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MARSHALLTOWN US 30 BY-PASS
TRAFFIC ASSIGNMENT STUDY

by
JOHN THIEL
9-17-87

Table of Contents

Purpose	1
Definitions of Terms and Variables	2
Approach to Traffic Assignment Study	3
The Study	3
Summary	5
Appendix	6

Purpose of Study

This is a traffic assignment for the proposed US 30 by-pass near Marshalltown, Iowa. The purpose of this study is to estimate the amount of traffic which might use the proposed route. This is necessary for pavement design, access analysis, and other design areas. A twenty year design period will be used for this appraisal (to the year 2007). This study will estimate average daily and hourly traffic and truck use. These volumes will be reported as average daily traffic (ADT), design hourly volume (DHV), and average daily truck traffic (ADTT).

The traffic assignment will be the sum of four kinds of traffic. The first type estimates the current volume of traffic on the by-pass if it were opened today. Next, traffic growth due to increased population and vehicles is accounted for. Finally, generated area traffic and location/development traffic is included.

This study is being conducted for the proposed by-pass alternate C. This highway will run South of US 30 for about four miles (2.5 miles West, 1.5 miles East of highway 14). The access to the by-pass will be controlled. These entrances will be at grade. These facts will be kept in mind when estimating useage, generation, etc.

good

Definitions of Terms and Variables

- V_0 : current traffic; the volume of traffic that would use the new facility if it were opened to traffic today. Reported in vehicles per day (VPD)
- V_1 : normal traffic growth; the increase in volume due to increased useage of motor vehicles over time. Reported in VPD
- V_f : future traffic. Reported in VPD
- V_2 : generated traffic; trips that would not have been made in the general area, or made at all; additional use to the facility due to its attractiveness. Reported in VPD
- V_3 : development traffic; increased traffic due to accelerated land use caused by the by-pass. Reported in VPD
- ADT : average daily traffic; average 24 hr traffic volume for a given year. Reported in VPD (for the design year 2007 in this report)
- DHV : design hourly volume; hourly volume of traffic for a given year. Reported in vehicles per hour (VPH) for design year 2007
- ADTT: average daily truck traffic; percentage of trucks in the average daily traffic. Reported in trucks per day (TPD) for year 2007
- R_1 : land use development; 15 acres low density, high value, single family dwelling development
- R_2 : land use development; 10 acres medium to high density, multiple family dwelling development
- R_3 : land use development; 10 acres high density, single family dwelling development and trailer home development
- C_1 : land use development; 5 acres of agri-commercial development
- C_2 : land use development; 20 acres of commercial and small business offices and motels

Approach to Traffic Assignment Study

In the course of this study, many factors had to be examined and interpreted in order to obtain reasonable volume estimates. Engineering judgement based on available traffic data has produced this study. Described below is the general approach used to develop the traffic assignment. First, I will discuss the division of the study area in three zones (see figure 1). Next, the traffic volume calculated for each one will be detailed. Sample calculations are provided in the appendix for varification of the figures provided.

The Study

The first step taken to estimate volumes was to divide the area into three major traffic sectors (see figure 1). Volumes are now computed for each sector to help define the dynamics of traffic flows.

Traffic counts at various stations along US 30 were found in the Iowa DOT report on average annual daily traffic. The current by-pass traffic was determined by taking a percentage of traffic off US 30 and other surrounding roads. For stations, percentages, volumes, etc., see figure 1 . This figure shows the division of traffic from area roads onto the by-pass. I assumed that traffic leaving the Marshalltown area to the East or West will use

existing highways. Traffic from these are not included in the analysis. The totals for current traffic for each sector was increased by 3.3% per year for six years. The DOT study was conducted in 1981.

Sector 1 : I estimated that 2000/3200 US 30 VPD will use the Eastbound by-pass. This sector will pick up an additional 70 VPD from S75 and 1100 off of Ia 14. Eighty percent of the Westbound by-pass traffic and 40% off of Governor's Road will continue through sector 1. In addition, 120 VPD of local traffic is assumed to use the new road. Estimated current traffic = $4790(3.3\%) = 5700$ VPD

Sector 2 : This sector will see 80% of the US 30 by-pass VPD from both directions. Also, 40% of S75 traffic will enter the sector. Governor's road will contribute 350 and Ia 14 will add 1200 VPD. Local traffic is estimated at 80 VPD. Estimated current traffic = $4600(3.3\%) = 5500$ VPD

Sector 3 : About 1700 of the 3500 Westbound US 30 traffic will use the by-pass. As mentioned earlier, 80% of this will travel through sections 1 and 2 and back onto US 30. Likewise, sector 3 will get 80% of the Eastbound traffic from the sector 1 by-pass area. Forty percent of the Eastbound traffic off of S75 will continue through this sector. The third sector will take 90% of the 1200 VPD that pass through sector 2 off of Ia 14. In addition, 250 VPD will enter from Governor's Road. Local traffic load is assumed to be 100 VPD. Estimated current traffic = $4746(3.3\%) = 5700$ VPD

Next, the growth factors were calculated for all three sectors using the formula: $V_1 = V_f - V_0$. Consult the graphs and calculations in the appendix. A factor of 1.2 was used in the calculations. The 20% increase was based on an assumed increase in trips. The growth factors added 2700 VPD for sectors 1 and 3, 2500 VPD for sector 2.

Traffic generated in the area due to the attractiveness of the new by-pass is assumed to be 8%. The estimate is moderate because the by-pass is fairly short and doesn't connect with many major arteries. This 8% added 460,440, and 460 VPD for sections 1,2, and 3 respectively.

Consult the table in the calculations section for location and development traffic assignment. The estimates for the changes in traffic flows for the land use areas are summarized here. I estimated the amount of VPD that will be transferred to the by-pass for each of the three sections. See the land use areas outlined in figure 2.

Finally, design hourly volume (DHV) and average daily truck traffic (ADTT) are calculated based on the sum of the above (ADT) for each section. The DHV has been previously determined to be 10% and the ADTT to be 13% of the ADT.

Summary

Many aspects must have been taken into account to complete this study. Engineering judgement and interpretation of existing traffic data has been utilized continually. The values estimated are on the conservative side. That is, the volumes estimated should well surpass actual traffic. The final estimates are:

Zone 1 : ADT = 9300 VPD
 DHV = 930 VPH
 ADTT = 1210 TPD

Zone 2 : ADT = 8900 VPD
 DHV = 890 VPH
 ADTT = 1160 TPD

Zone 3 : ADT = 9200 VPD
 DHV = 920 VPH
 ADTT = 1200 TPD

APPENDIX

2 traffic study maps

2 calculation pages

futures graph

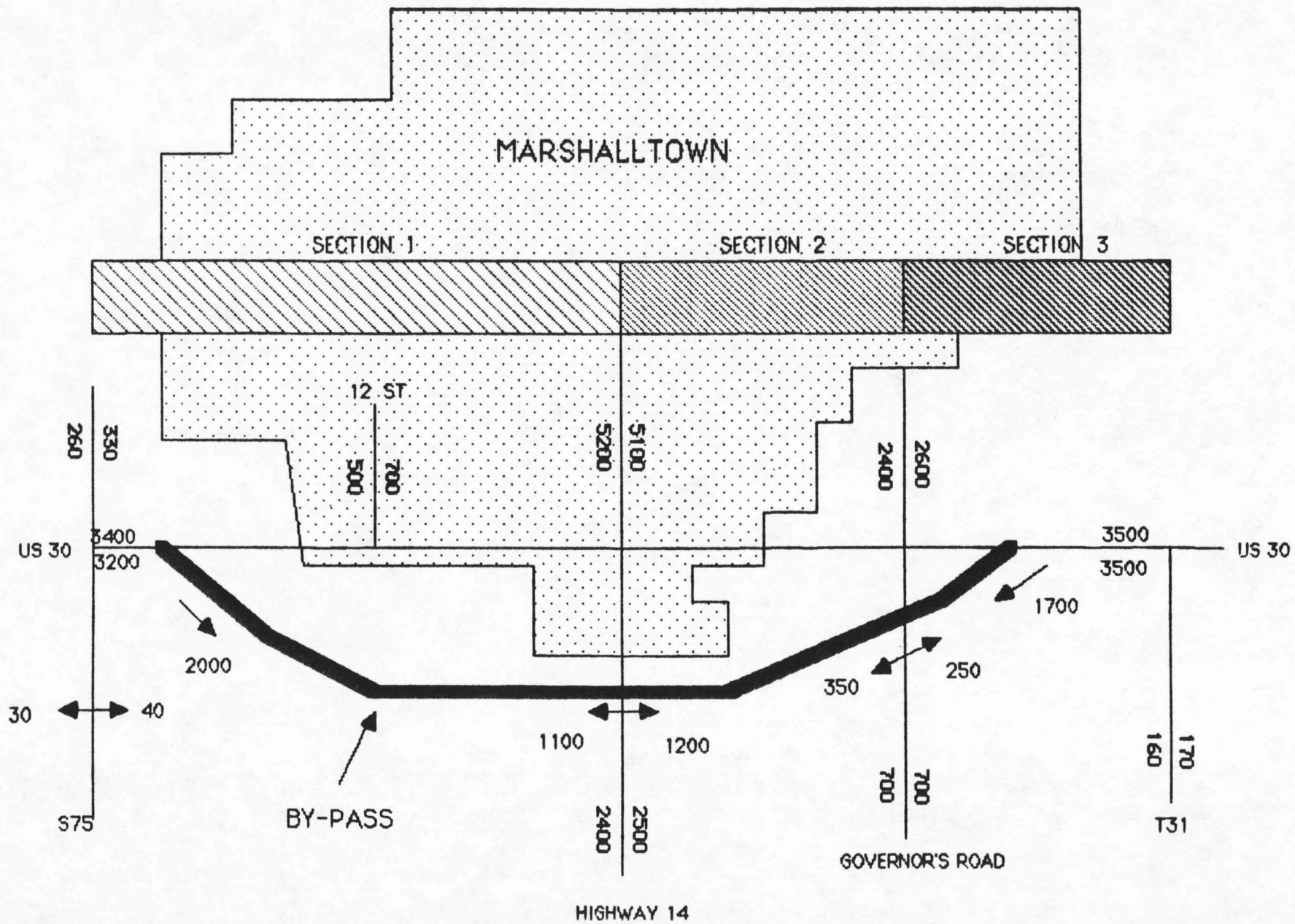


FIGURE 1

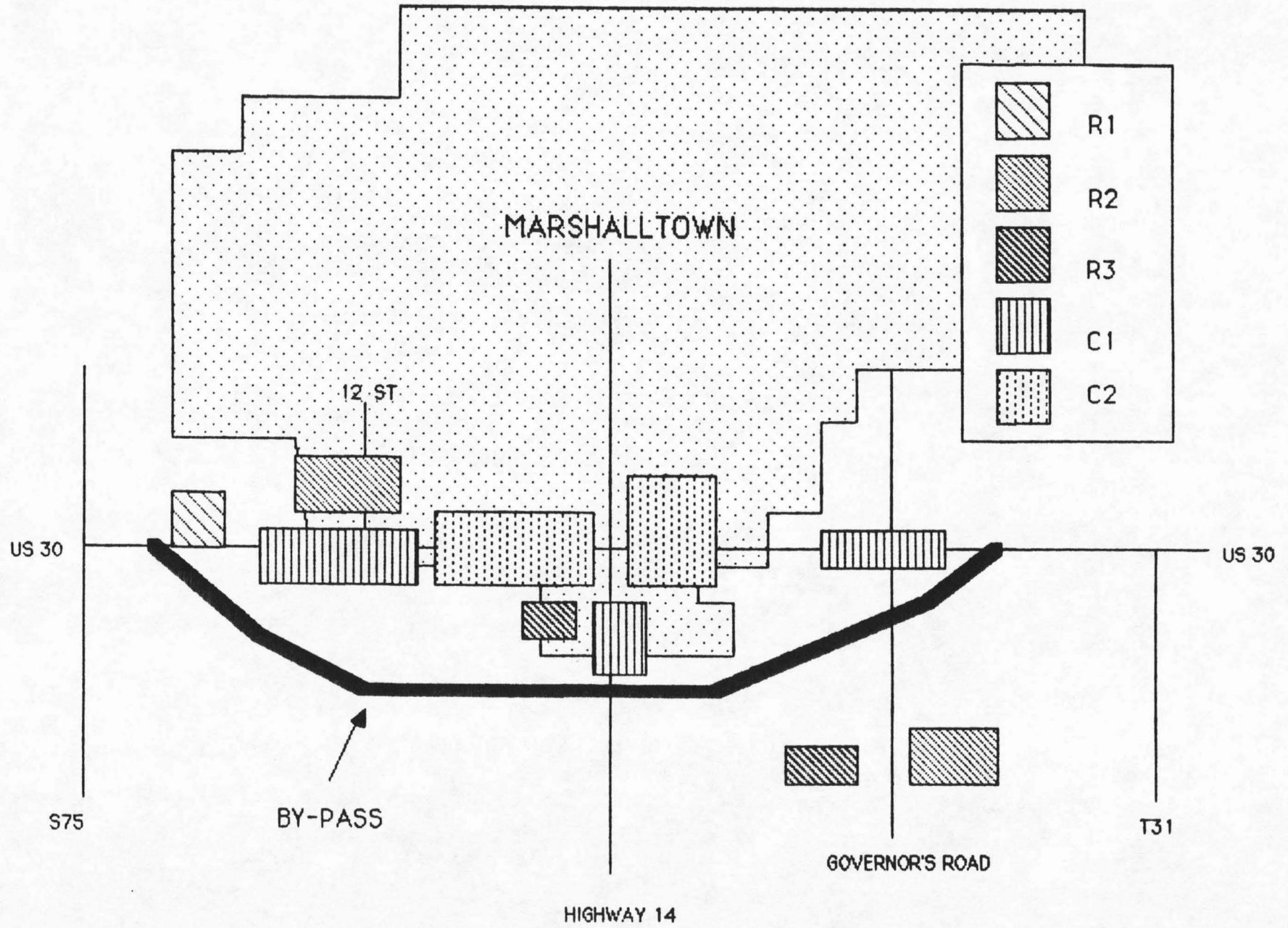


FIGURE 2

CALCULATIONS

Current Traffic:

$$\begin{aligned}\text{Zone 1 VPD} &= 2000 + 40 + 1100 + 30 + 120 + (.8 \times 1700) + (.4 \times 350) \\ &= 4790 \times 3.3\% = 5700 \text{ VPD}\end{aligned}$$

$$\begin{aligned}\text{Zone 2 VPD} &= (.8 \times 2000) + (.4 \times 40) + 1200 + (.8 \times 1200) + 350 \\ &= 4600 \times 3.3\% = 5500 \text{ VPD}\end{aligned}$$

$$\begin{aligned}\text{Zone 3 VPD} &= (.8 \times 2000) + (.4 \times 40) + (.9 \times 1200) + 250 + 1700 + 100 \\ &= 4750 \times 3.3\% = 5700 \text{ VPD}\end{aligned}$$

Growth Factors:

$$V_1 = V_f - V_0 \quad \text{See graphs on pg}$$

Sample calculation for zone 1: $f = 1.2$ as explained earlier

$$V_f = 5700 \times \frac{39000}{31000} \times \frac{62000/46000}{47000/42000} \times 1.2 = 8400 \text{ VPD}$$

$$V_1 = 8400 - 5700 = 2700 \text{ VPD} \quad \text{for section 1}$$

$$= 2500 \text{ VPD} \quad \text{for section 2}$$

$$= 2700 \text{ VPD} \quad \text{for section 3}$$

Generated Traffic:

As explained earlier, generated traffic (V_2) will be calculated at 8% of the current traffic estimations

$$\text{section 1} \quad .08 \times 5700 = 460 \text{ VPD} = \text{section 3}$$

$$\text{section 2} \quad .08 \times 5500 = 440 \text{ VPD}$$

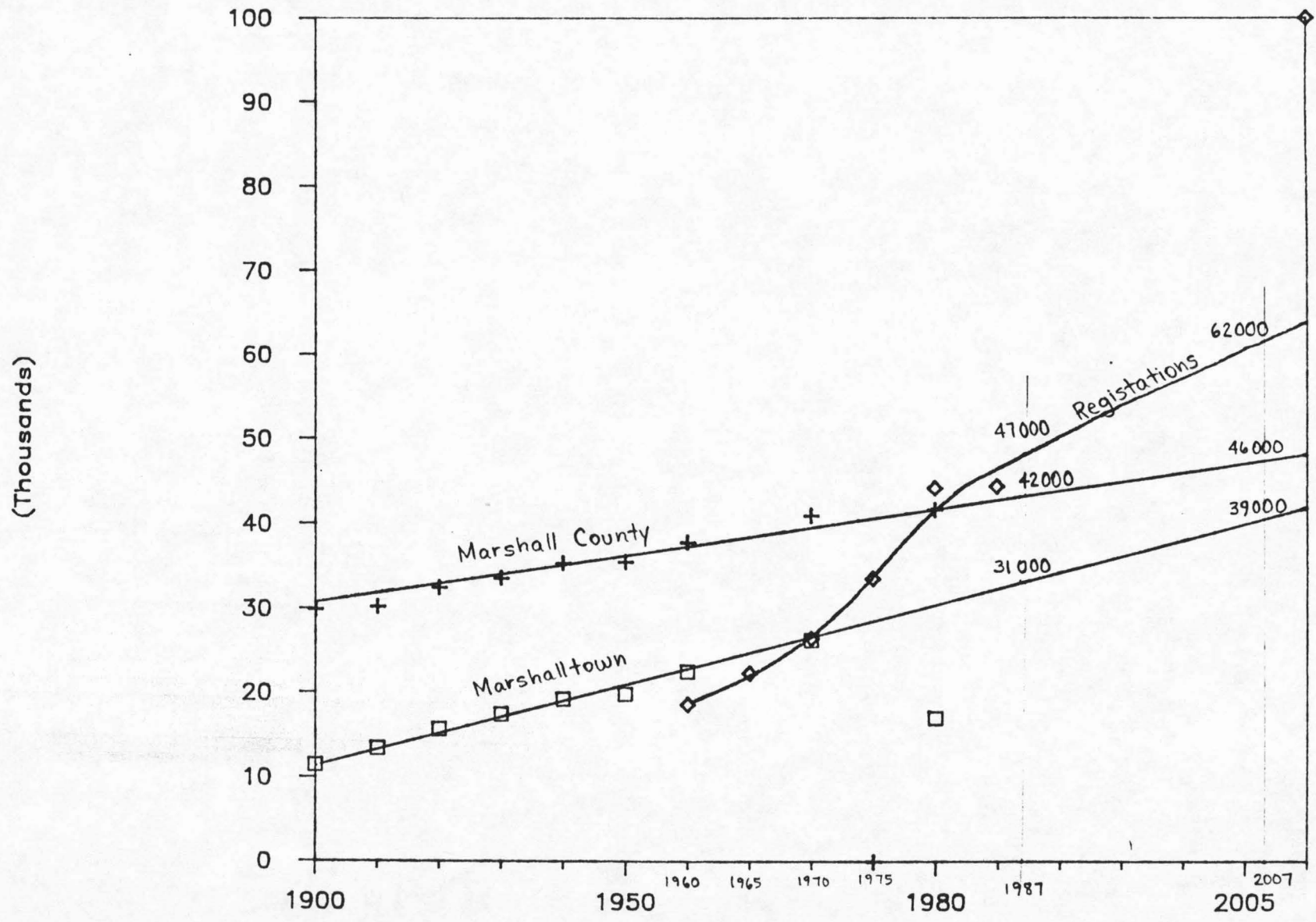
Location and Development:

	zone 1	zone 2	zone 3	total
R1	10 % 33VPD	10% 33VPD	10% 33VPD	330 VPD
R2	10 44	5 22	10 44	440
R3	5 44	10 87	5 44	870
C1	15 60	20 80	20 80	400
C2	20 <u>240</u>	20 <u>240</u>	15 <u>180</u>	
	420	460	380	

Totals for ADT, DHV, ADTT:

As explained earlier, DHV = 10%, ADTT = 13%

	ADT	DHV	ADTT
Zone 1: 5700+2700+460+420 = 9300	930	1210	
Zone 2: 5500+2500+440+460 = 8900	890	1160	
Zone 3: 5700+2700+460+380 = 9200	920	1200	



TRAFFIC ASSIGNMENT

LAB #2

CE 452

BRIAN HORN

CALCULATION OF POPULATION:

MARSHALLTOWN -

YEAR	1900/1910	1910/1920	1920/1930	1930/1940	1940/1950	1950/1960	1960/1970	1970/1980
GROWTH RATE	15.9%	17.6%	10.4%	10.8%	3.0%	13.6%	16.4%	-35.4%

AVG. GROWTH RATE = $\frac{\text{TOTAL GROWTH}}{\text{PERIODS}} = \frac{0.523}{8} = 6.5\% \text{ GROWTH PER DECADE}$

EST. 1987 POPULATION = $(1.0455)^8 (17709) = 17,709$

EST. 2007 POPULATION = $(1.065)^8 (17709) = 20,086$

Good
Annual Yr's

MARSHALL COUNTY -

YEAR	1900/1910	1910/1920	1920/1930	1930/1940	1940/1950	1950/1960	1960/1970	1970/1980
GROWTH RATE	1.0%	7.8%	3.4%	5.0%	0.6%	6.7%	8.1%	1.4%

AVG. GROWTH RATE = $\frac{\text{TOTAL GROWTH}}{\text{PERIODS}} = \frac{0.34}{8} = 4.25\% \text{ GROWTH PER DECADE}$

EST. 1987 POPULATION = $(1.03)^8 (42,902) = 42,902$

EST. 2007 POPULATION = $(1.0425)^8 (42,902) = 46,626$

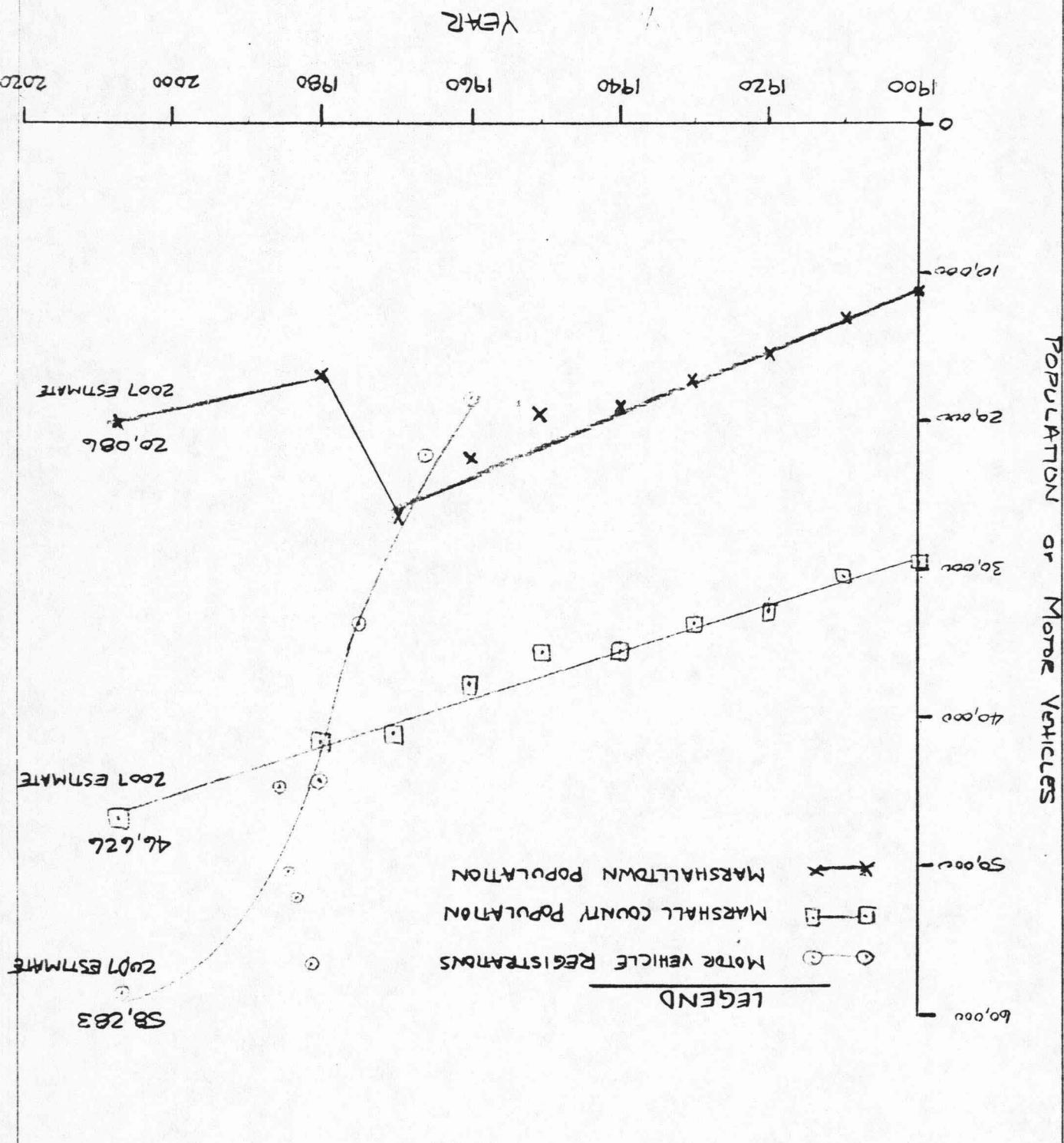
CALCULATION OF VEHICLE REGISTRATIONS:

MARSHALL COUNTY -

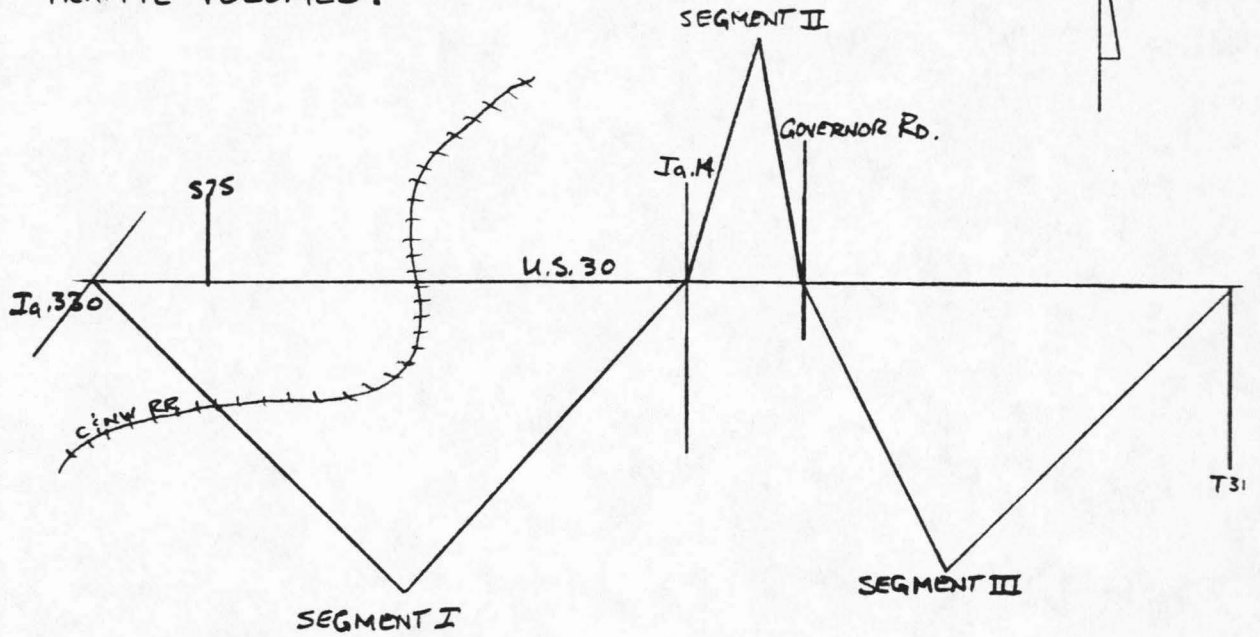
() = ESTIMATED VALUES

YEAR	REGISTRATIONS	POPULATION	POP/REG.
1960 (1)	18,555	37,984	2.05
1970 (2)	26,478	41,076	1.55
1980 (3)	44,144	41,652	0.94
1987 (37)	(50,473)	(42,902)	(0.85)
2007 (57)	(58,283)	(46,626)	(0.80)

MARSHALLTOWN, IOWA POPULATION CHART
MARSHALL COUNTY, IOWA MOTOR VEHICLE REGISTRATIONS CHART
1900 to 2007 (EST.)



SUBDIVIDED CORRIDOR TO CALCULATE CURRENT TRAFFIC VOLUMES.



LAB 2

CURRENT TRAFFIC

BRIAN HORN

SEGMENT I:

U.S. 30 - Ia. 330

6010 VPD.

(1981)

7303 VPD.

(1987)

U.S. 30 - Ia. 14
(WEST)

7813 VPD

(1981)

9493 VPD

(1987)

SEGMENT II:

U.S. 30 - Ia. 14
(EAST)

6900 VPD

(1981)

8384 VPD

(1987)

U.S. 30 - GOVERNOR RD.
(WEST)

6420 VPD

(1981)

7801 VPD

(1987)

SEGMENT III:

U.S. 30 - GOVERNOR RD.
(EAST)

6164

(1981)

7490

(1987)

U.S. 30 - MARSHALL Co. RD.
T31

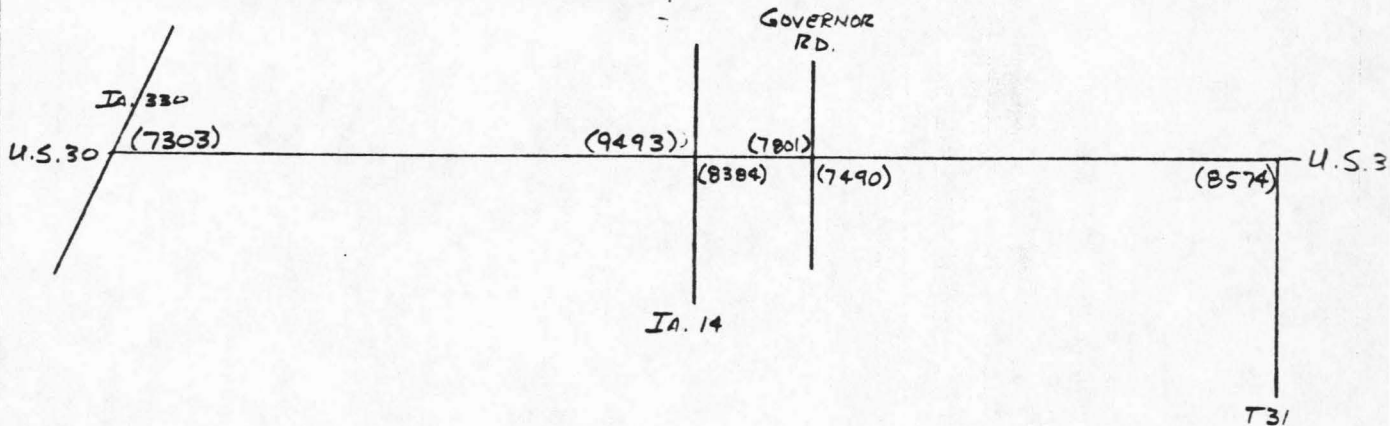
7056

(1981)

8574

(1987)

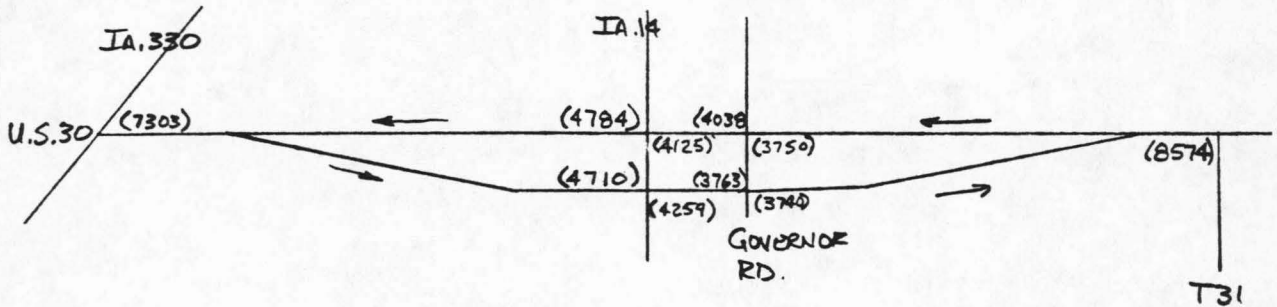
CURRENT 1987 TRAFFIC ON EXISTING FACILITY:



TO ADEQUATELY INTERPRET CURRENT TRAFFIC TO THE "PREFERRED ALTERNATIVE", USE THE DIRECTIONAL TRAFFIC COUNTS TIMES THE GROWTH FACTOR. EXAMPLE: U.S.30-GOVERNOR RD. (WEST) WESTERLY = 3323

$$\times (1.033)^6 = 4000$$

CURRENT 1987 TRAFFIC ON "PREFERRED ALTERNATIVE"



SINCE TRAFFIC ACCESS IS LIMITED, VOLUME FOR U.S. 30 WEST, BETWEEN GOVERNOR RD. AND IA. 14 SHOULD BE EQUAL.

THEREFORE, THE HIGHER VOLUME WILL BE USED TO ELIMINATE ANY POSSIBLE UNDER ESTIMATION OF TRAFFIC.

SEGMENT	AVERAGE DAILY TRAFFIC (ADT)
I	9494
II	8384
III	8574

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ANNUAL PREDICTED TRAFFIC GROWTH = 1.3% (ASSUMED)

FUTURE TRIP FACTOR = 1.08 (ASSUMED)

$$V_f = \left[\frac{\text{Future MARSHALLTOWN POP'N}}{\text{Present MARSHALLTOWN POP'N}} \right] \cdot \frac{\left[\frac{\text{future Registrations}}{\text{future County Pop'n}} \right]}{\left[\frac{\text{present Registrations}}{\text{present County Pop'n}} \right]} (f) * (V_0)$$

$$V_f = \text{future traffic} = \left(\frac{20,086}{17,709} \right) \frac{\left(\frac{58,283}{46,626} \right)}{\left(\frac{50,473}{42,902} \right)} 1.08 * (V_0)$$

$$V_f = 1.3015 V_0$$

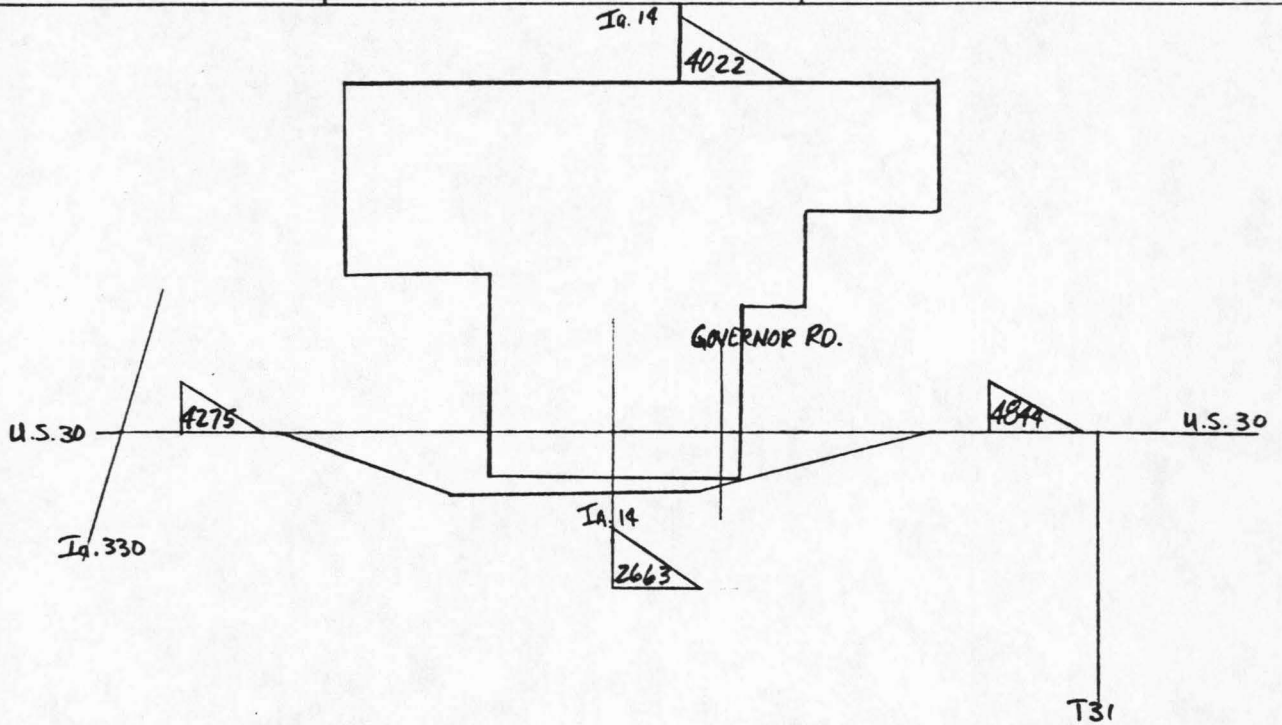
$$V_i = V_f - V_0$$

<u>SEGMENT</u>	<u>V₀</u>	<u>V_f</u>	<u>V_i = V_f - V₀</u>	<u>GROWTH RATE</u>
I	9494	12,357	2863	1.3%
II	8384	10,912	2528	1.3%
III	8574	11,159	2585	1.3%

ACTUAL GROWTH RATE FOR ALL THREE SEGMENTS

IS 1.3% PER YEAR FOR THE 20-YEAR DESIGN LIFE.

No - 130% from V₀ → V_f



SEGMENT	FROM TO	TOTAL VOLUME	NEW TRAFFIC	% NEW TRAFFIC	% NEW * CURRENT	TOTAL GENERATED
I	IA. 14 NORTH U.S. 30 WEST	4022	15	0.37%	0.37% (4784) = 17.84	18
I	U.S. 30 WEST U.S. 30 EAST	4275	10	0.23%	0.23% (4710) = 11.02	11
I	IA. 14 SOUTH U.S. 30 WEST	2663	10	0.38%	0.38% (4784) = 17.96	18
II	IA. 14 NORTH U.S. 30 EAST	4022	15	0.37%	0.37% (4259) = 15.76	16
II	U.S. 30 WEST U.S. 30 EAST	4275	10	0.23%	0.23% (4259) = 9.80	10
II	IA. 14 SOUTH U.S. 30 EAST	2663	10	0.38%	0.38 (4259) = 16.18	16
III	IA. 14 NORTH U.S. 30 EAST	4022	15	0.37%	0.37% (3744) = 13.85	14
III	U.S. 30 WEST U.S. 30 EAST	4275	10	0.23%	0.23% (3744) = 8.61	9
III	IA. 14 SOUTH U.S. 30 EAST	2663	10	0.38%	0.38% (3744) = 14.23	14

THE FUTURE TRAFFIC GENERATED BY LAND DEVELOPMENT NEAR THE U.S. 30 BYPASS IS BASED ON ASSUMED FUTURE PATTERNS. FACTORS TO CONSIDER ARE; POPULATION, ECONOMIC AND SOCIAL TRENDS OF THE MARSHALLTOWN AREA;

AFTER CONSIDERING THESE FACTORS, A LOCATION AND DEVELOPMENT RATIO WAS CREATED.

$$R_1 : R_2 : R_3 : C_1 : C_2 = 2 : 4 : 6 : 8 : 2$$

$$R_1 = 2 (10 \text{ trips}) = 20 \text{ trips}$$

$$R_2 = 4 (10 \text{ trips}) = 40 \text{ trips}$$

$$R_3 = 6 (10 \text{ trips}) = 60 \text{ trips}$$

$$C_1 = 8 (5) (80 \text{ trips}) = 320 \text{ trips}$$

$$C_2 = 2 (20) (60 \text{ trips}) = 2400 \text{ trips}$$

THE MAJORITY OF THE LOCATION AND DEVELOPMENT TRAFFIC (V_3) IS IN SEGMENTS ONE AND THREE. SEGMENT TWO V_3 TRAFFIC WILL PRIMARILY BE DUE TO COMMERCIAL DEVELOPMENT. TO ASSESS THE IMPACT OF V_3 , THE ACCUMULATED TRIPS WILL BE APPLIED TO ALL THREE SEGMENTS TO ACCOUNT FOR UNDER-ESTIMATIONS OF FUTURE DEVELOPMENT.

$$\text{TOTAL TRIPS } (V_3) = \underline{\underline{2840 \text{ VPD}}}$$

COMPARISON OF ALL THREE SEGMENTS.

<u>VOLUMES</u>	<u>SEGMENT 1</u>	<u>SEGMENT 2</u>	<u>SEGMENT 3</u>
V ₁	2863	2528	2585
V ₂	81	70	62
V ₃	2840	2840	2840
CURRENT (1987)	9494	8384	8574
2007 ADT	15,300	13,800	14,100

CRITICAL SECTION : SEGMENT I

SEGMENT I BREAKDOWN : EASTERLY = 7710 VPD
 (50.39%/49.61%) WESTERLY = 7590 VPD

2007 ADT = 15,300 VPD

DHV = 1530

ADTT = 1989

THE ANALYSIS OF THE TRAFFIC ASSIGNMENT USED THE FOLLOWING ASSUMPTIONS. FOR CURRENT TRAFFIC, SEGMENT II SHOULD HAVE EQUAL VOLUMES BETWEEN THE LIMITS BECAUSE OF NO ACCESS. THE NORMAL TRAFFIC GROWTH TRIP FACTOR WAS BASED ON THE MARSHALLTOWN POPULATION AND ITS ECONOMIC CLIMATE.

FOR GENERATED TRAFFIC, AN ASSUMPTION WAS MADE ON HOW MANY NEW TRIPS WOULD BE GENERATED BY THE

BYPASS. FOR THIS, TRAFFIC TO THE NORTH OF THE BYPASS WAS TOTALLY IGNORED. IT WAS ASSUMED THAT THEIR DESTINATION WOULD REQUIRE THEM TO USE THEIR SAME ROUTES. EXTERNAL-EXTERNAL TRAFFIC FROM IA. 14 NORTH MIGHT INCREASE, BUT THE BYPASS WOULD NOT DRAW ANY APPRECIABLE AMOUNT OF INTERNAL TRAFFIC. TO THE SOUTH OF THE BYPASS, THE PARALLEL TRAFFIC WAS ASSUMED TO BE SOLELY HOME TRIPS, NOT EXTERNAL-EXTERNAL TRIPS.

THE LOCATION AND DEVELOPMENT TRAFFIC VALUES WERE BASED ON THE ASSUMPTION OF WHERE THE DEVELOPMENT WOULD OCCUR. MOST OF THE NEW COMMERCIAL DEVELOPMENT WILL BE CENTERED BETWEEN IA. 14 AND GOVERNOR RD. RESIDENTIAL WILL MOST LIKELY OCCUR TO THE EAST AND WEST OF IA. 14 - GOVERNOR RD, IN SEGMENTS I & III. TO NOT UNDER ESTIMATE THE LOAD THE HIGHWAY MIGHT CARRY, THE V_3 VOLUME WAS APPLIED TO ALL THREE SEGMENTS.

TRAFFIC ASSIGNMENTLAB NO. 3OBJECTIVE

IN ORDER TO PROPERLY DESIGN THE BYPASS ROUTE PROPOSED IN LAB NO. 2 THE ENGINEER MUST OBTAIN INFORMATION REGARDING EXPECTED TRAFFIC FLOW ON THE ROADWAY. THE DESIGN LIFE OF THE BYPASS IS 20 YEARS AND IT IS THE EXPECTED TRAFFIC VALUES AT THAT TIME THAT WILL BE USED IN THE DESIGN. INFORMATION REGARDING TRAFFIC COUNTS WAS OBTAINED FROM THE INSTRUCTOR (1981 IOWA DOT VEHICULAR TURNING MOVEMENTS, AND 1985 MARSHALL CO. TRAFFIC COUNT DATA). USING INFORMATION ON POPULATION AND VEHICLE REGISTRATION FROM PAST YEARS, VALUES FOR 2007 CAN BE EXTRAPOLATED GRAPHICALLY. ALSO, USING PROPER GROWTH RATES THE ENGINEER CAN PROJECT ESTIMATED TRAFFIC IN THE YEAR 2007. ✓

ASSIGNMENT INFORMATION

THE FOLLOWING THREE PAGES CONTAIN INFORMATION NEEDED IN DETERMINING FUTURE TRAFFIC ASSIGNMENT: POPULATION TRENDS GRAPH FOR MARSHALLTOWN; VEHICULAR REGISTRATION GRAPH FOR MARSHALL CO.; AND, A ROUGH MAP SHOWING DESIGN CORRIDORS AND MAJOR TRAFFIC FLOWS.

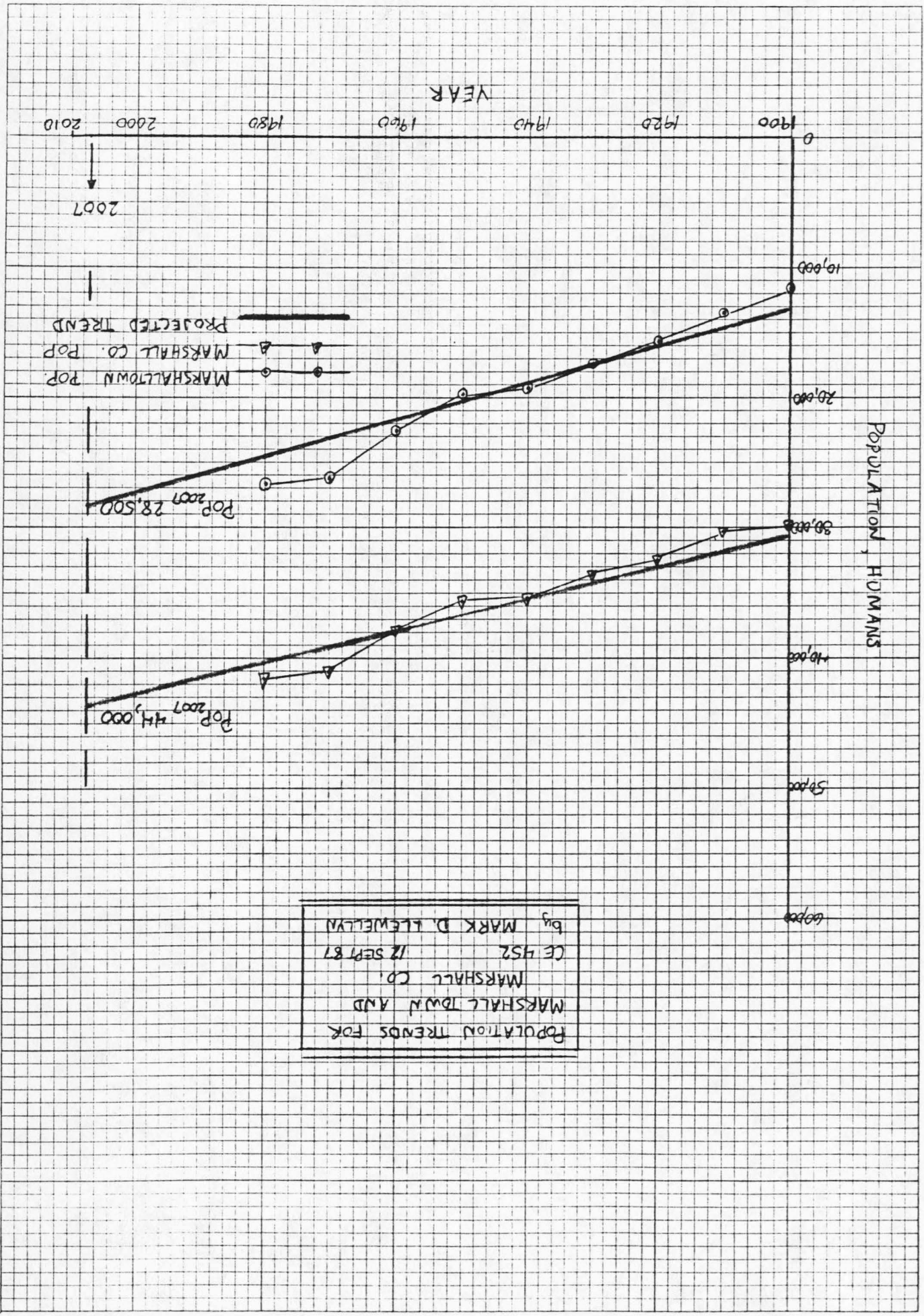
THE POPULATION FOR THE MARSHALL CO. AREA WAS RECORDED AS 30,000 IN 1900 AND GREW TO 41,600 IN 1980. FOLLOWING THIS TREND AND ASSUMING A "BEST FIT" LINEAR PLOT THE POPULATION OF THE SAME AREA IN 2007 IS TO BE IN THE AREA OF 44,000 PERSONS. THE PLOT WAS TAKEN OFF OF ITS TRUE COURSE BY A SMALL AMOUNT TO TAKE INTO CONSIDERATION THE CURRENT ECONOMIC SLUMP IN THE AREA WHICH IS KNOWN TO STUNT POPULATION GROWTH. THE POPULATION FOR MARSHALLTOWN ALONE FOLLOWED AN IDENTICAL TREND, AND THE PROJECTED POPULATION FOR 2007 IS TO BE IN THE AREA OF 28,500 PERSONS. ✓

THE VEHICULAR REGISTRATION INFORMATION FOR THE REGION WAS OBTAINED DATING BACK FROM 1960. ASIDE FROM THE PERIOD FROM 1979-1984 THE DATA SEEMS TO FOLLOW A STABLE TREND. THE PERIOD MENTIONED APPEARS TO COINCIDE WITH THE ECONOMIC BOOM OF THE EARLY 80'S WHEN AMERICANS IN GENERAL WERE SPENDING MORE. THIS CAN BE CARRIED OUT TO SUGGEST MORE CARS WERE BOUGHT THUS MORE VEHICULAR REGISTRATIONS OCCURRED. THE PROJECTED REGISTRATION COUNT FOR 2007 IS IN THE AREA OF 60,000 REGISTRATIONS. ✓

THE LAND ADJACENT TO THE PROPOSED ROUTE CAN BE SEEN ON THE RELIEF BLUEPRINT. WITH THE EXCEPTION OF TWO MAJOR AREAS THE LAND CAN BE COLLECTIVELY CALLED FARMLAND. THE TWO EXCEPTIONS ARE THE AREAS AROUND THE INTERSECTION OF THE BYPASS AND HIGHWAY 14, AND THE BYPASS AND GOVERNOR'S ROAD. AT THE FIRST INTERSECTION EXISTS A COMMUNITY COLLEGE, COMMERCIAL BUSINESS, AND NEIGHBORHOOD DEVELOPMENTS. THE SECOND INTERSECTION APPEARS TO BE THE BEGINNING OF WHAT SHOULD BECOME A SIZEABLE NEIGHBORHOOD. ✓

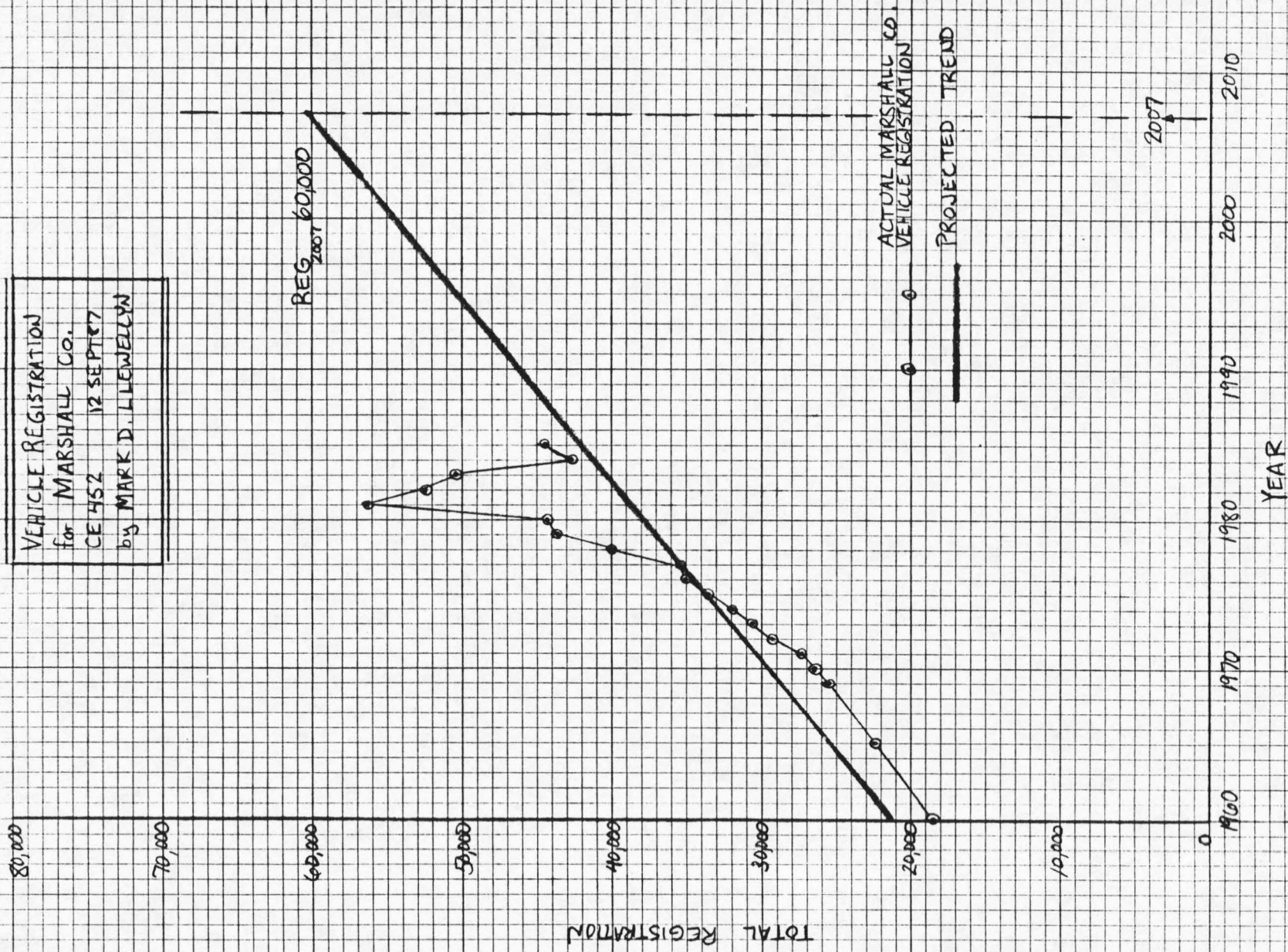
good

maybe high.



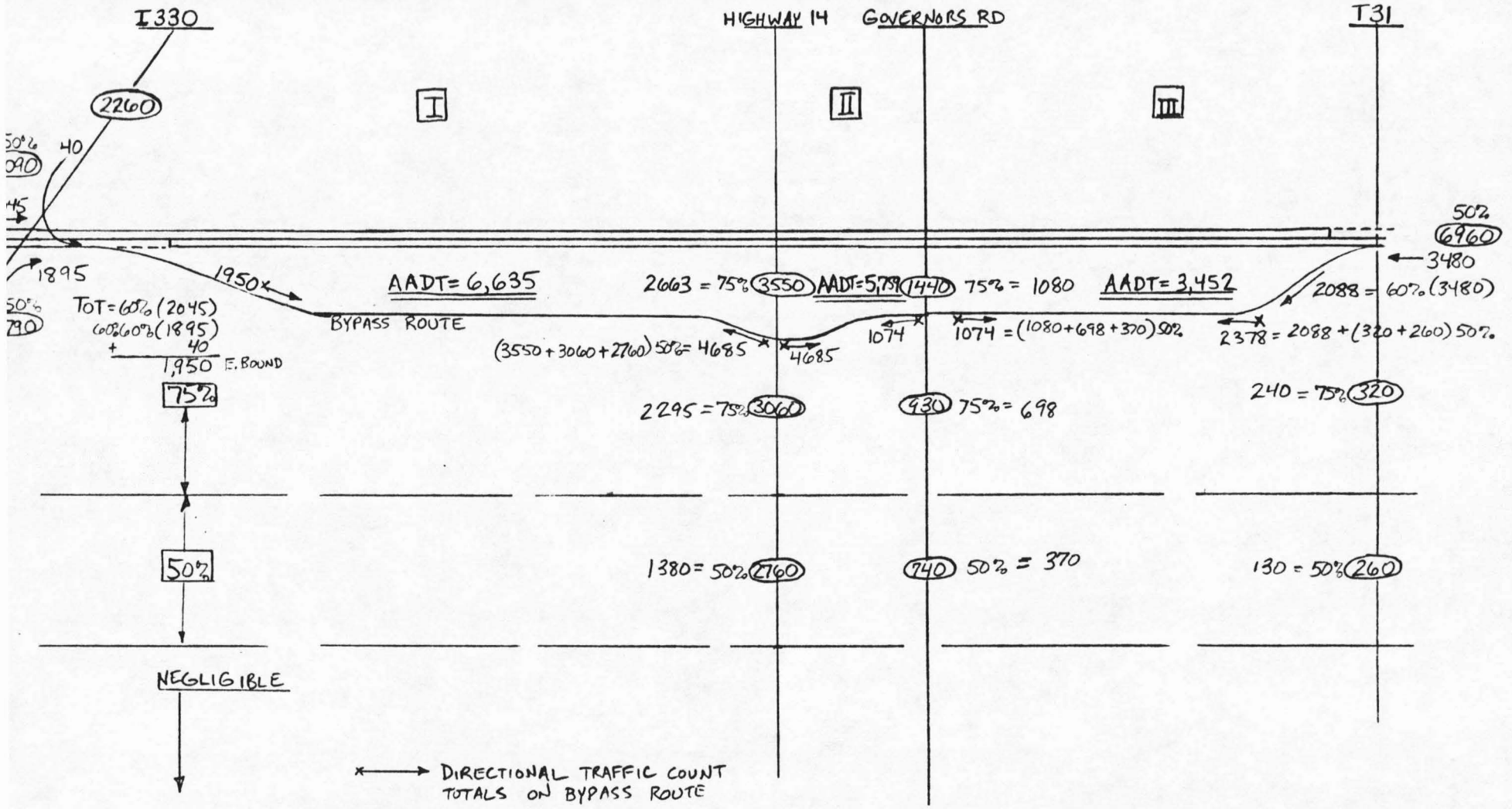
1/2

VEHICLE REGISTRATION
 for MARSHALL Co.
 CE 452 12 SEPT 87
 by MARK D. LLEWELLYN





ROUGH SCALE 1" = 1mi



NOTE: THE FOLLOWING PAGE WILL ASSIST IN EXPLAINING THE ABOVE MAP. THE TRAFFIC FLOWING ON THE ROADS SHOWN IS CONSIDERED TO BE THE MAJOR INPUT TO THE BYPASS. FOR THIS REASON THE TRAFFIC COUNTS FOR THE OTHER ROADS IN THE REGION ARE NOT DIRECTLY CONSIDERED (DUE TO THE SMALL NUMBERS) BUT THEY ARE ACCOUNTED FOR BY THE HIGH PERCENTAGE ZONE RATES OF 75% AND 50%.

CURRENT TRAFFIC VOLUME

AS WAS PREVIOUSLY MENTIONED THE TRAFFIC COUNTS WERE OBTAINED FROM BOTH IOWA DOT VEHICULAR TURNING MOVEMENT TABLES FOR 1981, AND A TRAFFIC COUNT LAYOUT FOR THE MARSHALL CO. AREA IN 1985. IN USING THESE AIDS SEVERAL ASSUMPTIONS WERE MADE:

ASSUMPTIONS

- MOTORISTS NORTH OF I30 WILL NOT USE THE BYPASS BECAUSE THEY WILL HAVE ACCESS TO I30 TO TRAVEL EAST OR WEST, THUS NO TRAFFIC COUNTS FROM THIS AREA ARE CONSIDERED.
- 60% OF THE CARS ENTERING THE DESIGN CORRIDOR FROM THE EAST OR WEST ALONG I30 WILL TAKE THE BYPASS ROUTE. THE POSSIBILITY EXISTS OF CREATING A BREAK IN THE PAVEMENT IN EACH DIRECTION TO FORCE ALL OF THE TRAFFIC ENTERING FROM THE EAST AND WEST THROUGH THE BYPASS. (i.e. RIGHT AFTER I30-330 INTERCHANGE GOING EAST, RIGHT AFTER I30-T31 INTERSECTION GOING WEST). THE IDEA IS TO ACCOMMODATE THE INDIVIDUALS DESIRING TO BYPASS MARSHALLTOWN, AND AT THE SAME TIME ALLEVIATE THE TRAFFIC USING I30 AS A CONNECTOR BETWEEN TWO LOCATIONS IN MARSHALL CO.. THOSE ENTERING FROM THE EAST OR WEST DESIRING TO EXIT INTO MARSHALLTOWN WILL NOT BE TROUBLED BECAUSE THEY CAN EXIT VIA 330, HIGHWAY 14, OR GOVERNORS ROAD.
- OF THOSE ENTERING THE BYPASS FROM THE EAST OR WEST ALONG I30 60% DESIRE TO BYPASS MARSHALLTOWN. ALTHOUGH THE ACTUAL PERCENTAGE IS MORE IN THE AREA OF 10%-20% THIS NUMBER ALLOWS FOR HEAVY TRAFFIC ALONG THE BYPASS AND ENSURES A SAFE PAVEMENT DESIGN.
- 75% OF THE TRAFFIC COUNTS BETWEEN I30 AND THE BYPASS ROUTE WILL USE THE BYPASS. AGAIN, THIS NUMBER IS PURPOSEFULLY HIGH TO ADD A REASONABLE FACTOR OF SAFETY INTO THE DESIGN OF THE PAVEMENT. THIS IS ALSO THE REASONING BEHIND THE FOLLOWING TWO ASSUMPTIONS.
- 75% OF THE TRAFFIC COUNTS FOR THE FIRST MILE BELOW/PARALLELING THE BYPASS WILL UTILIZE THE BYPASS.
- 50% OF THE TRAFFIC COUNTS FOR THE SECOND MILE BELOW/PARALLELING THE BYPASS WILL UTILIZE THE BYPASS.
- FINALLY, DIRECTIONAL SPLITS ENTERING THE ROUTE AT HIGHWAY 14 AND GOVERNORS ROAD ARE 50-50. WHY? BECAUSE THE LAW OF AVERAGES SUGGESTS IT TO BE TRUE.
- THE IDEA MENTIONED IN THE SECOND ASSUMPTION WILL NOT BE USED, INSTEAD IT WILL EXIST AS A FUTURE ALTERNATIVE. THE 60% BYPASS RATE WILL BE USED.

good documentation

PROJECTED TRAFFIC

THE TRAFFIC COUNTS TABULATED BELOW ARE BASED ON A 1985 TRAFFIC COUNT. THE FUTURE TRAFFIC IS BASED ON A GROWTH RATE OF 3% PER YEAR, AND A FUTURE TRIP FACTOR OF 1.05. THE FOLLOWING FORMULA FOR FUTURE TRAFFIC WAS USED: WHERE V_0 = CURRENT TRAFFIC

$$V_f = V_0 \left[\frac{\text{future city population}}{\text{present city population}} \right] \times \left[\frac{\text{future car registration}}{\text{future county population}} \right] \times f = V_1$$

$$V_f = V_0 \left[\frac{26,000}{28,500} \right] \left[\frac{60,000/44,000}{46,000/41,500} \right] (1.05) = 1.18 V_0 \quad \checkmark$$

NOTE: THE LARGEST ONEWAY COUNT IN EACH REGION IS CONSIDERED THE DESIGN COUNT FOR BOTH DIRECTIONS IN THE REGION.

AVERAGE DAILY TRAFFIC COUNTS:

SUBDIVISION	$V_{1985} * 1.06 \Rightarrow V_0 = V_{1987} * 1.18 \Rightarrow V_1 = V_{2007}$		
I	6,635	7,033.	8,300
II	5,759	6,104	7,200
III	3,452	3,660	4,300

NOTE: THE FUTURE TRIP FACTOR, $f = 1.05$, WAS DETERMINED BY ASSUMING THAT THE AMOUNT OF ADDITIONAL TRIPS MADE TO THE AREA WOULD RUN JUST AHEAD OF THE POPULATION TREND. THE POPULATION INCREASE FOR THE TIME PERIOD WAS GRAPHICALLY DETERMINED TO BE 3%. FOR THIS REASON 5% FUTURE TRIP INCREASE SEEMED REASONABLE, THUS $f = 1.05$. ✓

GENERATED TRAFFIC

THE BYPASS ROUTE PROPOSED HAS SEVERAL REDEEMING QUALITIES THAT WILL ATTRACT MOTORISTS WHO WOULD TAKE ALTERNATE ROUTES WERE THE BYPASS NONEXISTENT. THE LOCATION STUDY EXAMINES THESE QUALITIES AND OUTLINES THE ROUTE'S GENERAL ATTRACTIVENESS.

WITH THE AID OF THE 1967 MARSHALLTOWN TRAFFIC STUDY - ORIGIN AND DESTINATION INFORMATION, IT WAS POSSIBLE TO OBTAIN PERCENTAGES OF TRAFFIC USING ROUTES THAT POTENTIALLY FEED INTO THE BYPASS AREA. TO PROJECT GENERATED TRAFFIC. THE ORIGIN AND DESTINATION STUDY DISPLAYED TRAFFIC PATTERNS ON MAJOR ROUTES SUCH AS I30 (EAST AND WEST), HIGHWAY 14, AND GOVERNOR'S ROAD. THE PERCENTAGES WILL BE MULTIPLIED BY THE CURRENT TRAFFIC FOUND IN EACH SECTION (I, II, AND III) TO DETERMINE THE CURRENT GENERATED TRAFFIC ✓

GENERATED TRAFFIC (CONT)

PLEASE REFER TO Pg. 4 FOR THE MAP OF THE ROADS OF CONCERN.

ALTHOUGH IT WAS PREVIOUSLY STATED THAT TRAFFIC FROM THE NORTH OF I30 WOULD NOT CONTRIBUTE TO THE BYPASS TRAFFIC, THE TRAFFIC IN MENTION WAS CURRENT TRAFFIC. THE POSSIBILITY DOES EXIST OF PEOPLE BEING DRAWN FROM THE NORTH TO USE THE ROUTE. IT WAS DETERMINED THE FOLLOWING PERCENTAGES OF THE CURRENT TRAFFIC WILL BE GENERATED FROM THE NORTH ALONG HIGHWAY 14 :

$$I \Rightarrow \frac{679 \text{ USED THIS SECTION}}{4022 \text{ ENTERING ALONG HI. 14}} \times 100 = 16.8\%$$

$$II \Rightarrow \frac{133}{4022} \times 100 = 3.3\%$$

$$III \Rightarrow \frac{133}{4622} \times 100 = 3.3\%$$

TRAFFIC ENTERING THE STUDY AREA FROM THE SOUTH ALONG HIGHWAY 14 HAD MINIMAL EFFECT ON GENERATED TRAFFIC AND WAS THUS CONSIDERED NEGLIGIBLE.

TRAFFIC ENTERING THE BYPASS AREA ALONG I30 APPEARED TO HAVE EQUAL PERCENTAGES DEPARTING THE ROUTE AND HIGHWAY 14, GOVERNOR'S ROAD AND CONTINUING ON IN THE PROSPECTIVE EAST OR WEST DIRECTION. DUE TO THE SIMILARITIES ALONG THE SECTION THE AVERAGE OF THE TWO PERCENTAGES BYPASSING MARSHALLTOWN ENTIRELEY WILL BE USED AS THE GENERATED TRAFFIC PERCENTAGE DUE TO EAST/WEST TRAVEL ALONG I30.

$$\left[\frac{1309 \text{ VEHICLES BYPASSING ENTIRELY}}{4275 \text{ VEHICLES ENTERING FROM WEST}} + \frac{1330 \text{ VEHICLES BYPASSING ENTIRELY}}{4844 \text{ VEHICLES ENTERING FROM EAST}} \right] \div 2 \times 100\% = 29.0\%$$

$$I \% = II \% = III \% = 29\%$$

TOTAL PERCENTAGE VALUES :

$$I = 29\% + 16.8\% = 45.8\% \quad II = 29\% + 3.3\% = 32.3\% \quad III = 29\% + 3.3\% = 32.3\%$$

RECALL THE CURRENT ADT VALUES FROM pg. 6, AND THESE WILL BE MULTIPLIED BY THEIR RESPECTIVE PERCENTAGE TO DETERMINE GENERATED TRAFFIC FOR THE SECTION.

GENERATED TRAFFIC :

SUBDIVISION	V ₂
I	3,220
II	1,970
III	1,182



LOCATION AND DEVELOPMENT TRAFFIC

1 acre = 43,560 sq. ft

I 330

HIGHWAY 14

GOVERNOR'S RD

T 31

R₁

R₃

C₂

$\frac{1}{2}C_1$

$\frac{1}{2}C_1$

R₂

BYPASS ROUTE

$\frac{1}{2}C_1$

R₂

R₁

KEY

- R₁ = 15 ACRES, LOW DENSITY HIGH QUALITY HOUSING
- R₂ = 10 ACRES, MEDIUM AND HIGH DENSITY MULTIPLE FAMILY DWELLING
- R₃ = 10 ACRES, HIGH DENSITY SINGLE FAMILY DWELLING/TRAILER PARK.
- C₁ = 5 ACRES OF AGRI-COMMERCIAL DEVELOPMENT
- C₂ = 20 ACRES OF COMMERCIAL/SMALL BUSINESS OFFICES.

15 SEPTEMBER 87

CE 452 HIGHWAY ENGINEERING
DESIGN PROJECT

LEWELLYN, MARK D.

15 SEPTEMBER 87

CE 452 HIGHWAY ENGINEERING
DESIGN PROJECT

LLEWELLYN, MARK D.

LOCATION AND DEVELOPMENT TRAFFIC

IT IS A FACT THAT THE BYPASS WILL PRODUCE DEVELOPMENTAL TRAFFIC DUE TO BUSINESSES, HOMES, AND TRAILER PARKS GROWING IN THE REGION. FOR THE MOST PART THIS DEVELOPMENT WILL BE LOCATED AT THE INTERSECTIONS OF HIGHWAY 14 AND BYPASS ROAD, AND GOVERNOR'S ROAD AND BYPASS ROAD.

MUCH OF THE DEVELOPMENT WILL BE WITH RESPECT TO HOUSING/ RESIDENTIAL BUILDING. TO ACCOMMODATE THE INCREASE IN POPULATION THROUGHOUT THE 20 yr DESIGN PERIOD. THE LAND NEAR THE BYPASS SEEMS FEASIBLE FOR THE DEVELOPMENT OF LOWER COST/HIGHER DENSITY RESIDENTIAL HOUSING. A DISTANCE OF UP TO 1/2 MILE REMOVED FROM THE BYPASS SEEMS TO BE A FINE LOCATION FOR HIGHER PRICED LOWER DENSITY HOUSING. THERE IS ALREADY SUCH HOUSING IN THE REGION NOTED ON THE PREVIOUS PAGE, SO IT SEEMS TO FOLLOW THAT THE NEIGHBOR HOOD WOULD GROW OVER THE 20 yr DESIGN LIFE OF THE BYPASS.

DUE TO INCREASED TRAFFIC THROUGH THE BYPASS AREA AND SUBSEQUENT BOOM IN HOUSING THERE WILL BE AN INCREASE IN COMMERCIAL BUILDINGS IN THE AREA WHICH WOULD ALSO ADD TO DEVELOPMENTAL TRAFFIC. THE SOUTH SIDE OF THE INTERSECTION OF HIGHWAY 14 AND I30 WAS SEEN TO BE A LARGE REGION FOR COMMERCIAL/SMALL BUSINESS OFFICES/MOTELS. THIS WOULD FOLLOW FROM THE BUSINESS AREA TO THE NORTH OF I30. I30 WOULD ACT MORE AS A CONNECTOR OF LOCATIONS FOR TRIPS BEGINNING AND ENDING IN MARSHALL CO., SO PERSONS WOULD BE MORE WILLING TO LOCATE BUSINESSES NEXT TO I30 ON THE SOUTH SIDE. SOUTH OF THE INTERSECTION OF HIGHWAY 14 WITH BYPASS ROAD LIES LAND THAT INVITES SMALL BUSINESS. THIS IS ALSO TRUE OF THE AREA TO EITHER SIDE OF GOVERNOR'S ROAD WHERE IT INTERSECTS BYPASS ROAD.

THE AMOUNT OF DEVELOPMENT PLACED AROUND THE BYPASS IS REALISTIC FOR A 20 yr PERIOD AND SHOULD GIVE RELIABLE INFORMATION PERTAINING TO LOCATION AND DEVELOPMENT TRAFFIC. IT FOLLOWS THE TREND OF THE PROJECTED POPULATION (POSSIBLY SLIGHTLY MORE DEVELOPMENT THAN THE POPULATION INCREASE WARRENTS) WHICH ALSO SUGGESTS IT IS RELIABLE.

THE VALUES CALCULATED BELOW WILL BE USED FOR DEVELOPMENT TRAFFIC:

$$2R_1 \rightarrow \frac{30 \text{ acres} \times 43,560 \text{ sq. ft}}{20,000 \frac{\text{sq. ft}}{\text{unit}}} \frac{10 \text{ trips}}{\text{unit}} = 653 \text{ trips}$$

$$2R_2 \rightarrow \frac{20 \text{ acres} \times 43,560 \text{ sq. ft}}{10,000 \frac{\text{sq. ft}}{\text{unit}}} \frac{10 \text{ trips}}{\text{unit}} = 871 \text{ trips}$$

$$1R_3 \rightarrow \frac{10 \text{ acres} \times 43,560 \text{ sq. ft}}{5,000 \frac{\text{sq. ft}}{\text{unit}}} \frac{10 \text{ trips}}{\text{unit}} = 871 \text{ trips}$$

$$1SC_1 \rightarrow 1.5 (5 \text{ acres}) \frac{80 \text{ trips}}{\text{acre}} = 120 \text{ trips}$$

$$1C_2 \rightarrow 20 \text{ acres} \times 60 \frac{\text{trips}}{\text{acre}} = 1,200 \text{ trips}$$

$$\text{TOTAL DEVELOPMENT TRAFFIC} = 3,715 \text{ trips} = V_3$$

NOTE: THIS TRAFFIC WILL BE ASSUMED TO USE THE ENTIRE STRETCH OF BYPASS.

SUMMARY

IN ORDER THAT THE BYPASS BE DESIGNED TO THE PROPER SPECIFICATIONS, THE ENGINEER MUST KNOW THE TRAFFIC TO TRAVEL THE ROUTE IN ITS DESIGN LIFE. THE PREVIOUS PORTIONS OF THIS LAB SET OUT THE METHODS THROUGH WHICH THIS DESIGN TRAFFIC COULD BE OBTAINED. BELOW IS A TABLE SUMMARIZING THE THREE SECTIONS AND THE TRAFFIC LOAD ON EACH (ADT).

AVERAGE DAILY TRAFFIC COUNTS :				
SUBDIVISION	V_1_{2007}	$V_2_{GENERATED}$	$V_3_{DEVELOPMENT}$	V_{DESIGN}
I	8,300	3,220	3,715	15,235
II	7,200	1,970	3,715	12,885
III	4,300	1,182	3,715	9,197

AS CAN BE SEEN FROM THE TABLE ABOVE THE ADT FROM SUBDIVISION I RULES AS THE DESIGN ADT. THE RESULTS ARE SUMMARIZED BELOW.

ADT FOR 2007	<u><u>15,200</u></u>
DHV (BASED ON 10% OF THE ADT)	<u><u>1,500</u></u>
ADTT (BASED ON 13% OF THE ADT)	<u><u>2,000</u></u>