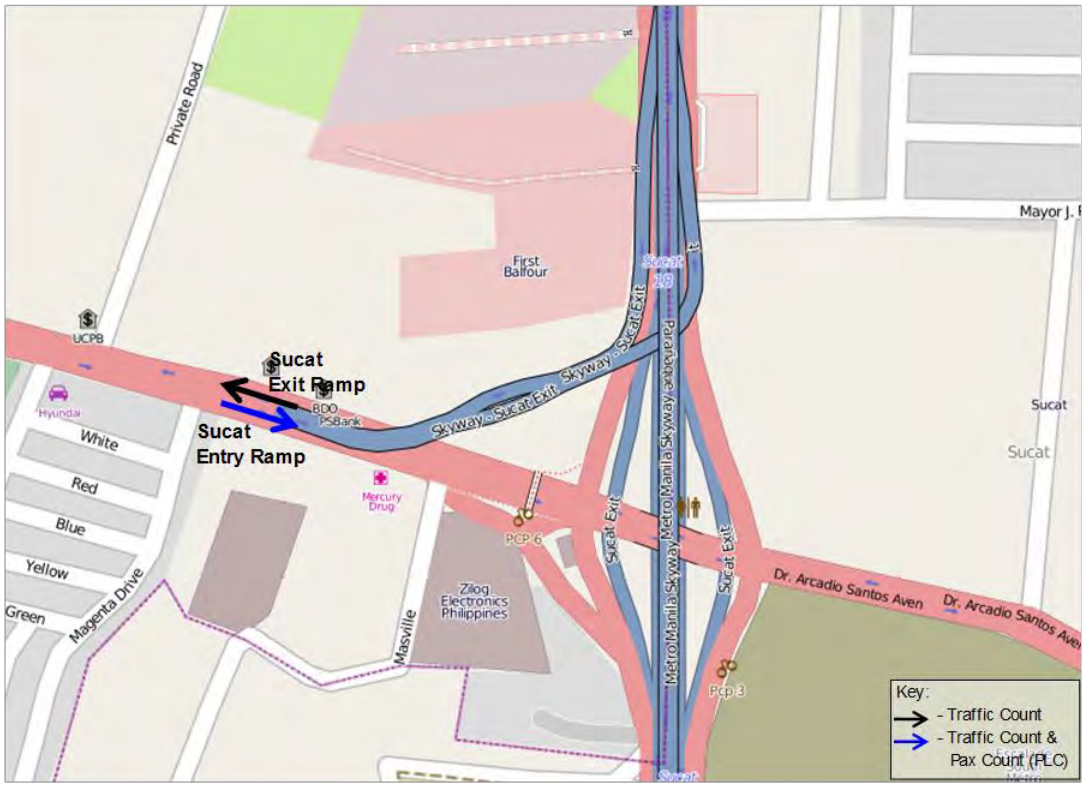


Table 3.1-15: Manual Classified Count: Station S-6: Skyway-Hillsborough Entry/Exit Ramps

Station Code: S-6
Station Name: Skyway Hillsborough Entry/Exit Ramps
Date: 04/25/2013
Weather: Fine

Time Period	ON-RAMP						OFF-RAMP					
	Private Car/Sedan/SUV/Pick-Up/Jeep (Owner Type)/Taxi/Airport Taxi	Private or Public Van (Seats 8 to 19)	Jeepney (Seats 20+)	ALL BUSES	Delivery Veh./All Trucks/Special Vehicles	Total	Private Car/Sedan/SUV/Pick-Up/Jeep (Owner Type)/Taxi/Airport Taxi	Private or Public Van (Seats 8 to 19)	Jeepney (Seats 20+)	ALL BUSES	Delivery Veh./All Trucks/Special Vehicles	Total
05:00 - 06:00	117	22	6	77	15	237	51	26	0	29	2	108
06:00 - 07:00	328	64	16	159	16	583	266	87	0	64	9	426
07:00 - 08:00	667	132	23	179	12	1,013	240	54	0	57	6	357
08:00 - 09:00	608	121	17	116	16	878	217	87	0	68	3	375
09:00 - 10:00	467	120	16	96	23	722	250	92	1	87	4	434
10:00 - 11:00	420	103	9	81	25	638	232	90	0	76	11	409
11:00 - 12:00	329	62	10	66	17	484	241	131	0	86	19	477
12:00 - 13:00	295	52	7	61	12	427	280	98	1	71	21	471
13:00 - 14:00	474	104	10	93	24	705	255	85	0	54	18	412
14:00 - 15:00	429	87	7	59	22	604	215	132	1	64	12	424
15:00 - 16:00	416	102	15	66	19	618	237	84	1	62	14	398
16:00 - 17:00	382	75	7	81	19	564	252	118	1	54	8	433
17:00 - 18:00	402	86	10	69	19	586	267	194	2	80	3	546
18:00 - 19:00	444	99	8	67	19	637	293	234	1	101	3	632
19:00 - 20:00	289	80	10	55	17	451	329	154	2	96	12	593
20:00 - 21:00	227	59	9	47	8	350	487	104	1	123	17	732
21:00 - 22:00	127	39	8	45	11	230	379	51	4	90	9	533
22:00 - 23:00	99	19	4	32	6	160	202	33	0	43	8	286
Total	**6,520**	**1,426**	**192**	**1,449**	**300**	**9,887**	**4,693**	**1,854**	**15**	**1,305**	**179**	**8,046**

See Location Map below:

Figure 3.1-14: Location Map: Station S-6: Skyway-Hillsborough Entry/Exit Ramps

Sta. S-6 - Skyway Hillsborough Entry/Exit Ramps

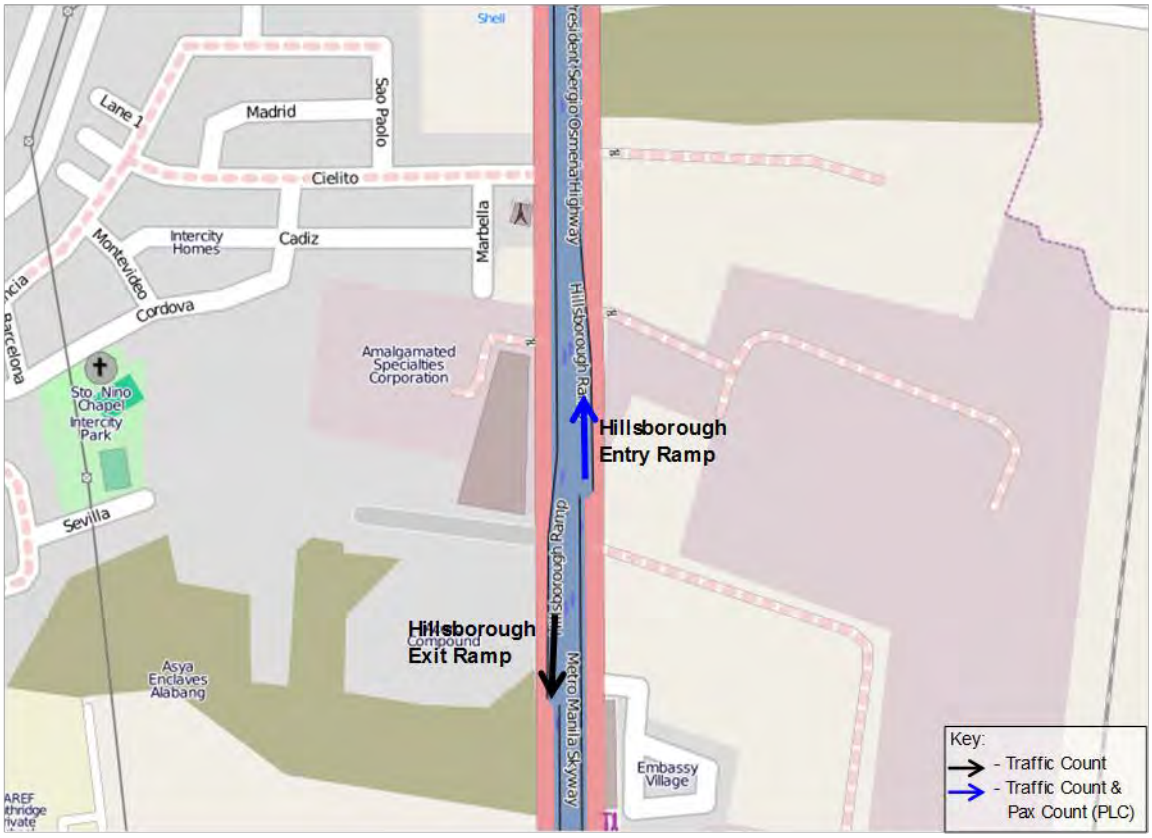


Table 3.1-16: Manual Classified Count: Station S-7: Skyway-Alabang Entry/Exit Ramps

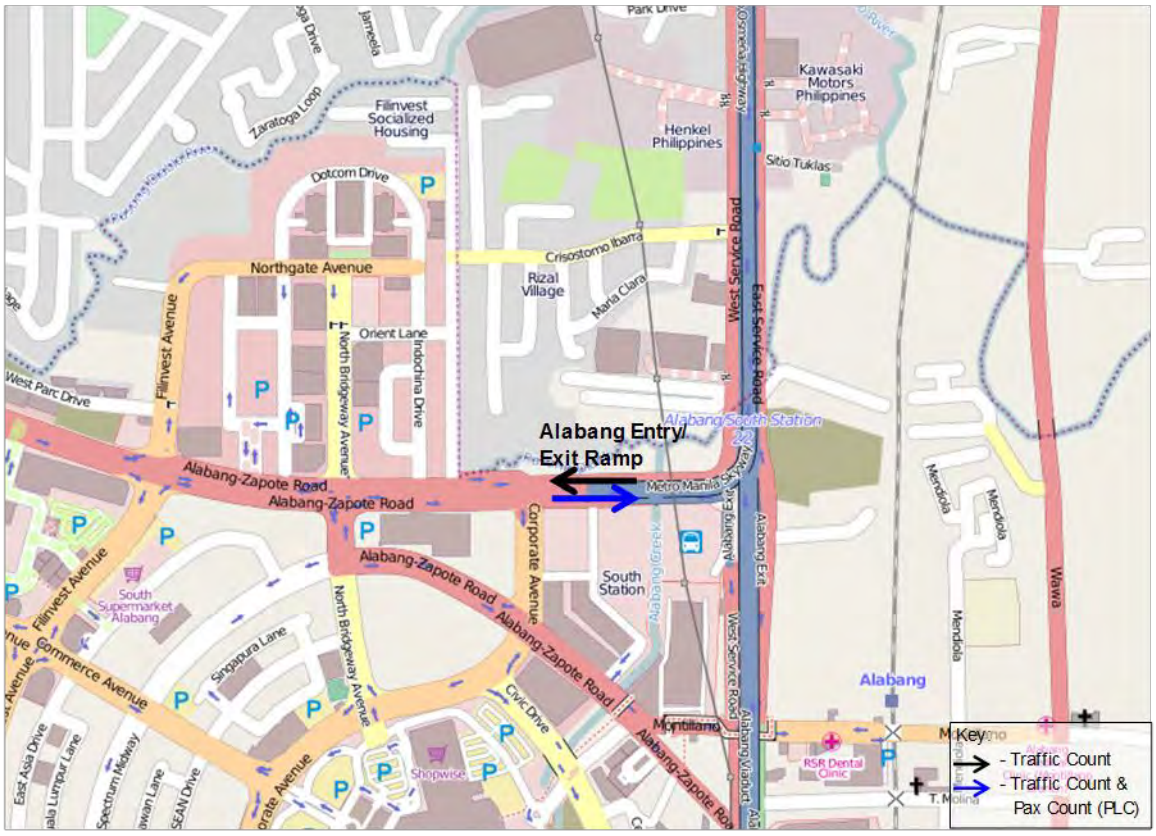
Station Code: S-7
Station Name: Skyway Alabang Entry/Exit Ramps
Date: 04/25/2013
Weather: Fine

Time Period	ON-RAMP						OFF-RAMP					
	Private Car/Sedan/SUV/Pick-Up/Jeep (Owner Type)/Taxi/Airport Taxi	Private or Public Van (Seats 8 to 19)	Jeepney (Seats 20+)	ALL BUSES	Delivery Veh./All Trucks/Special Vehicles	Total	Private Car/Sedan/SUV/Pick-Up/Jeep (Owner Type)/Taxi/Airport Taxi	Private or Public Van (Seats 8 to 19)	Jeepney (Seats 20+)	ALL BUSES	Delivery Veh./All Trucks/Special Vehicles	Total
05:00 - 06:00	47	34	0	0	3	84	20	23	0	1	2	46
06:00 - 07:00	168	200	0	0	0	368	34	56	0	1	3	94
07:00 - 08:00	315	289	1	0	1	606	44	80	0	0	0	124
08:00 - 09:00	274	197	0	0	2	473	45	75	0	0	0	120
09:00 - 10:00	184	176	0	0	1	361	80	82	0	0	0	162
10:00 - 11:00	177	133	0	0	2	312	72	71	0	0	1	144
11:00 - 12:00	106	139	0	1	5	251	129	52	0	0	1	182
12:00 - 13:00	143	159	0	1	2	305	102	73	0	2	2	179
13:00 - 14:00	361	168	0	0	2	531	85	107	0	0	3	195
14:00 - 15:00	209	117	0	0	6	332	175	106	0	2	5	288
15:00 - 16:00	180	83	0	0	5	268	170	138	0	1	1	310
16:00 - 17:00	164	94	0	0	3	261	208	143	0	0	4	355
17:00 - 18:00	148	87	0	0	9	244	199	218	0	2	1	420
18:00 - 19:00	123	182	0	0	7	312	341	308	0	0	4	653
19:00 - 20:00	115	136	0	0	3	254	288	262	0	1	4	555
20:00 - 21:00	90	95	0	0	2	187	245	230	0	2	0	477
21:00 - 22:00	66	72	0	0	0	138	178	234	0	0	4	416
22:00 - 23:00	35	42	0	0	0	77	171	100	0	1	1	273
Total	**2,905**	**2,403**	**1**	**2**	**53**	**5,364**	**2,586**	**2,358**	**0**	**13**	**36**	**4,993**

See Location Map below:

Figure 3.1-15: Location Map: Station S-7: Skyway-Alabang Entry/Exit Ramps

Sta. S-7 - Skyway Alabang Entry/Exit Ramps



3.2 VEHICLE OCCUPANCY SURVEY

Table 3.2-2 to 3.2.14 shows the vehicle occupancy and sample size gathered, by vehicle type for all stations. The tables are arranged, as summarized below.

Table 3.2.1: Summary of Vehicle Occupancy Count Result

Station Code	Station Name	Direction	Private Cars	Private/ Public Vans (seats 8 to 19)	Jeepneys (Seats 20+)	All Buses
Sta. A-1	SLEX (North of C-5 Access Ramp)	Northbound	1.8	2.4	22.2	45.0
Sta. A-2	East Service Road (Screenline)	Northbound	1.8	2.7	16.4	30.9
Sta. A-3	West Service Road (Screenline)	Northbound	1.6	1.9	17.2	2.0
Sta. B-1	SLEX	Northbound	1.7	5.5	17.0	44.5
Sta. B-2	East Service Road	Northbound	1.8	2.4	8.1	0.0
Sta. B-3	West Service Road	Northbound	1.5	2.7	10.9	1.7
Sta. D-1	Sales Road	Eastbound	1.7	2.6	6.2	31.2
Sta. S-1	Skyway Arnaiz Entry/Exit Ramps	On-Ramp	1.6	2.5	0.0	10.0
Sta. S-2	Skyway Sales Road Entry/Exit Ramps	On-Ramp	2.0	2.6	1.0	24.9
Sta. S-4	Skyway Bicutan Entry/Exit Ramps	On-Ramp	1.4	14.5	24.1	11.7
Sta. S-5	Skyway Sucat Entry/Exit Ramps	On-Ramp	1.9	10.9	21.0	0.0
Sta. S-6	Skyway Hillsborough Entry/Exit Ramps	On-Ramp	1.4	2.8	22.6	51.3
Sta. S-7	Skyway Alabang Entry/Exit Ramps	On-Ramp	1.5	4.1	10.0	8.0

Table 3.2-2: Vehicle Occupancy Count: Station A-1: SLEX (North of C-5 Access Ramp)

Station Code: A-1
Station Name: Slex (North of C-5 Access Ramp)
Date: 04/25/2013 (Thursday)
Weather: Fine
Direction: SLEX - Northbound

Time	SLEX - NORTHBOUND											
	Vehicle Type 1			Vehicle Type 2			Vehicle Type 3			Vehicle Type 4		
	No. of Vehicles	No. of Passengers	Average Occupancy	No. of Vehicles	No. of Passengers	Average Occupancy	No. of Vehicles	No. of Passengers	Average Occupancy	No. of Vehicles	No. of Passengers	Average Occupancy
0600-0630	372	665	1.8	84	237	2.8	17	378	22.2	96	4,590	47.8
0630-0700	372	687	1.8	86	230	2.7	23	490	21.3	88	4,365	49.6
0700-0730	372	677	1.8	71	184	2.6	22	484	22.0	82	4,140	50.5
0730-0800	372	636	1.7	77	196	2.5	19	420	22.1	81	4,245	52.4
0800-0830	372	649	1.7	80	245	3.1	17	369	21.7	62	3,315	53.5
0830-0900	371	684	1.8	81	241	3.0	3	62	20.7	60	3,120	52.0
0900-0930	288	496	1.7	96	276	2.9	8	175	21.9	55	2,850	51.8
0930-1000	328	546	1.7	88	201	2.3	11	251	22.8	40	1,935	48.4
1000-1030	319	532	1.7	75	187	2.5	7	159	22.7	44	2,340	53.2
1030-1100	307	564	1.8	71	189	2.7	9	201	22.3	33	1,785	54.1
1100-1130	348	599	1.7	97	274	2.8	7	157	22.4	40	2,115	52.9
1130-1200	294	488	1.7	68	133	2.0	5	111	22.2	33	1,605	48.6
1200-1230	220	349	1.6	54	107	2.0	1	23	23.0	37	1,650	44.6
1230-1300	293	495	1.7	58	126	2.2	1	23	23.0	33	1,382	41.9
1300-1330	317	528	1.7	71	174	2.5	3	67	22.3	37	1,102	29.8
1330-1400	313	509	1.6	82	165	2.0	9	201	22.3	62	2,054	33.1
1400-1430	371	684	1.8	90	166	1.8	4	90	22.5	59	1,987	33.7
1430-1500	372	673	1.8	119	290	2.4	6	136	22.7	58	2,100	36.2
1500-1530	372	639	1.7	144	275	1.9	8	180	22.5	71	2,628	37.0
1530-1600	372	720	1.9	101	207	2.0	5	117	23.4	58	2,274	39.2
1600-1630	372	769	2.1	88	176	2.0	7	163	23.3	68	2,316	34.1
1630-1700	372	650	1.7	137	302	2.2	9	207	23.0	57	2,479	43.5
1700-1730	372	602	1.6	110	218	2.0	11	251	22.8	71	3,241	45.6
1730-1800	372	609	1.6	103	254	2.5	17	372	21.9	79	3,600	45.6
Total	8,233	14,450	1.8	2,131	5,053	2.4	229	5,087	22.2	1,404	63,218	45.0

Vehicle Type: 1 - Private Car/SUV/Pick-Up/ Jeep (Owner Type)/Taxi, 2 - Private or Public Van, 3 - Jeepney, 4 - All Buses, and 5 - All Trucks

Time	SLEX - NORTHBOUND			
	% Vehicle Sampled			
	Type 1	Type 2	Type 3	Type 4
0600-0630	75%	97%	100%	77%
0630-0700	62%	93%	88%	79%
0700-0730	53%	90%	79%	81%
0730-0800	64%	91%	86%	91%
0800-0830	77%	93%	85%	94%
0830-0900	86%	92%	100%	92%
0900-0930	78%	94%	89%	90%
0930-1000	88%	98%	100%	91%
1000-1030	81%	97%	88%	83%
1030-1100	73%	92%	90%	87%
1100-1130	86%	96%	100%	82%
1130-1200	87%	94%	100%	87%
1200-1230	59%	92%	100%	88%
1230-1300	80%	95%	100%	77%
1300-1330	94%	89%	100%	59%
1330-1400	79%	90%	100%	100%
1400-1430	65%	87%	100%	98%
1430-1500	65%	90%	100%	82%
1500-1530	68%	95%	100%	80%
1530-1600	90%	95%	83%	89%
1600-1630	87%	85%	100%	99%
1630-1700	75%	96%	100%	78%
1700-1730	72%	90%	100%	88%
1730-1800	73%	75%	94%	87%
Total	74%	92%	92%	85%

Table 3.2-3: Vehicle Occupancy Count: Station A-2: East Service Road

Station Code: A-2
Station Name: East Service Road
Date: 04/25/2013 (Thursday)
Weather: Fine
Direction: East Service Road – Northbound

Time	EAST SERVICE ROAD - NORTHBOUND											
	Vehicle Type 1			Vehicle Type 2			Vehicle Type 3			Vehicle Type 4		
	No. of Vehicles	No. of Passengers	Average Occupancy	No. of Vehicles	No. of Passengers	Average Occupancy	No. of Vehicles	No. of Passengers	Average Occupancy	No. of Vehicles	No. of Passengers	Average Occupancy
0600-0630	372	691	1.9	40	140	3.5	111	2,002	18.0	18	792	44.0
0630-0700	372	671	1.8	44	165	3.8	105	2,175	20.7	13	592	45.5
0700-0730	372	665	1.8	51	256	5.0	109	2,275	20.9	11	595	54.1
0730-0800	372	650	1.7	48	236	4.9	119	2,550	21.4	13	616	47.4
0800-0830	372	671	1.8	51	191	3.7	108	2,225	20.6	10	383	38.3
0830-0900	372	617	1.7	57	140	2.5	71	1,408	19.8	6	285	47.5
0900-0930	372	702	1.9	79	213	2.7	71	1,363	19.2	10	332	33.2
0930-1000	372	630	1.7	69	228	3.3	73	1,362	18.7	9	218	24.2
1000-1030	372	604	1.6	73	198	2.7	73	1,364	18.7	14	348	24.9
1030-1100	372	622	1.7	54	122	2.3	59	1,036	17.6	5	216	43.2
1100-1130	372	695	1.9	54	127	2.4	63	947	15.0	9	258	28.7
1130-1200	372	724	1.9	54	127	2.4	51	860	16.9	9	293	32.6
1200-1230	287	534	1.9	41	92	2.2	61	902	14.8	6	197	32.8
1230-1300	352	670	1.9	49	146	3.0	82	1,163	14.2	7	260	37.1
1300-1330	342	655	1.9	56	98	1.8	59	937	15.9	4	139	34.8
1330-1400	365	666	1.8	56	128	2.3	60	978	16.3	6	97	16.2
1400-1430	372	716	1.9	70	162	2.3	62	742	12.0	14	277	19.8
1430-1500	332	609	1.8	61	116	1.9	59	744	12.6	6	119	19.8
1500-1530	372	717	1.9	64	143	2.2	68	856	12.6	8	179	22.4
1530-1600	372	748	2.0	48	94	2.0	64	738	11.5	16	243	15.2
1600-1630	372	737	2.0	75	187	2.5	76	844	11.1	14	209	14.9
1630-1700	372	722	1.9	49	85	1.7	89	944	10.6	11	234	21.3
1700-1730	372	709	1.9	52	103	2.0	91	1,016	11.2	9	215	23.9
1730-1800	341	632	1.9	43	91	2.1	79	1,063	13.5	10	249	24.9
Total	8,715	16,057	1.8	1,338	3,588	2.7	1,863	30,494	16.4	238	7,346	30.9

Vehicle Type: 1 - Private Car/SUV/Pick-Up/ Jeep (Owner Type)/Taxi, 2 - Private or Public Van, 3 - Jeepney, 4 - All Buses, and 5 - All Trucks

Time	East Service Road - NORTHBOUND			
	% Vehicle Sampled			
	Type 1	Type 2	Type 3	Type 4
0600-0630	92%	80%	93%	95%
0630-0700	75%	100%	90%	93%
0700-0730	74%	98%	86%	85%
0730-0800	67%	87%	92%	100%
0800-0830	66%	89%	90%	91%
0830-0900	77%	97%	89%	86%
0900-0930	58%	98%	92%	91%
0930-1000	65%	96%	92%	75%
1000-1030	74%	95%	92%	100%
1030-1100	74%	93%	92%	63%
1100-1130	75%	95%	91%	82%
1130-1200	88%	95%	91%	100%
1200-1230	98%	93%	88%	100%
1230-1300	86%	78%	99%	100%
1300-1330	85%	93%	94%	80%
1330-1400	100%	90%	95%	40%
1400-1430	89%	95%	94%	93%
1430-1500	90%	95%	94%	86%
1500-1530	83%	84%	94%	73%
1530-1600	95%	98%	93%	89%
1600-1630	98%	95%	95%	100%
1630-1700	82%	98%	93%	73%
1700-1730	93%	98%	93%	82%
1730-1800	87%	98%	90%	77%
Total	80%	93%	92%	85%

Table 3.2-4: Vehicle Occupancy Count: Station A-3: West Service Road

Station Code: A-3
Station Name: West Service Road
Date: 04/25/2013 (Thursday)
Weather: Fine
Direction: West Service Road – Northbound

Time	West Service Road - NB											
	Vehicle Type 1			Vehicle Type 2			Vehicle Type 3			Vehicle Type 4		
	No. of Vehicles	No. of Passengers	Average Occupancy	No. of Vehicles	No. of Passengers	Average Occupancy	No. of Vehicles	No. of Passengers	Average Occupancy	No. of Vehicles	No. of Passengers	Average Occupancy
0600-0630	317	485	1.5	110	173	1.6	51	890	17.5	0	0	0.0
0630-0700	289	430	1.5	149	229	1.5	47	912	19.4	0	0	0.0
0700-0730	372	562	1.5	155	265	1.7	47	903	19.2	0	0	0.0
0730-0800	372	610	1.6	124	213	1.7	39	818	21.0	0	0	0.0
0800-0830	351	521	1.5	124	256	2.1	36	716	19.9	0	0	0.0
0830-0900	297	416	1.4	76	166	2.2	28	520	18.6	0	0	0.0
0900-0930	279	423	1.5	93	163	1.8	27	541	20.0	0	0	0.0
0930-1000	250	390	1.6	67	136	2.0	31	603	19.5	0	0	0.0
1000-1030	228	360	1.6	92	161	1.8	23	460	20.0	0	0	0.0
1030-1100	236	396	1.7	97	202	2.1	26	483	18.6	1	2	2.0
1100-1130	225	363	1.6	98	217	2.2	29	460	15.9	0	0	0.0
1130-1200	186	316	1.7	62	125	2.0	24	369	15.4	0	0	0.0
1200-1230	186	277	1.5	95	166	1.7	24	427	17.8	0	0	0.0
1230-1300	217	340	1.6	94	182	1.9	31	445	14.4	0	0	0.0
1300-1330	247	401	1.6	97	189	1.9	25	412	16.5	0	0	0.0
1330-1400	212	360	1.7	93	234	2.5	22	337	15.3	0	0	0.0
1400-1430	228	360	1.6	106	174	1.6	20	305	15.3	0	0	0.0
1430-1500	210	355	1.7	93	175	1.9	26	340	13.1	0	0	0.0
1500-1530	182	302	1.7	95	209	2.2	26	263	10.1	0	0	0.0
1530-1600	149	249	1.7	110	192	1.7	20	306	15.3	0	0	0.0
1600-1630	148	257	1.7	94	206	2.2	22	343	15.6	0	0	0.0
1630-1700	180	290	1.6	105	185	1.8	33	494	15.0	0	0	0.0
1700-1730	199	366	1.8	117	238	2.0	37	599	16.2	0	0	0.0
1730-1800	186	300	1.6	101	177	1.8	42	721	17.2	0	0	0.0
Total	5,746	9,129	1.6	2,447	4,633	1.9	736	12,667	17.2	1	2	2.0

Vehicle Type: 1 - Private Car/SUV/Pick-Up/ Jeep (Owner Type)/Taxi, 2 - Private or Public Van, 3 - Jeepney, 4 - All Buses, and 5 - All Trucks

Time	**West Service Road - NORTHBOUND**			
	% Vehicle Sampled			
	Type 1	Type 2	Type 3	Type 4
0600-0630	100%	79%	98%	0%
0630-0700	88%	85%	84%	0%
0700-0730	81%	82%	85%	0%
0730-0800	77%	75%	89%	0%
0800-0830	86%	95%	88%	0%
0830-0900	93%	85%	93%	0%
0900-0930	89%	70%	96%	0%
0930-1000	96%	74%	94%	0%
1000-1030	99%	97%	96%	0%
1030-1100	99%	94%	100%	100%
1100-1130	98%	92%	100%	0%
1130-1200	97%	77%	96%	0%
1200-1230	100%	86%	80%	0%
1230-1300	92%	94%	94%	0%
1300-1330	96%	89%	100%	0%
1330-1400	99%	82%	88%	0%
1400-1430	98%	86%	83%	0%
1430-1500	99%	85%	79%	0%
1500-1530	98%	96%	93%	0%
1530-1600	89%	88%	100%	0%
1600-1630	99%	88%	96%	0%
1630-1700	100%	97%	94%	0%
1700-1730	98%	98%	97%	0%
1730-1800	86%	94%	95%	0%
Total	92%	87%	92%	50%

Table 3.2-5: Vehicle Occupancy Count: Station B-1: SLEX (between Bicutan and Sucat Interchanges)

Station Code: B-1
Station Name: SLEX (Bet. Bicutan IC and Sucat IC)
Date: 04/23/2013 (TUESDA)
Weather: Fine
Direction: SLEX-NORTHBOUND

Time	SLEX - NORTHBOUND											
	Vehicle Type 1			Vehicle Type 2			Vehicle Type 3			Vehicle Type 4		
	No. of Vehicles	No. of Passengers	Average Occupancy	No. of Vehicles	No. of Passengers	Average Occupancy	No. of Vehicles	No. of Passengers	Average Occupancy	No. of Vehicles	No. of Passengers	Average Occupancy
0600-0700	291	522	1.8	135	1,229	9.1	19	292	15.4	108	5,592	51.8
0700-0800	325	576	1.8	180	1,702	9.5	27	424	15.7	82	3,840	46.8
0800-0900	324	583	1.8	141	948	6.7	20	332	16.6	79	3,623	45.9
0900-1000	333	611	1.8	193	1,355	7.0	8	116	14.5	144	6,357	44.1
1000-1100	292	516	1.8	191	1,094	5.7	9	149	16.6	76	3,292	43.3
1100-1200	264	420	1.6	104	424	4.1	4	77	19.3	77	3,547	46.1
1200-1300	314	464	1.5	163	489	3.0	8	132	16.5	88	3,750	42.6
1300-1400	315	493	1.6	108	384	3.6	7	131	18.7	122	5,410	44.3
1400-1500	303	455	1.5	159	564	3.5	8	163	20.4	105	4,155	39.6
1500-1600	316	489	1.5	175	674	3.9	6	94	15.7	122	5,245	43.0
1600-1700	314	515	1.6	194	876	4.5	10	194	19.4	131	5,521	42.1
1700-1800	293	515	1.8	204	927	4.5	15	288	19.2	136	6,175	45.4
Total	3,684	6,159	1.7	1,947	10,666	5.5	141	2,392	17.0	1,270	56,507	44.5

Vehicle Type: 1 - Private Car/SUV/Pick-Up/ Jeep (Owner Type)/Taxi, 2 - Private or Public Van, 3 - Jeepney, 4 - All Buses, and 5 - All Trucks

Time	SLEX - NORTHBOUND			
	% Vehicle Sampled			
	Type 1	Type 2	Type 3	Type 4
0600-0700	28%	64%	68%	47%
0700-0800	21%	87%	82%	79%
0800-0900	25%	80%	80%	44%
0900-1000	23%	69%	89%	81%
1000-1100	24%	89%	75%	78%
1100-1200	23%	90%	67%	82%
1200-1300	30%	93%	73%	75%
1300-1400	23%	91%	78%	85%
1400-1500	19%	71%	100%	81%
1500-1600	22%	68%	100%	81%
1600-1700	18%	55%	83%	78%
1700-1800	17%	57%	100%	73%
Total	22%	72%	81%	71%

Table 3.2-6: Vehicle Occupancy Count: Station B-2: East Service Road

Station Code: B-2
Station Name: East Service Road
Date: 04/23/2013 (TUESDAY)
Weather: Fine
Direction: East Service Road - NORTHBOUND

Time	EAST SERVICE ROAD - NORTHBOUND											
	Vehicle Type 1			Vehicle Type 2			Vehicle Type 3			Vehicle Type 4		
	No. of Vehicles	No. of Passengers	Average Occupancy	No. of Vehicles	No. of Passengers	Average Occupancy	No. of Vehicles	No. of Passengers	Average Occupancy	No. of Vehicles	No. of Passengers	Average Occupancy
0600-0700	76	131	1.7	17	39	2.3	129	1,282	9.9	0	0	0.0
0700-0800	102	158	1.5	28	63	2.3	119	1,335	11.2	0	0	0.0
0800-0900	74	119	1.6	24	46	1.9	117	936	8.0	0	0	0.0
0900-1000	69	126	1.8	24	67	2.8	88	732	8.3	0	0	0.0
1000-1100	50	92	1.8	17	47	2.8	85	523	6.2	0	0	0.0
1100-1200	64	132	2.1	22	62	2.8	97	599	6.2	0	0	0.0
1200-1300	62	122	2.0	19	50	2.6	87	710	8.2	0	0	0.0
1300-1400	53	109	2.1	19	51	2.7	76	651	8.6	0	0	0.0
1400-1500	64	128	2.0	33	81	2.5	104	555	5.3	0	0	0.0
1500-1600	52	92	1.8	28	57	2.0	104	725	7.0	0	0	0.0
1600-1700	45	87	1.9	24	65	2.7	87	711	8.2	0	0	0.0
1700-1800	57	124	2.2	36	70	1.9	112	999	8.9	0	0	0.0
Total	768	1,420	1.8	291	698	2.4	1,205	9,758	8.1	0	0	0.0

Vehicle Type: 1 - Private Car/SUV/Pick-Up/ Jeep (Owner Type)/Taxi, 2 - Private or Public Van, 3 - Jeepney, 4 - All Buses, and 5 - All Trucks

Time	East Service Road - NORTHBOUND			
	% Vehicle Sampled			
	Type 1	Type 2	Type 3	Type 4
0600-0700	99%	38%	93%	0%
0700-0800	99%	65%	96%	0%
0800-0900	76%	65%	99%	0%
0900-1000	100%	73%	98%	0%
1000-1100	96%	74%	99%	0%
1100-1200	97%	71%	98%	0%
1200-1300	76%	70%	98%	0%
1300-1400	79%	54%	96%	0%
1400-1500	58%	83%	96%	0%
1500-1600	96%	70%	94%	0%
1600-1700	70%	73%	93%	0%
1700-1800	84%	90%	96%	0%
Total	84%	68%	96%	0%

Table 3.2-7: Vehicle Occupancy Count: Station B-3: West Service Road

Station Code: B-3
Station Name: West Service Road
Date: 04/23/2013 (TUESDAY)
Weather: Fine
Direction: West Service Road - NORTHBOUND

Time	West Service Road - NORTHBOUND											
	Vehicle Type 1			Vehicle Type 2			Vehicle Type 3			Vehicle Type 4		
	No. of Vehicles	No. of Passengers	Average Occupancy	No. of Vehicles	No. of Passengers	Average Occupancy	No. of Vehicles	No. of Passengers	Average Occupancy	No. of Vehicles	No. of Passengers	Average Occupancy
0600-0700	269	365	1.4	52	149	2.9	77	1,044	13.6	1	1	1.0
0700-0800	279	412	1.5	31	71	2.3	70	1,135	16.2	0	0	0.0
0800-0900	281	435	1.5	32	65	2.0	90	886	9.8	0	0	0.0
0900-1000	269	420	1.6	39	118	3.0	52	511	9.8	0	0	0.0
1000-1100	182	267	1.5	36	74	2.1	39	473	12.1	0	0	0.0
1100-1200	179	279	1.6	35	86	2.5	31	298	9.6	0	0	0.0
1200-1300	162	239	1.5	29	78	2.7	60	469	7.8	0	0	0.0
1300-1400	163	260	1.6	41	90	2.2	57	500	8.8	0	0	0.0
1400-1500	156	251	1.6	35	73	2.1	50	490	9.8	0	0	0.0
1500-1600	159	244	1.5	28	75	2.7	64	537	8.4	2	4	2.0
1600-1700	140	242	1.7	32	81	2.5	77	661	8.6	0	0	0.0
1700-1800	155	244	1.6	25	162	6.5	93	1,247	13.4	0	0	0.0
Total	2,394	3,658	1.5	415	1,122	2.7	760	8,251	10.9	3	5	1.7

Vehicle Type: 1 - Private Car/SUV/Pick-Up/ Jeep (Owner Type)/Taxi, 2 - Private or Public Van, 3 - Jeepney, 4 - All Buses, and 5 - All Trucks

Time	West Service Road - NORTHBOUND			
	% Vehicle Sampled			
	Type 1	Type 2	Type 3	Type 4
0600-0700	99%	75%	88%	100%
0700-0800	99%	89%	76%	0%
0800-0900	99%	73%	80%	0%
0900-1000	98%	93%	75%	0%
1000-1100	96%	97%	80%	0%
1100-1200	97%	97%	66%	0%
1200-1300	96%	100%	92%	0%
1300-1400	96%	93%	83%	0%
1400-1500	88%	92%	91%	0%
1500-1600	94%	90%	85%	100%
1600-1700	75%	82%	88%	0%
1700-1800	81%	78%	96%	0%
Total	94%	87%	84%	50%

Table 3.2-8: Vehicle Occupancy Count: Station D-1: Sales Road

Station Code: D-1
Station Name: Sales Road
Date: 04/23/2013 (TUESDAY)
Weather: Fine
Direction: Sales Road (At-grade) - EB

Time	Sales Road (At-grade) - EB											
	Vehicle Type 1			Vehicle Type 2			Vehicle Type 3			Vehicle Type 4		
	No. of Vehicles	No. of Passengers	Average Occupancy	No. of Vehicles	No. of Passengers	Average Occupancy	No. of Vehicles	No. of Passengers	Average Occupancy	No. of Vehicles	No. of Passengers	Average Occupancy
0600-0700	170	293	1.7	148	353	2.4	19	112	5.9	7	174	24.9
0700-0800	204	349	1.7	175	446	2.5	24	134	5.6	3	122	40.7
0800-0900	162	289	1.8	108	264	2.4	7	25	3.6	1	45	45.0
0900-1000	143	244	1.7	119	224	1.9	0	0	0.0	0	0	0.0
1000-1100	224	379	1.7	152	360	2.4	12	77	6.4	3	122	40.7
1100-1200	154	258	1.7	119	286	2.4	15	82	5.5	1	2	2.0
1200-1300	216	393	1.8	150	369	2.5	17	93	5.5	5	189	37.8
1300-1400	244	426	1.7	169	409	2.4	24	113	4.7	0	0	0.0
1400-1500	155	277	1.8	115	321	2.8	26	149	5.7	0	0	0.0
1500-1600	157	289	1.8	92	275	3.0	32	245	7.7	1	1	1.0
1600-1700	247	411	1.7	154	512	3.3	17	133	7.8	1	2	2.0
1700-1800	233	425	1.8	138	367	2.7	15	120	8.0	1	60	60.0
Total	2,309	4,033	1.7	1,639	4,186	2.6	208	1,283	6.2	23	717	31.2

Vehicle Type: 1 - Private Car/SUV/Pick-Up/ Jeep (Owner Type)/Taxi, 2 - Private or Public Van, 3 - Jeepney, 4 - All Buses, and 5 - All Trucks

Time	**Sales Road (At-grade) - EASTBOUND**			
	% Vehicle Sampled			
	Type 1	Type 2	Type 3	Type 4
0600-0700	28%	46%	41%	70%
0700-0800	40%	36%	43%	75%
0800-0900	45%	21%	18%	50%
0900-1000	56%	24%	0%	0%
1000-1100	34%	38%	18%	60%
1100-1200	25%	21%	37%	100%
1200-1300	29%	70%	23%	83%
1300-1400	32%	42%	69%	0%
1400-1500	18%	47%	74%	0%
1500-1600	16%	23%	74%	100%
1600-1700	25%	46%	43%	100%
1700-1800	20%	38%	31%	50%
Total	27%	35%	38%	64%

Table 3.2-9: Vehicle Occupancy Count: Station S-1: Skyway Arnaiz Entry/Exit Ramps

Station Code: S-1
Station Name: Skyway Arnaiz Entry/Exit Ramps
Date: 04/25/2013 (THURSDAY)
Weather: Fine
Direction: Skyway (Off-Ramp) - NORTHBOUND

Time	Skyway (Off-Ramp) - NORTHBOUND											
	Vehicle Type 1			Vehicle Type 2			Vehicle Type 3			Vehicle Type 4		
	No. of Vehicles	No. of Passengers	Average Occupancy	No. of Vehicles	No. of Passengers	Average Occupancy	No. of Vehicles	No. of Passengers	Average Occupancy	No. of Vehicles	No. of Passengers	Average Occupancy
0600-0700	273	433	1.6	32	54	1.7	0	0	0.0	0	0	0.0
0700-0800	282	455	1.6	72	135	1.9	0	0	0.0	1	10	10.0
0800-0900	307	475	1.5	66	118	1.8	0	0	0.0	0	0	0.0
0900-1000	343	520	1.5	46	109	2.4	0	0	0.0	0	0	0.0
1000-1100	327	527	1.6	26	60	2.3	0	0	0.0	0	0	0.0
1100-1200	315	534	1.7	34	62	1.8	0	0	0.0	0	0	0.0
1200-1300	325	533	1.6	30	68	2.3	0	0	0.0	0	0	0.0
1300-1400	342	592	1.7	32	64	2.0	0	0	0.0	0	0	0.0
1400-1500	349	602	1.7	44	88	2.0	0	0	0.0	0	0	0.0
1500-1600	321	528	1.6	20	33	1.7	0	0	0.0	0	0	0.0
1600-1700	347	595	1.7	43	81	1.9	0	0	0.0	0	0	0.0
1700-1800	372	597	1.6	47	380	8.1	0	0	0.0	0	0	0.0
Total	3,903	6,391	1.6	492	1,252	2.5	0	0	0.0	1	10	10.0

Vehicle Type: 1 - Private Car/SUV/Pick-Up/ Jeep (Owner Type)/Taxi, 2 - Private or Public Van, 3 - Jeepney, 4 - All Buses, and 5 - All Trucks

Time	Skyway (Off-Ramp) - NORTHBOUND			
	% Vehicle Sampled			
	Type 1	Type 2	Type 3	Type 4
0600-0700	100%	100%	0%	0%
0700-0800	99%	100%	0%	50%
0800-0900	99%	100%	0%	0%
0900-1000	99%	100%	0%	0%
1000-1100	99%	100%	0%	0%
1100-1200	99%	100%	0%	0%
1200-1300	90%	100%	0%	0%
1300-1400	92%	82%	0%	0%
1400-1500	93%	98%	0%	0%
1500-1600	58%	44%	0%	0%
1600-1700	64%	57%	0%	0%
1700-1800	40%	39%	0%	0%
Total	78%	78%	0%	25%

Table 3.2-10: Vehicle Occupancy Count: Station S-2: Skyway Sales Road Entry/Exit Ramps

Station Code: S-2
Station Name: Skyway Sales Road Entry/Exit Ramps
Date: 04/25/2013 (THURSDAY)
Weather: Fine
Direction: Skyway (On-Ramp) - EASTBOUND

Time	Skyway (On-Ramp) - EASTBOUND											
	Vehicle Type 1			Vehicle Type 2			Vehicle Type 3			Vehicle Type 4		
	No. of Vehicles	No. of Passengers	Average Occupancy	No. of Vehicles	No. of Passengers	Average Occupancy	No. of Vehicles	No. of Passengers	Average Occupancy	No. of Vehicles	No. of Passengers	Average Occupancy
0600-0700	301	504	1.7	137	402	2.9	0	0	0.0	1	1	1.0
0700-0800	372	671	1.8	237	849	3.6	0	0	0.0	1	1	1.0
0800-0900	372	695	1.9	224	668	3.0	1	1	1.0	0	0	0.0
0900-1000	372	721	1.9	225	472	2.1	0	0	0.0	0	0	0.0
1000-1100	372	706	1.9	263	657	2.5	0	0	0.0	0	0	0.0
1100-1200	372	749	2.0	189	485	2.6	0	0	0.0	1	2	2.0
1200-1300	372	716	1.9	129	367	2.8	0	0	0.0	0	0	0.0
1300-1400	372	754	2.0	171	364	2.1	0	0	0.0	0	0	0.0
1400-1500	193	387	2.0	124	263	2.1	0	0	0.0	0	0	0.0
1500-1600	224	471	2.1	148	321	2.2	0	0	0.0	0	0	0.0
1600-1700	243	607	2.5	178	426	2.4	0	0	0.0	1	30	30.0
1700-1800	372	825	2.2	252	589	2.3	0	0	0.0	3	140	46.7
Total	3,937	7,806	2.0	2,277	5,863	2.6	1	1	1.0	7	174	24.9

Vehicle Type: 1 - Private Car/SUV/Pick-Up/ Jeep (Owner Type)/Taxi, 2 - Private or Public Van, 3 - Jeepney, 4 - All Buses, and 5 - All Trucks

Time	Skyway (On-Ramp) - EASTBOUND			
	% Vehicle Sampled			
	Type 1	Type 2	Type 3	Type 4
0600-0700	98%	44%	0%	50%
0700-0800	50%	54%	0%	50%
0800-0900	49%	55%	100%	0%
0900-1000	62%	58%	0%	0%
1000-1100	74%	78%	0%	0%
1100-1200	78%	57%	0%	50%
1200-1300	85%	41%	0%	0%
1300-1400	95%	54%	0%	0%
1400-1500	61%	36%	0%	0%
1500-1600	54%	41%	0%	0%
1600-1700	59%	48%	0%	100%
1700-1800	65%	45%	0%	75%
Total	66%	51%	25%	50%

Table 3.2-11: Vehicle Occupancy Count: Station S-4: Skyway Bicutan Entry/Exit Ramps

Station Code: S-4
Station Name: Skyway Bicutan Entry/Exit Ramps
Date: 04/25/2013 (THURSDAY)
Weather: Fine
Direction: Skyway (On-Ramp) - NORTHBOUND

Time	Skyway (On-Ramp) - NORTHBOUND											
	Vehicle Type 1			Vehicle Type 2			Vehicle Type 3			Vehicle Type 4		
	No. of Vehicles	No. of Passengers	Average Occupancy	No. of Vehicles	No. of Passengers	Average Occupancy	No. of Vehicles	No. of Passengers	Average Occupancy	No. of Vehicles	No. of Passengers	Average Occupancy
0600-0700	269	389	1.4	44	523	11.9	21	465	22.1	6	20	3.3
0700-0800	372	511	1.4	94	1,359	14.5	39	876	22.5	3	75	25.0
0800-0900	372	512	1.4	74	1,169	15.8	46	1,100	23.9	2	60	30.0
0900-1000	331	455	1.4	49	744	15.2	20	474	23.7	2	2	1.0
1000-1100	213	310	1.5	30	475	15.8	13	317	24.4	2	2	1.0
1100-1200	177	264	1.5	22	281	12.8	9	223	24.8	0	0	0.0
1200-1300	139	200	1.4	13	181	13.9	26	646	24.8	1	1	1.0
1300-1400	93	151	1.6	24	383	16.0	12	308	25.7	1	60	60.0
1400-1500	91	143	1.6	27	394	14.6	12	308	25.7	2	2	1.0
1500-1600	84	129	1.5	21	290	13.8	7	185	26.4	0	0	0.0
1600-1700	90	157	1.7	27	357	13.2	9	233	25.9	0	0	0.0
1700-1800	86	131	1.5	28	431	15.4	15	385	25.7	0	0	0.0
Total	2,317	3,352	1.4	453	6,587	14.5	229	5,520	24.1	19	222	11.7

Vehicle Type: 1 - Private Car/SUV/Pick-Up/ Jeep (Owner Type)/Taxi, 2 - Private or Public Van, 3 - Jeepney, 4 - All Buses, and 5 - All Trucks

Time	Skyway (On-Ramp) - NORTHBOUND			
	% Vehicle Sampled			
	Type 1	Type 2	Type 3	Type 4
0600-0700	98%	100%	100%	100%
0700-0800	62%	97%	100%	100%
0800-0900	55%	94%	94%	67%
0900-1000	99%	96%	100%	40%
1000-1100	97%	97%	100%	100%
1100-1200	98%	100%	100%	0%
1200-1300	99%	65%	90%	100%
1300-1400	93%	100%	100%	100%
1400-1500	95%	100%	100%	100%
1500-1600	90%	100%	100%	0%
1600-1700	100%	100%	100%	0%
1700-1800	95%	100%	100%	0%
Total	80%	96%	97%	83%

Table 3.2-12: Vehicle Occupancy Count: Station S-5: Skyway Sucat Entry/Exit Ramps

Station Code: S-5
Station Name: Skyway Sucat Entry/Exit Ramps
Date: 04/25/2013 (Thursday)
Weather: Fine
Direction: Skyway (On-Ramp) – NORTHBOUND

Time	Skyway (On-Ramp) - NORTHBOUND											
	Vehicle Type 1			Vehicle Type 2			Vehicle Type 3			Vehicle Type 4		
	No. of Vehicles	No. of Passengers	Average Occupancy	No. of Vehicles	No. of Passengers	Average Occupancy	No. of Vehicles	No. of Passengers	Average Occupancy	No. of Vehicles	No. of Passengers	Average Occupancy
0600-0700	239	438	1.8	24	344	14.3	2	22	11.0	0	0	0.0
0700-0800	323	563	1.7	80	1,210	15.1	6	138	23.0	0	0	0.0
0800-0900	310	585	1.9	39	409	10.5	3	67	22.3	0	0	0.0
0900-1000	284	522	1.8	27	350	13.0	3	68	22.7	0	0	0.0
1000-1100	241	462	1.9	34	271	8.0	3	58	19.3	0	0	0.0
1100-1200	129	250	1.9	27	258	9.6	1	25	25.0	0	0	0.0
1200-1300	132	236	1.8	12	67	5.6	0	0	0.0	0	0	0.0
1300-1400	130	252	1.9	10	41	4.1	0	0	0.0	0	0	0.0
1400-1500	138	275	2.0	27	233	8.6	0	0	0.0	0	0	0.0
1500-1600	137	284	2.1	22	137	6.2	0	0	0.0	0	0	0.0
1600-1700	188	386	2.1	23	228	9.9	0	0	0.0	0	0	0.0
1700-1800	161	359	2.2	18	176	9.8	0	0	0.0	0	0	0.0
Total	2,412	4,612	1.9	343	3,724	10.9	18	378	21.0	0	0	0.0

Vehicle Type: 1 - Private Car/SUV/Pick-Up/ Jeep (Owner Type)/Taxi, 2 - Private or Public Van, 3 - Jeepney, 4 - All Buses, and 5 - All Trucks

Time	Skyway (On-Ramp) - NORTHBOUND			
	% Vehicle Sampled			
	Type 1	Type 2	Type 3	Type 4
0600-0700	84%	89%	67%	0%
0700-0800	38%	85%	100%	0%
0800-0900	52%	98%	100%	0%
0900-1000	67%	79%	100%	0%
1000-1100	68%	85%	100%	0%
1100-1200	56%	68%	100%	0%
1200-1300	68%	60%	0%	0%
1300-1400	73%	71%	0%	0%
1400-1500	59%	75%	0%	0%
1500-1600	73%	96%	0%	0%
1600-1700	90%	77%	0%	0%
1700-1800	88%	82%	0%	0%
Total	61%	82%	90%	0%

Table 3.2-13: Vehicle Occupancy Count: Station S-6: Skyway - Hillsborough Entry/Exit Ramps

Station Code: S-6
Station Name: Skyway Hillsborough Entry/Exit Ramps
Date: 04/25/2013 (THURSDAY)
Weather: Fine
Direction: Skyway (On-Ramp) - NORTHBOUND

Time	Skyway (On-Ramp) - NORTHBOUND											
	Vehicle Type 1			Vehicle Type 2			Vehicle Type 3			Vehicle Type 4		
	No. of Vehicles	No. of Passengers	Average Occupancy	No. of Vehicles	No. of Passengers	Average Occupancy	No. of Vehicles	No. of Passengers	Average Occupancy	No. of Vehicles	No. of Passengers	Average Occupancy
0600-0700	322	397	1.2	53	131	2.5	12	272	22.7	123	6,330	51.5
0700-0800	372	491	1.3	104	341	3.3	20	458	22.9	168	9,630	57.3
0800-0900	372	538	1.4	94	514	5.5	15	345	23.0	114	6,009	52.7
0900-1000	372	554	1.5	95	342	3.6	12	276	23.0	83	4,008	48.3
1000-1100	348	583	1.7	83	166	2.0	8	184	23.0	60	3,030	50.5
1100-1200	277	461	1.7	48	105	2.2	9	207	23.0	57	2,567	45.0
1200-1300	238	353	1.5	41	94	2.3	6	138	23.0	40	2,027	50.7
1300-1400	372	449	1.2	79	161	2.0	9	207	23.0	68	3,324	48.9
1400-1500	314	434	1.4	72	149	2.1	6	117	19.5	55	2,578	46.9
1500-1600	265	407	1.5	92	175	1.9	14	295	21.1	57	2,580	45.3
1600-1700	288	355	1.2	63	137	2.2	6	138	23.0	64	3,156	49.3
1700-1800	346	437	1.3	76	180	2.4	8	184	23.0	54	3,115	57.7
Total	3,886	5,459	1.4	900	2,495	2.8	125	2,821	22.6	943	48,354	51.3

Vehicle Type: 1 - Private Car/SUV/Pick-Up/ Jeep (Owner Type)/Taxi, 2 - Private or Public Van, 3 - Jeepney, 4 - All Buses, and 5 - All Trucks

Time	Skyway (On-Ramp) - NORTHBOUND			
	% Vehicle Sampled			
	Type 1	Type 2	Type 3	Type 4
0600-0700	98%	83%	75%	77%
0700-0800	56%	79%	87%	94%
0800-0900	61%	78%	88%	98%
0900-1000	80%	79%	75%	86%
1000-1100	83%	81%	89%	74%
1100-1200	84%	77%	90%	86%
1200-1300	81%	79%	86%	66%
1300-1400	78%	76%	90%	73%
1400-1500	73%	83%	86%	93%
1500-1600	64%	90%	93%	86%
1600-1700	75%	84%	86%	79%
1700-1800	86%	88%	80%	78%
Total	74%	81%	85%	84%

Table 3.2-14: Vehicle Occupancy Count: Station S-7: Skyway-Alabang Entry/Exit Ramps

Station Code: S-7
Station Name: Skyway Alabang Entry/Exit Ramps
Date: 04/25/2013 (THURSDAY)
Weather: Fine
Direction: Skyway (On-Ramp) - NORTHBOUND

Time	Skyway (On-Ramp) - NORTHBOUND											
	Vehicle Type 1			Vehicle Type 2			Vehicle Type 3			Vehicle Type 4		
	No. of Vehicles	No. of Passengers	Average Occupancy	No. of Vehicles	No. of Passengers	Average Occupancy	No. of Vehicles	No. of Passengers	Average Occupancy	No. of Vehicles	No. of Passengers	Average Occupancy
0600-0700	99	156	1.6	117	555	4.7	0	0	0.0	0	0	0.0
0700-0800	153	216	1.4	150	1,064	7.1	1	10	10.0	0	0	0.0
0800-0900	242	332	1.4	127	690	5.4	0	0	0.0	0	0	0.0
0900-1000	163	211	1.3	97	276	2.8	0	0	0.0	0	0	0.0
1000-1100	101	145	1.4	93	239	2.6	0	0	0.0	0	0	0.0
1100-1200	64	88	1.4	80	216	2.7	0	0	0.0	1	1	1.0
1200-1300	67	108	1.6	78	242	3.1	0	0	0.0	1	15	15.0
1300-1400	102	145	1.4	80	252	3.2	0	0	0.0	0	0	0.0
1400-1500	72	103	1.4	68	158	2.3	0	0	0.0	0	0	0.0
1500-1600	128	206	1.6	43	97	2.3	0	0	0.0	0	0	0.0
1600-1700	126	195	1.5	45	180	4.0	0	0	0.0	0	0	0.0
1700-1800	102	156	1.5	53	212	4.0	0	0	0.0	0	0	0.0
Total	1,419	2,061	1.5	1,031	4,181	4.1	1	10	10.0	2	16	8.0

Vehicle Type: 1 - Private Car/SUV/Pick-Up/ Jeep (Owner Type)/Taxi, 2 - Private or Public Van, 3 - Jeepney, 4 - All Buses, and 5 - All Trucks

Time	Skyway (On-Ramp) - NORTHBOUND			
	% Vehicle Sampled			
	Type 1	Type 2	Type 3	Type 4
0600-0700	59%	59%	0%	0%
0700-0800	49%	52%	100%	0%
0800-0900	88%	64%	0%	0%
0900-1000	89%	55%	0%	0%
1000-1100	57%	70%	0%	0%
1100-1200	60%	58%	0%	100%
1200-1300	47%	49%	0%	100%
1300-1400	28%	48%	0%	0%
1400-1500	34%	58%	0%	0%
1500-1600	71%	52%	0%	0%
1600-1700	77%	48%	0%	0%
1700-1800	69%	61%	0%	0%
Total	58%	56%	100%	100%

3.3 Incident during the Survey

The survey was conducted smoothly with no untoward incident occurring. Skyway O & M Corporation, the operator of South Luzon Express (SLEX) gave its support to the survey team.

付属資料 **B**： 対象地域の地質状況

1 MAGALLANES – NICHOLS

SUBSURFACE SOIL EXPLORATION
METRO MANILA SKYWAY, STAGE 1
(Sta. 5+123.300 to 7+325.000)

1.1 INTRODUCTION

This report embodies a brief factual information on the Field Boring Test and Laboratory Tests concluded along portion of the Metro Manila Skyway Project, Stage 1 from Sta. 5 + 123.300 to 7+325.000 which covers the alignment from Magallanes to Nichols along South Luzon Expressway.

This portion of the project is covered by Boreholes A-29 to A-48 as shown in the attached drawings.

1.2 GENERAL GEOLOGICAL CONDITIONS

1.2.1 Geological Setting

The Metro Manila area is bordered by the Manila Bay on the west, tidal flats extensively developed in to fishponds on the Northwest, the Central Luzon Valley on the North, the foothills of the Sierra Madre mountain range on the Northeast and the East, the Laguna de Bay on the Southeast and a narrow neck of flat land on the sound.

Metro Manila is located at the southern tip of an apron of a wide delta at the eastern shore of the Manila Bay. This delta is part of lowlands with elevations of less than 4 meter above mean sea level, which are composed of alluvial deposits originating from distributories and marine currents, and which overlay tuffacious formations originating from the Quaternary period. The tuffacious formations are exposed at an elevation of about 10 m. at the eastern part of the delta, and are locally known as Guadalupe Tuff.

1.2.2 Geological History

The Central Luzon Valley was formed during the late-Mesozoic and Cenozoic times as part of a North-South oriented eugeosyncline which was filled largely with tuffaceous and volcanic sediments, and minor chalk limestone. Orogenic action from the late-Cretaceous to the middled-Miocene resulted in the development in the east of the folded mountain range of the Sierra Madre and in the West of the folded and trusted mountains of Zambales. By the end of the Miocene epoch, the eugeosyncline had been reduced to an intermontane trough, in extent approximating the present Central Luzon Valley. With the rather rapid sedimentation of which took place during the late-Miocene, a relatively constant depositional area was maintained through gradual subsidence, occasional orogenic isostatic movement and post platform tectonic activities.

During the Quaternary and recent times, numerous eustatic changes in sea level resulted in the gradual emergence of the Central Luzon Valley and the change in depositional environment from marine to continental. The withdrawal of the sea from the Central Luzon

Valley was accomplished by uplifting associated with tectonic action. The uplifting caused the Manila Bay and Laguna de Bay, once a continuous arm of the sea, to become separated by the Land area which now comprises Pasig, Cainta and Tagaytay.

1.2.3 Geological Formation

1) Quaternary Alluvium

Quaternary alluvium, comprising sediments of gravel, sand, silt and clay.

Shells and other organic materials encountered in the boring samples confirm that these sediments were at least partly deltaic in origin and were deposited in a marine environment. These alluvial sediments are overlaying the Guadalupe Tuff Formation.

2) Guadalupe Tuff Formation

The Quaternary Guadalupe Tuff Formation originates from the Pleistocene period, and is composed of pyroclastic and sedimentary units which crop out the Project. The upper member of the Guadalupe Tuff Formation (Diliman Tuff) consists of thin to medium-bedded, fine grained vitric tuffs and welded volcanic breccias with a subordinate amount of tuffaceous, fine to medium grained sandstone and siltstone; the lower member (Alat Conglomerate) is a thick sequence of massice conglomerate, silty mudstone and tuffceous sandstone.

1.2.4 Site Geology

The General are of the existing South Expressway from Magallanes Commercial Center in Makati to Taguig is basically underlain by Tuff (“Adobe”) rocks collectively known as the Guadalupe Formation. These tuffaceous sedimentaries area essentially ancient Volcanic sand and ash ejecta deposited in a shallow marine environment during past geologic times.

According to Gervasio, the Guadalupe Formation is composed of a thick intercalation of Lithified Volcanic Ash, Lapili and Crystal Tuff generally compacted or slightly cemented by precipitated silica and (or) clay. The sedimentary beds consisting the formation display a regional dip of 5° to 10° to the West (to the direction of Manila Bay). In addition, the Tuff rocks ate characteristically highly-weathered and fractured as can be observed in the extracted rock cores. However, the preferred fracture orientation is generally horizontal correlative to the bedding planes to the Tuff beds.

The Tuff (“Adobe”) rocks are widespread and can be noted to be exposed as far North to Novaliches and South towards the Cavite area. It is typical of the Tuff rock to be overlain by variably thick layers of uncontrolled overburden fill materials composed of mixtures of sand, silt and clay with variable amounts of imported gravel and sandstones/ siltstone fragments. These shallow layers of overburden fills are then underlain by floodplain soils composed generally clay and silt exhibiting variable plasticity and consistency and sometimes grades into more stiff or dense residual or sapprolitic soils as these are in place weathering and degradation by products of the Tuff rocks.

Presence of variably thick layers of overburden fills and floodplain soils are indicated in some the Boreholes drilled along Stage 1 for the Project.

Particularly Boreholes BH-A30, 33, 34, 35 and 37, the underlying Tuff rocks within influence Boreholes are characteristically soft and friable due possibly to the poor cementation that the Tuff beds have undergone during the ancient past. Weak and fractured rock zones are also indicated by the relatively low Rock Quality Designators (RQD). The Tuff rocks are composed of intercalations of brown to grayish brown fine to coarse Tuff (Siltstone) and gray sandy Tuff (Sandstone). The presence of variable amounts of Tuff pebbles within the fine Tuff matrix impart pebbly or conglomeratic texture.

1.2.5 Groundwater

Groundwater Table (GWT) measurements 24 hours after completion of each Borehole indicate variable depths shallowest at BH-A45 to within 3.0 m depth and deepest at BH-A30 to within 20.7 m depth. These highly fluctuating depths indicate that the measures GWT levels are possibly entrapped drilling water that have yet to seep through the underlying Tuff rock. Borehole BH-A31 was dry when GWT measurement was made 24 hours after its completion.

It is important to note that some portion of the existing South Expressway from the Magallanes Commerical to Taguig is easily inundated during periods of sustained heavy rains. This should be anticipated by the Contractor and for the project and would have to prepare for this eventuality.

1.3 FIELD AND LABORATORY TEST PROCEDURES

Field Boring Test were performed by the drilling crew of the Philippines Geoanalytics, Inc. on November 25, 1995 to April 08, 1996. Four (4) complete sets of the following drilling rigs were utilized for the drilling works:

* Banseok Hydraulic Rotary Drilling Rig and Accessories
* Tone Tas Hydraulic Rotary Drilling Rig and Accessories
* Acker Hydraulic Rotary Drilling Rig and Accessories
* Explorer Mechanical Rotary Drilling Rig and Accessories

1.3.1 Drilling Procedure

The boreholes were advanced by Wash boring and Rotary Drilling using NQ Triple core barrels to the maximum boring depths. Standard Penetration Tests were conducted at every 1.5 meter interval or oftener with change in formation of Consistency/ Density. When necessary more particularly within shallow soil layers, NW standpipe casing was used to prevent collapse of the Borehole walls. Standard Penetration Tests were also performed within the underlying Tuff rock when Nil RQD values are being obtained. This is to check soil stiffness.

The Standard Penetration Tests consists of driving a Standard Split Spoon Sampler of 5.08 cm (“2 O.D.) diameter in three successive 15 cm. (6”) intervals using a drop hammer of 64 kg (140 lbs.) weight from a height of 76 cm (30”). The number of blows to penetrate 15 cm. are recorded successively until the seating interval is penetrated. The first interval blow counts from the second and third intervals are added to give what is known as the N-value which is measure of the density or consistency of the underlying soils. In order to eliminate operator error and enable repeatability of results, a free fall automatic hammer of the “PILCON” type was used for this project. Undisturbed samples were taken in soft to stiff soil deposits for strength testing and determination of consolidation characteristics. Coring

using NQ Triple Core Barrels was resorted to in order to penetrate the underlying Tuff ("Adobe") rock.

1.3.2 Laboratory Test Procedure

Laboratory Tests on extracted Borehole samples are in accordance with the Standards of the American Society for Testing and Materials (ASTM). The Borehole samples were tested with the tests schedules provided by the Client Representative.

The following laboratory tests and their brief description were carried out on soil samples obtained from the site:

1) Classification of Soils for Engineering Purposes
(United Soil Classification System)
ASTM D 2487 – 93

This Standard describes as system for classifying mineral and organo-mineral soils for engineering purposed based on laboratory determination of particle size characteristics, liquid limit and plasticity index.

2) Particle Size Analysis of Soils
ASTM D 422 – 63
Soil was passed through a series of sieves, the weight of soil retained on each sieve determined and recorded. For each sample analyzed, a gradation curve was drawn based on the percent finder by weight.

3) Liquid Limit of Soils
ASTM D 4318-95
Is the water content expressed a percentage of the weight of the oven-dried soil, at the boundary between the liquid and plastic states.

4) Plastic Limit and Plasticity of Soils
ASTM D 4318-95
The plastic limit of a soil is the water content, expressed as a percentage of the mass of the over-dried soil, at the boundary between the plastic and semi-solid states.

5) Laboratory Determination of Moisture Content of Soils
ASTM D 2216 – 92
This test method covers the laboratory determination of the water (moisture) content of soil, rock and similar materials by mass. The water contact of material is defined as the ration expressed as a percentage of the weight of water in a given mass of soil to the weight of the solid particles.

6) Unconfined Compressive Strength of Intact Rock Cores
ASTM D 2938 – 95
This method covers the determination of the Uniaxial Comprehensive strength of intact rocks cores by a strain controlled application of load.

7) Specific Gravity of Soils
ASTM D 854 – 92
This test used to determine the specific gravity of soils.

1.4 RESULTS AND OBSERAVTIONS

1.4.1 Phase 1-A (Sta. 5+123.300 – 6+088.000)

The completed Boreholes along Sta. 5+123.300 to 6+088.000 are widely spaced from 50.0 to 160 meters. As such, it is highly possible that subsurface soil conditions particularly the depths to bedrock between Boreholes may vary from those detected within influence Boreholes completed.

Thus, the results of the Field Boring and Laboratory tests performed on extracted Boreholes depict subsurface conditions specifically within each Borehole location.

The depths indicated herein were reckoned from the Borehole collars at existing ground line at time of borings.

The completed Boreholes reveal variable depths to the underlying Tuff ("Adobe") rock as indicated in the summary below;

INFLUENCE BOREHOLE	DEPTHS TO TUFF BEDROCK
BH-A29	-1.13 m
BH-A30	-6.00m
BH-A31	-1.48m
BH-A32	-1.33m
BH-A33	-7.75m
BH-A34	-4.50m
BH-A35	-3.20m
BH-A36	-1.30m
BH-A37	-9.80m

Notes:

2. *The indicated depth of Tuff bedrock also corresponds to the thickness of overburden soils Within Borehole influence area.*

3. *Depths to Tuff bedrock reckoned from Borehole Collars at existing ground line of borings.*

The shallow layers approximately 1.13m to 1.48m thick of sapprolitic soils detected in Boreholes **BH-A29, BH-A31, BH-A32 and BH-A36** are composed of slit, sandly lean clay **(CL)** and clayey silt with Tuff fragments. These possess hard consistency as indicated by Refusal **(+50 blows/ft)** N-Values. These are immediately underlain by the underlying Tuff *("Adobe")* rock.

Skyway Project – GTF at 10m Depth

BEARING LOAD (kN) for F=1

Pile Lengths (m): Diameters:

$Lnet_k$	0.6m $Q_{0,k}$	0.9m $Q_{1,k}$	1.2m $Q_{2,k}$	1.5m $Q_{3,k}$	1.8m $Q_{4,k}$	2.0m $Q_{5,k}$	2.2m $Q_{6,k}$	2.5m $Q_{7,k}$
16	4517	6602	11644	16186	21381	25207	29323	36040
18	5150	7441	12883	17718	23199	27212	31512	38499
20	5809	8313	14173	19314	25094	29302	33794	41065
22	6505	9236	15539	21005	27102	31518	36216	13788
24	7238	10207	16979	22787	29220	33857	38772	46665
26	7983	11194	18440	24597	31373	36233	41369	49587

UPLIFT LOAD (kN) for F=1

Pile Lengths (m): Diameters:

$Lnet_k$	0.6m $P_{0,k}$	0.9m $P_{1,k}$	1.2m $P_{2,k}$	1.5m $P_{3,k}$	1.8m $P_{4,k}$	2.0m $P_{5,k}$	2.2m $P_{6,k}$	2.5m $P_{7,k}$
16	3320	4475	6857	8707	10612	11912	13235	15266
18	3980	5362	8205	10409	12674	14218	15789	18197
20	4666	6282	9604	12175	14813	16610	18437	21234
22	5390	7253	11079	14035	17066	19128	21223	24428
24	6150	8073	10607	16087	10408	21768	24144	27776
26	6922	9308	14197	17967	21825	24446	27106	31170

ASSUMED DATA:

= =

Pile: B=4 Embedment

wp = 24 Pile Unit Weight

zw = 2 Water Table Depth

ww = 10 Unit weight of water

F = 1 Factor of Safety

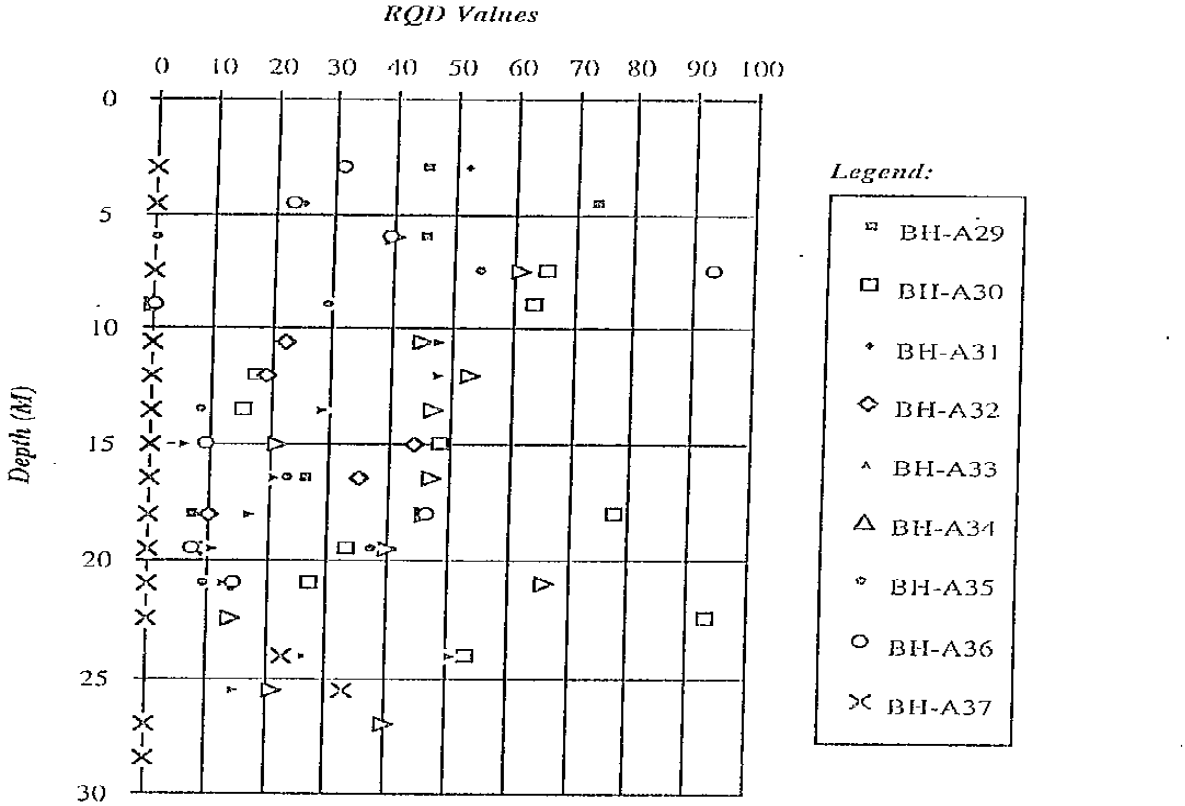
Soil Layer Data:
Col 0 – unit weight
Col 1 – effective cohesion
Col 2 – effective friction angle (Degrees)
Col 3 – k
Col 4 - factor
Col 5 - factor
Col 6 – cap on skin
Col 7 – cap on end
Col 8 –layer thickness

$$S = \begin{pmatrix} 18 & 25 & 10 & 0.8 & 0.55 & 1 & 50 & 200 & 6 \\ 19 & 75 & 26 & 0.8 & 0.55 & 1 & 100 & 2000 & 4 \\ 20 & 100 & 33 & 0.8 & 0.55 & 1 & 200 & 5000 & 34 \end{pmatrix}$$

Presence of relatively thick layers of overburden and floodplain clays *(3.20m to 7.75m thick)* are indicated in Boreholes **BH-A30, BH-A33, BH-A34, and BH-A35.** These are composed of low plasticity silts **(ML)** and highly plastic silts **(MH)** and clay **(CH)** that possess variable consistency with N-Values ranging from **Nil** (Pressed) to **43 blows/ft.** Verify soft to medium stiff clays **(CH)** with N-Values from **Nil** (Pressed) to only **9 blows/ft** were detected in **BH-A30** at – 1.50m to – 1.95m depth, in **BH-A33** at – 3.0m to -3.90m depth and in **BH-A35** at – 1.05m to – 1.50m depth.

In Borehole BH-A37, approximately 9.0m thick of medium stiff to verify stiff elastic silt **(MH)** and fat clay **(CH)** layers were detected. These possess N-Values from **8** to **26 blow/ft.** The upper 3.40m depth is underlain by very dense overburden thick overburden soils of variable consistency and degraded rock condition in this particular Borehole is possibly due to the influence effects of the nearby *Maricaban Creek.*

The results of borings indicate generally very poor to fair Tuff rocks immediately underlying the overburden soils. This is indicated by Rock Quality Designators **(RQD)** with the mean RQD of only 21%. However, it is typical of the underlying Tuff rock at site to have localized resistant layers as revealed by relatively high RQD values (71% to 100%) at some depth zones as depicted by Boreholes **BH-A29, BH-A30** and **BH-A36**. This can be observed in the plot of the Rock Quality Designators (% RQD) against depth (m) presented in the ***RQD Scatter Chart*** below:



It is also typical of the underlying Tuff rock to have highly-degraded zones as Standard Penetration Tests attempted reveal N-Values of **63 blows/ft.** to Refusal **(+50 blows/ft).** These highly degraded rock zones were detected in **BH-A29, BH-A31, BH-A32, BH-A34, BH-35** and **BH-A37**. Degraded rock character is likewise indicated by Nil RQD values.

Using Bieniawski's Geomechanics[2]] Classification the underlying Tuff rock possess a total Rock Mass Rating **(RMR)** of 43 which is within ***Class III*** or ***Fair*** Rock mass quality.

The results of some intact core samples subjected to Unconfined Compression Test indicate Rock **qu** values from **1.91** to **40.4 kg/cm^2 (0.19 to 3.96 MPa)** with a mean Rock **qu** of **19.946 kg/cm^2 (1.96 MPa)** and Standard Deviation of **13.089 kg/cm^2 (1.28 MPa).**The relatively high standard deviation indicates variabilities in strength of the underlying Tuff rock.

The average Rock Unit Weight **(γwet)** is about **1.545 gm/cc.**

In the case of the anticipated Bored Piling works for the structure foundation the mean Rock **qu** of **19.946 kg/cm^2 (1.96 MPa)** indicates relatively soft rock character that can be easily penetrated by Bored Piling tools for Rock. However, the fracture rock character and the presence of weak rock zones indicate the need for Bentonite sealing of Borehole walls to prevent collapse or Borehole casing installed.

[2]] Goodman R.E. "**Introduction to Rock Mechanics**" 2nd Ed. John Wiley & Sons NYNY 1989 pp 43 to 46

1.4.2 Phase 1-B (Sta. 6+088.00 to 7+325.500)

The results of the completed borings along this section reveal the presence of shallow overburden soil layers (1.18 to 4.95 meters thick) for most of the Boreholes except Borehole BH-A39 where overburden soil is relatively thick extending down to 14.69 meters depth.

The depths to the underlying Tuff ("Adobe") rock within influence Borehole completed is as summarized below:

INFLUENCE BOREHOLE	THICKNESS OF OVERBURDEN SOIL [1]
BH-A38	4.50m
BH-A39	14.69m
BH-A40	3.45m
BH-A41	1.18m
BH-A42	1.50m
BH-A43	1.50m
BH-A44	3.50m
BH-A45	4.95m
BH-A46	1.43m
BH-A47	1.30m
BH-A48	1.50m

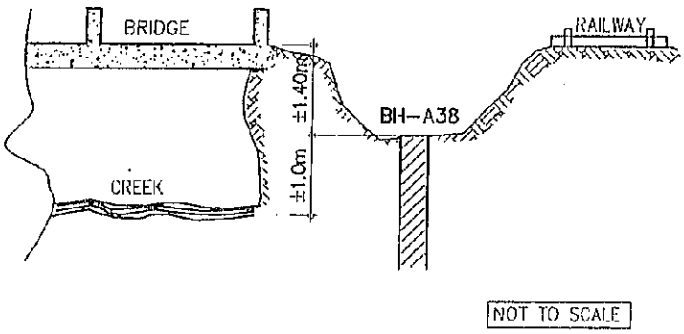
Notes:

The indicated depth of Tuff bedrock also corresponds to the thickness of overburden soils within Borehole influence area.

Depths to Tuff bedrock reckoned from Borehole Collars at existing groundline of borings.

The overburden soils are composed of shallow layers of uncontrolled Fill materials, floodplain clays and sapprolitic or residual layers derived from in-place weathering and degradation of the underlying Tuff rock.

The near surface Tuff bedrock in BH-A40, BH-A41, BH-A42, BH-A43, BH-A46, BH-A47 and BH-A48 are overlain by approximately 1.18m to 1.50m thick hard silt/silty clay and fat clay with relatively high N-values that range from 32 blows/ft to Refusal (+50 blows/ft).
In the case of Boreholes BH-A38, BH-A44 and BH-A45, the overburden soils approximately 3.45m to 4.95m thick are composed of hard sapprolitic soils in BH-A45 with Refusal (+50 blows/ft) blow counts and floodplain clays (CH/CL) and clayey sand (SC) in BH-A38 and BH-A44 that possess N-values that range from Nil to about 40 blows/ft. The soft clay (CH) layer with N-values from Nil to 4 blows/ft was detected in BH-A38 at -1.50m to -1.95m depth. It should be noted that BH-A38 was drilled approximately 1.4m below top of deck of the existing Maricaban Bridge as illustrated in the Sketch below:

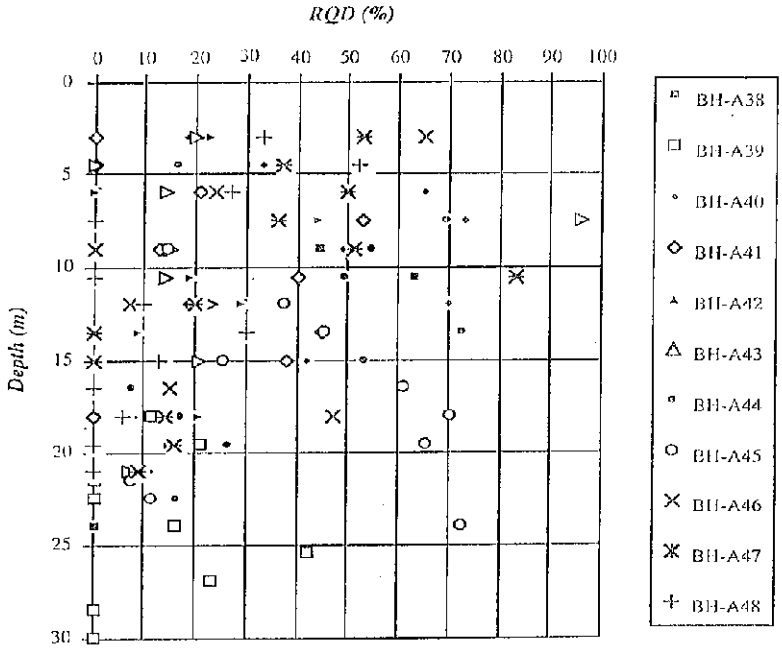


Relatively thick *(approximately 14.69m thick)* overburden soils was detected in **BH-A39** before the underlying Tuff rock was reached. The overburden soils are composed of *5.0m thick* fat clay (**CH**) that possess low N-values of only **5 blows/ft** to **9 blows/ft.** These are, in turn, underlain by stiff to hard fat clay (**CH**) lean clay (**CL**) and elastic silt (**MH**) sapprolitic soils with higher N-values that range from **12 blows/ft** to **37 blows/ft**. These overburden clays and silts are basically high plastic with Plasticity Indeces (**PI**) of 25 to 53.

The overburden soils within influence Boreholes BH-A38 to BH-A48 are immediately underlain by Tuff rock layers belonging to the so called ***Guadalupe Formation.*** The Tuff rocks are composed of intercalation of Tuffaceous Claystone, Ash Tuff, Fine to Coarse Tuff and Tuffaceous Sandstone beds exhibiting variabilities in weathering resistance and degrees of cementation.

Highly degraded rock zone where Standard Penetration Tests were performed are indicated in BH-A47 starting from -12.0m to -16.75m depth. N-values of **41 blows/ft** to Refusal (+**50 blows/ft**) were obtained indicative of soft rock character but essentially hard soil (**ML**) consistency. Nil RQD Values were obtained during coring runs within this depth zone.

Rock condition is generally very poor to fair as indicated by Rock Quality Designators (***RQD***) from Nil to 96%. The ***mean RQD*** Value was computed to be **22%**. The relatively low RQD Values reflect variably weathered and fractured rock condition. The plot of the Rock Quality Designators (RQD in %) against Depth (in meters) is presented in the RQD Scatter Chart below;



The RQD Scatter Chart shows widely dispersed plots of Rock Quality Designators (**RQD**) indicative of the highly variable rock quality. In addition, the chart also reveals the presence of localized resistant rock layers in BH-A38, BH-A40, BH-A43, BH-A44, BH-A45, BH-A46 and BH-A47 as indicated by dispersed plots within the 50% to 100% range at variable depth. This is typical of the underlying Tuff rock of the ***Guadalupe Formation.***

Using *Bieniawski's* Geomechanics classification[2], the underlying Tuff rocks for the Stage 1B of the Project possess a total Rock Mass Rating (RMR) of 47 which is within ***Class III*** or **Fair** Rock Mass Quality.

Unconfined Compression Test (UCT) performed on some intact rock cores extracted reveal ***Rock qu*** values from **2.95 kg/sq.cm *(0.29 MPa)*** to **69.2 kg/sq cm *(6.79 MPa)*** indicative of relatively soft rock character. Statical analysis of the UCT results indicate a ***mean Rock qu*** of **23.003 kg/sq.cm *(2.26 MPa)*** and standard deviation of **20.186 kg/sq.cm.** The average rock wet unit ***(γ wet)*** is ***1.69 gm/cc.*** The relatively high standard deviation of the UCT results indicates variabilities in degrees of cementation that the underlying Tuff rocks have been subjected to in the past. The soft rock character is also evidenced by the friable and relatively weak rock cores extracted.

As the case in Stage 1A for the Project, Bored Piling Works at Stage 1B would be undertaken with ease due the relatively soft Tuff Rock. The need for protecting the Borehole Walls from collapse should be anticipated as fractured and weak rock zones were detected. Installation of Borehole casings or sealing of Borehole walls by Bentonite may be undertaken for this purpose.

The final logs for Boreholes **BH-A38** to **BH-A48** comprising the Stage 1 Phase 1B of the project are included in the *Attachments for this report.* These logs embody the results of the Field Tests and Laboratory Tests on selected Borehole samples.

[2] Goodman R.E. "Introduction to Rock Mechanics", 2nd Ed. John Wiley & Sons NYNY 1989 pp. 43 to 46

2 MALOLOS – CALOOCAN

LITHOLOGIC CHARACTER OF STRATUM AND GEOLOGICAL STRUCTURE

2.1 Lithologic Character of Stratum

The stratum belongs to Quaternary System along the whole line and major genetic types are: alluvium, marine accumulation, volcanic deposit and artificial accumulation, including the abandoned railway and highway embankment.

2.2 Geologic Structure

The Philippines is one of the countries with the most active tectogenetic movement. Magnitude 7.8 earthquake occurred on Luzon Island on 16th July, 1990; Pinatubo Volcanic Eruption erupted on 14th June, 1991. Both caused disasters. The line is about 110km far away from Luzon earthquake epicenter, 60km far away from Pinatubo Volcanic crater.

The northeast border of Luzon Central Plain is the major fault of Philippines, in southeast-northwest direction, passing through Luzon Island. It is the boundary line among Luzon Central Plain, Cordillera Central and Caraballo Mountain. There are frequent seismic activities along this fault. The above-mentioned Luzon Earthquake was caused by this fault. The railway line is parallel with and far away (about 60km) from this fault. There is another developed West Marikina Valley Faults about 15 ~ 20km away (southeast) from the start point of the railway, which caused Magnitude 6~7 earthquake in 1853.

Luzon Central Plain is a large flat territory, resulting from the filling of the geosynclinals basin existing between Sierra Madre and Zambales range, since the early tertiary until now. The upper filling materials of Luzon Basin are of Quaternary age. In the studied area, recent alluvial deposits (Holocene) cover an older geological unit (Pleistocene) of volcanic-sedimentary origin, known as "Guadalupe Formation." Guadalupe Formation is horizontally deposited in the area, it is geologically very young, and though light tectonic suffering in show.

2.3 Evaluation and Treatment of Special Soil

2.3.1 Soft soil

Major lithology includes puddle soil, sludge, peat soil, gray, grayish black and black, fluid plastic~soft plastic, distributed in section of:

1) Km.81+109~Km.81+545, lithology is puddle clay and peat soil, top plate elevation: -0.4~-5.28m, bottom plate elevation: -0.4~-12.82m, maximum thickness: 7.6m, plunges to the river bed of Tullahan River.

2) Km.75+840~Km.77+236.50, lithology is puddled clay, top plate elevation: 1.64~-1.30m, bottom plate elevation: 0.21~-4.46m, partly mixed with lenticles of silt and silty clay.

3) Km.74+945~Km.75+050, lithology is puddle silty clay, distributed in the pools on the right of the existing line, thickness: 0.7~1.0m.

4) Km.72+716~Km.74+780, lithology is puddled clay, top plate elevation: 1.0~-1.73m, bottom plate elevation: 1.0~2.54m, maximum thickness: 1.9m.

5) Km.71+397~Km.71+815, lithology is puddled clay, top plate elevation: 2.4~0.5m, bottom plate elevation: 2.33~0.1m, maximum thickness: 0.8m.

6) Km.68+925~Km.70+095, lithology is puddled silty clay, top plate elevation of upper layer soft soil: 2.65~1.32m, bottom plate elevation: 2.33~-1.37m, maximum thickness: 3.6m. Under layer soft soil is in form of lenticle, only distributed in 0.5-Jd-043 hole, thickness: 2.7m.

7) Km.67+673~Km.68+650, lithology is puddle silty clay, normal thickness: 1.8m, plunges to the side with greater mileage, top and bottom plate elevation: range : 2.75~-6.55m.

8) Km.65+046~Km.66+999, among which Km.65+618 lithology is sludge, top and bottom plate elevation: -4.22~-9.52m, other sections lithology is puddled silty clay, puddled clay, top plate elevation: 2.80~-1.07m, bottom plate elevation: -1.07~-10.74m, mixed with fine sand, silt, clay layer.

9) Km.63+670~Km.64+910, main lithology is puddled silty clay, top plate elevation: -0.13~-2.84m, bottom plate elevation: -0.65~-8.32m, sludge only distributed in 05-Zd-159 hole in the section.

10) Km.59+319.50~KM.63+545.15, in the sections Km.62+565~ Km.63+545.15, Km.59+319.50~Km.60+640 and 05-Zd-171 hole is sludge, other sections are puddle silty clay, sludge top plate elevation: 0.54~-5.07m, bottom plate elevation: -5.64~-12.22m; puddled silty clay top plate elevation: 0.76~-3.96m, bottom plate elevation: -4.44~-5.66m.

11) Km.51+345.68~Km. 59+236.5, sludge continuously distributed in the section, top and bottom plate elevation: range: 1.31~-13.33m, puddled silty clay interruptedly distributed in surface layer, top and bottom plate elevation: range: 5.12~-3.99m. The maximum thickness of soil in this section: 13.3m.

The above soft soil is with large void ration, high water content and high compressibility. The engineering performance is poor and corresponding treatment shall be taken. The physical and mechanical statistic indexes are shown in Table 3.4-1, including puddled soil of alluvial layer, sludge and puddled soil of marine accumulation layer of Holocene.

2.3.2 Fills

1) Artificial soil: distributed in existing embankment, mainly contains fine round gravels and silty clay, filled when the existing railway built.

2) Miscellaneous fills: widely distributed on both sides of the abandoned railway, mainly constituted with construction rubbish and domestic garbage, especially in the section of Km.80+570~81+540. The maximum depth of garbage is 5.4m. This soil shall be treated.

2.3.3 Clay (Swelling clay)

Mainly distributed in section of Km.68+540~Km.74+650, Km.63+250~ Km.66+150, Km.60+000~Km.62+150. Main lithology is clay, with grayish yellow and grayish green stripes. The soil is fine with soapy feeling, free swelling rate is Fs=41.3~73.0%. Because of high groundwater level, low variation of water content in clay and small swelling and shrinkage deformation, it has minor impact on this project.

2.3.4 Totally Weathered Claystone

In volcanic deposit layer of upper and mid Pleistocene ($Q_{2\text{-}3}^{vl}$), the totally weathered tuff claystone layer (W_4) of Guadalupe Formation is mainly constituted with clay grain and silt grain, which will become soft when meeting water and the engineering geology is poor. During survey, sounding and drilling tests were performed at some typical points in retaining wall worksite of section Km.81+540~Km.82+050. Test results are shown in Table 3.4-2 and Table 3.4-3.

According to the above data analysis, totally weathered claystone has large void ratio, medium compressibility, and sounding tip resistance is large. The structural strength is high and basic bearing capacity reaches 200kPa. It can be bearing layer of retaining wall, culverts and civil works, as for bridge foundation, pile foundation should be adopted.

Table 3.4-1
Physical Mechanics Index of Puddle Soil of Alluvium Layer, Sludge and Puddled Soil of Marine Accumulation Layer of Holocene

Index		Natural Water Content (ω %)	Natural Density Y (kN/m^3)	Natural Void Ratio e	Liquidity limit ω_L (%)	Liquidity Index I_L	Compression Coefficient	Compression Modulus	Direct fast shear		Unconsolidated undrained shear		Organic Content Wu(%)	Unconfined compressive strength q_u (kPa)	Tip resistance of CPT q_c (MPa)
							$\delta_{0.1\text{-}0.2}$ (1/MPa)	$Es_{0.1\text{-}0.2}$ (MPa)	Internal friction angle (°)	Cohesion (kPa)	Internal friction angle (°)	Cohesion (kPa)			
Puddled soil of alluvium layer	Statistics number	41	41	41	41	41	21	21	18	18	4	4	9	5	923
	Average value	43.43	17.4	1.40	45.16	0.79	0.88	3.31	9.81	33.22	2.0	18.0	6.13	81.0	0.56
	Maximum value	84.5	18.8	2.407	70.7	1.79	2.3	8.26	16.4	76			9.8		
	Minimum value	22.1	15.5	0.897	25.3	0.45	0.26	1.25	3.1	10			4.4		
	Standard value	47.4	17.4	1.53	45.2	1.0	1.15	2.58	7.35	25.5			7.3	81.0	
Sludge of marine accumulation layer	Statistics number	205	205	205	205	205	170	170	125	125	5	5	25	19	1825
	Average value	67.3	15.73	1.95	57.0	1.43	1.68	1.93	5.46	18.82	1.5	21.0	6.07	54.26	0.62
	Maximum value	110.6	17.9	3.54	83.1	3.19	3.2	7.56	13.3	40			12.2	87.0	
	Minimum value	34.9	12.8	1.11	33.4	0.52	0.33	0.83	1.2	7			3.5	28.0	
	Standard value	69.0	15.7	1.99	57.0	1.50	1.76	1.82	4.88	17.04			6.8	47.6	
Puddled soil of marine alluvium layer	Statistics number	82	82	82	82	82	55	55	38	38	4	4	2	13	820
	Average value	47.74	16.9	1.39	46.23	1.25	0.94	2.78	13.28	31.74	1.17	11.25	4.75	72.54	0.622
	Maximum value	80.4	18.4	2.288	84.2	3.23	2.33	6.31	25.3	59				98.0	
	Minimum value	32.3	14.8	0.968	31.9	0.58	0.44	1.29	5.6	9				38.0	
	Standard value	49.5	16.9	1.435	46.2	1.34	1.06	2.56	10.4	23.87				62.9	

TABLE 3.4–2
Physical Mechanics Index of Totally Weathered Tuff Claystone of Retaining Wall

Index / Item	Natural water ratio ω (%)	National density γ kN/m^3	Natural void ratio e	Liquidity Limit ω_L %	Liquidity index I_L	Compression coefficient	Compression modulus	Direct fast shear	
						a 0.1-0.2 (1/MPa)	Es 0.1-0.2 (MPa)	Internal friction angle Φ q (°)	Cohesion Cq (kPa)
Statistics number	10	8	8	10	10	8	8	8	8
Average value	31.77	17.82	1.05	45.17	0.32	0.34	7.00	23.85	70.63
Maximum value	45.9	18.7	1.4	69.1	0.5	0.7	12.9	36.5	137.0
Minimum value	24.5	16.6	0.8	38.4	0.0	0.1	3.0	11.2	38.0
Standard value	35.3	17.8	1.167	45.2	0.40	0.45	4.92	18.6	50.1

Table 3.4–3
Table of Layer Comparison of Sounding and Drilling In Tuff Claystone Totally Weathered Layer for Retaining Wall

Drilling mileage	Depth (m)	Sounding mileage	Depth (m)	Tip resistance q_c (MPa)
Km. 82+050 left 9.0m	4.0-10.5	Km. 81 + 950 right 5m	8.0-12.0	7.43
Km. 81 + 883	6.2-10.4	Km. 81 + 890 right 9m	6.2-15.1	5.32
Km. 81 + 750	3.5-10.0	Km. 81 + 820 right 5m	5.1-8.1	4.83
Km. 81 + 545 right 5.0m	2.8-4.8	Km. 81 + 679 right 4m	2.7-9.0	3.83
		Km. 81 + 610 left 9m	3.0-7.6	4.05

2.4 Evaluation and Treatment Measures of Unfavorable Geology

This line locates in areas with high earthquake intensity and seismic liquefaction is liable to occur in surface and lower silt, silty, fine and medium sand layer. Treatment measures shall be taken correspondingly. Soft soil with poor bearing capacity is liable to quaked sinking and differential deformation to buildings, which shall be emphasized in design and construction.

2.5 Evaluation and Treatment Measures of Geologic Condition at Guiguinto River Area, Soft Soil Subgrade at Km.51+345.68 to Km.63+545.15

This section is divided into two sections by Guiguinto River. It is in North Luzon Alluvial Plan, which is flat in landform. There are plenty of buildings along the line. The surface is constituted with artificial accumulation layer of Holocene (Q_4^{ml}), the lower layer is constituted with sludge, puddled soil, clay, silty clay, silt, fine sand, medium sand, fine round gravel in alluvium deposit and marine accumulation (Q_4^{al+m}) layer of Holocene. The bottom layer is constituted with tuff claystone,

tuff silt sandstone, tuff sandstone of volcanic deposit of upper and mid Pleistocene ($Q_{2\text{-}3}^{vl}$), totally weathered~strongly weathered.

Main physical mechanical indexes (Direct fast shear) of soft soil layer are:

Sludge: γ= 15.5kN/m^3; C=14.7~16.3kPa; ϕ=3.1°~5.5°;

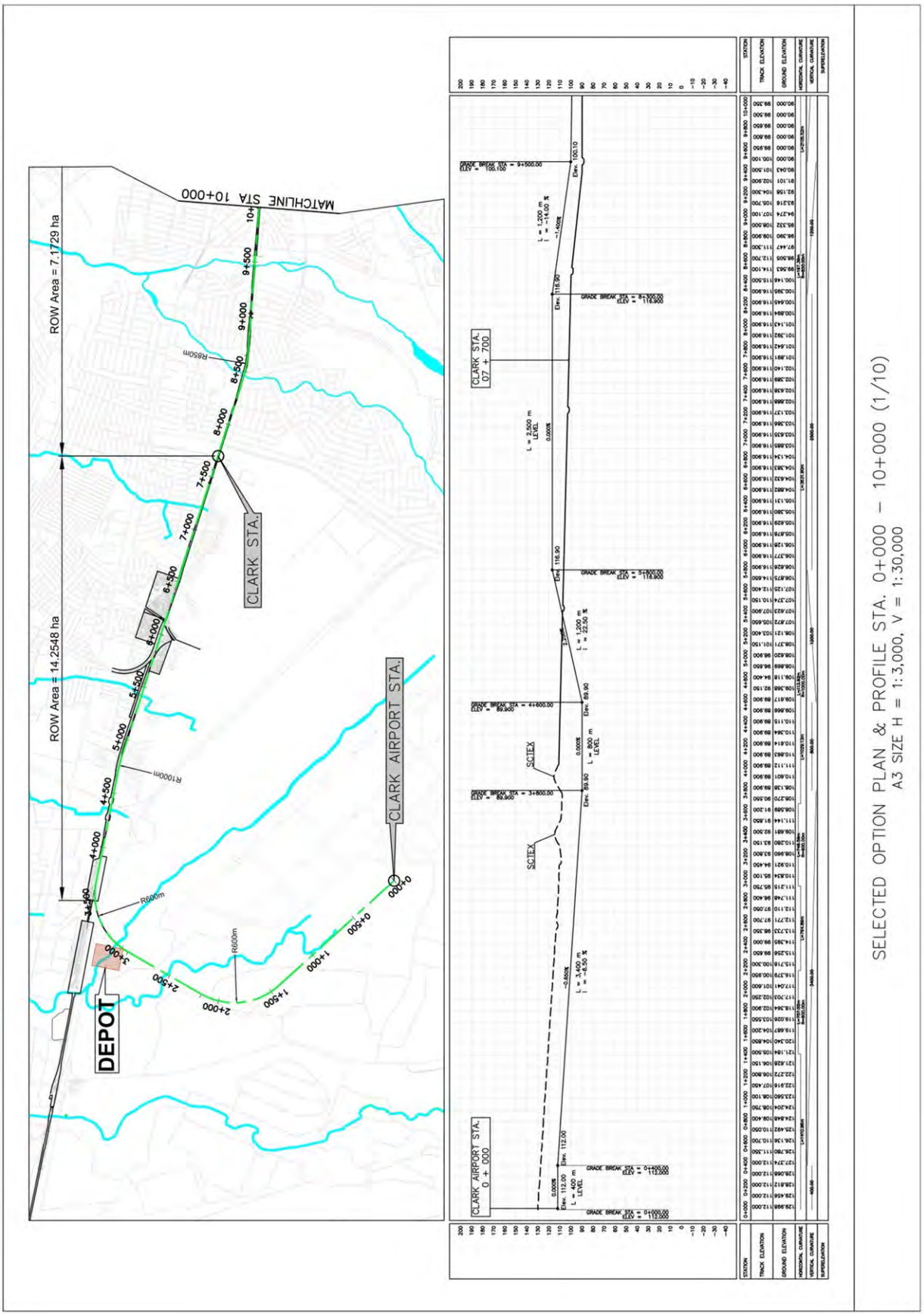
Puddled Clay: γ= 17.5kN/m^3; C=23kPa; ϕ=4.7°;

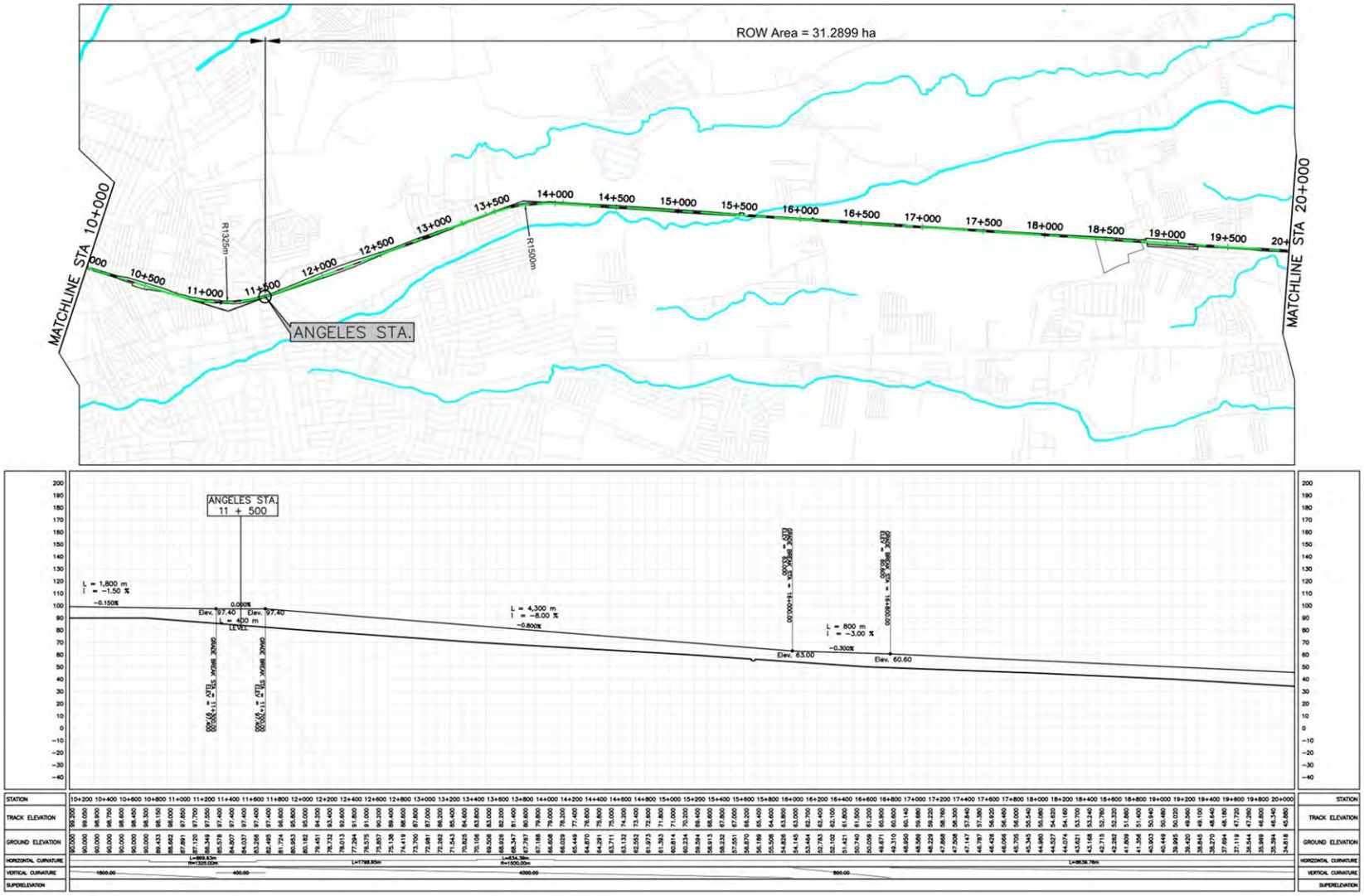
Puddled Silty Clay: γ= 15.5~17.8kN/m^3; C=17.3~41.8kPa; ϕ=5.2°~12.8°

Soft soil with poor engineering property is liable to quaked sinking and shall be treated. There is artificial soil in the site and miscellaneous soil is mainly constituted with construction rubbish and domestic garbage and need to be treated.

The seismic peak ground acceleration of this section is ≥ 0.4g (earthquake basic intensity ≥IX). Seismic liquefaction is liable to occur in surface and lower silt, silty, fine and medium sand layer. Treatment measures shall be taken correspondingly.

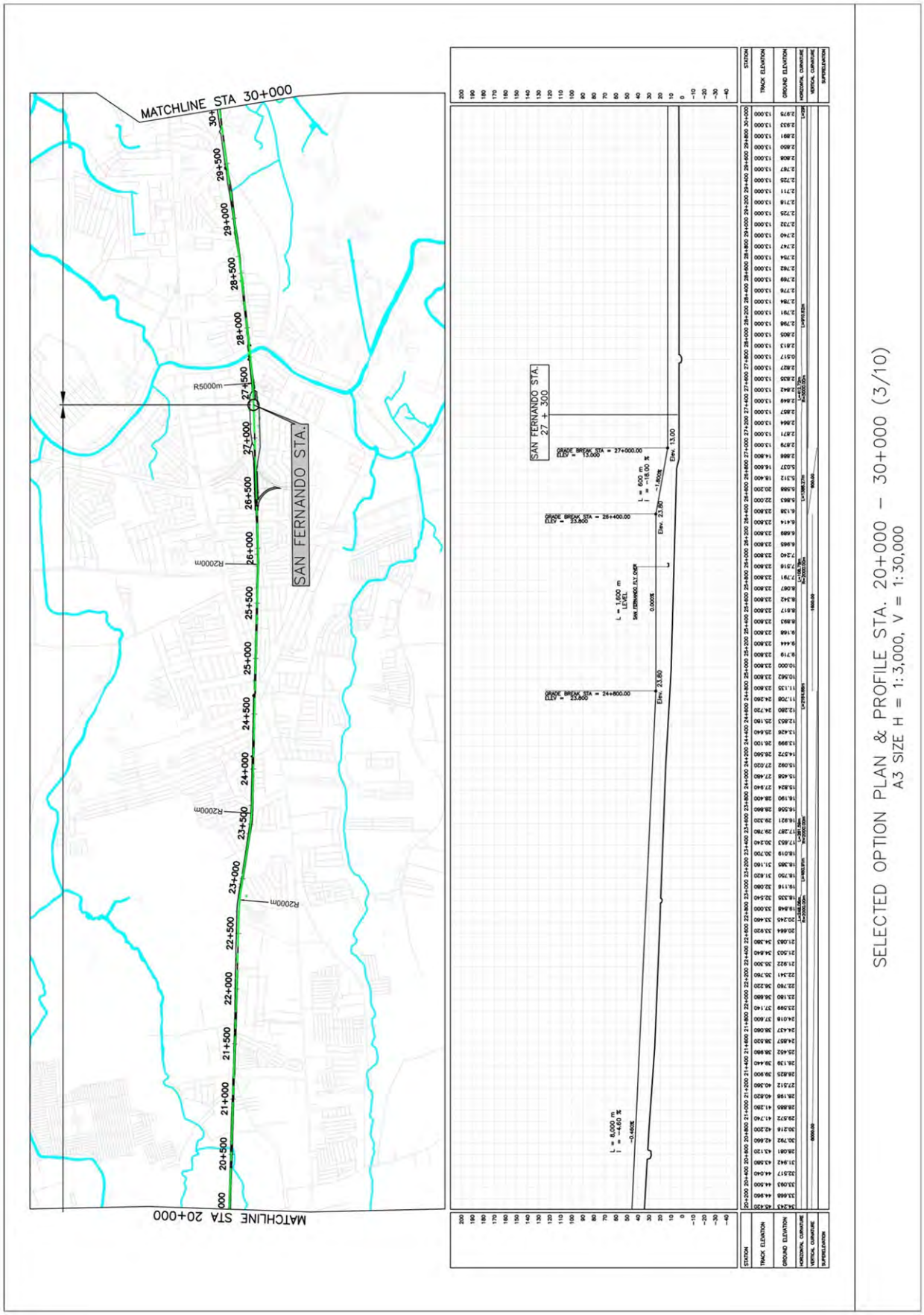
付属資料 C：　推奨路線案の平面・縦断線形





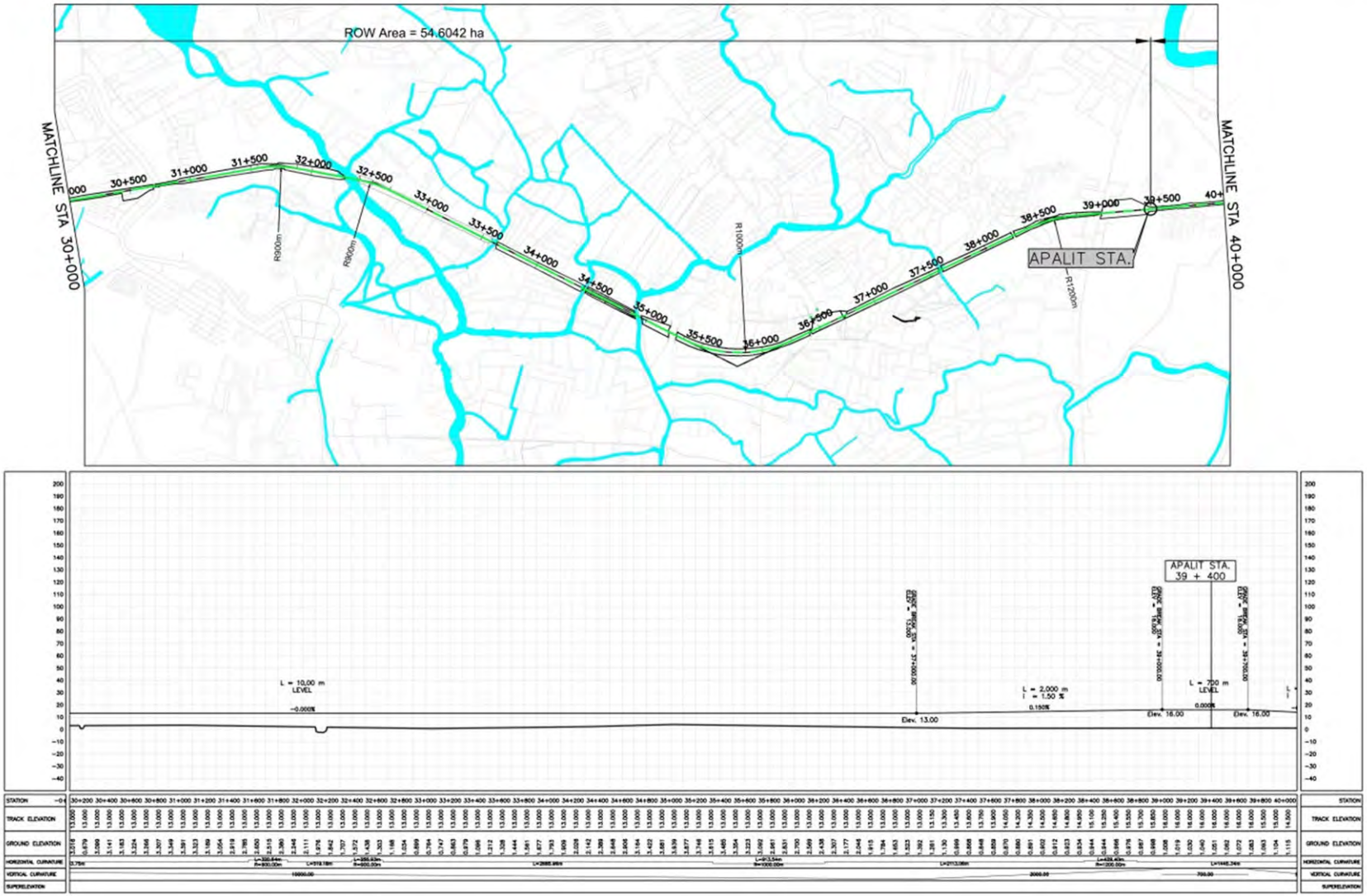
SELECTED OPTION PLAN & PROFILE STA. 10+000 – 20+000 (2/10)

A3 SIZE H = 1:3,000, V = 1:30,000



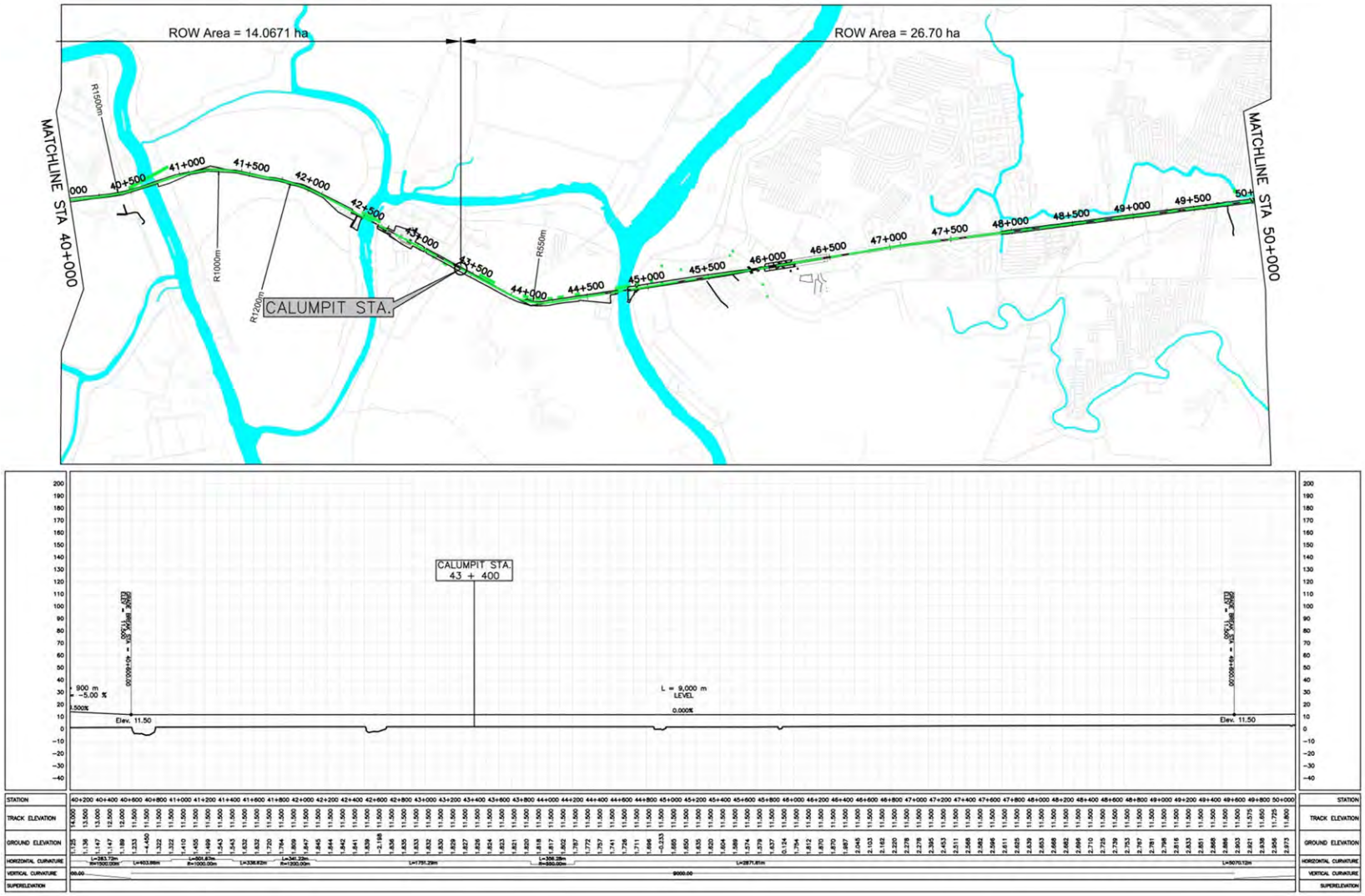
SELECTED OPTION PLAN & PROFILE STA. 20+000 – 30+000 (3/10)

A3 SIZE H = 1:3,000, V = 1:30,000



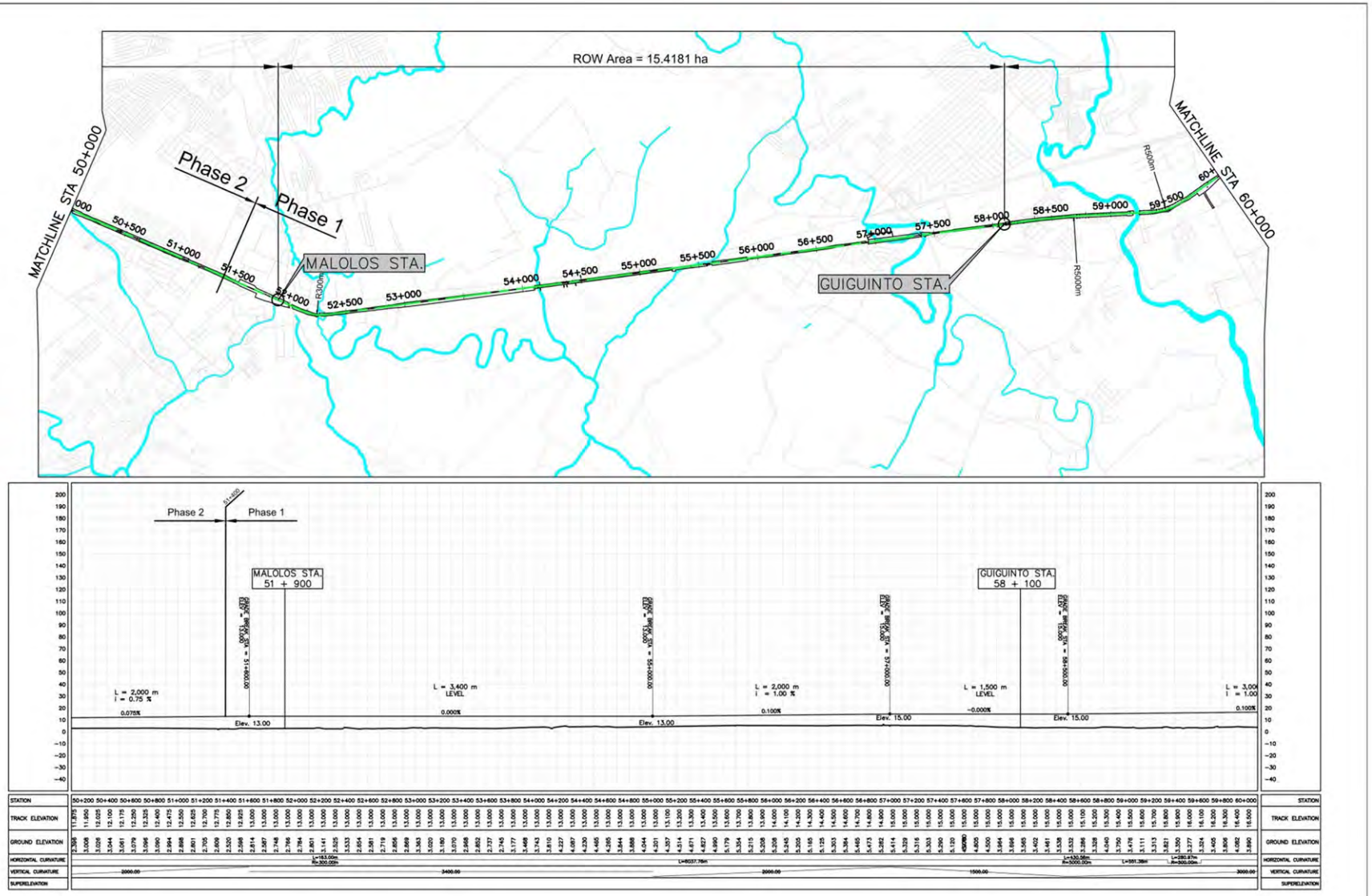
SELECTED OPTION PLAN & PROFILE STA. 30+000 – 40+000 (4/10)

A3 SIZE H = 1:3,000, V = 1:30,000

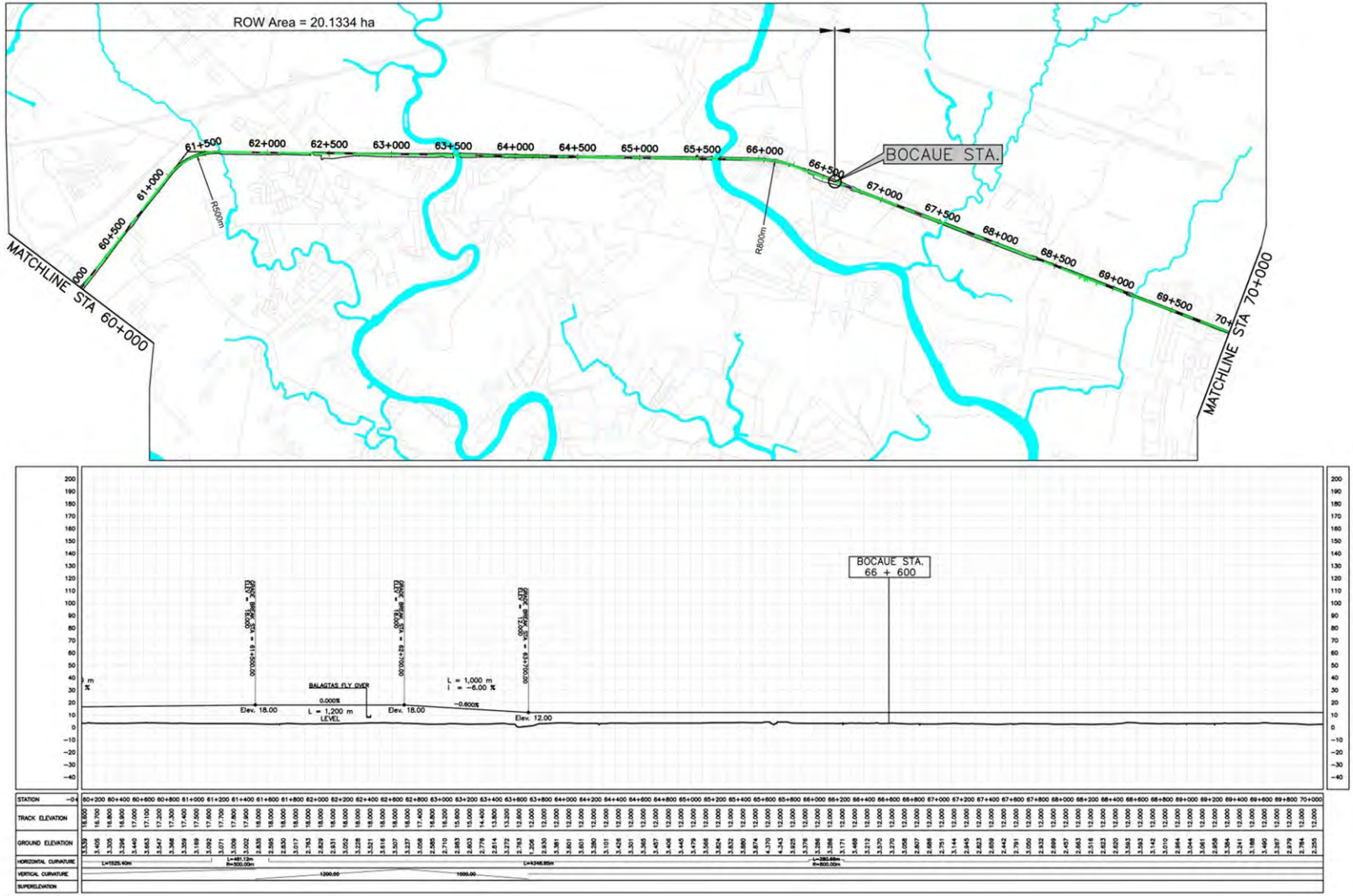


SELECTED OPTION PLAN & PROFILE STA. 40+000 – 50+000 (5/10)

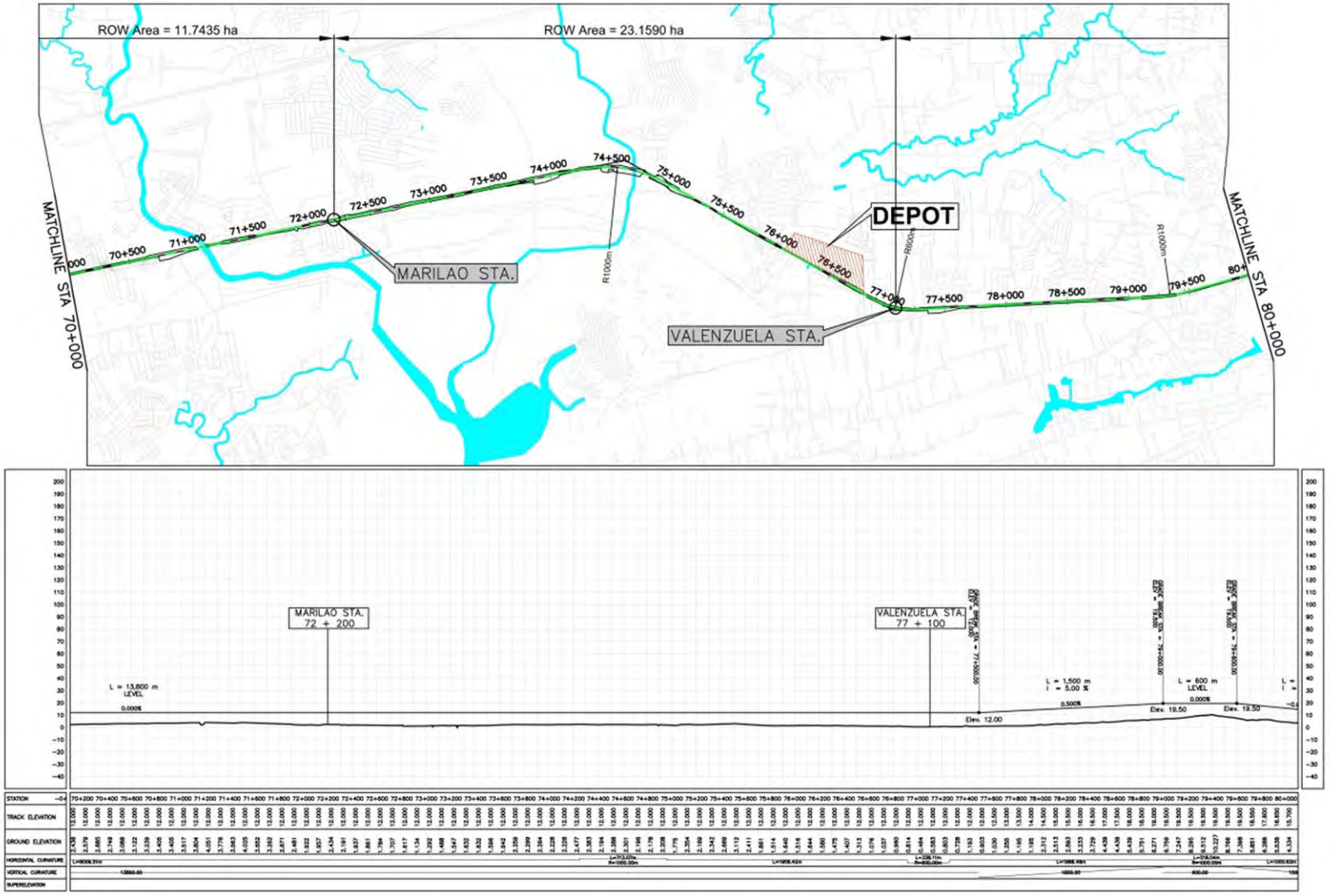
A3 SIZE H = 1:3,000, V = 1:30,000



SELECTED OPTION PLAN & PROFILE STA. 50+000 – 60+000 (6/10)
A3 SIZE H = 1:3,000, V = 1:30,000

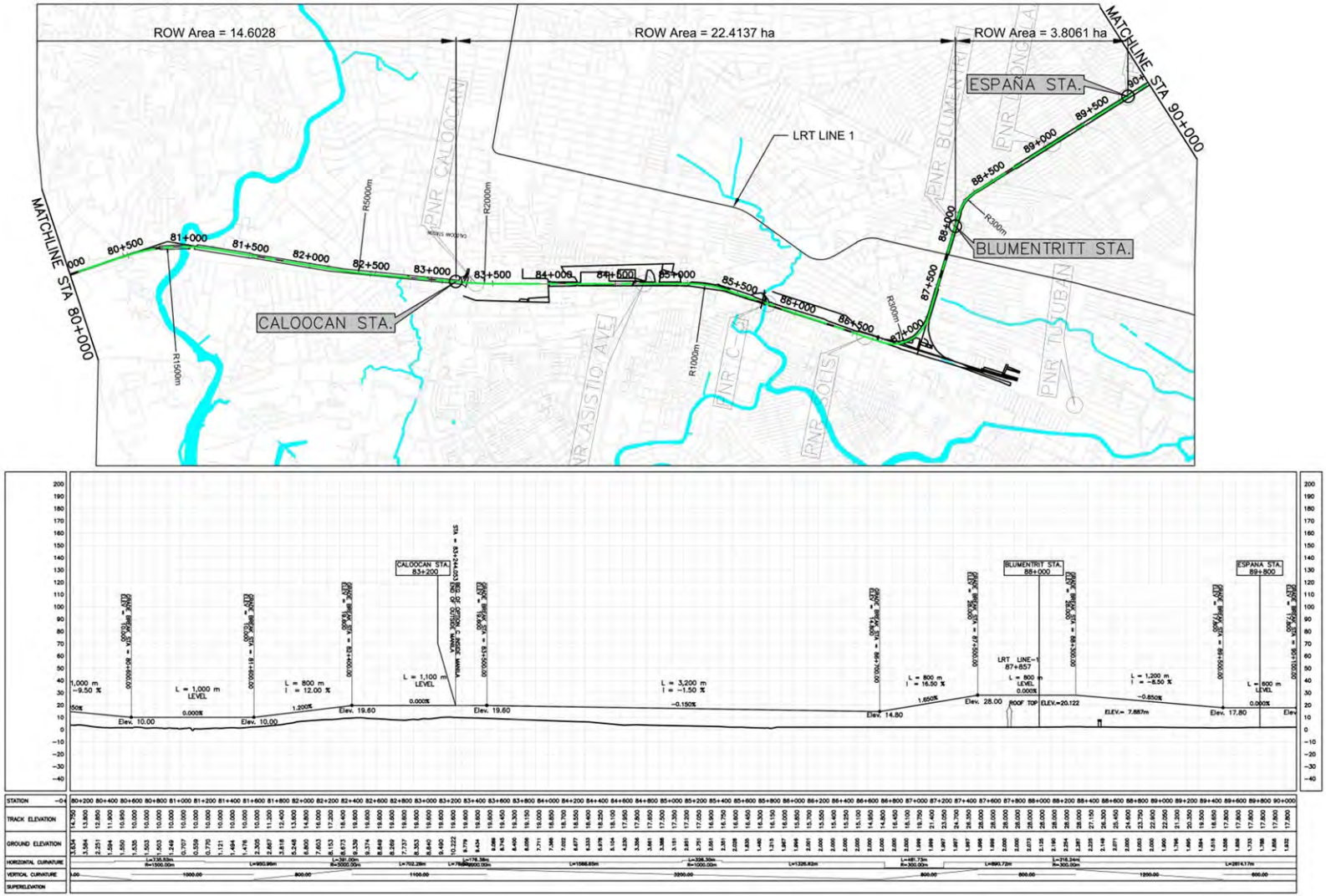


SELECTED OPTION PLAN & PROFILE STA. 60+000 – 70+000 (7/10)
A3 SIZE H = 1:3,000, V = 1:30,000



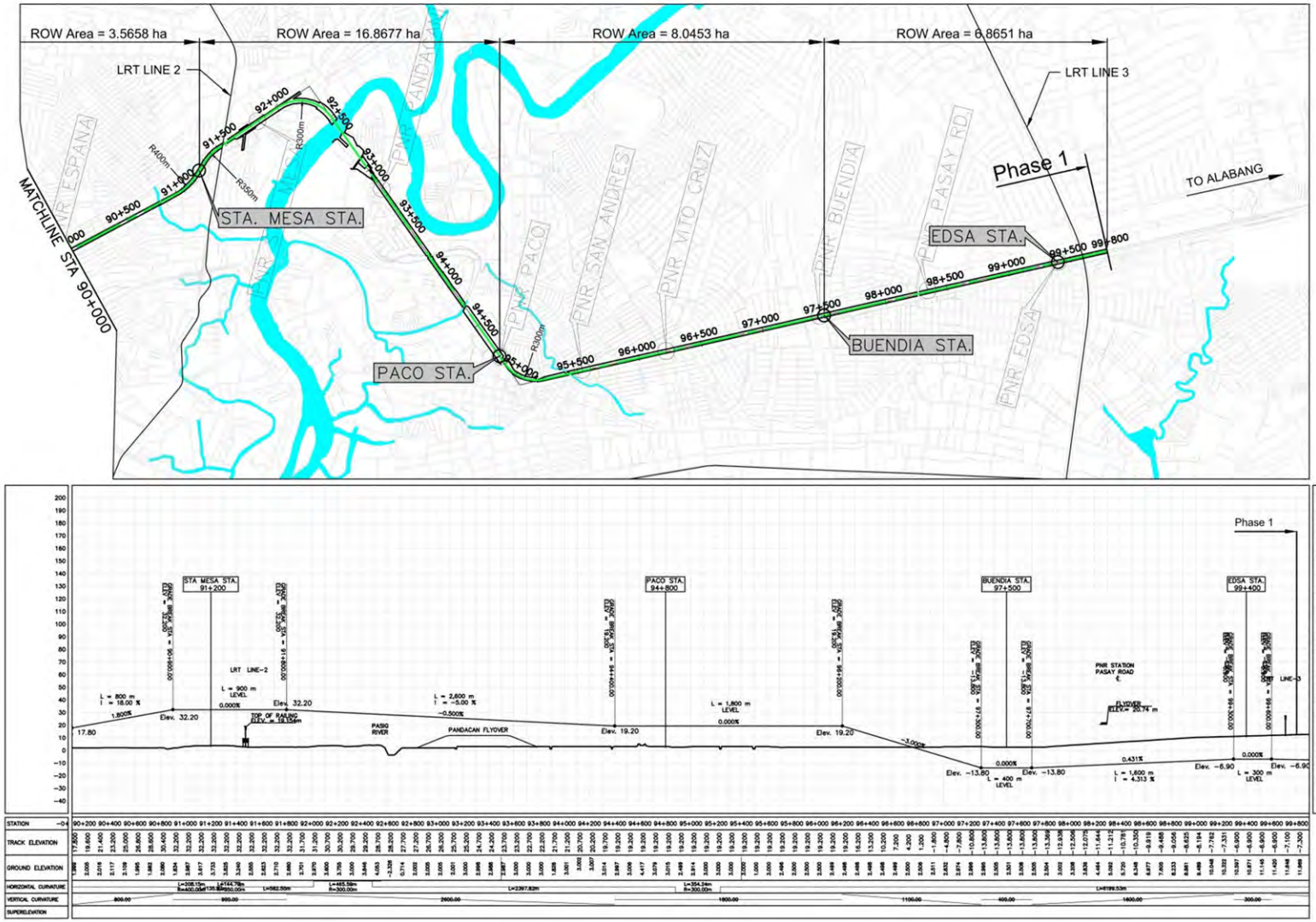
SELECTED OPTION PLAN & PROFILE STA. 70+000 – 80+000 (8/10)

A3 SIZE H = 1:3,000, V = 1:30,000



SELECTED OPTION PLAN & PROFILE STA. 80+000 – 90+000 (9/10)

A3 SIZE H = 1:3,000, V = 1:30,000



SELECTED OPTION PLAN & PROFILE STA. 90+000 – END OF PROJECT (10/10)

A3 SIZE H = 1:3,000, V = 1:30,000

付属資料 D

頁

付属資料 D-1：代替オプションのスコーピング案

Table 1 Draft Scoping for the Outside of Manila Options

No	Items	Option A (Option D)			Option B			Option C		
		Rating			Rating			Rating		
		Construction Phase	Operation Phase	Brief Description	Construction Phase	Operation Phase	Brief Description	Construction Phase	Operation Phase	Brief Description
Social Environment *Regarding the impacts on “Gender” and “Children’s Rights”, might be related to all criteria of the Social Environment.										
1	Involuntary Resettlement	A-	D	【Pre-construction】 (-)Informal settlers have occupied the PNR ROW along the Clark Airport on the north side of the SCTEX Mabiga Exit, large scale displacement will be unavoidable. (-) The connection route between PNR line and Burol I.C. requires additional land acquisition. Involuntary resettlement is unavoidable. •No large scale resettlement may be anticipated along NLEX. •Relocation of informal settler families has been completed between Caloocan and Malolos.	A-	D	【Pre-construction】 (-)Informal settlers have occupied the PNR ROW along the Clark Airport on the north side of the SCTEX Mabiga Exit, and large scale relocation will be unavoidable. (-)Additional land acquisition will be needed at the underpass section on Mindanao Avenue. Large scale displacement may not be avoided. •No large scale resettlement may be anticipated along NLEX.	A-	D	【Pre-construction】 (-) Informal settlers have occupied the following areas in PNR ROW, therefore large scale relocation will be unavoidable. • Along the CIA at Mabalacat • Cities of San Fernando and Angels • Calumpit (-)Involuntary resettlement is unavoidable due to additional land acquisition of for the narrow ROW sections, e.g., river banks near San Fernando and Calumpit.
2	The poverty group	C	C	【Pre-construction】 Some of informal settlers might be considered as being in the poverty group.	C	C	Same as Option A	C	C	Same as Option A
3	Indigenous and ethnic people	D	D	There are no indigenous or ethnic people in or around the project site.	D	D	Same as Option A	D	D	Same as Option A
4	Local economy such as employment and livelihood, etc.	B±	B±	【Construction】 (+)Employment of skilled and unskilled labor will be expected. (-) Land acquisition will force some small businesses to move out and might cause income loss and unemployment. 【Operation】 (+) Commuter trains may ease traffic congestion and boost regional	B±	B±	Same as Option A	B±	B±	Same as Option A

No	Items	Option A (Option D)			Option B			Option C		
		Rating			Rating			Rating		
		Construction Phase	Operation Phase	Brief Description	Construction Phase	Operation Phase	Brief Description	Construction Phase	Operation Phase	Brief Description
				economic activities along the route. (-) Resettlement and livelihood rehabilitation at the relocation site might take a longer period of time.						
5	Land use and utilization of local resources	D	B±	【Operation】 (+) Effective utilization of present unused land is anticipated due to new development in the surrounding area. (-) Uncontrolled land use might result in a loss of productive land.	D	B±	Same as Option A	D	B±	Same as Option A
6	Social institutions such as social infrastructure and local decision-making institutions	B-	B-	【Operation】 (-)Loss of residents by a large scale relocation might affect local community institutions and barangays. (-)Conflict resolution between existing residents and new settlers might take longer in newly resettled barangays.	B-	B-	Same as Option A	B-	B-	Same as Option A
7	Existing social infrastructures and services	B-	B+	【Construction】 (-) Due to an increase in air pollution, noise and vibration and accidents due to traffic congestion, and operation of heavy duty vehicles during construction, neighboring residents might get negative impacts. 【Operation】 (+)Traffic congestion on the roads will be eased.	B-	B+	Same as Option A	B-	B+	Same as Option A
8	Misdistribution of benefits and damage	D	D	Misdistribution of benefits and damage will not be expected.	D	D	Same as Option A	D	D	Same as Option A
9	Local conflict of interests	C	C	【Pre-construction】 Differences caused by land acquisition such as needs for resettlement, eligibility requirements and contents of compensation and livelihood rehabilitation assistance, might lead to local conflicts.	C	C	Same as Option A	C	C	Same as Option A

No	Items	Option A (Option D)			Option B			Option C		
		Rating			Rating			Rating		
		Construction Phase	Operation Phase	Brief Description	Construction Phase	Operation Phase	Brief Description	Construction Phase	Operation Phase	Brief Description
10	Water Usage or Water Rights and Rights of Common	D	D	Water usage or water rights, rights of common may not be changed since the routes of the alternative options will be planned along the existing PNR route and/or NLEX highway.	D	D	Same as Option A	D	D	Same as Option A
11	Historical /Cultural heritage	D	D	There are no historical or cultural heritage sites along the route.	D	D	Same as Option A	B-	D	【Pre-construction】 (-) The old PNR Stations such as San Fernando are recognized as historical heritage sites and are considered for preservation.
12	Landscape	B-	B-	【Construction】 (-) The express railway will employ mostly viaducts and bridges. Local aesthetic views might be disturbed temporarily during construction. 【Operation】 (-) Aesthetic value of local town scape might be affected due to viaducts.	B-	B-	Same as Option A	B-	B-	Same as Option A
13	Sunlight easement	D	B-	【Operation】 (-) Viaduct might cause sunlight shadows over nearby residential areas.	D	B-	Same as Option A	D	B-	Same as Option A
14	Sanitation	B-	D	【Construction】 (-)Sanitary conditions will become unfavorable if enough portable toilets and litter bins are not provided at the construction site.	B-	D	Same as Option A	B-	D	Same as Option A
15	Hazards (Risk) Infectious diseases such as HIV/AIDS	B-	D	【Construction】 (-)Most construction workers will be hired locally. However, infectious diseases such as HIV/AIDS might be spread due to workers from outside and poor sanitary conditions.	B-	D	Same as Option A	B-	D	Same as Option A
	Natural Environment									

No	Items	Option A (Option D)			Option B			Option C		
		Rating			Rating			Rating		
		Construction Phase	Operation Phase	Brief Description	Construction Phase	Operation Phase	Brief Description	Construction Phase	Operation Phase	Brief Description
16	Topography and Geological features	B-	D	【Construction】 (-) Filling of swampy ground during construction will be needed for access roads to the construction sites. Temporary land alteration may be unavoidable. 【Operation】 Change of landform by soil erosion or landslide is not predicted.	B-	D	Same as Option A	B-	D	Same as Option A
17	Soil Erosion	B-	D	【Construction】 (-) Construction work might cause soil erosion at borrow pits and quarriesy. Borrow pits and quarriesy are to be checked prior to construction work. 【Operation】 There will be no risk of soil erosion.	B-	D	Same as Option A	B-	D	Same as Option A 【Construction】 (-) The PNR ROW has been scoured along Cultcut Creek and at the bank of Abacan River. Riverbank protection work will be needed before installing viaducts.
18	Groundwater	B-	B-	【Construction】Tunnel zone: (-)Digging of tunnels will be likely to cut off underground water veins and deteriorate the groundwater quality. 【Operation】 (-)Tunnels might affect the underground water flow.	B-	B-	Same as Option A	B-	B-	Same as Option A
19	Hydrological Situation	C	C	【Pre-construction】 The alternative routes go through the flood prone zone of Pampanga River Delta. It should be confirmed that no structures will increase the risk of flooding and inundation.	C	C	Same as Option A	C	C	Same as Option A

No	Items	Option A (Option D)			Option B			Option C		
		Rating			Rating			Rating		
		Construction Phase	Operation Phase	Brief Description	Construction Phase	Operation Phase	Brief Description	Construction Phase	Operation Phase	Brief Description
20	Flora, Fauna and Biodiversity	B-	D	【Construction】 ・No adverse impacts on wildlife in the protected areas due to construction activities will be anticipated. Candaba Swamp Conservation Area is located about 5 kilometers away. (-)There will be fewer access roads to the construction sites in swamp areas, temporary land alteration in swamp areas will be needed, and thus restoration will be necessary. 【Operation】 ・Protected area is not located in the vicinity of the alternative routes. ・No endangered species of flora and fauna are observed in the vicinity of the route.	B-	D	Same as Option A	B-	D	Same as Option A
21	Meteorology	D	D	No impacts are expected through the project activities.	D	D	Same as Option A	D	D	Same as Option A
22	Global Warming	B-	B+	【Construction】 (-)The operation of construction machines and vehicles will emit CO_2 temporarily but the impact on global warming might be slight. 【Operation】 (+)The project may contribute to the ease of traffic congestion and decrease of CO_2 emission.	B-	B+	Same as Option A	B-	B+	Same as Option A
	Pollution Control									
23	Air Pollution	B-	B+	【Construction】 (-)Emission of pollutants due to the operation of construction machines and vehicles might slightly deteriorate the ambient air quality. 【Operation】 (+)The project may contribute to the ease of traffic congestion and	B-	B+	Same as Option A	B-	B+	Same as Option A

No	Items	Option A (Option D)			Option B			Option C		
		Rating		Brief Description	Rating		Brief Description	Rating		Brief Description
		Construction Phase	Operation Phase		Construction Phase	Operation Phase		Construction Phase	Operation Phase	
				decrease of air polluting emissions.						
24	Water Pollution	B-	B-	【Construction】 (-)Surface water, such as swamps, rivers and creeks will be likely to be deteriorated by suspended solids discharged from construction sites. (-) Alkaline drainage from concrete poring will increase the pH level of surface water. (-)Discharge of oil and grease emitted from ill-serviced construction machines, heavy vehicles and wastewater from the site might degrade river and creek water quality. (-)Piling work for installation of the long-span bridge piers will disturb bottom sediment and cause deterioration of water quality with suspended solids. 【Operation】 (-) Untreated wastewater from stations and maintenance facilities in the Depot might deteriorate the surface water quality.	B-	B-	Same as Option A	B-	B-	Same as Option A
25	Soil Contamination	B-	D	【Construction】 (-) Oil and grease emitted from ill-serviced construction machines and heavy vehicles might contaminate soil at the construction site.	B-	D	Same as Option A	B-	D	Same as Option A

No	Items	Option A (Option D)			Option B			Option C		
		Rating			Rating			Rating		
		Construction Phase	Operation Phase	Brief Description	Construction Phase	Operation Phase	Brief Description	Construction Phase	Operation Phase	Brief Description
26	Waste	B-	B-	【Construction】 (-) Construction work may generate solid waste such as removed soil and sand of the existing structures. Construction workers may also create additional garbage. 【Operation】 (-) Improper disposal of solid waste from stations and maintenance facilities in the Depot might deteriorate the environmental quality of surrounding communities.	B-	B-	Same as Option A	B-	B-	Same as Option A
27	Noise and Vibration	B-	B-	【Construction】 (-)Noise and vibration due to construction activities and vehicles will be likely to affect the nearby communities. (-)Along detour routes, noise from increased vehicles may also affect the sound environment in the vicinity. 【Operation】 (-)Noise and vibration will cause a nuisance along the route, especially for residential areas.	B-	B-	Same as Option A	B-	B-	Same as Option A
28	Ground Subsidence	B-	B-	【Construction】Tunnel zone: (-)Digging of tunnels might affect the underground water flow and cause ground subsidence. 【Operation】 (-)Tunnels might affect the underground water flow and cause ground subsidence.	B-	B-	Same as Option A	B-	B-	Same as Option A
29	Offensive Odors	D	D	No impacts are expected through the project activities.	D	D	Same as Option A	D	D	Same as Option A

No	Items	Option A (Option D)			Option B			Option C		
		Rating			Rating			Rating		
		Construction Phase	Operation Phase	Brief Description	Construction Phase	Operation Phase	Brief Description	Construction Phase	Operation Phase	Brief Description
30	Bottom sediment	B-	B-	【Construction】 (-) Piling work for installation of long-span bridge piers will disturb bottom sediment and cause adverse impacts on riverine organisms with hazardous materials if the bottom sediment has been contaminated. (-)Discharge of oil and grease emitted from ill-serviced construction machines, heavy vehicles and water from the site might degrade bottom sediment quality. 【Operation】 (-)Untreated wastewater from stations and maintenance facilities in the Depot might contaminate the sediments of rivers and swamps.	B-	B-	Same as Option A	B-	B-	Same as Option A
	Others									
31	Accidents	B-	D	【Construction】 (-)Traffic accidents are likely to occur due to the increase of construction vehicles. 【Operation】 No accidents are anticipated since tracks will be installed on viaducts and/or underground tunnels.	B-	D	Same as Option A	B-	D	Same as Option A

Source: JICA Study Team

Rating:

A±: Significant positive/negative impact is expected.

B±: Some positive/negative impact is expected.

C: Extent of positive/negative impact is unknown. (A further examination is needed, and the impact could be clarified as the study progresses for the priority project in the Draft Final Report.)

D: No impact is expected. IEE/EIA is not necessary.

Table 2 Draft Scoping for the Inside of Manila Options

No	Items	Option A (Option C)			Option B			Option D		
		Rating		Brief Description	Rating		Brief Description	Rating		Brief Description
		Construction Phase	Operation Phase		Construction Phase	Operation Phase		Construction Phase	Operation Phase	
Social Environment *Regarding the impacts on "Gender" and "Children's Rights", might be related to all criteria of the Social Environment.										
1	Involuntary Resettlement	A-	D	【Pre-construction】 (-)Resettlement due to additional land acquisition for all station areas will be needed. (-)Relocation of informal settlers will be unavoidable along the existing PNR route.	A-	D	【Pre-construction】 (-)Land acquisition and large scale resettlement will be needed in the following portions: - Between Trinoma Terminal and Quezon Avenue - Between España Boulevard and PNR España Station - Underpass Section on Quezon Avenue	A-	D	【Pre-construction】 (-)Resettlement due to additional land acquisition for all station areas will be needed. (-) Large scale relocation of informal settlers will be needed along the old PNR line southeast of Sta Mesa due to construction of the U-shape line. (-)Relocation of informal settlers will be unavoidable along the existing PNR route.
2	The poverty group	C	C	【Pre-construction】 Some of informal settlers might be considered as being in the poverty group.	C	C	Same as Option A	C	C	Same as Option A
3	Indigenous and ethnic people	D	D	There are no indigenous or ethnic people in or around the project site.	D	D	Same as Option A	D	D	Same as Option A
4	Local economy such as employment and livelihood, etc.	B±	B±	【Construction】 (+)Employment of skilled and unskilled labor will be expected. (-) Land acquisition will force some small businesses to move out and might cause income loss and unemployment. 【Operation】 (+)Commuter trains may increase citizen's convenience. (-) Resettlement and livelihood rehabilitation at the relocation site might take a longer period of time.	B±	B±	Same as Option A	B±	B±	Same as Option A

No	Items	Option A (Option C)			Option B			Option D		
		Rating		Brief Description	Rating		Brief Description	Rating		Brief Description
		Construction Phase	Operation Phase		Construction Phase	Operation Phase		Construction Phase	Operation Phase	
5	Land use and utilization of local resources	D	D	The project will install viaducts and underground tunnels in existing urban areas, therefore no changes in land use or utilization of local resources is expected.	D	D	Same as Option A	D	D	Same as Option A
6	Social institutions such as social infrastructure and local decision-making institutions	B-	B-	【Operation】 (-)Loss of residents by a large scale relocation might affect local community institutions and barangays. (-)Conflict resolution between existing residents and new settlers might take longer at newly resettled barangays.	B-	B-	Same as Option A	B-	B-	Same as Option A
7	Existing social infrastructures and services	B-	B+	【Construction】 (-) Due to increase in air pollution, noise and vibration and accidents by due to traffic congestion, and operation of heavy duty vehicles during construction, neighboring residents might get negative impacts. 【Operation】 (+)Traffic congestion on the roads will be eased.	B-	B+	Same as Option A	B-	B+	Same as Option A
8	Misdistribution of benefits and damage	D	D	Misdistribution of benefits and damage will not be expected.	D	D	Same as Option A	D	D	Same as Option A
9	Local conflict of interests	C	C	【Pre-construction】 Difference caused by land acquisition such as needs for resettlement, eligibility requirements and contents of compensation and livelihood rehabilitation assistance, might lead to local conflicts.	C	C	Same as Option A	C	C	Same as Option A
10	Water Usage or Water Rights and Rights of Common	D	D	Water usage or water rights, rights of common may not be changed since the routes of the alternative options will be planned along the existing PNR route and/or NLEX highway.	D	D	Same as Option A	D	D	Same as Option A

No	Items	Option A (Option C)			Option B			Option D		
		Rating		Brief Description	Rating		Brief Description	Rating		Brief Description
		Construction Phase	Operation Phase		Construction Phase	Operation Phase		Construction Phase	Operation Phase	
11	Historical /Cultural heritage	B-	D	【Pre-construction】 (-) The old PNR Stations such as Paco are recognized as historical heritage sites and are considered for preservation.	B-	D	Same as Option A	D	D	There are no historical or cultural heritage sites along the route.
12	Landscape	B-	B-	【Construction】 (-) The express railway will employ mostly viaducts. Local aesthetic views might be disturbed temporarily during construction. 【Operation】 (-) Aesthetic value of the city scape might be affected due to viaducts.	B-	B-	Same as Option A	B-	B-	Same as Option A
13	Sunlight easement	D	B-	【Operation】 (-) Elevated structures and viaducts might cause sunlight shadow over nearby residential areas.	D	B-	Same as Option A	D	B-	Same as Option A
14	Sanitation	B-	D	【Construction】 (-)Sanitary conditions will become unfavorable if enough portable toilets and litter bins are not provided at the construction site.	B-	D	Same as Option A	B-	D	Same as Option A
15	Hazards (Risk) Infectious diseases such as HIV/AIDS	B-	D	【Construction】 (-)Most of the construction workers will be hired locally. However, infectious diseases such as HIV/AIDS might be spread due to workers from outside and poor sanitary conditions.	B-	D	Same as Option A	B-	D	Same as Option A
	Natural Environment									
16	Topography and Geological features	D	D	No filling or cutting of slopes is expected during the construction in urban areas. Change of landform by soil erosion or landslide is not predicted.	D	D	Same as Option A	D	D	Same as Option A

No	Items	Option A (Option C)			Option B			Option D		
		Rating		Brief Description	Rating		Brief Description	Rating		Brief Description
		Construction Phase	Operation Phase		Construction Phase	Operation Phase		Construction Phase	Operation Phase	
17	Soil Erosion	B-	D	【Construction】 (-) Construction work might cause soil erosion at the borrow pits and quarriesy. The borrow pits and quarriesy are to be checked prior to construction work. 【Operation】 There will be no risk of soil erosion.	B-	D	Same as Option A	B-	D	Same as Option A
18	Groundwater	B-	B-	【Construction】Tunnel zone: (-)Digging of tunnels will be likely to cut off underground water veins and deteriorate the groundwater quality. 【Operation】 (-)Tunnels might affect the underground water flow.	B-	B-	Same as Option A	B-	B-	Same as Option A
19	Hydrological Situation	C	C	【Construction】 Construction of piers for the long-span bridge in Pasig river might temporarily impact on the stream flow. 【Operation】 Hydraulic effect on the stream flow of Pasig River by installation of piers for the long-span bridge should be checked.	C	C	Same as Option A	D	D	Any changes on hydrological situation of surface water may not be anticipated.
20	Flora, Fauna and Biodiversity	B-	D	【Construction】 (-)Trees and vegetation within the construction limit might be removed. 【Operation】 ・No protected area is located in the vicinity of the urban routes. ・No endangered species of flora and fauna are observed in or around the alternative routes.	B-	D	Same as Option A	B-	D	Same as Option A
21	Meteorology	D	D	No impacts are expected through the project activities.	D	D	Same as Option A	D	D	Same as Option A

No	Items	Option A (Option C)			Option B			Option D		
		Rating		Brief Description	Rating		Brief Description	Rating		Brief Description
		Construction Phase	Operation Phase		Construction Phase	Operation Phase		Construction Phase	Operation Phase	
22	Global Warming	B-	B+	【Construction】 (-)The operation of construction machines and vehicles will emit CO_2 temporarily but the impact on global warming might be slight. 【Operation】 (+)The project may contribute to the ease of traffic congestion and decrease of CO_2 emission.	B-	B+	Same as Option A	B-	B+	Same as Option A
	Pollution Control									
23	Air Pollution	B-	B+	【Construction】 (-)Emission of pollutants due to the operation of construction machines and vehicles might slightly deteriorate the ambient air quality. 【Operation】 (+)The project may contribute to the ease of traffic congestion and decrease of air polluting emissions.	B-	B+	Same as Option A	B-	B+	Same as Option A
24	Water Pollution	B-	B-	【Construction】 (-) Discharge of oil and grease emitted from ill-serviced construction machines, heavy vehicles and wastewater from the site might degrade river and creek water quality. (-) Alkaline drainage from concrete poring will increase the pH level of surface water. (-)Piling work for installation of the long-span bridge piers will disturb bottom sediment and cause deterioration of water quality with suspended solids. 【Operation】 (-) Untreated wastewater from stations might deteriorate the surface water quality.	B-	B-	Same as Option A	B-	B-	Same as Option A (but there will be no long span bridge)

No	Items	Option A (Option C)			Option B			Option D		
		Rating		Brief Description	Rating		Brief Description	Rating		Brief Description
		Construction Phase	Operation Phase		Construction Phase	Operation Phase		Construction Phase	Operation Phase	
25	Soil Contamination	B-	D	【Construction】 (-) Oil and grease emitted from ill-serviced construction machines and heavy vehicles might contaminate soil at the construction site.	B-	D	Same as Option A	B-	D	Same as Option A
26	Waste	B-	B-	【Construction】 (-) Construction work may generate solid waste such as removed soil and sand of the existing structures. Construction workers may also create additional garbage. 【Operation】 (-) Improper disposal of solid waste from stations and maintenance facilities in the Depot might deteriorate the environment quality of surrounding communities.	B-	B-	Same as Option A	B-	B-	Same as Option A
27	Noise and Vibration	B-	B-	【Construction】 (-)Noise and vibration due to construction activities and vehicles will be likely to affect the nearby communities. (-)Along detour routes, noise from increased vehicles may also affect the sound environment in the vicinity. 【Operation】 (-)Noise and vibration will cause a nuisance along the route, especially for residential areas.	B-	B-	Same as Option A	B-	B-	Same as Option A
28	Ground Subsidence	B-	B-	【Construction】Tunnel zone: (-)Digging of tunnels might affect the underground water flow and cause ground subsidence. 【Operation】 (-)Tunnels might affect the underground water flow and cause ground subsidence.	B-	B-	Same as Option A	B-	B-	Same as Option A

No	Items	Option A (Option C)			Option B			Option D		
		Rating		Brief Description	Rating		Brief Description	Rating		Brief Description
		Construction Phase	Operation Phase		Construction Phase	Operation Phase		Construction Phase	Operation Phase	
29	Offensive Odors	D	D	No impacts are expected through the project activities.	D	D	Same as Option A	D	D	Same as Option A
30	Bottom sediment	B-	B-	【Construction】 (-) Piling work for installation of long-span bridge piers will disturb the bottom sediment and cause adverse impacts on riverine organisms with hazardous materials if the bottom sediment had been contaminated. (-)Discharge of oil and grease emitted from ill-serviced construction machines, heavy vehicles and water from the site might degrade bottom sediment quality. 【Operation】 (-)Untreated wastewater from stations and maintenance facilities in the Depot might contaminate sediments.	B-	B-	Same as Option A	B-	B-	Same as Option A (but there will be no long span bridge)
	Others									
31	Accidents	B-	D	【Construction】 (-)Traffic accidents are likely to occur due to the increase of construction vehicles. 【Operation】 No accidents are anticipated since the tracks will be installed on viaducts and/or underground tunnels.	B-	D	Same as Option A	B-	D	Same as Option A

Source: JICA Study Team

Rating:

A±: Significant positive/negative impact is expected.

B±: Some positive/negative impact is expected.

C: Extent of positive/negative impact is unknown. (A further examination is needed, and the impact could be clarified as the study progresses for the priority project in the Draft Final Report.)

D: No impact is expected. IEE/EIA is not necessary.

付属資料 D-2：自然環境及び社会環境の現況

1. Natural Environment

1.1. Regional Meteorology and Climatology

1.1.1. Climate

There are four (4) recognized climate types in the Philippines according to on rainfall distribution. Climate in the entire study area as illustrated in the Modified Corona's Classification presented in Figure 1.1-1, belongs to Type 1. This climate type is described by two (2) very pronounced seasons, the wet and the dry. From May to October, the study area experiences moderate to heavy precipitation periods, while dry the rest of the year. Maximum rain period is expected from June to September.

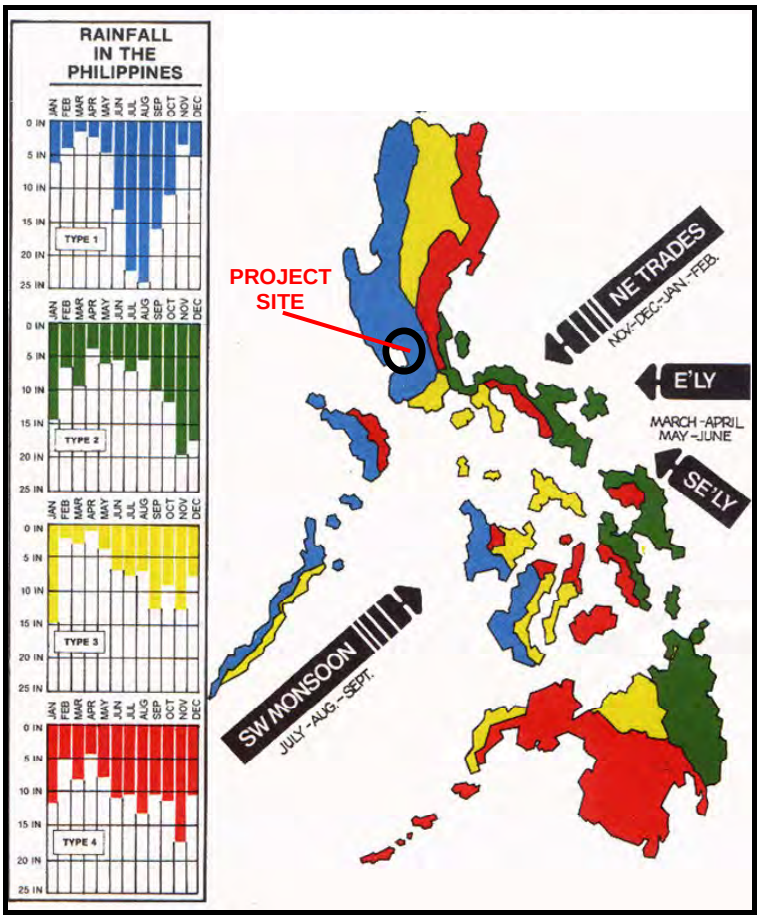


Figure 1.1-1 Climate Map of the Philippines (Based on Modified Corona's Classification)

Type I: There are two pronounced seasons: The dry season (from November to April) and wet season (rest of the year).

Type II: There is no dry season under this classification, with a very pronounced rainfall from November to January.

Type III: Seasons are not very pronounced. It is relatively dry from November to April, and wet during the rest of the year.

Type IV: Rainfall is more or less evenly distributed throughout the year under this classification.

1.1.2. Rainfall

August is the wettest month of the year in the entire study area. During this month, the Province of Pampanga received the highest amount of rainfall of 607.9 mm (please refer to Table 1.1-1). As shown in Table 1.1-2, the Bulacan area, as well as Valenzuela City, Malabon City, Caloocan City, and Quezon City also recorded a significant amount of rain in August with 504.2 mm. Existing data presented in Table 1.1-3 indicate that the rainfall collected in the Cities of Pasay, Makati, and Parañaque is highest in August with 418.4 mm. While approximately 432.4 mm of precipitation was recorded in the City of Manila, the southwest part of Caloocan City, and some western parts of Makati City in August.

More rainy days are experienced in August compared to any other months. In Pampanga, 26 days of rain were recorded, and there are about 23 days of rain observed in the Province of Bulacan, and the Cities of Valenzuela, Malabon, Caloocan, and Quezon. The Cities of Pasay, Makati, and Parañaque experience around 19 days of rain, while Manila has 21 (see Table 1.1-4).

1.1.3. Temperature

From March to November, moderately warm temperature is felt in the study area with a mean average of 26.6°C to 28.9°C. In summer, the temperature can heat up from a cool 24.3°C to a sweltering 33.5°C. Comparatively, warmer temperature with average of 34.4°C is felt during the summer months of March to May in the Bulacan and the Cities of Valenzuela, Malabon, Caloocan, and Quezon.

Once the northeasterly trade winds begin to blow, cooler temperature is experienced in the study area. Among the affected areas, Pampanga experiences the coolest weather during the cold months of December to February, with an average of temperature of 20.8°C. Manila on the contrary feels a warmer temperature average of 24.1°C during this period.

1.1.4. Relative Humidity

Moisture content of the atmosphere in the whole study area is at its highest in August with an average relative humidity of 83%. Humidity is at its minimum when the temperature is at its maximum during the month of April. The recorded average relative humidity in the project area is 65%. The average annual relative humidity is in the study area 75%, wherein the highest amount of 78% is felt in Bulacan, and the Cities of Valenzuela, Malabon, Caloocan, and Quezon.

1.1.5. Tropical Cyclones (Typhoons)

The Philippines sit astride the typhoon belt, and the country suffers an annual onslaught of dangerous storms from July through October. These are especially hazardous for northern and eastern Luzon and the Bicol and Eastern Visayas regions, but Metro Manila and Central Luzon get devastated periodically as well. Typhoon is locally termed as “Bagyo”. Of the average of 20 typhoons that enter the Philippine Area of Responsibility (PAR) each year, about 15 affect Central Luzon. Typhoon combined with monsoons discharge a high rate of precipitation in the region, and flooding is a common occurrence, since a wide expanse of the region is low-lying including the Pampanga Delta. In 1993, a record 19 typhoons made landfall in the country making it the most in one year. Historically, the deadliest tropical cyclone to impact the Philippines was “Uring” (Tropical Storm Thelma) which caused floods that killed thousands of people in 1991.

Typhoons are categorized into four (4) types according to its wind speed by the PAGASA. All tropical cyclones, regardless of strength, are named by PAGASA.

- Tropical Depressions have maximum sustained winds of between 55 kilometres per hour (30 kn) and 64 kilometres per hour (35 kn) near its center;

- Tropical Storms have maximum sustained winds of 65 kilometres per hour (35 kn) and 119 kilometres per hour (64 kn);
- Typhoons achieve maximum sustained winds of 120 kilometres per hour (65 kn) to 185 kilometres per hour (100 kn); and
- Super typhoons having maximum winds exceeding 185 kilometres per hour (100 kn)

1.1.6. Wind

Southerly wind predominates in Pampanga from June to September. It has an estimated average speed of 2.6 m/s. In the Cities of Valenzuela, Malabon, Caloocan, Quezon, and the Province of Bulacan, the northerly wind prevails the whole year. The average wind speed recorded is 1 m/s. The easterly wind occurs prevails in Pasay, Makati, and Parañaque areas from October to March. It has an average wind speed of 2.7 m/s. From May to September, the southwesterly wind predominates in manila City. It has a recorded wind speed average of 3.2 m/s.

Table 1-1 Climatological Normal Values

Station Name: CLARK INTERNATIONAL AIRPORT
Period: 2010-2011
Latitude: 15°11" N
Longitude: 120°07" E
Elevation: 154.8 m

MONTH	RAINFALL		TEMPERATURE			Vapor Pressure (MBS)	Relative Humidity (%)	WIND	
	Amount (mm)	No. of RD	Maximum (°C)	Minimum (°C)	Mean (°C)			Direction (16 pt)	Speed (mps)
JAN	26.8	4	29.9	20.4	25.2	21.2	68	NW	3
FEB	24.2	2	31.3	20.1	25.7	21.1	65	ENE	3
MAR	45.1	4	32.2	21.7	26.9	22.0	64	NE	3
APR	46.4	5	34.0	22.5	28.2	22.3	59	E	3
MAY	268.3	12	34.2	24.0	29.1	26.4	68	SE	2
JUNE	727.6	20	31.3	23.9	27.6	28.5	80	S	3
JULY	671	23	31.0	23.2	27.1	27.8	81	S	3
AUG	607.9	26	30.5	23.4	27.0	28.3	83	S	2
SEP	595.1	20	30.8	23.2	27.0	27.7	81	S	2
OCT	537.1	15	31.0	23.1	27.0	27.1	78	NW	3
NOV	378.3	13	30.5	22.8	26.6	26.0	77	N	3
DEC	123.3	6	30.5	21.9	26.2	24.4	72	NW	3
ANNUAL	4051.1	148	31.4	22.5	27.0	25.2	73	S	3

Source: PAGASA/CAD/CDS

Table 1-2 Climatological Normal Values

Station Name: SCIENCE GARDEN, QUEZON CITY
Period: 1981-2010
Latitude: 14°38'41" N
Longitude: 121°02'31" E
Elevation: 43.0 m

MONTH	RAINFALL		TEMPERATURE						Vapor Pressure (MBS)	Relative Humidity (%)	Mean Sea Level Pres (mbs)	WIND		Cloud Amount (okta)	Number of Days with	
	Amount (mm)	No. Of RD	Maximum (°C)	Minimum (°C)	Mean (°C)	Dry Bulb (°C)	Wet Bulb (°C)	Dew Point (°C)				Direction (16 pt)	Speed (mps)		Thunder storm	Light-ning
JAN	18.5	4	30.6	20.8	25.7	25.3	22.2	20.9	24.6	76	1012.3	N	1	5	1	0
FEB	14.6	3	31.7	20.9	26.3	26.0	22.3	20.8	24.4	73	1012.0	NE	1	5	0	0
MAR	24.8	4	33.4	22.1	27.8	27.6	23.2	21.5	25.4	69	1011.3	SE	1	4	2	1
APR	40.4	5	35.0	23.7	29.4	29.2	24.4	22.7	27.2	67	1009.7	SE	1	4	4	2
MAY	186.7	12	34.7	24.7	29.7	29.3	25.3	23.9	29.5	72	1008.5	S	1	5	12	8
JUNE	316.5	18	33.1	24.6	28.8	28.4	25.5	24.5	30.6	79	1008.1	SW	1	6	17	9
JULY	493.3	22	31.9	24.1	28.0	27.5	25.2	24.4	30.5	83	1007.7	SW	2	6	19	9
AUG	504.2	23	31.3	24.2	27.8	27.3	25.2	24.5	30.6	84	1007.4	SW	2	7	17	6
SEP	451.2	22	31.6	24.0	27.8	27.2	25.1	24.4	30.4	84	1010.6	SW	1	6	18	9
OCT	296.6	18	31.6	23.5	27.6	27.0	24.7	23.9	29.5	83	1008.8	N	1	6	11	6
NOV	148.8	14	31.4	22.7	27.1	26.5	24.1	23.2	28.4	82	1010.1	N	1	5	5	1
DEC	78.7	8	30.5	21.6	26.0	25.5	22.8	21.7	25.9	79	1011.5	N	1	5	1	0
ANNUAL	2574.4	153	32.2	23.1	27.7	27.2	24.2	23.0	28.1	78	1009.8	N	1	5	107	51

Table 1-3 Climatological Normal Values

Station Name: NAIA (MAI), PASAY CITY
Period: 1981-2010
Latitude: 14°31'00" N
Longitude: 121°01'00" E
Elevation: 21.0 m

MONTH	RAINFALL		TEMPERATURE						Vapor Pressure (MBS)	Relative Humidity (%)	Mean Sea Level Pres (mbs)	WIND		Cloud Amount (okta)	Number of Days with	
	Amount (mm)	No. Of RD	Maximum (°C)	Minimum (°C)	Mean (°C)	Dry Bulb (°C)	Wet Bulb (°C)	Dew Point (°C)				Direction (16 pt)	Speed (mps)		Thunder storm	Light-ning
JAN	6.8	2	30.2	22.0	26.1	26.0	22.6	21.2	25.1	75	1013.4	E	3	5	0	0
FEB	4.2	1	31.0	22.5	26.7	26.6	22.7	21.1	24.9	72	1013.2	E	3	4	0	0
MAR	4.0	1	32.5	23.6	28.0	27.9	23.4	21.7	25.7	68	1012.4	E	4	4	0	1
APR	16.0	1	34.1	25.0	29.5	29.4	24.5	22.7	27.4	67	1010.8	ESE	4	4	1	3
MAY	70.4	6	33.8	25.5	29.7	29.4	25.3	23.9	29.4	72	1009.3	W	3	5	5	12
JUNE	265.2	14	32.5	25.1	28.8	28.5	25.3	24.2	30.0	77	1008.7	W	3	6	7	13
JULY	316.7	16	31.3	24.6	28.0	27.7	25.1	24.2	30.1	81	1008.4	W	3	6	8	13
AUG	418.4	19	30.8	24.6	27.7	27.4	25.1	24.3	30.3	83	1008.0	W	3	7	6	8
SEP	255.2	16	31.0	24.6	27.8	27.5	25.2	24.4	30.5	83	1008.8	W	2	6	8	11
OCT	283.4	14	31.1	24.3	27.7	27.5	24.8	23.8	29.4	80	1009.6	E	2	6	5	8
NOV	99.0	8	31.1	23.7	27.4	27.2	24.2	23.1	28.1	78	1010.8	E	2	5	1	3
DEC	28.6	3	30.2	22.7	26.5	26.3	23.1	21.9	26.1	76	1012.5	E	2	5	0	0
ANNUAL	1767.8	101	31.6	24.0	27.8	27.6	24.3	23.0	28.1	76	1010.5	E	3	5	41	72

Table 1-4 Climatological Normal Values

Station Name: PORT AREA (MCO), Manila
Period: 1981-2010
Latitude: 14°35'08" N
Longitude: 120°58'07" E
Elevation: 16.0 m

MONTH	RAINFALL		TEMPERATURE						Vapor Pressure (MBS)	Relative Humidity (%)	Mean Sea Level Pres (mbs)	WIND		Cloud Amount (okta)	Number of Days with	
	Amount (mm)	No. Of RD	Maximum (°C)	Minimum (°C)	Mean (°C)	Dry Bulb (°C)	Wet Bulb (°C)	Dew Point (°C)				Direction (16 pt)	Speed (mps)		Thunder storm	Light-ning
JAN	17.3	4	29.6	23.8	26.7	26.7	22.9	21.4	25.3	72	1012.6	N	2	7	0	0
FEB	14.2	3	30.6	24.2	27.4	27.3	22.9	21.2	24.9	69	1012.4	E	3	6	0	0
MAR	15.8	3	32.1	25.3	28.7	28.5	23.7	21.9	26.0	67	1011.7	SE	3	6	0	1
APR	23.7	4	33.5	26.6	30.1	30.0	24.9	23.1	28.0	66	1010.2	SE	3	6	2	2
MAY	147.2	10	33.2	26.9	30.0	30.0	25.7	24.3	30.0	71	1008.6	SW	3	6	9	9
JUNE	253.5	17	32.2	26.4	29.3	29.3	25.8	24.6	30.8	76	1008.1	SW	3	7	11	9
JULY	420.5	21	31.2	25.9	28.5	28.5	25.6	24.6	30.8	79	1007.7	SW	3	7	12	9
AUG	432.4	21	30.8	25.8	28.3	28.2	25.6	24.7	31.0	81	1007.3	SW	4	7	11	7
SEP	355.1	20	31.0	25.7	28.4	28.3	25.5	24.6	30.7	80	1008.2	SW	3	7	12	8
OCT	234.8	17	31.1	25.7	28.4	28.3	25.2	24.1	29.9	78	1009.0	SW	3	7	7	6
NOV	121.7	12	30.9	25.1	28.0	28.0	24.5	23.2	28.3	75	1010.1	N	3	7	3	1
DEC	67.4	7	29.8	24.2	27.0	27.0	23.4	22.0	26.3	74	1011.8	N	2	7	1	0
ANNUAL	2103.6	139	31.3	25.5	28.4	28.4	24.6	23.3	28.5	74	1009.8	SW	3	7	68	52

1.2. Geology and Geomorphology

1.2.1. Geomorphology

Briefly described below are the morpho-tectonic units that contribute to the formation of the Pampanga Delta including the river systems that empty into the Manila Bay through the Pampanga Delta.

1) The Central Luzon Plain

The Pampanga Delta occupies the southern end of the Central Luzon Plain, a 200 km-long, 80 km wide plain that stretch from Lingayen Gulf to Manila Bay. This north-south oriented depression is the largest flatland in the Philippines. Bounded to the northeast by the Philippine Fault and to the west by the Zambales Range, the Central Plain depression was filled with loose clastic sediments during Tertiary and Quaternary times. Thickness of the sedimentary sequence is 14 km based on the multichannel seismic reflection in the center of the Plain (Bachman et al 1983). Volcanic eruptions from bordering volcanic centers from the Quaternary to the Present deposited thick lahars. Best example is the lahar flows after the 1990 Mt. Pinatubo eruption composed of sand, boulder and silt. Mount Arayat (1,030 m), a Quaternary volcano breaks the monotony of the plain.

2) Pampanga Delta

The Pampanga Delta is located on the southernmost end of Central Luzon Plain and the northern coastline of Manila Bay. With a land area of 179,000 hectares covering 27 municipalities, the Pampanga Delta stretches from the Provinces of Bataan in the east, across Pampanga and towards Bulacan. Its southernmost fringes extend towards Valenzuela, Navotas, Malabon and Caloocan City.

The Pampanga Delta is marked by submerged and partially submerged areas and adjoining upper deltaic accumulation north of Manila Bay, extending inland towards Mt. Arayat. The area is characterized by flat terrain with subtle undulations, very low elevation, and lack of general gradient and subjected to periodic tidal intrusions.

Southeast of Mount Arayat and the Pampanga River is the Candaba Swamp, covering an area of some 250 km², absorbing most of the flood flows from the western slopes of a portion of the Sierra Madre and the overflowing of the Pampanga River via the Cabiao Floodway. Candaba Swamp is a large closed synclinal depression which is affected by the seasonal occurrence of high and prolonged floods from the upper Pampanga River Basin and from the adjacent elevated watersheds draining into the basin. This area is submerged during the rainy season but is relatively dry during summer. Very low elevations, lack of natural drainage and a unique water regime characterized the Candaba Swamp.

The delta is formed by riverine depositions from the major river systems (Pampanga, Angat Rivers) and several criss-crossing anatomizing smaller streams. Prominent terrain features are estuaries, brackish water marshes and wet lands, freshwater swamps and relatively high and dry flat lands with water courses and channels.

The Caloocan-Malabon-Navotas-Valenzuela (CAMANAVA) is on the south eastern most extension of the Pampanga Delta. Exposed prior to urbanization and extending from what is now the North Harbor to Malolos, Bulacan are relics of old coastline. From available satellite image, this old coastline marked by what was once open beach, tidal flats and marches. A beach is an area of sediment accumulation (usually sand) exposed to wave action along the coast. Beaches extend from the low tide level inland to dunes or beach ridges. Generally, beaches are well formed in relatively low energy areas such as bays. High wave energy tends to erode sand and transport it to lower energy areas.

Prominent feature at the coastal plains of Navotas is a series of beach ridges which are elongated terrain feature composed of sand formed by wave action parallel to the coastline. Prior to their disturbance to their current land use, these asymmetrical ridges running parallel to the coast are separated by shallow troughs or runnels of about 50-100 m wide. These terrain features is often cited as indicator of the positions of ancient seashores and associated sea levels since they form on the foreshore of mesotidal to microtidal beaches where the moderate wave-energy conditions prevail on flat beaches with abundant sediment supply.

This coastal landform extends far inland close to the town proper of Obando, north to Marilao. Relic coastal features extend north to Guiguinto and Malolos, about 13 km inland from the present coastline of Manila Bay.

3) The Pampanga River

The Pampanga River is within the 4th largest basin in the Philippines and covers an approximate aggregate area of 10,454 km^2 (includes the allied basin of Guagua River). The headwaters are located at the Sierra Madre and run a south and south westerly course for about 260 kilometers to Manila Bay (Figure 1-2). The basin extends over the southern slopes of the Caraballo Mountains, the western slopes of the Sierra Madre range and the major portions of the Central Plain of Luzon. The basin covers the Provinces of Nueva Ecija; part of Bulacan, Tarlac and Quezon; and almost whole of Pampanga. Tributaries of Pampanga River are Peñaranda and the Coronel-Santor Rivers on the eastern side of the basin and the Rio Chico River from the northwest side.

The basin is drained through the Pampanga River and via the Labangan Channel into the Manila Bay. The Labangan channel acts as a cut-off channel for the Angat River into Manila Bay.

At the Pampanga Delta, the Pampanga River system divide into relatively small anastomossing branches, crisscrossed by fishponds with sluggish flow on tidal flats and channels. The main river has a low-gradient channel particularly at the middle and lower sections.

Downstream of the Sulipan Bridge to the Manila Bay is a typical channel with poor drainage capacity. Throughout this reach, the rivers meander to different shallow river beds. Although part of its floodwaters flow through the Bebe-San Esteban diversion channel to the Pasag River or the Guagua River, its insufficient carrying capacity causes flooding of the surrounding areas. Similar condition exists in the Pasag, Guagua, Hagonoy and Labangan rivers and other network of small streams in the area.

The basin experiences, on an average, at least one flooding in a year.

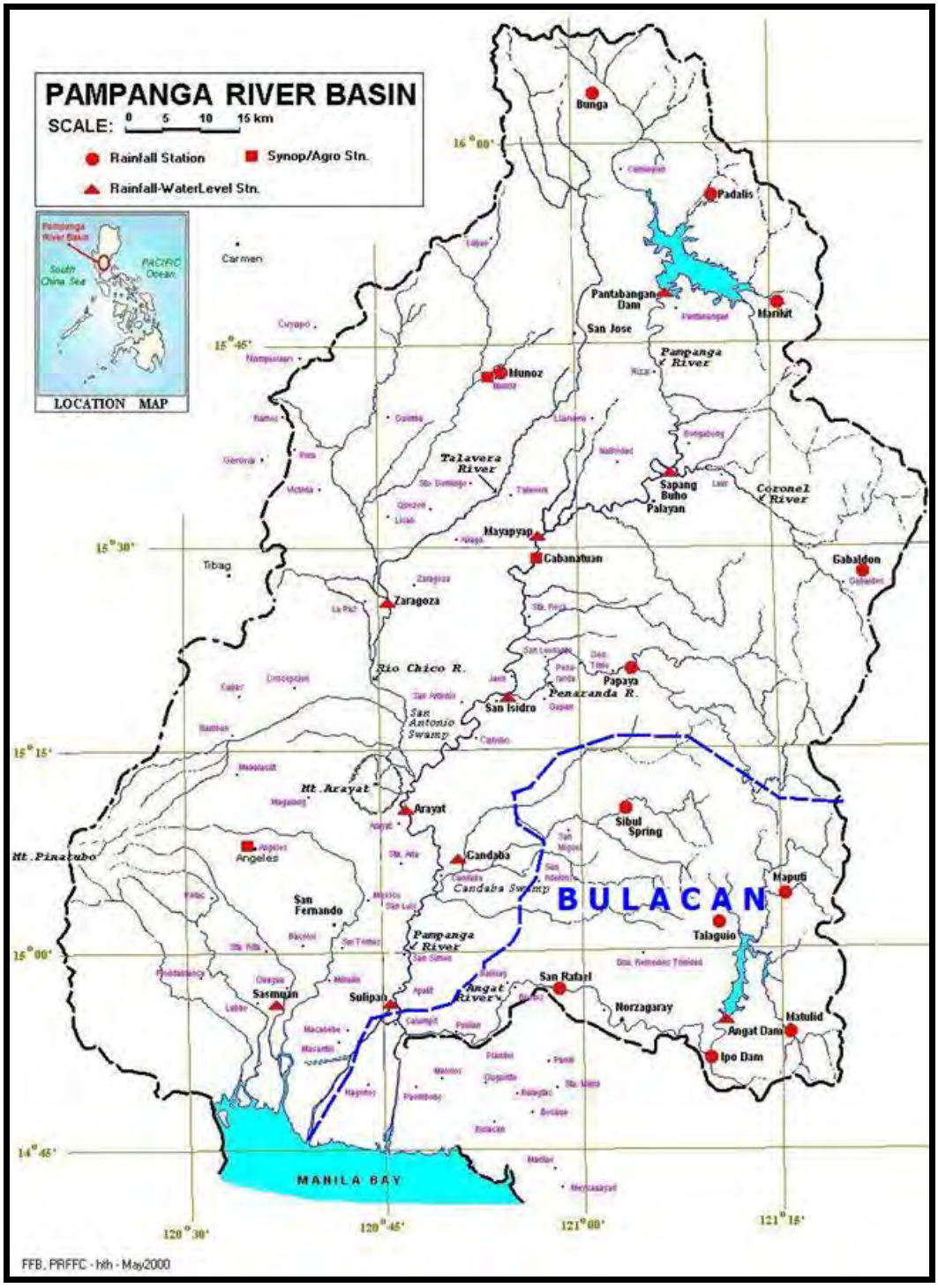


Figure 1-2 The Pampanga River Basin

4) The Guagua River

The Guagua River is in the basin of allied system of rivers and creeks to the Pampanga River virtually converging down with the latter close at the outlet into the Manila Bay. The basin drains an approximate area of 1,371 km^2, bounded on the north partly by the Agno River Basin and on the south by the Manila Bay, on the east by the Pampanga River Basin, where an earth dike protecting the right bank of the Pampanga River separates them, and on the west by the Zambales mountain Range.

The major river systems draining the basin are the Pasig-Potrero, Porac-Gumain, Abacan and Pasac-Guagua Rivers. Other small creeks and secondary rivers that significantly affect the basin are the Sapang-Maragul and Gugu creeks.

5) The Angat River

Angat River flows from the Sierra Madre mountain range to Manila Bay. Angat, Ipo and Bustos Dams are all located in the river as it snakes through 11 towns of Bulacan, including Angat, Baliwag, Bustos, Doña Remedios Trinidad (DRT), Norzagaray, Pulilan, San Rafael, Plaridel, Paumbong, and Hagonoy.

Angat Dam, a hydroelectric dam, is the biggest of the three and drains an aggregate area of 568 km^2. The Ipo dam is primarily a diversion dam and diverts water from the Angat and Ipo Rivers into tunnels that lead to La Mesa reservoir and Balara filtration areas. It supplies about 90% of raw water requirements for Metro Manila through the facilities of the Metropolitan Waterworks and Sewerage System (MWSS) and it irrigates about 28,000 hectares of farmland in Bulacan and Pampanga. Ipo Dam impounds around 7.5 million m^3 of water and is about 7 km downstream of the Angat Dam. On the other hand, Bustos Dam is an irrigation dam that further impounds and diverts the Angat River and is situated a few kilometers downstream of Ipo Dam. Angat Dam has a reservoir capacity of around 850 million m^3. If the impounded water exceeds this volume, water starts to overflow. Angat River runs for about 61 kilometers from the Ipo reservoir to its diversion in Labangan channel.

The Angat River joins the Pampanga River at Calumpit, Bulacan via the Bagbag River.

1.2.2. Morphogeologic Framework

The terrain surrounding the Clark Special Economic Zone (CSEZ) is dictated by and consequential to the activities the line of volcanoes the most prominent of which is Mt. Pinatubo, a 1,745-meter high volcano made famous by its June 1991 eruption. The CSEZ occupies the north eastern corner of a volcano clastic apron at the foot of the Mt. Pinatubo highland.

The volcano clastic apron is a gently-sloping with the apex at about 500 meters above sea level (masl) terminating near the North Luzon Expressway. Terrain is very gentle to nearly flat with elevation of about 20 m at the distal end to about 100 m at the midsection to the apex.

The topography was formed by inflow of pyroclastic deposits and lahar from the flanks of the Pinatubo highlands into the alluvial plains towards the Pampanga River. The 1991 Pinatubo eruption resulted in the in filling of the headwater of the river system that drains the highlands. Succeeding erosion of pyroclastic deposits due to rain fall and lahar flow left behind deep dendritic drainage network at headwater (Newhall et al 1996). Progressive erosion of the volcanic clastic ejectas from pre-1991 eruptions left behind distinctive pinnacle features along the valley walls of the Sacobia River. Pre-historic lahar flows also sculptured the valley, deeply incised the Sacobia River channel leaving behind near vertical channel walls.

Lining the western margin of the Pampanga Delta are volcanic centers located west-southwest of CSEZ. These are composed of older volcanic centers and relics of the ancestral Mount Pinatubo. The prominent peaks are Mt. Negron, Mt. McDonald, Mt. Tayawan Caldera and Mt. Dorst. To the south towards Bataan Peninsula, the terrain is dominated by Mt. Natib and Mt Mariveles.

The Bataan Volcanic Arc Complex is a northeast-trending swath of volcanic centers portion of which stretching from Bataan peninsula, Zambales and Arayat, Pampanga. Dated Late Miocene to Recent, the arc complex is composed of basalt, andesites, dacite, pyroclastic flow, and tuff. Within the Central Luzon segment, two (2) distinct belts of volcanic centers are recognized. The western belt stretch from Pinatubo to Samat-Mariveles extruded through the Zambales ophiolite terrain. The eastern belt - consisting of Balungao, Amorong, Cuyapo and Arayat - lies along the axis of the Central Luzon Basin upon which a thick pile of Tertiary sedimentary rocks have been laid (Pena 2005).

Figure 1-3 Morphogeoloic Features Surrounding the Proposed Clark-Trinoma Rail Alignment

To the east of the Central Luzon Basin is the Sierra Madre mountain range, a north-south belt from Montalban, eastern Bulacan to Nueva Ecija, just south of the Laur-Dingalan portion of the Philippine Fault. The youngest rock type present is the Pleistocene Antipolo Basalt (Figure 1-4). The Middle Miocene Madlum Formation is composed of lower clastic member middle Alagao Volcanics and upper Buenacop Limestone. The Madlum Formation conformably rests on top of the Early Miocene Angat Formation, Angat Formation unconformable over Bayabas, Sta. Ines Diorite, Barenas-Baito and Binangonan Formations. The Late Oligocene to Early Miocene Binangonan Formation is unconformable over the Maybangain Formation. The Early Oligocene Sta. Ines Diorite occurs as dikes and sills intruding the Cretaceous to Eocene sedimentary units of Kinabuan and Maybangain formations.

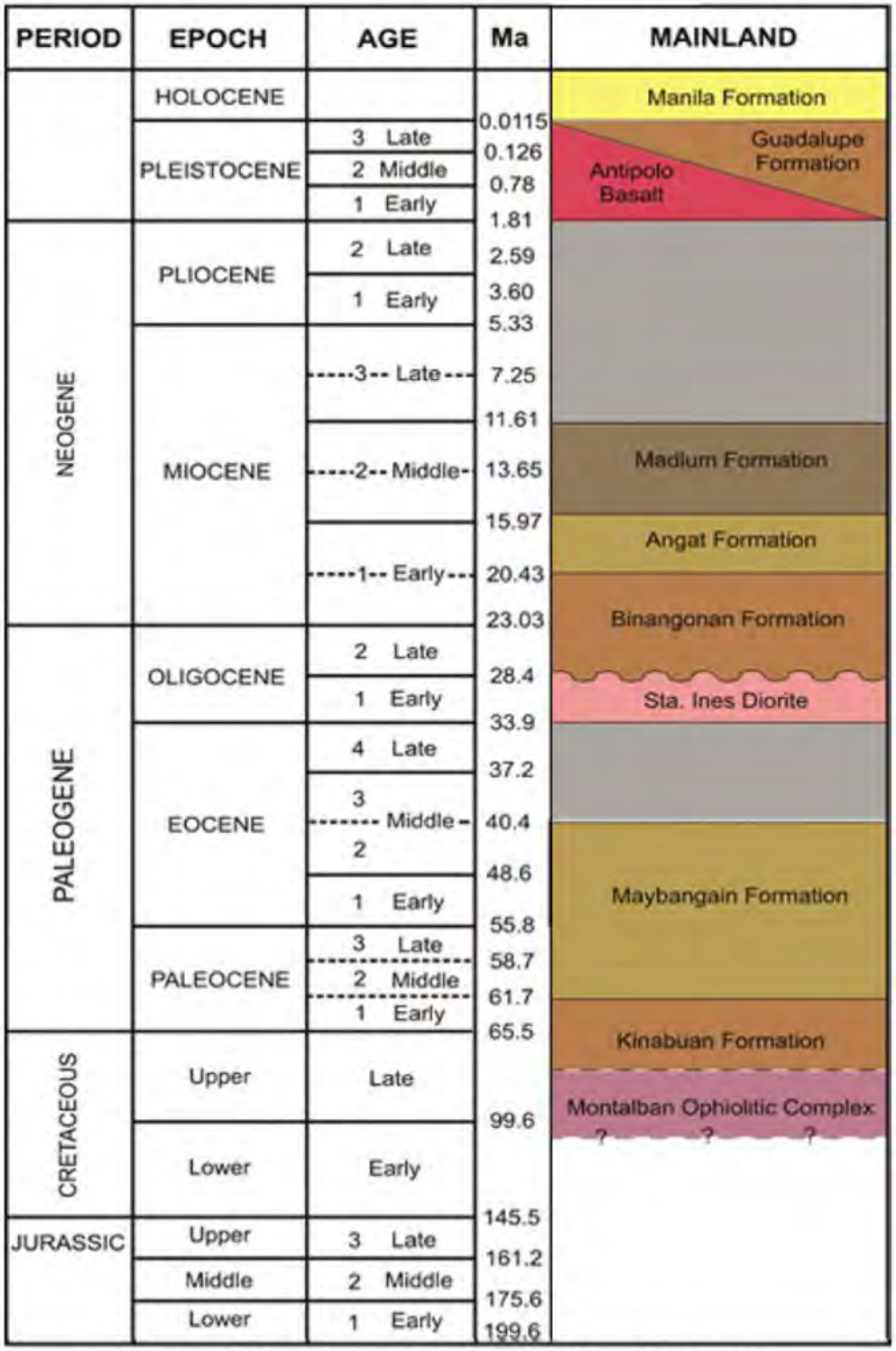


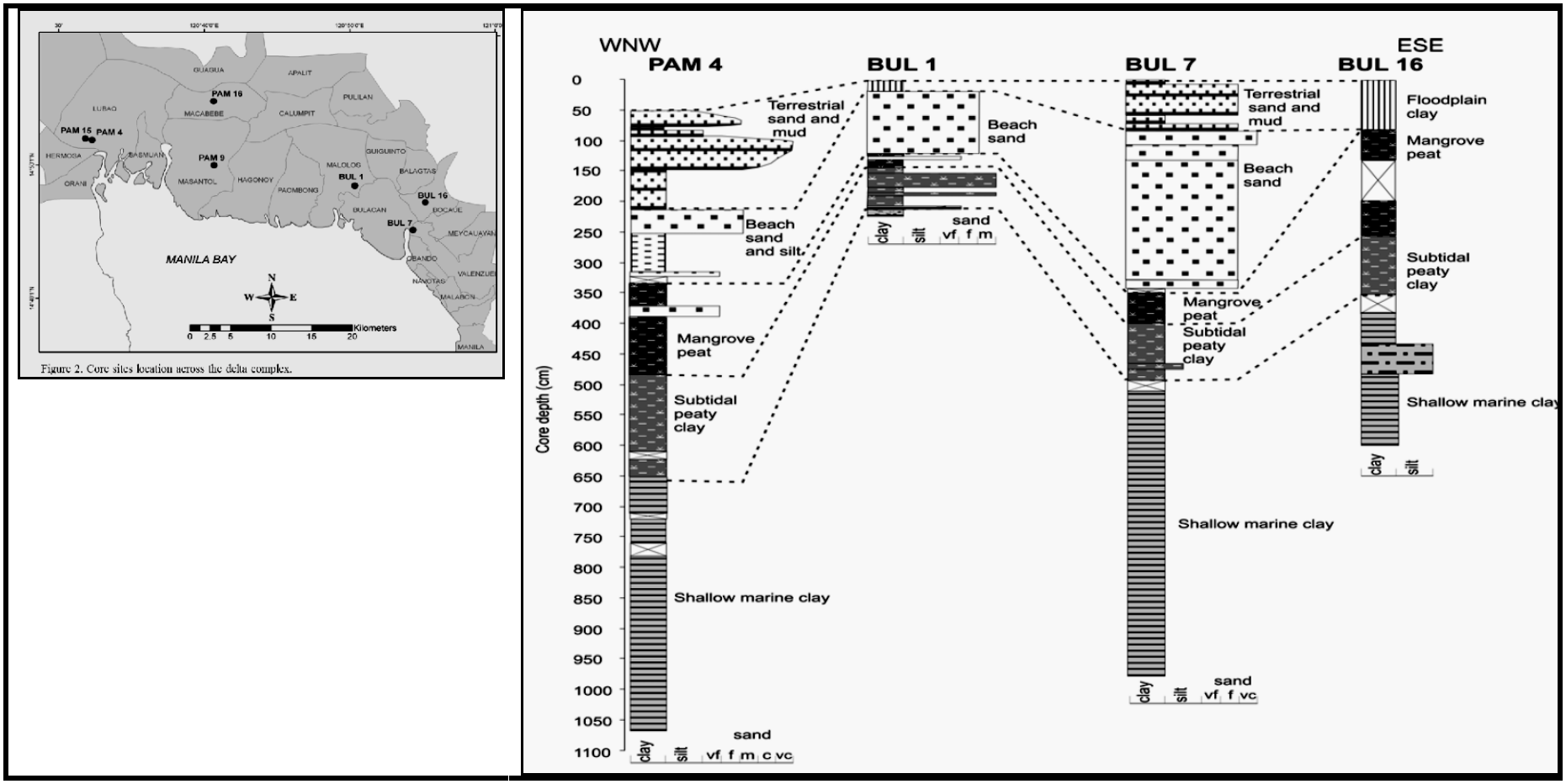
Figure 1-4 Stratigraphic Sequence of Southern Sirra Madre

The Middle Paleocene – Middle Eocene, Maybangain Formation rests unconformably over the Kinabuan Formation and unconformably overlain by the Binangonan Formation. The early Late Cretaceous Montalban Ophiolitic Complex constitutes the basement of the southern Sierra Madre.

Between the Pinatubo Highlands and the Sierra Madre Mountain is the Pampanga Basin. This inter-mountain area is nearly flat just a few meters above sea level. Terrain features are the wide expanse of the flood plains the Pampanga Delta and the Candaba Swamp. Seismic-reflection data and exploratory boreholes show a column of Miocene to Recent deltaic and shallow-marine rocks more than 7 km thick beneath the onshore and near shore (Bureau of Energy Development, 1986). Present within the basin are Oligocene to Miocene carbonates, marine clastics and volcaniclastics, Pliocene to Pleistocene shallow marine to terrestrial sedimentary and pyroclastics (BMG, 1982; BED, 1986; Encarnacion, 2004). Quaternary alluvium in the form of lahars and flood plain sediments blankets the basin. Young flovio-marine sediments are found towards the delta.

Cores from drilling done in the delta by Soria, Siringan and Rodolfo (2005) show a complete upward sequences consisting of basal shallow-marine clay, transitioning into a mangrove-peat that in turn is overlain by beach and capped by fluvial sand and mud transitioning to floodplain clays (Figure 1-5). These represent deposition in successively shallower environments; the beach sand on top of the peat show deepening by relative sea level rise, followed by fluvial progradation. The shoaling upward sequence from marine clay to mangrove peat indicates shoreline progradation. Subsequently, as evidenced by beach sand overlying peat layers, the coastline retreated, possibly due to either regional sea-level rise or a local seismic event affecting the entire delta plain. The Buag eruption of Mt. Pinatubo, or fault movements along one or more of the many lineaments in the delta plain may have caused co-seismic subsidence. Finally, natural and human-induced compaction lowered the beach sands to their present depths. Importantly, the peat deposits overlain by beach sand in other core sites indicate a bay wide event, not localized erosion caused by delta shifts. The beach sands deposited soon after the eruption of Pinatubo 500 to 800 years ago record a pre-eruption shoreline more landward than the present one. High sediment input after the eruption rapidly filled the Paleo- Pampanga Bay (Gaillard et al., 2005), prograding fluvial sediments translating the shoreline seaward close to its present position.

Manila Formation found between Navotas and Caloocan overlays the Diliman Tuff. The deposit is a sequence of unconsolidated fluvial, deltaic and marine deposits believed to have been laid down during Holocene time. Subsurface data from core drilling along the Light Rail Transit 2 (LRT 2) route from Santolan, Pasig to Recto, Manila indicate the unconsolidated deposits consist of clay, silt, gravelly sand and tuffaceous silt (Purser and Diomampo 1995).
The Pleistocene Age Guadalupe Formation is composed of Lower Alat Conglomerate member (conglomerate, sandstone, mudstone) and Upper Diliman Tuff member (tuffs, pyroclastic breccias, tuffaceous sandstones). The formation unconformably overlies the Tartaro Formation and dated at Pleistocene Age. The Corridor from Caloocan City to Trinoma will cut through this rock type.



(From J. L. A. Soria, F. P. Siringan and K. S. Rodolfo 2005)

Figure 1-5 Shallow Subsurface Stratigraphy of the Pampanga Delta

Manila Formation found between Navotas and Caloocan overlays the Diliman Tuff. The deposit is a sequence of unconsolidated fluvial, deltaic and marine deposits believed to have been laid down during Holocene time. Subsurface data from core drilling along the Light Rail Transit 2 (LRT 2) route from Santolan, Pasig to Recto, Manila indicate the unconsolidated deposits consist of clay, silt, gravelly sand and tuffaceous silt (Purser and Diomampo 1995).

The Pleistocene Age Guadalupe Formation is composed of Lower Alat Conglomerate member (conglomerate, sandstone, mudstone) and Upper Diliman Tuff member (tuffs, pyroclastic breccias, tuffaceous sandstones). The formation unconformably overlies the Tartaro Formation and dated at Pleistocene Age. The Corridor from Caloocan City to Trinoma will cut through this rock type.

1.2.3. Geohazard Identification

Given the physiographic, climatological and geological condition of the site, the geological hazards that might impact the route alignment area are described in the following section.

1) Active Faults

Potential earthquake generators or active faults within the region of Central Luzon are the Philippine Fault (PF) which passes along Province of Nueva Ecija, the extension of the Marikina Valley Fault System (MVFS) at Angat, Bulacan and active faults east and south of the Zambales Range. Earthquake generators on the other hand are the Casiguran Fault located offshore of Casiguran in Aurora, Philippine Fault extension north of the region and the Lubang Fault near Lubang Island and Mindoro Island. The location of these fault lines relative to the route alignment is shown in Figure 1-6.

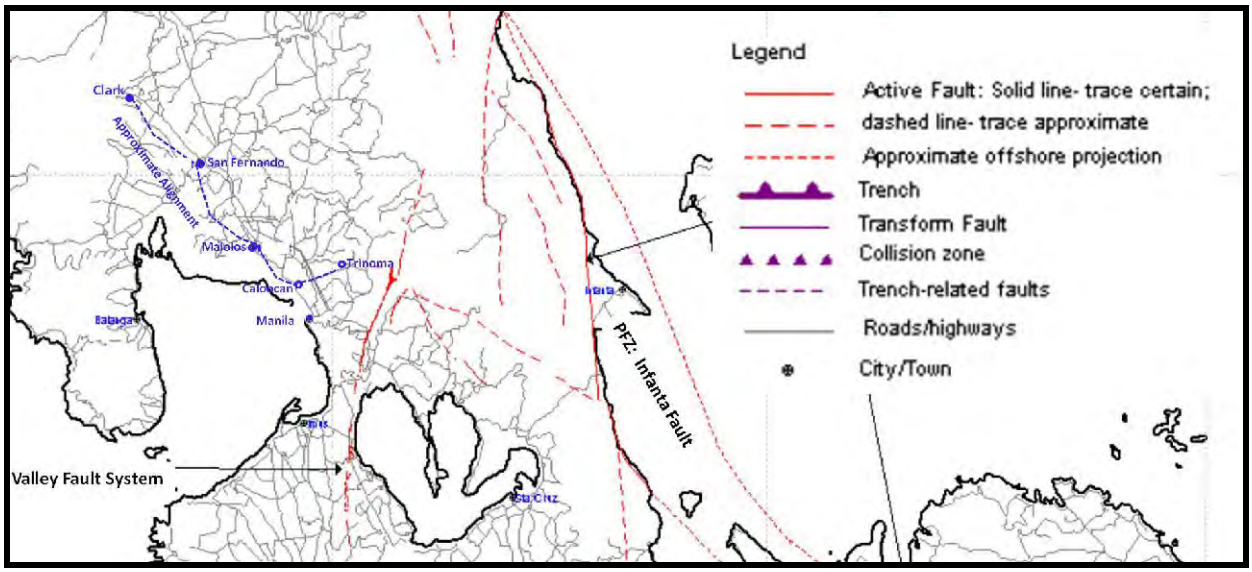


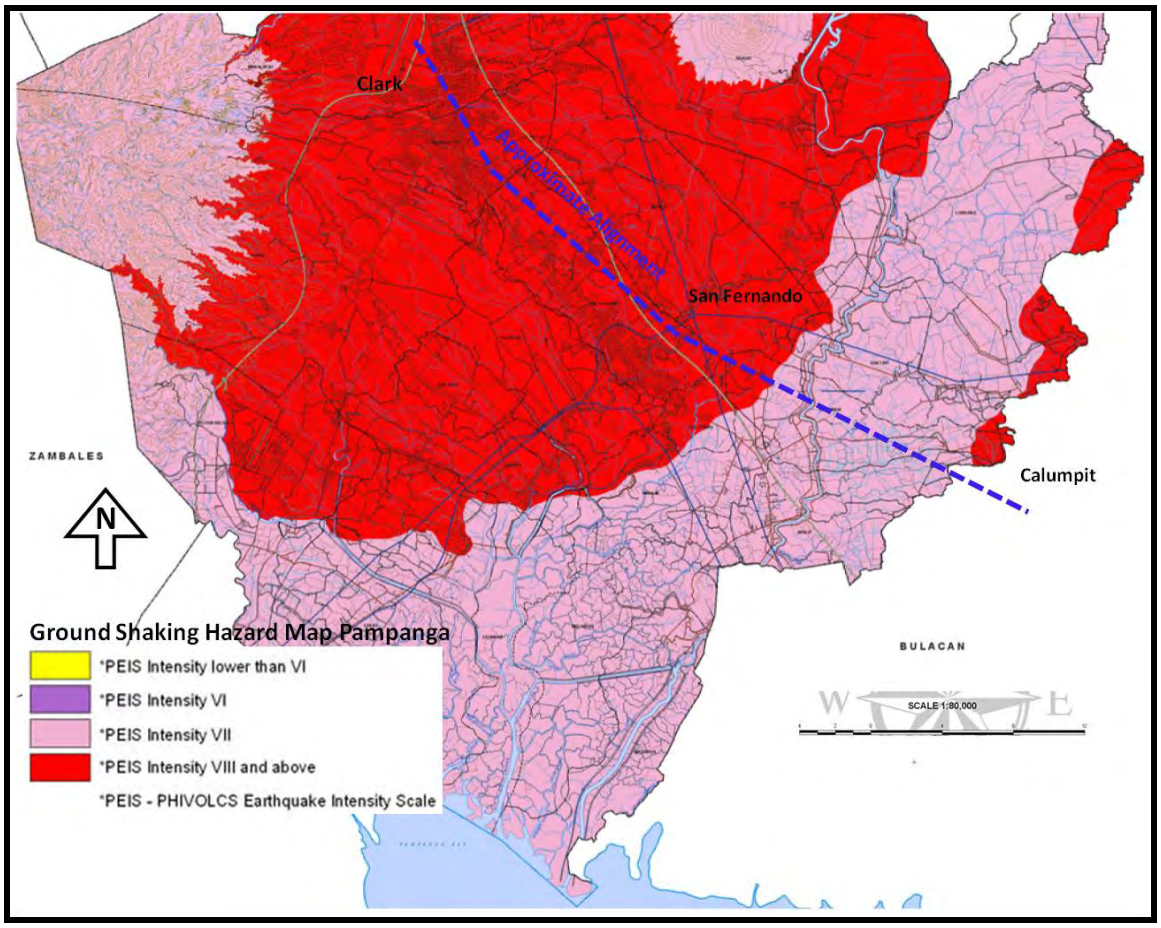
Figure 1-6 Location of Active Faults in Central Luzon Relative to the Clark-Trinoma Rail Alignment

2) Ground Shaking

Strong ground vibrations caused by the passage of seismic waves from the earthquake source (foci) to the ground surface may cause damages to the proposed project. The intensity of ground shaking in a given area is influenced by the magnitude of the earthquake, distance of the site from earthquake generator, and the modifying effects of subsoil conditions. Usually, the shallower the earthquake source and the closer the area from the epicentral area, the stronger is the felt intensity within the particular site. The resulting possible damage can be exuberated by the quality of the materials used, the quality of the design and the mode of construction.

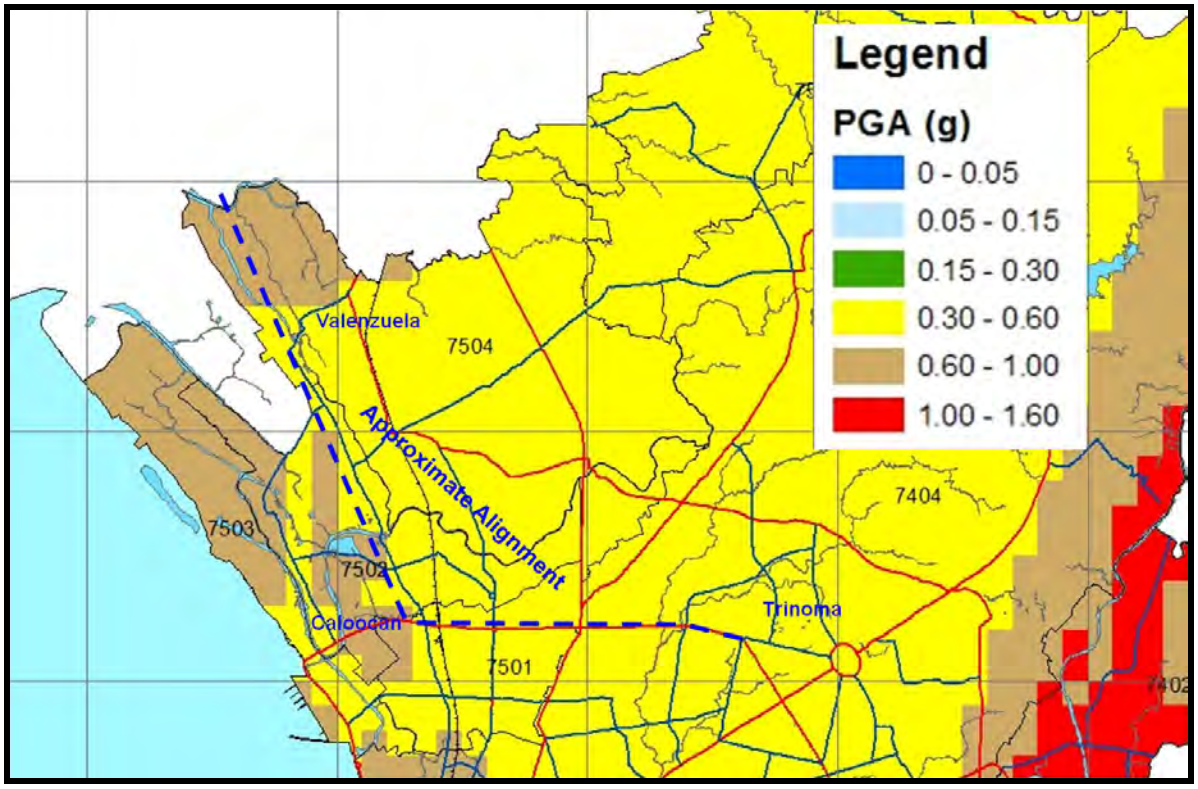
There are a number of possible earthquake generators which might have an effect on the project. PHIVOLCS had mentioned that the West Valley Fault is ripe for an earthquake based on its return period. Aside from the Marikina Fault, other earthquake generators within the close proximity to the alignment are Manila Trench and the Philippine Fault.

Maps from READY Project for Pampanga in Figure 1-7 and Metro Manila Earthquake Impact Reduction Study for Metro-Manila in Figure 1-8 show the probable level of ground shaking on a regional context, where the intensity of the ground shaking is usually translated into percentage of the ground acceleration (g). These hazard maps took into consideration the contribution of all possible earthquake generators within a broad area for certain span of time (e.g. 100 return period) and the result expressed in probabilities (e.g. 90% of non-exceedence).



(Modified from READY Project)

Figure 1-7 Ground Shaking Map for Pampanga



(Modified from MMEIRS)

Figure 1-8 Peak Ground Acceleration Estimates for Earthquake Generated By Marikina Fault

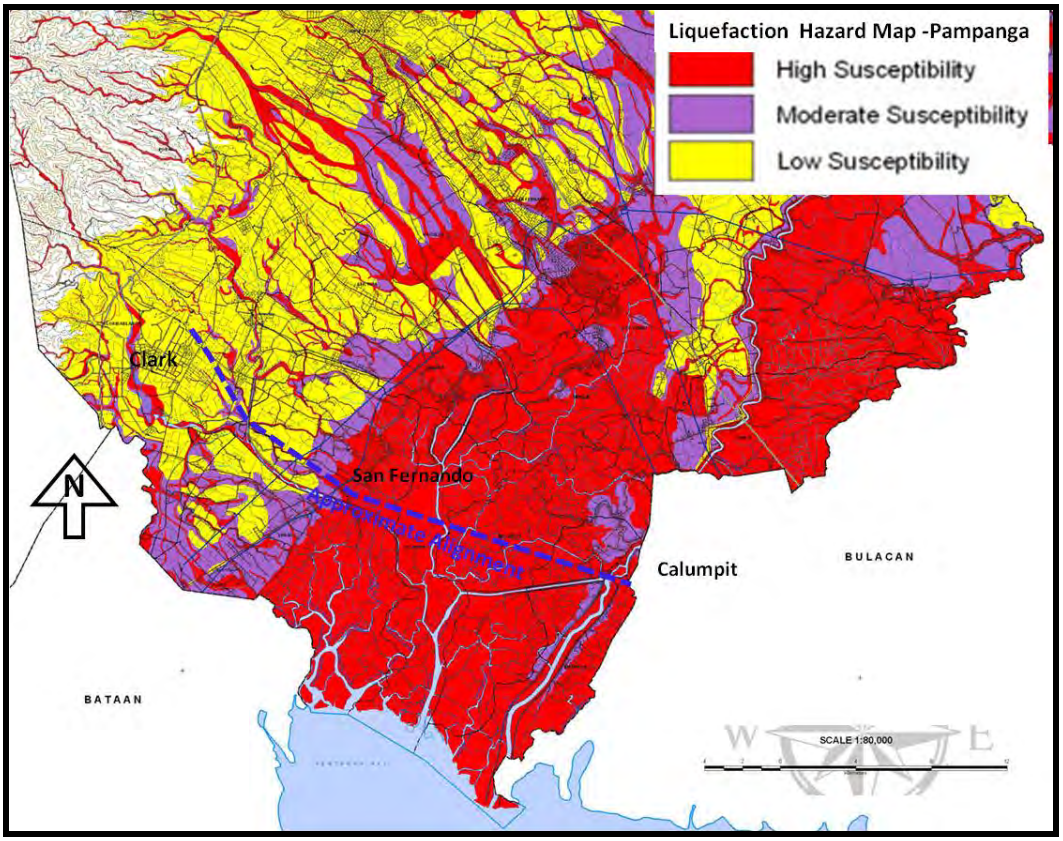
3) Liquefaction

Strong ground vibrations could cause the underlying foundations to temporarily assume a semi-liquid behavior in areas underlain by loosely-compacted, water-saturated fine sediments such as sand. Associated liquefaction effects are sand fountaining or sand boils, lateral spreading and ground undulation. Consequent to the withdrawal of materials beneath the ground surface, liquefaction is usually accompanied by differential settlement. Structures built with no special engineering designs against this hazard tend to settle or sink as the underlying foundation loses strength.

Available data of the subsurface materials along the route corridor shows the presence of unconsolidated, loose, non-plastic sand, sandy silt and sandy clay layers. Also common is the shallow water table. The combination of loose sediments and shallow ground water table which makes them likely to liquefy under certain seismic condition.

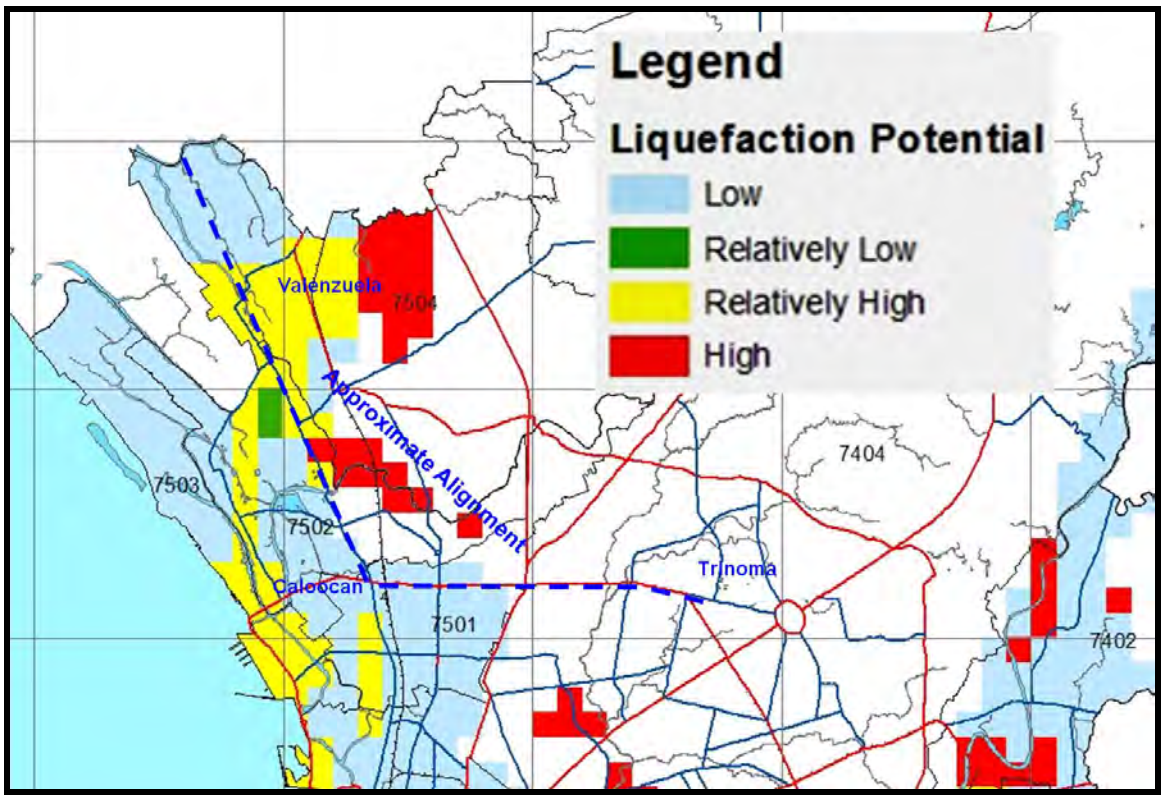
Geohazard mapping conducted by the Mines and Geosciences Bureau (MGB) shows 43 barangays in Pampanga and Nueva Ecija are prone to liquefaction. Further, mapping effort of the MGB also showed all 23 barangays of the coastal town of Sasmuan in Pampanga are prone to liquefaction. The other areas similarly at risk are Barangays Batasan, Candelaria, Consuelo, San Esteban and San Francisco in Macabebe town, and Bulac, Sta. Catalina, Daue, San Francisco I, San Francisco 2, Manica, Sta. Rita, San Pedro and Saplad in Minalin town, all in Pampanga.

Figures 1-9 and 1-10 show the areas with potentials to experience liquefaction in Pampanga and Metro-Manila.



(Modified from READY Project)

Figure 1-9 Liquefaction Hazard Map for Pampanga



(Modified from MMEIRS)

Figure 1-10 Liquefaction Potential for Earthquake Generated By Marikina Fault

4) Ground Rupture/Creep

Surface rupturing or the breaking and movement of the ground along an active fault trace could result to horizontal/vertical shifting of the ground or the combination of both. Damage can be severe for structures directly standing and located within a narrow zone of the active fault traces. The location, pattern and style of surface faulting generally appear to occur along pre-existing fault traces, hence the precise delineation of these traces are very important, in mitigating damages due to surface rupturing.

In general, the stronger the earthquake, the longer the expected length of the surface ruptures and consequently, the anticipated maximum displacements are also larger. For the Marikina Faults, available empirical relationships relating the earthquake magnitudes, length of surface rupture and maximum displacements indicate that a 7.5 magnitude earthquake from this source may generate a surface rupture of about 70 kilometers (PHIVOLCS 1993).

Soria, *Siringan* and *Rodolfo* (2005) identified a number of lineaments within the Pampanga Delta two (2) of which is somewhere in the boundary of Pampanga and Bulacan. At this stage, no one is sure of the nature of these lineaments and it can only be assumed that some of these lineaments might be faults experiencing creep with still unknown but possibly substantial vertical displacement due to compaction caused by the accumulating weight of the delta mass.

1.3. Hydrology

1.3.1. Flooding

The Pampanga Delta occupies the northern coastline of Manila Bay and extends from Orani, Bataan in the east to the CAMANAVA Area of Metro-Manila to the west. About 25% of the entire deltaic area is under permanent flooding condition and 12% are subjected to prolonged and deep flooding during the rainy season. In addition, approximately 24% of the area including deep fine textured soils located on the low alluvial plain have very poor to poor natural drainage. The lower lying areas are also subjected to prolonged flooding that restricts their use only after high water recedes (Guanzon and Basa).

Somewhere within the delta, an area experiences on an average, at least one (1) flooding in a year. The delta is vulnerable to flooding primarily because of its low elevation and flat terrain, its proximity to Manila Bay where tides impede the river and creek flow several kilometers upstream, and narrow and silted waterways brought largely by the eventful Mount Pinatubo eruption (1991). Possible contributory cause is the reported slow sinking of the delta making the area very vulnerable to instant flooding.

The dry season generally occurs from December to May, and wet the rest of the year. The wettest months are from July to September. The Pampanga River Basin could handle between 100-130 mm of 24-hour rainfall. Extensive flooding occurred at the Pampanga River Basin in May 1966 during typhoon Irma (Klaring); May and June 1976 during typhoon Olga (Didang) in May and typhoon Ruby (Isang) in June 1976. June, July and August 1972 during the passage of typhoon Ora (Konsing) over Luzon in June, and a very slow moving typhoon Susan (Edeng) that made landfall for more than 24 hours in Luzon during July and with the southwest monsoon. It brought continuous heavy rains from July 6-11 then formed super typhoon Rita (Gloring) and typhoon Tess over the Philippine Sea and enhanced very heavy southwest monsoonal flow which brought continuous heavy rainfall from July 17-21 over Luzon. And in addition tropical storm Winnie and typhoon Alice enhanced more strong southwest monsoonal flow which brought more rains over Luzon from July 25-August 5 with very intense rains falling from July 27-August 3. Then super typhoon Betty (Maring) brought more rains over Luzon from Aug 13-18. Other destructive floodings occurred in June 1985 when typhoon Hal (Kuring) and typhoon Irma (Daling) enhanced heavy southwest monsoon flow causing extensive flooding in Luzon. More recent flooding were experienced during typhoons Ondoy, Peping and the rains brought by the typhoon Saola and the southwest monsoon in August 2012.

Presented in Figures 1.3-1, 1.3-2 and 1.3-3 are the areas prone to flooding within the Delta.

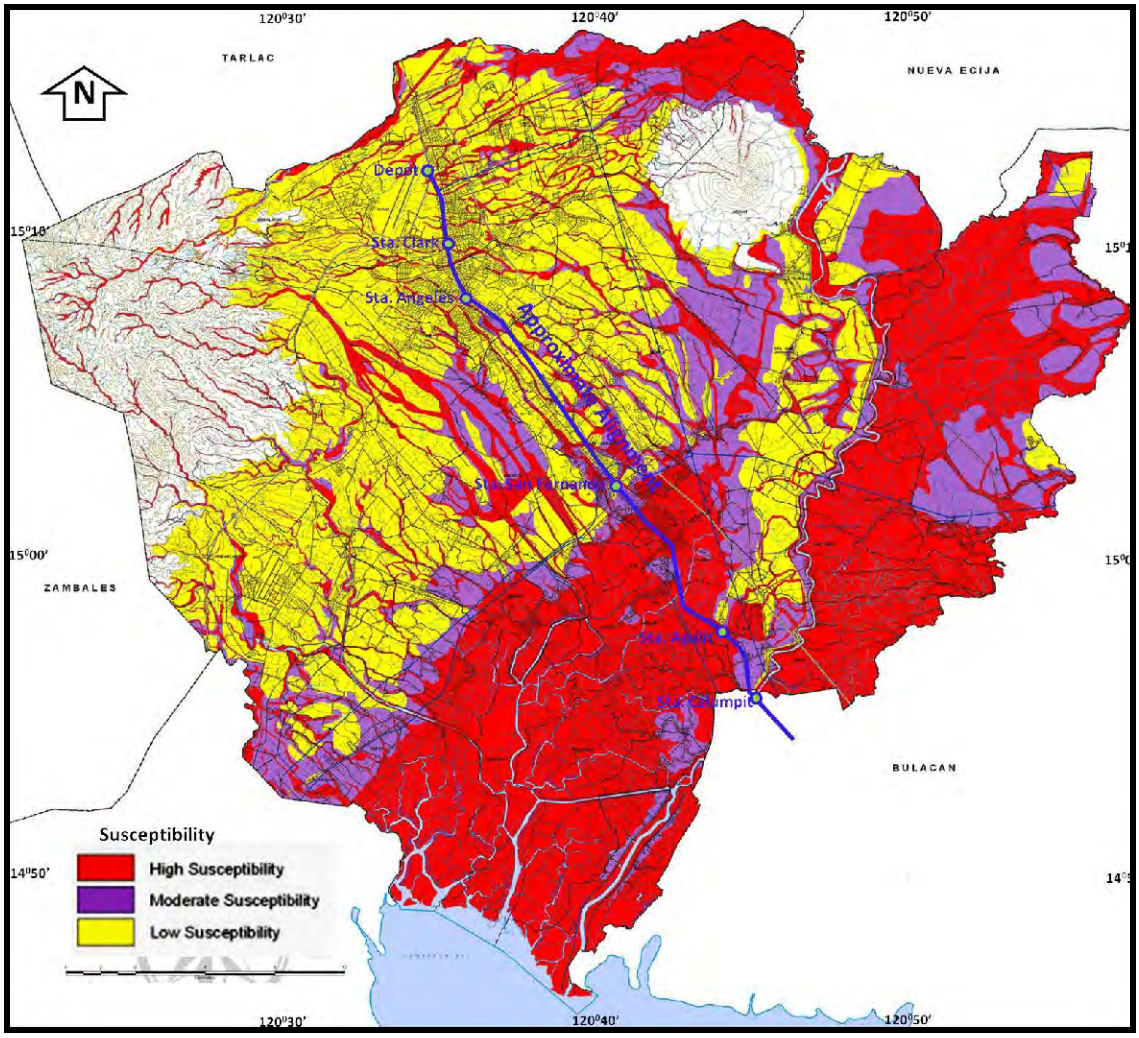


Figure 1.3-1 Flood Hazard Map for the Province of Pampanga

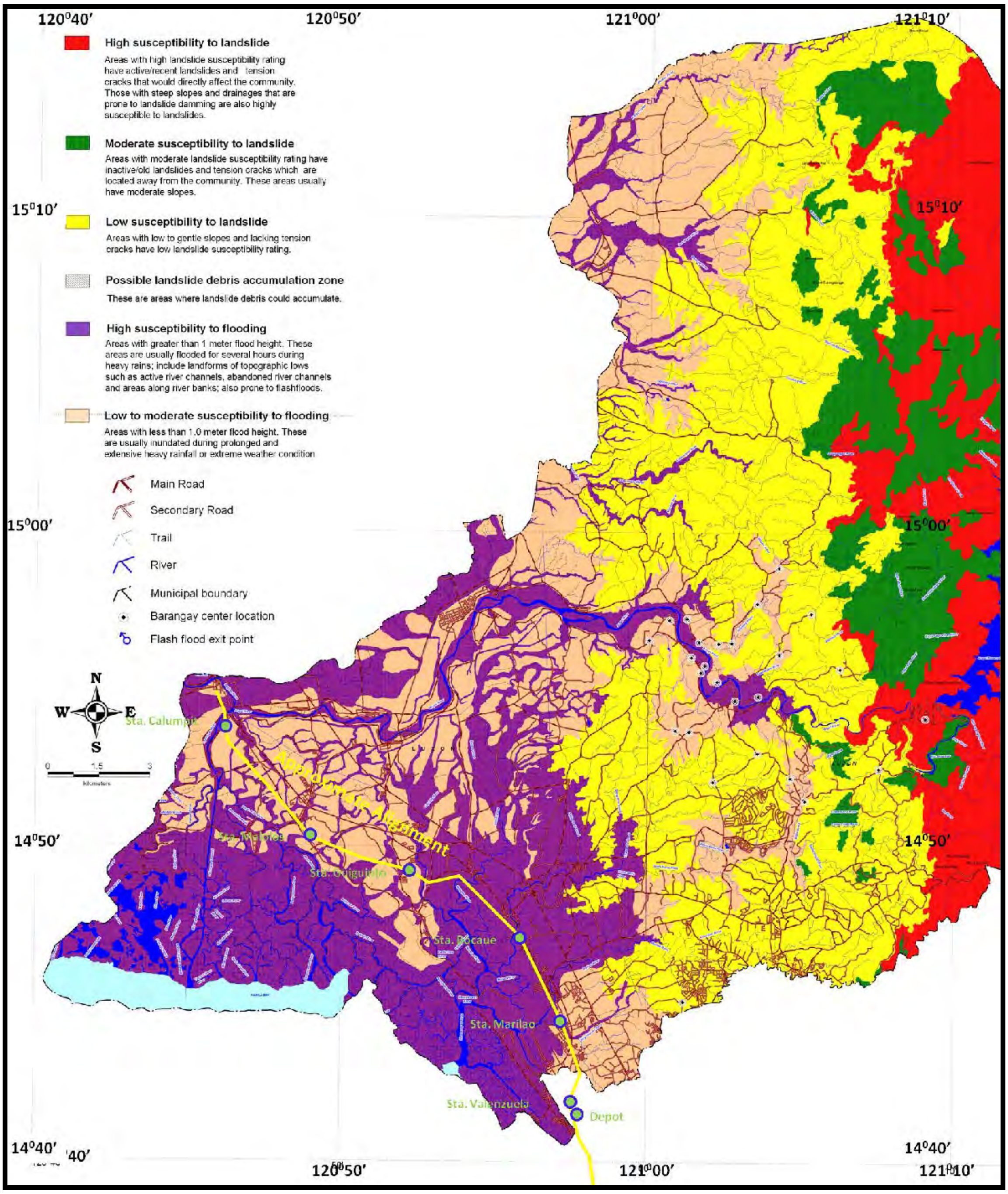


Figure 1.3-2 Flood Hazard Map for the Province of Bulacan

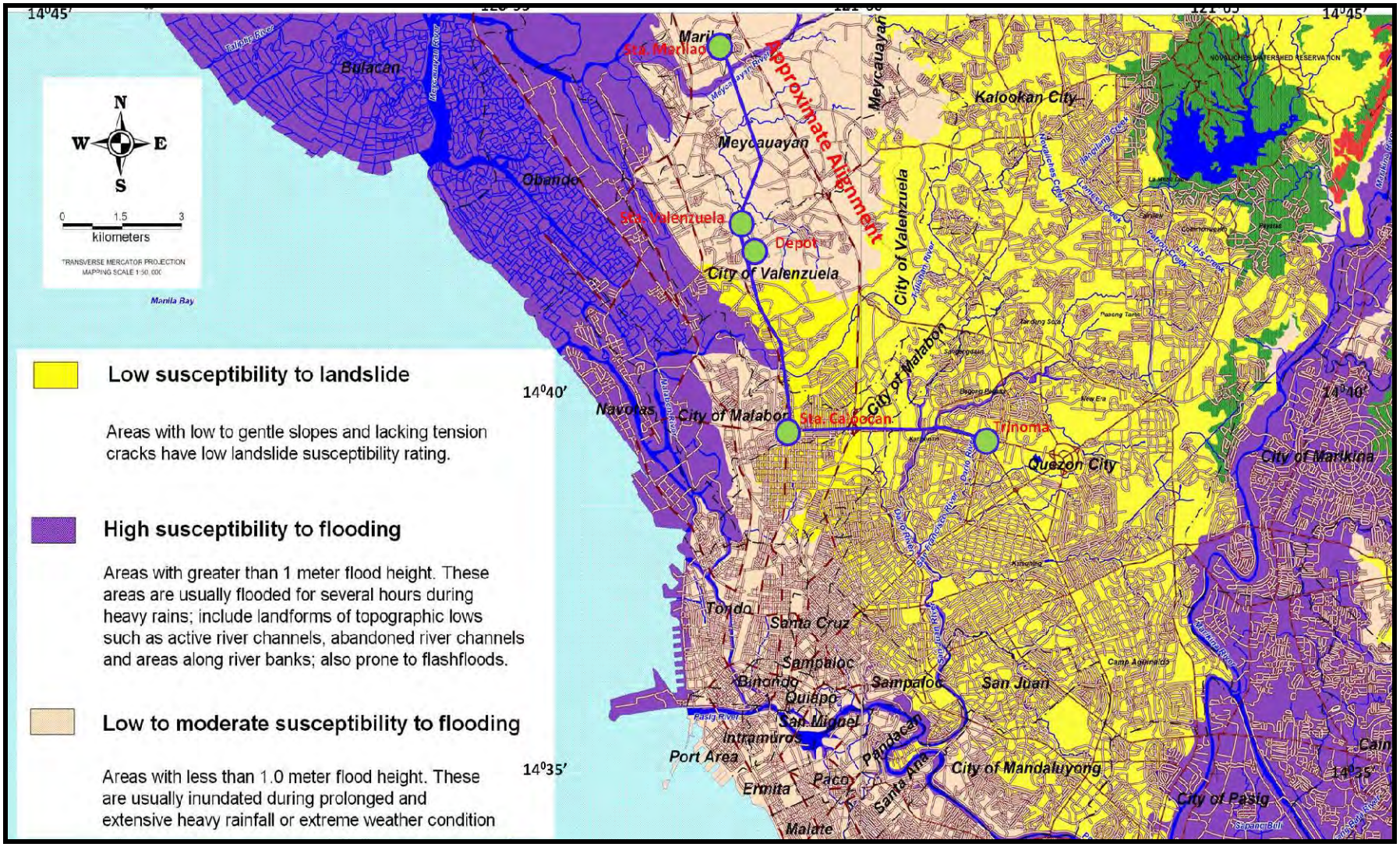


Figure 1.3-3 Flood Hazard Map for Metro Manila

1.3.2. Causes of Flooding in the Pampanga Delta

Flooding in the Pampanga Delta is a recurrent phenomenon. A number of factors were identified as the cause of or contributing to aggravate flooding. Some of these factors are interrelated and ironically some were even designed to mitigate flooding. The causes of flooding are:

- Illegally constructed fishpond dikes which occupies or intrude into main waterways of the different tributaries of Pampanga River. Fishponds along the river delta between Bulacan and Pampanga obstruct the flow of water from Candaba in Pampanga Province to the neighboring Calumpit town in Bulacan and on to Manila Bay. The clogging eventually leads to flooding in parts of Central Luzon. These structures rustics and or constricted the flow of flood water and expansion of areas for pond operation from both sides of the river banks makes the waterways narrower. A number of these structures were demolished even during the time of martial law under Presidential Decree 25 (Guanzon and Basa).

  Towards the general area of Bulacan and CAMANAVA, dwellings of informal settlers commonly encroach the waterways;

- The 1991 Mt. Pinatubo eruption left at least 5.5x109 m^3 of pyroclastic debris on the volcano flanks (Newhall & Jones, 1996). In the post eruption monsoon-typhoon seasons, great volumes of the eruption ejectas were mobilized into catastrophic lahars. Flooding on later years has been worsened by successions lahar flows (volcanic debris flows) and sediment enriched flood flows. Stream channels were filled with the reworked volcanic sediments. Enhanced flooding commonly has been attributed to this loss of channel capacity;

- The Pampanga River experienced decreased flow capacities due to massive siltation due to post Pinatubo eruption lahar deposition. Several Mt. Pinatubo rehabilitation projects were implemented to increase the conveyance capacities of these rivers. However, the magnitude and extent of the lahar affected areas and the limited resources of government have left some areas to depend on reactive solutions to the flooding problems (NEDA 2011).

- Construction of levees and dikes as part of the lahar containment efforts in the years following the Mt. Pinatubo eruption. This resulted to raised channel bed, some by as much as 10 meters above the adjacent flood plain (See Plate 1). Since the raised river cannot function as a natural drainage line, surface water accumulates and inundated the areas adjacent to the river bank. Since water cannot drain naturally, period of inundation takes days sometimes weeks.

  Levees and dikes are generally single-purpose flood protection structures built adjacent to the banks of rivers susceptible to flooding. Bank stabilization projects include such features as reduction of erosion from river banks and removal of natural growth and debris from channels to allow passage of greater flows.

  In the CAMANAVA area and to some degree in some small creeks or channels in Bulacan are in varying degree clogged by unabated disposal of domestic garbage, channels are littered with plastic bags filled with domestic and human waste.

Plate 1 Portion of Sta. Rita dike used as alternate road blocking direct access to the Pasig-Potrero River

- Release of water from six (6) dams in Luzon is commonly attributed to the worsening flood condition in Central Luzon. Senate hearings were held to discuss the Philippines' out-dated dam protocol to wit water is released when downstream areas are already flooded thus the source of contentions for the dams contributing to flooding. As an example, the National Power Corporation (NPC) releases water from Angat Dam during Typhoons Pedring and Quiel. NAPOCOR claim released water is at a rate of 500 m^3/s after water elevation in the reservoir reached 215 masl. As per NPC, the dam's spilling level is 210 masl and the reservoir maximum capacity is 217 masl. Commonly impacted by flood attributed to the released dam water are the low laying areas along the Angat River covering Hagonoy, Malolos, Calumpit, Pulilan and Baliauag.

- Flooding blamed on the release of water from La Mesa Dam is also experienced in Tullahan and Malabon Rivers.

- Change of land use in a way also contributed to the flooding. Large tracks of land had been converted from agricultural to industrial estates, housing and subdivision. Surface paving and roofing from these land use reduced infiltration and percolation of surface water into the ground. Engineered drainage lines allow direct discharge of surface water into the river system thus contributes to increased flood height at a relatively shorter time.

- Further, forest cover in several critical watersheds throughout the region diminished through time, blamed primarily on illegal logging, "kaingin" and encroachment. It was also determined that limited and overlapping mandates in the management of forest resources (watersheds included) weaken the implementation of otherwise resource conservation programs in these areas. It is also said that dam capacities have decreased due to siltation as a result of denudation of the respective watersheds.

- Tide in Pampanga Delta is predominantly diurnal and microtidal with a tidal range of 1.25 m. The record for highest spring tide, 1.93 m, was set on July 4, 2000 (Nippon Koie, 2001). The height can further be increased when southerly and westerly airflows that deliver heavy rainfall

with the monsoon to the region cause the sea level to temporarily rise above the normal tide height at the coast by piling up the seawater against it. Similar to a storm surge, high tide level can rise by as much as 80% (Siringan & Ringor, 1998). This "pile up" timed when floods flow out to see would cause back flow of river water flowing out to sea;

- Subsidence is a major consideration in the flooding in the entire delta from Pampanga to Metro-Manila. The study of Siringan and Rodolfo (2003) showed subsidence is the result of a) over pumping of groundwater, and b) natural compaction or compression of sediments.

  In the delta area, subsidence is a result of over extraction of ground water for domestic, industrial, agricultural, and aqua-cultural uses. The exploitation of groundwater leads to a dewatering processes result to compaction of the under laying sediments. Water occupying pore spaces in sand and other detritus when removed leads to loss of support, and the original volume of detritus is drastically reduced.

  The estimated subsidence rate in the Pampanga Delta is between 2-4 cm/year with average of 2.5 cm/year (Siringan and Rodolfo 2003). As a result, some areas that stood above tide levels 30 years ago are now frequently flooded almost a meter deep during high tide. The coastline of Metro Manila is sinking by several centimeters/year or one (1) meter in four years and Malabon, has been sinking by 10 centimeters a year (Dr. F. Siringan GMA Report August 17).

  Deltaic sediment naturally compact or compress under its own accumulating weight (Siringan and Rodolfo 2003). Natural compaction of sediments can be assumed to be relatively minor. Deltaic sediments with porosities in excess of 50% are "auto compacted" by the accumulating overburden as water is squeezed out and at depths greater than 2-3 km. It is estimated that deposition of the first 1000 m releases sufficient volume of water, reducing porosity at the base of the column to about 20%, and that comparable volumes are released by continuing compaction until porosity is minimized at about 10 km of burial. The compaction ratio of near-surface sediments indicate that of the 2-8 cm/year of subsidence, about 2-8% can be attributed to natural compaction of the near surface sediments. This implies that enhanced dewatering of the upper 30 m of the sediment column can potentially account for almost 98% of the subsidence rates during the past decade (Soria, Siringan and Rodolfo 2005).

- The sea level in Manila Bay is rising by almost one (1) centimeter per year because of global warming. At Manila's South Harbor, a tide gauge recorded a relative sea level rise of 2.35 cm/year from 1963 to 1980 an order of magnitude higher than both the local rate from 1902 to 1930, as well as the global average rate (Siringan & Ringor, 1998). In Manila, the relative sea level rose to about 2 mm/year from 1902 to the early 1960s, essentially the rate of eustatic rise.

  The estimated mean global eustatic sea level rise of 0.12-0.18 cm/year is only half of the present rate of sea level rise being experienced by the Pampanga Delta region (Siringan and Rodolfo 2003).

  However, the rate of sea level rise is much slower than the effect produced by subsidence of the delta deposits, which is greatly accelerated by over pumping of groundwater.

  At the Pampanga Delta, subsidence is an order of magnitude more rapid than the present eustatic rise, measured in centimeters per year. Natural phenomena that may cause Pampanga Delta to subside are:

  In the NEDA 2011 Report, it was mentioned that there was an increases in regional land and sea surface temperatures in the past 40 years. Based on Manton etal. (2001) study, the Manila Observatory predicts that Central Luzon's provinces shall be subjected to high and very high risks to projected rainfall changes (Figure 18).

1.4. Groundwater Resources

1) Overview

The main source of drinking water for most Filipinos is groundwater based on a National Irrigation Authority (NIA) Study (Salvador, NIA, 1995). Groundwater from wells and springs provide 97% of water supplies while the remainder is supplied by surface water such as lakes, streams and rivers.

Problems in groundwater mining particularly in major urban centers have been experienced in many areas. However, there are very limited scientific studies that can quantify and identify problems such as over-extraction. In 1991, a JICA study identified nine (9) water-critical areas in the country. These consist of: Metro Manila, Metro Cebu, Davao City, Baguio City, Angeles City, Bacolod City, Iloilo City, Cagayan de Oro City and Zamboanga City.

In February 2001 the Philippine Institute for Development Studies (PIDS) came up with a series of discussion papers which aimed to assess the groundwater resources of Metro Manila and Metro Cebu, particularly in terms of groundwater potential and associated problems, including storage coefficient, transmissivity, safe yield, and salt water intrusion. Due to complexity and expensive nature of actual field investigation, monitoring, and analysis, mathematical modeling was used instead. Results of the study showed that Metro Manila gets an annual recharge of 206 MCM, which is basically due to the high rainfall events during the wet season. Inflows from Laguna Lake and leakage from MWSS distribution systems was also identified as contributors to the recharge. It was also found that due to the over pumping of wells in some coastal areas in Metro Manila, seawater intrusion of aquifers has become a serious problem. Part of the recommendation was to a develop a regional scale groundwater and environmental planning scheme for the two metropolis by linking the models with GIS so groundwater data base maps can be overlaid with land use, management practices, recharge distribution and mass loadings of chemicals.

In 2004, another paper entitled, "*Identification of Groundwater Critical Areas in Metro Manila and Vicinity and Formulating an Integrated Approach to Aquifer Recharge and Protection*" was compiled by Edmund Allan Piquero Jr. The main objective was to utilize assessment of Metro Manila water resources in coming up with a tool for water regulation. Results of the study showed that eight (8) sites within the study area (Metro Manila and adjacent areas) were considered in need of urgent attention. These are: (i) Guiguinto, (ii) Bocaue – Marilao, (iii) Meycauyan – North Caloocan, (iv) Navotas – Caloocan – West Quezon City, (v) Makati – Mandaluyong – Pasig – Pateros, (vi) Parañaque-Pasay, (vii) Las Piñas – Muntinlupa and (viii) Dasmariñas, in the Province of Cavite. Some of the recommendations made are as follows:

- **Drilling of monitoring wells** (if abandoned wells suited for use as monitoring well is not available) so that data loggers can be installed to measure groundwater levels and electrical conductivities (EC) be implemented in these areas. This would allow time series recording of groundwater level declines and recording of water quality deterioration.

- **Alternative sources of water be developed** (such as the Kaliwa or Kanan River water sources) and constructed within the next 10 years that would allow water well users to shift from groundwater to using surface water from the MWSS and its concessionaires. This should be supplemented by an information campaign that would educate the general public and all groundwater users of the gravity of the situation and that measures are being undertaken to address the impending problem.

- **Construction of long horizontal infiltration galleries** 30 to 50 meters from the lake shoreline (to allow filtering of the objectionable constituents present in Laguna Lake water) and parallel to Laguna Lake (Sta. Rosa to Los Baños, Laguna), which would tap the

groundwater from aquifer beneath the silty/clayey lakebed. Pumped groundwater from sump wells constructed at the ends and at intervals along the gallery could supply recharge wells (abandoned wells or newly drilled recharge wells).

- **Utilize untreated excess surface water overflows in dams**. These waters are cleaner and fresher, since they come from the mountains. This will be utilized to artificially recharge the aquifer particularly at the cones of depressions that are adjacent to existing dams. Using this method, water surplus during the rainy season can be tapped as a source for recharging the Metro Manila Aquifer.

- **Impose restrictions in groundwater withdrawal**. Well location of new applicants for well permits should not be within the identified cones of depressions (i.e., areas identified as experiencing over-extraction). Should the well location be outside the cones of depression, the new groundwater applicant's well should be evaluated using the model on the basis of its immediate effects on the nearest well.

2) Groundwater System of Metro Manila

Characterization of Metro Manila's groundwater system was obtained from the 2001 PIDS paper entitled, "*Metro Manila and Metro Cebu Groundwater Assessment. Discussion Paper Series No. 2001-05*, by R.S. Clemente et.al."

3) Confined Aquifers

The groundwater system of Metro-Manila is found in groundwater formations underneath the Guadalupe Plateau and the Antipolo Plateau. The main aquifer is the one formed by the Guadalupe formation which covers 472 km^2 and which also covers much of the area of the NCR. It is believed to extend beneath the bed of Laguna Lake. Groundwater is stored and transmitted in this main aquifer by openings and fractures in the tuffaceous formation. This main aquifer is under pressure (thus the term artesian). It is separated from the overlying material by a semi-permeable or semi-confining layer, also called an *aquitard*. The thickness of this layer varies from 15 to 45 m.

The semi-permeable layer separates the aquifer below (thus the term confined aquifer) and is responsible for creating a pressurized condition. However, in some parts of Metro-Manila where drawdowns of more than 50 m have been caused by over pumping, the main aquifer has been converted to a water table aquifer (i.e, the aquifer is no longer pressurized).

4) Unconfined Aquifers

Water is also stored in the earth material above the confining layers of the main aquifer (so-called phreatic or water table aquifers). This water occurs in a non-pressurized state. Alluvial sediments derived from erosion of the Guadalupe formation provide the medium or material for water table aquifers. Such alluvial sediments occur in three areas within the NCR---the Manila Bay deltaic plain, the Marikina Valley, and the alluvial deposits found at both the periphery and bottom of Laguna Lake. The alluvial sediments occur as irregular lenses varying in form and thickness (i.e., from about 50 m along the Manila Bay shore to about 100 m near and underneath Laguna Lake).

The layers confining the main pressurized aquifer in the predominantly tuffaceous strata and the water table aquifer in the overlying alluvial formation are not totally impermeable, however. Some "leakage" is believed to take place between the main pressurized (or confined) aquifer and the overlying water table aquifer.

5) Aquifer Characteristics

Results of recent studies indicate that the average value of the transmissivity coefficient in Metro-Manila's Guadalupe formation is 58 sqm/day, with a range of 50 to 100 sqm/day, characteristic of an aquifer with slightly moderate water transmitting properties. Zones with high transmissivity (up to 200 sqm/day) are found locally in coastal areas along Manila Bay and Laguna Lake, as well as in the Marikina Valley.

The storage coefficient in the main aquifer varies from 0.1 in the water table aquifer located south of the NCR to 0.0001 in the northern part where the aquifer is believed to be under artesian (pressurized) conditions. However, in parts of the main aquifer where leakage from the water table aquifer occurs, higher values of storage coefficient are observed (i.e., 0.002 to 0.006). Higher storage coefficient values mean that the aquifer is able to release more water from a unit volume for a unit change in head.

6) Aquifer System Recharge

The semi-confining layer or aquitard separating the main artesian aquifer below from the water table aquifer above has a leakage coefficient that varies from $1x10^{-11}$ to $3x10^{-9}$ per sec, which is a measure of the water transmission rate across the aquitard. Before large scale pumping took place, the pressure head in the artesian aquifer was believed to be higher than that of the water table aquifer in some parts of Metro-Manila (particularly near the coast and around Laguna Lake), resulting in upward leakage (and even free flowing wells in certain areas). With pumping, however, the pressure or head in the artesian aquifer is reduced. When the water pressure in the artesian aquifer becomes lower than the hydrostatic head of the upper (water table) aquifer, leakage occurs in the downward direction. In this way, the overlying water table aquifer recharges the artesian aquifer below, a process that is believed to have be happening in the Metro-Manila aquifer system.

Because of over pumping, as previously mentioned, groundwater levels in the main aquifer have been lowered below the bottom of the semi-confining layer. In this case, maximum downward leakage would have been attained and no further increase in recharge to artesian aquifer from the overlying water table aquifer can be expected. The estimated leakage from the water table aquifer to the main aquifer is about 421,000 cum/day or 154 million cum/yr. In turn, recharge to the water table aquifer comes from rainfall that infiltrates into the ground. This occurs over an area of about 650 sq km.

Aside from rainfall, recharge to the Metro Manila aquifer system (consisting of both the water table aquifer and the artesian aquifer) comes from other sources. For instance, deep cones of depression created by pumping along the Manila Bay coastline and along the western shore of Laguna Lake have the effect of inducing inflow to both the water table aquifer and artesian aquifer. Along the Manila Bay coast, however, this process induces saltwater intrusion. There is also inflow coming from contiguous aquifers located in the North and South where the piezometric surface is higher. Another source of groundwater recharge is leakage from MWSS pipes.

Overall, it is estimated that the total annual recharge to the groundwater system is about 217 million cum/yr or 594,000 cum/day. Much of this amount comes from precipitation over a 790 km^2 area (148 m cum/yr). Induced flow from Laguna Lake is estimated at 22 m cum/yr; inflow from the North, at 12 m cum/yr; and inflow from the South, at 10 m cum/yr. Recharge from MWSS pipeline leakage is estimated at 25 m cum/yr.

1.5. Protected Areas

The National Integrated Protected Areas System (NIPAS) was enacted into law as Republic Act (R.A.) 7586 in June 1992. All areas or islands in the country that has been proclaimed pursuant to a law, presidential decree, presidential proclamation, or executive order as national park, strict nature reserve, watershed, mangrove reserve, fish sanctuary, natural and historical landmark, protected and managed landscape/seascape, as well as identified virgin forests before the effectivity of the Act were designated as initial components of the System.

From 1992 to the present, 203 Protected Areas (PAs) have been included as initial components of the NIPAS; 23 of these are located in Region 3, and one (1) in NCR. Of these, 107 have been proclaimed by the President. However only 11 have been enacted by Congress and therefore are established under the National Integrated Protected Areas System (NIPAS). Of these 11, only one (1) is located in Region 3, Bulacan Province, which is the Biak-Na-Bato National Park. None of these protected areas shall be traversed by the Project. It is important to note that both initial and established components of the NIPAS are at least more than 20 km away from the proposed railway alignment.

A list of PAs found in Region 3 and NCR is presented in Table 1.5-1. The location of these are shown in Figures 1.5-1, and 1.5-2 for Region 3, and NCR, respectively.

Table 1.5-1 List of Protected Areas found in the 200 km-Radius Metro Manila Study Sphere

Name of Protected Area	Location	Area (Ha)	Status Under NIPAS
Region 3 - Central Luzon			
1. Minalungao National Park	Gapan and Gen. Tinio, Nueva Ecija	2,018.00	Initial Component
2. Biak-na-Bato National Park	San Miguel and Doña Remedios Trinidad, Bulacan	658.85	NIPAS R.A. 8546
3. Capas Death March Monument	Capas, Tarlac	1.54	Initial Component
4. Mt. Arayat National Park	Arayat and Magalang, Pampanga	3,715.23	Initial Component
5. Bataan National Park	Hermosa, Orani, Samal, Abucay, Pila, Balanga, and Morong, Bataan	23,688.00	Initial Component
6. Roosevelt National Park	Hermosa and Dinalupihan, Bataan	1,334.59	Initial Component
7. Olongapo Naval Base Perimeter	Olongapo City, Zambales	9.04	For disestablishment
8. Aurora Memorial Park (Bongabon- Baler National Park)	Bongabon, Nueva Ecija and Baler, Quezon	5,676.00	Initial Component
9. Lake Malimanga Bird & Fish Sanctuary	Candelaria, Zambales	12.35	Initial Component
10. Mariveles Watershed Forest Reserve	Mariveles, Bataan	325.00	Initial Component
11. Olongapo Watershed Forest Reserve	Olongapo, Zambales	6,335.00	Initial Component
12. Angat Watershed and Forest Range	Norzagaray, San Jose, Bulacan and Montalban, Nueva Viscaya	6,600.00	Initial Component

13. Talavera Watershed Reservation	Sta. Fe, Nueva Viscaya, Carranglan, Lupao, San Jose, Pantabangan, Nueva Ecija	37,156.00	Initial Component
14. Pantabangan-Carranglan Watershed Reservation	Pantabangan, Carranglan, Nueva Ecija	84,500.00	Initial Component
15. Doña Remedios/General Tinio Watershed	Doña Remedios, Bulacan, Gen. Tinio Nueva Ecija	20,760.00	Initial Component
16. Calabgan Watershed Forest Reserve	Casiguran, Aurora	4,803.00	Initial Component
17. Dipaculao Watershed Forest Reserve	Dipaculao, Aurora	1,786.00	Initial Component
18. Dinadiawan River Protected Landscape	Dipaculao, Aurora	3,387.00	Initial Component
19. Amro River Protected Landscape	Casiguran and Dilasag, Aurora	6,470.00	Initial Component
20. Talaytay Protected Landscape	Dinalungan, Aurora	3,527.87	Initial Component
21. Simbahan-Talagas Protected Landscape	Dinalungan, Aurora	2,266.49	Initial Component
22. Dibalo-Pingit-Zabali-Malayat Watershed Forest Reserve	Baler, San Luis, Aurora	4,528.00	Initial Component
23. Aurora Watershed Forest Reserve	Baler, Quezon	430.00	Initial Component
National Capital Region (Metro Manila)			
1. Quezon Memorial National Park (Ninoy Aquino Parks and Wildlife)	Diliman, Quezon City	No data	Initial Component

Source: Planning Section, DENR Protected Areas and Wildlife Bureau (PAWB)

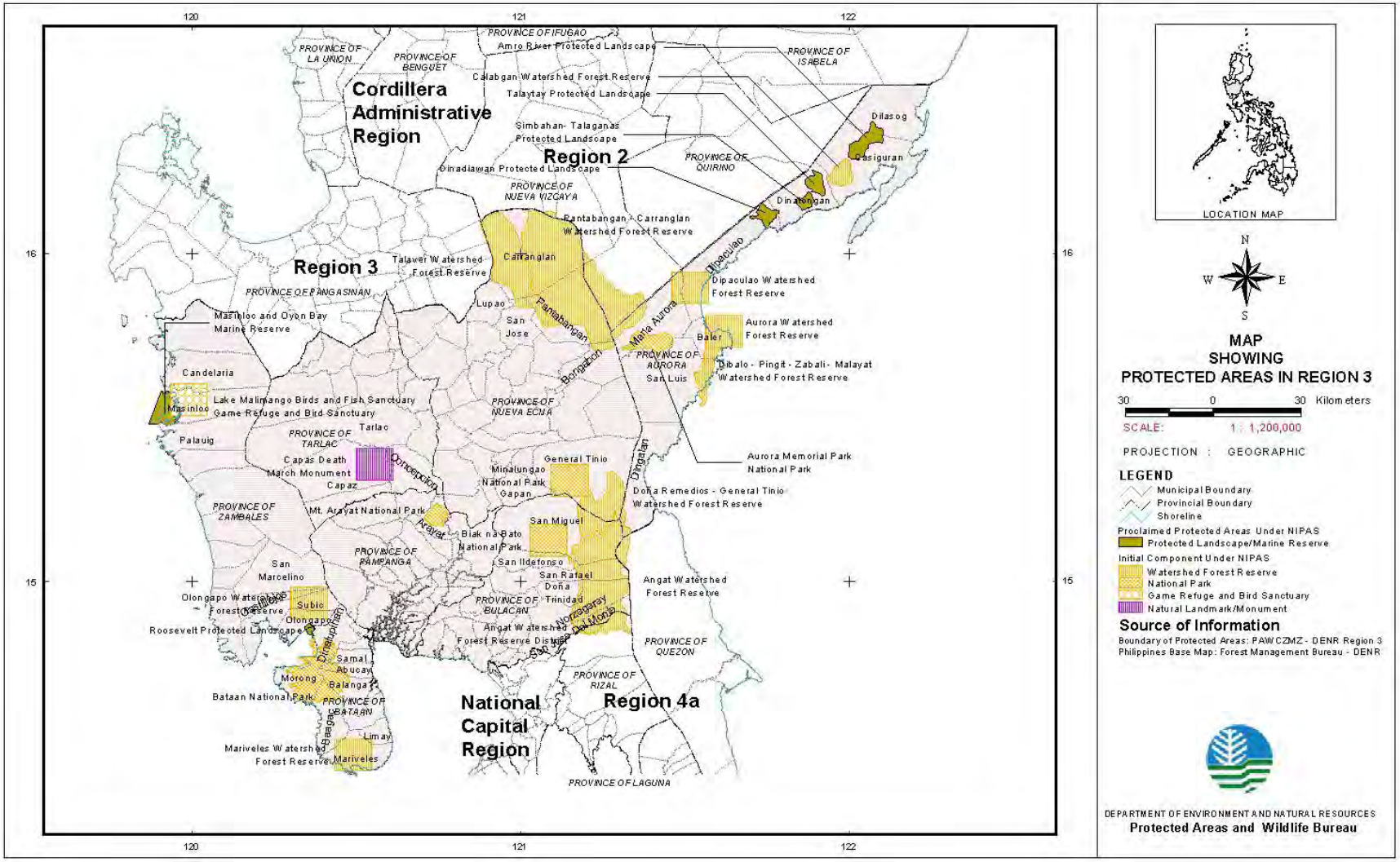


Figure 1.5-1 Protected Areas Found in Region 3 – Central Luzon

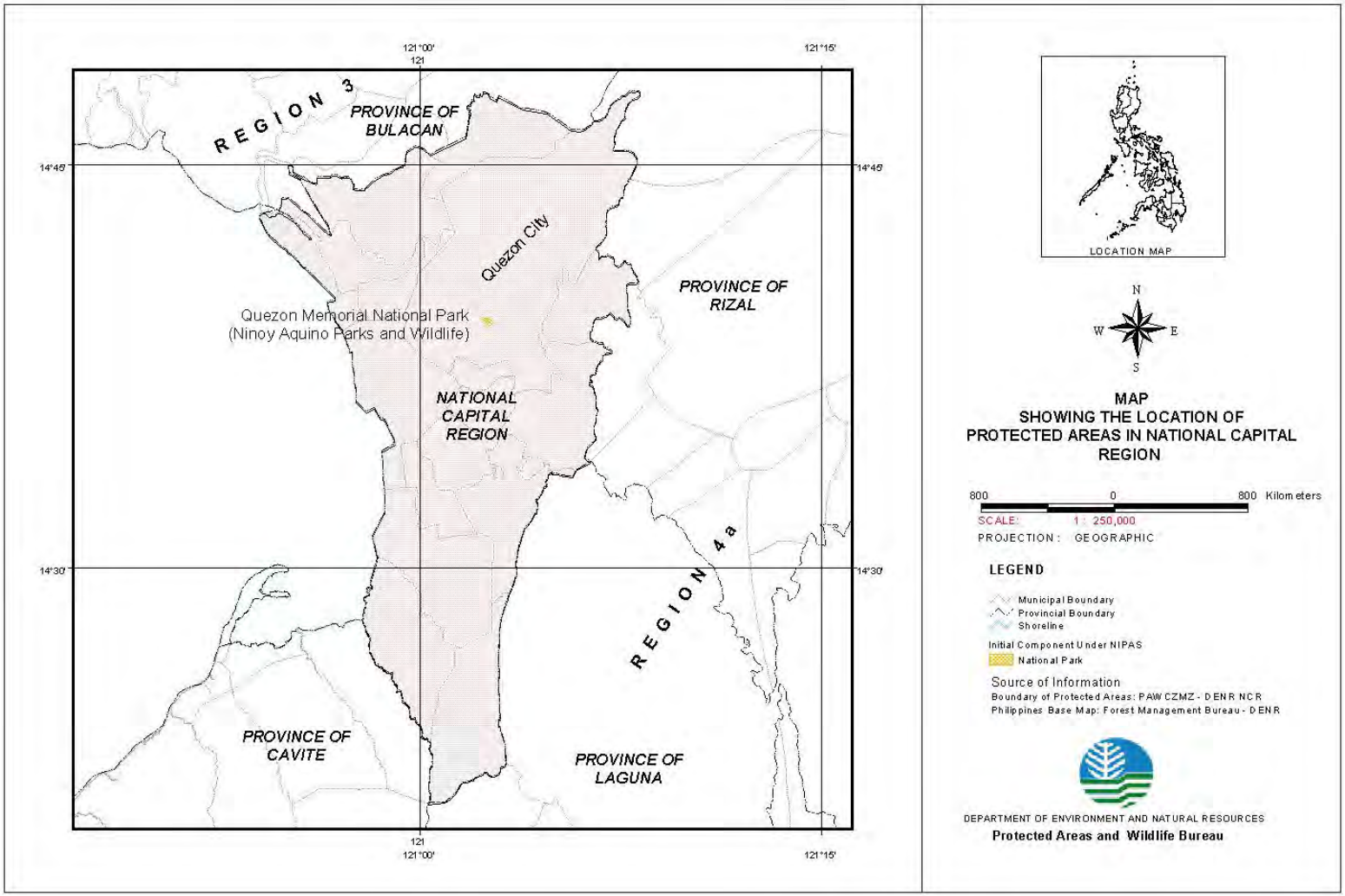


Figure 1.5-2 Protected Areas Found in NCR – Metro Manila

1.6. Biodiversity

Candaba Swamp is situated in Central Luzon near the towns of Candaba, San Miguel, and San Ildefonso, in Pampanga and Bulacan Provinces, with coordinates 12º53.00' East 15º5.00 North. It is described as a complex of freshwater ponds, swamps, and marshes with surrounding areas of seasonally flooded grassland, arable land and palm savannah on a vast alluvial plain. The entire area is usally flooded in the wet season, but most of dries out during the dry season, and is converted into rice fields and plantations of watermelons (Haribon Foundation, 2012). It serves as a natural flood retention basin holding wet season overflow from the Maasim, San Miguel, Garlang, Bulu, and Peñaranda Rivers, which drain into Pampanga River. Candaba Swamp is a potential Ramsar site but not a protected area. There has been no mammal survey in Candaba Swamp and on Mt. Arayat.

The Convention on Wetlands of International Importance, called the Ramsar Convention, is an intergovernmental treaty that provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources. The Ramsar Convention is the only global environmental treaty that deals with a particular ecosystem. The treaty was adopted in the Iranian city of Ramsar in 1971 and the Convention's member countries cover all geographic regions of the planet, including the Philippines.

In 2001 the Candaba Swamp was assessed under the Birdlife Important Bird Area (IBA) Programme[1], which resulted into the establishment of the following IBA criteria:

(i) A1. Globally Threatened Species - The site is known or thought regularly to hold significant numbers of a globally threatened species, or other species of global conservation concern. Further and in general, the regular presence of a Critical or Endangered species, irrespective of population size, at a site may be sufficient for a site to qualify as an IBA. For Vulnerable species, the presence of more than threshold numbers at a site is necessary to trigger selection. Thresholds are set regionally, often on a species by species basis. The site may also qualify if holds more than threshold numbers of other species of global conservation concern in the Near Threatened, Data Deficient and, formerly, in the no-longer recognized Conservation Dependent categories.

(ii) A4.i Congregations - Site known or thought to hold, on a regular basis--- 1% of a biogeographic population of a congregatory waterbird species;

(iii) A4. iii Congregations - Site known or thought to hold, on a regular basis---20,000 waterbirds or 10,000 pairs of seabirds of one or more species.

Shown in Table 1.6-1 below are populations of IBA trigger species:

[1] The function of this Programme is to identify, protect and manage a network of sites that are significant for the long-term viability of naturally occurring bird populations, across the geographical range of those bird species for which a site-based approach is appropriate. It is global in scale and, to date, over 10,000 sites have been identified world-wide, using standard, internationally recognized criteria for selection. The IBA Programme aims to guide the implementation of national conservation strategies, through the promotion and development of national protected-area programmes. It is also intended to assist the conservation activities of international organizations and to promote the implementation of global agreements and regional measures.

Table 1.6-1 Populations of IBA Trigger Species in Candaba Swamp

Species	Season	Period	Population Estimate	IBA Criteria	IUCN Category
Philippine Duck Anas luzonica	-	2001	present units unknows	A1, A4i	Vulnerable
Northern Pintail Anas Acuta	winter	2001	present units unknows	A4.i	Least concern
Garganey Anas querquedula	winter	2001	present units unknows	A4i	Least concern
Baer's Pochard Aythya baeri	-	2001	present units unknows	A1	Critically Endangered
Great egret Casmerodius albus	unknown	2001	present units unknows	A4i	Least concern
Spot-billed Pelican Pelecanus philippensis	-	2001	present units unknows	A1	Near Threatened
Streaked Reed-warbler Acrocephalus sorghophilus	-	2001	present units unknows	A1	Vulnerable
A4.iii Species group - waterbirds	unknown	2001	20,000 individuals	A4.iii	

Source: Birdlife International website

Main threats to Candaba Swamp include: (i) the conversion of marshland to agricultural purposes, and (ii) changes in agricultural practices. In recent years local people have started to grow rice instead of watermelons in the surrounding area, which necessitates draining the marshes in December or January instead of March or April. Due to this only a few ducks now winter at Candaba. The effect on other waterbird species is still unknown at this point. Other threats to the wetlands and their biodiversity include: (i) siltation and (ii) introduction of exotic fish species. Hunting of waterbirds for food and recreational purposes is a continuing and persistent problem, although now illegal (Birdlife International, 2012).

A list of common bird species observed in the field is listed in Table 1.6-2.

Table 1.6-2 List of Bird Species Encountered in the Study Area

Common Name	Scientific name	Conservation Status
Barred rail	*Gallirallu storquatus*	Least Concerned
Barred-button quail	*Turnix suscitator*	Least Concerned
Black-naped oriole	*Oriolus chinensis*	Least Concerned
Brown shrike	*Laniu scristatus*	Least Concerned
Cattle egret	*Bubulcus ibis*	Least Concerned
Chestnut munia	*Lonchura malacca*	Least Concerned
Crested myna	*Acrido therescristatellus*	Least Concerned
Eurasian tree sparrow	*Passer montanus*	Least Concerned
Glossy swiftlet	*Collocalia esculenta*	Least Concerned
Large-billed crow	*Corvus macrorhychos*	Least Concerned
Lesser coucal	*Centropus bengalensis*	Least Concerned
Long-tailed shrike	*Lanius schach*	Least Concerned
Olive-backed sunbird	*Cinnyris jugularis*	Least Concerned
Pied fantail	*Rhipidura javanica*	Least Concerned
Striated grass bird	*Megaluruspalust*	Least Concerned
White-breasted wood swallow	*Artamus leucorynchus*	Least Concerned
White-collared kingfisher	*Halcyon chloris*	Least Concerned
Yellow-vented bulbul	*Pycnonotus goiavier*	Least Concerned
Zebra dove	*Geopelia striata*	Least Concerned

Source: As Observed during site reconnaissance

1.7. Ambient Environmental Qualities

1.7.1. Ambient Air Quality

Four (4) air quality sampling stations were established at selected sites along the proposed alignment (Figure 1.7-1). Air Quality Sampling Station #1 (AQSS) was located at the old PNR station in Angeles City, Pampanga; AQSS#2 was established at the old San Fernando PNR station also in Pampanga; AQSS#3 was located at the old Malolos PNR station in Bulacan; and AQSS#4 was sited near the old Bocaue PNR station, also in Bulacan. Sampling was undertaken twice in a day, one in the morning and another in the afternoon.

The particulate matter parameters measured are Total Suspended Particulates (TSP), Lead (Pb), Particulate Matter-10 (PM_{10}); while the gaseous air pollutant parameters include Sulfur Dioxide (SO_2), Nitrogen Dioxide (NO_2), Ozone (O_3), and Carbon Monoxide (CO).

1) Particulate Matters

The observed TSP levels at the four (4) sampling stations during the 1-hour morning and afternoon monitoring periods ranged between 95-585 µg/Ncm. With the exception of the TSP level observed at AQSS#3 (585 µg/Ncm) during the afternoon monitoring which exceeded the permissible limit, all the values recorded are within the specified DENR standard of 230 µg/Ncm.

The PM_{10} level observed at the sampling stations ranged between <3.0-10.4 µg/Ncm. These values are very well within the DENR Standard of 150 µg/Ncm for a 24-hour averaging period. Similarly, the Pb concentration levels obtained in all sampling stations are way below the DENR Standard of 1.5 µg/Ncm for three months average. The observed Pb concentration level ranged from <0.003-0.14 µg/Ncm.

Complete results of the air quality sampling undertaken are given in Table 1.7-1.

Table 1.7-1 Ambient Air Quality (Particulate Matters) Observed at Selected Sampling Sites along the Proposed Manila-Clark Railway Alignment

Station	Date & Time	Parameters (in µg/Ncm)		Date & Time	Parameter (in µg/Ncm)
		TSP	(Pb)		PM10
AQSS#1 Angeles City	20 October 2012 1050-1150 H	129	<0.003	23 October 2012 1035-1135H	48.1
	20 October 2012 1540-1640 H	102	<0.003	23 October 2012 1510-1610H	48.5
AQSS#2 San Fernando City	20 October 2012 0820-0920 H	155	<0.003	23 October 2012 0815-0915	25.3
	20 October 2012 1340-1440 H	126	<0.003	23 October 2012 1310-1410	<3.0
AQSS#3 Malolos City	19 October 2012 0855-0955 H	95	<0.003	24 October 2012 0835-0935	61.8
	19 October 2012 1400-1500 H	585	<0.003	24 October 2012 1305-1405H	91.3
AQSS#4 Bocaue	19 October 2012 1045-1145 H	133	0.14	24 October 2012 1050-1150H	67.9
	19 October 2012 1640-1740 H	145	0.10	24 October 2012 1510-1610H	104.4
DENR STANDARD (24-Hour Sampling Average)		230	1.5 (3 month)		150

2) Gaseous Pollutants

The observed ambient SO_2 concentration level of <0.05 µg/Ncm at all sampling stations is way below the DENR Standard of 180 µg/Ncm. As well, the NO_2 values recorded are well within the standard DENR of 150 µg/Ncm. The concentration levels observed ranged from 1.865-3.313 µg/Ncm. For carbon monoxide (CO), the concentration levels observed at the sampling sites ranged between 0.31-0.92 ppm. These are also within the acceptable limit set by DENR of 30 ppm.

For O_3, the observed concentration levels ranged between 21.37-932.70 µg/Ncm. As can be discerned from Table 1.7-1, the O_3 levels recorded at AQSS#4 during the morning (21.37 µg/Ncm) and afternoon (37.60 µg/Ncm) sampling periods are well within the allowable limit of 140 µg/Ncm. On the contrary, the observed AQSS#1, AQSS#2, and AQSS#3 all exceeded the permissible limit. The highest concentration level of 932.70 µg/Ncm was observed at AQSS 1 during the morning sampling. This value exceeded more than six (6) times the acceptable limit. Equally, the recorded O_3 level of 925.63 µg/Ncm at AQSS 2 extremely exceeded the permissible limit.

Table 1.7-2 Ambient Air Quality (Gaseous Air Pollutants) Observed at Selected Sampling Sites Established along the Proposed Manila-Clark Railway Alignment

Station	Date & Time	Parameters (in µg/Ncm)		Date & Time	Parameters (in µg/Ncm)	
		SO_2	NO_2		O_3	CO in ppm
AQSS#1 Angeles City	20 October 2012 1050-1150H	<0.05	3.313	19 October 2012 1035-1135H	932.70	0.69
	20 October 2012 1540-1640H	<0.05	1.865	19 October 2012 1510-1610H	292.23	0.85
AQSS#2 San Fernando City	20 October 2012 0820-0920H	<0.05	3.272	23 October 2012 0815-0915	925.63	0.46
	20 October 2012 1340-1440H	<0.05	2.281	23 October 2012 1310-1410	883.26	0.69
AQSS#3 Malolos City	19 October 2012 0855-0955H	<0.05	3.093	24 October 2012 0835-0935	659.56	1.15
	19 October 2012 1400-1500H	<0.05	2.700	24 October 2012 1305-1405H	546.65	0.92
AQSS#4 Bocaue	19 October 2012 1045-1145H	<0.05	2.702	24 October 2012 1050-1150H	21.37	0.31
	19 October 2012 1640-1740	<0.05	2.059	24 October 2012 1510-1610H	37.60	0.62
DENR STANDARD (24-Hour Sampling Average)		180	150		140	30 ppm

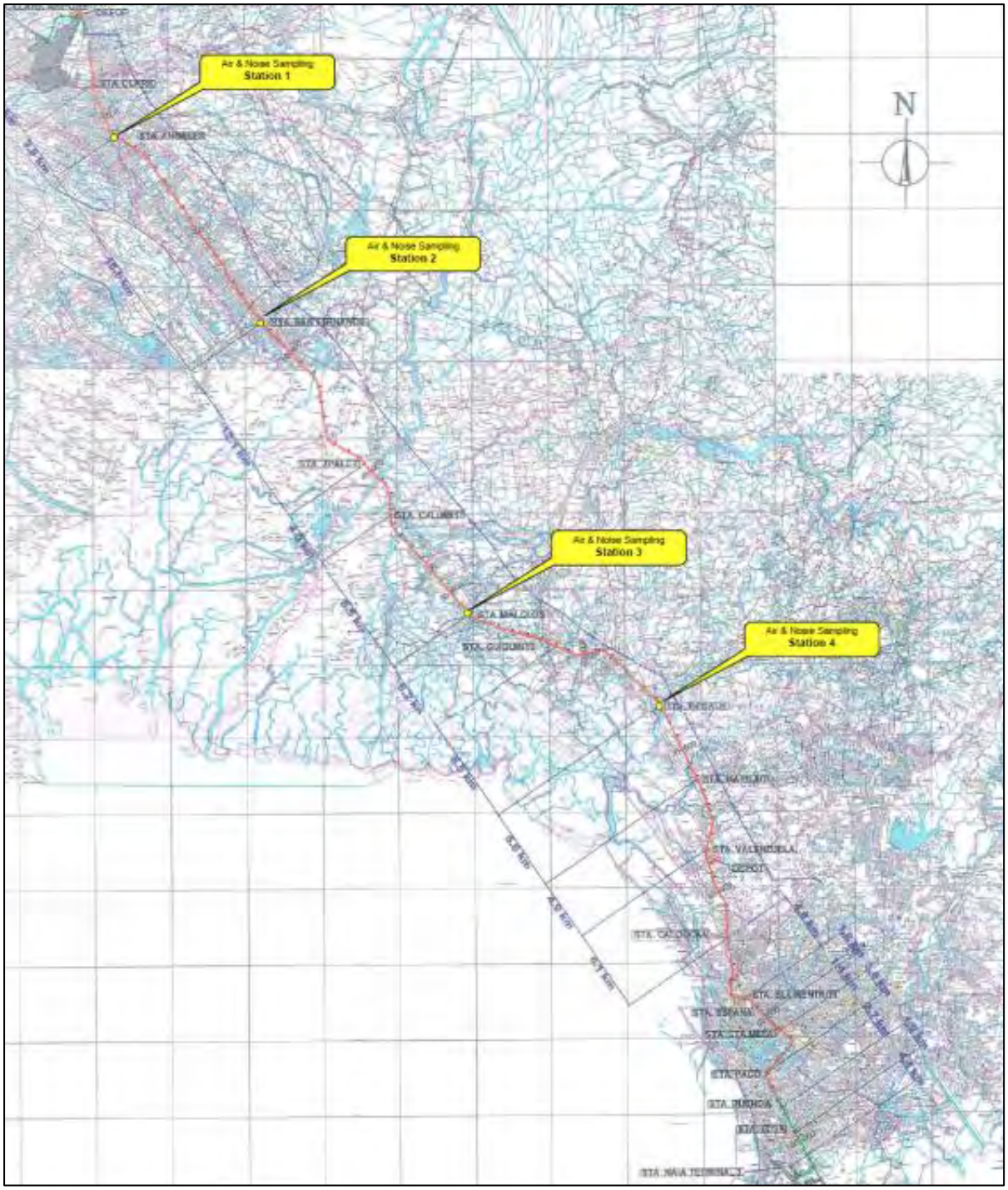


Figure 1.7-1 Ambient Air Quality & Noise Level Monitoring Sites

1.7.2. Surface Water Quality

Ten (10) water quality sampling stations (WQSS) were established at the downstream portions (with reference to the alignment) of selected rivers/creeks crossed by the proposed alignment (Figure 1.7-2). The sampling was undertaken from 22-23 October 2012. Water samples were collected and prepared strictly following the standard procedure and then later brought to the laboratory for analyses. To maintain freshness of the samples during transport to the laboratory, the bottles were placed in ice-filled chests.

A total of 18 parameters, including seven (7) heavy metal elements were analyzed. Results of the laboratory analyses are summarized in Table 1.7-3.

On-site measurement of the acidity showed that the recorded pH level range of the water samples at all stations (6.7-8.5) is within the DENR standard of 6.5-8.5. The observed temperature range is between 24ºC-29ºC.

Except for the Cn^{-1} level of 0.119 mg/L observed at WQSS#9 (Meycauayan River), the detected concentration level of all heavy metals (i.e. As, Cu, Hg, Cd, Pb, Cr_6, and $Cn^{-1)}$ analyzed are within the DENR Standard limit for Class C Waters. The observed concentration level of Cn^{-1} at WQSS#9 slightly exceeded the acceptable limit of 0.05 mg/L.

At all stations, the observed coliform content of the water samples exceeded the DENR Standard of 5,000 MPN/100 ml. Water samples from WQSS#2 and WQSS#10 exhibited the highest level of coliform content of 540,000 MPN/100 ml. The lowest coliform contents of 24,000 MPN/100 ml on the other hand were detected from the water samples collected from WQSS#1, WQSS#4, WQSS#5, and WQSS#6.

The oil & grease content of the water samples from WQSS#2 (2.4 mg/L), WQSS#8 (2.1 mg/L), and WQSS#9 (3.2 mg/L) slightly exceeded the permissible limit of 2.0 mg/L. The rest of the samples are within the DENR standard.

Figure 1.7-2 Water Quality Monitoring Sites

Table 1.7-3 Physico-Chemical Properties of the Waterways Crossed by the Proposed Manila-Clark Railway Project Alignment

	SAMPLING STATIONS										
	WQSS#1 Quitanguil River	WQSS#2 Abacan River	WQSS#3 Calutcut Creek	WQSS#4 Masaluso River	WQSS#5 Sulipan Channel	WQSS#6 Labangan River	WQSS#7 Balagtas River	WQSS#8 Bocaue River	WQSS#9 Meycauayan River	WQSS#10 Malabon River	DENR Standard Class C Waters
Date & Time of Sampling	22 October 2012 0710H	22 October 2012 0805H	22 October 2012 0950H	22 October 2012 1345H	23 October 2012 0640H	23 October 2012 0750H	23 October 2012 0922H	23 October 2012 1005H	23 October 2012 1115H	23 October 2012 1255H	
PARAMETERS											
pH	8.3	8.5	7.4	7.4	8.5	8.0	7.2	7.0	6.7	6.7	6.5 – 8.5
Temperature	25ºC	24ºC	29ºC	28ºC	28ºC	28ºC	27.5ºC	28ºC	29ºC	28ºC	Not more than 3ºC increase
Arsenic (As)	0.0011	0.0010	<0.0011	0.0011	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.05 mg/L
Copper (Cu)	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.05(o) mg/L
Mercury (Hg)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.002 mg/L
Free Cyanide	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.016	0.119	0.036	0.05 mg/L
Nitrate (NO3)	24.2	27.8	14.9	24.2	2.4	1.5	1.0	1.7	2.7	4.1	10(j) mg/L
Cadmium (Cd)	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	0.01 mg/L
Lead (Pb)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.05 mg/L
5-Day 20ºC (BOD)	2.7	5.0	11.1	2.7	5.6	2.0	11.5	8.2	62.2	19.3	7(10) mg/L
Chloride (Cl-)	7.0	14.6	16.8	7.0	10.3	36.3	8.2	770.9	914.9	1,026	350 mg/L
Chromium Hexavalent (Cr6)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.05 mg/L
Dissolved Oxygen (Minimum)	6.0	6.4	5.3	6.0	4,45	4.64	2.39	2.00	<0.05	<0.05	5.0 mg/L
Oil & Grease	1.6	2.4	1.7	1.6	1.2	1.3	1.6	2.1	3.2	1.4	2 mg/L
Phosphate (as Phosphorous)	0.87	1.12	2.36	0.87	0.438	0.099	3.409	4.419	5.126	3.507	(k)
Phenol	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.005(l) mg/L
Anionic Surfactants as MBAS	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.5 mg/L
TSS	38.0	117.0	10.0	38.0	31.0	38.0	53.0	15.0	21.0	14.0	Not more than 30 mg/L increase
Coliform	24,000	540,000	160,000	24,000	24,000	24,000	35,000	220,000	94,000	540,000	5,000(m) MPN/ 100 mL

Footnotes:

j) Applicable only to lakes or reservoirs, and similarly impounded water;

k) When applied to lakes or reservoirs, the Phosphate as P concentration should not exceed an average of 0.05 mg/L nor a maximum of 0.1 mg/L;

l) Not present in concentrations to affect fish flavour/taste;

m) These values refer to the geometric mean of the most probable number of coliform organism during a 3-month period and that the limit indicated shall not be exceeded in 20% of the samples taken during the same period

Sampling Station Locations:

1.7.3. Noise Level

Ambient noise level measurement was simultaneously undertaken with the conduct of the air quality monitoring at the same sampling stations. Monitoring was done using a Center 322 Datalogging sound level meter on A-weighting scale within a 30-second averaging time.

The selected monitoring sites are typical of an urban area characterized by moderate to heavy traffic volume (Figure 1.7-1). Results of the monitoring summarized in Table 1.7-4 show that the observed average noise levels for all the monitoring periods are within the permissible limit set by the DENR for Class B Areas (direlctly fronting or facing a four-lane road +5dB(A)). The daytime noise levels recorded ranged from 56.2-65.1 dB(A), while the morning time noise levels average ranged from 53.9-63.0 dB(A). The evening time average noise levels ranged between 54.6-59.1 dB(A) and the nighttime average noise ranged from 49.9-55.3 dB(A).

Table 1.7-4 Ambient Noise Level Observed at the Established Sampling Sites along the Proposed Manila-Clark Railway Alignment

Station	Average Noise Levels in dBA			
	Morning Time (5AM-9AM)	Daytime (9AM-6PM)	Evening Time (6PM-10PM)	Nighttime (10PM-5AM)
NLSS#1	53.9	65.0	54.6	55.3
NLSS#2	62.9	56.2	58.0	49.9
NLSS#3	56.3	65.1	55.9	50.8
NLSS#4	63.0	61.9	59.1	53.2
DENR Noise Standard for Class AA Areas	45.0	50.0	45.0	40.0
DENR Noise Standard for Class A Areas	50.0	55.0	50.0	45.0
DENR Noise Standard for Class B Areas	60.0	65.0	60.0	55.0

Note: For areas directly facing a public transportation route or an urban traffic artery, the foregoing standards plus a sorrection factor equivalent to the following shall apply:

i- Areas directly froning or facing a four-lane road: +5 dB(A)

ii-Areas directly froning or facing a four-lane or wider road: +10 dB(A)

Category of area:

Class AA: a section or contiguous area which required quietness, such as areas within 100 meters from school sites, nursery schools, hospitals and special homes for the aged

Class A: a section or contigious area which is primarlly used for residential purposes

Class B: a section or contigious area which is primarlly used for a commercial area

1.7.4. Noise Sensitive Receptors

Although most of the areas to be traversed can be considered urbanized to urbanizeable, some institutions would not be as tolerant to high noise levels during construction and even during operation. As such it is important to identify these institutions to have a general idea of what can be expected during conduct of Feasibility Study. An initial list of noise sensitive receptors is provided in Table 1.7-5:

Table 1.7-5 Noise Sensitive Receptors

Institution	Approximate Distance from AER Alignment (m)	Indicative Location
PAMPANGA PROVINCE		
MABALACAT CITY		
1. Dolores Chapel	100	NE
2. San Joaquin Elementary School	300	NE
3. San Joaquin Chapel	300	NE
4. Our Lady of Grace Parish Church	350	NE
5. St. Jude Thaddeus Chapel	250	NE
6. Ignesia ni Cristo	300	NE
7. Tiglao Medical Center Foundation	350	NE
8. Mabalacat Baptist Church	400	NE
9. Mabalacat Elementary School	250	NE
10. Don Tedoro V. Santos Institute	450	NE
11. School of Infant Jesus	250	NE
12. St. Anthony College of Technology	1,500	NE
13. San Francisco Elementary School	1,200	NE
14. Mabiga Elementary School	1,400	NE
15. Mabalacat District Hospital	100	E
16. San Rafael Parish Church	700	E
17. Mary Help of Christian School	900	NE
18. San Rafael Parish Church	400	E
19. St. Raphael Foundation & Medical Center	400	E
20. Children of Fatima School	700	E
21. First Baptist Church of Mabalacat Pampanga	400	E
ANGELES CITY		
1. Holy Angel University	500	NE
2. Angeles University Foundation	400	NE
3. Angeles University Foundation Medical Center	400	NE
4. Angeles City Science High School	250	NE
5. Dr. Clemente N. Dayrit Sr. Elementary School	250	NE
6. Our Lady of Lourdes Parish	400	NE
7. Sta. Teresita Elementary School	400	SW
8. Lourdes Sur Church	50	SW
9. Iglesia ni Cristo Sta Teresita Locale	50	SW
10. Our Lady of Perpetual Help Hospital	500	NE
11. Pulung Bulu Elementary School	200	SW
12. Philippine Women's University	100	NE
13. The Medical City	100	SW
14. Holy Family Medical Center	250	NE
15. Sto. Rosario Elementary School	500	SW
16. Angeles Elementary School	100	SW
17. OB Montessori	200	NE
18. Holy Rosary Cathedral	700	SW
19. Holy Angel University	900	SW
20. Republic Central Colleges	500	SW
SAN FERNANDO CITY		
1. Sindalan Elementary School	750	SW
2. Mother Teresa Calcuta Medical Center	500	SW
3. Saint Scholastica's Academy	50	SW
4. San Fernando Hospital	600	NE
5. Dolores Elementary School	800	NE
6. Jose B. Lingad Memorial Hospital	800	NE
7. Pampanga High School	800	NE
8. Data College	50	NE
9. Sta. Lucia Parish	250	SW
10. Sta. Lucia Elementary School	400	SW
11. San Nicholas Elementary School	900	NE
12. Jesus is Lord Church	200	SW
13. Infant Jesus Academy	750	SW
14. San Pedro Cutud Elementary School	300	SW
15. San Pedro Parish	300	SW
STO. TOMAS		
1. Sapa Elementary School	200	SW
2. Sto. Niño Parish Church	500	SW
3. San Matias Parish Church	500	NE

Institution	Approximate Distance from AER Alignment (m)	Indicative Location
4. San Matias Elementary School	600	NE
5. Matinian School	300	SW
6. Iglesia ni Cristo locale of San Matias	700	NE
APALIT		
1. Sta. Maria High School	300	NE
2. Sampaga Elementary School	100	SW
3. Macario Arnedo Elementary School	500	NE
BULACAN PROVINCE		
CALUMPIT		
1. Frances High School	50	W
2. Frances Elementary School	900	W
3. Sta. Cruz Hospital	250	E
4. F Mendoza Memorial Elementary School	500	E
5. St. John the Baptist Church	600	E
6. Calumpit Central School	250	E
7. Ecumenical Christian School	150	E
8. Cellegio de Calumpit	50	SW
9. Calumpit District Hospital	500	NE
10. Caniogan Elementary School	500	NE
11. Calumpit National High School	50	SW
12. San Marcos Elementary School	300	NE
13. Calumpang Elementary School	300	SW
MALOLOS CITY		
1. Centro Escolar University – Malolos Campus	50	NE
2. Bulacan Polytechnic College	200	NE
3. Bulihan National High School	800	SW
4. Holy Spirit Parish Church	250	SW
5. Bulacan State University	50	NE
6. Regina Carmelli University	50	SW
7. Barasoain Memorial Elementary School	150	NE
8. La Consolacion University Philippines	150	SW
9. Stella Maris Academy of Malolos	250	SW

Institution	Approximate Distance from AER Alignment (m)	Indicative Location
10. Ma. Therese Montessori School	300	SW
11. Sacred Heart Hospital Alta Medical Arts Bldg.	250	NE
12. AMA Computer College	200	NE
13. EENT Hospital	250	NE
14. Holy Infant School	50	SW
15. Holy Spirit Academy of Malolos	250	S
16. Sta. Isabel Elementary School	500	S
17. Marcelo H. del Pilar National High School	400	S
18. Tikay Elementary School	50	NE
GUIGUINTO		
1. TESDA Guiguinto	50	SW
2. San Martin de Porres Catholic School	500	S
3. Guiguinto National Vocational School	600	S
4. San Ildefonso Parish Church	400	S
5. Jesus of Nazareth Hospital	100	S
6. Tuktukan Elementary School	500	S
7. Guiguinto Hospital	400	N
BALAGTAS		
1. Longos Elementary School	100	SW
2. STI College	400	NE
BOCAUE		
1. Taal High School	200	NE
2. Taal Elementary School	750	NE
3. Wakas Elementary School	750	SW
4. St. Paul College of Bocaue	500	NE
5. Wise High School	100	SW
6. Biñang Elementary School	800	SW
7. Queen of Angels Church	700	SW
8. Bunlo Elementary School	300	SW
9. Bunducan Elementary School	300	SW
10. Bambang Elementary School	500	SW
11. Jesus is Lord Church Prayer Garden	400	SW
12. Lolomboy National High School	800	NE

Institution	Approximate Distance from AER Alignment (m)	Indicative Location
13. Lolomboy Elementary School	700	SW
14. Iglesia ni Cristo locale Bocaue	400	SW
MARILAO		
1. Kingdom Hall of Jehova's Witnesses	500	SW
2. Abangan Sur Elementary School	600	SW
3. Tabing Ilog Elementary School	50	SW
4. St. Michael Family Hospital	300	SW
5. St. Michael Parish	300	SW
MEYCAUAYAN		
1. Saluysoy Central School	600	SW
2. Kingdom Hall of Jehova's Witnesses	500	E
3. Saluysoy Catholic Chapel	500	W
4. Iglesia ni Cristo locale Meycauayan	100	SW
5. St. Mary's College of Meycauayan City	100	SW
6. Sheperd's College	50	NE
7. Holy Angels Hospital	300	SW
8. Mariano Quinto Alarilla Polytechnic College	700	NE
9. Lozada Maternity Clinic	700	NE
10. Meycauayan Seventh-Day Adventist Church	500	E
11. Meycauayan College	150	SW
12. Calavario Elementary School	250	SW
13. Banga Elementary School	800	E
14. Meycauayan Doctors Hospital	900	E
15. San Bartholomew Parish Church	100	W
16. Tugatog Elementary School	500	W
17. Bancal Elementary School	700	W
18. Bancal Ext. Elementary School	50	W
VALENZUELA CITY		
1. Jesus is Lord Christian School & Church	500	W
2. Dalandan High School	500	W
3. Church of God	200	W
4. Santos Encarnacion Memorial School	500	W
5. San Pedro San Pablo Chapel	300	W
6. Valenzuela City Science High School	700	E
7. Iglesia ni Cristo locale Valenzuela City	50	SW
8. Parish Church of San Isidro Labrador	50	W
9. Pamantasang Lunsod ng Valenzuela	600	NE
10. St. Johns Hospital	150	NE
11. Malinta Elementary School	100	NE
12. Malinta National High School	400	SW
13. St. Jude Academy	450	SW
14. Mary Immaculate School of Valenzuela	100	SW
15. Caruhatan National High School	300	E
MALABON CITY		
1. Tinajeros Elementary School	400	E
2. Tinajeros High School	400	E
3. Church in Malabon	100	E
4. Philippine Buddhist Seng Guan Memorial Institute	100	E
5. Hwa Chong Temple	200	E
CALOOCAN CITY		
1. Iglesia ni Cristo	100	E
2. Caloocan Seventh Day Adventist Center Church	300	E
3. University of the East Caloocan	200	E
4. AMA Caloocan	200	E
5. Univeristy of Caloocan	200	W
6. Col. Salvador T. Villa Memorial Hospital (PNR Hospital)	400	E
7. A. Bonifacio Elementary School	50	E
8. San Roque Parish Church	300	W
9. Caloocan Central Elementary School	100	W
10. Center for Children's Well Being	300	W
11. Iglesia ni Cristo locale Caloocan City	500	W
12. Grace Park Elementary School Unit 1	200	E

Institution	Approximate Distance from AER Alignment (m)	Indicative Location
13. Grace Park Elementary School	200	E
14. Sampalukan Elementary School	600	E
MANILA CITY		
1. Martinez Memorial College	200	E
2. Maypajo Elementary School	900	E
3. Marulas Elementary School	100	W
4. Barrio Obrero Elementary School	200	E
5. Amisola Maternity Hospital	500	E
6. Lapu-Lapu Elementary School	500	E
7. FG Calderon Integrated School	600	E
8. Manuel L. Quezon High School	700	E
9. St. Joseph School	600	W
10. Jose P. Laurel High School	800	W
11. Sergio Osmeña High School	700	W
12. Torres High School	600	W
13. F. Benitez Elementary School	500	W
14. Lakandula Elementary School	400	W
15. Antipolo Chapel (Manila)	50	E
16. Melchora Aquino Elementary School	500	E
17. Lakan Dula High School	500	W
18. Emmanuel Community Hospital	800	E
19. Manila Central Seventh Day Adventist	200	N
20. Iglesia ni Cristo locale Manila	600	NE
21. Ramon Magsaysay High School	600	SW
22. Legarda Elementary School	200	NE
23. Most Holy Trinity College	500	NE
24. Most Holy Trinity Parish	500	NE
25. Gen. Geronimo Elementary School	700	SW
26. Moises Salvador Elementary School	700	SW
27. Iglesia ni Cristo locale Manila	100	NE
28. P. Burgos Elementary School	500	NE
29. Antonio Maceda Integrated School	500	NE
30. Manila Chinese 7th Day Adventist Church	300	SW
31. Polytechnic University of the Philippines	100	SW
32. Beata Elementary School	300	SW
33. Mariano Marcos Memorial High School	600	SW
34. Iglesia ni Cristo locale Manila	300	NW
35. Isabelo de los Reyes Elementary School	500	NW
36. Our Lady of Peñafrancia Church	700	NW
37. Manuel A. Roxas Elementary School	400	NW
38. La Concordia College	500	SE
39. F. Ma. Guerrero Elementary School	500	SE
40. Dr. Celedonio A. Salvador Elementary School	700	NW
41. Paco Catholic School	700	NW
42. Rafael Palma Elementary School	300	NE
MAKATI CITY		
1. Francis School of Makati	300	NE
2. San Ildefonso Parish Church	300	SW
3. St. John Bosco School	300	NE
4. St. Jogn Bosco Parish	300	NE
5. AMA Computer College	100	SW
6. Bangkal Elementary School-Main	250	SW
7. Bangkal High School	150	SW
8. Bangkal Elementary School I	400	SW
9. Bangkal Elementary School II	450	SW
10. New Apostolic Church	500	SW

1.7.5. Soil

Based on data from the Environmental Impact Statement for the North Rail Project (2007), the Caloocan – Valenzuela section of the PNR ROW is underlain by the following:

i. ***Obando Fine Sandy Loam*** in the western part of the route. The Obando Fine Sandy Loam of the Obando series is classified as Island and Basin soil. As per the soil survey report of Bulacan Province, the Obando Fine Sandy Loam is characterized by a brown fine sandy loam surface soil with a depth ranging from 10 to 30 cm. Below the surface, at a depth of about 80 cm, is a subsoil of fine brown sand. Beneath the subsoil are gray sands mixed with marine shells.

ii. ***Prensa Gay Loam*** in the eastern part of the route. The Prensa Series is classified as upland and ***mountain*** soils. The Prensa Gay Loam is the lower member of the Prensa Series. The surface soil is brown to light reddish brown clay loam, loose and granular with numerous spherical iron concretions. Its depth ranges from 20 to 25 cm . The soil within the depth from 40 to 50 cm is loose and gravelly clay grading to sandy clay with many concretions. Substratum from a depth of 50 cm is gravelly clay and the presence of ruffaceous material . The presence of clay makes it more plastic than the sandy loam. Prensa Gay Loam is distributed in the gently sloping area along the PNR ROW in Malahon and extends eastward to the foothills of the Sierra Madre mountain ranges.

2. Social Environment

2.1. Land Use

2.1.1. Makati City

1) Residential Development

Makati City shall maintain the presence of low density residential villages, allow lower and middle-income housing densities to rise incrementally in order to expand the housing supply that caters to the majority, and, as a whole, provide for a wider mix of uses in all residential areas. Future growth shall be allowed but shall be controlled through area-specific density controls and land use limitations. The City will strive to maximize existing infrastructures and service capacities so that it can remain to be competitive with alternative locations in Metro Manila.

To cope with urban growth, the City shall establish density controls. As cited in their CLUP, "density control help in managing growth in congested or near-congested areas, preventing further over-concentration of land uses in areas that are already strained to support existing activities". Further, these will be established according to the following guidelines:

- The entire City is subject to some form of density control.
- Where density controls already exist, these are maintained in order not to disrupt the land market to the detriment of Makati's competitiveness with other CBDs.
- Density controls are applied to areas where none exist. These controls are defined in consideration of adjacent land uses, existing and future infrastructure and utility capacity, and other strategic objectives of the city

2) Commercial Development

Existing trends show that the Central Business District (CBD)-type activities have been expanding into the peripheral areas of the traditional business district. Such an expansion needs to be defined and should also be controlled to avoid environmental and land use conflicts with existing developments. The compact characteristic of the CBD shall also be maintained to enhance current efforts to improve transit efficiency and the pedestrian environment. To the extent possible, efforts shall be made so that CBD expansion areas can fit into existing plans for transit/pedestrian projects.

Future demand for CBD land is also anticipated and provided. The City's Land Use Plan indicates and defines land use and density controls for CBD expansion areas according to existing and future infrastructure and utility capacities

3) Green Spaces, Pocket Parks, Landscaping

Green spaces in the City need to be augmented. Given limitations due to the built-up character of the CBD, along with the conversion of a substantial part of Fort Bonifacio to commercial use, the City's strategy is to identify and designate areas where green spaces, pocket parks, and landscaped gardens can be developed and linked according to an overall Green Plan. This Plan will be formulated based on the Land Use Plan of the City and will include:

- Utilization of some commercial land parcels in the CBD as green space. Private property owners will be encouraged to utilize part of their lots, although zoned as commercial land in the 1981 ordinance, as green space.
- Enhancing streetscapes through landscaping and the aesthetic improvement of sidewalks. Key street segments that extend throughout the city will be identified for priority implementation of landscaping

and sidewalk improvement measures. When completed these landscaped street segments will also form a series of green corridors that visually integrate the Old Town, the CBD, and the Fort Bonifacio areas of the City.

- Development of pocket parks and landscaped gardens. Small but strategically located and highly visible land parcels will be developed into pocket parks and landscaped gardens.
- Expansion of riverside park. The existing Liwasang Makati will be a major element of the Green Plan. Its unique location offers an opportunity to integrate open and green spaces with active recreational and commercial land uses.
- Landscaping of major infrastructure elements. Recent infrastructure projects such as the EDSA-MRT3, the Kalayaan flyover, and the Skyway link will be improved through landscaping and other features that will reduce their heavy and obtrusive image.
    - Enhancing local capability to manage and maintain green spaces. The Plan serves as an initial step towards the establishment of an institutional framework and corresponding organization needed to manage and maintain the city's green spaces. This organization will cover support requirements such as tree and plant nurseries and will include substantial private sector participation.

2.1.2. Quezon City

1) Residential Development

Due to its proximity to Metro Manila's inner core, Quezon City having a vast area of vacant spaces has been the refuge of migrants who were displaced from inner metropolitan areas consisting mostly of low-income families. This resulted to the proliferation of squatters who built shanties on almost any available lot, whether it is private or government property or even along waterways, beneath power transmission lines and other high-risk areas. Recent notable change is evident in the deterioration of some of the city's old residential areas such as Galas, La Loma and Project 4.

From the 70's, residential growth continued its northward spread so that in mid 80's, new communities had established inwards from both sides of Quirino Highway and Tandang Sora Avenue. A faster pace is observed along Commonwealth Avenue (which, by then, was of more improved condition, widened and concreted) where large residential developments have taken place, like Filinvest Homes, Don Antonio, BF Homes and Mapayapa subdivisions. Lagro became the new satellite community, integrating the linear growth from Quirino Highway on the west to that along Commonwealth Avenue on the east. The southern parts of the city grew inwards and diminished what used to be pockets of vacant land in the inner areas.

This inward growth pattern of residential communities prevailed until recent years. With the opening of new subdivisions mostly in the Capitol Area, some in Payatas, Novaliches and Tandang Sora, the city experienced a noticeable expansion towards the north due to road constructions at Mindanao Avenue, SB Diversion Roads and Congressional Avenue in Brgy. Pasong Tamo and the completed segment at Brgy. Culiat.

2) Commercial Development

A ribbon type of growth has been the dominant feature of commercial development in Quezon City as manifested by the proliferation of commercial establishments near residential concentrations. This type of development normally leads to traffic congestion.

In the early 70's, commercial strips along major roads were mostly concentrated at Quezon Avenue and A. Bonifacio Avenue. Only the Cubao area could be considered a more prominent commercial node in the city although smaller commercial centers of neighborhood scale usually established around a public market, could be found throughout the developed residential areas in southern Quezon City, at the Balintawak market area, at Munoz Market vicinity, and at Novaliches Proper.

With the introduction of the "shopping center" type of commercial establishments in the mid 70's, activity in Cubao increased, followed by SM City in the northern area then at Broadway Centrum in New Manila in the 80's. In 1995 more commercial nodes emerged such as at Sta. Mesa where SM Centerpoint is located and at Capitol which is being affected by the Ever Gotesco Center. Simultaneously, intensification and continuing linear spread took place within the populated districts so that by 1995, commercial areas had trebled to 2.93% of the urban area. Likewise, areas with distinct features emerged as popular sites (e.g. Banawe Street for car accessories and Tomas Morato Avenue as a restaurant row).

In the year 2000 additional commercial areas emerged in Fairview (SM City site), North Triangle Business Center (where MRT3 main depot is located), and the Eastwood Cyberpark, the country's free trade area for information technology at Bagumabayan where the headquarters of IBM and Citibank are located.

Latest major land developments consist of the redevelopment of the Cubao Araneta Center (Gateway), The UP Science and Technology Park (UP-Ayala Technohub) in Commonwealth Avenue, the Triangle North of Manila (Trinoma) and the proposed development of the Central Business District in the North Triangle area.

3) Industrial Development

Availability of large land parcels, proximity to industrialized areas of adjoining towns and cities (Caloocan, Malabon, Valenzuela and Pasig), and accessibility to international and domestic sea and airports (via A. Bonifacio-Quirino Highway) were the important factors considered in the allocation of industrial districts. The traditional industrial districts of the city, as early as the 60's, consist of:

i) Medium-High Intensity Industrial zones designated along Kaingin Road, parts of Manresa and Masambong in San Francisco del Monte as well as certain areas in Barangays San Roque, Obrero, Kalusugan, Kaunlaran and portions along EDSA in Bahay Toro, Bago Bantay, South Triangle, Socorro and Bagong Lipunan ng Crame;

ii) Light industries were allocated to the west side of Quirino Highway from Zabarte in Novaliches until EDSA, Balingasa and Pag-Ibig sa Nayon and the area of E. Rodriguez, Jr. Avenue in Brgy. Ugong Norte;

iii) The strip of Quirino Highway from Novaliches Proper to Tandang Sora Avenue designated for agro-industrial use.

The growth of the sector in term of land area utilized, from 274.36 hectares in 1972 to 769.05 hectares in 1995, has largely been confined in these traditional zones. The sporadic spread in other parts of the City is of small-scale types of operation.

After the issuance of the Metro Manila Zoning Ordinance (MMC *1-01) in the early 80's, only 960 hectares were retained as industrial zones in Quezon City. Many portions were converted to residential use. The largest area reclassified to residential use was in the Novaliches District. This 1981 ordinance likewise disallowed heavy industries to locate in Metro Manila effectively restraining expansion of this sector. This eventually led to the shifting of investors' preference to the fast growing industrial parks in the provinces of Laguna and Cavite.

The potential for industrial growth particularly in the Balintawak and Novaliches districts remeined consistent with the prospects of several major road projects that would increase links to the sea ports and to the North Luzon agro-industrial and economic centers such as the Subic Freeport and Clark Economic Zone. Future spread would most likely be westwards thru consolidation with neighboring industrial zones and preference for activities less hazardous to the environment.

4) Institutional Development

In the early 70's, institutional areas were concentrated mostly in Districts I, II, and IV particularly along East Avenue and the Elliptical Road. Offices of national agencies (LTO, SSS, BIR, DA, DAR) and medical institutions (Heart Center, East Avenue Medical Center) including the Quezon City Hall Complex have been established since then. Large tracks of land occupied by major universities/colleges such as the University of the Philippines (UP), Ateneo de Manila University and Miriam College also form part of the traditional institutional zone.

With the rapid increase of the city's population resulting in the growth of residential communities, more and more institutional buildings such as primary and secondary schools, both public and private and health facilities emerged, specifically in District II or in the northern portion of the city. The National Government Center (NGC) site, one of the major institutional zones is located in the same district. Situated in the NGC are the Philippine Congress, Civil Service Commission (CSC), Department of Social Welfare and Development (DSWD), Commission on Audit (COA) and the Sandigang Bayan.

Other institutional areas include those occupied by at least 491 public and private schools offering different levels of education (preparatory, elementary, and secondary levels), 87 colleges/universities including vocational and technical schools, 61 public and private hospitals, 60 health centers, 125 churches and chapels and about 64 government offices/agencies.

5) Parks and Open Spaces

To date, the city has 554 existing neighborhood parks aggregating to some 226.06 hectares of the City's urban land area of 13, 5342.71 hectares. These consist primarily of subdivision open spaces intended for park functions which have been turned over to the City Government by subdivision developers or owners and homeowners associations. As to major parks, the only protected area in NCR is found in Quezon City--the Ninoy Aquino Parks and Wildlife. Another major park if the Quezon City Memorial Circle.

2.1.3. City of Manila

1) Residential Development

For the projected population, additional housing units are proposed at Districts IV and VI which will have low to medium residential development with supporting commercial/retail facilities, neighborhood center, parks & open spaces. At Districts I & II, the plan proposes for development of affordable housing for low-income families and resettlement of squatters. This comprises low to medium residential development, neighborhood commercial facilities, sports amenities, parks and open spaces.

River bank occupancy is no longer acceptable in the city. The presence of the Oil Depot at Pandacan area will eventually be removed on a by-staged/phased development as agreed between the city and the 'Big 3' under the city Ordinance No. 8027, rezoning Pandacan Terminal area to Commercial 1 from Industrial II. At present an approximately 2.0 hectare linear park is developed along the Oil Depot area as a buffer zone between the depot and the residential development adjacent to it.

2) Water Bodies/Bay, River, Canals & Esteros

In line with the on-going Pasig River Rehabilitation Plan, approximately 500 meters on both sides of the riverbank from its highest water level are zoned as multi-use mixed use. Its ten meters easement is planned as linear parks.

3) Open Space /Parks/Buffer Zones

In enhancing the quality of the "built" environment, the proposed plan will consist of additional parks and playground as needed based on the requirement of the area and population. The absences of space for such development are relegated to development of roof gardens within the city especially in the Commercial 2 and Commercial 3 area.

The plan also proposes the re-establishment of the Old Burnham plan of having the City as a walkable area with lush greeneries every 600 meters. This can be achieved by the development of wide sidewalks with appropriate street trees and revival of the lost parks and plazas which is now presently being undertaken by the City under the "Buhayin Ang Manila" Project.

Although, at present there is limited open space in the city, these areas shall be enhanced by planting of trees all over these open lands. The existing parks and plazas in the different districts shall be developed as breathing spaces. Construction of more parks will be developed and integrated in the different nodes of the area wherein these open spaces will become greenhearts whereby trees and grass will be planted and maintained. Not only do they enhance the land values, they also serve to upgrade the quality of life and personal satisfaction of the residents.

4) Commercial Development

The plan is to create a vibrant, mixed-use economy by directing downtown office economy into currently under-utilized areas or zone-segregated areas. Based on the CLUP, this can be achieved by:

i) Enhancing the city's core by encouraging neighbourhood-oriented businesses;

ii) Strengthening the area's existing entertainment and visitor sectors; and

iii) Ensuring that neighborhood residents share in the economic benefits of City's revitalization/development.

Commercial mixed use land uses are encouraged along the LRT and PNR lines and the major roads. Along with the retention and maintenance of existing commercial facilities, the Plan proposes the commercial development along the University district. With the future development of LRT4 and near completion of LRT 2, City Core commercial development will be pushed to the Old Bilibid area promoting a development of Intermodal transport and commercial complex.

The work area where it is presently concentrated on the western side of the city's is devoted to the city's major employment. This heavy concentration of work areas will be dispersed with the development strategy being proposed to disperse point sources of pollution. The dispersal of commercial activity in the City will bring it into convenient proximity to living areas where energy-efficient interconnecting transit and thorough fare routes can be designed to insure access back and forth. Convenient proximity to other work areas and where uses accessory to one another will have access to interconnecting routes and should provide sites adequate in size, economic to develop, and attractively situated for the particular uses intended.

5) Institutional Development

The projected population will require more basic service facilities. The plan proposes for the establishment of a wider educational zone called the University District Overlay Zone. The development will comprise convention centers, additional health, education and protective and other support service facilities. Development of sub-units for the above facilities is also suggested at the transition zone, center of the majority of the population.

6) Industrial Development

All pollutive and high-security risk industries within the city especially along the Pasig shall be eventually removed. For environmental protection and conservation purposes, buffer zones shall be established between conflicting land uses (i.e., industrial and residential uses). Protected areas include potential and existing tourist spots, rivers and creeks. These areas shall be declared as protected areas and any form of development that will destroy these assets shall be disallowed.

7) Mixed Use

The Plan proposes a variety of mixed use development along major roads specifically along major transport corridor where the LRT projects are presently and planning to be located. These are along Rizal Avenue up to Taft Avenue, the Espana Boulevard and Ramon Magsaysay Boulevard. A high density mixed use development is encourage along these corridors to lessen the transportation trips of residents and commuters from one place to another and at the same time have a diversified tax base for the different activities within a structure or within 600 meters radial distance from point origin in this case the transport terminals.

This mixed use development is actually encouraged for the whole city depending on the prevailing and use pattern. In the case of the university belt, the plan proposed a wider scope of development into a university district overlay zone. This will encourage an institutional mixed use development within the zone to provide commercial and recreational activities and facilities that would complement the student's needs.

The mixed use development will further strengthen the present 24-hour city activity that will constitute safe and affordable places to work, play and reside.

2.1.4. Caloocan City - South Caloocan

1) Urban Land Use Plan

The Urban Land Use Plan is the result of various schemes designed according to several parameters indicated in the Land Use Studies conducted. The current land use trend, existing land uses, physical constraints and socio-economic parameters are given primary consideration in the re-classification of urbanized areas and vacant plots. Allocations of space are not computed according to standard space requirements, but rather on the specific constraints, role and potential of particular urban area in the overall development of the City.

2) Residential Development

Proposed residential areas in South Caloocan City are those currently used for permanent or transient dwelling purposes and some mix-use areas not suitable for non-residential use. These areas are old residential subdivision, declared Areas for Priority Development (APD), communities undergoing processing for housing mortgage, existing government housing and slum upgrading projects, and residential blocks with no ample road network or potential for commercial or industrial development. In categorizing residential use, considerations are given to specific land use objectives for the area. Those objectives are to facilitate the development of blighted areas through land use control regulations and effective urban land management system, and to control further expansion ('invasion-succession') of industrial activities into residential blocks not suitable for other uses. Existing residential areas that are rapidly transforming to other uses or mixed use type, are classified under either industrial or commercial category. These land use alteration mostly transpire at Grace Park District, where design of roads and subdivision lots are suitable for mixed-use development.

Strategies on promoting urban growth within residential plots include merging of neighboring residential blocks into one exclusive housing community complex or "superblocks". Roads shall serve as vehicles originating and terminating only from and within the community while through traffic will be controlled. Streets on high-density areas can be converted into "street parks" or "street open spaces" that will eventually serve as parking or playground spaces.

3) Commercial Development

Proposed commercial land in South Caloocan City covers tracts with all types of establishments involved in wholesale, retail and service activities serving areas larger than a neighborhood. These areas are those found in traditional trading centers on intersection roadsides and shopping centers. The plan aims to integrate the City's urban core into one compact CBD and provide urban goods and services at the most suitable location. The plan also intend to promote growth of business and financial areas that will serve the CAMANAVA area and provide shopping amenities that are nearest to dwelling areas and transit points. Proposed locations of commercial area, shall be near major roads and intersections with ample local and collector-road network system, and with current or potential patronage of shoppers and traders.

Future location of commercial areas in South Caloocan City shall provide support facilities to pedestrians more than motor vehicles in order to deter traffic congestion. 'Pedestrian malls' or 'street malls' are envisioned to develop in between commercial blocks that will finally inter-connect shoppers and travelers with public transport or intermodal facilities.

4) Industrial Development

Lands classified for industrial use include all areas with building and ground engaged in product manufacturing and processing. Industries like canning, tannery, chemical manufacturing, and metal and glass smelting contribute unmanageable amount of pollution to both air and water environment. The plan intends to decrease and disperse growths of these highly pollutive and hazardous industries from within the City's hub

The Plan also aims to provide space for light industries with large labor absorption capacity at the most suitable location — near residential areas and transit points. This scheme expects to shorten home to work trips, decreases level of traffic congestion, and increases savings rate from travel expense, time, and other potential social cost. Areas predominantly industrial in character and with adequate collector and distributor road network system, similarly within the inner hub of the Grace Park area, are classified under industrial use.

Existing industrial blocks within the Dagat-Dagatan area are also classified under industrial use. These establishments found near seaports, and consist mainly of warehouses, are suitable locations for trading of industrial parts and process goods and products.

The recommended strategy to improve growth of industrial block, is to provide these areas with appropriate infrastructure support facilities like properly designed roads and drainage and area sewage treatment plants. The plan shall also advance roadside greening and setting up traffic management system including putting traffic cells between industrial blocks.

5) Institutional Development

The use of public school for other public activities can serve as an alternative land use management strategy. Public school buildings particularly classrooms and play courts can be used after school hour for public assembly by other government (for instance a Barangay council), private or socio-civic organizations. The City Government aims to device program to design and develop classrooms and play courts that are convertible to functional and aesthetically acceptable assembly spaces.

6) Open Space Development

Maintaining open space is the most critical land use management problem in South Caloocan. Since the area is highly urbanized for a long period without any significant expanse of green, acquiring new open space is almost unfeasible. The land use plan however intends to utilize easements of riverbanks such as along Tullahan River to develop into linear parks or urban forest. This measure could also be a means of protecting the environment, similarly to preserve and stabilize riverbanks and eventually prevent massive soil erosion and river siltation.

2.1.5. Valenzuela City

The major land uses in the city include residential, industrial, agricultural, and fishponds. Commercial land use, although quite intense in several locations, are not very significant in terms of area coverage as most are small-scale in nature.

1) Residential

A variety of residential land use types could be observed in the city. It hosts 170 residential subdivisions which are characterized by relatively large house and lots. Many of these subdivisions are found in Barangays Gen. T. De Leon and Marulas in Area III. Socialized housing areas are, in turn, found in Barangays Bignay and Punturin in Area I. Outside these gated communities is a mixture of low- to medium density residential units. The former are characteristic of older houses while the latter comprise apartment and townhouse type units and an observed brisk development in the number of medium rise housing units.

2) Industrial

Industrial use is also quite significant such that issues regarding their close location to residential areas have emerged. Industrial establishments are quite prevalent in Barangays Marulas, and Karuhatan in Area III, Canumay and Lawang Bato in Area I, Ugong in Area II as well as Maysan and Malinta in Area IV.

3) Agricultural

Agricultural areas are mainly found in Barangays Bignay, Punturin, Lawang Bato and Canumay in Area 1. Poultry and piggery farms are, in turn, located in Barangays Bignay, Canumay and Lawang Bato in Area 1, Parada in Area III as well as Veinte Reales and Maysan in Area IV.

4) Fishponds

These are mainly located in Area 5 particularly in Barangays Balangkas, Bisig, Coloong, Isla, Malanday, Tagalag and Wawang Pulo.

2.1.6. Province of Bulacan

1) Land Use Plan

The provincial government of Bulacan had difficulties in obtaining the latest information on the existing structure of land uses in the province. In the past five years, the provincial government through the Provincial Planning and Development Office (PPDO), had been trying to obtain this information by requesting the 24 municipalities to immediately submit recent information on their respective existing municipal land use. Unfortunately, only a few were able to submit to the PPDO maps showing their existing

municipal land uses. The second alternative was to rely mostly on available information that may be obtained from the various national government agencies such as the BSWM and NAMRIA's topographic maps but these information were based on the old land survey conducted by the government during the 1980's. Without a map showing the current usage of the land, it would be next to impossible to plan for its future use.

The existing land uses of Bulacan consist of six (6) major categories. The largest user of Bulacan's land resources is the agricultural sector particularly those involving the cultivation of lands for production purposes. Covering close to 32 percent of the total land area of the province, agricultural lands almost cover the western half of Bulacan, thus practically dividing the province into two equal parts with the western portion mostly devoted to agricultural production. Cultivation of lands starts from the northern most portion of the province specifically east of the municipal poblacion of San Miguel and down to the boundaries between the municipalities of San Jose Del Monte and Sta. Maria.

Although not specifically shown on the map, these lands are mostly devoted to the cultivation of rice, both irrigated and rainfed. Irrigated areas are concentrated in the western portion of the agricultural lands. With the irrigation water provided by the National Irrigation Administration (NIA) from Angat River, farmers have the luxury of having two to three cropping per year barring the negative impacts of storms and typhoons. In some areas where the infrastructure of NIA is yet to extended, communal irrigation systems have been put in place by the government.

2) Land Suitability

To determine whether the current usage of lands jibe with the inherent characteristics of the land, a Land Suitability Analysis was conducted. This particular technique represents one of the many forms of land use planning tool that determines the proper use of land resources. Essentially, suitability analysis is a three-step land use-planning model that involves the analysis of the local land resource through the identification or broad land management units or LMUs. The LMUs are the basic mapping units delineated by identifying homogeneous physiographic characteristics. Its delineation may be heavily influenced by the nature of geologic materials underground, slope and topography, and soil characteristics. Simultaneously, a list of land use categories with their corresponding environmental requirements had been identified and this serves as the proposed set of activities for the proposed land use plan. The third and final step calls for the matching of the characteristics of the basic mapping units with the environmental requirements of the proposed land use categories. The output would be map showing the suitability of each mapping unit.

Based on the identified land management units the Plan has identified eight land use types that can be introduced in the province. These forms of land use categories were identified with the view of optimizing land production and the protection of the environment. These are:

- Agro-forestry
- Protection Forest
- Production Forest
- Rainfed Mixed Farming
- Urban Expansion Areas
- Diversified Crops
- Irrigated Rice Paddy
- Aquaculture

2.1.7. Province of Pampanga

The goal of the Province for land resource management is to optimize utilization and ensure sustainable land use. To achieve this goal, there is a need to limit the conversion of agricultural land brought about by

rapid urbanization and economic growth, and the minimization of population invasion on protection and over-used production lands.

Realization of the urban growth strategy will bring about the emergence of Angeles City and san Fernando as Primary Urban Centres, and Mabalacat, Guagua and Apalit as Large Towns. This will entail the development of neighboring areas wherein land sustainability could be adversely affected.

The transformation of Guagua, Mabalacat and Apalit to Large Towns will result into changes in land utilization. However, they will retain their basic agricultural use. Rural-based towns envisioned as Medium Towns consist of: Lubao, Magalang and Arayat. These municipalities will likewise remain agricultural-based. The Apalit-San Simon area may accommodate small to medium industrial establishments considering their accessibility and reduced potential for agricultural use.

Increase in rural population on municipalities with protected lands in the year 2002 will not spread on protected areas. Most rural densely populated is Floridablanca where protected land is only 0.51 square kilomenter; Arayat and Magalang are next with a total of 37.14 square kilometer – the contigous area is the location of Mt. Arayat. Population pressure is limited in the foothills of Mt. Arayat. Human settling beyond these area is being restricted. Porac's 50.77 hectares of protection land is inaccessible due to the absence of roads. An estimated 11.50 sq. km. of these was buried by lahar and cannot be rehabilitated in the near future. Certain protected areas in Floridablanca, Mabalacat and Porac include the ancestral domain of the Aeta Tribes.

The increasing rural population most likely will expand to development opportunity land of municipalities and these will eventually result in sustainable land use. The increase in population size which is only below 35% for every municipality is not expected to decrease land sustainability. Population increase will likely concentrate on existing settlements areas.

For under-used land to be sustainable they need to be provided with roads to facilitate the mobility of goods and accessibility. Most of these under-utilized land are located in Mabalacat and Porac. Mabalacat's lack of roads leading to development opportunity areas could be well-addressed through the development of the Clark sub-zone area.

Porac's development opportunity lands are located along the hilly area of the municipality. Some portions of these were buried by lahar hence, construction of roads leading to these development opportunity lands may not be economically feasible within the immediate planning period. Should new roads be found viable, the municipality will be encouraged to include them in its development plan as priority farm-to-market roads to facilitate the mobilization of farm produce.

2.2. Demography

2.2.1. Makati City

As of the year 2007, the total population of the City of Makati, which was 510,383 persons, was the 9th largest in Metro Manila. It is interesting to note that the City's daytime population is 3.7 million during weekdays based on its City Transport and Traffic Improvement Plan. People who go to Makati for business and service transactions during the daytime accounts for this figure.

Makati City began to emerge as a center for business and commercial activities in the 60's. It was also during this period that its population grew at a very fast rate of 8.75% per annum (1960-1970). In the next decades this tapered off to 4.77% (1970-1975), to 2.19% (1975 to 1980), 1.98% (1980-1990), 1.25% (1990 to 1995), even went negative, -1.80% (1995 to 2000) and 0.44% (2000 to 2007). This decline is attributed to the City's maturity into a primary CBD of the country.

2.2.2. Quezon City

Results of the National Statistics Office (NSO) census in 2007 showed that Quezon City has a population of 2,679,450, an increase of 505,619 persons or 23.26% over the 2000 population of 2,173,831. The City's population is the largest comprising nearly one-fourth (23.19%) of Metro Manila's population of 11,553,427. Quezon City contributes 3.03% of the 88.5M 2007 Philippine population. It also ranks 3rd among the cities with the largest population in the country. Based on the 2007 growth rate of 2.92%, the City is expected to double its population in a span of 24 years.

2.2.3. City of Manila

Based on the 2000 Philippine Census of Population, the total population of the City of Manila, which was 1,581,082 persons was the second largest in Metro Manila, next to Quezon City. However contrary to other developing cities in Metro Manila, it experienced its population slowed down from the 1960s. In fact it even experienced negative growth rates from 1980 to 1990 and from 1995 to 2000. The decline in population was attributed to the out-migration from the city core to less dense areas in Metro Manila and its peripheries. In addition, the development of new central business districts in Makati, Ortigas, and San Juan further added to this considering that these areas catered to the needs of the people seeking services that are wither no longer available or have deteriorated in the older City of Manila.

2.2.4. Caloocan City

As of the latest census conducted by the National Statistics Office (NSO) in 2000, the city's total population is 1,177,604. The average annual growth rate based on 1995 and 2000 actual census is 3.06% extremely higher compared to the National Capital Region's (NCR) 1.06. It was projected that by year 2013 the population of Caloocan will reach 1,743,152.

2.2.5. Valenzuela City

Valenzuela City had a population of 568,928 in 2007. It ranked sixth out of the 16 cities and one municipality of the National Capital Region. Valenzuela accounted for 4.92 percent of the NCR's population surpassing the cities of Parañaque, Las Piñas and Makati. Although its population is about five times lesser than Quezon City, the most populated city in the NCR, it is still considered as one of the region's fastest growing cities with a 2.21 average annual growth rate from 2000 to 2007. Using the average annual growth rate of 2.21 percent and an average household size of 4.52, it is estimated that Valenzuela City will have a population of 723,577 and approximately 160,083 households by 2018. It is estimated that the city will double its 2007 population after 32 years (2039).

2.2.6. Province of Bulacan

Based on Bulacan's 2010 Socio-Economic Profile, it registered a total of 2,826,926 in 2007, and 2,924,433 in May 2010. Bulacan ranks first, in terms of population among other provinces in Region 3 (Central Luzon), with a share of 29.1%. of the region's total population of 9,720,982. Population of the proposed routes in cities and municipalities as of May 2010 is as follows: (i) Calumpit – 101,068; (ii) Malolos – 234,945; (iii) Guiguinto – 90,507, (iv) Balagtas – 65,440, (v) Bocaue – 106,407; (vi) Meycauayan – 199,154; (vii) Marilao – 185,624.

2.2.7. Province of Pampanga

Based on the population census conducted by NSO in 2007, and as indicated in its Provincial Physical Framework Plan (PPDP), Pampanga ranked number two among the provinces in Region 3 in terms of

population size, with a total population of 2,226,127, which represented 22.9% of the region's total population. The registered annual average growth rate was 2.39% between the 2000 and 2007 period.

Among the municipalities that registered high growth rates during the period, namely, Angeles City, City of San Fernando, Mabalacat and Mexico, three (3) shall be traversed by the railway alignment. The high growth rates were attributed to business opportunities in these areas.
Population of the proposed routes in cities and municipalities of 2007 Census is as follows: (i) Mabalacat - 203,307; (ii) Angeles City – 314,493; (iii) San Fernando – 269,365; (iv) San Simon – 48,050; (v) Sto. Tomas – 37,866; (vi) Minalin – 40,084; (vii) Apalit – 97,296.

2.3. Local Economy

2.3.1. Makati City

1) Business Condition

Makati's CBD is the country's premier business district. It has approximately three million square meters of prime office space, with a business district four times larger than the second largest (Ortigas area) in the country. It is also the country's primary link to international finance and global economy, holding about 50% of Metro Manila's prime office space inventory.

Makati City has a large number of business establishments. As of 2009 these totaled 56, 578. On top of the list are service oriented establishments (34.2%), followed by wholesale/retail (29.3%), real estate (17.3%), convenient stores, restaurants, and amusement places (7.76%), banks and finance (6.24%), export/import (3.00%), and manufacturing (2.11%). Aside from business establishments, the City is also host to embassies, consulates, international organizations, cooperatives, community savers center, and other finance-related institutions. (Source: Makati Basic Facts and Figures 2009. Makati City Urban Development Department).

2) Tourism

Makati has several international-class tourist facilities. Several luxury hotels that are well equipped with business centers and convention facilities are located at the CBD. Shopping and commercial centers, which offer international goods and services are also available. Other tourist destinations include museums, art galleries, cinemas, disco houses, music lounges, and restaurants that offer international cuisine. In the Fort Bonifacio area, tourists can also visit memorial parks, shopping centers, and play in golf courses.

3) Transportation

Makati City is serviced by five (5) major road networks namely: (i) EDSA, (ii) C5, (iii) South Expressway, (iv) JP Rizal Avenue, and (v) Gil Puyat (Buendia) Avenue, which link the City to the rest of Metro Manila. Among these, EDSA and South Expressway are the busiest, linking the City with the northern and southern regions, including CALABARZON. It is estimated that these volumes exceed the capacity of said road networks by about 25-50%.
Several road projects are expected to be implemented to augment heavy vehicular traffic using existing thoroughfares. These include the, NLEX-SLEX Connector, completion of C3-link through Makati, and Pasig River Expressway.

Aside from road networks, the City is also serviced by the Philippine National Railway (PNR), which operates a commuter rail that connects Makati to the northern and southern parts of Metro Manila. Another high capacity link is provided by the MRT-3 along EDSA. Four of its stations are located in

Makati, namely: Guadalupe, Gil Puyat, Ayala, and Magallanes. Among these stations, Ayala is one of the busiest, with about 100,000 daily commuters.

2.3.2. Quezon City

Growth centers or growth areas are special points of interest in a city because they perform functions or offer services patronized by a wide-ranging clientele that extends beyond their immediate environs. In the case of Quezon City, the growth centers service not only their immediate surroundings but also the entire city and even the metropolitan population. This is the main reason for identifying and delineating the five (5) growth areas, namely, the:

i) CBD-Knowledge Community District,
ii) Cubao Growth Center,
iii) NGC-Batasan Growth Center,
iv) Novaliches-Lagro Growth Area, and
v) Balintawak-Munoz Growth Area.

These growth areas shall continue to enjoy priority in public investments in order that their central place functions be enhanced. The simple economic logic of this strategy is that by offering tertiary level services in the growth centers communities within the immediate influence areas as well as people from across the city's borders will come and avail of these services thereby contributing to inflow of capital and increased gross domestic product of the city. Because strengthening their central place functions is the main focus of policy intervention in this Plan, only tertiary level services are emphasized in each growth center.

2.3.3. City of Manila

Manila's economy is diverse and multifaceted. With its fully protected harbor, Manila serves as the Chief Seaport of the Country, one of the busiest in the world. Diverse manufacturers produce industrial-related products such as chemicals, textiles, clothing, and electronic goods. Local entrepreneurs process primary commodities for export, including rope, plywood, refined sugar, copra, and coconut oil. Food, beverages and tobacco products are also locally produced. The food-processing industry is one of the most stable major manufacturing sectors in the City.

1) Tourism

Manila, having several landmarks and destinations, attracts over 1 million tourists each year. Major destinations include the Rizal Park, Manila Ocean Park, Manila Zoo, Intramuros, museums such as the National Museum, and events such as the Feast of Black Nazarene and free performances in Rizal Park. The Manila nightlife offers everything from cultural exhibitions to discothèques, casinos, entertainment lounges, and fashionable cafes. Ermita and Malate, being a popular tourist destination, showcase a wide variety of hotels, restaurants, clubs, bars, cafes, art and antique shops. Binondo and San Nicolas, being Manila's Chinatown, are known for authentic Chinese cuisine and delicacies. Quiapo and Divisoria are the shopping destination for a variety of wholesale and retail products. Highest in the NCR, Manila has 28 hotels which served as tourism support infrastructure (SEPP 2005) while Tutuban, 168, SM Malls, Robinsons, Savemore, Puregold are among the famous shopping establishments.

2) Public Enterprise

Manila has 27 public markets and talipapa that are strategically located in its 6 legislative districts. These markets are classified according to average monthly income during the preceding three months: Class A (Php 60,000 or more); Class B (Php 30,000 – 59,000); Class C (less than Php 30,000) (SEPP 2005).

3) Transportation

Major modes of land public transport in Manila are bus, taxi, FX, jeepney, and tricycle while informal land transport systems are kalesa, pedicab and kuliglig. The Philippine National Railways (PNR) and the Light Rail Transit Authority (LRTA) operate the railway systems in Manila. The PNR has 6 terminals or stations within Manila, which includes Blumentritt, España, Laong Laan, Pandacan, Pedro Gil, and Tutuban. The LRT-1 (Yellow Line) that runs along the length of Taft Avenue (R-2) and Rizal Avenue (R-9), and the LRT-2 (Purple Line) that runs along Ramon Magsaysay Blvd (R-6) are the only mass rail rapid transit lines traversing Manila. As the chief seaport of the Philippines, the Port of Manila along Manila Bay served as the City's main entry/exit point accessible via passenger/ cruise ships, while the Pasig River can be traversed via ferry service.

Manila is the premier international port in the country and one of the major domestic ports for inter-island shipping. As a major center of water transport and storage, it has experienced a steady increase in shipping, cargo and container traffic from 1994 to 1997. The shipping cargo and container traffic generate substantial revenues to the City, reaching PHP2.227 billion in 1997. The port will remain the major international and domestic port for the country in the future. It will continue as one the main entry points for passengers, immigrants from the island provinces, imported goods and products from various parts of the country. It will also remain as a major exit point for the country's exports.

2.3.4. Caloocan City

The City of Caloocan, being strategically positioned in the northern portion of Metropolitan Manila, is considered as the gateway of the metropolis towards North Luzon. Being as such, the City continues to be the premier center for trade and industry in CAMANAVA (Caloocan-Malabon-Valenzuela-Navotas) area. Within the last seven years (2000 – 2006), the City has registered its highest number of business establishments in 2006 at 15,199 establishments. However, from 2000 to 2006, number of business establishments showed an unstable rate of change having its lowest figures at 10,287 establishments in 2002.

About 65.28% of these economic activities in 2006 were engaged in trading, 27.70% in services and the remaining 7.02% were in manufacturing, mostly located in South Caloocan.

A. Bonifacio Monument area serves as the Central Business District (CBD) of Caloocan City. This area covers approximately 102 hectares of land, with various business establishments like variety stores, specialty shops, banks, business and professional offices, restaurants, malls, department stores, theaters and other entertainment facilities. Considered as the CBD's advantage points are the presence of a 90-meter wide Circumferential Road (EDSA), the Rizal Ave. Extension, Light Rail Transit (LRT), major modes of transportation such as buses and jeepneys, different communication facilities and other public utilities. As a result, the area extends its services to its neighboring cities and municipalities like Malabon, Navotas and Valenzuela, and areas as far as Marilao and Meycauayan, Bulacan. With a developed trading, banking and other complimentary industrial activities, it now serves as an alternative financial and transaction center, to Manila, Makati and Quezon City.

Growth of commercial strips with chain of eateries like Jollibee, Max's Restaurant, Barrio Fiesta, Hap Tian, Kentucky Fried Chicken and other restaurants and food chains now extends up to Rizal Avenue Extension and 10th Avenue. At present, there are also 40 commercial and savings banks situated along these major roads.

The Caloocan City Commercial Complex, formerly Plaza Rizal Park, which is located in front of the Caloocan City Hall, also housed the various business establishments, like food chains, salons, computer shops, convenience store, coffee shops and others.

Sangandaan area on the other hand, having minor concentric development is slowly growing into a medium-intensity commercial site. Once the long overdue expansion of Samson Road is realized, it is expected that this area will become another Central Business District (CBD).

Intersections of C-3 Road and A. Mabini Street, and C-3 Road and Rizal Avenue Extension (RAE) are both business potential sites capable of accommodating High- Intensity Commercial Development. Said areas have ideal road pattern, capacity, and location, modes of transportation, communication facilities and distribution of goods to other areas.

Due to the existence of small parcel of lands along these major arteries, land consolidation is imperative to adapt high intensity commercial activities. Likewise, underdeveloped spaces for foot traffic along these areas needs to be addressed.

Areas in North Caloocan which shows potentials for commercial growth are the following: (i) CamarinZabarte Roads intersection, (ii) junction of Susano, Camarin and Congressional Roads, (iii) Block Phase 1 Bagong Silang, Sta. Quiteria Road, Tala Road and (iv) Quirino Hi-way (Caloocan side). Despite being potential sites, economic progress along these areas are limited due to its existing narrow roads, insufficient transportation facilities and support facility services like communication, water supply and other public utilities.

2.3.5. Valenzuela City

While regional accounts show a remarkable decrease in the number of registered industrial establishments from 1995 to 2005, Valenzuela City posted a generally increasing trend. More than half (62.02%) of the total number of manufacturing industries in NCR are located in Valenzuela City.

The number of manufacturing industries in 2007 showed remarkable increase in almost all industry types. Metal works, machine shops, and fabricators had the biggest share in terms of the number of industries. This was followed by manufacturers of plastic and rubber products, food products and beverages, metal works machine shop/fabricators, garments and wearing apparels, and manufacturers with machinery.

There are about 7,695 commercial establishments in Valenzuela City in 2007. Wholesale and retail which particularly pertains to trade and repair of motor vehicles, motorcycles and personal and household goods was the most dominant sector comprising 41.99 percent of the total number of establishments. Real estate rentals and business activities followed contributing about 21.73 percent of the total. The rest of the types of commercial establishments had a less than ten percent share of the commercial establishments in the city.

Large commercial centers can also be found in the city including SM Supercenter Valenzuela in Karuhatan, Puregold Supermarket in Dalandanan, Royal Family Mall and CVC Supermarket in Paso de Blas, South Supermarket in Karuhatan, two public markets in Marulas and privately-managed wet and dry markets in several barangays.

About two percent (2%) or 89.70 hectares of the city's total land area is devoted to agricultural crop production. These are located in Barangays Bignay, Canumay, Lawang Bato, Malinta, parade and Punturin. The crops produced, rice, corn and vegetables, are either for household consumption or sold to the markets for family's subsistence.

There are also six commercial and two semi-commercial livestock, poultry farms are operating in the city located in Barangays Canumay, Parada, Veinte Reales, Lawang Bato, Maysan and Bignay. Fishpond areas, on the other hand, are located in Barangays Balangkas, Bisig, Coloong, Isla, Malanday, Tagalag and Wawang Pulo.

2.3.6. Province of Bulacan

The manufacturing sector plays a significant role in the overall economy of Bulacan Province. Based on initial results of the 1995 NSO census, the manufacturing sector is the second leading economic activity because it offers some 113,051 individuals employment opportunities in the various sub-sectors of this particular activity. This number represents at least 15 percent of the total employment in Bulacan (for 1995) making it the second leading sector in terms of providing employment opportunities to Bulakenos.

However despite the highly urbanized nature of the province, agriculture remains to be the major economic activity in the area. Aside from the services and manufacturing sectors, agriculture is the third leading sector in terms of total number of employed individuals. Based on trend analysis, the sector's contribution in the overall economy of the province will diminish in view of the massive rush of urban development. During the period 1990 to 1995, the agricultural sector decreased by 1.35 percent or -0.27 percent per year and of the seven major sectors, only the agricultural sector experienced a decline in the employment pattern.

2.3.7. Province of Pampanga

Farming and fishing are the two main industries of the province. Major products include rice, corn, sugar cane, and tilapia. In addition to these main industries, the province also supports thriving cottage industries that specialize in wood carving, furniture-making, guitars, and handicrafts. Every year during the Christmas season, the province of Pampanga becomes the center of a thriving industry centered on handcrafted lighted lanterns called "parol" that displays a kaleidoscope of light and color. Other industries include its casket industry and the manufacturing of All-purpose Utility Vehicles (AUV) in the Municipality of Sto. Tomas.

The province is famous for its sophisticated culinary industry. Kapampangans are well known for their culinary creations. Well known food products range from the ordinary to the exotic. Pampanga's Best and Mekeni Food are among the better known meat brands of the country producing Kapampangan favorites such as pork and chicken tocinos, beef tapa, hot dogs, and longanizas (Philippines-style sausages and cured meats.)

Tourism is a growing industry in the province of Pampanga. Clark Freeport Zone, in Angeles City, is home to Diosdado Macapagal International Airport, Luzon's second International Airport and designated as the Philippines future premier gateway site. Within the Clark Special Economic Zone are well established hotels and resorts. Popular tourist destinations in the province include: St. Peter Shrine in Apalit, Mt. Arayat National Park in San Juan Bano, Arayat, the Paskuhan Village in the City of San Fernando, the Casino Filipino in Angeles City, and for Nature and Wildlife "Paradise Ranch and Zoocobia Fun Zoo" in Clark. Well known annual events include the Giant Lantern Festival in December, the annual hot air balloon festival in Clarkfield during the month of February, the San Pedro Cutud Lenten Rites celebrated two days before Easter and the Aguman Sanduk in Minalin celebrated on the afternoon of New Year's Day.

Other developing economies include a semiconductor industry involved in the manufacturing of electronics and computers mostly located within the Clark Special Economic Zone in Angeles City.

Rurban development aims for the equal distribution of economic and social development in rural and urban communities. In the rurban areas, essential infrastructures will be improved and new road linkages will be constructed to support the economic activity in primary growth centers such as the Angeles City, San Fernando, Mabalacat and Guagua. These growth centers hope to generate employment and economic opportunities in the urban areas to improve the living condition of the urban population which will be growing in huge number by 2002.

Although the province's economy is basically agriculture, it is more urbanized than rural. The classification of many areas in the province to urban was based mainly on the definition set by the NSO.

Apart from Angeles City and San Fernando, four municipalities will be totally classified as urban areas. These are Apalit, Guagua, Macabebe, Minalin and Sto. Tomas.

In the countryside, farm families will be assisted technically and financially to improve agricultural production. To augment their income, agricultural-based industries will be introduced to help them economically meet their needs and uplift their living condition.

Rurban development will bring about a dispersal of population growth to the rural areas which is the end result of promoting agro-industrial development. Municipalities which are basically agricultural will increase in rural population. Magalang will increase by 8.96%, Candaba – 8.62%, Mexico – 8.27% - Floridablanca and Arayat by 7.59%. Agro-industrial boom will be possible because of the availability of employment and business opportunities which will be generated by the improvement of agricultural produce and development of agro-based industries.

San Fernando's role as the regional capital of Region III and Angeles City as the prime commercial district of Central Luzon in the year 2002 will be a significant factor in their emergence as Small/Medium Cities in the year 2002.

Mabalacat's transformation from Medium Town to Large Town is primarily due to its becoming urbanized and the economic activity entailed by the development of the Clark Special Economic Zone which is within its boundary. Guagua and Apalit will all rise as Large Towns as they will be supplied with additional functional facilities to serve surrounding small towns.

Lubao as Medium Town will perform Guagua's role as service-provider of nearby towns in case the latter will be affected by lahar. Magalang and Arayat will likewise be transformed from Small Towns to Medium Towns due to their potential for agricultural and industrial development.

2.4. Employment

2.4.1. Makati City

The largest employment base of the City is the service sector. The employment situation suggests that economic gains of the City have not translated into employment opportunities for Makati residents. Ironically there is a mismatch between the educational attainment and skills of the local labor with those required, obviously due to the metropolitan and international level of activities taking place at the CBD. Most of the highly skilled specialty workers are either tapped from other Cities or filled in by expatriates.

Based on the result of the Labor Force Survey in 2003 conducted by NSO, Makati has a total labor force of 229,000 of which 84.5% are working either as an employee or self-employed, while 15.5% are unemployed. To address the problem of unemployment, the city government through the Public Employment Service Office (PESO) is providing employment assistance. Said office is implementing two (2) major employment assistance projects such as the Job Placement Program and Job Fair. However, PESO caters not only to job applicants from the City but also from other localities. Thus, job competition is not only between Makati residents but also the latter versus non-Makati residents.

2.4.2. Quezon City

In Quezon City, 2003 employment data is the latest available city data. Such city level data is no longer available in the NSO Labor Force Survey (LFS) results from 2004 onwards, only provided are the national and regional (NCR) figure.

Based on 2003 data, 64.8% of the city's population (2,345,303) belonged to the working age population or the potentially employable aged 15 years old and over. The working age population is divided into:

i) The economically active population or those in the labor force - This group comprises 66.9% or 1,016,000 of the employable population. It is composed of 85.7% employed and 14.3% unemployed. Although majority of the city's working age population are females, the labor force is still dominated by males (male – 53.8%, female – 46.2%). It could be noted however that there is an increasing participation of females in the workforce. This may be viewed not only in terms of economic considerations but the opening of equal work opportunities to them.

ii) The economically inactive population or those not in the labor force - The city's economically inactive population is the 33.1% or 503,000 of the employable population composed of housewives, students, retired persons, the sick and the disabled (differently-abled). About 69.8% of those not in the labor force were females. With regards to disabled persons, however, the Magna Carta for Disabled Persons or RA 7277 is ensuring productivity among persons with disabilities to enable them to become active members of the labor force.

Dependent on the employed population are those who are of dependent age (below 15 years old), those who are of working age but are economically inactive and the unemployed persons. These individuals totaled 1,474,303 in year 2003. Supported by 871,000 employed persons, this means that there is a 1.7:1 dependency ratio or about two (2) dependents for each worker. With an average household size of about five (5), at least two (2) members are employed. (Please refer to Table D2.4-1)

Table D2.4-1 Population 15 Yrs. Old & Over by Gender and by Employment Status: 2003

Employment Status	Total	%	Male	%	Female	%
Total persons 15 yrs. old & over	1,519,000	100.00	699,000	46.0	820,000	54.0
In the labor force	1,016,000	66.9	547,000	53.8	469,000	46.2
Employed	871,000	85.7	450,000	51.7	421,000	48.3
Unemployed	145,000	14.3	97,000	66.9	48,000	33.1
Not in the labor force	503,000	33.1	152,000	30.2	351,000	69.8
Total Estimated Population (2003) = 2,345,303						
Labor Force Participation Rate (Labor Force/Working Age Population) x 100 = 66.9%						
Employment Rate = 85.7%						
Unemployment Rate = 14.3%						
Visible Underemployment Rate = 3.3% of employed population						
Dependency Ratio (Total Population - Employed Labor Force) = Dependent Population/Employed Labor Force = 2,345,303 – 871,000 = 1,474,303 / 871,000 = 1.7:1 or 2:1						

Source: National Statistics Office

2.4.3. City of Manila

Manila is predominantly a service-oriented city. It is one of the most densely populated cities in the country, next to Navotas, and it is fully built-up. Thus very little agriculture, forestry, mining and quarrying are undertaken. The leading industries, namely ---- textile/garments, food, personal products, chemical/pharmaceutical, and rubber/plastic products, are generally light, labor-intensive activities. They take advantage of the city's substantial labor and the labor supply from the rest of the metropolis. Service

sector employment has steadily dominated the share in total employment, to average about 80% from 1994-1999. The rest are employed in industry sector with a minuscule number in agriculture, possibly backyard vegetable growing and small-scale fishing.

Like major global cities, Manila has become less of a center of manufacturing but more of a center for services, amenities and leisure. Given the centrality of the city in the National Capital Region, it provides employment, services, amenities and facilities for a large floating population that does not reside in the city. Unfortunately there is no data on labor force status.

Table D2.4-2 Estimates of Employment Rates (2008-2010)

Year	2008				2009				2010			
Region/City	Jan.	Apr.	July	Oct.	Jan.	Apr.	July	Oct.	Jan.	Apr.	July	Oct.
NCR	87.5	86.2	87.2	87.2	86.0	86.6	87.9	88.2	89.2	88.2	89.1	87.4
Makati City	87.4	86.8	92.5	82.9	90.5	88.9	93.9	90.6	94.1	92.5	92.5	89.1
Parañaque City	89.5	89.5	88.5	92.1	88.6	88.7	91.2	90.9	91.7	91.1	92.9	90.3
Pasay City	86.1	83.5	82.6	90.7	88.0	86.6	88.1	88.9	90.6	88.9	90.0	89.2
Taguig City	84.2	86.8	82.7	88.1	86.2	87.8	88.1	89.9	89.2	91.2	91.1	84.8

Source:National Statistics Office, Labor Force Survey, various years (2008, 2009, 2010)

2.4.4. Caloocan City

As of April, 2003, Caloocan City's potential labor force was estimated at 882,000 or 3.39% over the record of year 2000 labor force. Meanwhile, economically active force was posted at 535,000 (60.66%) of which 426,000 or 79.63% were employed and 109,000 or 20.37% are unemployed. On the other hand, labor force, which is economically inactive, was posted at 347,000. (Please See Table D2.4-3)

In 2003, the City has an unemployment rate of 20.37%. The City ranked 4th in NCR cities and municipalities with highest unemployment rate in 2003. Based on 2000-2003 report, the City's projected labor force was estimated to reach 1,126 (in thousands) by 2010.

Table D2.4-3 Labor Force Status Caloocan City

	2000	2001	2002	2003
Total Labor Force	798	821	855	882
Economically Active	496	523	555	535
Employed	412	445	460	426
Unemployed	84	78	95	109
Not Economically Active	302	298	300	347
Employment Rate	83.06%	84.89%	82.88%	79.63%
Unemployment Rate	16.94%	15.11%	17.12%	20.37%

2.4.5. Valenzuela City

No data available.

2.4.6. Province of Bulacan

In Bulacan, the province's total working population was estimated at 1,116,000. With a labor force participation rate of 62.6 percent, the total labor force was pegged at 699,000. Records from the Provincial NSO showed that the province normally have an employment rate of 94.6 percent. Ten years hence, with

a total population of 2,683,000 and a labor force of 970,000, projected employed labor force will reach close to the one million marks.

2.4.7. Province of Pampanga

No data available.

2.5. Health Care Facilities

2.5.1. Makati City

Health is one of the City's top priorities every year. Based on its Socio Ecological Profile of 2009, the City spent a total of PhP1.19Billion for health services for the same year. The Makati Health Program (MHP) received first international recognition from the Dubai International Award for Best Practices to Improve the Living Environment.

Under the MHP, all of the residents are required to get their Yellow Card as a means of benefit in case of illness. The yellow card is a means to discount bills in hospitalization or consultation. In this way, it could ease up the burden of paying all the hospital bills.

At present the City has a total of five (5) hospitals, two (2) of which are public while three (3) are private (Makati Medical Center, Maria Lourdes Hospital and St. Claire Hospital). The City has also 173 private and 27 public health centers and medical clinics, including the City Employees Clinic located at the City Hall. Aside from these, it has also three (3) lying-in clinics located in barangays Comembo, Guadalupe Nuevo, and Bangkal.

2.5.2. Quezon City

1) Health Centers and "Super Health Centers"

Data on health centers and so called "Super Health Centers" was obtained from Quezon city's 2010 Socio-Economic Profile. The city has a total of sixty (60) Health Centers. Seven (7) are Super health centers and fifty three (53) are regular health centers. Super health centers are those which render 24 hours medical consultation and treatment. Services include pediatrics, internal medicine, obstetrics-gynecology, minor surgery and laboratory examination. It also serves as rehydration clinic for moderate to severely dehydrated diarrhea cases. There are thirteen (13) sub-health stations. Majority of the health centers/super health centers are certified "Sentrong Sigla", which means that these facilities have met standards set by the Department of Health (DOH) in promoting availability of good quality health services to the City's constituents. Most of these health centers/super health centers are located in District II, having 23 regular health centers and 4 super health centers. These Super Health Centers are located at Barangays Novaliches, Batasan Hills , Sta. Lucia & Holy Spirit (Betty Go Belmonte). The three (3) other super health centers are in District I (Frisco), District III (Murphy) and in District IV (Kamuning). Other health facilities include two (2) Reproductive Health Clinic or Teens Center (Cubao and Bernardo HCs), three (3) Social Hygiene Clinic (Proj. 7, Batasan and P. Bernardo HCs), two (2) Laboratory Clinic (City Clinic and Novaliches District Center) and seventeen (17) Microscopy health centers (TB-DOTS).

2) Hospitals

Sixty one (61) hospitals, 18 of which are government owned and 43 are privately owned hospitals service the constituents of Quezon City. Of the 61 hospitals mentioned, 22 are classified as tertiary hospitals or hospitals with metrowide and nationwide service areas and usually have complete service facilities. These types of hospitals are mostly found in District IV. Some of these are offering highly specialized services among which are the Philippine Heart Center for Asia, National Kidney and Transplant Institute, Lung

Center of the Philippines and the ultra-modern St. Luke's Hospital. Seventeen (17) others are primary hospitals, and 22 are classified as secondary hospitals.

The two (2) city-owned hospitals, the Quezon City General Hospital (QCGH) and Novaliches District Hospital (NDH) serve as referral centers for the different health centers and other hospitals and clinics. Since the creation of said hospitals, both have pursued the objective of providing the people, particularly the low-income residents of the city the best medical care that the city government can afford. The QCGH provides patient treatment, ambulatory and domiciliary care and preventive services and serves as center for training of health workers and allied professions and for advancement of medical services through research.

2.5.3. City of Manila

Similar to those for Quezon City, data were obtained from the 2005-2020 Secio-Economic Profile report of the City of Manila. The city of Manila has 23 private hospitals, six (6) national government hospitals, and four (4) city government hospitals. The hospitals operated by the City of Manila are the Ospital ng Maynila, Ospital ng Tondo II, Ospital ng Sampaloc and Gat Andres Bonifacio Hospital. The distribution of health facilities shows that District IV has eight of the 23 private hospitals in Manila, while District II has one private hospital. District III has three national hospitals.

The health center-population ratio is 1:32,267. The Department of Health (DOH) minimum standard is 1:20,000, which may means that 30 additional health centers are needed in the city. The Manila Health Department reported that 22 new health centers will be constructed under the World Bank-funded Urban Health and Nutrition Project of the Department of Health. While the detailed architectural and engineering plans have been prepared and approved, sites in Manila have yet to be identified for such new health centers. A major criterion in the site identification is the accessibility of the health centers to their urban poor clients.

While there are more private hospitals than public hospitals, the total bed capacity of public hospitals is greater (3,769 beds compared to 3,438). Thus, the hospitals bed population ratio is more favorable in the public sector (one bed per 419 population) than in the private sector (one bed per 460 population).

All hospitals, whether secondary or tertiary, fulfill the requirement on the number of beds according to their service category.

2.5.4. Caloocan City

Data on health facilities and manpower were obtained from Caloocan City's 2008-2013 Socio-Economic Profile (SEP). Caloocan has twelve (12) private hospitals, a birthing home and three (3) government-owned hospitals in the entire city. One of the government hospitals is the Jose N. Rodriguez Memorial Hospital, a special hospital. The total bed capacity of the private hospitals is 529. The newly constructed Diosdado Macapagal Memorial Medical Center, a tertiary hospital, has a total bed capacity of 82 and is equipped with facilities such as Intensive Care Unit, X-ray, Laboratory, Operating Room, Physical Therapy, Dental Clinic and Ambulance. Health services include OPD, emergency room, specialty clinic, laboratory, X-ray, pharmacy, physical therapy, dental , surgery, Animal Bite Center, social service, dietary, newborn screening, family medicine, ICU and DOTS. Another effort of the city government for the health benefit of the city residents is the free laboratory procedures and seminars on fasting blood sugar determination, cholesterol determination, triglycerides, Electrocardiogram (ECG), fat screening, bone screening and diabetes education. In partnership with non-government organizations, free surgical procedures were given to 77 harelip cases under the "Operation Smile", 48 were cataract patients and 200 persons benefitted under the operation Tule. As of 2006, the DMMC responded to 64,557 treatments comprising of: 41,504 emergency room consultation, 12,109 out-patient, 2,887 admission of patients (ward), 1,045 dental consultation and 7,217 availed the Specialty Clinic consultation.

Health manpower is provided by 8 regular doctors and 38 consultants, 17 regular nurses and 35 consultants and 11 regular midwives while the government health centers has 36 physicians, 41 nurses, 66 midwives and 28 dentists.

Aside from hospitals, Caloocan maintains forty (40) health centers located in different barangays of the City. Nine (9) of these heath centers are certified by the Department of Health (DOH) as "Sentrong Sigla" centers (Level 1) which means that they passed strict evaluation criteria on quality health servicing. These centers provide local health services to maintain and improve the health of the populace. Services include vaccination, medical and dental services, nutrition supplements, immunization programs and family planning services. These health centers are under the administrative and technical supervision of the City Health Department whose tasks extend to continuous monitoring of water supply and ensuring public access to safe water and promoting the use of sanitary toilet facilities particularly in depressed barangays.

2.5.5. Valenzuela City

Data on health facilities was obtained from the City's 2009-2018 Socio-Economic Profile. Valenzuela City has 51 public health facilities, which include two hospitals, two lying-in clinics, two physical therapy clinics and 41 health centers in 29 barangays. There are also private hospitals (7), medical clinics (38), rehabilitation clinics (2) and laboratory/diagnostic/drug testing centers (21) which are supplementing the city's public health services.

2.5.6. Province of Bulacan

Data on health facilities was obtained from the Province's 1998-2007 Socio-Economic Profile. The province is well served with a network of hospitals. According to the Provincial Health Office (PHO), there are 68 government and private hospitals and clinics in the province but the biggest in terms of number of beds available is the Provincial Hospital with a total capacity of 200 beds. The provincial hospital serves as the main health facility for the entire province of Bulacan.

2.5.7. Province of Pampanga

1) Government Hospitals

The existing government facilities in the province consist of two (2) primary hospitals, eleven (11) secondary hospitals and one (1) tertiary hospitals, forty five (45) rural helath units an three hundred thirteen (313) Barangay Health Stations. The over-all bed capacity of government hospitals in the province is seven hundred twenty five (725) beds.

2) Private Hospitals

A total of thirty three (33) private hospitals are located within the province. Fifteen (15) are classified primary, thirteen (13) are classified secondary and five (5) are classified tertiary.These hospitals offer specialized medical services with the aid of modern health equipment comparable to those in Metro Manila. There is a total bed capacity of eight hundred thirty three (833) beds.

2.6. Historical and Cultural Heritage Areas

Table D2.6-1 shows a list of historic sites, structures, and monuments installed with historical markers that are within a two-kilometer radius from the existing PNR alignment. As can be discerned from the said table, the PNR alignment will not entail any displacement/removal of such historic sites and structures. The nearest historical site, which is located approximately 0.2 km north of the existing Paco PNR Station is the Lord Justo Ukon Takayama Plaza (more commonly known as the Plaza Dilao, in Paco, Manila).

Table D2.6-1 List of Historic Sites, Structures, and Monuments Installed with Historical Markers within the 2 Kilometer Radius of the Proposed Manila-Clark Railway Alignment

Province/Region	Title of Marker	Category	Type	Location	Date of Installation of Marker	Approximate Distance
Pampanga	Bahay Ni Angel Pantaleon de Miranda	Building	House	290 Brgy. Sto. Rosario, Angeles City, Pampanga	December 07, 1986	**1.5 km**, south of the Old Angeles PNR Station
Pampanga	Dayrit House	Building	House	Brgy. Dolores, San Fernando City	January 04, 2004	Approximately **0.8 km** east of the Old San Fernando PNR Station
Pampanga	Augusto P. Hizon House	Building	House	Brgy. Santo Rosario, San Fernando City	December 10, 2010	Approximately **0.5 km**, southeast of the Old San Fernando PNR Station
Pampanga	Pampanga Provincial Jail	Structure	Jail	Capitol Blvd., Brgy. Santo Niño, San Fernando City	December 01, 2009	Approximately **0.5 km** southwest of the Old San Fernando PNR Station
Bulacan	Church of Barasoain	Building	House of Worship	Paseo del Congreso, Brgy. San Miguel, Malolos City	1940	**1 km**, southwest of the proposed Malolos City Station of the Manila-Clark Railway Project
Bulacan	Pook Na Kinatatayuan ng Bahay Paaralan ng mga Kadalagahan ng Malolos (*Instituto Mujeres*)	Site	Site	Sto. Niño Cor. Pariancillo Sts., Brgy. Sto. Niño, Malolos City	1961	**1.5 km**, southwest of the proposed Malolos City Station of the Manila-Clark Railway Project
Bulacan	Pook ng Gobierno Militar de la Plaza (Adriano-Vasquez Mansion)	Structure	Private Company (now MERALCO)	Pariancillo St., Brgy. Sto. Niño, Malolos City		**1.5 km**, southwest of the proposed Malolos City Station of the Manila-Clark Railway Project
Bulacan	Simbahan ng Marilao	Building	House of Worship	Brgy. Poblacion II, Marilao City	May 08, 1996	Approximately **0.8 km**, northwest of the Old Marilao PNR Station
Bulacan	Church of Meycauayan (St. Francis of Assisi Parish Church)	Building	House of Worship	Brgy. Marcosina, Meycauayan City	1938	Approximately **0.6 km** south of the Old Marilao PNR Station
NCR	Bantayog ni Andres Bonifacio	Structure	Monument	Bonifacio Monument, Caloocan City	November 30, 2009	Approximately **1.5 km**, east of the Old Caloocan-Sangandaan PNR Station
NCR	Ang Pampangulaong Kotse ng	Structure	Object	Tutuban Station, Tondo Manila	July 31, 1984	Approximately **1.9 km**

Province/Region	Title of Marker	Category	Type	Location	Date of Installation of Marker	Approximate Distance
	Tren					southwest of the existing Blumentritt PNR Station
NCR	Mouseleo de los Veteranos de la Revoluon (Mausoleum for the Veterans of the Revolution)	Building	Cemetery	Manila North Cemetery	1993	Approximately **1.2 km** northeast of the existing Blumentritt PNR Station
NCR	Bulwagang Paraninfo	Building	Hall	University of Sto. Tomas (UST) Compound, Sampaloc, Manila	December 16, 1981	Approximately **0.1 km** southwest of the existing Laon Laan PNR Station
NCR	Sto. Tomas Concentration Camp	Site	School	UST Compound, Sampaloc, Manila	No Date	Approximately **0.1 km** southwest of the existing Laon Laan PNR Station
NCR	Church of Sampaloc (St. Anthony Church)	Building	House of Worship	Bustillos St., Sampaloc, Manila	No Date	Approximately **1.1 km** southwest of the existing España PNR Station
NCR	Beaterio De Terciarias Agustinas Recoletos	Building	Convent	Sta. Rita College Compound, San Rafael St., Sampaloc, Manila	1939	Approximately **1.7 km** southwest of the existing España PNR Station
NCR	Church of San Sebastian (San Sebastian Basilica)	Building	House of Worship	Plaza Del Carmen, Quiapo, Manila	1934	Approximately **1.7 km** southwest of the existing España PNR Station
NCR	Apolinario Mabini (Inscription Inside the Shrine)	Building	House	Transferred to PUP, Sta. Mesa, Manila	1941	Approximately **0.5 km** southeast of the existing Sta. Mesa PNR Station
NCR	Polytechnic University of the Philippines (1904-2004)	Building	School	PUP Compound, Sta. Mesa, Manila	2004	Approximately **0.5 km** southeast of the existing Sta. Mesa PNR Station
NCR	Malacañan Palace	Building	Government Center	Malacañang Compound, J.P. Laurel Sr., St., San Miguel, Manila	1941	Approximately **1.7 km** northwest of the existing Pandacan PNR Station
NCR	Kalayaan Hall	Structure	Government Center	Kalayaan Hall Bldg., Malacañang Compound, J.P. Laurel Sr., St., San Miguel, Manila	February 26, 2011	Approximately **1.7 km** northwest of the existing Pandacan PNR Station

Province/Region	Title of Marker	Category	Type	Location	Date of Installation of Marker	Approximate Distance
NCR	Goldenberg Mansion	building	Government Office	Gen. Solano St., San Miguel, Manila	1957	Approximately **1.7 km** northwest of the existing Pandacan PNR Station
NCR	Abbey of Our Lady of Monserrat (San Beda College Benedictine Abbey Church)	Building	Monastery	San Beda College Compound, Mendiola St., San Miguel, Manila	1939	Approximately **1.7 km** south of the existing España PNR Station
NCR	Simbahan ng San Miguel (National Shrine of St. Michael and the Archangels)	Building	House of Worship	Jose P. Laurel Sr. St., San Miguel, Manila	September 28, 2003	Approximately **1.9 km** northwest of the existing Pandaca PNR Station
NCR	Mabini Bridge	Structure	Bridge	Nagtahan Bridge Site, Pandacan, Manila	1967	Approximately **1.2 km** northwest of the existing Pandacan PNR Station
NCR	Ang Simbahan ng Pandakan (Sto. Niño de Pandacan Parish Church)	Building	House of Worship	Jesus St., Brgy. 834, Zone 91, Pandacan, Manila	July 13, 1976	Approximately **0.7 km** northwest of the existing Pandacan PNR Station
NCR	Simbahang San Fernando de Dilao ng Paco (Paco Church)	Building	House of Worship	1521 Paz St., Paco Manila	1936	Approximately **0. 6 km** west of the existing Paco PNR Station
NCR	Lord Justo Ukon Takayama	Site	Plaza	Plaza Dilao, Paco Manila	November 17, 1992	Approximately **0.2 km** north of the existing Paco PNR Station
NCR	Simbahan ng Birheng Peñafrancia (Our Lady of Peñafrancia Parish)	Building	House of Worship	Gomez St., Brgy. 826, Pandacan, Manila	July 04, 1975	Approximately **1.4 km** southwest of the existing Pandacan PNR Station Approximately **0.7 km** northwest of the existing Paco PNR Station
NCR	Paco Cemetery	Structure	Cemetery	San Marcelino & Gen. Luna Sts., Brgy. 674, Paco, Manila	1938	Approximately **1.2 km** west of the existing Paco PNR Station
NCR	Tahanan ni Jose P. Laurel	Building	House	Peñafrancia St. Cor. Sto. Sepulcro St., Brgy. 681, Paco, Manila	April 16, 1970	Approximately **0.3 k m** west of the existing Paco PNR Station

Province/Region	Title of Marker	Category	Type	Location	Date of Installation of Marker	Approximate Distance
NCR	Church of Sta. Ana (Our Lady of the Abandoned Church)	Building	House of Worship	New Panaderos & Lamayan Sts., Sta. Ana, Manila	1936	Approximately **1.1 km** southeast of the existing Pandacan PNR Station
NCR	Felipe G. Calderon (1868-1908)	Structure	Monument	Plaza Felipe G. Calderon, Sta. Ana, Manila	1954	Approximately **1.1 km** southeast of the existing Pandacan PNR Station
NCR	Ellinwood Malate Church	Building	House of Worship	1660 Dr. Antonio Vasquez St., Malate Manila	October 21, 2007	Approximately **1.4 km** west of the existing Paco PNR Station
NCR	Adamson University	Building	School	San Marcelino St., Ermita, Manila	February 08, 2007	Approximately **1.7 km** northwest of the existing Paco PNR Station
NCR	Church of San Vicente de Paul	Building	House of Worship	San Marcelino St., Ermita, Manila	1939	Approximately **1.7 km** northwest of the existing Paco PNR Station
NCR	Philippine General Hospital (PGH)	Building	Hospital	Taft Ave., Ermita, Manila	1992	Approximately **1.5 km** west of the existing Paco PNR Station
NCR	Philippine School of Arts and Trades (Technological University of the Philippines)	Building	School	Ayala Boulevard, Ermita, Manila	1952	Approximately **2.0 km** northwest of the existing Paco PNR Station
NCR	Compañia General de Tabacos de Filipinas	Site	Site	D. Romualdez St., Ermita, Manila	1951	Approximately **1.5 km** northwest of the existing Paco PNR Station
NCR	Mannuel Araullo y Gonzales	Structure	Monument	Araullo High School, Taft Ave., Ermita, Manila	1991	Approximately **1.7 km** northwest of the existing Paco PNR Station
NCR	Manila Science High School	Building	School	Manila Science High School, Taft Ave., Ermita, Manila	1982	Approximately **1.5 km** northwest of the existing Paco PNR Station
NCR	Casino Español de Manila	Building	Social Club	T. M. Kalaw St., Ermita, Manila	1993	Approximately **1.7 km** northwest of the existing Paco PNR Station

Province/Region	Title of Marker	Category	Type	Location	Date of Installation of Marker	Approximate Distance
NCR	United Nations Plaza (Plaza Rueda)	Structure	Plaza	United Nations St., Ermita, Manila	1951	Approximately **1.6 km** northwest of the existing Paco PNR Station
NCR	Plaza Olivia Salamanca	Structure	Plaza	Taft Ave., Ermita, Manila	1955	Approximately **1.8 km** northwest of the existing Paco PNR Station
NCR	Church of Malate	Building	House of Worship	M.H. del Pilar St., Brgy. 700, Malate, Manila	1937	Approximately **1.8 km** west of the existing San Andres PNR Station
NCR	Grand Lodge of Free and Accepted Masons of the Philippines (Plaridel Masonic Temple)	Building	Masonic Lodge	San Marcelino & Gen. Luna Sts., Ermita Manila	December 19, 1987	Approximately **1.0 km** west of the existing Paco PNR Station
NCR	Masoneriyang Scottish Rite (Scottish Rite Temple)	Building	Masoic Lodge	1828 Taft Ave., Brgy. 696, Malate, Manila	March 15, 1991	Approximately **1.1 km** west of the existing San Andres PNR Station
NCR	Chapel of the Crucified Christ	Building	House of Worship	St. Paul University Compound, 680 Pedro Gil St., Malate, Manila	November 23, 2007	Approximately **1.5 km** west of the existing San Andres PNR Station
NCR	St. Cecillia's Hall	Building	Theater	St. Scholastica's College Compound, Leon Guinto St., Brgy. 728, Malate, Manila	July 19, 1999	Approximately **0.8 km** southwest of the existing Vito Cruz PNR Station
NCR	Elpidio R. Quirino	Structure	Monument	Quirino Ave., cor Roxas Blvd., Malate, Manila	March 01, 1994	Approximately **1.9 km** southwest of the existing Vito Cruz PNR Station
NCR	Fort San Antonio Abad	Structure	Fort	Central Bank of the Philippines Compound, A. Mabini St., Brgy. 719, Malate, Manila	1939	Approximately **1.9 km** southwest of the existing Vito Cruz PNR Station

2.7. Sewerage and Toilet Facilities

2.7.1. Makati City

Sewage disposal is mostly through individual septic tanks. Effluents are discharged directly into storm drains that lead ultimately into more than 30 esteros in three waterways in Metro Manila, namely: (i)Parañaque River, (ii)Tenejeros-Tullahan River, and (iii)Pasig River. As of 2005, the Biochemical Oxygen Demand (BOD) level in Guadalupe water monitoring station is 11.75 mg/l. which is higher than that of the standard (10 mg/l). This number is expected to increase if no rehabilitation efforts will be undertaken.

The City has three (3) types of drainage systems, namely the: (i)open canal, (ii)reinforced concrete covered pipe, and (iii)box culvert. Domestic and industrial wastes are discharged into storm drains and ultimately into the nine (9) rivers and creeks that extend from Del Pan Street to San Jose, Guadalupe.

2.7.2. Quezon City

1) Sewerage System

As for sewerage, the most common type is the individual septic tank. Community sewer treatment plants exist only in older residential communities mostly developed by the then PHHC (now NHA) namely: Roxas District, Quirino 2 and 3, Project 4, 6, and 7, Malaya Housing Project (UP Village, Teachers Village, Central, Pin-yahan, Sikatuna Villages) GSIS Village, Congressional Village South Triangle, Kamuning, Heroes Hill and Philam Subd.

Maynilad undertook massive replacement and rehabilitation of the old pipes which dominate its territory being mostly old communities. Expansion of its distribution pipelines network to cover newer communities was also undertaken. From 2007 to 2009, Maynilad spent more than Php 1 Billion for this effort in various parts of the City under its concession area.
There are still parts in the City not yet covered by the supply network of Maynilad. These are in Payatas (around the dumpsite and near the boundary of Rodriguez Rizal), in Holy Spirit (north part of BF Homes), in North Fairview and in Kaligayahan (inner part of Zabarte Subd.).

Maynilad is currently upgrading its Communal Septic Facilities at Congressional Avenue, Project 7 (Road A and Roosevelt) and Project 8 (Legal and Grant) and has plans to build 13 Sewerage Treatment Plants along Dario Creek, San Fran-cisco River and San Juan River from 2010 to 2012.

Manila Water is currently undertaking community-wide water pipe laying works in Culiat and Pasong Tamo (Mira Nila, Tierra Bella, Casanova, Muslim Com-pound), and Capitol Hills, and main line replacement at Laging Handa, Damayang Lagi, and E. Rodriguez Cubao. For most parts of the City within its concession area, Manila Water has previously completed rehabilitation and replacement of its water distribution pipes but more improvement works are lined up for implementation in 2011 to 2013. This includes pipe replacement along Quezon Avenue, Commonwealth Avenue, North Avenue, and Kamuning Road.

Also being implemented by Manila Water is the massive replacement of sewer lines in Project 6, UP Village, Teachers Village, Central, Pinyahan, Sikatuna, the entire Quirino District and Project 4. Pro-grammed for 2011 are West Triangle, Sta Cruz, South Triangle, Laging Handa, Paligsahan and Kamuning.

2) Access to Sanitary Toilets

Statistics show that households with access to sanitary toilets likewise improved from 92.00% in 2006 to 95.00% in 2007. The rates are also higher than Metro Manila's 80.00% in 2006 and 76.80% in 2007. Districts II and IV had 99.00% of households with access to sanitary toilet, District III with 98.00% and District I, 90.00%. (Refer to Table D2.6-1).

Table D2.7-1 Access to Safe Water and Sanitary Toilets, Quezon City and Metro Manila (2006-2007)

	Access to Safe Water		Access to Sanitary Toilets	
	2006	2007	2006	2007
Quezon City	92.00	96.00	92.00	95.00
Metro Manila	80.00	79.90	80.00	76.80

2.7.3. Manila

The Manila Sewerage System was constructed in 1909 with the original overload capacity to serve 450,000 people. The system covers 1,850 hectares, serving 530,000 people with the total length of 240 km.

Sewage is collected by lateral interceptor pipes of 15 cm. to 150 cm. in diameter from the various districts of the City. It is the conveyed to the Tondo main sewage pumping station through seven pumping stations. Sta. Ana, a sub-district of Manila, has a separate system and has its wastes discharging directly to the Pasig River. However, the construction of a sewer main line is presently ongoing to interconnect the system in Sta Ana to the Paco Sewage Station.

Table D2.7-2 Sewage Pumping Stations and Sewer Outfall, 1996

I. Sewage Pumping Stations :				
A. Pumping Station I (Composed of 1 Pumping Stations)				
1. Tondo Sewage Pumping Station	Lot Area 4,200 sqm	Design Flow 5,000	No./Pump Capacity 2 x 2,330 (LS) 2 x 1,440 (LS)	Status:Operational
B. Pumping Stations II (Composed of 7 Lift Stations)				
1. Sta Cruz Sewage Lifting Station (Recto cor Alonzo, Sta Cruz)				
2. Legarda Sewage Lifting Station (Recto cor Legarda, Sampaloc)				
3. Luneta Sewage Lifting Station (Burgos cor Orosa Ermita)				
4. Malate Sewage Lifting Station (P. Gil cor Mabini, Malate)				
5. Paco Sewage Lifting Station (P. Gil cor Dart, Paco)				
6. Sta. Ana Sewage Lifting Station (Francisco cor Tejeron, Sta. Ana)				
7. Port Area Lifting Station (Chicago cor 12th St., Port Area)				
II. Sewer Outfall				
Tondo Sewer Outfall (Manila Bay)				
Length of Outfall	2.7 off shore 1.2 on shore			
Outfall Diameter (mm)	1,800			
No. of Diffuser Risers	25			
Diameter Risers (mm)	400			
No. of Diffuser Ports	98			
Diameter Port Holts (mm)	150			
Status	Operation			

Not all of the City of Manila are connected to the system of the sewers and lift stations. In these areas, the sewerage is combined in one. In residential areas and in light commercial districts, the septic vault is used to pre-treat wastewater. In newer building constructions housing bigger populations, the use of package-type wastewater treatment plants being pursued.

Among the problems in sanitation and sewage in Manila is the heavy pollution from the effluent of domestic septic tanks. According to the Manila Second Sewerage Project (World bank-JGA TF 2252-3PH), the estimated number of septic tanks in the year 2000 is about 125, 279 with a population septic tanks in the year 2000 is about 125,279 with a population septic tank ratio of 13:6. The number of septic tanks is expected to increase slightly with new constructions and rehabilitation. There are no records of desludging of tank nor of the in use of packaged type waste water treatment plants but their use may be seen in high-rise commercial-residential buildings in Central Manila.

With the Manila Sewerage System serving roughly 30% of the City, other households discharge wastewater either into storm drain, septic tank or directly into esteros. The untreated water in this case carries with it fecal matter and other debris which finds its way in catch basins or ultimately to nearby bodies of water. Records of desludging are unavailable, but adequately sized septic tanks normally are desludged once in two or three years.

2.7.4. Caloocan (Source: Socio-Economic Profile 2008-2013)

1) Metropolitan Waterworks and Sewerage System (MWSS)

The Metropolitan Waterworks and Sewerage System (MWSS) is a public corporation mandated to handle, supervise and control waterworks and sewerage systems in Metropolitan Manila that includes Caloocan City. The sewerage system, in this case, refers to the network of manmade channels and facilities installed for the collection, transmission, treatment and disposal of sewage or domestic wastewater. Nevertheless, in most instances, drainage and sewerage systems in Metro Manila share a single network system of pipes or canals, except in City of Manila and some parts of Makati. Sewerage system has treatment facilities purifying wastewater that will conform to acceptable standards, prescribed by authority.

The MWSS operates sewerage systems for more than 50 years now and most of this system is already aged and in defective operating condition 36. Among the sewerage systems, the Dagat-Dagatan Sewer System and Wastewater Treatment Pond, is the sole facility that serves portion of Caloocan City, particularly Kaunlaran Village (DagatDagatan Development Project). Dagat-Dagatan Treatment Pond along with the sewer system was built in the late 1970‘s at the Tondo Foreshore Reclamation and Housing Development Project, of which a large portion lies within Caloocan City. The oldest treatment facilities being operated by MWSS are Manila Central Sewerage System, that is formerly built during 1900‘s with last major expansion and rehabilitation made in 1985; the Ayala Sewerage System and Treatment Plant follows the construction in the 1960s, and then, various communal sewer systems of government housing projects completed during the 1960s and 1970s. The Manila Central and Ayala sewerage systems serve the largest population and have been recommended for major rehabilitation and upgrading in past studies.

2) Sanitation and Sewage

One of the major problems in the sanitation and sewage condition of Caloocan City is the heavy pollution from the effluent of domestic septic tanks. In year 2000, there are about 149,985 septic tanks built in Caloocan City and expected to increase up to 179,398 units in 10 years 39 . In as much as the design and utility of septic tanks is concerned, these tanks need to be desludged once every 5 to 10 years for them to maintain effective treatment of sewage. Settling sludge in tanks is accumulated from long period of use, which eventually fills the tank. The wastewater or fecal matter discharged from an under sludge tank, in time, releases through and not restrained as expected. Inevitably, the effluent becomes an untreated

sewage that flows into storm drains and finally discharges to nearby bodies of water. At the time rainy season come, creeks or esteros' overflow from clogged drainage and cause floods, exposing people to hazards of polluted floodwater. During dry periods, the problem gets worse when discharges from septic tanks fill the street drains, since concentration of pollution on storm water increases accordingly when no rain is available to flush the sewage.

Population of Caloocan City in year 2000, should be about 1.35 million, and is estimated to increase to 2.35 million in 2010. At a BOD 38 generation rate of 35 gms/capita/day, the population of Caloocan City shall generate about 47.25 tons/day (t/d) of BOD in year 2000. According to past studies, septic tank serves 60% of Metro Manila's population. Correspondingly, in Caloocan City, septic tank serves about 0.81 million persons, that generates 28.35 t/d of BOD in their sewage. Concerning BOD removal rate of desludged tanks, that is 28-65% BOD load reduction, BOD load in sewage water will reduce about 13-31 t/d, if all tanks will be desludged. These results are equivalent to 27-65% of total BOD generation in Caloocan City. Treated accordingly, desludging also removes suspended solids, significantly improves the sanitary condition of the community and reduces pollution level on waterways.

Based on estimates, septic tanks in Caloocan shall increase by about 20% for the next 10 years or an average of 2,941 septic tanks per year. However, the ratio of population to number of septic tanks also increases proportionately. In year 2000, the ratio of household per one septic vault shall be at 1.9, and expected to increase after ten years at about a ratio of 2.7.

Table D2.7-3 Number of Septic Tanks in CAMANAVA Area and Adjoining Cities of Caloocan City (2000 and 2010)

City / Municipality	No. of Septic Tank		Population/Septic Tank Ratio	
	2000	2010	2000	2010
Quezon City	337,068	382,165	7.0	8.5
Caloocan City	149,985	179,398	9.0	13.1
Manila	125,279	126,571	13.6	14.3
Valenzuela	85,106	114,514	6.5	7.7

3) Toilet Facilities

Data on toilet facilities for Caloocan City is shown in Table D2.7-4.

Table D2.7-4 Distribution of Households in Occupied Dwelling Units in Caloocan City by Type of Toilet Facilities

Particulars	Number	% Share
Total	**249,567**	**100**
Water Sealed, Sewer/Septic Tank, exclusively by the HH	175,023	70.13
Water Sealed, Sewer/Septic Tank shared by the HH	37,916	15.19
Water Sealed, Sewer/other depository, used by the HH	20,877	8,37
Water Sealed, Sewer/Other depository, shared by the HH	8,819	3.53
Closed Pit	2,067	0.83
Open Pit	1,221	0.49
Others	2,654	1.06
None	990	0.4

2.7.5. Valenzuela City (Source: Socio-Economic Profile 2009-2018)

1) Sanitation and Sewage

The topographic characteristic of the city is one of the factors that make it susceptible to flooding. Barangays which normally experience flooding are on the western portion of the city where the Polo River and Coloong River traverses.

To address flooding, several flood control structures have already been constructed throughout the city, particularly in the flood prone areas. The city's drainage facilities include concrete-lined canals, open ditches, sidewalk gutters and river dikes. The existing drainage structures, however, are unable to cope with the increasing water discharges and surface run-off. Some of these structures are already clogged while some were built with deficient outfalls..
Toilet Facilities

2) Access to Sanitary Toilet

Most (98.96%) of the households surveyed in Valenzuela City have access to toilet facilities. Only about 1.04 percent of the 73,037 households surveyed by the Sanitation Division do not have access to sanitary toilets. All surveyed households in Barangays Bagbaguin, Lawang Bato, Pariancillo Villa and Poblacion have access to sanitary toilet facilities.

Table D2.7-5 Number of Households in Occupied Housing Units in Valenzuela City by Access to Toilet Facilities (2007)

Barangay	Total No. of Household	No. of HH Actual Surveyed	No. of HH with Sanitary Toilet	Household without Sanitary Toilet	
				Number	Percent (%) to Total HH Surveyed
Arkong Bato	2,232	1,151	1,148	3	0.26
Bagbaguin	2,976	2,934	2,934	0	0.00
Balangkas	2,243	1,862	1,859	3	0.16
Bignay	3,276	1,262	1,258	4	0.32
Bisig	222	74	68	6	8.11
Canumay	6,541	4,048	3,868	180	4.45
Coloong	1,932	856	850	6	0.70
Dalandanan	3,343	2,871	2,842	29	1.01
Gen. T. de Leon	14,248	12,789	12,740	49	0.38
Isla	700	250	245	5	2.00
Karuhatan	6,552	2,508	2,505	3	0.12
Lawang Bato	4,087	877	877	0	0.00
Lingunan	2,288	1,757	1,719	38	2.16
Mabolo	278	278	278	0	0.00
Malanday	3,221	2,725	2,680	45	1.65
Malinta	12,138	10,095	10,044	51	0.51
Mapulang Lupa	4,298	3,032	2,998	34	1.12
Marulas	10,794	2,590	2,528	62	2.39
Maysan	5,853	2,826	2,815	11	0.39
Palasan	1,055	588	576	12	2.04
Parada	2,565	1,825	1,798	27	1.48

Pariancillo Villa	333	271	271	0	0.00
Paso de Blas	2,610	1,979	1,898	81	4.09
Pasolo	955	697	685	12	1.72
Poblacion	44	44	44	0	31.82
Pulo	200	175	173	2	1.14
Punturin	2,799	2,183	2,172	11	0.50
Rincon	900	828	794	34	4.11
Tagalag	589	213	212	1	0.47
Ugong	7,119	6,865	6,860	5	0.07
Veinte Reales	4,098	2,385	2,345	40	1.68
Wawang Pulo	566	199	191	8	4.02
Total	111,055	73,037	72,261	762	1.04

2.7.6. Central Luzon

In terms of toilet facility, 48.68 percent of the households used exclusively water sealed, sewer/septic tank; 22 percent used water sealed, other depository; 5.68 percent used closed pit; and 3.45 percent did not use any toilet facility. (Please note that there are no data on the provincial and municipal level for Pampanga and Bulacan.)

2.8. Solid Waste Management

2.8.1. Makati City

1) Generation

The Makati s Solid Waste Management Division (SWMD) is responsible for the solid waste collection. Five garbage contractors have been contracted by the city to collect and haul off wastes. The contractors are required to make about 153 trips daily throughout 27 barangays of the city. Each collection truck is required to make two daily trips. Overall collection efficiency has been estimated at 86% efficiency, based on 1994 data. Solid waste collection in the CBD and in six residential villages surrounding the business district is handled by the private sector.

To address issues related to solid waste management, the City is currently implementing its Solid Waste Management Plan. One of the activities conducted by the DES-SWMD is the waste segregation using its Material Recovery Facilities (MRF).

Makati City's garbage primarily comes from different sources according to classification. In 2009, households were the major source of garbage in the City followed by markets. Other sources include the industrial sector, institutional sector, commercial, offices, health centers and funeral parlors.

2) Collection System and Facilities

Solid waste is collected through a cell system. One cell is estimated to contain from 12 to 15 cubic meters of waste. These are collected along the road/street at curbside. Residents and owners of establishments are required to discharge wastes in plastic bags or trash receptacles prior to the arrival of the collection trucks.

Three types of collection trucks are used: 10-wheeler, 6-wheeler, and compactors, with 15, 10, and 8 cubic meters minimum capacity, respectively. Handcarts are utilized where narrow streets do not allow the access of collection trucks, and collection points are designated for systematic collection.

Makati has the following support facilities and equipment for solid waste collection:

- Two dispatching areas located in Districts I and II
- One Vanguard 3000 mechanized sweeper
- Two Johnston 2000 mechanical sweeper
- Two garbage compactors at 12.8 cubic meter per compactor

2.8.2. Quezon City

1) Generation

Quezon City generates very large amount of solid waste due to its huge population and high concentration of social and economic activities. The Waste Analysis and Characterization Study (WACS) conducted by the Environment Protection and Waste Management Department (EPWMD) in 2003 showed that almost fifty percent of the solid waste was biodegradable; a large portion could be recycled and only 13 % ideally should go to the disposal site.

2) Collection

The city contracts out its solid waste collection to private haulers. In 2002 the LGU implemented the Package Clean-Up Collection System wherein private contractors were assigned specific collection cells with the full responsibility to manage, administer and directly carry out the actual collection, cleaning and disposal of solid wastes in those cells. This system dropped the volume of garbage collected from 3,133,861.02 cu.m. in 2001 to 2,532,229.98 cu.m. in 2002. The EPWMD noted the efficiency in the new system, and cited better monitoring and reporting as main factors for inducing improvement in the system. Private contractors were compelled to deliver better service at lower cost to the City Government.

In addition to City-contracted haulers, some barangays also do garbage collection using their own dump trucks. Commercial establishments, on the other hand, are held responsible for collecting and disposing their own wastes. In 2006, the city collected 2,044,112 cu.m. while the barangays and private companies collected 185,888 cu.m. for a total of 2,230,000 cu.m. of solid waste collected. These wastes are then disposed at the Payatas Controlled Dump Facility.

3) Disposal

The Payatas Controlled Dump Facility is Quezon City's lone disposal facility. It is situated in Barangay Payatas, near the northeastern part of the boundary with Rodriguez, Rizal. It is around 3.5 kilometers from the junction of Litex Road and Commonwealth Avenue. Access is though the two-lane concrete paved Litex Road. City officials are amenable to the installation of a transfer site and delivery to solid waste disposal areas, such as the Cardona and San Mateo disposal area.

In Payatas, are two distinct garbage dumps that are about 200 meters apart. The old mound located in the northwest is no longer used to accommodate waste and is now largely a park. In 2007, 16 wells were drilled in the old mound to initiate the Biogas Emission Reduction Project of the City Government in cooperation with PANGEA Green Energy. This project involved the extraction, collection, flaring and conversion to energy of biogas from the dumpsite.

4) Dumpsite Location

The Payatas Dumpsite is situated in the Northern part of the area some 3 kilometers from Commonwealth via Litex Road. It occupies more than 13 hectares of entirely private properties. An estimated 2,000 cubic meters (924 tons) of garbage is being dumped in Payatas daily by the residents of Quezon City. Please refer to Figure D2.8-1.

Figure D2.8-1 Location of the Payatas Dumpsite

2.8.3. City of Manila

1) Generation

Garbage generated in Manila is includes wet and dry household waste, industrial waste commercial waste, and some hospital waste. In 1997, solid waste collection became the responsibility of the local governments and only one percent (1%) was handled by the MMDA.

2) Collection

Passing of Republic Act 9003 reinforced the LGU's responsibilities for the collection of non-biodegradable and special wastes. Barangays units were given the responsibility of segregating and collecting biodegradable, compostable, and reusable wastes. At present the LGUs collect city/municipal solid waste in Metro Manila either through private contracts (11 of the LGUs), or through the LGU's own sanitation services departments (6 LGUs). Manila has 100% coverage of solid waste collection through a private contractor which uses 250 compactors and heavy equipment are used for collection on a daily basis. Provision of facilities for segregation in the community may helped encourage the citizens to participate in the city's solid waste management.

3) Disposal

Since the city has no final disposal facility, waste collected is brought to a transfer station situated at Pier 18, NHA Compound, Tondo. Waste is brought to either the Tanza Facility or the Rodriguez Facility. This 10-hectare Pier 18 facility (Vitas Transfer Station) is located on an area of reclaimed land within the Manila North Harbor Center, adjacent to the Smokey Mountain dump site. Low-income housing, informal settlements and industrial developments bound it on the landward side, while Manila Bay is immediately

adjacent to the north and west. The facility currently includes a site office and two 500-ton capacity barges each docked at the end of 2 separate ramps. Operations started in October 2002 under the management of its builder, Phil. Ecology Systems Corporation.

Table D2.8-1 Dumpsite Location (Source:)

LGU	Location for Disposal
Manila	Rodriguez, Rizal
	Pier 18, Manila
	Tanza, Navotas
Quezon	Payatas, Quezon City
Makati	Rodriguez, Rizal
Caloocan	Rodriguez, Rizal
Valenzuela	Lingunan

Source: Manila Socio-Economic Profile - 2005-2020

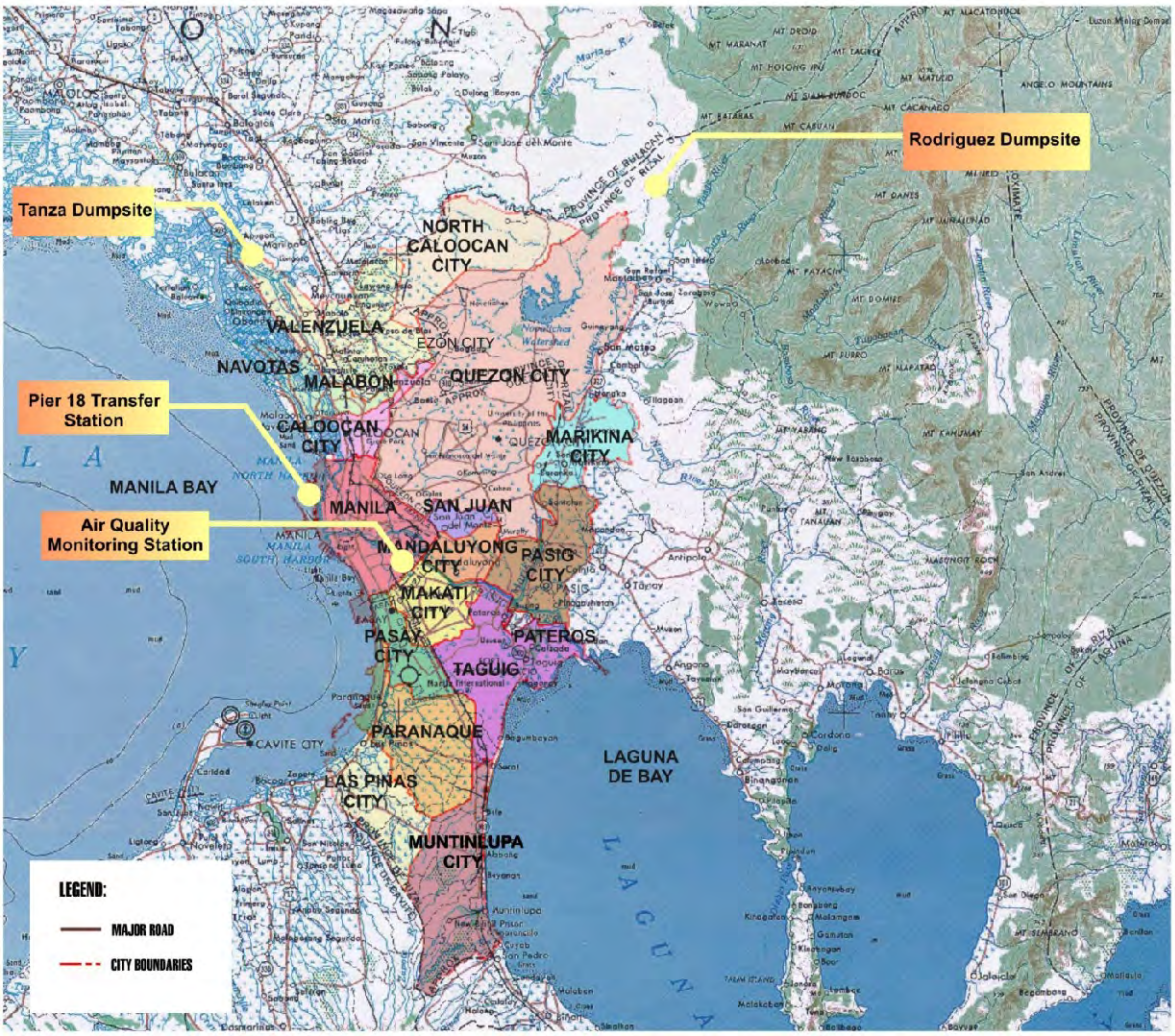


Figure D2.8-2 Location of the Various Dumpsites in Metro Manila

2.8.4. Caloocan City

1) Generation

Based on its CLUP, the average waste-generation-rate per day in the City is 0.60 kilograms per person and the average municipal waste generation rate varies from 212 to 316 tons per day. The density of these wastes is estimated at 330 kilograms per cubic meter, while waste composition are 66% biodegradable (yard waste, food waste, wood, etc.), and 34% non-biodegradable (metals, glass, plastic, etc.).

2) Collection

Solid Waste Management in Caloocan City is presently under the supervision of the Environmental Sanitation Services (ESS) with two sections namely, the: (1) Garbage Collection and Disposal Services, and (2) Street Cleaning Services. In accordance with Metropolitan Manila Council Resolution No. 15 series of 1991, and through a Memorandum of Agreement (MOA) signed 7 August 199, the services of ESC were devolved under the supervision of the City Government. The refuse collection operation at present is being managed by a Public Services Officer who serves as the assistant of the City General Services Officer in the delivery of the said basic service.

3) Disposal

Hauling is primarily used in solid waste collection. As of 1995, solid waste collected daily within the City by private contractors are transported to Payatas dumpsite (open dumpsite), San Mateo Landfill, or dumped to an open area in Bagumbong, North Caloocan. However, there is still no available information on the number of trips accounted to each final disposal site.

4) Dumpsite Location

As of 1995, the solid waste collected daily within the City by private contractors are transported to Payatas dumpsite (open dumpsite), San Mateo Landfill, or dumped to an open area in Bagumbong, North Caloocan. However, there is still no available information on the number of trips accounted to each final disposal site. Earlier In 1991, Caloocan City opened a landfill facility on its 20-hectare estate in Bo. Camarin — located further north of the boundary. The decision to operate this facility resulted from the common problem of inefficient garbage collection and transportation that is due to infeasible distance of final disposal sites from collection routes. In 1993, the Department of Environment and Natural Resources (DENR) ordered the closure of the said dumpsite as appealed by the residents surrounding the dumpsite. Previous record showed that as of 1989, Caloocan City dumped the collected garbage in an open dumpsite in Valenzuela; about 5.3 kilometers from South Caloocan. Valenzuela dumpsite is about 15 to 25 kilometer closer to the City borders than the present dumping areas. The average travel distance of collection and disposal vehicles to the present dumpsites, Payatas and San Mateo, is about 19 and 31 kilometers, respectively. Please see Figure D2.8-1 and Figure D2.8-3

2.8.5. Valenzuela City

1) Collection and Disposal

Like most LGUs, the city is not yet fully compliant with the provisions of R.A. 9003 or the Solid Waste Management Act of 2000. It is, however, in the process of closing the existing dumpsite in Barangay Lingunan. At present, the city is utilizing the five-hectare controlled dumpsite in Barangay Lingunan. Unsegregated garbage is collected from households twice a week for every route while daily collection is done in markets and along the major thoroughfares of the city. Parts of the garbage collected in the 32

barangays are diverted for recovery and recycling at the Valenzuela EcoCenter and MRF in Barangay Marulas before these are finally disposed into the controlled dumpsite.
In order to achieve efficient and ecological means of managing solid waste, the city government institutes the support of barangays for waste minimization, segregation and recycling. It is also studying the possibility of acquiring land for a Materials Recovery Facility. Even though garbage collection is available to all households in the city, there are still about 493 households (0.68%) from the total households surveyed which do not have proper garbage storage and disposal facilities.
Central Luzon Traversed Areas

2) Dumpsite Location

At present, the city is utilizing the five-hectare controlled dumpsite in Barangay Lingunan. Unsegregated garbage is collected from households twice a week for every route while daily collection is done in markets and along the major thoroughfares of the city. Parts of the garbage collected in the 32 barangays are diverted for recovery and recycling at the Valenzuela EcoCenter and MRF in Barangay Marulas before these are finally disposed into the controlled dumpsite. Please see Figure D2.8-3

Figure D2.8-3 Location of theValenzuela Dumpsite

2.8.6. Province of Bulacan

Majority of the municipalities in Bulacan are still using traditional way of disposing their solid wastes, which is through open dumping. Of the 24 municipalities, 21 towns practice open dumping, while remaining three municipalities have simplified landfilling.

Disposal of solid waste represents a major challenge to residents of Bulacan. In a series of consultations conducted by the provincial government, it has been found that majority of the municipalities of the province has difficulties dealing with the management of their own solid wastes. One reason cited is the absence of proper disposal sites particularly in highly urbanized areas where most of the vacant lands have been built-upon by subdivisions and industries. Neighboring municipalities with enough space for disposal sites, on the other hand, reject any prelude from municipalities with disposal problem, as this would tarnish the image of the municipalities. Table D2.8-2 shows the solid waste disposal system of various municipalities in the Bulacan Province as of 1996.

Table D2.8-2 Solid Waste Disposal System Province of Bulacan, 1996

Municipality	Solid Wastes Disposal Sites	Methods Use	Volume OF Refuse Generated/Day (CU.M)
Angat	Baybay	Open Dumping	8
Balagtas	Wawa	Open Dumping	20
Baliuag	Sabang	Open Dumping	336
Bocaue	Bundukan	Open Dumping	280
Bulacan	Purok 5, Bambang	Sanitary Landfill	30
Bustos	Bonga Menor	Open Dumping	1
Calumpit	Sapang Bayan	Open Dumping	5
Dona Remedios Trinidad	None	Household Disposal	-
Guiguinto	None	Household Disposal	3
Hagonoy	Sto Nino	Open Dumping	40
Malolos	Matimbo	Sanitary Landfill	30
Marilao	Sta. Rosa	Open Dumping	56
Meycauayan	Tugatog	Open Dumping	84
Norzagaray	Tabtub	Open Dumping	112
Obando	Tawiran	Open Dumping	7
Pandi	Baka-bakahan	Open Dumping	2
Paombong	San Roque	Open Dumping	8
Plaridel	Parulan	Open Dumping	8.4
Pulilan	Longos	Open Dumping	4
San Ildefonso	Alagao	Open Dumping	25
San Jose Del Mote	Minuyan, Sapang Palay	Open Dumping	84
San Miguel	Sibul	Open Dumping	8
San Rafael	Coral na Bato	Open Dumping	8
Sta. Maria	Pila, Catmon	Open Dumping	42

Source: Provincial Physical Framework Plan of Bulacan (1998-2007)

2.8.7. Province of Pampanga

Based on Pampanga's Provincial Physical Framework Plan (PPFP) there are seven existing solid waste disposal sites in the Province of Pampanga. These are located in the municipalities of Guagua, Mabalacat, Macabebe, Masantol, Mexico, San Fernando and Sta. Ana. The usual ways of households in disposing garbage are dumping in individual pit, burning, composting, burying, feeds to animals and by garbage truck collections. With the rapid urbanization of many municipalities, the operation of an incinerator within the province is being proposed to process the increasing volume of solid wastes produced by urban municipalities.

It has been proposed since 1992 that every municipality have its own garbage disposal system through recycling and utilization of organic wastes for energy consumption. However to date, no literature is yet available to determine to what extent this plan has been realized, as the updating of Pampanga's PPFP is still underway.

付属資料 D-3：環境社会配慮調査のＴＯＲ案

Table 1 Outline of Draft TOR for EIA and RAP Surveys

Items	Potential Impacts	Outline of TOR	
		Baseline Survey	Prediction and Assessment
Social Environment			
Involuntary Resettlement	•Relocation of Informal Settlers •Land acquisition and resettlement	•Review the existing documents regarding relocation plans done by the Northrail project. •Conduct the socio-economic surveys for drafting the RAP.	•Draw up the project resettlement policy, to prepare the draft RAP based on the results of the socio-economic surveys. •Reflect the opinions and comments obtained through Public Consultation Meetings, focus group discussion and interview survey in the draft RAP.
Local economy such as employment and livelihood, etc.	•Restoration of income loss •Livelihood and living status	•Conduct the socio-economic surveys for drafting the RAP.	•Based on the results of the socio-economic surveys, confirm the eligible people and include their compensation and livelihood rehabilitation measures in the draft RAP.
Land use and utilization of local resources	•Uncontrolled land use	•Check the LGUs' land use plan.	•Draw on the LGUs' opinions and comments through stakeholder consultation to predict any changes in future land use.
Social institutions such as social infrastructure and local decision-making institutions	•Identity of Community •Conflict Resolution	•Conduct the socio-economic surveys for drafting the RAP.	•Reflect the opinions and comments obtained through Public Consultation Meetings, focus group discussion and interviews with barangay officials in the draft RAP
Existing social infrastructures and services	•Utility service interruption •Traffic congestion •Public nuisance	• Utility service to be relocated shall be surveyed based on the information provided by LGUs. •Check the location of schools, hospitals, religious facilities and commercial facilities by field reconnaissance and interviews.	•Predict the impacts on communities due to the utility service interruption to consider the countermeasures. •Based on the construction plan, predict the traffic congestion and evaluate the risk of traffic accidents.
Water Usage or Water Rights and Rights of Common	•Blockage of Irrigation canals	•Survey the locations and usage of irrigation canals.	•Predict the impacts on irrigation based on the construction plan.
Historical /Cultural heritage	•Old PNR stations	•Conduct filed reconnaissance and interview surveys to confirm the existence of the cultural/ historical heritages in local communities.	•Predict and assess the impacts on the historical/ cultural facilities by railway facilities siting plan and construction activities.
Landscape	•Preservation of landscape resources	•Collect the information on aesthetic/ visual resources by filed reconnaissance and interview.	•By using visual presentation methods such as perspectives, evaluate the visual impacts on the city scape referring to the opinions and comments obtained through public consultation.
Sunlight easement	•Shadows of elevated structures	•Conduct field reconnaissance and interviews to grasp the current sunlight conditions	•Predict the shadow area of viaducts and bridges and assess the impacts on the surrounding communities referring to the opinions and comments obtained through public consultation.
Sanitation	•Public health during construction	•Grasp the sanitary facilities and health problems in and around the project area by interview surveys.	•Based on the construction plan, draw up the plan for portable toilets and litter bins and consider the measures for local communities to maintain a good sanitary condition.
Hazards (Risk) Infectious diseases such as HIV/AIDS	•Public health during construction	•Grasp the policy and measures of LGUs for preventing HIV/AIDS by interview surveys.	•Based on the LGUs' policy and measures for preventing HIV/AIDS, consider the educational and training programs on community health for contractors and workers.
Natural Environment			
Topography and Geological features	•Land alteration	•Survey the environmental conditions of planed access roads.	•Based on the construction plan, predict and assess the impacts due to temporary land

Items	Potential Impacts	Outline of TOR	
		Baseline Survey	Prediction and Assessment
			alteration, by drawing from examples of similar projects.
Soil Erosion	•Soil erosion at borrow pits and quarries	•Survey the location and status of borrow pits and quarries for this project by existing materials and interview.	•Based on the construction plan, estimate the sand and rock from the borrow pits and quarries and evaluate the possibility of land alteration and soil erosion by drawing from examples of similar projects.
Groundwater	•Impacts on groundwater veins and quality	•Analyze the data obtained by geological survey. •Conduct field measurements of groundwater levels, quality and usage at the underground section in Makati City. •Parameters to be surveyed: Color, Water Temperature, pH, Turbidity, Total hardness, TDS, Ba, Nitrate, Nitrites, Sulfates, Fluoride, Mn, Fe, Chloride, Ag, As, Cd, Cr^{6+}, Cu, Pb, Total Hg, Se, Zn, Total Coliforms •Sampling site: Underground section (5 boreholes/wells)	•Based on the tunnel and underground facilities design and construction methods, predict and assess the impacts on groundwater flow and quality, by drawing from examples of similar projects.
Hydrological Situation	•Increase of flood and inundation risk	•Conduct a literature review, filed reconnaissance and interview survey on hydrology, flood and inundation records.	•Conduct the hydrological and hydraulic analyses. •Based on the results, predict and assess the risks of flooding and inundation.
Flora, Fauna and Biodiversity	•Temporary loss of swap habitat •Cutting trees and clearing vegetation	•Conduct a literature review and field reconnaissance to understand the current status of flora and fauna in and around the project area, including swamps, fishponds, rivers and creeks.	•Based on the survey results, estimate the location and area of trees and vegetation to be removed, and assess the impacts on biodiversity and habitats.
Global Warming	• Temporary increase of CO_2 emission	•Grasp the policy and measures against global warming in the traffic and transportation sector in the Philippines by reviewing existing materials.	[Construction] •Based on the construction plan, estimate the emission of CO_2 from operation of construction machines and heavy vehicles, and assess the impacts on global warming. [Operation] •Based on the predicted future traffic demand, estimate the increase or decrease of CO_2 emission for both with and without-project cases and compare the difference.
Pollution Control			
Air Pollution	• Temporary increase of air pollutant emission	•Conduct field measurements to understand the current status of ambient air quality in the project area. •Parameters to be surveyed: TSP, PM_{10}, NO_2, SO_2, CO, O_3 and Lead (Pb). •Sampling sites: Along the proposed route (5 locations)	[Construction] •Based on the construction plan, estimate the emission of pollutants from operation of construction machines and heavy vehicles, and compare the predicted concentrations with the ambient air quality guideline values [Operation] •Qualitatively assess the positive effect on improvement of ambient air quality.
Water Pollution	•Deterioration of surface water quality •Wastewater treatment	•Conduct field measurements to understand the current status of river and swamp water quality. •Parameters to be surveyed: Color, Water Temperature, pH, DO, BOD, TSS, Surfactants, Oil/Grease, Nitrate, Phosphate, Phenolic Substances, Total Coliforms, Chloride, Dissolved	[Construction] •Based on the construction plan, estimate the generation of suspended solids from the piling work for the piers, predict the diffusion of turbid water and assess the impacts on river water quality. [Operation] •Evaluate the impacts on surface water quality due to the discharges of wastewater,

Items	Potential Impacts	Outline of TOR	
		Baseline Survey	Prediction and Assessment
		Cu, As, Cd, Cr^{6+}, Cyanide, Pb, Total Hg and Organophosphate. •Sampling site: Along the proposed route (5 locations)	by drawing from examples of similar projects.
Soil Contamination	•Contamination of soil	•Review the existing documents and conduct interview surveys regarding soil contamination, and conduct a field sampling and lab analysis to determine if there is a brownfield site. •Parameters to be surveyed and sampling locations: determined by the existing records of brownfields.	[Pre-construction] •Based on the contamination levels, consider whether or not remediation is needed in accordance with the international guidelines and standards.
Waste	•Disposal of waste soil/sand •Disposal of solid waste	•Grasp the LGUs' policy and procedures for solid waste management by existing materials and interviews.	[Construction] •Based on the construction plan, estimate the generation of solid waste and by-products, and consider the treatment and disposal procedures to avoid adverse impacts on neighborhoods.
Noise and Vibration	•Noise and vibration due to construction • Noise and vibration emitted from train operations	•Conduct field measurements to understand the current status of noise and vibration •Parameters to be surveyed: A-weighted sound pressure level [dB(A)] and Vibration Acceleration (m/s^2 and dB). •Sampling sites: Along the proposed route (at 10 proposed stations)	[Construction] •Based on the construction plan, estimate the emissions of noise and vibration from the operation of construction machines and heavy vehicles, predict and assess the surrounding sound environment to compare the environmental standards [Operation] •Estimate the emitted noise and vibration from trains and assess the surrounding sound environment to compare the environmental standards
Ground Subsidence	• Ground subsidence due to changes in underground water veins	(Refer to "Groundwater")	•Based on the tunnel and underground facilities design and construction methods, study whether or not ground subsidence will occur, by drawing from examples of similar projects.
Bottom sediment	•Deterioration of water quality due to contaminated sediment •Deterioration of sediment quality due to wastewater	•Conduct field measurements to understand the current status of river and swamp sediment quality. •Parameters to be surveyed: Particle size, Organic compound and Nutrients, Heavy metals, Persistent Organic Pollutants, Polycyclic Aromatic Hydrocarbons •Sampling sites: The sites where the long-span bridge piers are installed in rivers and swamps.	[Construction] •Based on the construction plan of the long-span bridges, estimate the diffusion of hazardous materials from the piling work and assess the impacts on riverine organisms [Operation] •Evaluate the impacts on river sediment quality due to the surface flushing by rainfall runoff, by drawing from examples of similar projects
Others			
Accidents	•Risk of traffic accidents during construction	•Grasp the LGUs' procedure on traffic management during construction by interview.	•Based on the construction plan, evaluate the risk of traffic accidents, by drawing from examples of similar projects.

Source: JICA Study Team