has a low transport efficiency. This change in modal split also reflects the degree of transport efficiency, i.e. to transport 1,000 person trips in 1980 requires only 194 pcu to 219 pcu in year 2000 or an increase of about 13%. For this reason, the PUV system should be strengthened to be an efficient transport system thereby maximizing the use of available road space, or more passengers transported per unit length of road.

6. SELECTION OF THE OPTIMUM ROUTE AND FORMULATION OF ALTERNATIVE PLANS

1) Role and Function of the Project Roads

C–5

This circumferential road, which will function as a major distributor of traffic, will substantially contribute to the improvement of traffic condition along C–4, the most important thoroughfare in the NCR, and at the same time share traffic coming from the northern parts of Luzon that are presently using the MNE and the MacArthur Highway. Locally, it will distribute traffic from Quirino Highway to Mindanao Avenue and/or Visayas Avenue.

C–6

This is the outermost circumferential road of the NCR, whose function and classification are the same with that of C–5. When constructed, C–6 will distribute traffic on the Quirino Highway to Mindanao Avenue and/or Visayas Avenue. In the future, the whole legnth of C–6 will become an important road for connection between satellite cities that will be developed on the fringes of the NCR.

Mindanao and Visayas Avenue

These roads belong to a secondary major road and their main function is to attract traffic presently using existing congested radial roads via C–5 and C–6. Also, they will service the generated traffic along its length and traffic from Quirino Highway to C–4 and/or C–5.

In addition to their traffic function, the project roads will function as developmental roads. The Project Area presently lacks adequate major roads, and therefore, sporadic concentrations of development activities are seen in the areas along the existing roads. The strong development pressure on the project area, will necessitate the construction of the project roads to accelerate development of this area into an orderly land use.

2) Selection of Optimum Route

The major steps used in the establishment of candidate routes up to the selection of optimum route are described below:

a) Selection of Candidate Routes

Candidate routes were established by first determining the general corridor of each project road, and within the corridor, control points, such as open areas, existing roads, reserved right-of-way that could be utilized including those areas that should be avoided, such as schools, churches, commercial centers, high density residential areas, were marked in an aerial photo. From this map, all possible alignments of each project road were established and were screened down to two or three competitive routes (see Figure 7).

b) Selection of Preferred Routes

The candidate routes of each project road were evaluated individually using such factors as social and environmental impacts, engineering impacts, difficulty of implementation and construction cost. One or two of the candidate routes were selected for each project road and are summarized below:

TABLE 4 PREFERRED ROUTES

Project Road	*Preferred Routes*
C–5	A–1 and A–2
C–6	B–1 and C–4
Mindanao Avenue	C–2 and C–3
Visayas Avenue	D–1 and D–2

c) Selection of Alternative Road Networks

The preferred routes were used in the formulation of alternative road network plans (See Figure 8).

d) Selection of Optimum Routes

The result of the evaluation of the eight (8) alternative road network plans shows that plans 2 and 4 have the highest rating with 88.2 and 83.3 points, respectively.

The alignment of C–5 is the only difference between the two plans. Plan 4 has a more balanced distribution of Circumferential Roads 4, 5 and 6, while Plan 2, has a more balanced distribution of the overall road network. The advantages of Plan 2 over Plan 4 are as follows:

FIGURE 7. CANDIDATE ROUTES

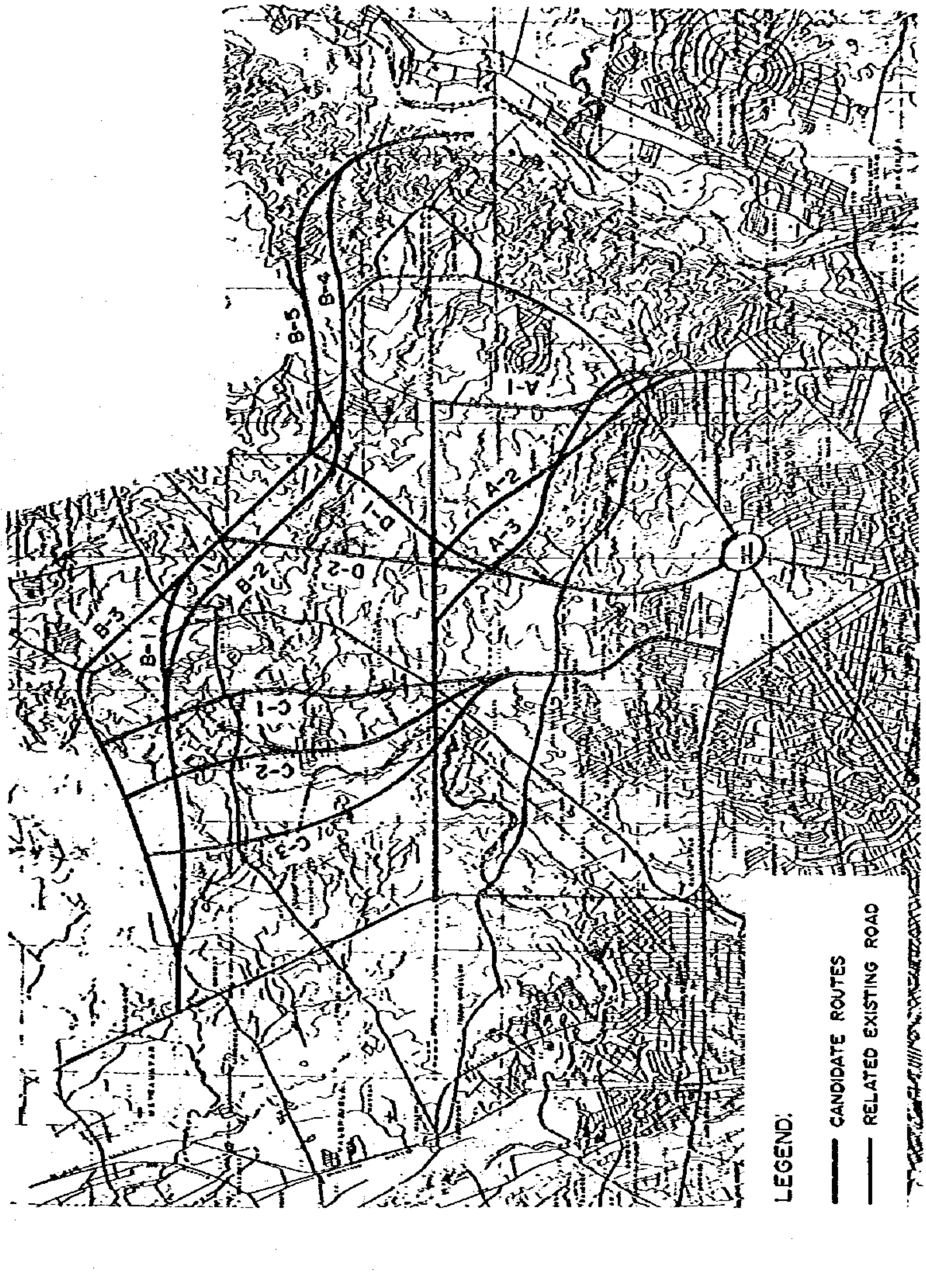
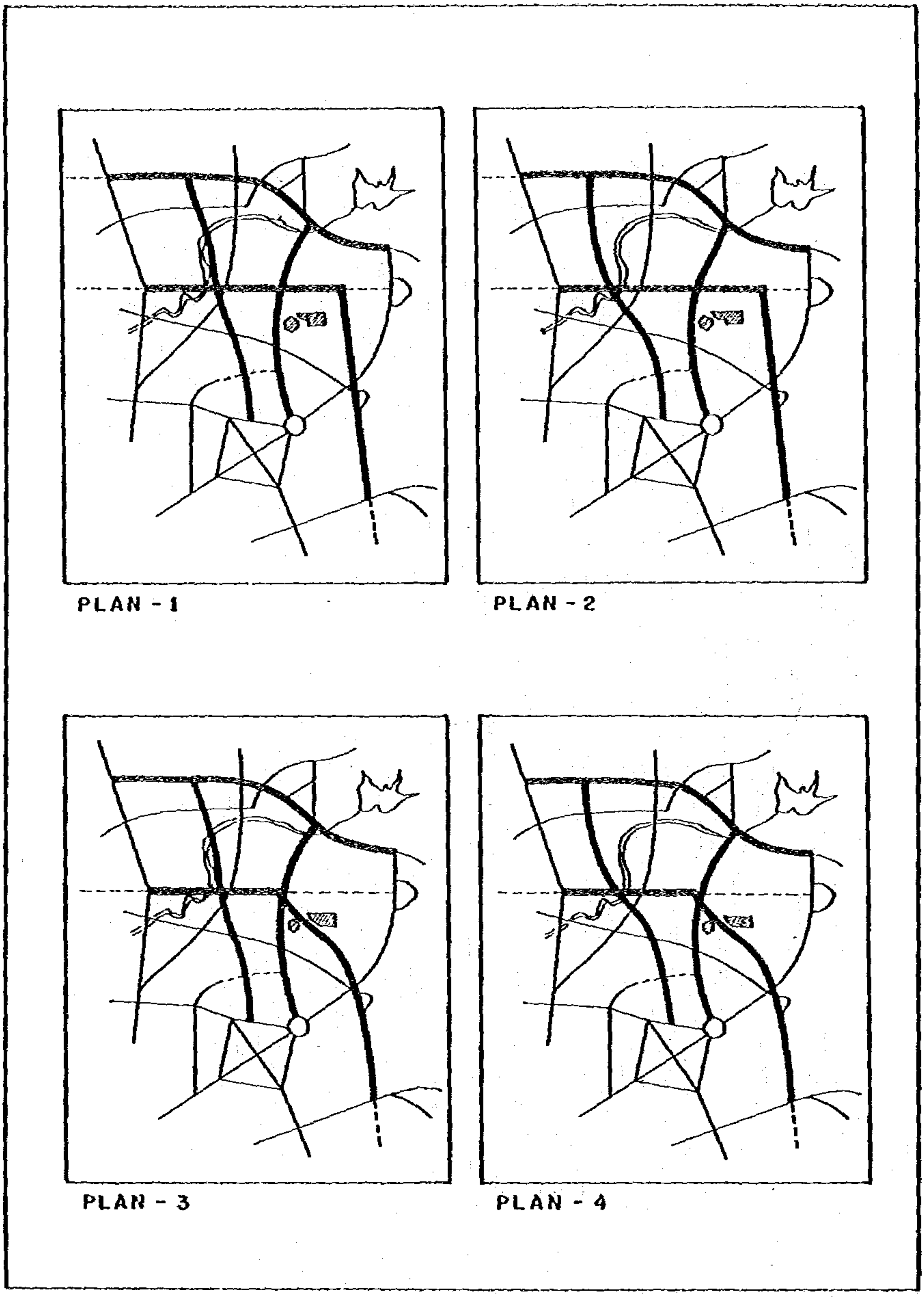
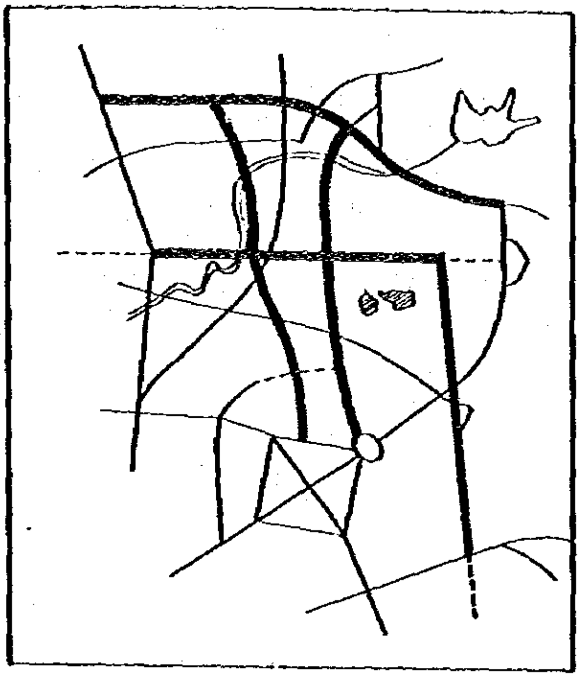
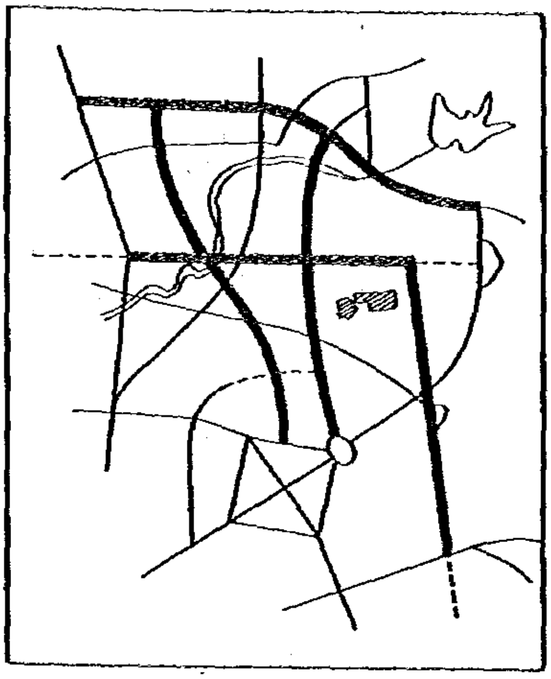


FIGURE 8. ROAD NETWORK ALTERNATIVES

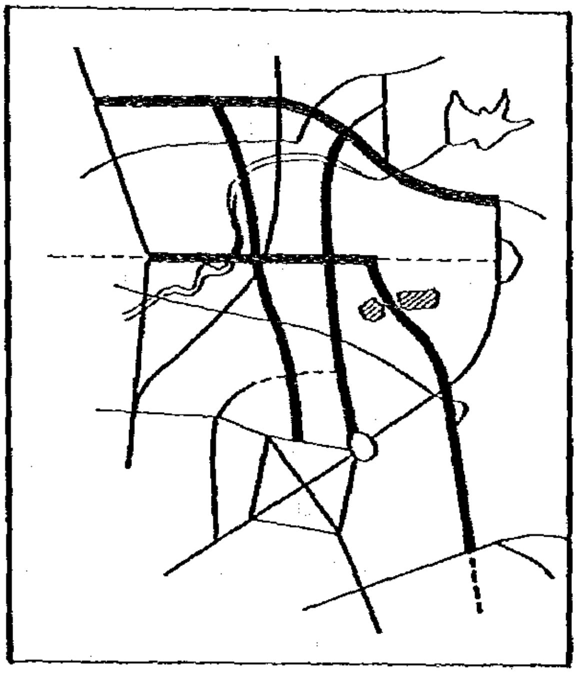




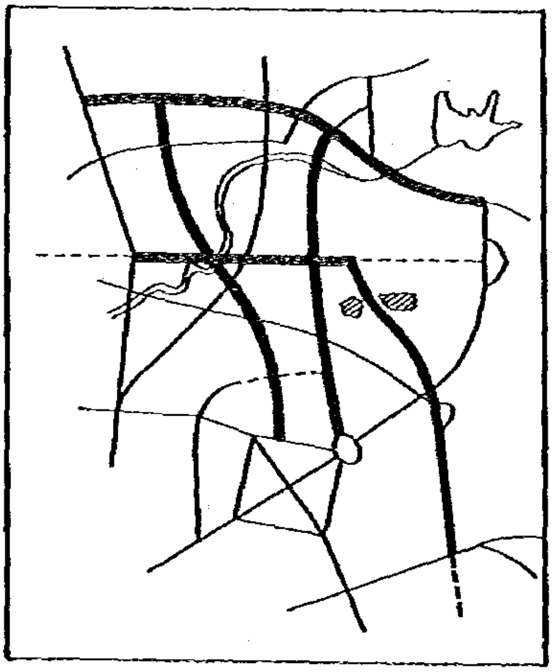
PLAN-5



PLAN-6



PLAN-7



PLAN-8

* balanced distribution of north-south direction roads which would accelerate a well-balanced development of the area;
* most economical plan;
* Far Eastern University development plan will not be affected; and
* most extensive use of existing roads and reserved right-of-way.

Plan 2 was selected as the optimum road network in the area and the proposed alignment of the project roads is summarized as follows:

TABLE 5 OPTIMUM ROUTE

Project Road	*The Optimum Route*
C–5	A–1
C–6	(B–1) + (B–4)
Mindanao Avenue	C–3
Visayas Avenue	D–1

3) Alternative Plans

a) Policy

Alternative development plans of the recommended optimum routes were formulated using the following factors:

Type of Pavement

Type of intersections and grade separations

Type of bridge and drainage structures

Number of lanes

Phasing of construction

The first three factors were evaluated independently and the result of the evaluation were used in the formulation of alternative plans.

The following are the basic policies in the formulation of alternative plans:

* The entire routes of the project roads be constructed in the initial stage;
* The construction be in two stages with the following type of improvements: (1) aims at the achievement of minimum investment by constructing the minimum number of lanes needed to meet

the traffic demand in each stage, and (2) aims to achieve a higher traffic efficiency in the Project Area as a whole by constructing slightly more lanes than needed to meet the demand in each phase; and that in either alternatives a bus/jeepney lane be constructed in Stage 2 to allow the efficient use of available lanes;

* In view of the amount of annual investment needed for the construction of the project roads in one stage (Stage 1) the construction of Stage 1 be divided into two consecutive phases, Phase 1 and Phase 2;

* The completion of Stage 2 construction be at least five years after the completion of Stage 1; and

* The upgrading, improvement, or construction of existing or new related roads be implemented during the study period on the basis of the established implementation timing of the related roads. (See Figure 9).

b) Road Network Analysis

The future road network with and without the project roads were established. To get an indication of the traffic demand on the road network, a non-capacity constraint traffic assignment was undertaken, which allows trips to select the shortest route regardless of the actual road capacity for years 1980, 1990 and 2000. The result of the non-capacity constraint traffic assignment for year 2000 without the project roads indicates that:

* Quirino Highway, with its present limited capacity, will attract large volume of traffic which would require further widening. This, however, is practically impossible due to the present roadside development;

* Tandang Sora Avenue, which is also difficult to widen due to roadside development, would be handling traffic more than its capacity;

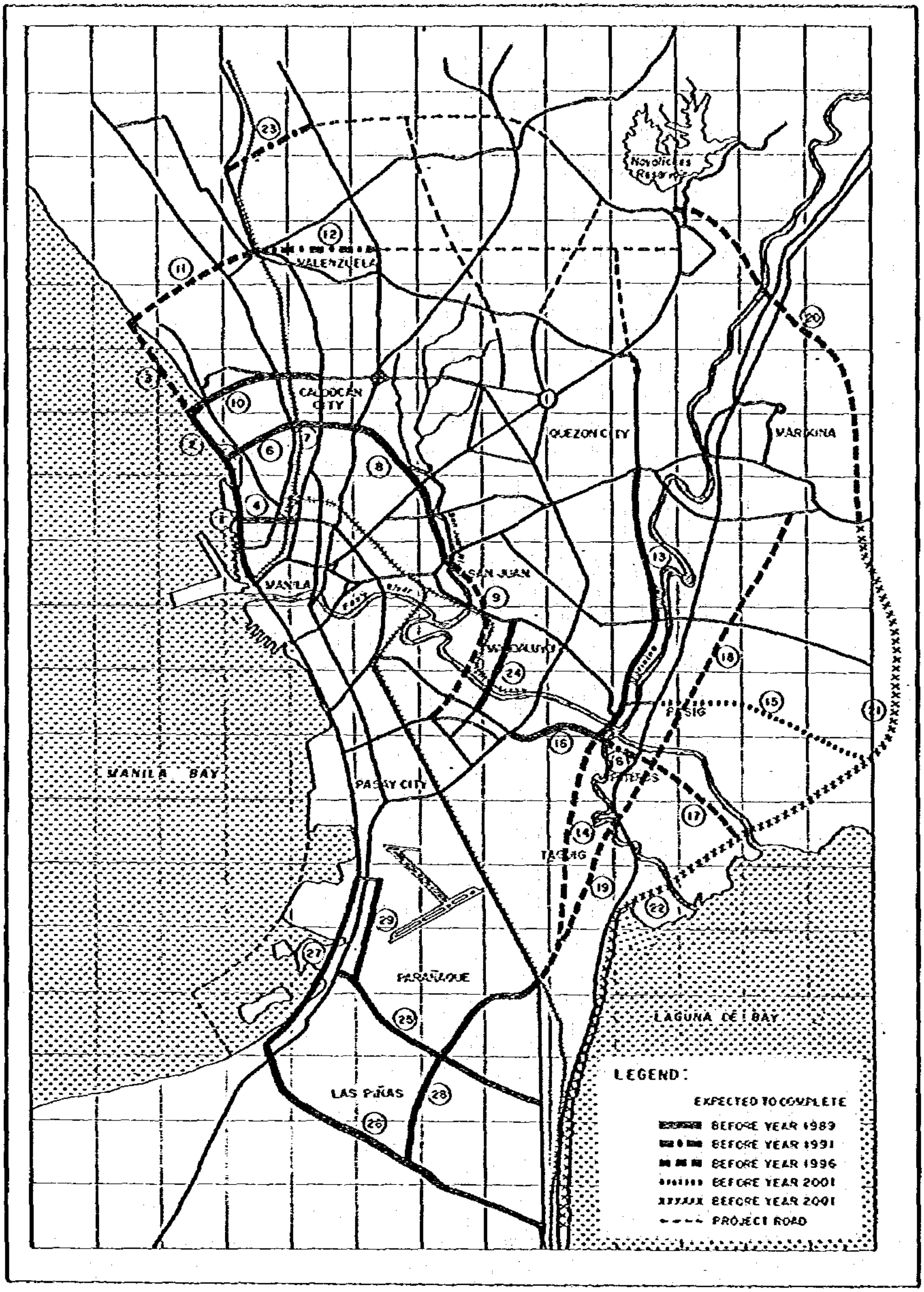
* EDSA or C–4, which is the most important thoroughfare in Metro Manila would be handling traffic more than its capacity; and

* The urbanization of the DIZ, especially within the Capitol Hills Urban Land Reform, would generate traffic which will congest the Don Mariano Marcos Avenue and Katipunan Avenues.

c) Number of Lanes

To determine the level of service of the road network, the DIZ was subdivided into several screen lines. The number of lanes necessary to service the future traffic demand by screen lines includes the proposed widening and

FIGURE 9. EXPECTED ROAD CONSTRUCTION SCHEDULE



improvement of other related roads excluding the project roads. The remaining traffic demand will then be served by the project roads. The estimated traffic volume by screen lines for years 1980, 1990 and 2000 and the required number of lanes are presented in Table 6 and Table 7.

d) Formulation of Alternative Plans

Based on the road network analysis and the rquired number of lanes on each screen line, four alternative plans: Alternatives–1 (A), –1 (B), –2(A), and –2 (B) were formulated from two basic plans (Plans–1 and –2) with different number of lanes and two modifications (Plans –A and –B) as Phase 1 of Stage 1 with different priority emphases. The basic plans are described as follows.

Plan–1 aims at the least investment by providing the minimum number of lanes for the project roads just enough to meet the traffic demand.

Plan–2 aims at the achievement of a higher level of service than Plan 1 to attract more traffic from highly congested roads.

Plans–A and –B on the other hand, were established giving different priority emphases on the implementation of Stage 1. Plans–A and –B are described as follows:

Plan–A (Priority Emphasis: Circumferential Roads)

The plan aims at the strengtheming of circumferential road functions in the DIZ and the urbanization of areas along Republic and Luzon Avenues.

Plan–B (Priority Emphasis: Radial Roads)

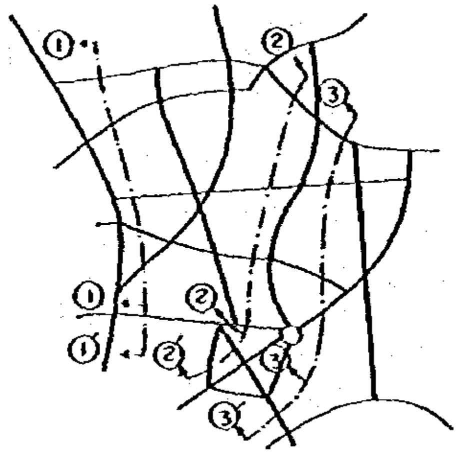
The plan aims at the strengthening of radial road functions and the urbanization of areas along Mindanao Avenue and Visayas Avenue.

7. PRELIMINARY ENGINEERING STUDY

For the preliminary engineering study, particular care was taken to achieve the following:

* The establishment of appropriate design to conform with the existing road network and to maintain continuity with related roads;
* The vertical alignment to follow the existing ground as much as possible, to provide direct access to roadside developments;

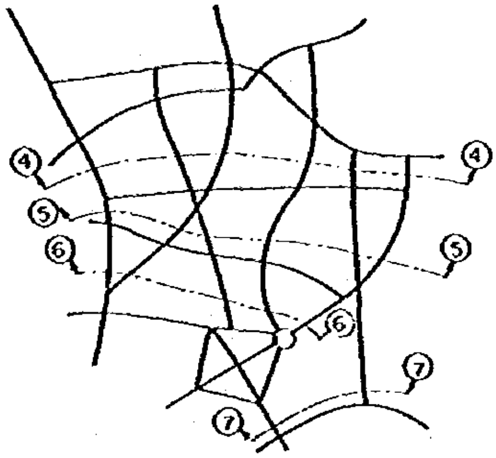
TABLE 6 TRAFFIC VOLUME AND NUMBER OF LANES REQUIRED BY SCREEN LINE



Cross Section	Traffic Volume (100 veh/day) 1980	1990	2000	No. of Lanes Required 1980	1990	2000	o Name of Road	No. of Lanes of Each Road 1980	1990	2000
							o C-6	–	S-2 (1.5)	D-2 (4)
							o G. Luis	S-2 (1.5)	S-2	S-2
							o Republic (C-5)	–	D-2 (4)	D-3 (6)
							o Tandang Sora	S-2 (1.5)	S-2 (1.5)	S-2 (1.5)
①-①	91	136	215	9	13	20	o Quirino Highway	S-4 (3)	S-4 (3)	S-4 (3)
							Sub-total 1 – 1	8 (6)	14 (11.5)	18 (16)
①-①'	(162)	(206)	(325)	(15)	(19)	(30)	o EDSA	D-3 (6)	D-4 (8)	D-5 (10)
							TOTAL 1 – 1	14 (12)	22(19.5)	28 (26)
							o C-6	D-2 (4)	D-2 (4)	D-3 (6)
							o Republic (C-5)	–	D-2 (4)	D-3 (6)
							o Tandang Sora	S-2 (1.5)	S-2 (1.5)	S-2 (1.5)
							o Ext. Congressional	–	–	D-2 (4)
②-②	36	87	171	4	8	16	o North Ave.	S-2 (1.5)	D-2 (4)	D-2 (4)
②-②'	(101)	(175)	(291)	(10)	(16)	(27)	Sub-Total 2 – 2	8 (7)	14(13.5)	22(21.5)
							o EDSA	D-3 (6)	D-4 (8)	D-5 (10)
							o West Ave.	S-4 (3)	S-6 (5)	S-6 (5)
							Total 2 – 2	18 (16)	28(26.5)	38(36.5)
							o C-6	–	D-2 (4)	D-3 (6)
							o Republic (C-5)	–	D-2 (4)	D-3 (6)
							o Tandang Sora	S-2 (1.5)	S-2 (1.5)	S-2 (1.5)
							o Don Mariano	D-2 (4)	D-3 (6)	D-4 (8)
③-③	60	112	181	6	11	17	Sub-total – 3	6 (5.5)	16(15.5)	22(21.5)
							o EDSA	D-4 (8)	D-5 (10)	D-5 (10)
③-③'	(143)	(227)	(366)	(13)	(21)	(33)				
							Total 3 – 3	14(13.5)	26(25.5)	32(31.5)

o Traffic Capacity of one lane is assumed to be 11,000 veh/day

TABLE 7 TRAFFIC VOLUME AND NUMBER OF LANES REQUIRED BY SCREEN LINE



Cross Section	Traffic Volume (1000 veh/day) 1980	1990	2000	No. of Lanes Required 1980	1990	2000	No. of Lanes of Each Road: Name of Road	1980	1990	2000
							o North Express-way	D–2 (4)	D–2 (4)	D–3 (6)
							o Mindanao Ave.	–	S–2 (1.5)	D–2 (4)
④–④	73	142	198	7	13	18	o Quirino High-way	S–4 (3)	S–4 (3)	S–4 (3)
							o Visayas Ave.	–	D–2 (4)	D–2 (4)
							o New Link	–	–	D–2 (4)
							o Don Mariano	D–2 (4)	D–2 (4)	D–3 (6)
							Total 4 – 4	12 (11)	16(15.5)	28 (27)
							o North Express-way	D–2 (4)	D–2 (4)	D–3 (6)
							o Quirino High-way	S–4 (3)	S–4 (3)	S–4 (3)
							o Mindanao Ave.	–	D–2 (4)	D–3 (6)
⑤–⑤	119	214	299	11	20	28	o Visayas Ave.	–	D–2 (4)	D–2 (4)
							o C–5 (Luzon)	–	D–2 (4)	D–3 (6)
							o Don Mariano	D–2 (4)	D–3 (6)	D–4 (8)
							Total 5 – 5	12 (11)	26 (25)	34 (33)
							o North Express-way	D–2 (4)	D–2 (4)	D–3 (6)
							o Quirino High-way	S–4 (3)	S–4 (3)	S–4 (3)
⑥–⑥	191	217	292	18	20	27	o Congressional Ave.	D–2 (4)	D–2 (4)	D–2 (4)
							o Mindanao Ave.	D–2 (4)	D–2 (4)	D–3 (6)
							o Visayas Ave.	D–2 (4)	D–2 (4)	D–2 (4)
							o Don Mariano	D–2 (4)	D–3 (6)	D–4 (8)
							Total 6 – 6	24 (23)	26 (25)	32 (31)
							o Katipunan	S–2 (1.5)	D–3 (6)	D–4 (8)
⑦–⑦	109	210	295	10	19	27	o Mayala Ave. Ext.	D–2 (4)	D–2 (4)	D–2 (4)
							o EDSA	D–5 (10)	D–5 (10)	D–5 (10)
							Total 7 – 7	16(15.5)	20 (20)	22 (22)

- The planning should ensure that all work accomplished in Stage 1 could be utilized in Stage 2; and
- The type of structure, pavement and interchange to be adopted should be based on a comparative analysis of the various types.

1) Geometric Design Standards

The geometric design standards of each Project Road were established as shown in Table 8.

TABLE 8 GEOMETRIC DESIGN STANDARDS

	UNIT	C–5		C–6	MINDANAO & VISAYAS AVENUES
		REPUBLIC AVENUE	OTHER SECTIONS		
Design Speed	kph	80	80	80	60
Right-of-Way Width	M	50	40–60	45	38
Lane Width	M	3.50	3.50/3.25	3.50	3.50/3.25
Bus/Jeepney Land Width	M	3.50	3.25	3.50	3.00
Median Width	M	4.00	4.00/2.50	6.00	3.00
Inner Shoulder Width	M	0.25	0.25	0.25	0.25
Outer Shoulder Width	M	2.00	2.00	2.00	2.00
Outer Shoulder Width (When B/J lane provided	M	0.50	0.25	0.50	0.50
Crossfall of Roadway	%	1.5/2.0	1.5/2.0	1.5/2.0	1.5/2.0
Minimum Radius	M	260	260	260	260
Maximum Superelevation	%	6	6	6	6
Maximum Gradient	%	7	7	7	8
Critical Length of Gradient	M	400	400	400	300

FIGURE 10.

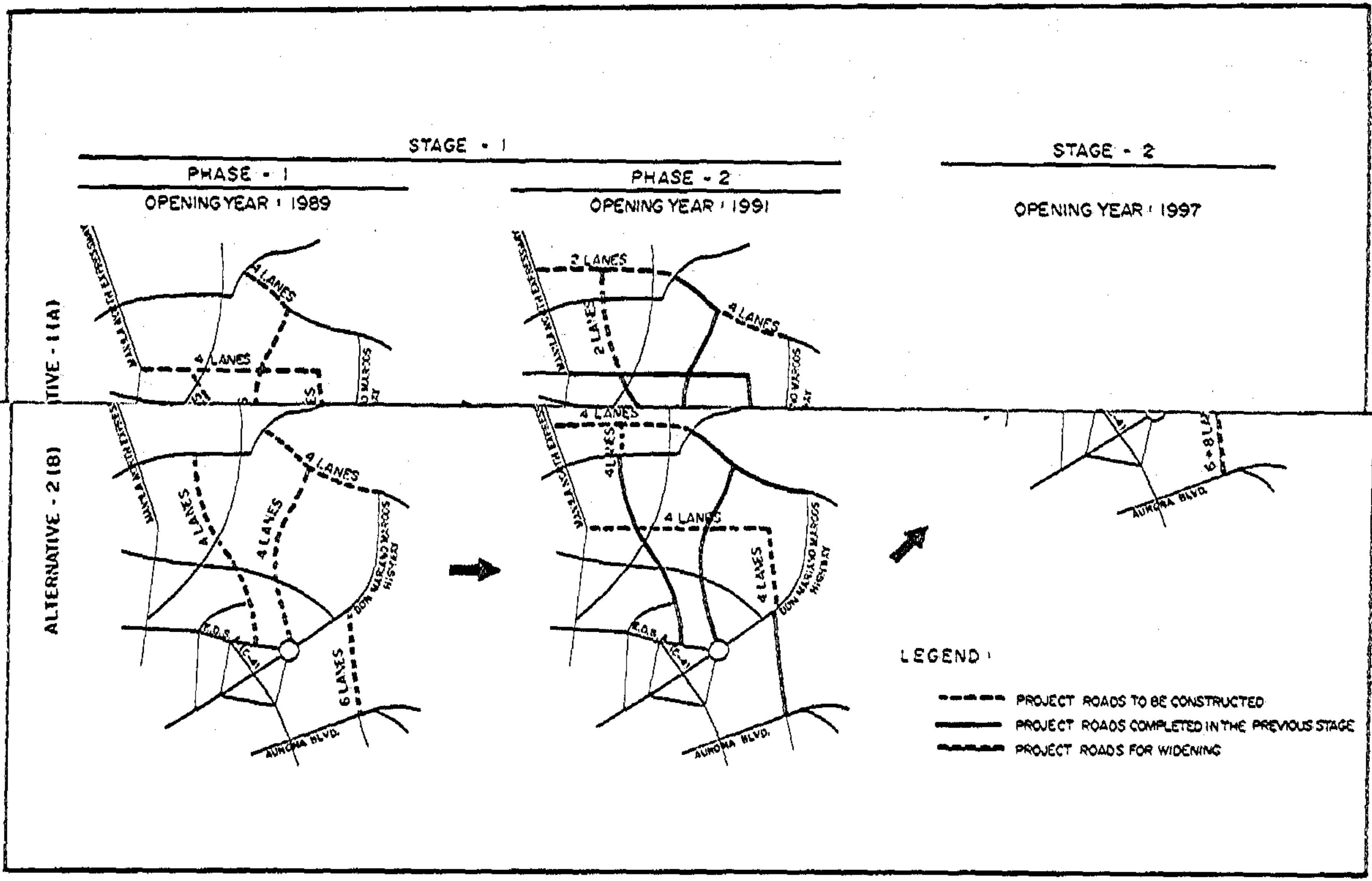
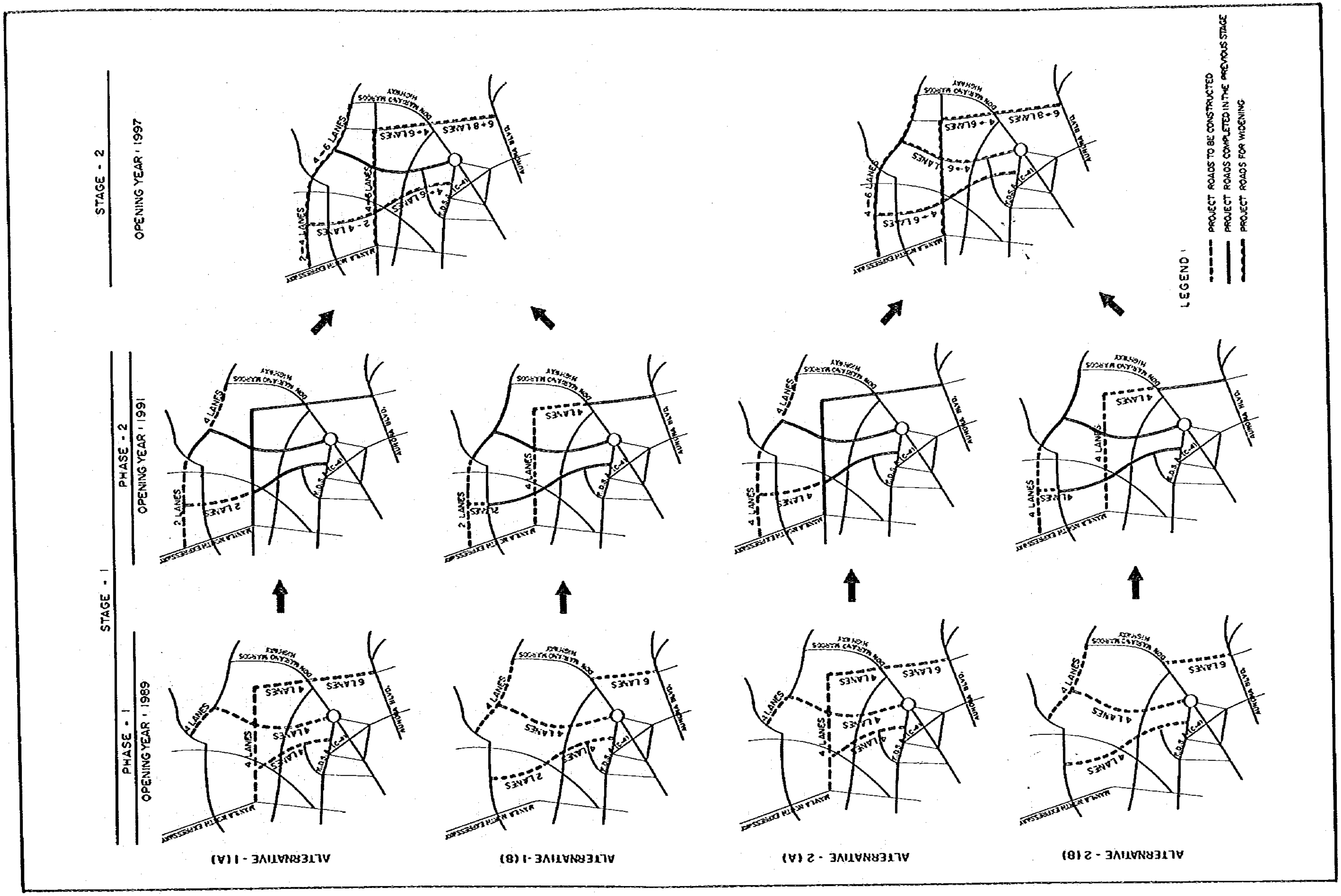

STAGE - 1
PHASE - 1
OPENING YEAR : 1989
PHASE - 2
OPENING YEAR : 1991
STAGE - 2
OPENING YEAR : 1997
TIVE - 1 (A)
ALTERNATIVE - 2 (B)
4 LANES
2 LANES
6 LANES
6 + 8 LA
AURORA BLVD.
DON MARIANO MARCOS HIGHWAY
MANILA NORTH EXPRESSWAY
LEGEND :
PROJECT ROADS TO BE CONSTRUCTED
PROJECT ROADS COMPLETED IN THE PREVIOUS STAGE
PROJECT ROADS FOR WIDENING

FIGURE 10. ALTERNATIVE PLANS



2) Standard Cross-Section

The elements of the cross-sections for the Project Roads are as follows:

- Lane width shall be 3.5 meters and may be reduced to 3.25 meters when right-of-way is limited;
- Jeepney/bus lanes shall be installed in Stage 2 with a width of 3.5 meters as a principle (3.0 meters minimum);
- The inner shoulder shall be 0.25 meter;
- The outer shoulder shall be 2.0 meters or, where jeepney/bus lane is installed, 0.50 meter. No outer shoulder may be installed when necessary;
- The minimum center median and sidewalk width shall be 2.5 meters and 3.0 meters, respectively; and
- For phasing of construction work from Stage 1 through the final stage, outer lanes (those adjoining the sidewalk) shall be constructed first.

The cross-section of each road at different stages is illustrated in Figure 11.

3) Intersection

Intersections will be either of the following: (See Figure 12).

a) Grade Separation

Intersections between major roads and intersections between a major road and a secondary major road will be built at-grade in Stage–1 and will be upgraded to grade separation in Stage–2.

b) Major At-Grade Intersection

This will allow traffic to proceed to all directions (straight, left, and right) from any of the approach roads. Spacing between these intersections are usually between 500 to 700 meters, with the allowable minimum of 300 meters as a principle.

c) Minor At-Grade Intersection

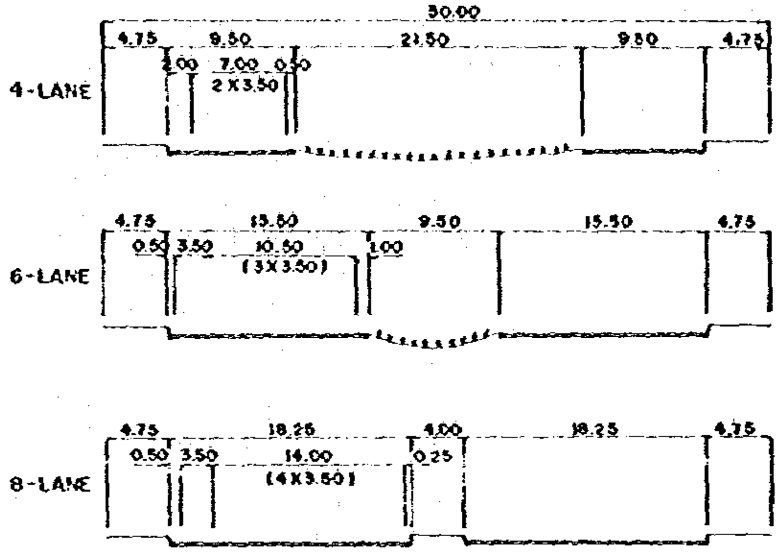
Intersections of the Project Roads with local roads will be of this type, with the center median of the Project Road closed to discourage crossings and that the traffic from the local roads could make right-turn only.

FIGURE 11. STANDARD CROSS-SECTIONS

C-5 (REPUBLIC AVE.)

NO. OF LANES

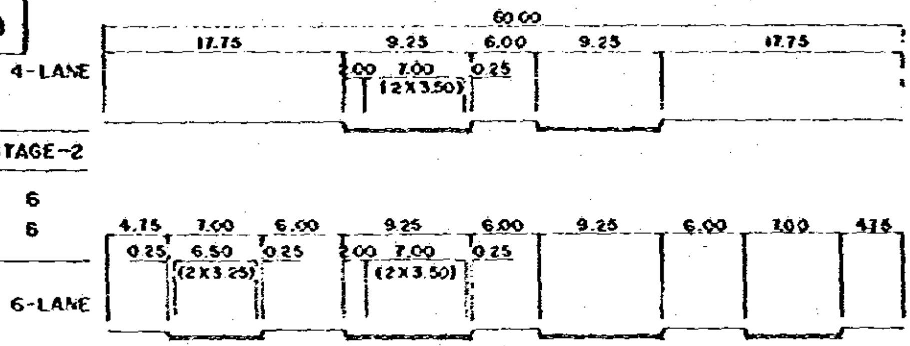
	STAGE-1	STAGE-2
ALT.-1	4	6
-2	4	6



C-5 (LUZON AVE.)

NO. OF LANES

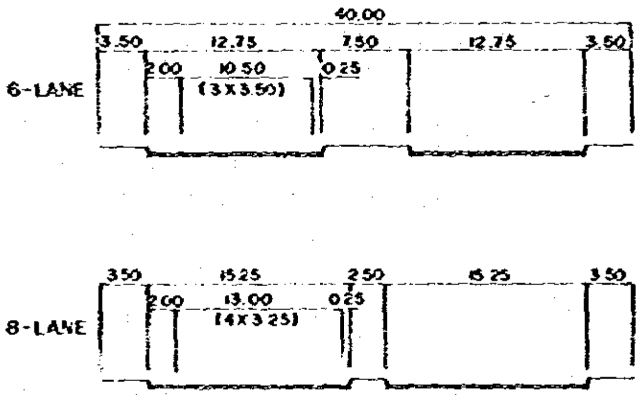
	STAGE-1	STAGE-2
ALT.-1	4	6
-2	4	6



C-5 KATIPUNAN AVE

NO. OF LANES

	STAGE-1	STAGE-2
ALT.-1	6	8
-2	6	8

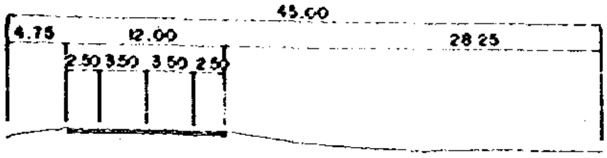


C-6

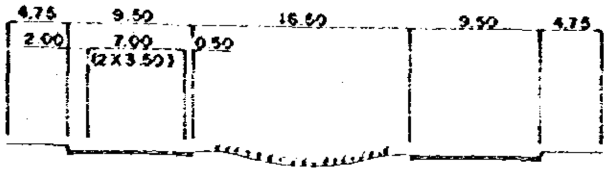
NO. OF LANES

	STAGE-1	STAGE-2
ALT-1	2	4
	4	6
-2	4	6

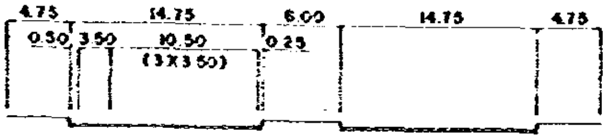
2-LANE



4-LANE



6-LANE

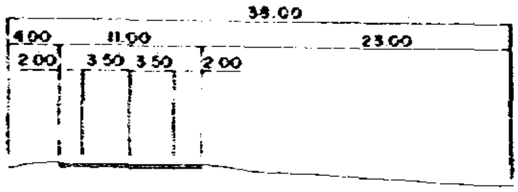


MINDANAO AVE.

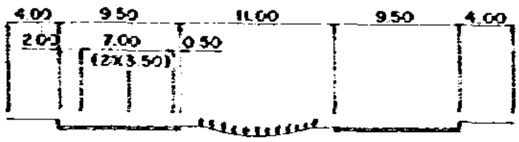
NO. OF LANES

	STAGE-1	STAGE-2
ALT.-1	2	4
	4	6
-2	4	6

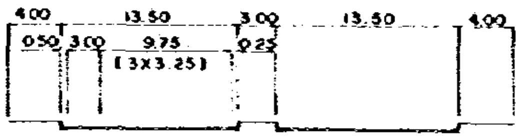
2-LANE



4-LANE



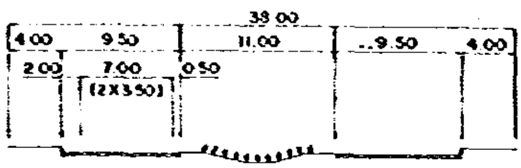
6-LANE



VISAYAS AVE.

NO. OF LANES

	STAGE-1	STAGE-2
ALT.-1	4	4
-2	4	6



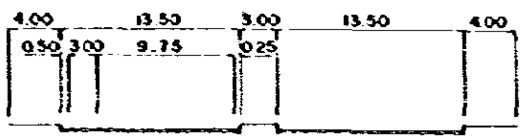
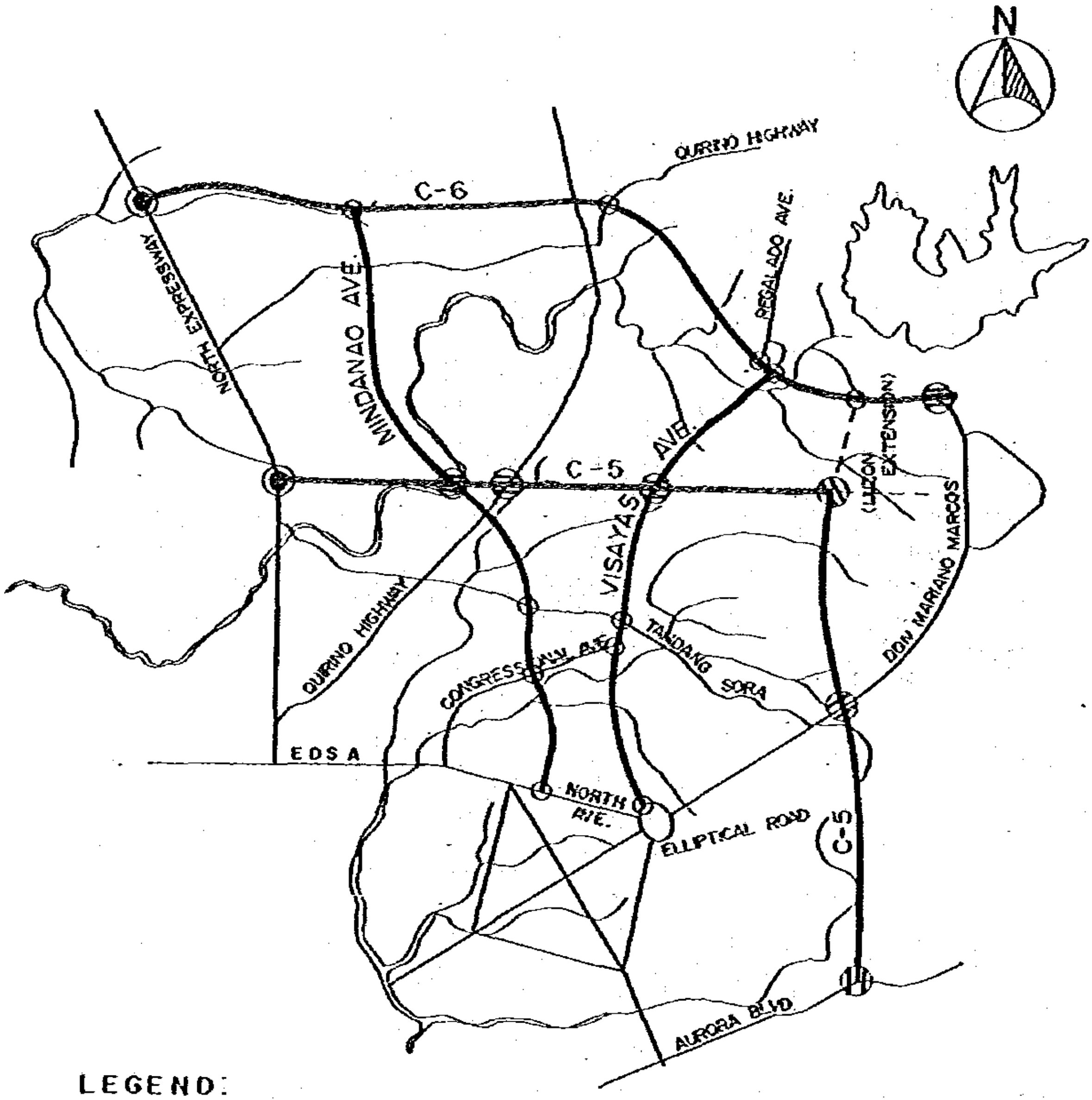


FIGURE 12. LOCATION OF MAJOR INTERSECTION/INTERCHANGE



LEGEND:

- : PROPOSED ROAD
- : EXISTING ROAD
- : INTERCHANGE
- : GRADE SEPARATION
- : AT– GRADE INTERSECTION (TRAFFIC ANALYSIS MADE)

4) Interchange

Interchanges will be constructed at the intersections of C–5 and C–6 with the MNE, an access-controlled speedway. A double trumpet is recommended in view of its lower construction cost and it conforms with the major traffic flow.

5) Pavement Type

After comparing portland cement concrete pavement with asphalt concrete pavement, the former was selected in preference of its lower maintenance requirement over the lower initial investment cost of the latter.

6) Structures

All structures were designed based on "Standard Specifications for Highways and Bridges (12th Edition, 1977)" and the latest edition of "Interim Specifications for Bridges" released by the American Association of State Highway and Transportation Officials (AASHTO). However, matters not covered by the AASHTO standards were considered based on the standards of the Ministry of Public Works and Highways or those used in Japan.

8. ENVIRONMENTAL IMPACT

1) Prediction and Assessment of the Impacts

The environmental impacts are categorized into pre-construction phase, construction phase and operation phase. The operation phase is further subdivided into direct impact and indirect impact. Figure 13 shows the general environmental impact caused by the implementation of the project roads.

2) Mitigating Measures

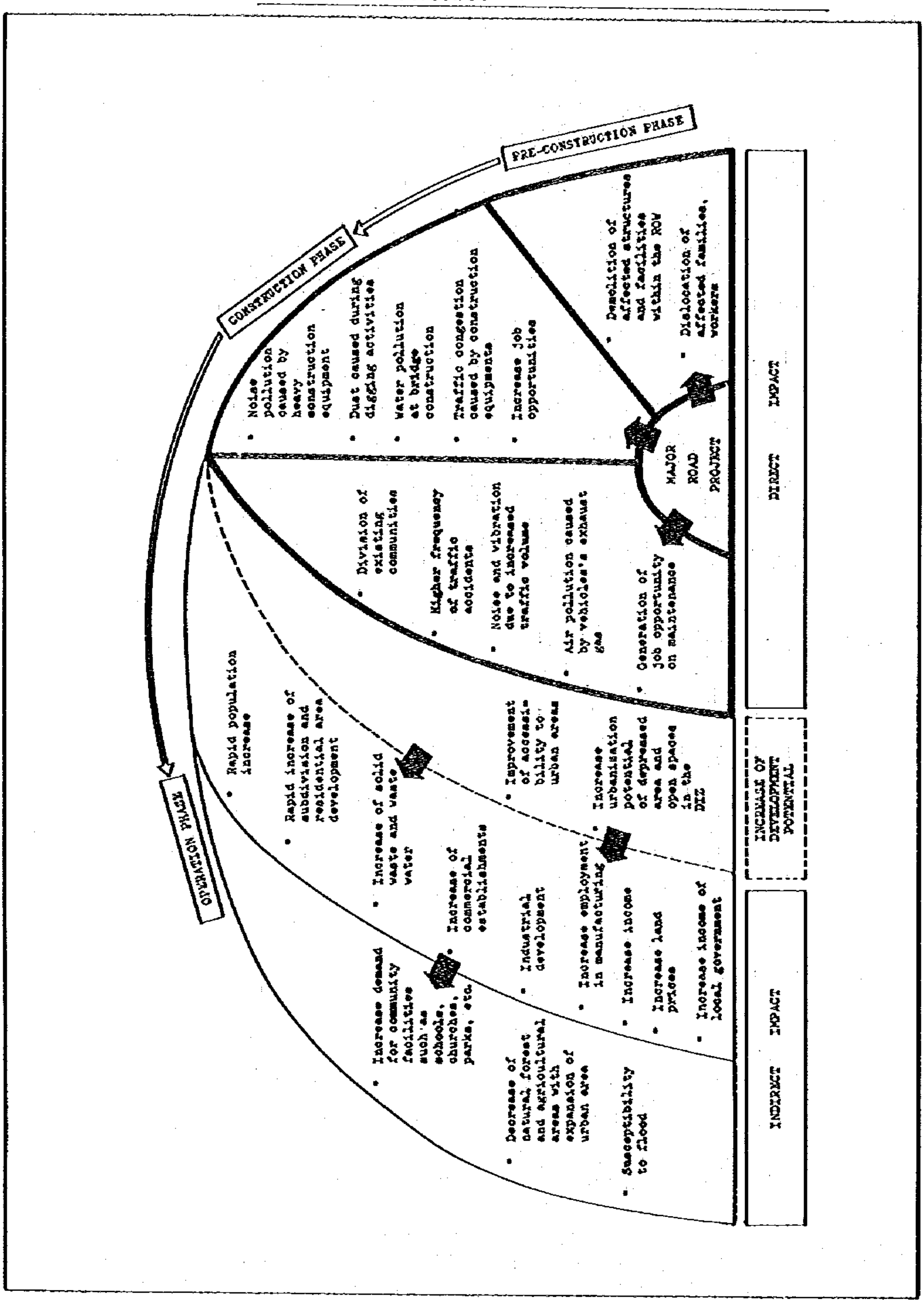
- Affected Families

  For dislocated families, the Government, through the MHS, gives priority to those affected families in subdivisions near the area.

- Demolition of affected structures and facilities

  In the demolition of structures and facilities, the Government should extend assistance in the form of manpower personnel and equipment.

FIGURE 13. GENERAL ENVIRONMENTAL IMPACT CAUSED BY MAJOR URBAN ROAD PROJECT



* Construction Nuisance

  The nuisance and inconvenience during construction should be significantly reduced by introduction of proper construction management and supervision and adoption of proper construction equipment and methods.

* Pollution

  Noise pollution from traffic is more eminent than other pollutions. This pollution could be mitigated by providing space for planting strip. The land used control through the zoning system is another effective measure and should be introduced along the roads.

* Community Cohesiveness

  To maintain the cohesiveness of existing communities, traffic safety devices at strategic points, such as pedestrian crossings with road markings, traffic signs and signals, and pedestrian overpasses are necessary.

* Provisions of utilities and facilities associated with the urbanization caused by the project roads.

  The Government, as well as the private sector, should join hands in planning and construction of utilities and facilities, such as water supply, electricity, drainage, sewerage, telecommunication, schools, churches, etc., associated with expected urbanization caused by the project roads.

9. PROJECT COST

The summary of project costs is shown in Table 9.

TABLE 9 SUMMARY OF PROJECT COST

Unit: Million Pesos (May 1982 constant price)

	ALTERNATIVE			
	1 (A)	1 (B)	2 (A)	2 (B)
STAGE 1				
Phase 1				
Foreign	209.34	154.62	211.81	167.36
Local	286.22	240.82	287.41	247.31
Tax	53.97	39.79	54.55	43.04
Total	549.53	435.23	553.77	457.71
Phase 2				
Foreign	48.23	102.94	90.12	134.55
Local	93.18	138.58	114.81	154.90
Tax	12.50	26.69	23.36	34.90
Total	153.91	268.21	228.29	324.35
Sub-Total				
Foreign	257.56	254.56	301.93	301.93
Local	379.40	379.40	402.22	402.22
Tax	66.48	66.48	77.91	77.91
Total	703.44	703.44	782.06	782.06
STAGE 2				
Foreign	211.20	211.20	200.50	200.50
Local	199.28	199.28	113.24	113.24
Tax	53.84	53.84	51.13	51.13
Total	384.32	384.32	364.87	364.87
GRAND TOTAL				
Foreign	468.76	468.76	502.43	502.43
Local	498.68	498.68	515.46	515.46
Tax	120.32	120.32	129.04	129.04
Total	1,087.76	1,087.76	1,146.93	1,146.93

10. PROJECT EVALUATION

1) Economic Analysis

a) Methodology

The procedures for the quantification of benefits that would accrue from the implementation of the project were patterned after the present practice of the MPWH as incorporated in the "Highway Planning Manual" though with some adjustments to suit present conditions in urban area. The quantified benefits were purely from the savings in traffic costs by comparing the effectiveness of the road network of the DIZ with or without the project roads. The project roads involving mostly new construction on a potential area for urbanization, and their developmental effect were quantified in the form of traffic costs savings from the generated traffic.

b.) Traffic Cost

The basic traffic costs, which are defined as the costs incurred by vehicles using roads in good condition, lane width of at least 3.00 meters, flat gradients and minimum roadside friction, were patterned after the present practice of the MPWH.

The basic traffic costs are presented below:

TABLE 10 BASIC TRAFFIC COSTS

Vehicle Type	Basic Running Costs Vehicle/Km.	Basic Fixed Costs Vehicle/Hour	Basic Passenger Time Costs Vehicle/Hour
Light Car	0.9704	1.74	6.77
Jeepneys	0.6053	9.36	5.62
Large Bus	1.8209	18.70	21.75
Medium Truck	1.6850	15.19	—

c) Benefits

The construction of the project roads which will complete the major roads in the DIZ and make the road network function as a system will change the traffic pattern in the area. When the project roads shall be opened to traffic, there will be a more balanced utilization of road spaces, i.e., roads that are presently under utilized will be having more traffic, the roads that are presently saturated will experience traffic decongestion and the existing sections of the project roads will improve their level of service. The beneficiaries of these effects are:

- Traffic that presently uses the existing sections of the project roads with and without the project. This traffic will experience savings in traffic costs due to improved level of service.

- Traffic that will be attracted to the project roads. This traffic will realize faster travel compared to their old congested and circuitous routes.

* Traffic that would remain on affected major roads. This traffic will enjoy the decongestion effect due to the diversion of some traffic using the existing roads to the project roads.

d) Cost-Benefit Analysis

Each of the alternative plans was subjected to economic analysis using the following assumptions:

* The opportunity cost of capital at 15 percent
* Benefit calculation is 20 years after the construction of Phase I, Stage 1.
* Shadow price of the foreign component by an additional 18%.
* No salvage value to the road structure after the study period.

TABLE 11 ECONOMIC EVALUATION

Alternatives	Net Present Value (₱ Million)	B/C Ratio	IRR (Percent)
Plan 1(A)	1,748.7	4.26	44.9
Plan 1(B)	1,720.5	4.35	46.3
Plan 2(A)	1,763.6	4.10	44.0
Plan 2(B)	1,741.7	4.17	45.2

The tabulation shows that all the Alternative Plans are all economically feasible The degree of viability of all the plans are practically the same.

e) Sensitivity Analysis

A sensitivity test was conducted to determine the risk of the project in terms of the following factors:

1) Construction Cost (+20%)
2) Traffic Volume (±20%)
3) Construction Cost (+20%)
   Traffic Volume (−20%)
4) Discount Rates at 12% and 18%

The result of the sensitivity analysis shows that the priority ranking of the project roads are basically the same with that of the results in the economic evaluation.

2) Financial Analysis

a) General

The published planning manuals of MPWH do not specifically set a guideline on financial analysis of road investment. The analysis, therefore, tries to present a flexible schedule for the implementation of the project (as well as the on-going, committed and/or programmed projects), taking into consideration the resource capability of the government. The financial requirement of the project, which will come from the national infrastructure fund, will be analyzed with the following preparatory procedures:

* A time series simulation of investment cost;
* A possible measurement of financial resources; and
* An analytical appraisal of the first two.

This kind of analysis, however, is rather more analogous to financial programming than financial analysis.

b) Infrastructure Funds of NCR

There are development plans prepared for Metro Manila, composed of the Five-Year Development Plan, 1983-1987 prepared by NEDA, the Regional Development Framework Plan (RDFP) 1983-1992 and the Capital Investment Folio (CIF), 1982-1987, both prepared by the Metro Manila Commission. With the MPWH's Annual Report CY 1979-1981, the Capital Outlay of Highway CY 1981-1986, and the 1983-1987 Infrastructure Program, the NCR financial resources for infrastructure is shown in the Table 12.

c) Highway Funds for NCR

MPWH cash allocation for NCR Highways for 1983-1987 is assumed to increase at the level of 14.3% per annum as disclosed by the Five-Year Plan in its cash disbursement program for infrastructure requirement. Beyond the period of the plan, the ceiling perspective would be drawn within the frame of GNP, GDP, GDP and NCR GRDP where the high and low estimations are based on the GDP growth ratio and NCR GRDP, respectively, as shown in the Table 13.

TABLE 12 NCR FINANCIAL RESOURCES FOR INFRASTRUCTURE

(Million Pesos)

		1983	1984	1985	1986	1987	1983–1987
Low	A	1,970	2,200	2,520	2,840	3,260	12,790
	B	1,790	1,810	1,890	1,940	2,020	9,450
High	A	3,220	3,750	4,390	5,040	5,900	22,300
	B	2,930	3,100	3,300	3,440	3,670	16,440
Average							
	A	2,595	2,975	3,455	3,940	4,580	17,545
	B	2,360	2,455	2,595	2,690	2,845	12,945

Remarks : A is Current Prices
B is 1982 Constant Prices

d) Possible Allocation for the Project

The Table 14 indicates limited funds/requirement vis-a-vis by alternative schemes of the project investment cost. A yearly investment requirement is escalated at 9.5% per annum, as the midpoint of inflation 9% per year estimated in the Five-Year Development Plan 1983-1987 and 10% forecasted in MMC's CIF for the same period.

Based on the low estimation, no schemes are within the estimated allocation. However, only Plan 1 (B) can stay within the high allocation.

3) Traffic Impact

The traffic impacts of the different alternative plans are basically the same, providing a road network that would improve the traffic condition in the area. In year 1989, the proposed opening year of the different alternative plans of Phase 1, Stage 1, the average volume-capacity (V/C) ratio of the road network in the DIZ would improve from 0.88 without Phase 1 to about 0.75. Comparing the different alternatives, Plans 1(B) and 2(B) would provide a more balanced network with a V/C ratio of 0.51 to 0.86 for the project roads and 0.82 to 1.43 for other related roads. Plans 1(A) and 2(A) have high variation in the level of service with 0.39 to 0.91 for the project roads and 0.77 to 1.35 for other related roads. The traffic assessment shows that Plan B would provide a more balanced road network in the DIZ.

TABLE 13 CORRELATION OF FUNDS, REQUIREMENT AND MPWH CASH SUPPORT FOR NCR HIGHWAYS

(Million Pesos)

YEAR	NCR Fund For Infra-structure	NCR Infra-structure Require-ment	Highways Require-ment	MPWH Cash Allocation NCR (In Thousand Pesos)		
1979	–	–	–		171,797 ($4,963)	
1980	–	–	–		134,713 ($2,965)	
1981	–	–	–		207,867 ($2,977)	
1982	–	3,827	201		235,205 ($3,981)	
1983	2,595	6,920	458		340,000 ($4,000)	
1984	2,975	8,203	817		388,620	
1985	3,455	9,531	1,139		444,190	
1986	3,940	11,050	1,354	Low	507,710	High
1987	4,580	11,911	1,234	Estimate	580,320	Estimate
1988	5,086	13,920	1,420	665,970		691,020
1989	5,807	15,892	1,621	760,340		783,190
1990	6,600	18,036	1,842	864,210		884,280
1991	7,385	20,211	2,062	966,970		995,200
1992	8,251	22,581	2,303	1,080,300		1,116,800
1993	9,181	25,126	2,563	1,202,100		1,250,000
1994	10,192	27,894	2,845	1,334,600		1,395,900
1995	11,291	30,901	3,152	1,478,400		1,555,300
1996	12,484	34,166	3,485	1,634,600		1,729,000
1997	13,778	37,708	3,846	1,804,000		1,920,000
1998	15,181	41,549	4,238	1,988,000		2,128,000
1999	16,719	45,759	4,667	2,189,000		2,355,000
2000	18,368	50,271	5,128	2,405,000		2,602,000

Sources: Regional Development Framework Plan, 1983–1992. MMC OCP November 1982
Metropolitan Manila Capital Investment Folio Study, Final Report. MMC OCP November 1982
MPH Annual Report CY 1979–1981
MPWH Infrastructure Program CY 1982, September 1981
1983 MPWH Infrastructure Program, NCR

TABLE 14 POSSIBLE ALLOCATION FOR THE PROJECT

	Possible Allocation		Requirement			
	Low[1/]	High[2/]	Plan 1 (A)	1 (B)	2 (A)	2 (B)
1984	39.9	94.6	4.5	4.5	5.3	5.3
1985	55.5	108.2	18.9	7.7	119.2	108.0
1986	64.9	123.6	144.5	118.9	144.9	122.6
1987	63.8	141.3	154.8	122.6	155.4	128.3
1988	69.8	165.2	163.3	162.1	163.8	166.7
1989	79.7	187.9	74.0	123.8	104.7	146.9
1990	90.6	212.9	38.6	82.5	72.2	107.8
1991						
1992						
1993	126.0	298.5	8.6	8.6	8.2	8.2
1994	139.8	332.4	3.1	3.1	3.0	3.0
1995	154.9	369.4	274.8	274.8	260.7	260.9
1996	171.3	409.6	308.4	308.4	292.9	292.9

1/ Based on the low estimate of MMC

2/ Based on the high estimate of MPWH

4) Contribution to Regional Economy

The quantified benefits in the form of vehicle operating costs and passenger time cost have either direct or indirect contribution to the regional and national economy. The direct impact is the savings in fuel consumption (gasoline and diesel) from the running cost of the vehicle operating costs. In 1991, the completion year of Stage 1, fuel saving would amount to about 204,500 and 210,000 barrels for Alternatives 1 and 2, respectively. In terms of monetary value of the savings in fuel consumption, about 60% of the value represents the foreign cost. This foreign cost savings could contribute to the international trade deficit of the country or dollar outflow of foreign currency. The amount of foreign costs savings in the opening year of Stage 1 would amount to about U.S. $10..3 million and expected to increase more than twice after the completion of Stage 2 in 1999. The table below shows the fuel savings of the project by alternative plans.

TABLE 15 FUEL SAVINGS OF THE PROJECT

YEAR	PLAN	PREMIUM Q	GASOLINE A	DIESEL Q	DIESEL A	TOTAL
1989	1A, 2A	19,392 (122.0)	101,809 (61,085)	7,265 (45.7)	22,606 (14,016)	124,415 (75,101)
	1B	15,289 (96.2)	80,271 (48,163)	6,472 (40.7)	20,133 (12,482)	100,404 (60,645)
	2B	15,956 (100.4)	83,767 (50,260)	6,576 (41.4)	20,460 (12,685)	104,227 (62,945)
1991	1	21,082 (132.6)	110,679 (66,407)	11,435 (71.9)	35,552 (22,042)	146,231 (88,449)
	2	22,341 (140.6)	117,296 (70,378)	11,055 (69.6)	33,045 (20,488)	150,341 (90,866)
1977	1	27,928 (175.7)	146,620 (87,972)	16,696 (105.0)	51,920 (32,190)	198,540 (120,162)
	2	29,620 (186.4)	155,503 (93,302)	18,485 (116.3)	57,482 (35,639)	212,985 (128,941)

Q : Quantity; Thousand liters (thousand barrels)

A : Amount ; In thousand pesos, 1982 market price
( ) Foreign portion

From the tabulation, Plan 2 shows a higher contribution to the national economy.

5) Conclusion

On the basis of the results of the project evaluation, the different alternative plans could be arranged according to their rank on each of the criteria used in the evaluation as shown below:

TABLE 16 PRIORITY RANKING OF ALTERNATIVE PLANS

CRITERIA	Plan 1(A)	1 (B)	2 (A)	2 (B)
a) Economic Evaluation	2nd	1st	4th	3rd
b) Financial Assessment	3rd	1st	4th	2nd
c) Traffic Impact	4th	2nd	3rd	1st
d) Contribution to the National Economy	4th	3rd	2nd	1st

The tabulation shows that Plans 1(B) and 2(B) are the most viable plans for the project. If the criteria used were given weights, the most important would be the financial assessment, followed closely by the economic evaluation, then the contribution to the national economy and the traffic impact in that order. In the economic assessment, Plan 1(B) is the first priority, though the other three are not far behind. In terms of financial assessment, only Plan 1(B) satisfies the high estimates of the annual possible allocation for the project. Furthermore, if the cash flow of the investment up to the completion of Stage 2 in current prices, including escalation, were converted to present values using a discount rate of 15%, the present opportunity cost of capital in the country, Plan 1(B) would be about ₱46.7 million less than Plan 2(B). This difference in the total capital investment could be utilized for other developmental projects. For the last two criteria, where Plan 2(B) obtained the first priority, Plan 1(B) or the other two remaining plans would offer basically the same impact as Plan 2(B).

In view of the above, it could clearly be concluded that Plan 1(B) would provide the greatest overal impacts to the region as well as to the nation in general.

11. PROJECT IMPLEMENTATION

The evaluation of the project roads recommended Alternative 1(B), as the most advantageous plan and on this basis, the following is the proposed implementation program.

1) Detailed Engineering

The detailed engineering design for Stage 1, which will require 16 months, should be undertaken at the earliest possible time, taking into consideration the ultimate stage features, to avoid as much as possible, double investment during the succeeding stages.

Stage 2 construction includes widening of roadways as well as construction of grade separation at major intersections. Therefore, the projected traffic demand in this Study should be re-assessed during the operational phase of Stage 1. Sixteen-month period will be required to complete the design in this Stage.

The detailed engineering costs at 1982 price were estimated as follows:

TABLE 17 DETAILED ENGINEERING COST

Unit: Million Pesos

	Foreign	Local	Tax	Total
Stage 1	7.54	3.39	1.64	12.57
Stage 2	6.34	2.85	1.38	10.57

2) Right-of-Way and Property Acquisition

Since land acquisition can be a serious obstacle to road construction in urban areas, MPWH's close contact with and full coordination with relevant offices of Quezon City, Caloocan City and Municipality of Valenzuela, as well as the Human Settlements Regulatory Commission, MHS, and the Metro Manila Commission, be maintained to enforce strict control over the development activities on and along the proposed routes of the project roads.

The full road right-of-way width of the ultimate stage should be acquired in Stage 1. After the limits of the right-of-way had been established during the detailed engineering phase, land and property acquisition should start for the road sections included in Plan 1(B).

Estimated cost of land and property acquisition were estimated as follows:

TABLE 18 LAND AND PROPERTY ACQUISITION COST

(1982 Price)

Phase 1	161.50 million pesos
Phase 2	85.44 million pesos
Total	246.94 million pesos

3) Construction

The Project should be implemented in two (2) stages, namely Stages 1 and 2. Stage 1 involves the construction of the project roads with minimum improvement, 6 lanes for the Katipunan Avenue and 2 to 4 lanes to the remaining projects just enough to service the traffic demand in the area for the next five years. Stage 2 involves the upgrading and widening of the project roads including grade separation on selected major intersections.

Stage 1 will be further sub-divided into Phases 1 and 2. In Phase 1, radial roads will first be developed, then the rest of the Project Roads will be constructed in Phase 2. Immediately after the completion of Phase 1, Phase 2 will follows.

Estimated construction costs were shown in the Table 19.

4) Fund Preparation

a) Foreign Funds

Financial assistance from a foreign country or an international financing institution will be necessary. The estimated amounts of foreign loans which are equivalent to the foreign currency component, were shown in the Table 20.

TABLE 19 CONSTRUCTION COSTS

Million pesos (1982 Price)

	FOREIGN	LOCAL	TAX	TOTAL
Stage 1				
Phase 1	138.21	71.94	36.22	246.37
Phase 2	96.73	50.35	25.34	172.42
Sub-Total	234.94	122.29	61.56	418.79
Stage 2	192.16	110.71	49.71	352.58
TOTAL	427.10	233.00	111.27	771.37

TABLE 20 FOREIGN FUND REQUIREMENT

(1982 Price)

	MILLION ₱	(MILLION $)
STAGE 1		
Detailed Engineering	7.54	(0.88)
Phase 1 Construction	138.21	(16.17)
Phase 2 Construction	96.73	(11.32)
Phase 1 Supervision	8.87	(1.04)
Phase 2 Supervision	6.21	(0.73)
Sub-Total	257.56	(30.14)
STAGE 2		
Detailed Engineering	6.34	(0.74)
Construction	192.16	(22.48)
Supervision	12.70	(1.49)
Sub-Total	211.20	(24.71)
GRAND TOTAL	468.76	(54.85)

b) Local Funds

The Government should make available the following local funds to implement the Project.

TABLE 21 LOCAL FUND REQUIREMENT

Unit : Million (1982 Price)

	LOCAL CURRENCY COMPONENT	TAX	TOTAL
STAGE 1			
Phase 1			
Detailed Engineering	3.39	1.64	5.03
Right-of-Way Acquisition	161.50	–	161.50
Construction	71.94	36.22	108.16
Supervision	3.99	1.93	5.92
Sub-total	240.82	39.79	280.61
Phase 2			
Right-of-Way Acquisition	85.44	–	85.44
Construction	50.35	25.34	75.69
Supervision	2.79	1.34	4.13
Sub-total	138.58	26.69	165.27
Sub-Total			
Detailed Engineering	3.39	1.64	5.03
Right-of-Way Acquisition	246.94	–	246.94
Construction	122.29	61.56	183.85
Supervision	6.78	3.28	10.06
TOTAL	379.40	66.48	445.88
STAGE 2			
Detailed Engineering	2.85	1.38	4.23
Construction	110.71	49.71	160.42
Supervision	5.72	2.75	8.47
TOTAL	119.28	53.84	173.12
GRAND TOTAL			
Detailed Engineering	6.24	3.02	9.26
Right-of-Way Acquisition	246.94	–	246.94
Construction	233.00	111.27	344.27
Supervision	12.50	6.03	18.53
TOTAL	498.68	120.32	619.00

5) Implementation Schedule

Based on the previous discussion in this Chapter, the overal implementation schedule was developed as shown in Figure 14.

FIGURE 14. IMPLEMENTATION SCHEDULE

				1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
DETAILED ENGINEERING					STAGE-1	STAGE-1								STAGE-2	STAGE-2			
R.O.W. ACQUISITION						PHASE-1	PHASE-1	PHASE-1	PHASE-2	PHASE-2								
TENDER						PHASE-1			PHASE-2						STAGE-2			
CONSTRUCTION							PHASE-1	PHASE-1	PHASE-1	PHASE-2	PHASE-2					STAGE-2	STAGE-2	
CONSTRUCTION SUPERVISION							PHASE-1	PHASE-1	PHASE-1	PHASE-2	PHASE-2					STAGE-2	STAGE-2	
ANNUAL FINANCIAL REQUIREMENT 1/	STAGE-1	PHASE-1	FOREIGN		5.66	1.88	42.12	58.84	42.12									
			LOCAL		2.54	81.60	71.23	62.67	22.78									
			TAX		1.23	0.41	11.45	15.25	11.45									
			TOTAL		9.43	83.89	126.80	136.76	76.35									
		PHASE-2	FOREIGN						–	51.48	51.46							
			LOCAL						59.81	52.21	26.56							
			TAX						–	13.35	13.34							
			TOTAL						59.81	117.04	91.36							
	STAGE-2		FOREIGN											4.76	1.58	102.43	102.43	
			LOCAL											2.14	0.71	58.22	58.21	
			TAX											1.04	0.34	26.24	26.22	
			TOTAL											7.94	2.63	186.89	186.86	
	TOTAL				9.43	83.89	126.80	136.76	136.16	117.04	91.36			7.94	2.63	186.89	186.86	

1/ MILLION PESOS (1982 PRICE)

STUDY ORGANIZATION

STUDY ORGANIZATION

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	• Jose R. Valdecañas	Assistant Minister, MOTC
	• Exequiel Gumayan	Chief, MPWH
	• Rosalio Mallonga	Director, MPWH
	• Teodoro T. Guitierrez	Project Manager V, URPO, MPWH
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	• Gerardo Magat	Project Manager, Quezon City
	• Tateo Ashimi	JICA Consultant, MPWH

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	• Shigeaki Matsubara	MOC
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Team Member:

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• Mitsuo Hatakeyama	Road Planner
• Kenji Funaki	Traffic Planner
• Masaaki O'hashi	Transportation Economist/ Project Evaluator
• Nobuho Sona	Urban Planner
• Kouichi Kaneko	Region Economist/ Environmentalist
• Takashi Yoshikawa	Road Structure Planner/ Hydrologist
• Tsuneo Kobuchi	Soils and Materials Engineer
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• Benilda S. Belen	Technical Researcher
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• Oscar G. Tatlonghari	Supplies Officer
• Efren M. Mindo	Senior Storekeeper
• Avelina V. Acorda	Supervising Clerk I
• Fe Alcala	Janitress

JICA