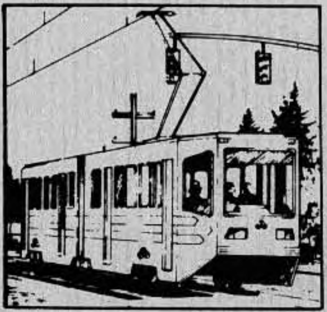
Regional LRT System Plan

MILWAUKIE CORRIDOR

October 1984



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MILWAUKIE CORRIDOR
NOTEBOOK

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Milwaukie Corridor
Working Paper "A"

TRAVEL FORECASTS

October 1984

METROPOLITAN SERVICE DISTRICT

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REGIONAL LRT SYSTEM PLAN

MILWAUKIE CORRIDOR

WORKING PAPER "A"

TRAVEL FORECASTS

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FOREWARD

This is one in a series of working papers used to document results of the Milwaukie portion of the Regional LRT System Plan. Because it is one in a series, by itself this working paper does not cover all issues important to deciding on the long-term transportation strategy for the Milwaukie Corridor. Working papers for the Milwaukie Corridor are:

- A: Travel Forecasts
- B: Alignment Description Report
- C: Preliminary Impact Assessment
- D: Capital and Operating Costs and Economic Evaluation
- E: Initial Evaluation of Central Eastside Alternatives

In addition to the working papers, a summary report--incorporating the major conclusions of each working paper--has been prepared.

SUMMARY AND MAJOR CONCLUSIONS

Summarized below are some of the more significant findings of the travel forecasts conducted for the Milwaukie Corridor as part of the Regional LRT System Plan. The forecasts allow analysis of changes in travel between today and the year 2000--accounting for changes in population and employment, as well as changes in the highway and transit system.

Below is a description of travel changes from 1980 to 2000; an evaluation of LRT and bus alternatives in the Portland to Milwaukie Corridor and the Central Eastside; a description of highway demand; and an evaluation of the staging of highway and transit improvements proposed for the corridor based on growing highway and transit demand.

McLoughlin Corridor Travel: Growth in population and employment in Clackamas County, together with growth in employment in central Portland, results in the following major changes in travel in the McLoughlin Corridor by the year 2000:

- Overall corridor travel demand will increase 52 percent between 1980 and 2000, as measured north of Tacoma Boulevard in the evening peak-hour southbound direction.
- Increased transit patronage is expected to absorb over 60 percent of this increase in travel demand, while less than 40 percent of the demand will be absorbed by the highway system--as measured in the evening peak hour north of Tacoma.
- North of Tacoma, evening peak-hour southbound trips by persons in autos are expected to increase 25 percent, from 3,977 in 1980 to 5,038 by 2000.
- The I-205 corridor is expected to grow much more dramatically than the McLoughlin Corridor, increasing traffic carried by 160 percent between 1980 and 2000, from 2,720 to 7,070 southbound in the p.m. peak hour.

Portland to Milwaukie Transit Alternatives: An all-bus network and three light rail alternatives were evaluated for serving the Portland to Milwaukie trunk route. Major conclusions of this evaluation are summarized on Figure A, and discussed below:

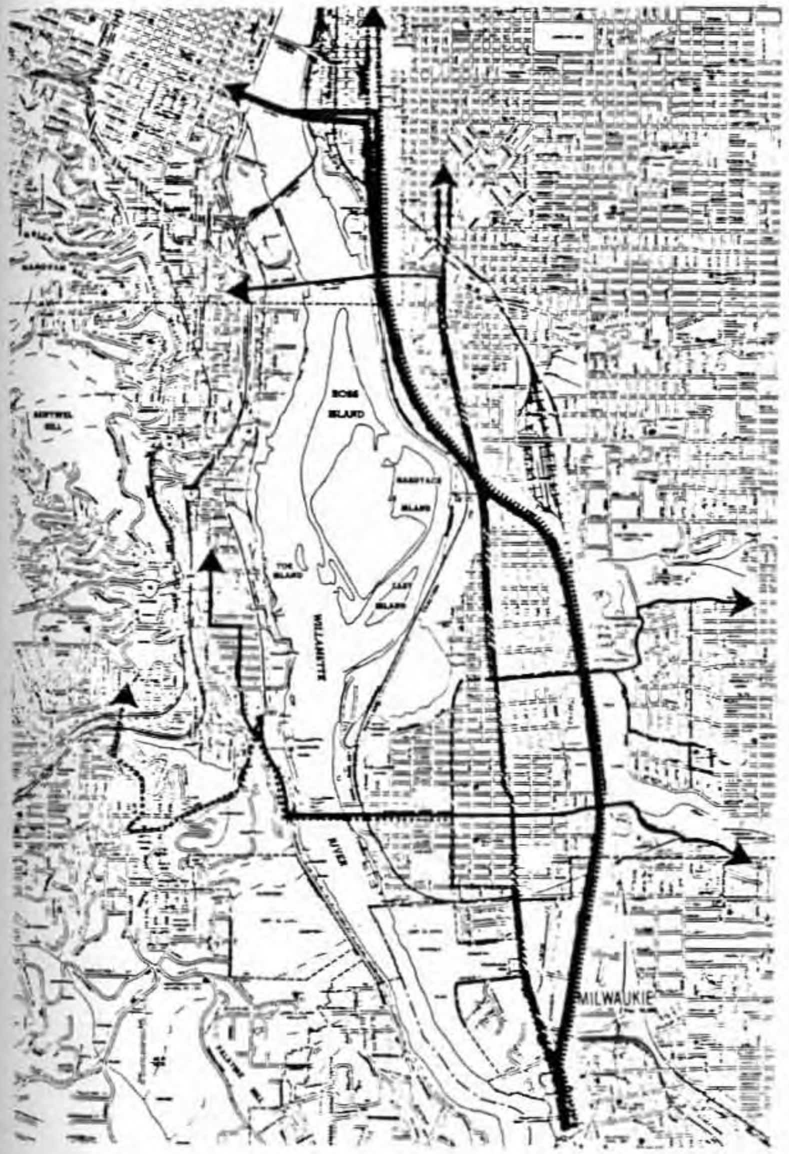
- All alternatives--one bus and three light rail--produce nearly identical levels of corridor transit ridership. On a daily basis, total ridership in the year 2000 is projected to be 33,700 for the Sellwood LRT and the all-bus networks, 33,800 for the Portland Traction Company (PTC) LRT, and 34,000 for the McLoughlin LRT.
- Year 2000 total daily riders on the Portland to Milwaukie trunk route--bus or LRT--was 13,000 for the PTC LRT, 13,500 for the

Regional LRT System Plan

FIGURE A

YEAR 2000 TRAVEL FORECASTS
SUMMARY OF MILWAUKIE CORRIDOR ALTERNATIVES

BASIC BUS/TSM

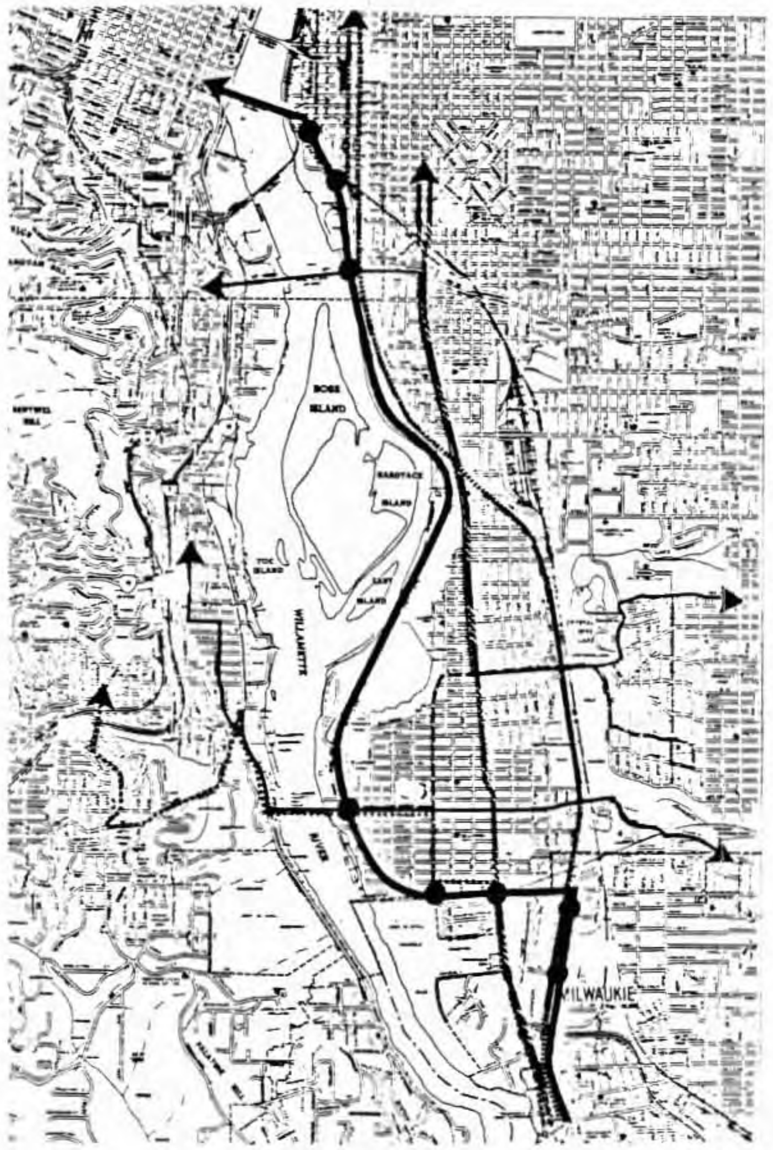


DAILY CORRIDOR RIDERS
33,760

DAILY McLOUGHLIN BUS TRUNK RIDERS
13,480

P.M. PEAK HOUR BUS TRUNK RIDERS
2990

PTC LRT

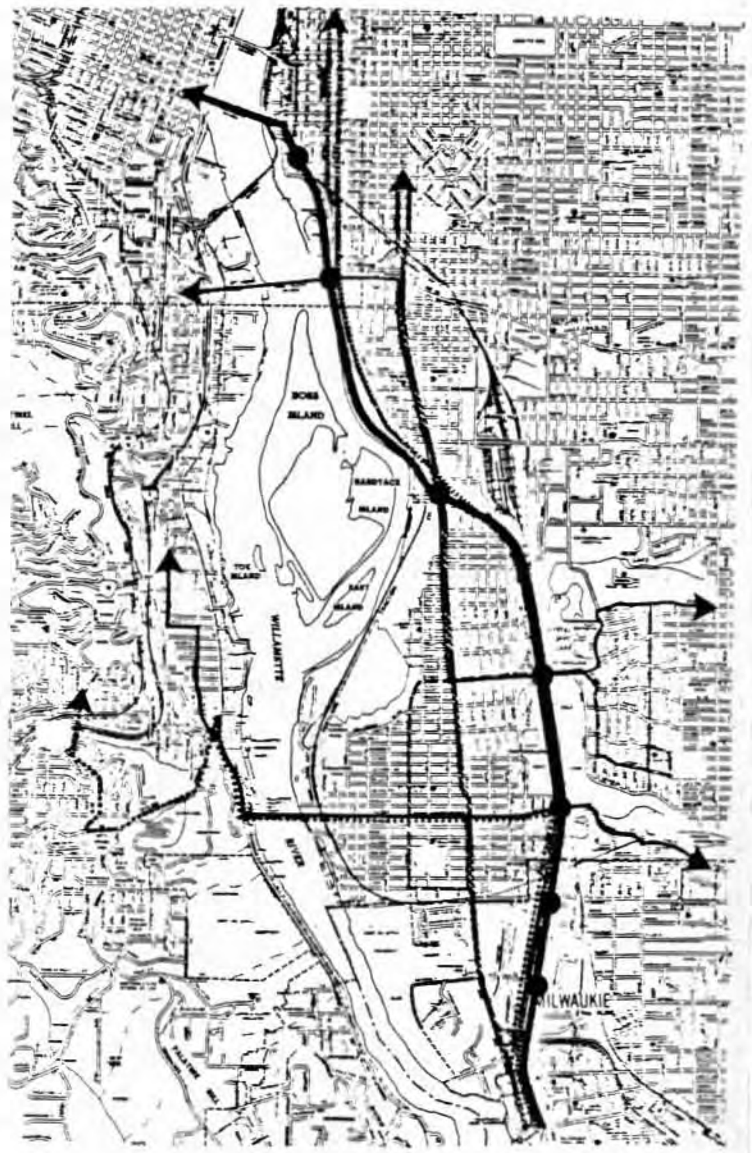


DAILY CORRIDOR RIDERS
33,840

DAILY PTC LRT RIDERS
12,940

P.M. PEAK HOUR LRT RIDERS
2860

McLOUGHLIN LRT

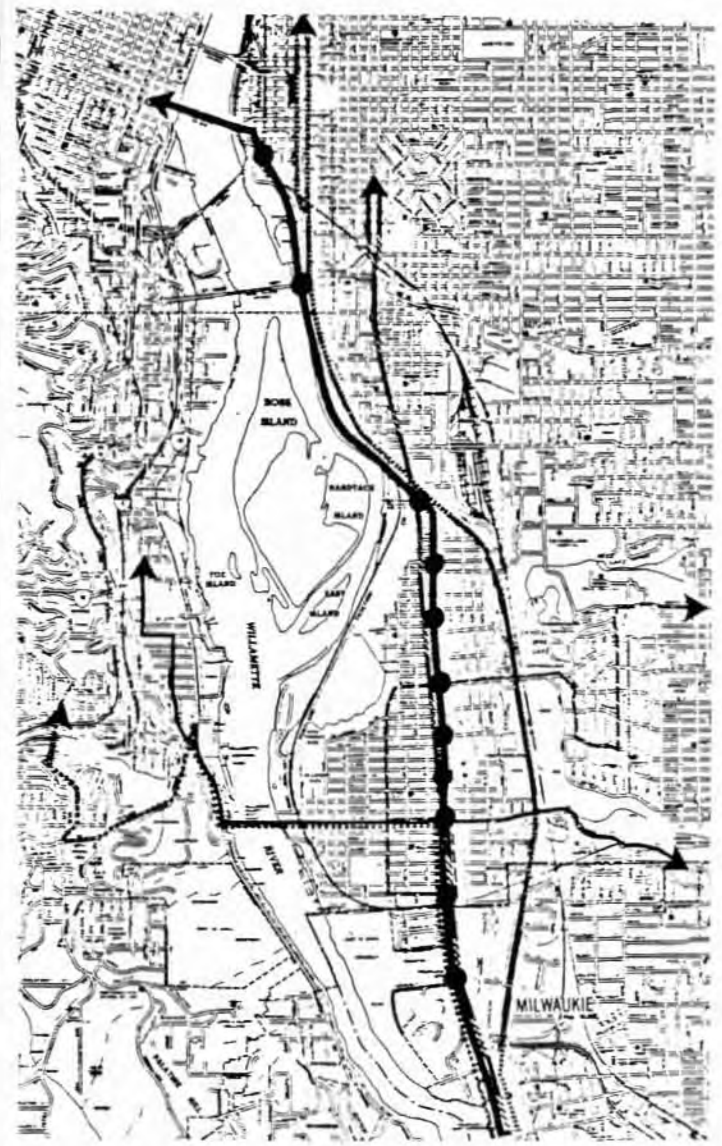


DAILY CORRIDOR RIDERS
34,030

DAILY McLOUGHLIN LRT RIDERS
14,900

P.M. PEAK HOUR LRT RIDERS
3310

SELLWOOD LRT



DAILY CORRIDOR RIDERS
33,720

DAILY SELLWOOD LRT RIDERS
14,230

P.M. PEAK HOUR LRT RIDERS
3160

All Bus, 14,200 for the Sellwood LRT, and 14,900 for the McLoughlin LRT.

- Each of the Portland to Milwaukie trunk route alternatives serve different travel markets, as illustrated for the evening peak-hour below:

Evening Peak-Hour Transit Riders on LRT or Bus Trunk (Year 2000) From:	TRUNK ROUTE ALTERNATIVES			
	McLoughlin Bus Trunk Riders	PTC LRT Riders	McLoughlin LRT Riders	Sellwood LRT Riders
Sellwood/Eastmoreland	160	290	600	710
Clackamas County	2,480	2,250	2,320	2,100
Other Areas	350	330	390	340
Total Riders	2,990	2,870	3,310	3,150

- Even though the trunk routes serve different areas, overall total daily transit riders from these areas are similar, as shown below, due to the provision of bus service to areas not served by LRT.

Year 2000 Total Daily Transit Riders From:	Southern Corridor Daily Transit Riders With:			
	Basic Bus Network	PTC LRT	McLoughlin LRT	Sellwood LRT
Sellwood/Eastmoreland	17,190	17,220	17,230	17,120
Clackamas County	16,570	16,620	16,800	16,600
Corridor Total	33,760	33,840	34,030	33,720

- P.M. peak-hour corridor transit trips, outbound from central Portland, are summarized on Figure B. As with the daily ridership totals discussed above, the p.m. peak-hour summary shows only a small difference between year 2000 alternatives. This volume, however, represents up to 37 percent of the peak-hour travel demand measured south of Tacoma.

- The Milwaukie Transit Center is projected to grow dramatically in importance between 1980 and 2000. Total passenger volume passing through the station is projected to increase from 1,260 per p.m. peak-hour in 1980 to 3,760 per peak-hour in 2000. In addition, the proportion of passengers actually transferring in Milwaukie will increase even more dramatically, growing from 10 percent of total passengers in 1980 to nearly 55 percent in 2000 with the light rail alternatives.

<u>Central Eastside Alignments</u>: An LRT alignment through the Central Eastside was compared to an "Eastbank" bus trunk. This bus trunk served the inner-Eastside on the Union-Grand couplet and was through-routed to the north on Interstate Avenue and to the south via McLoughlin Boulevard to Milwaukie. Major conclusions of this evaluation are:

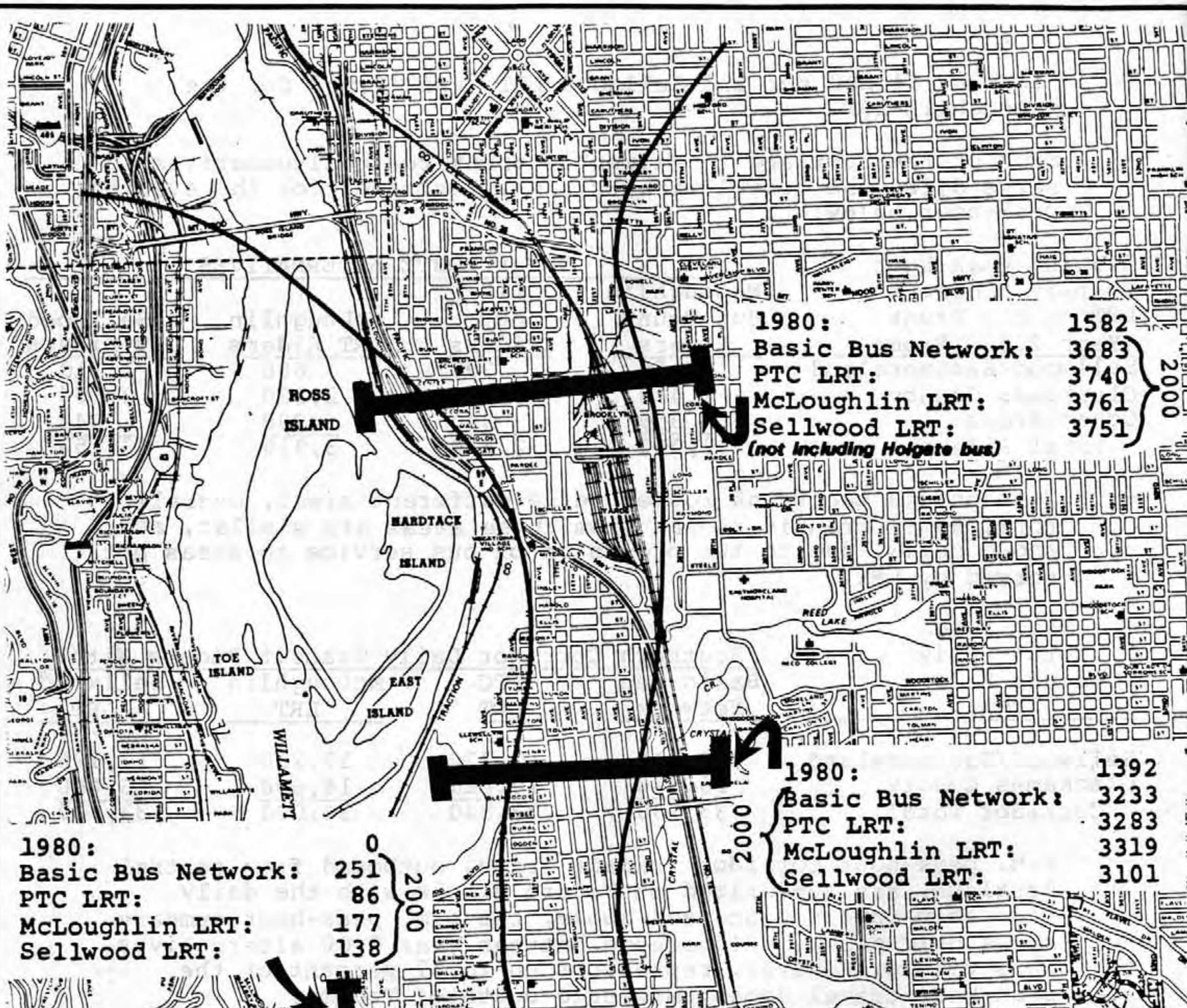


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FIGURE B

P.M. PEAK HOUR /PEAK DIRECTION CUTLINE TRANSIT RIDERS
1980 & 2000 BY ALTERNATIVE

- Daily transit trips to the Central Eastside will increase from 5,610 in 1980 to 6,880 in 2000 with the eastbank trunk bus route.

- Total Central Eastside transit ridership is the same with a north-south LRT line as with an "Eastbank" bus trunk (6,880 daily transit trips). In the year 2000 p.m. peak-hour near Hawthorne, this bus line would carry up to 420 in the southbound direction and 320 in the northbound direction. North-south LRT alternatives attract fewer riders than the bus alternative due to the added transfers necessary with the LRT network, which are avoided in the bus alternative with the long through-routed "Eastbank" bus line. The added transfers required in the LRT network result in transit patrons destined to the Central Eastside choosing alternate bus routes instead of the Eastside LRT.

- Serving downtown travel markets via a Central Eastside LRT line and a bus shuttle across the Willamette River will decrease downtown patronage approximately 4 percent.

- If a moderate parking cost is assumed in the Central Eastside, total patronage will increase 20 percent, from 6,880 to 8,270. However, this added patronage is from the entire region and does little to increase patronage on a north-south LRT line through the Inner-Eastside.

<u>McLoughlin Boulevard Traffic Analysis</u>: The travel forecasts also evaluated year 2000 traffic levels for McLoughlin Boulevard. Major conclusions of the highway analysis are:

- McLoughlin North of Tacoma - Traffic volume on 17th Avenue north of Tacoma is 890 vehicles in the p.m. peak direction. A reduction to 425 is readily achievable, thereby fully meeting the neighborhood traffic objective of diverting through traffic. To allow the 17th Avenue reduction and accommodate growth in the corridor, McLoughlin Boulevard capacity should be increased from today's volume of 2,000 vehicles per hour in the p.m. peak/southbound direction to 3,200.

- McLoughlin South of Tacoma - Traffic volume on 17th Avenue south of Tacoma is currently 1,180 vehicles per hour in the p.m. peak/southbound direction. Of this amount, a reduction to 1,047 vph is readily achievable simply by improving McLoughlin Boulevard, and an additional reduction to 750 can be achieved through selective neighborhood diversions of north-south through traffic. Both of these reductions generally affect trips toward the central Portland area. A further reduction to 330 is desirable to fully eliminate from 17th Avenue the flow of traffic from Clackamas County to the Sellwood Bridge.

  Of the vehicles diverted from 17th Avenue, nearly half would leave the corridor while the remainder would shift to McLoughlin Boulevard. Therefore, in order to meet the

McLoughlin highway project objectives, McLoughlin Boulevard should be increased in capacity from today's volume of 2,275 to a minimum of 2,900 vehicles per hour in the p.m. peak/southbound direction. This will allow 17th Avenue traffic to be reduced from 1,180 to 750 and will also accommodate expected growth in the corridor. A further increase in capacity to 3,150 would be desirable to facilitate the full 17th Avenue reduction to 330, thus allowing capacity for the Clackamas County to Sellwood Bridge traffic.

- Johnson Creek Boulevard Traffic Issues - Traffic levels on Johnson Creek Boulevard will vary based on the population and employment growth adjacent, and on the configuration of the McLoughlin/Tacoma improvement. Specifically:

  - The number of households and employees within close proximity to Johnson Creek Boulevard is expected to grow by 10 and 40 percent, respectively, by the year 2000.

  - Year 2000 traffic along Johnson Creek Boulevard between McLoughlin and 45th is expected to grow 5-11 percent from 1980 with no improvement of the McLoughlin/Tacoma intersection.

  - Year 2000 traffic on Johnson Creek Boulevard is expected to grow another 9-18 percent above the No-Build condition with a full McLoughlin Boulevard improvement, including a flyover at Tacoma, and another 3-4 percent if only Stage I--the Tacoma intersection improvement--is implemented, thus leaving the bottleneck at Ochoco. If an overpass is built with the full McLoughlin Boulevard improvement, year 2000 traffic is expected to grow 6-9 percent higher than with a flyover.

  - Traffic on Johnson Creek Boulevard serves local destinations. If Johnson Creek Boulevard itself does not provide an adequate route from McLoughlin Boulevard, alternate access routes to the same area such as Holgate, Bybee, 39th and King-Harrison will be used.

- I-205 Traffic Growth - By 2000, it is expected that traffic volumes on I-205 will increase 160 percent from 1980, illustrating the very heavy traffic demand I-205 is expected to carry, while McLoughlin Corridor traffic will increase only 35 percent.

Staging of Highway and Transit Improvements: The analysis of corridor demand today and in the year 2000 has led to an evaluation of corridor demand for intervening years. This corridor growth affects the need for and timing of various phases of the proposed McLoughlin highway project and expansion of transit service in the corridor. To examine this, two extremes of transit growth were reviewed: first, assuming a slow expansion in transit ridership, with major increases occurring after 1995; and second, a rapid expansion in transit ridership, occurring just after 1990. Based on these two extremes of transit expansion, the various stages of the McLoughlin highway project are required as noted below:

McLoughlin Highway Project Stage		Year Travel Demand Requires Project: With a Late Expansion In Transit	Year Travel Demand Requires Project: With an Early & Rapid Expansion In Transit
Stage 1:	Tacoma	Now	Now
Stage 2:	River Road to Tacoma	Now	Now
Stage 3B:	Powell to Harold	1991	1999
Stage 4:	Harold to Ochoco	1993	2001

Major conclusions of the staging analysis are:

- Stages 1 and 2 of the highway project (Tacoma and Highway 224 to Tacoma) are tied to meeting existing corridor demand. The timing of these two stages does not rely on growth in corridor travel or changes in travel habits (i.e., auto to transit shifts). Therefore, decisions on these two project stages can be made independent of transit.

- Stage 3A (Union-Grand viaduct) is tied to construction of the Marquam ramps project.

- Stage 3B (Powell to Harold reversible lane), Stage 4 (Harold to Ochoco widening), and major transit expansion (bus or LRT) are dependent on growth in travel, and their timing is interrelated. Specifically:

  - Early implementation of transit defers the need for highway stages 3B and 4 by five to 10 years.

  - Early implementation of highway stages 3B and 4 inhibits the ability to expand transit ridership by providing high-quality levels of service on McLoughlin Boulevard, and thus reinforces the "slow growth" transit ridership curve.

  - With a "slow growth" transit ridership curve, the improved Ochoco intersection, which controls McLoughlin capacity after stages 1 and 2, is over desirable capacity from 1991 to at least 1998. This will make it difficult to divert Clackamas County to Sellwood Bridge traffic from 17th Avenue to McLoughlin.

1.0 BACKGROUND AND PURPOSE

This paper documents the results of travel forecasts for the southern corridor, focusing on alternative ways of serving travel demand between Portland and Milwaukie. The forecasts are based on new travel-forecasting procedures developed by Metro which detail Clackamas and Multnomah Counties east of the Willamette River. This added detail allows a more refined estimation of future year travel, and allows a more accurate representation of the distribution of trips to different areas of the region, the split of trips between auto and transit travel, and assignment of trips to specific highway and transit facilities.

The forecasts are part of the Regional LRT System Plan, and are used to establish future year ridership estimates for transit system alternatives. These estimates are a key determinant of the feasibility of transit system alternatives. The forecasts also answer questions related to the design capacity of the McLoughlin Boulevard highway improvements and the feasibility of strategies to minimize the infiltration of regional traffic into neighborhoods adjacent to McLoughlin Boulevard. A final use of the forecasts is to establish the overall staging of highway and transit improvements in the corridor. The full package of transportation improvements for the McLoughlin Corridor was established in Metro Staff Report No. 69.

2.0 CHANGES IN CORRIDOR TRAVEL: 1980-2000

Major changes in travel in the southern corridor are expected to occur between 1980 and 2000. These changes are brought about by:

- Continued employment and population growth in Clackamas County; and employment growth in Downtown Portland;
- Continued application of Downtown Portland's parking policies, which when combined with continued downtown employment growth, provides the need for a major expansion of the transit system in the corridor and the region;
- Completion of new highway facilities, including I-205 between Foster Road and Clark County, and the Oregon City Bypass; and
- Improvement of McLoughlin Boulevard, and implementation of projects to reduce regional vehicle trips from infiltrating neighborhoods adjacent to McLoughlin.

This chapter traces some of the major changes resulting from these factors.

Corridor Defined and Analysis Districts

Figure 1 defines two geographical concepts used throughout this paper:

- Analysis Districts: The region has been divided into 18 districts. Information important to this study was then summarized based on these geographical units;
- McLoughlin Corridor: Figure 1 outlines the analysis districts focused on in this paper. These districts provide the overwhelming proportion of McLoughlin Corridor trips.

2.1 Population and Employment Growth

Projections of population and employment figure prominently in determining travel demand in the southern corridor. Figure 2 compares the growth in population, employment, and households for the key districts in the Portland to Milwaukie Corridor. These forecasts are based on Metro's Year 2000 Population/Employment forecasts produced for the Regional Transportation Plan.

In the study area outlined on Figure 2, (Districts 2, 3, and 9-13), population grows by nearly one-third, or 32 percent, and the number of households increase by 43 percent in Metro's 2000 projections. Employment increases even more rapidly, by 57 percent, illustrating

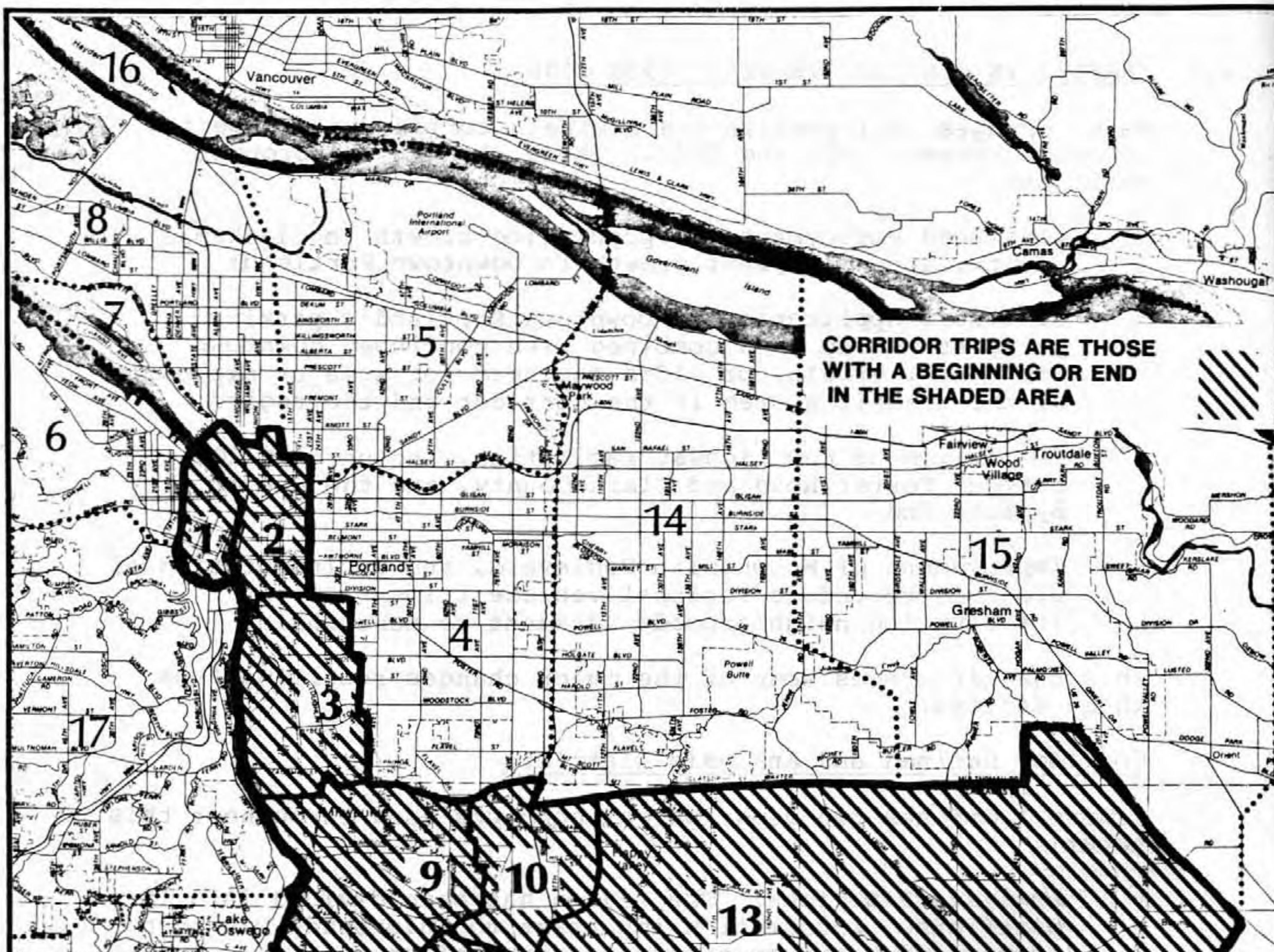

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FIGURE 1: CORRIDOR DEFINITION

AND DISTRICTS FOR ANALYSIS

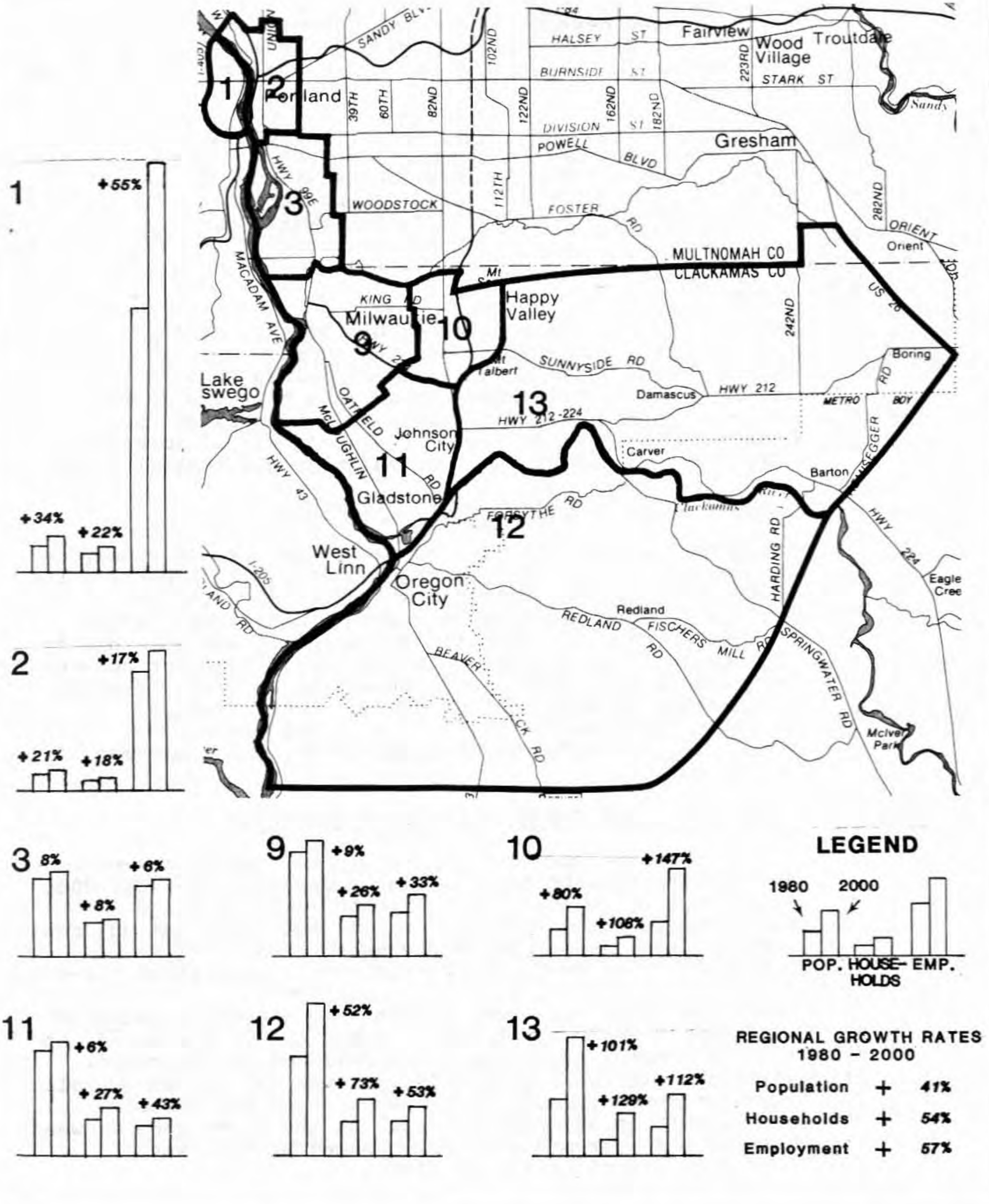

FIGURE 2: SOUTHERN CORRIDOR GROWTH RATES 1980 - 2000

the continued development of employment opportunities in Clackamas County. These changes are detailed on Table 1 for the corridor as a whole and for each district shown on Figure 2.

Table 1 shows the details. The most significant changes in population occur in the area surrounding Clackamas Town Center, District 10, and the area east of I-205, District 13. Major increases in employment occur in Downtown Portland, District 1, Clackamas Town Center, District 10 and the Clackamas Industrial Area, District 13.

2.2 Growth in Trips

Table 2 illustrates the impact of the increased population and employment on trips in the corridor. Trips produced in the corridor increase nearly 48 percent between 1980 and 2000, nearly the same growth rate as shown by the region as a whole. This growth is concentrated in Districts 10 (Clackamas Town Center area), 12 (Oregon City), and 13 (Sunnyside Road, Highway 224 east of I-205).

2.3 Changes in Trip Distribution: 1980-2000

The distribution of travel between districts is summarized on two tables. Table 3 shows the distribution pattern for 1980 and 2000, and illustrates that as shopping and employment opportunities increase in Clackamas County, more trips remain in Clackamas County. Trips internal to the corridor are projected to increase 58 percent between 1980 and 2000. Table 3 also shows the doubling of trips to Multnomah County east of the new I-205 freeway, reflecting the access provided by I-205 and the attractions provided by development of east Multnomah County.

2.4 McLoughlin Corridor Modal Split: 1980-2000

Travel forecasts project a much greater proportion of McLoughlin Corridor travel using transit in the year 2000 than was true in 1980. This growth in transit use minimizes vehicles using McLoughlin Boulevard and adjacent streets, and lessens highway congestion and the infiltration of regional traffic onto neighborhood streets.

Built into this year 2000 analysis is a greatly expanded bus transit network, an improved McLoughlin Boulevard, and traffic constraints through the Sellwood neighborhood. While transit and highway alternatives can affect overall corridor demand, analysis has shown that any effects specific to an alternative--such as the difference between LRT and bus systems--are overshadowed by the overall growth in travel in the corridor.

TABLE 1

SOUTHERN CORRIDOR POPULATION/EMPLOYMENT GROWTH RATES

	District	Population 1980	Population 2000	Population % chg	Employment 1980	Employment 2000	Employment % chg
1:	Downtown Portland	85,115	11,452	+ 34%	78,251	121,638	+ 55%
2:	Inner Eastside	5,684	6,857	+ 21%	35,750	41,870	+ 17%
3:	Sellwood-Moreland	23,266	25,252	+ 8%	21,869	23,216	+ 6%
9:	Central Milwaukie	31,557	34,492	+ 9%	13,520	18,013	+ 33%
10:	Clackamas Town Center Area	8,383	15,092	+ 80%	10,608	26,195	+147%
11:	So. McLoughlin Area	32,878	34,862	+ 6%	8,274	11,823	+ 43%
12:	Oregon City Area	30,834	46,905	+ 52%	10,317	15,774	+ 53%
13:	Clackamas Area	17,627	35,460	+101%	8,957	18,986	+112%
Regional Total		1,137,718	1,602,221	+ 41%	602,581	944,257	+ 57%

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TABLE 2

GROWTH IN TRIP PRODUCTIONS
1980-2000

Trips Produced in District:	1980 Trip Productions	1980 % of Corridor	2000 Trip Productions	2000 % of Corridor	% Growth 1980-2000
3: Sellwood/ Moreland	84,560	18.4%	94,470	13.9%	+ 12%
9: Milwaukie	92,240	20.1%	108,790	16.0%	+ 18%
10: Clackamas Town Center	36,870	8.0%	94,900	14.0	+157%
11: Oak Grove/ Gladstone	102,960	22.5%	120,080	17.7%	+ 17%
12: Oregon City	91,720	20.0%	153,330	22.5%	+ 67%
13: Sunnyside/ Hwy 224	49,870	10.9	108,350	15.9%	+117%
Corridor	458,220	100.0%	679,920	100.0%	+ 48%
Total Region	3,730,630		5,586,240		+ 50%

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TABLE 3

TRIP DISTRIBUTION: 1980-2000
ALL TRIP PURPOSES

Corridor[1] Trips Distributed to:	1980 Trips	1980 Percent Distribution	2000 Trips	2000 Percent Distribution	Percent Change 1980-2000
Internal to Corridor	274,030	59.8%	432,790	63.6%	+58%
Central Portland (1 & 2)[2]	37,790	8.2%	46,650	6.9%	+23%
SE Portland (4)	39,170	8.5%	44,890	6.6%	+15%
North, NE, NW Portland (5, 6, 7, 8, 16)	31,400	6.8%	39,730	5.8%	+26%
SW Portland (17, 18)	30,580	6.7%	37,020	5.4%	+21%
Mid-East Multnomah Co. (14, 15)	23,240	5.1%	46,740	6.9%	+101%
Other	22,020	4.8%	32,080	4.7%	+46%
Total	458,230	100.0%	679,900	100.0%	+48%

[1]Corridor defined as Districts 3, 9, 10, 11, 12, 13.
[2]Refer to Map of Districts, Figure 1.

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This analysis uses procedures developed based on Tri-Met's 1980 origin-destination survey and Metro's 1977 Travel Behavior Survey. Considered is the difference in cost of traveling by transit vs. auto (including auto operating costs, parking costs, and transit fares), together with estimates of future year travel times on the highway and transit systems. Auto occupancy is also evaluated. A major factor in determining transit patronage is the cost of parking in Downtown Portland, which was set to respond to Portland parking and circulation policies.

Shifts between 1980 and 2000 from private autos to transit is most dramatic in the southbound direction during the evening peak hour. Figures 3 and 4 illustrate this growing demand for transit in the McLoughlin Corridor in two locations. Figure 3 compares the highway and transit share of corridor trips north of Tacoma; Figure 4 illustrates the same information south of Tacoma. Detailed information is presented on Table 4.

North of Tacoma Cutline (13th, 17th, McLoughlin)

North of Tacoma Street, considering 13th, 17th, and McLoughlin, southbound evening peak-hour travel demand increases 52 percent between 1980 and 2000--from 5,180 to 7,880 persons. This overall growth in persons moving through the corridor is absorbed more by transit--which is projected to increase 137 percent from 1980--than by vehicles--which are projected to carry 27 percent more persons between 1980 and 2000. This indicates that the growth in transit travel accommodates 61 percent of the total growth in travel demand north of Tacoma Street. Specifically, 1,640 new transit riders as compared to a total of 2,700 new corridor trips. Conversely, 39 percent of the total growth in persons traveling though the corridor is projected to be accommodated by autos on the highway system.

While total trips by persons in autos increase less dramatically than transit trips, a disproportionate increase in auto travel occurs on McLoughlin Boulevard. This is because of the diversion of trips from 17th Avenue in the Sellwood neighborhood. With both diversion from neighborhood streets and traffic growth considered, McLoughlin Boulevard north of Tacoma is expected to carry 46 percent more trips in 2000 than in 1980, as illustrated on Figure 3.

South of Tacoma (17th and McLoughlin)

The same general relationship between highway and transit travel experienced north of Tacoma is illustrated even more dramatically south of Tacoma, as shown on Figure 4. Total evening peak-hour southbound corridor travel

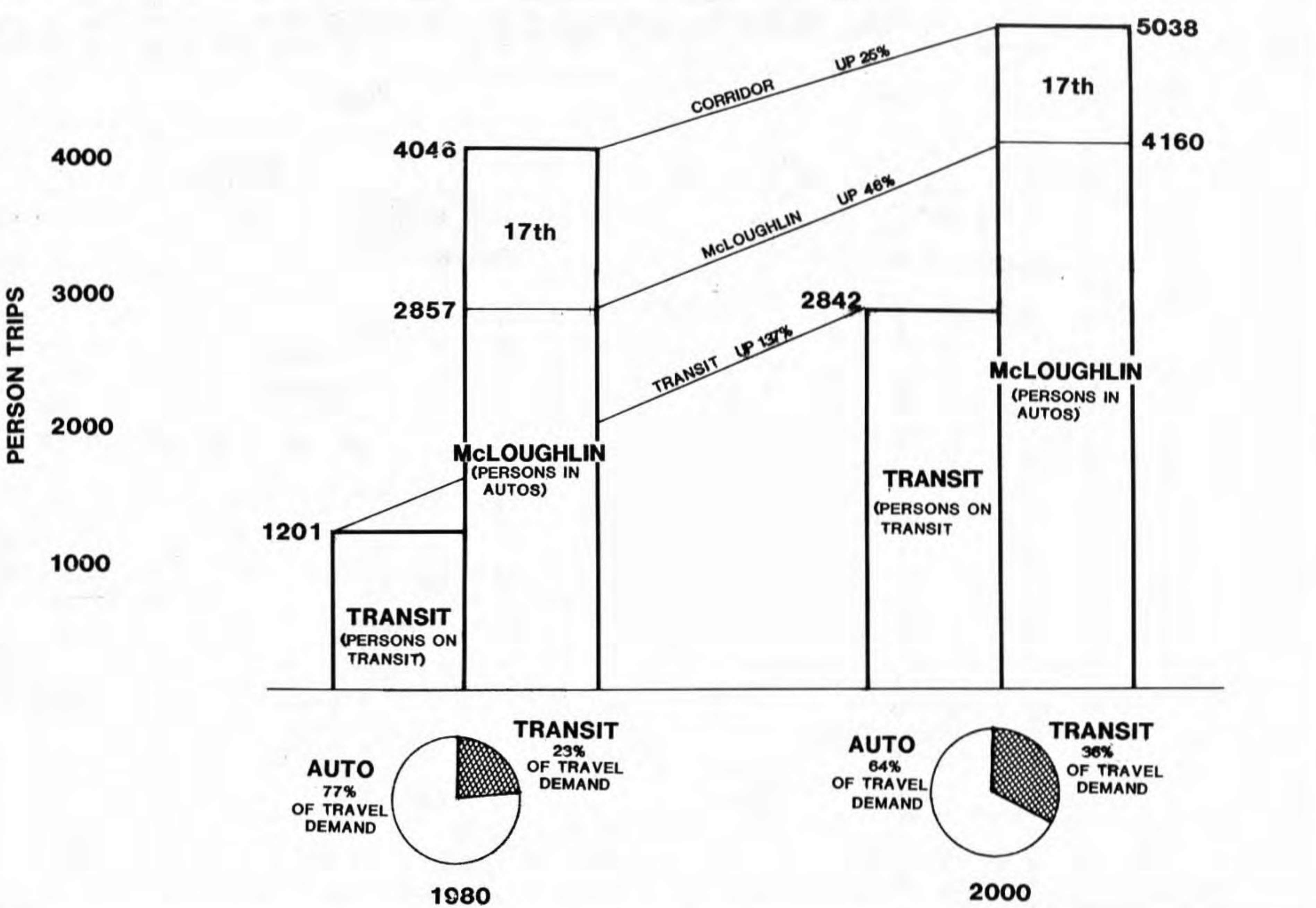

FIGURE 3: McLOUGHLIN CORRIDOR PERSON TRIPS
P.M. PEAK HOUR SOUTHBOUND - NORTH OF TACOMA

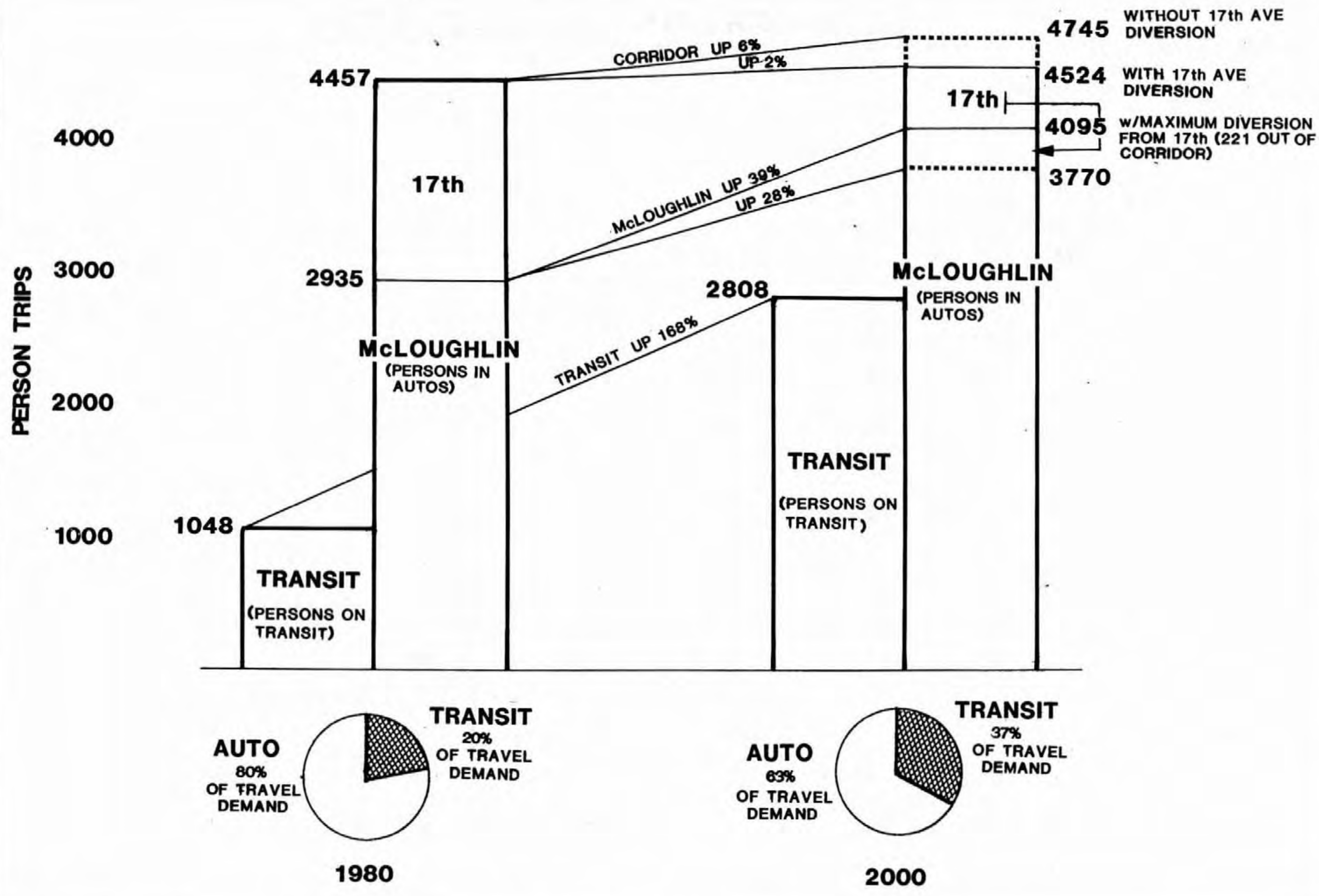

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FIGURE 4: McLOUGHLIN CORRIDOR PERSON TRIPS
P.M. PEAK HOUR SOUTHBOUND - SOUTH OF TACOMA

McLOUGHLIN CORRIDOR TRAVEL DEMAND
P.M. PEAK HOUR/SOUTHBOUND

	1980				2000			
	Vehicle Trips	Auto Persons (x 1.29)	Transit Persons	Total Persons	Vehicle Trips[1]	Auto Persons (x 1.30)	Transit[2] Persons	Total Persons
NORTH OF TACOMA								
McLoughlin	2,215	2,857	947	3,804	3,200	4,160	2,681	6,841
17th	868	1,120	254	1,374	675	878	161	1,039
Total	3,083	3,977	1,201	5,178	3,875	5,038	2,842	7,880
SOUTH OF TACOMA								
McLoughlin	2,275	2,935	845	3,780	2,900-3,150	3,770-4,095	2,653	6,423-6,748
17th	1,180	1,522	203	1,725	330-750	429-975	155	584-1,130
Total	3,455	4,457	1,048	5,505	3,480-3,880	4,524-4,745	2,808	7,332-7,533

[1]Assumes an improved McLoughlin Boulevard.
[2]Basic Bus Network: LRT alternatives vary less than one percent in overall transit modal share.

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increases 37 percent overall, from 5,500 to 7,500, while transit patronage increases 168 percent, from 1,050 to 2,800. Highway travel increases only slightly, growing from 4,460 persons in 1980 and to between 4,520 and 4,730 in 2000. This range of McLoughlin Boulevard trips depends on the amount of highway travel attracted to the corridor. This in turn relates to the diversion of auto trips from 17th.

The large growth projected for transit and the comparatively smaller growth in corridor highway demand indicates that south of Tacoma, 87 percent of the increase in corridor trips is expected to be accommodated by transit. This is somewhat higher than north of Tacoma, and shows the impact of transit service improvements in Clackamas County.

McLoughlin Boulevard auto travel also changes in relation to the diversion of auto trips from 17th. If all north-south traffic is diverted off 17th, McLoughlin highway demand south of Tacoma will grow 28 percent between 1980 and 2000. If, in addition to this, some or all Clackamas County to Sellwood Bridge traffic is shifted from 17th to McLoughlin, vehicles on McLoughlin Boulevard would increase up to 39 percent between 1980 and 2000.

The analysis both north and south of Tacoma illustrates the increasing role of transit in this corridor. If transit's share of the corridor's growth in travel is not accommodated, then additional congestion in the corridor will likely result -- leading once again to the problem of regional trips infiltrating local streets together with increases in the time and cost of travel.

3.0 HIGHWAY SYSTEM EVALUATION

This chapter describes existing and projected traffic in the southern corridor, and attempts to address at least three major issues associated with highway system improvements in the corridor. These issues are:

1. McLoughlin Boulevard Traffic: What is the correct design volume for McLoughlin considering the overall growth in vehicle trips in the corridor; the level of regional traffic to be diverted out of the Sellwood neighborhood; and the degree to which traffic would be diverted to or from other corridors such as Macadam or I-205?

2. Johnson Creek Traffic: With highway improvements at the east and west ends of Johnson Creek Boulevard, will through traffic be attracted to Johnson Creek?

3. Effect of I-205 on McLoughlin Boulevard: What will be the effect of I-205 on McLoughlin Boulevard?

Each of these issues are discussed in the sections which follow. The highway analysis assumed a greatly expanded all-bus network in the corridor. LRT networks were found to have similar ridership, and would not significantly affect highway demand.

3.1 McLoughlin Boulevard Traffic

To define the traffic volume which McLoughlin Boulevard is intended to serve, it is essential to understand the interrelationship between traffic on McLoughlin Boulevard itself and that currently using neighborhood streets to bypass McLoughlin Boulevard. The overall McLoughlin Boulevard Improvement Strategy is intended to serve both growth in travel demand in the corridor as well as reduce--or preferably eliminate--the problem of regional traffic diversion through the Sellwood neighborhood.

Existing and projected traffic demands through the corridor and the traffic "objective" for an improved McLoughlin Boulevard is defined by identifying:

1. the regional traffic that should be diverted out of the Sellwood neighborhood;

2. the degree to which this is possible through neighborhood disincentives; and

3. the degree to which this traffic would be diverted to McLoughlin Boulevard (vs. another corridor such as Macadam, 39th or I-205).

The analysis focuses on two general areas: north and south of Tacoma Boulevard. The portion of the corridor south of Tacoma requires diversion of two very different regional traffic patterns on 17th Avenue (River Road): 1) north-south traffic traveling the length of 17th or Milwaukie Avenue; and 2) Clackamas County to Sellwood Bridge traffic. The portion of the corridor north of Tacoma only involves the first of these two problems.

Analysis

Three year 2000 traffic conditions are described below:

- Level 1 Traffic: Level 1 traffic represents a base level condition with traffic growth on McLoughlin Boulevard north and south of Tacoma together with a partial reduction in traffic through Sellwood. The level of traffic diversion achieved is directly attributable to relieving the capacity bottleneck on McLoughlin Boulevard without additional neighborhood disincentives.

- Level 2 Traffic: Level 2 traffic represents a "feasible" level of traffic diversion from the Sellwood neighborhood and reflects specific disincentives on through traffic. McLoughlin Boulevard must be designed to carry Level 2 traffic at a minimum since it can be demonstrated by travel-forecasting techniques that this neighborhood traffic diversion can be accomplished.

- Level 3 Traffic: Level 3 traffic represents a "desirable" level of traffic diversion from the Sellwood neighborhood. It is based on the assumption that controls on 17th Avenue south of Tacoma could be implemented to route Sellwood Bridge to Clackamas County traffic--and the reverse movement--to Tacoma Boulevard and McLoughlin Boulevard, and off of 17th Avenue.

Figure 5 presents a summary of 1980 traffic and its relationship to Level 1, 2 and 3 traffic demand for the year 2000 south of Tacoma. McLoughlin should be designed to accommodate at least an increase in traffic volume of 38 percent, with one-half of this amount attributable to growth in the corridor and the other half neighborhood traffic diversion. This diversion produces a decrease of 17th Avenue traffic of between 37 and 72 percent. Level 1, 2 and 3 traffic levels are shown as progressive increases on McLoughlin from 2,850 vph to 2,900 vph to 3,150 vph with a corresponding reduction on 17th from 1,180 vph to 748 vph to 330 vph. Finally, the effect of diverting traffic to other corridors is displayed.

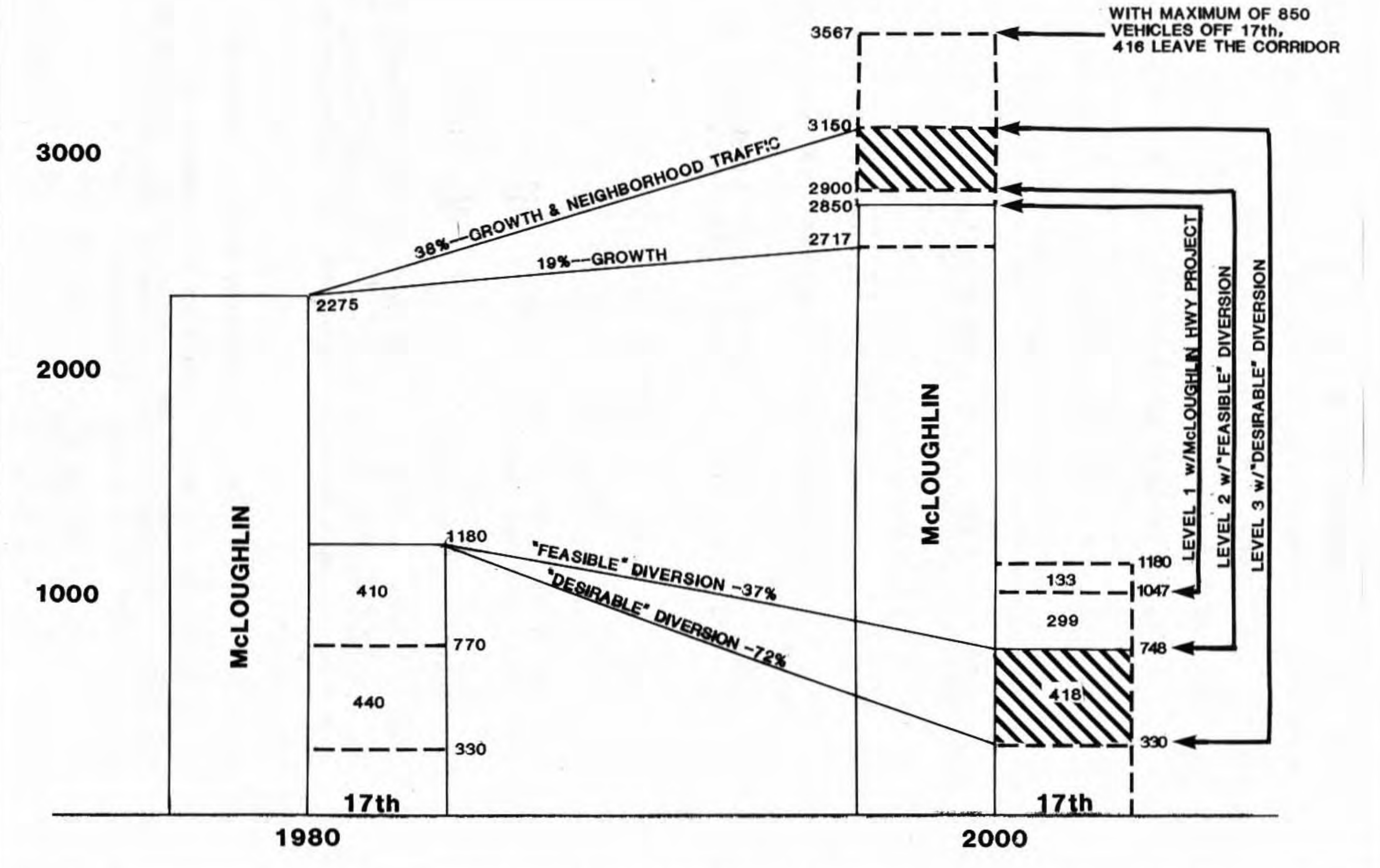

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FIGURE 5: P.M. PEAK HOUR SOUTHBOUND TRAFFIC
McLOUGHLIN AND 17th AVE. SOUTH OF TACOMA ST.

Achievement of Traffic Diversion Objective on 17th Avenue

Achievement of the traffic diversion objective on 17th Avenue is assessed below for two segments of 17th: 1) north of Tacoma, and 2) south of Tacoma.

1. North of Tacoma:

   Existing Southbound Peak-Hour Traffic: 890 vehicles.

   Goal - remove north-south regional traffic from 17th and Milwaukie. This is estimated at 440 vehicles.

Level 1 Traffic: (no disincentives)	$\frac{215\ \text{reduction}}{440\ \text{goal}}$	= 49%
Level 2, 3 Traffic: (disincentives applied)	$\frac{465\ \text{reduction}}{440\ \text{goal}}$	= 105%

2. South of Tacoma:

   Existing Southbound Peak-Hour Traffic: 1,180 vehicles.

   Goal A - Diversion of all north-south traffic: remove 410 vehicles.

   Goal B - Goal A plus diversion of all Clackamas County Sellwood Bridge traffic: Remove additional 440 vehicles.

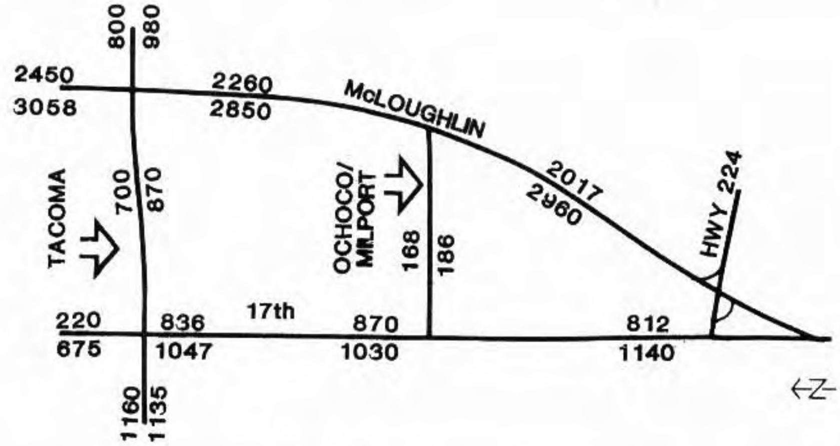
	Goal A	Goal B
Level 1 Traffic: (no disincentives)	$\frac{133}{410}$ = 32%	$\frac{0}{440}$ = 0%
Level 2 Traffic: (feasible diversion)	$\frac{410}{410}$ = 100%	$\frac{22}{440}$ = 5%
Level 3 Traffic: (desirable diversion)		$\frac{440}{440}$ = 100%

Figures 6 and 7 display detailed information for Level 1, 2 and 3 evening peak-hour traffic in the corridor. This traffic data, particularly the turn volumes at Tacoma, is needed to evaluate the capacity of McLoughlin Boulevard.

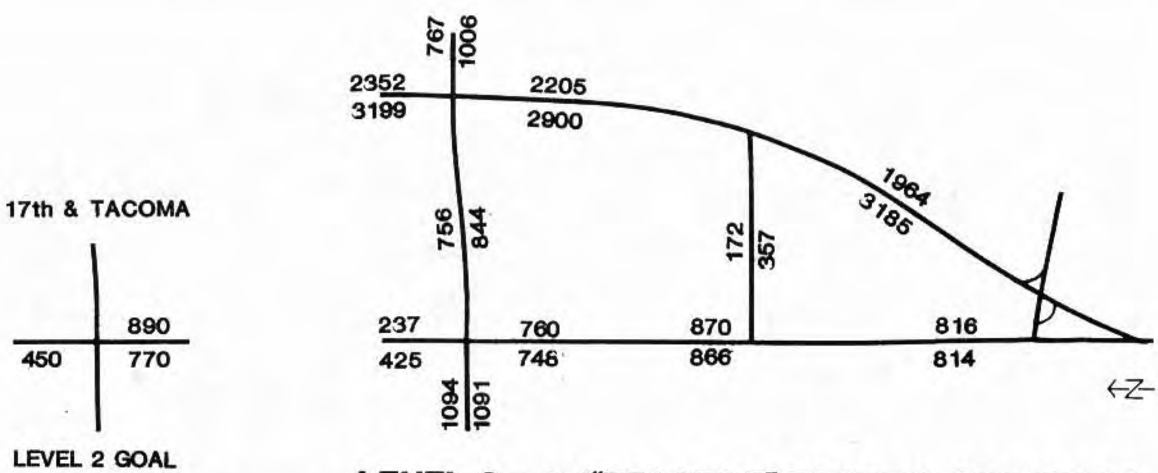
Conclusions

Based on the analysis, the following can be concluded:

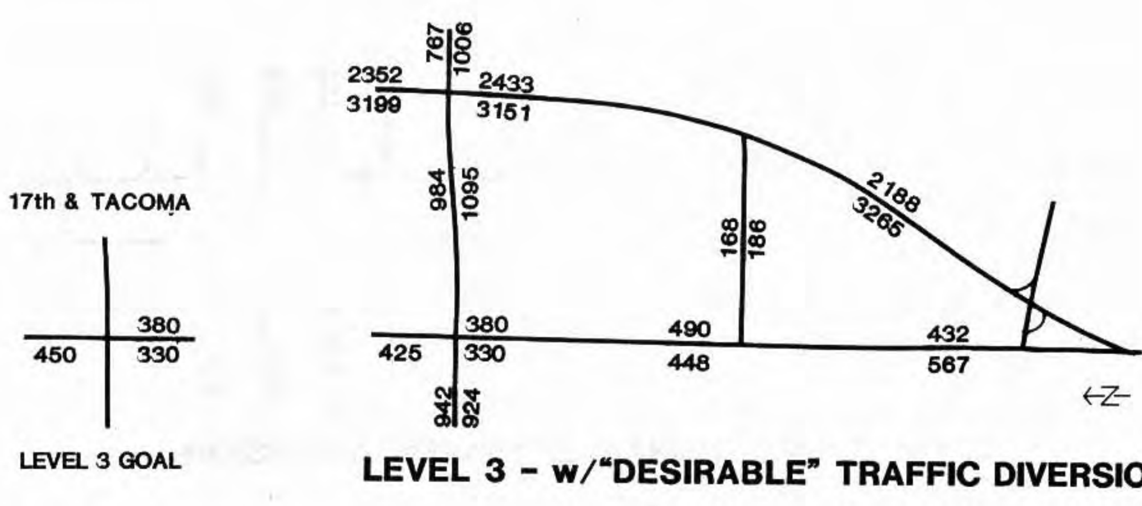
South of Tacoma - Traffic volume on 17th Avenue is currently 1,180 vehicles per hour in the p.m. southbound direction. A reduction to 1,047 vph is readily available simply by improving McLoughlin Boulevard, and an



LEVEL 1 - w/McLOUGHLIN HWY PROJECT



LEVEL 2 - w/"FEASIBLE" TRAFFIC DIVERSION



LEVEL 3 - w/"DESIRABLE" TRAFFIC DIVERSION

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FIGURE 6: **YEAR 2000 P.M. PEAK HOUR TRAFFIC VOLUMES**

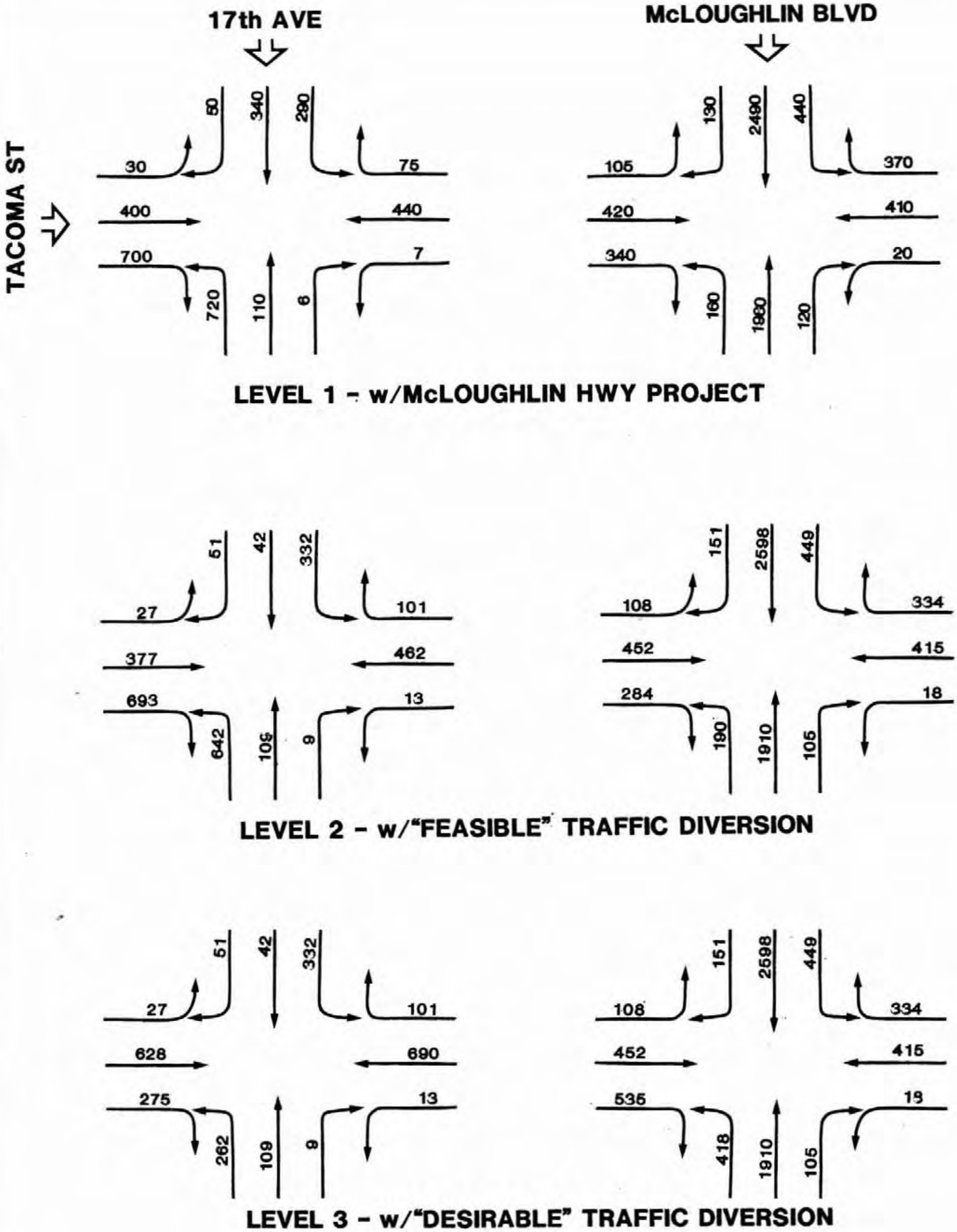

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FIGURE 7: **YEAR 2000 P.M. PEAK HOUR TURNING VOLUMES**

additional reduction to 748 can be achieved through selective neighborhood diversions. Both of these reductions generally affect trips toward central Portland. A further reduction to 330 is desirable to fully eliminate the Clackamas County to Sellwood Bridge traffic from 17th Avenue.

Of the 850 vehicle trips diverted from 17th Avenue, nearly half would leave the 17th and McLoughlin Corridor, while the remainder would shift to McLoughlin Boulevard. In order to meet the project objectives, McLoughlin Boulevard should be improved from today's capacity of 2,275 to a minimum of 2,900 vehicles per hour in the p.m. southbound direction. This would allow reduction of 17th Avenue traffic from 1,180 to 748 and accommodate expected growth in the corridor. A further increase in McLoughlin Boulevard capacity to 3,150 would be desirable to facilitate the full 17th Avenue reduction to 330--reflecting the diversion of Clackamas County Sellwood Bridge traffic from 17th Avenue.

<u>North of Tacoma</u> - Traffic volume on 17th Avenue north of Tacoma is 890 vehicles in the p.m. southbound direction. A reduction to 425 is readily achievable, thereby fully meeting the neighborhood traffic objective. McLoughlin Boulevard capacity should be increased from today's volume of 2,000 vehicles per hour in the p.m. southbound direction to 3,200 to allow the 17th Avenue reduction and to accommodate growth in the corridor.

3.2 Johnson Creek Boulevard Traffic Impacts

The potential for traffic growth on Johnson Creek Boulevard and the degree to which this growth in traffic is attributed to proposed highway improvements is described below. Presented are existing and projected p.m. peak-hour traffic volumes for six highway system alternatives:

1. 1984 traffic.

2. No-Build: year 2000 traffic attributed to development patterns but without any highway improvements on McLoughlin Boulevard.

3. Phase I Flyover: year 2000 traffic patterns assuming only the Flyover is implemented as Stage I of the McLoughlin Boulevard improvement; associated projects include widening the remaining portions of Tacoma Street to four lanes between 17th Avenue and McLoughlin Boulevard and reducing the capacity for through traffic along 17th Avenue through Sellwood. The Flyover is assumed to provide an uncongested intersection for turning movements but retaining the

slow, narrow roadway as Johnson Creek Boulevard proceeds east.

4. Full McLoughlin with Flyover: same as #3 above but with the full completion of the McLoughlin Boulevard project.

5. Full McLoughlin with overpass: same as #4 above but with the overpass option in lieu of the Flyover. The overpass is also assumed to provide an uncongested intersection for turning movements but with a more direct, higher speed connection from McLoughlin Boulevard east to Johnson Creek Boulevard.

6. Relocated Johnson Creek Boulevard: same as #3 and #4 with Johnson Creek Boulevard relocated from McLoughlin Boulevard to 45th.

In each year 2000 alternative, the transit ridership level and the planned interchange at I-205 and Lester Road were held constant. This isolated the traffic effect of the McLoughlin and Johnson Creek alternatives.

General Johnson Creek Traffic Patterns

Johnson Creek Boulevard functions as a "collector" facility, distributing traffic from McLoughlin Boulevard, the Sellwood Bridge, I-205 and 82nd Avenue into the surrounding industrial centers and neighborhoods. Traffic using Johnson Creek Boulevard is limited to destinations within close proximity because of the availability of alternate east-west collectors (Flavel, Woodstock, King-Harrison) and arterials (Highway 224, Powell Boulevard, Foster Road) for through traffic.

Traffic growth on Johnson Creek Boulevard east of 45th is directly attributed to employment growth in the surrounding industrial area. This portion of Johnson Creek Boulevard is expected to realize the greatest traffic increase. As new development occurs, traffic growth will follow, irrespective of planned highway improvements.

Traffic growth west of 45th is also attributed to growth in the corridor, although the route traffic will take to access the neighborhoods and employment areas is affected by the degree to which Johnson Creek Boulevard provides convenient access to McLoughlin Boulevard. If Johnson Creek Boulevard is designed to provide convenient access, traffic will use this route into and out of the neighborhood. If, on the other hand, Johnson Creek Boulevard provides an inconvenient or congested access road from McLoughlin Boulevard, traffic into and out of the neighborhood will begin to seek alternate routes to and from McLoughlin Boulevard such as King-Harrison, Bybee and Holgate depending upon the specific origin and destination. This traffic pattern shift has different impacts at different points between McLoughlin Boulevard and 45th Avenue. As traffic capacity is constrained west of 32nd Avenue, some of the traffic destined to and from 32nd Avenue and 42nd Avenue will enter and leave the neighborhood via 45th Avenue (from the east) rather than via McLoughlin Boulevard (from the west). Conversely, as traffic shifts toward an improved McLoughlin Boulevard, a portion will shift away from 45th Avenue (see Table 7).

Projected Household and Employment Growth

The major cause of traffic growth in the Johnson Creek Corridor is residential and employment growth in adjacent areas. Due to the barrier effect of Johnson Creek, the Portland Traction Railroad along Johnson Creek and the Southern Pacific Railroad along McLoughlin Boulevard, few routes are available into the neighborhood and nearby employment centers. As such, as development occurs, traffic growth will follow. As shown in Table 5, the traffic forecasts presented in this paper assume a 10 percent growth in households and a 40 percent growth in jobs. A majority of this development occurs east of 45th Avenue. If this level of development is higher or lower, traffic growth will be higher or lower accordingly.

TABLE 5

PROJECTED HOUSEHOLD AND EMPLOYMENT GROWTH
IN THE JOHNSON CREEK CORRIDOR

Area	Households			Employment			Combined
	1980	2000	%	1980	2000	%	Growth
McLoughlin to 45th	5,800	6,070	5%	4,400	5,140	17%	10%
45th to 82nd	2,440	2,960	21%	2,670	4,760	78%	51%
CORRIDOR TOTAL	8,240	9,030	10%	7,070	9,900	40%	24%

1984/2000 "No-Build" Traffic Comparison

As shown in Table 6, traffic will grow on the segment of Johnson Creek Boulevard between McLoughlin Boulevard and 45th Avenue up to 10 percent by the year 2000 as compared to 1984 assuming no highway improvements in the area. This level of traffic is a "constrained" forecast resulting from congestion in the McLoughlin Corridor inhibiting traffic from accessing the area via Johnson Creek Boulevard. As such, the true traffic demand is not expected to use Johnson Creek Boulevard with part of the traffic choosing instead to use routes such as Holgate, Bybee, 39th and King-Harrison.

TABLE 6

P.M. PEAK-HOUR TRAFFIC GROWTH
1984 VERSUS 2000 NO-BUILD

	1984			2000 - No-Build		
Johnson Creek Blvd.	East Bound	West Bound	2-Way	East Bound	West Bound	% Change
McLoughlin to 32nd	650	460	1,110	675	525	1,200 +9%
32nd to 42nd	540	390	930	585	440	1,025 +10%
42nd to 45th	650	600	1,250	685	640	1,325 +6%

Year 2000 Traffic Comparison: "Flyover" Alternative vs. "No-Build"

As shown in Table 7, full construction of the McLoughlin Boulevard improvement with the "Flyover" alternative results in a 20-22 percent traffic increase above that expected under a No-Build condition in the segment from McLoughlin Boulevard to 42nd. A reduction in westbound traffic in the section from 45th to 42nd occurs as a result of better eastbound access from McLoughlin Boulevard. The increase in eastbound traffic results from traffic not being diverted to other streets since--with the McLoughlin improvement--McLoughlin Boulevard would not be congested.

Also shown in Table 7 is the effect of implementing only Phase I of the McLoughlin Boulevard improvement. Under this condition, a severe bottleneck would remain south of Tacoma (at Ochoco and Milport) and a moderate bottleneck would remain north of Tacoma (the difference due to the fact that more capacity is already available in the northern segment). Under this condition, a portion of the traffic that would otherwise continue south on McLoughlin Boulevard into the King-Harrison/32nd/42nd vicinity would find it more convenient to avoid the McLoughlin/Ochoco bottleneck and use Johnson Creek Boulevard instead. This would result in a traffic level 2-3 percent higher than if the full McLoughlin project (in particular, the Ochoco segment) is ultimately completed.

TABLE 7

P.M. Peak-Hour Traffic Growth
Year 2000 - No-Build vs. Flyover

Johnson Creek Blvd.	No-Build			Flyover With Full Project			Phase I Flyover Only		
	East Bound	West Bound	2-Way	East Bound	West Bound	2-Way % Change	East Bound	West Bound	2-Way % Change
McLoughlin to 32nd	680	525	1,205	870	580	1,450 +20%	910	580	1,490 +3%
32nd to 42nd	585	440	1,025	730	525	1,255 +22%	760	525	1,285 +2%
42nd to 45th	685	645	1,330	685	520	1,205 -9%	715	520	1,235 +2%

Year 2000 Traffic Comparison: "Overpass" vs. "Flyover" Alternative

As shown in Table 8, full construction of the McLoughlin Boulevard project with an "overpass" at Tacoma would result in a traffic increase of 6-9 percent above that expected under a "Flyover" alternative. Again, this would result in traffic not being diverted to other streets to access the area.

TABLE 8

P.M. PEAK-HOUR TRAFFIC GROWTH
YEAR 2000 - FLYOVER VS. OVERPASS

Johnson Creek Blvd.	Flyover			Overpass		
	East Bound	West Bound	2-Way	East Bound	West Bound	2-Way % Change
McLoughlin to 32nd	870	580	1,450	970	610	1,580 +9%
32nd to 42nd	730	525	1,255	810	550	1,360 +8%
42nd to 45th	680	520	1,200	735	540	1,275 +6%

Year 2000 Traffic Comparison: McLoughlin Improvements With and Without Relocated Johnson Creek Boulevard

As shown in Table 9, constructing a relocated Johnson Creek Boulevard from east of McLoughlin Boulevard to 45th produces a 44-67 percent reduction in traffic on the "old"

Johnson Creek Boulevard. The new arterial itself is projected to carry about 1,700 two-way vehicle trips during the p.m. peak hour in the year 2000, representing a 67-85 percent increase in the overall cutline volume in the corridor. This increase in cutline volume represents a diversion of peak-hour vehicle trips from Holgate (-5 percent), Bybee (-17 percent) and King/Harrison (-14 percent) and only a 12 percent increase in through traffic on Johnson Creek Boulevard west of Linwood Avenue.

<u>Summary</u>

1. The number of households and employees within the Johnson Creek area is expected to grow by 10 and 40 percent, respectively.

2. Year 2000 traffic along Johnson Creek Boulevard between McLoughlin and 45th is expected to grow 6-10 percent from 1980 under a No-Build condition.

3. Year 2000 traffic on Johnson Creek Boulevard in the section from McLoughlin Boulevard to 42nd is expected to grow about 20 percent above the No-Build condition with a full McLoughlin Boulevard improvement including a Flyover at Tacoma and another 2-3 percent if Stage I only is implemented, leaving the bottleneck at Ochoco. A 19 percent reduction in westbound traffic from the No-Build on the 45th to 42nd segment of Johnson Creek Boulevard can be expected with the McLoughlin/Tacoma intersection improvements.

4. If an overpass is built with the full McLoughlin Boulevard improvement, year 2000 traffic is expected to grow 6-9 percent higher than the Flyover traffic level.

5. Traffic increases on Johnson Creek Boulevard is destined to locations within the corridor. If Johnson Creek Boulevard itself does not provide an adequate route to access the corridor from McLoughlin Boulevard, alternate access routes such as Holgate, Bybee, 39th and King-Harrison will be used.

6. A relocated Johnson Creek Boulevard arterial will provide significant traffic reduction (44-67 percent) on the "old" Johnson Creek Boulevard, as well as other access routes into the area. As a result, however, the corridor cutline volume will increase 67-85 percent, with the majority (54-76 percent) on the relocated arterial.

3.3 Effect of I-205 on McLoughlin Boulevard Traffic Volumes - Existing and Projected

A traffic evaluation of the effect of I-205 on year 2000 traffic demands between Clackamas and Multnomah Counties is presented below.

Year 2000 travel forecasts are based upon a number of significant assumptions pertinent to the I-205 corridor:

- Growth in travel demand is based upon growth in population and employment as defined in the various local comprehensive plans.

- The proportion of travel demand that is expected to use transit is predicated on a significant expansion in transit service in Clackamas County, and high-speed bus connections from Milwaukie to Portland in the McLoughlin Corridor and from Clackamas Town Center to the Banfield LRT's Gateway station in the I-205 corridor.

- Assignment of peak-hour traffic to the street system is based upon the shortest travel path between various points in the region. This takes into consideration a reduction in speed in locations with traffic congestion.

These factors are described further in Section 2.0. The result of these assumptions in the McLoughlin/I-205 corridor across the Multnomah/Clackamas County line, as shown in Table 9 below and Figure 8, is a 35 percent increase in McLoughlin Corridor traffic and a 160 percent increase in I-205 corridor traffic by the year 2000.

The 160 percent growth in traffic in the I-205 corridor reflects the new development of large areas by the year 2000. In addition, completion of I-205 to its full design will attract a large variety of long-distance trips unrelated to McLoughlin Boulevard.

The result of this traffic growth is a shift in the importance of the two corridors. The condition changes from that of today, where both McLoughlin and I-205 each carry about 40 percent of the corridor demand, to a year 2000 condition where I-205 will carry twice the demand of McLoughlin Boulevard (59 percent vs. 31 percent).

3.4 Corridor Traffic South of Milwaukie

The general traffic pattern outbound from Milwaukie in the p.m. peak hour is expected to increase in total volume by 24 percent between 1980 and 2000. However, the split of traffic between the south McLoughlin Corridor and the

TABLE 9

YEAR 2000 P.M. PEAK-HOUR TRAFFIC
WITH AND WITHOUT RELOCATED JOHNSON CREEK BOULEVARD

Johnson Creek Blvd.	Without New Arterial East Bound	Without New Arterial West Bound	Without New Arterial 2-Way	With New Arterial* East Bound	With New Arterial* West Bound	With New Arterial* 2-Way	% Change
McLoughlin to 32nd							
w/Flyover	870	580	1,450	500	280	780	-46%
w/Overpass	970	610	1,580				-51%
32nd to 42nd							
w/Flyover	730	525	1,255	420	280	700	-44%
w/Overpass	810	550	1,360				-48%
42nd to 45th							
w/Flyover	685	520	1,205	200	200	400	-67%
w/Overpass	735	540	1,275				-67%
New Johnson Creek Blvd.*							
McLoughlin to 45th	0	0	0	1,000	700	1,700	

Effect on Other Streets:

Holgate @ SP RR	-5%
Bybee @ SP RR	-17%
King/Harrison @ 43rd	-14%
Johnson Creek Boulevard @ Linwood	+12%

*Intersects with Johnson Creek Boulevard just south of Johnson Creek Bridge.

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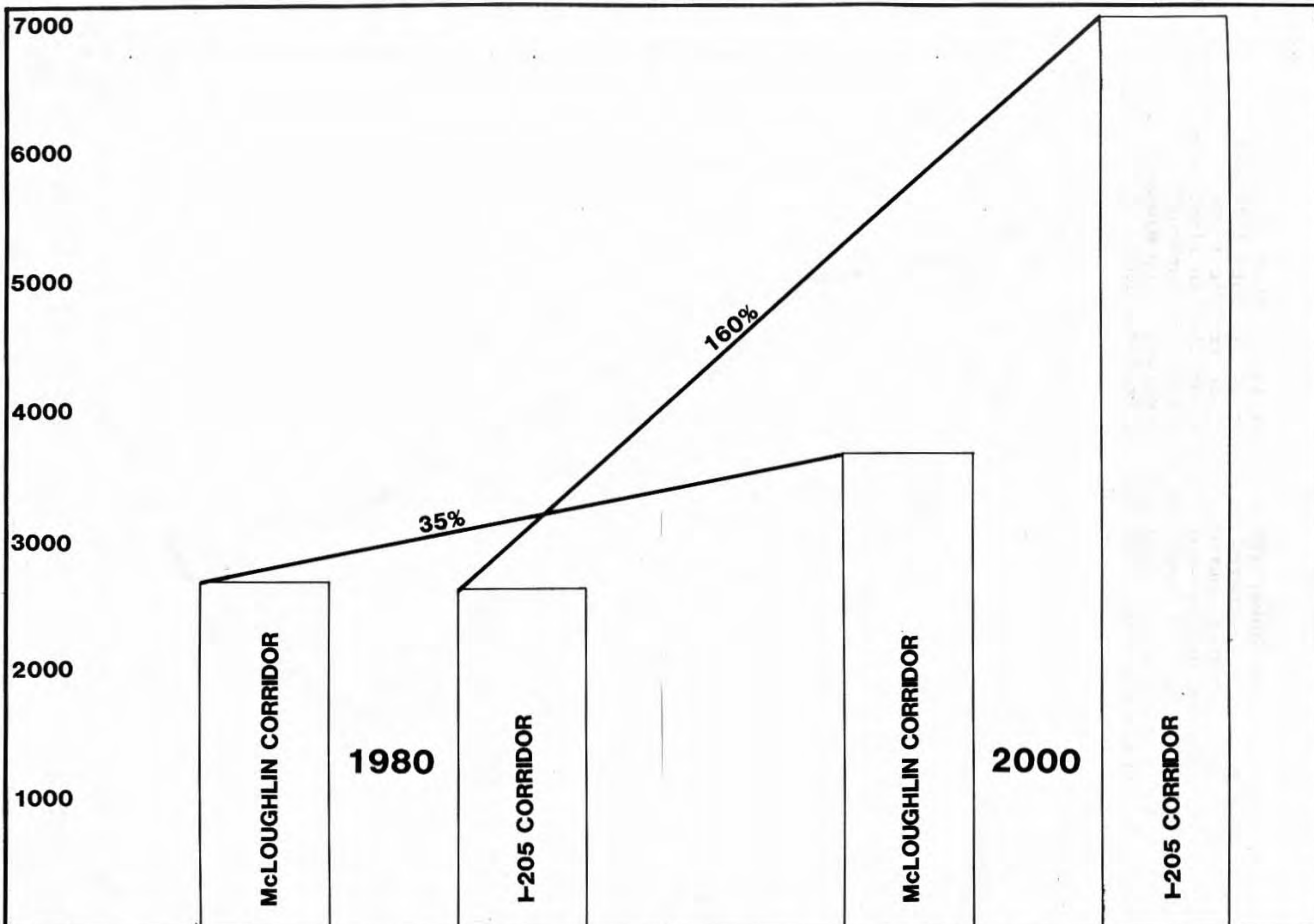
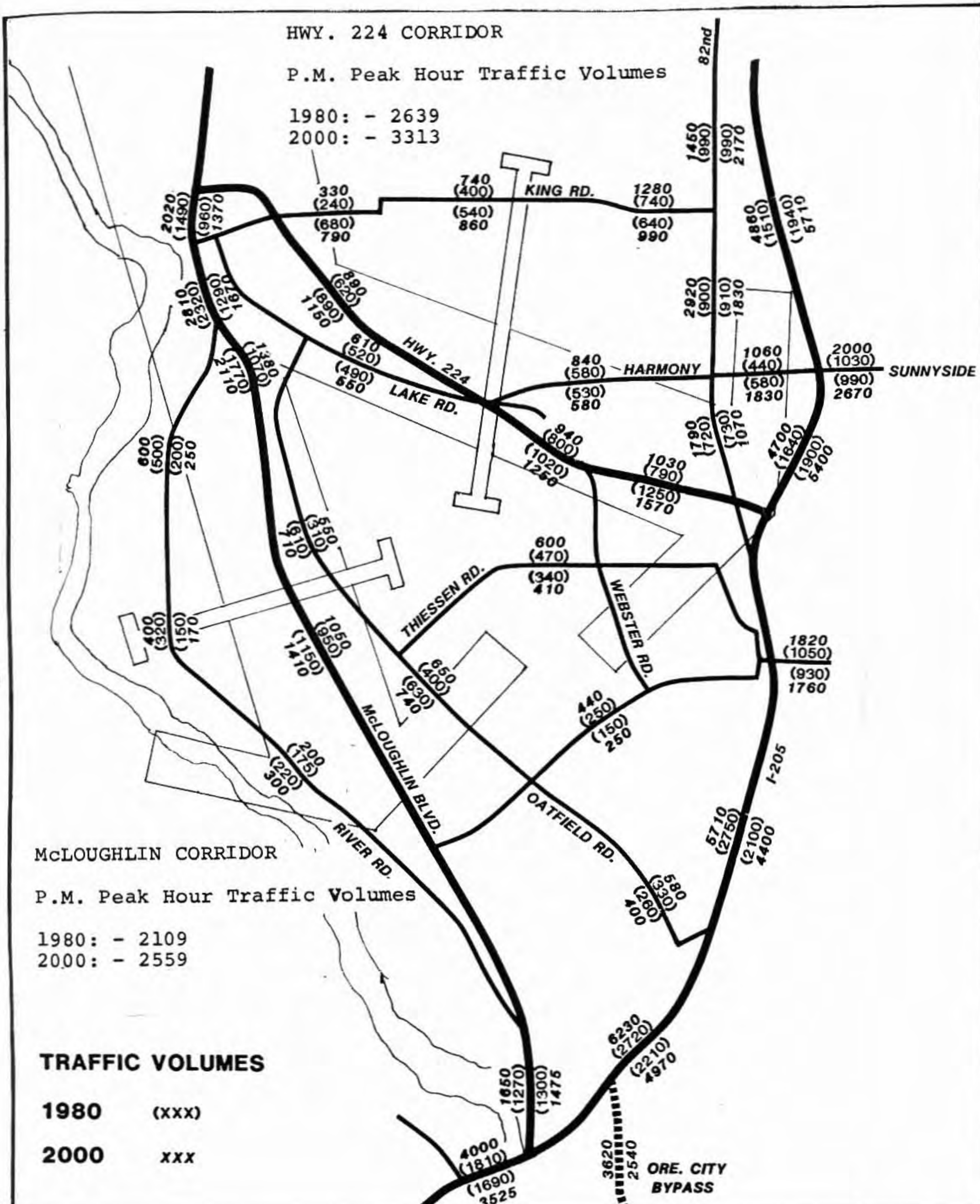


FIGURE 9: McLOUGHLIN/I-205 CORRIDOR SOUTHBOUND P.M. PEAK HOUR TRAFFIC GROWTH

King-Harrison-Highway 224 corridor is expected to remain constant, as illustrated on Figure 9. In both 1980 and 2000, 44 percent of outbound corridor traffic travels south via McLoughlin--splitting eventually to River Road and Oatfield. The remaining 56 percent of outbound traffic travels east from central Milwaukie on Highway 224, King, Harrison, Lake and Railroad-Harmony.



CORRIDOR TRAFFIC SOUTH OF MILWAUKIE **FIG. 9**

4.0 EVALUATION OF TRANSIT SYSTEM ALTERNATIVES

This chapter focuses on travel forecasts for alternative transit systems serving the Milwaukie Corridor. Daily and evening peak-hour ridership is reported for each of the alternatives listed on Tables 10 and 11. Alternatives are compared in two sets: First, as listed on Table 10, alternative Portland to Milwaukie Corridor systems are compared--one bus alternative and three light rail alignments. These focus on different ways to serve the transit demand between Portland and Milwaukie. Second, as listed on Table 11, transit systems with a Central Eastside LRT alignment linking the Milwaukie Corridor to the Banfield LRT and a possible north corridor LRT line are compared.

The forecasts will be used to assess transportation system benefits and to accurately size the system for operating cost estimates and vehicle requirements.

4.1 Role of Transit in the Southern Corridor: 1980-2000

The southern corridor is projected to undergo a reorientation between 1980 and 2000, becoming much more dependent on transit as a mode for accessing central Portland.

Table 12 shows that total corridor transit trips, defined as those trips with either a beginning or end in the area outlined on Figure 1, increase 123 percent between 1980 and 2000, assuming the basic bus network. This increase is from 15,125 trips in 1980 to 33,759 in the year 2000. Table 8 also shows the contribution of individual districts to this overall growth.

Both in 1980 and the year 2000, corridor transit trips are heavily oriented to central Portland destinations, with 64 percent of corridor transit trips attracted to Downtown and the Central Eastside. Table 13 shows the proportion of transit trips attracted to central Portland by district, and illustrates the importance of Downtown as a transit trip attractor.

These figures illustrate the magnitude of transit ridership growth between 1980 and 2000 projected for the corridor and the major increase in transit system capacity necessary to accommodate this growth in transit demand. Changes in transit demand caused by transit system alternatives (i.e., light rail vs. bus) are dwarfed by this overall growth in transit demand. This illustrates the need to expand the corridor's transit capacity significantly as part of an overall strategy for improving mobility in the McLoughlin Corridor.

TABLE 10

SUMMARY OF PORTLAND TO MILWAUKIE
CORRIDOR SYSTEMS EVALUATED

Alternative	Description	Purpose
1. 1980	1980 Highway and Transit Networks	Provides Model Calibration
2. Year 2000	Basic Bus Network: Greatly expanded corridor bus volumes (Figure 10).	Provides the transportation system management (TSM) base case transit analysis, comparison point for LRT alternatives.
3. Year 2000	Portland Traction Company (PTC) LRT Milwaukie to Downtown (Figure 11).	Evaluates the PTC as a "stand-alone" alternative.
4. Year 2000	McLoughlin LRT: Milwaukie to Downtown adjacent to McLoughlin Boulevard (Figure 12).	Evaluates this LRT alignment as a "stand-alone" alternative.
5. Year 2000	Sellwood LRT: Milwaukie to Downtown along 17th Avenue through the Sellwood Neighborhood (Figure 13).	Evaluates this alignment as a "stand-alone" alternative.

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TABLE 11

SUMMARY OF CENTRAL EASTSIDE TRANSIT
ALTERNATIVES EVALUATED

Alternatives and Description			Purpose
1.	1980	Transit and Highway Systems	Provides Model Calibration
2.	Year 2000	Central Eastside bus Route (Union-Grand bus trunk) with the PTC LRT (Figure 23).	Provides a base patronage forecast with which to compare LRT alignments, and to evaluate a Union/Grand bus route.
3.	Year 2000	Central Eastside Connector: As a supplement to a Downtown link (Figure 24).	Determines transit patronage changes by serving Central Eastside and Lloyd Center with a north-south LRT.
4.	Year 2000	Central Eastside Connector: As a replacement for a Downtown link--with a bus shuttle to Downtown (Figure 25).	Evaluates LRT feasibility in the corridor without a direct Downtown connection.
5.	Year 2000	Central Eastside Connector: As a North-South through route to an Interstate Avenue LRT (Figure 26).	Evaluates the patronage gain by a Southern-Northern Corridor through routing.

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TABLE 12

TOTAL 1980 AND 2000
McLOUGHLIN CORRIDOR TRANSIT
TRIPS BY DISTRICT

	District	1980 Trips Corridor[1]	2000 Trips Within the Corridor[1]	Percent Each District Contributed to Total Transit Trip Growth[1]
3:	Sellwood-Moreland	6,520	10,790	22.9%
9:	Central Milwaukie	3,190	6,400	17.2%
10:	Town Center Area	780	4,310	19.0%
11:	South McLoughlin Area	2,650	5,600	15.8%
12:	Oregon City Area	1,350	3,150	9.6%
13:	Clackamas Area	640	3,510	15.4%
		15,130	33,760	100.0%

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1 Includes three categories of trips: (1) Those produced in the district and attracted to the Corridor; (2) Those produced in the district and attracted outside the Corridor; and (3) Those produced outside the corridor and attracted to the District.

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TABLE 13

1980 AND 2000 TRANSIT RIDERSHIP
AND PROPORTION TO CENTRAL PORTLAND

District	1980: Total Transit Trips From:	To Central Portland No.	To Central Portland % of Total	2000: Basic Bus Network Total Transit Trips From:	To Central Portland No.	To Central Portland % of Total
3: Sellwood-Moreland	4,790	3,470	72%	8,730	6,890	79%
9: Central Milwaukie	2,890	1,710	59%	5,560	3,410	61%
10: Town Center Area	540	1,270	50%	2,290	960	42%
11: South McLoughlin Area	2,540	1,590	62%	4,990	2,860	57%
12: Oregon City Area	1,270	650	51%	2,630	1,480	56%
13: Clackamas Area	570	380	66%	2,920	1,910	65%
Subtotal	12,600	8,070	64%	27,120	17,510	64%
Trips from Outside the corridor to the Corridor	2,530			6,640		
TOTAL Corridor Trips	15,130			33,760		

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Milwaukie Transit Center: 1980-2000

The Milwaukie Transit Center is projected to play an increasingly important role as a hub of transit activity for the southern corridor. Growth of transit ridership in the corridor will more than double the number of transit riders passing through central Milwaukie by the year 2000.

In 1980, 1,257 passengers arrived at the Milwaukie Transit Center during the p.m. peak hour. Of those, 738 continued through on the same bus, 116 transferred to other buses and 403 walked to or from central Milwaukie destinations. In the year 2000, assuming the PTC LRT alignment, p.m. peak-hour arrivals at the Milwaukie Transit Center are predicted to total 3,757 passengers. Of those, only 204 continue through on the same bus, 2,015 transfer to other buses while 779 walk to central Milwaukie destinations.

The tremendous increase in transfer activity at this location is caused by two factors: 1) the overall increase in transit ridership in the corridor, and 2) the network design in which the trunk line to Portland--whether bus or LRT--and most bus lines terminate at the Transit Center, requiring timed transfers between bus routes.

On a daily basis, the Milwaukie Transit Center is expected to generate over 10,000 transfers and over 13,500 total passengers by the year 2000. This high level of transit patronage makes central Milwaukie of regional importance as a transit center.

Transit System Capacity: 1980-2000

Each year 2000 transit system evaluated is designed to serve the same overall transit demand, and each provides a very significant increase in person-carrying capacity from 1980. For the all-bus network, this is accomplished through an increase in service frequency and a switch to articulated buses for high-demand routes, such as the Milwaukie to Portland bus trunk route. Taken together, these two factors result in a 94 percent increase in peak-hour capacity and a 63 percent increase in mid-day capacity for those north-south routes serving the corridor, as measured just south of Holgate.

For the portion of the corridor between downtown Milwaukie and central Portland, the basic bus network shows that during the peak hour, transit service levels increase 49 percent over 1980 and 76 percent over 1980 for a typical mid-day hour.

4.2 Ridership of Corridor Transit Alternatives

Four transit networks focused on four different ways of providing trunk line service from the Milwaukie Transit Center to central Portland have been the basis of detailed patronage analysis. The results of this analysis are reported below focusing on two related questions:

1. Does the alternative result in a change in overall corridor ridership?

2. How do the alternative trunk routes serve different districts of the corridor?

4.2.1 Description of Alternatives

The travel forecasts evaluated four networks focusing on the Milwaukie to Downtown Portland trunk route. A detailed listing of routes associated with these networks is included in Appendix A. These four alternatives are:

Basic Bus Network (Figure 10): The basic bus network provides a major increase in bus service. With this network, evening peak-hour southbound capacity, as measured near Holgate, nearly doubles between 1980 and 2000 (up 94 percent). This provides a capacity of 3,930 on 42 buses. Mid-day hourly capacity also increases over 1980 by 63 percent.

The basic bus alternative also includes the following significant changes from the 1980 system:

- Creation of a Milwaukie to Portland trunk using articulated buses at a peak-hour frequency of 2.5 to 3 minutes;

- Development of an "Eastbank" trunk, providing high-capacity/high-frequency service from Milwaukie to the Central Eastside and North Portland;

- Reorganization of the 12th Avenue cross-town line to provide better connections to Northeast and North Portland;

- Provision of service across the Sellwood Bridge, linking the southeast and the southwest, and providing Downtown connections via Corbett Avenue;

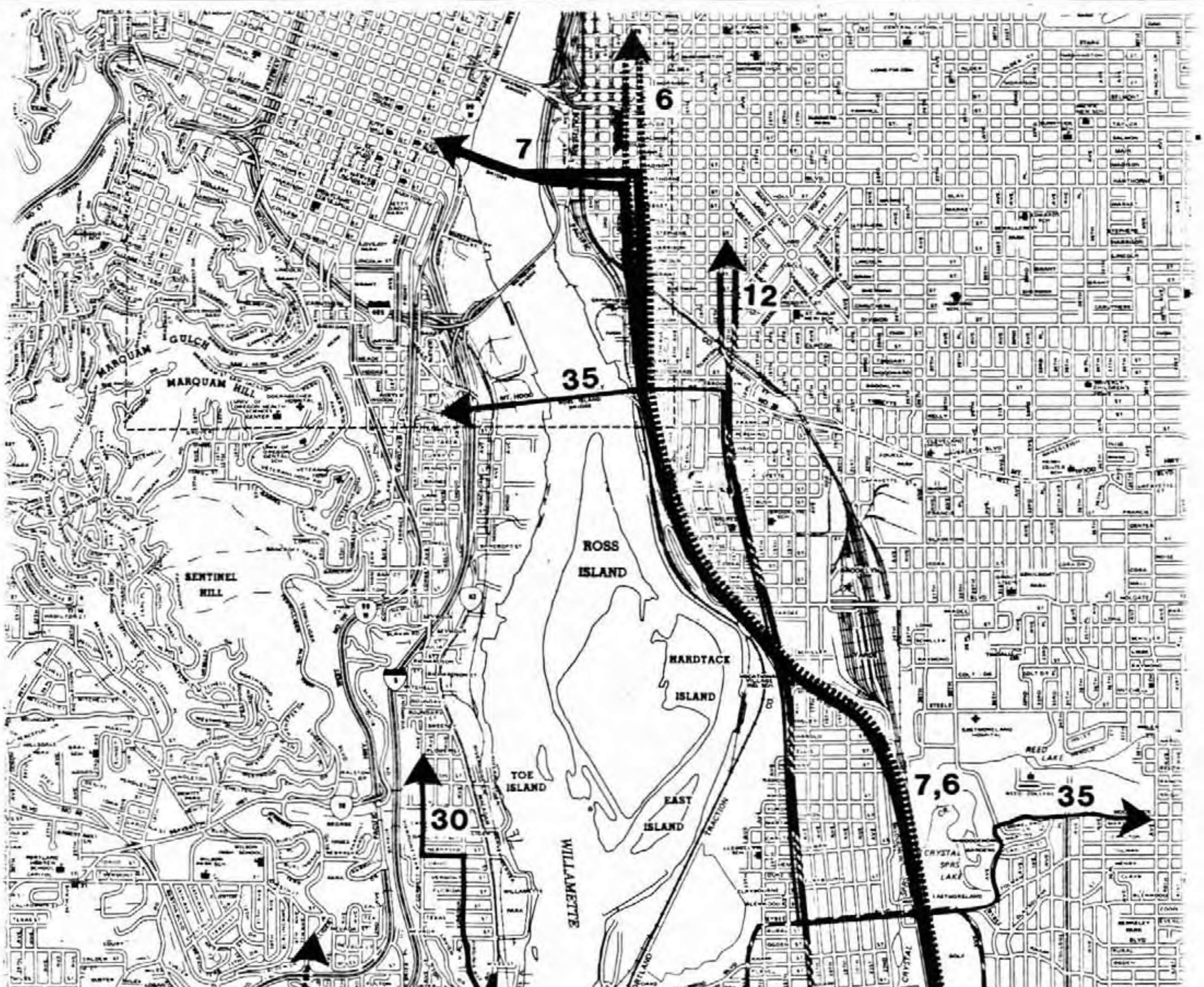

FIGURE 10: **BASIC BUS NETWORK**
IN PORTLAND TO MILWAUKIE CORRIDOR

- Local Sellwood bus service is moved to Milwaukie Avenue and off 17th Avenue--which is downgraded to a local street.

Portland Traction Company (PTC) LRT (Figure 11): The PTC LRT network focuses Portland to Milwaukie service on an LRT trunk route utilizing the existing PTC right-of-way (ROW) for most of its length. The LRT line would provide high-speed service with two-car trains at 7.5-minute headways during peak hours. The line would begin at a park and ride lot immediately south of Milwaukie and end in Downtown Portland, providing stops in downtown Milwaukie (2 stations), McBrod Road; Ochoco Street and McLoughlin; River Road and Ochoco; 13th Street (Golf Junction); the Sellwood Bridge; Oaks Park (an optional or on-demand stop); Ross Island Bridge; and Water Avenue just south of the Hawthorne Bridge. All routes and connections which were part of the basic bus network are provided with only minor routing changes to avoid duplication of service provided by the LRT. Bus transfer opportunities are provided at the Milwaukie Transit Center, the Sellwood Bridge and the Ross Island Bridge. As measured just north of Holgate, the network as a whole provides a p.m. peak-hour capacity of 3,970 on 26 transit vehicles, including light rail vehicles and local buses.

McLoughlin Light Rail (Figure 12): The McLoughlin LRT network is very similar to the basic bus network, except that the Milwaukie to Portland bus trunk is replaced with an LRT line adjacent to McLoughlin Boulevard. This LRT line provides high-speed, frequent service from a park and ride lot south of Milwaukie to Downtown Portland, with stops in Downtown Milwaukie (2), Ochoco, Tacoma Street, Bybee Boulevard, Mitchell Street, the Ross Island Bridge, and Water Avenue just south of the Hawthorne Bridge. The McLoughlin LRT emphasizes high-speed express commuter service with a minimum of stops, with bus transfer opportunities at the Milwaukie Transit Center, Bybee, Mitchell Street at Milwaukie Avenue, and Ross Island Bridge stations. This network provides the same general capacity as the PTC and basic bus networks.

The local bus network for the McLoughlin LRT in the travel forecasts is identical to that for the basic bus and PTC LRT alternatives. The McLoughlin alignment, however, allows the flexibility of re-routing or shortening local bus lines--thus reducing local bus operating costs. On Figure 12, this would primarily affect lines #35 and #36, and

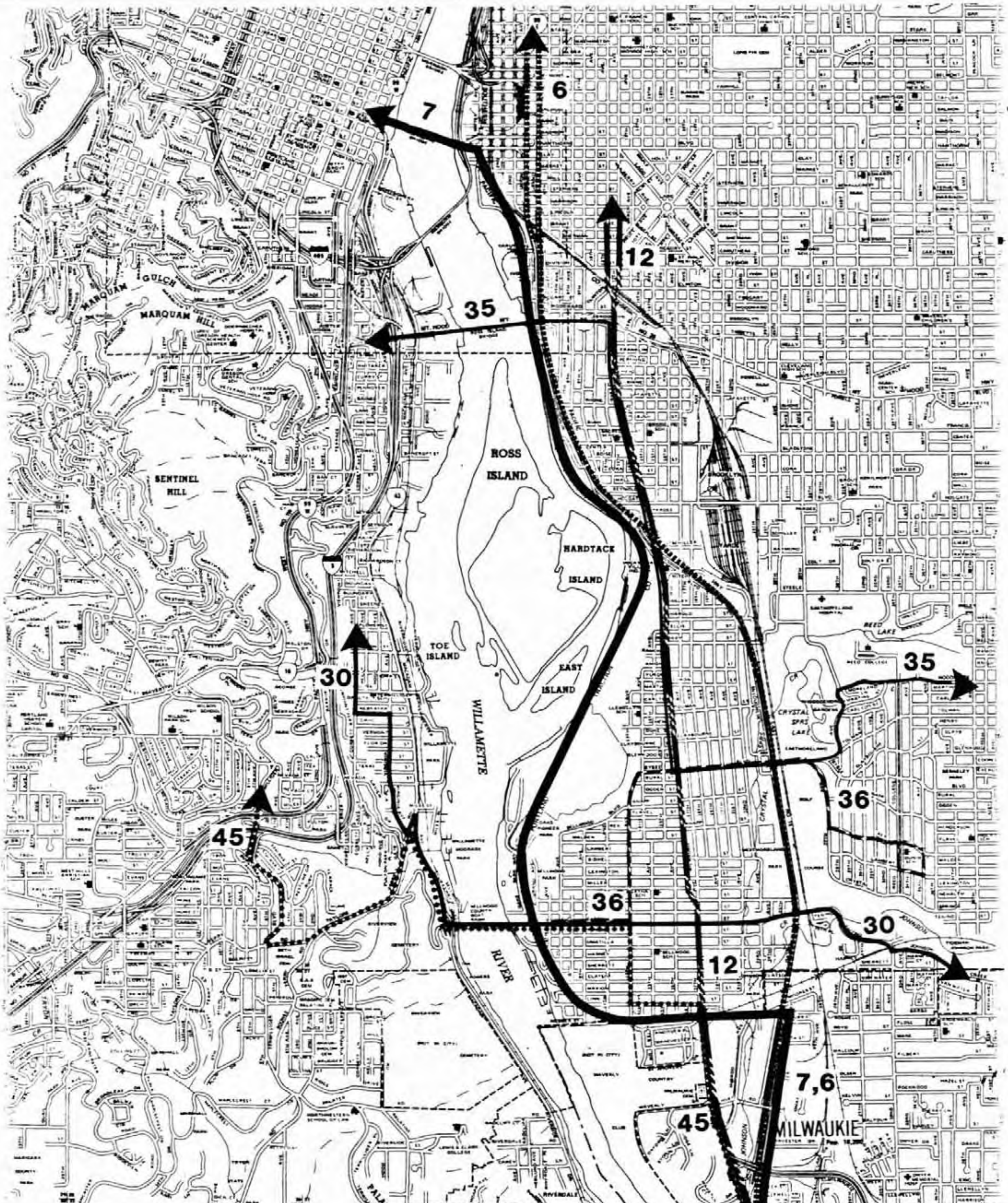

FIGURE 11: **PORTLAND TRACTION CO. (PTC) LRT NETWORK**

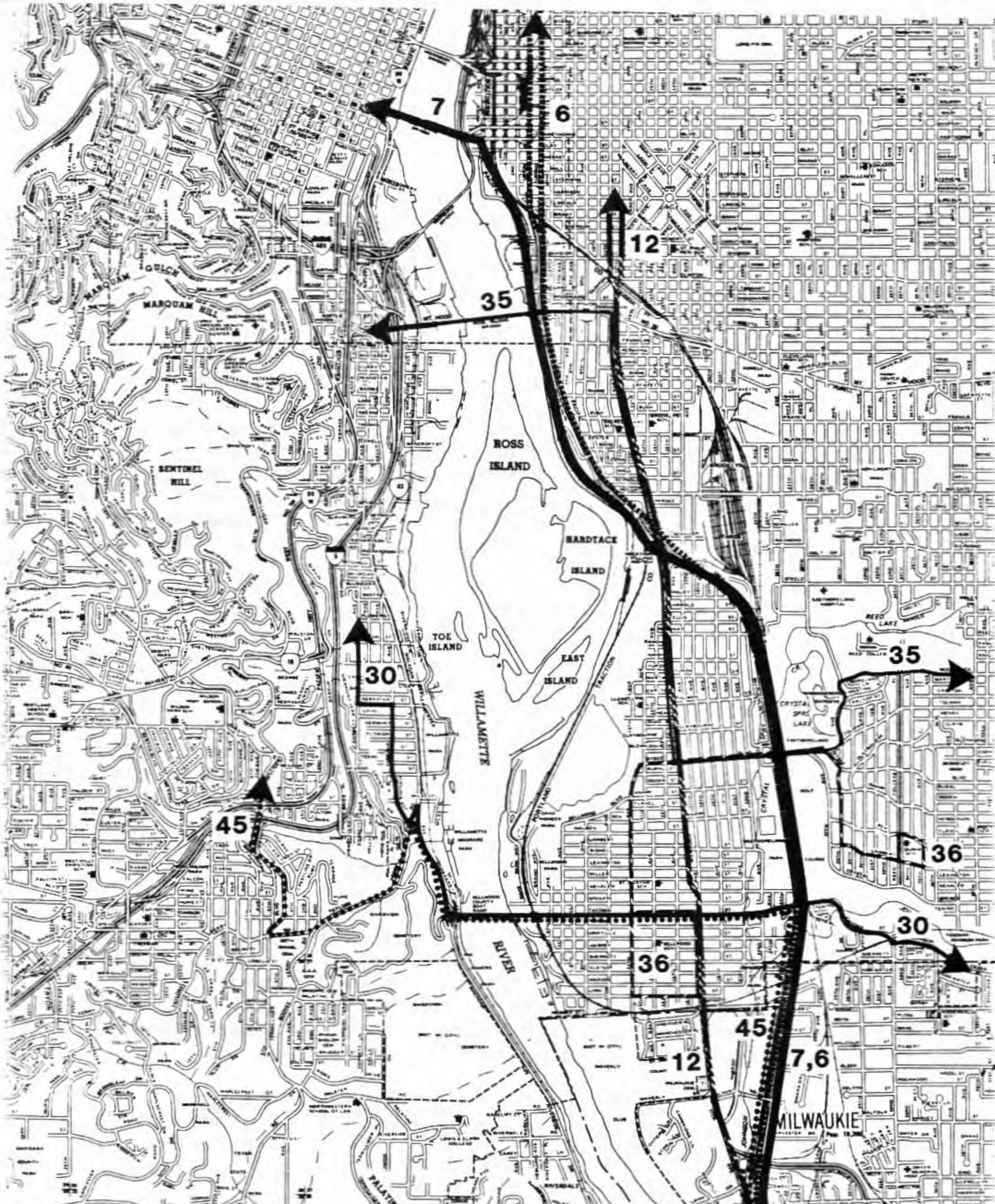

FIGURE 12: McLOUGHLIN LRT NETWORK

possibly others. These changes were not simulated separately, but would be likely candidates for further analysis as part of more detailed study of the McLoughlin LRT.

Sellwood LRT (Figure 13): The Sellwood LRT network focuses the Milwaukie to central Portland trunk route on an LRT alignment providing lower speed and frequent stop service through the Sellwood neighborhood. A total of eight stops would be provided between downtown Milwaukie and the Hawthorne Bridge, compared with five for the McLoughlin and PTC LRT alignments. The central location and increased number of stops are intended to maximize transit service to the Sellwood neighborhood, and provide for the opportunity to shorten or eliminate some Sellwood area bus lines. This is accomplished at the cost of providing somewhat slower service for Clackamas County commuters. The Sellwood LRT network provides a p.m. peak-hour southbound direction capacity of 3,580 just north of Holgate, on a total of 20 transit vehicles.

Clackamas County Service (Figure 14): Service within Clackamas County and throughout the Tri-Met system is the same for all alternatives. Clackamas County service is focused on a timed-transfer center in downtown Milwaukie, with timed-transfer stations also located at Clackamas Town Center and Oregon City. In general, the timed-transfer system pulses at 15 minutes during the peak and 30 minutes in the mid-day.

The background Tri-Met system is an all-bus system with the exception of the Banfield LRT line. The Eastside area is focused on a grid pattern of routes, all operating at 10- to 15-minute intervals thoughout the day. Suburban service is primarily oriented to timed-transfer centers which are linked to central Portland through high-capacity/frequent service trunk lines. A detailed listing of routes, including frequency and type of vehicle assumed, is included in Appendix A.

Travel Times of Milwaukie Corridor Trunk Alternatives: Table 14 shows speeds and travel times for the four Portland to Milwaukie LRT alternatives evaluated.

As shown on Table 14, the McLoughlin LRT is the fastest alternative, traveling from Milwaukie to Pioneer Square in Downtown Portland in 18.8 minutes. The PTC LRT covers the distance in 19.5

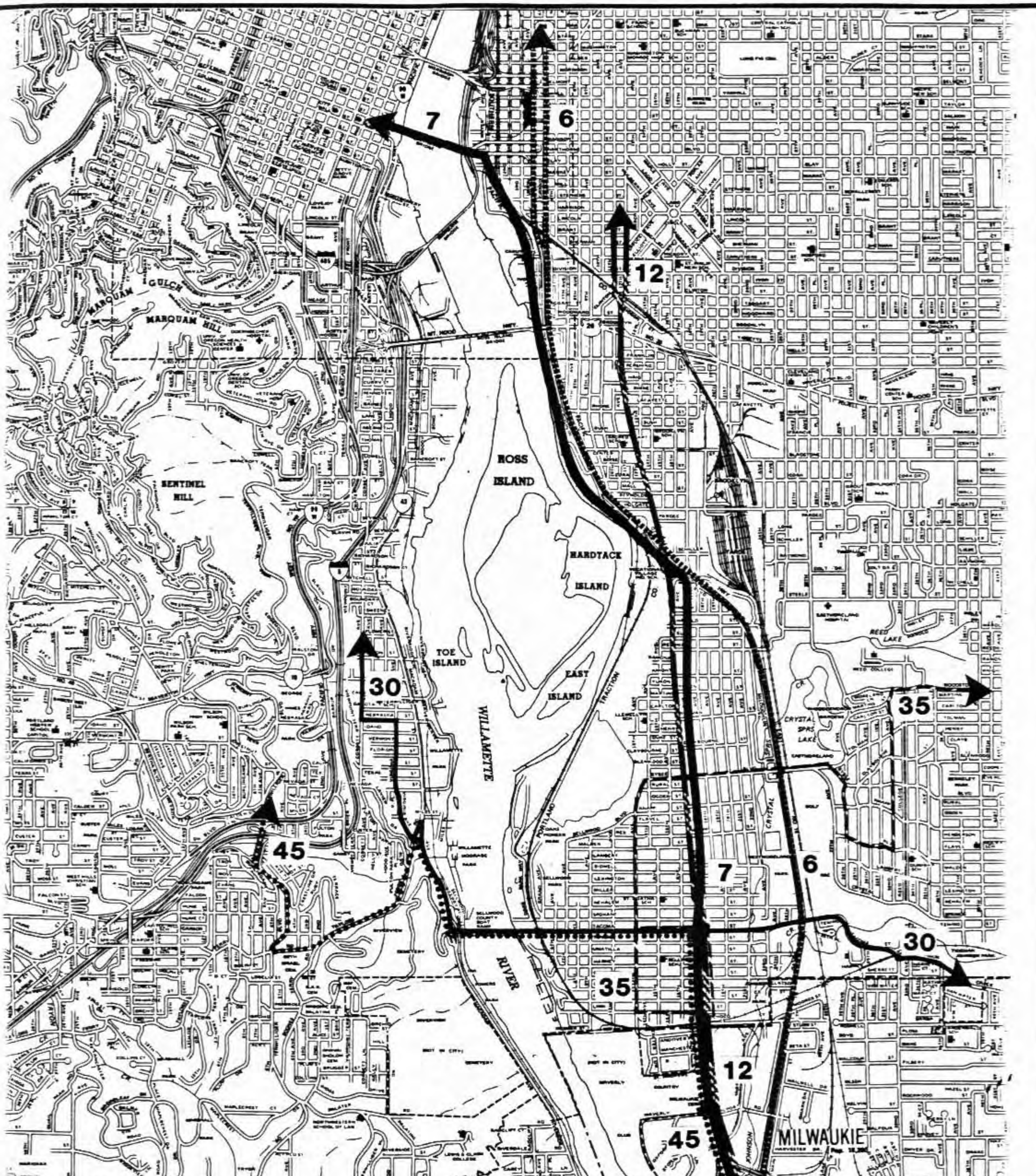

FIGURE 13: SELLWOOD LRT NETWORK

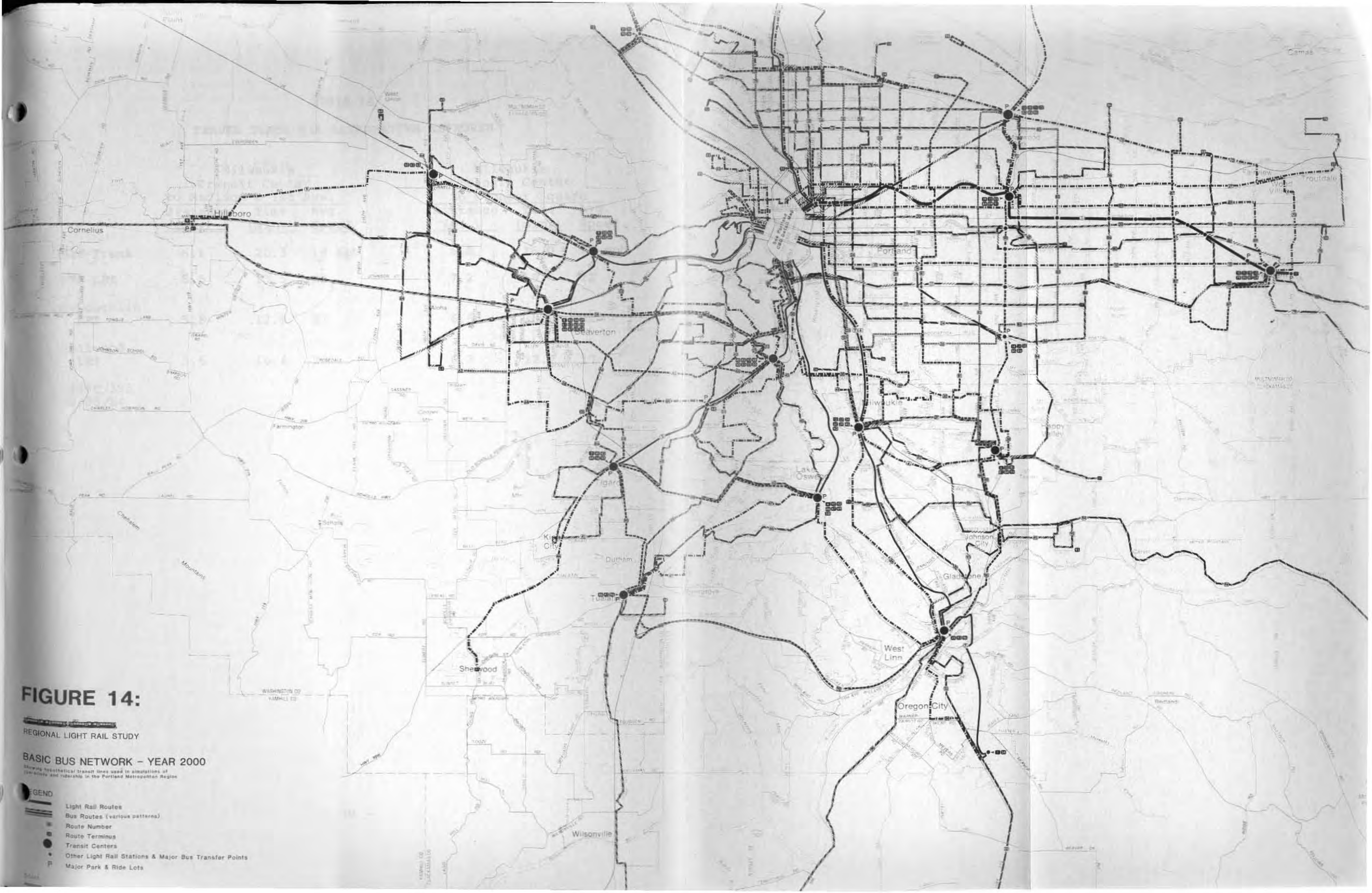

FIGURE 14:

REGIONAL LIGHT RAIL STUDY

BASIC BUS NETWORK - YEAR 2000

Showing hypothetical transit lines used in simulations of operations and ridership in the Portland Metropolitan Region

TABLE 14

TRAVEL TIMES VIA ALTERNATIVE NETWORKS

	Milwaukie Transit Center to Madison & 1st Ave.			Milwaukie Transit Center to Pioneer Square		
	Distance (mi.)	Time (min.)	Avg. Speed	Distance (mi.)	Time (min.)	Avg. Speed
Bus Trunk	6.1	20.3	18 mph	6.8	26.0	16 mph
PTC LRT	6.5	13.5	29	7.2	19.5	22
McLoughlin LRT	5.8	12.9	27	6.5	18.8	21
Sellwood LRT	5.6	16.4	20	6.3	22.2	17

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minutes, the Sellwood LRT 22.2 minutes, and the bus trunk 26.0 minutes. By way of comparison, the 1983 bus schedules show that McLoughlin Boulevard buses travel 22 minutes in the off-peak and 28 minutes in the peak from the Milwaukie Transit Center to 5th and Oak.

Tables 15 through 17 show the LRT speeds for major alignment segments. Major LRT operating assumptions upon which these speeds are based are:

Acceleration: 3 mph/sec.
Deceleration: 3 mph/sec.
Station dwell: 20 sec.
Peak operating speed: 55 mph

The Milwaukie to Portland bus trunk is assumed to travel at 75 percent of the year 2000 highway speed on an improved McLoughlin Boulevard.

4.2.2 Total Riders By Alternative:

Each of the four network alternatives were simulated to determine if changes in travel time or access to the trunk route would result in any major changes in transit patronage. The results of the patronage analysis are displayed in two forms, and discussed below:

Daily Corridor Transit Patrons: Table 18 compares the total corridor transit trips produced by each of the four alternatives. Trips are shown for each major district defined as part of the corridor defined on Figure 1. In total, patronage changes less than 1 percent between the highest patronage alternative--McLoughlin LRT--and the lowest patronage alternative--Sellwood LRT.

P.M. Peak-Hour Transit Assignment Screenlines: Figure 15 displays screenline volumes of transit riders on all routes serving Sellwood or the Milwaukie Transit Center, and also illustrates that there is little difference between alternatives in their ability to attract patrons in the corridor. In this analysis, Figure 15 shows that, at the Holgate cutline, there is less than a 3 percent difference between the highest and lowest alternative. Nearly all of this 3 percent difference is because the basic bus network assigns slightly more peak-hour riders to the Corbett/Sellwood Bridge bus line rather than the McLoughlin Corridor trunk line as happens with the higher speed LRT alternatives.

TABLE 15

PTC LRT SPEEDS

Segment	Distance (mi.)	Peak Speed	Average Speed	Time (sec.)
Pioneer Square to 1st/Madison	.68	12 mph	5 mph	348
1st/Madison to Water	.55	35	23	84
Water to Ross Island Bridge	.78	45	28	100
Ross Island Bridge to Oaks Park*	2.14	55	51	152
Oaks Park to Sellwood Bridge	.68	55	32	77
Sellwood Bridge to Goff Junction	.64	40	23	98
Goff Junction to River Road	.28	45	17	61
River Road to Ochoco	.45	45	22	75
Ochoco to Millport	.40	45	21	70
Millport to Harrison	.38	45	20	69
Harrison to Milwaukie Transit Center	.21	25	22	35
	7.19			1,169 (19.4 minutes)

*No Stop: Add 46 sec. if stop assumed.

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TABLE 16

MCLOUGHLIN LRT SPEEDS

Segment	Distance (mi.)	Peak Speed	Average Speed	Time (sec.)
Pioneer Square to 1st/Madison	.68	12 mph	5 mph	348
1st/Madison to Water	.55	35	23	84
Water to Ross Island Bridge	.83	45	31	97
Ross Island Bridge to 17th/Milwaukie	1.21	45	32	135
17th/Milwaukie to Bybee	1.06	45	31	123
Bybee to Tacoma	.64	45	26	89
Tacoma to Ochoco	.47	45	22	76
Ochoco to Millport	.40	45	21	70
Millport to Harrison	.38	45	20	69
Harrison to Milwaukie Transit Center	.21	25	22	35
	6.43			1,126 (18.8 minutes)

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TABLE 17

SELLWOOD LRT SPEEDS

Segment	Distance (mi.)	Peak Speed	Average Speed	Time (sec.)
Pioneer Square to 1st/Madison	.68	12 mph	5 mph	348
1st/Madison to Water	.55	35	23	84
Water to Ross Island Bridge	.83	45	31	97
Ross Island Bridge to 17th/Milwaukie	1.21	45	32	135
17th/Milwaukie to Reedway	.36	20	15	89
Reedway to Tolman	.30	20	14	78
Tolman to Bybee	.25	20	13	69
Bybee to Lambert	.38	20	15	92
Lambert to Tacoma	.28	20	14	74
Tacoma to Ochoco	.40	25	18	82
Ochoco to Waverly	.40	35	20	73
Waverly to Harrison	.49	35	21	83
Harrison to Milwaukie Transit Center	.17	35	20	30
	6.3			1,334 (22.2 minutes)

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TABLE 18

YEAR 2000 CORRIDOR[1] TRANSIT TRIPS BY ALTERNATIVE

District	Basic Bus Network	PTC LRT	McLoughlin LRT	Sellwood LRT
3: Sellwood-Moreland	10,790	10,850	10,770	10,750
9: Central Milwaukie	6,400	6,370	6,460	6,370
10: Clackamas Town Center	4,310	4,300	4,330	4,310
11: South McLoughlin Area	5,600	5,560	5,690	5,620
12: Oregon City Area	3,150	3,210	3,240	3,150
13: Clackamas Area	3,510	3,550	3,550	3,520
TOTAL	33,760	33,840	34,040	33,720

[1]All trips with either a beginning or end in the corridor.

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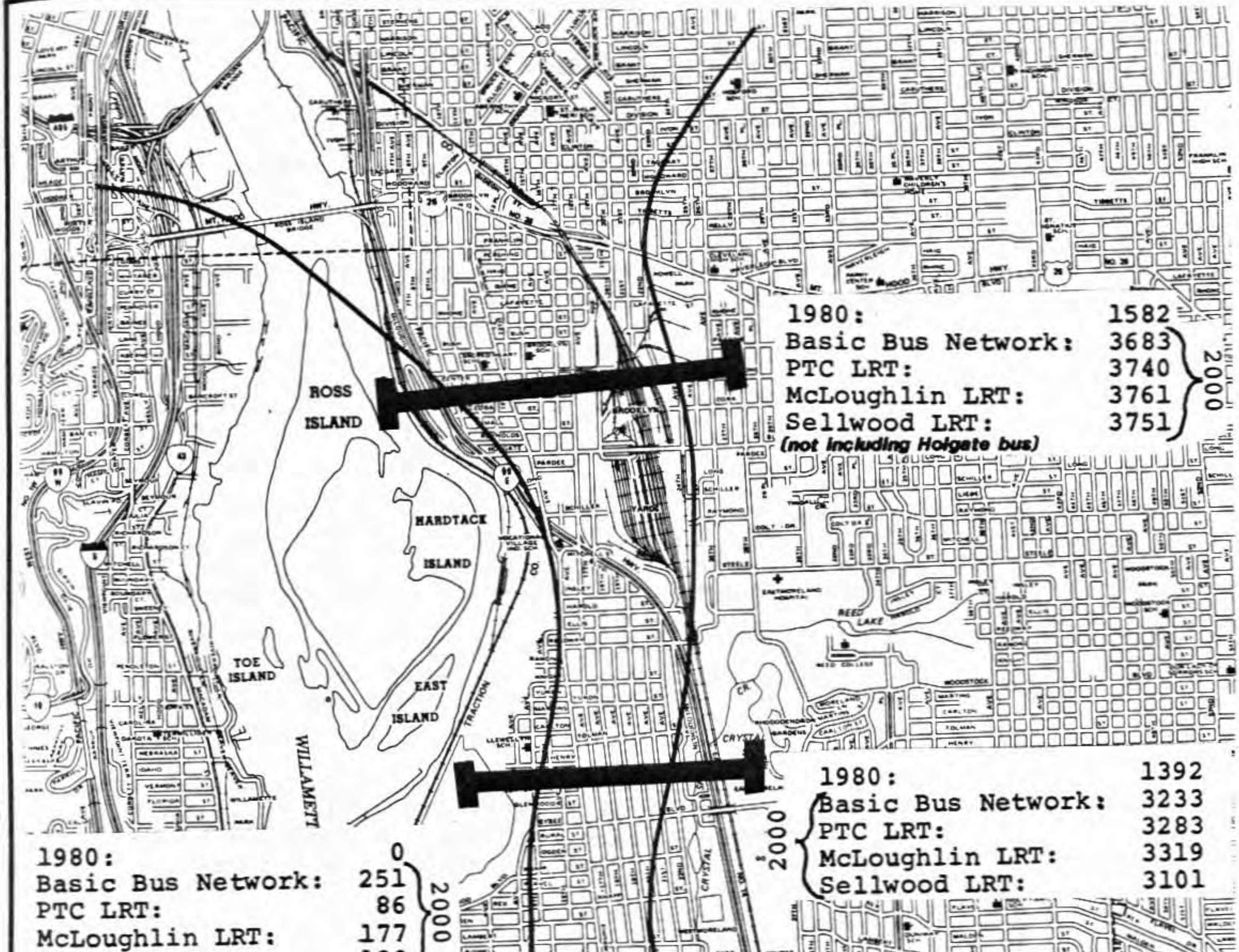

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FIGURE 15: P.M. PEAK HOUR /PEAK DIRECTION CUTLINE TRANSIT RIDERS
1980 & 2000 BY ALTERNATIVE

4.2.3 Trunk Route Riders By Alternative.

While corridor ridership changes very little between trunk route alternatives, these trunk routes do serve different transit markets. For example, the PTC LRT serves the south end of Sellwood and Clackamas County commuters well, but not the Sellwood/Moreland District north of Tacoma. The differences in local access to the trunk routes under evaluation results in differing use of the LRT or trunk route for each district and for the route as a whole, as shown on Table 19. Overall, Table 19 shows that the McLoughlin LRT attracts the greatest number of LRT riders and the PTC the lowest, with most or all of that difference resulting from the McLoughlin LRT's ability to provide walk and bus transfer access to the Sellwood/Moreland and East Moreland areas (Districts 3 and 4). The Sellwood LRT also attracts a greater LRT ridership in Districts 3 and 4, but attracts somewhat fewer Clackamas County commuters.

Table 20 displays daily ridership estimated for each of the LRT alternatives, and compares that to the total daily transit trips in the corridor.

Transit trunk route ridership between Milwaukie and central Portland, as well as ridership on transit routes providing parallel local or feeder service, is shown for the evening peak hour on Figures 16 through 19.

4.2.4 LRT Station Volumes

Passenger flows and total station volumes for each LRT alternative are shown on Figures 20 through 22. In each alternative, the Milwaukie Transit Center is by far the most heavily used station on each alignment, providing over 80 percent of each alignment's total patronage.

Each of the three alignments assume a station at the Ross Island Bridge--which is likely to be expensive and difficult to construct. Each alignment loses between 700 and 850 daily riders if the Ross Island Station is not developed. Specifically, the PTC LRT would lose 820 daily patrons, the McLoughlin LRT would register a daily loss of 840, while the Sellwood LRT would lose 720 if the Ross Island Station is not built.

TABLE 19

YEAR 2000 PM PEAK-HOUR TRUNK LINE
RIDERS BY ALTERNATIVE

	Basic Bus Network (McLoughlin Bus Trunk)		PTC LRT		McLoughlin LRT		Sellwood LRT	
	#	%	#	%	#	%	#	%
3: Sellwood-Moreland	90	3.0	280	9.7	420	15.3	620	19.7
4: SE Portland	70	2.2	10	.4	180	5.3	90	2.9
9: Central Milwaukie	1,050	34.9	1,010	35.3	1,050	30.8	960	30.4
10: Clackamas Town Center	150	4.8	150	5.3	160	4.6	100	3.1
11: South McLoughlin	1,070	35.9	920	32.0	930	27.4	900	28.4
12: Oregon City Area	120	4.1	80	2.8	90	2.5	80	2.5
13: Clackamas Area	90	3.1	80	2.9	90	2.7	70	2.2
Others:	350	11.8	330	11.6	390	11.4	340	10.8
TOTAL	2,990	100.0	2,860	100.0	3,310	100.0	3,160	100.0

TABLE 20

DAILY TRUNK LINE RIDERS BY ALTERNATIVE

	McLoughlin Bus Trunk	PTC LRT	McLoughlin LRT	Sellwood LRT
Estimated Daily Riders on LRT or Bus Trunk	13,480	12,940	14,900	14,230
Estimated Daily Corridor Riders (LRT and Bus)	33,760	33,840	34,030	33,720
% of Corridor Riders on LRT or Bus Trunk	40%	38%	44%	42%

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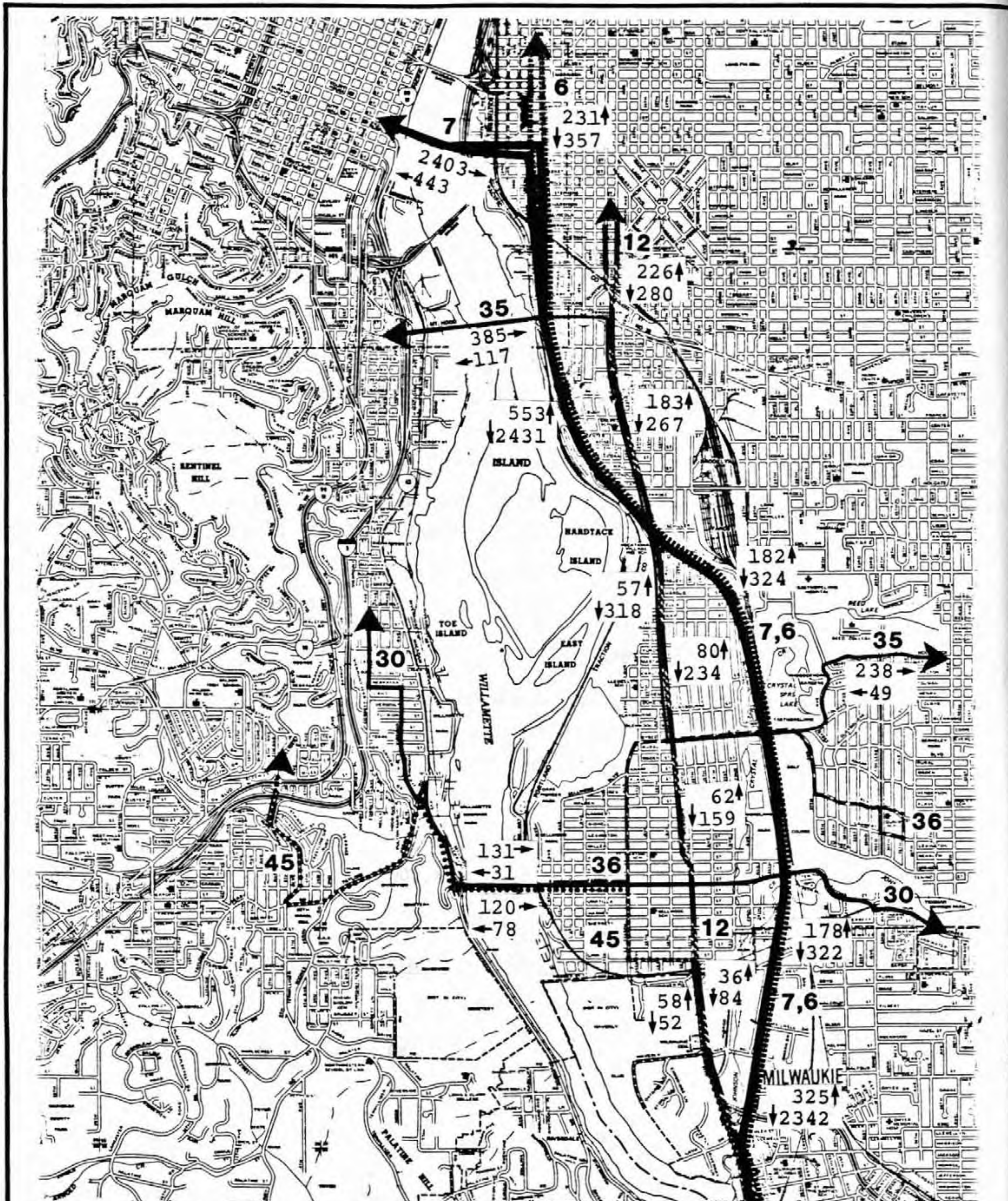

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FIGURE 16: **BASIC BUS NETWORK**
P.M. PEAK HOUR TRANSIT ASSIGMENT

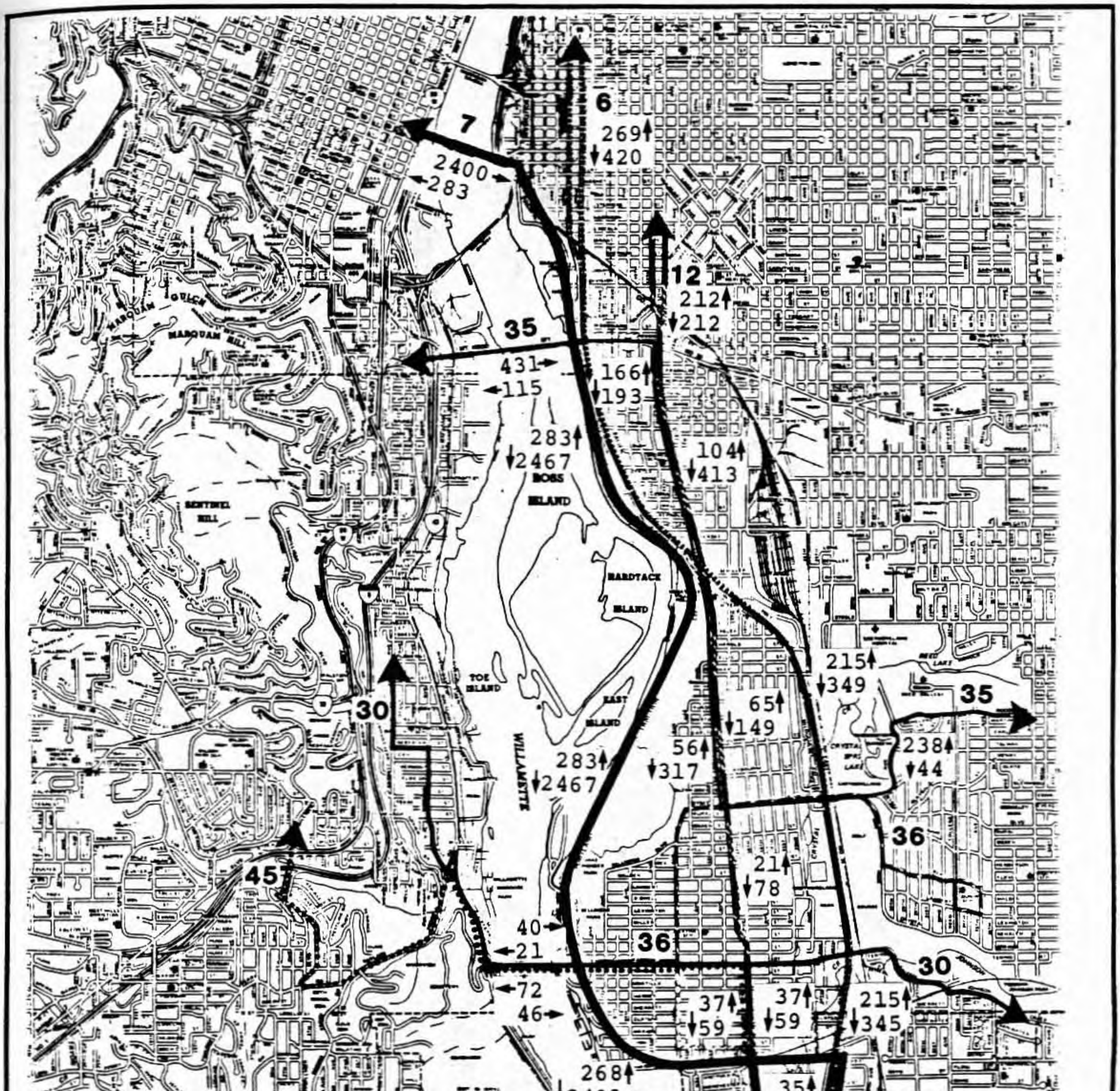

FIGURE 17: **PTC LRT**
P.M. PEAK HOUR TRANSIT ASSIGNMENT

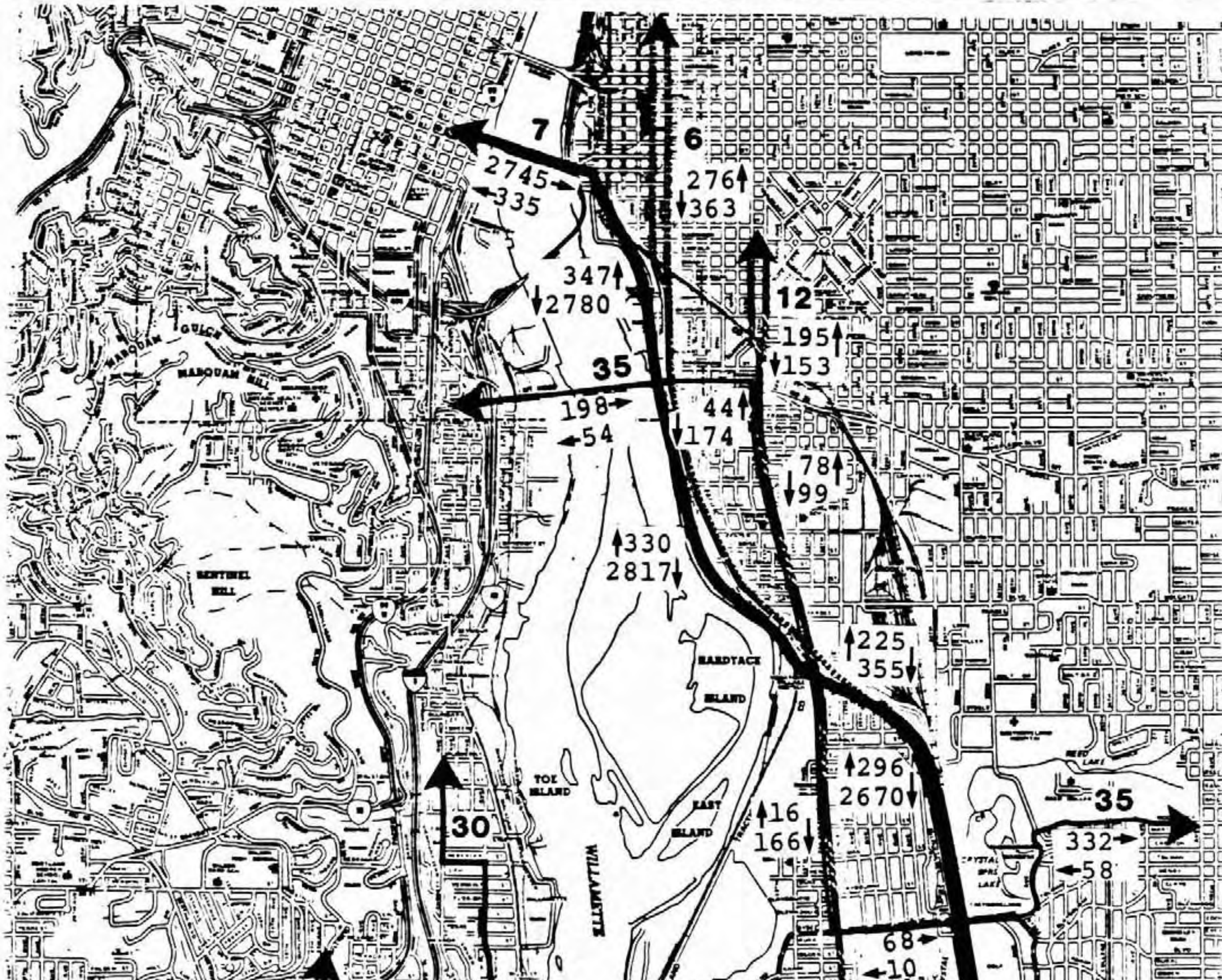

FIGURE 18: **McLOUGHLIN LRT**
P.M. PEAK HOUR TRANSIT ASSIGNMENT

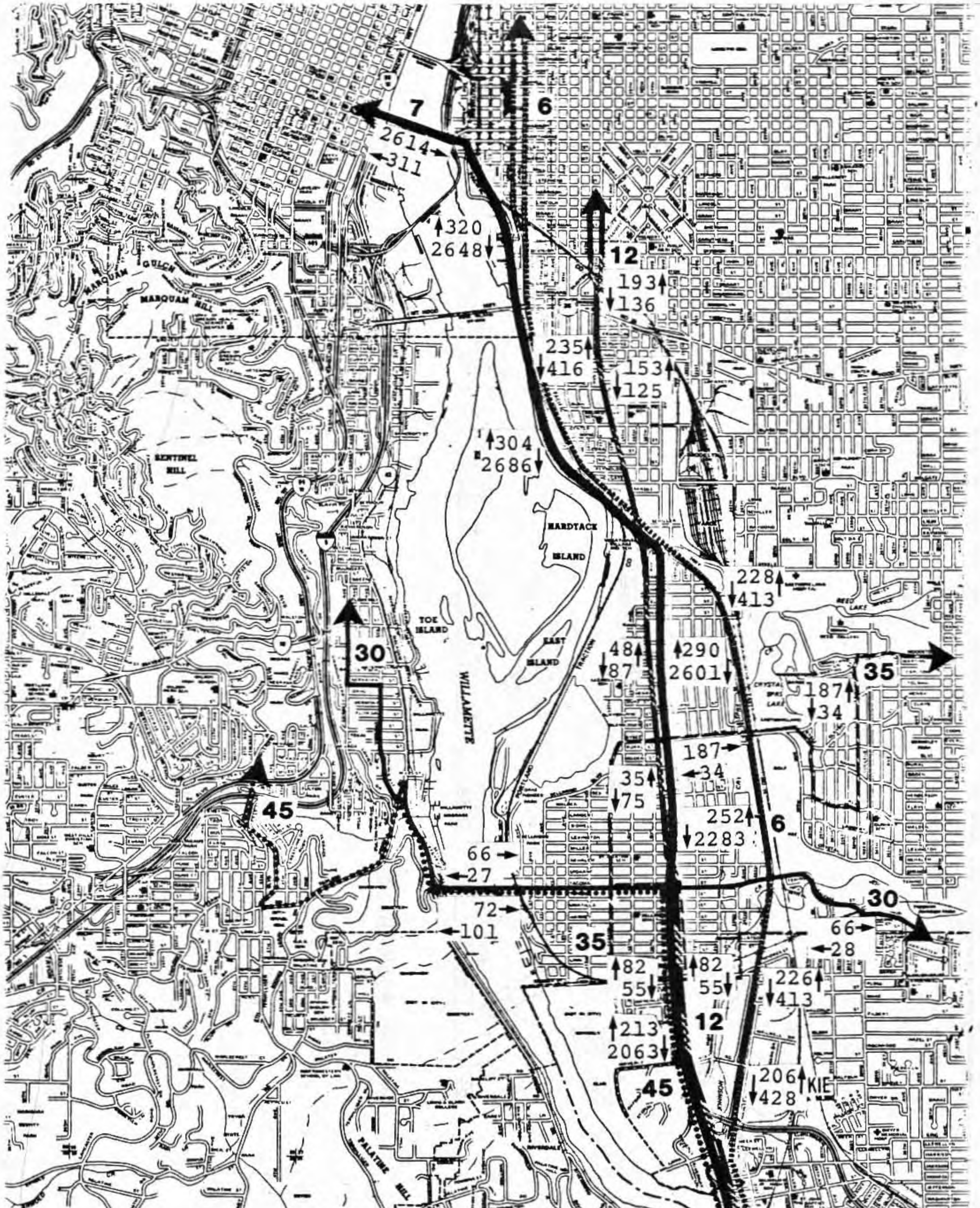

FIGURE 19: SELLWOOD LRT
P.M. PEAK HOUR TRANSIT ASSIGNMENT

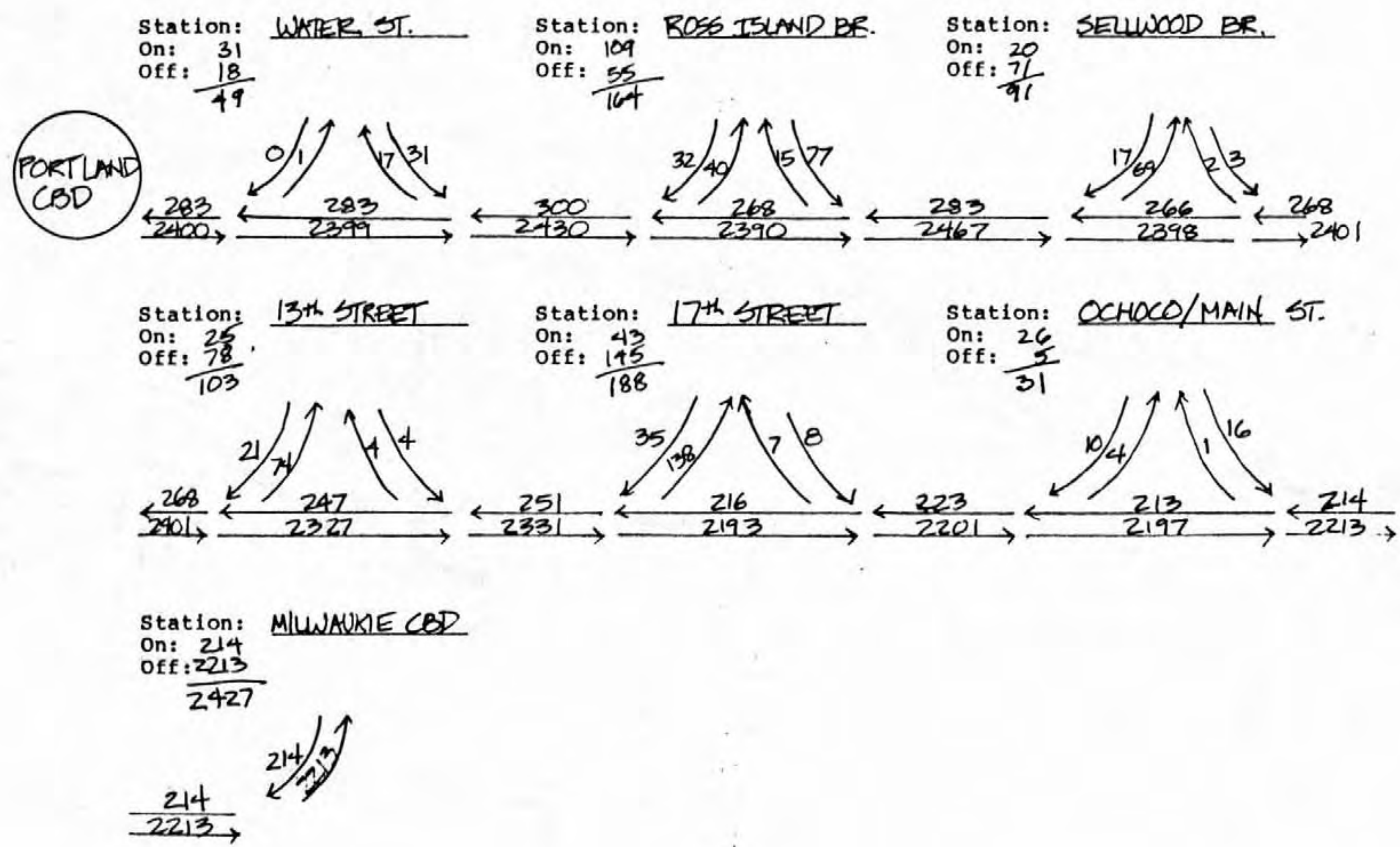

FIGURE 20: PTC LRT ALTERNATIVE
P.M. PEAK HOUR TRANSIT VOLUMES

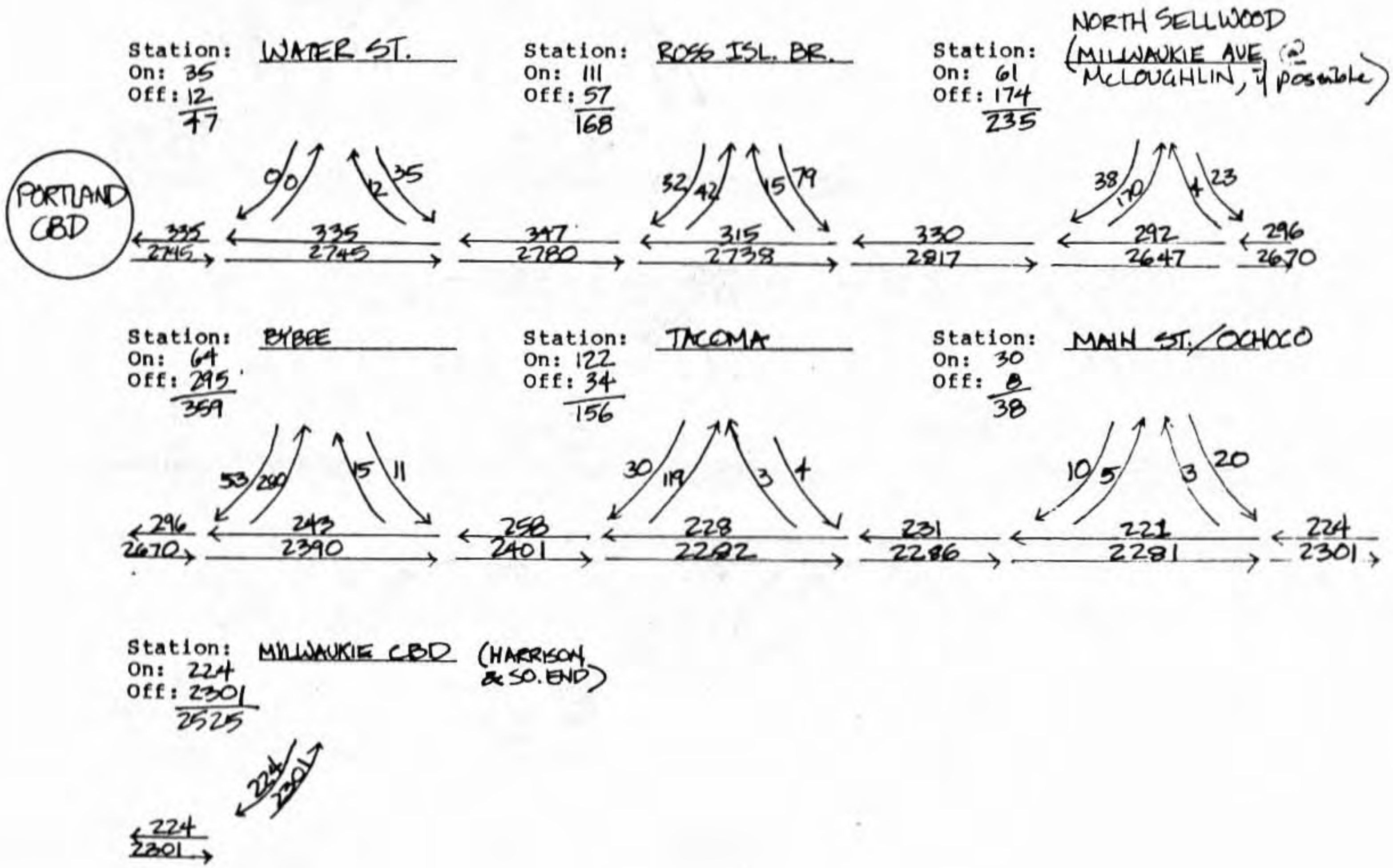

FIGURE 21: McLOUGHLIN LRT ALTERNATIVE P.M. PEAK HOUR TRANSIT VOLUMES

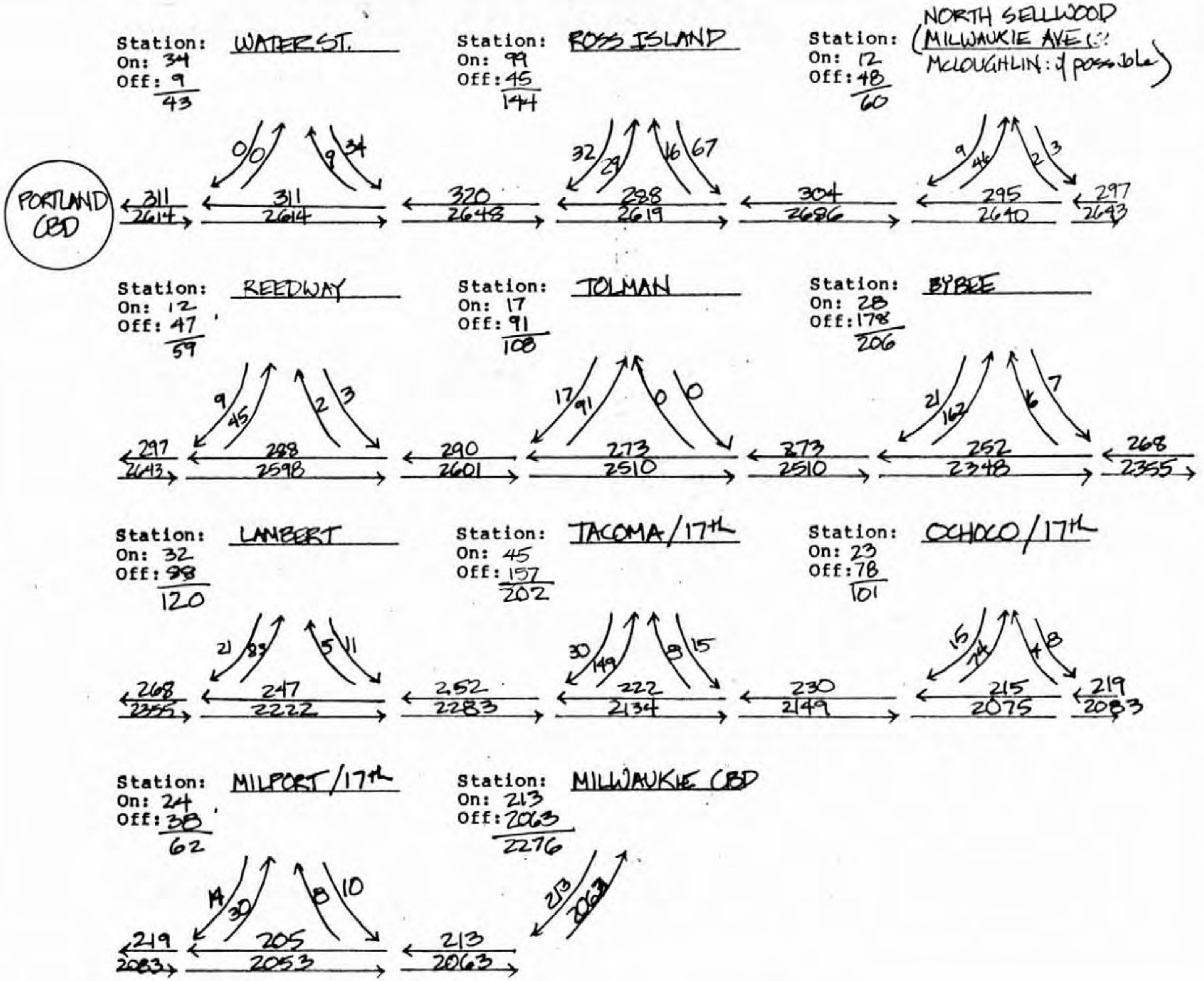

FIGURE 22: SELLWOOD LRT ALTERNATIVE P.M. PEAK HOUR TRANSIT VOLUMES

4.2.5 Transit Riders: Milwaukie Outbound

All alternatives have the same level of service in central Clackamas County and the same pattern of feeder bus routes leading to and from the Milwaukie transit center. This results in similar ridership patterns for all alternatives, as illustrated generally on Figure 23.

The number of riders, as well as their assignment to specific routes, varies between 1980 and 2000. Ridership in the corridor paralleling Highway 224 grows dramatically due to transit service improvements and continued population and employment growth in adjacent areas. However, as illustrated below, south McLoughlin is still projected to be the most heavily utilized transit access route to central Milwaukie.

P.M. Peak Hour/Outbound from Milwaukie
Transit Volumes

	1980		2000	
Highway 224 Corridor	118	(19%)	558	(33%)
South McLoughlin Corridor	493	(81%)	1,137	(67%)
	611		1,695	

This level of transit patronage provides major relief to overcrowded arterials in Clackamas County. In the Highway 224 corridor, 39 percent of total p.m. peak-hour person trip growth is absorbed by transit. While in the south McLoughlin Corridor, 59 percent of the p.m. peak-hour growth in travel by persons is projected to be accommodated by transit.

4.3 Evaluation of Central Eastside LRT Alignment

This section reviews travel forecasts prepared to evaluate ridership on a Central Eastside alignment. This connection, providing north-south LRT service through the Central Eastside, could run on a number of streets in the area, including Water, 6th or 7th Avenues. Bus transfer stations would exist for all of these alignments as they cross bridge-head streets such as Hawthorne, Morrison, and Burnside. This analysis focuses on the role this connection would play in the regional transit system, and not on the comparison of alternative Central Eastside alignments. Analysis thus far has found litlle or no ridership difference between alternative alignments.

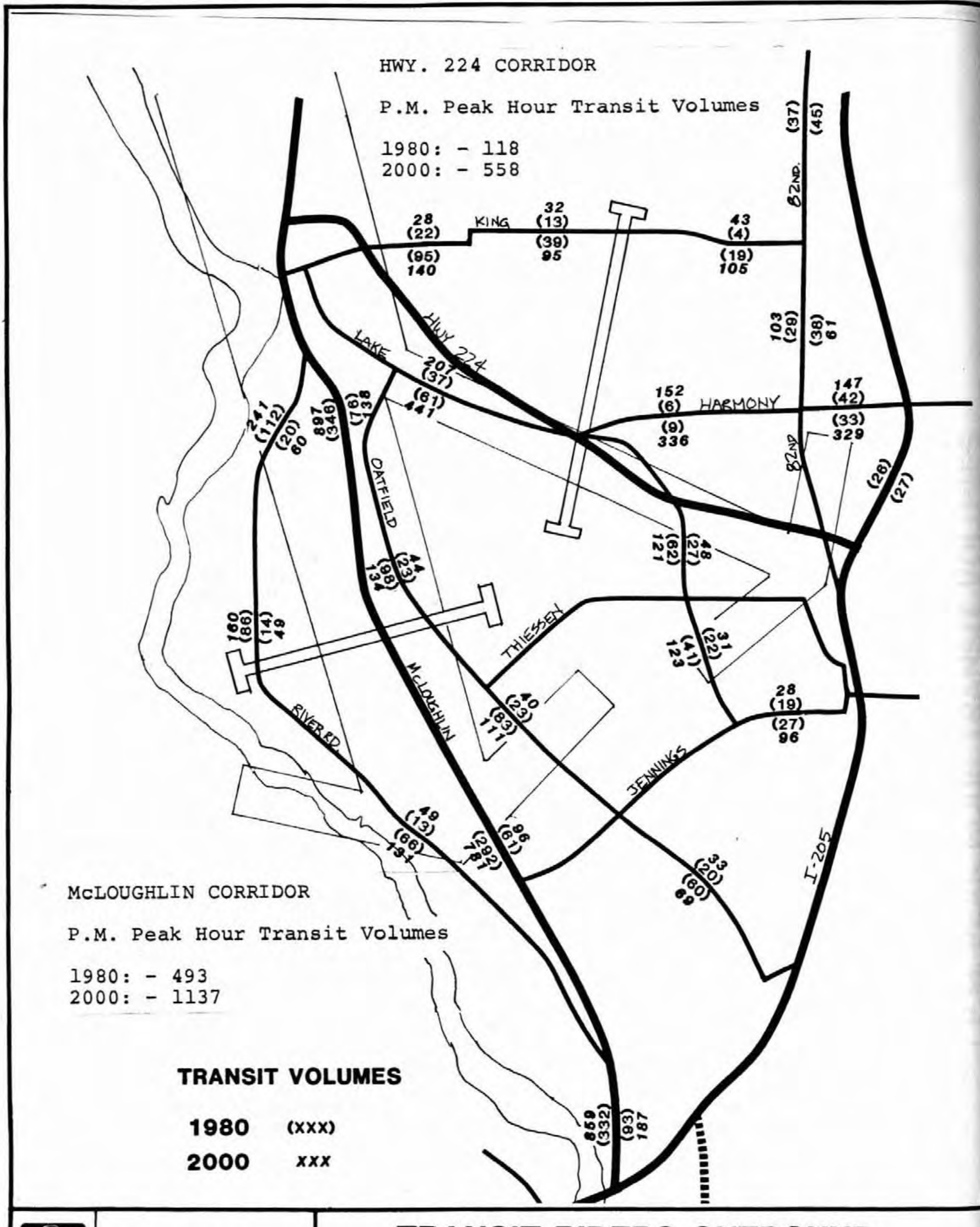

FIGURE 23: **TRANSIT RIDERS OUTBOUND FROM MILWAUKIE**

4.3.1 Roles of the Central Eastside LRT in the Regional System

The Central Eastside LRT alignment could fulfill two alternative roles as part of the regional transit system:

1. As a through route connecting a southern corridor LRT alignment to employment opportunities in the Central Eastside and Lloyd Center, and providing convenient transfers at the proposed Coliseum Transfer Station to North and Northeast Portland bus lines. In this role, the Central Eastside alignment would split from the main Milwaukie Corridor alignment, and continue north until merging with the Banfield LRT line, where it would terminate at the Banfield's Coliseum Station. In the future, this LRT route could continue north along an Interstate/I-5 corridor LRT alignment, thus providing through LRT service from North Portland to Milwaukie.

2. The second role a Central Eastside connector could play is as a replacement for a Downtown Portland rail alignment, supplemented with shuttle buses providing Downtown connections. The advantage of this alternative would be the capital cost savings if no Downtown alignment were constructed or if the Willamette River crossing proved excessively expensive. The disadvantages are: 1) the added transfer time added to rail trips destined Downtown--the major transit destination in the region--resulting in fewer trips on transit; 2) the added operating costs incurred by the bus shuttle; and 3) the capital costs of the Central Eastside alignment.

4.3.2 Central Eastside Industrial District

Affecting the ridership on the alignment are assumptions on the character and growth potential of the Central Eastside Industrial area. Employment forecasts for the Central Eastside show a slow to moderate level of employment growth, due primarily to the area's lack of available vacant land in comparison to competing industrial areas in the region. Other market factors affecting location decisions which could change these forecasts include: 1) the escalating cost of public improvements and the extent to which private developers are expected to contribute toward their provision; and 2) tax credits for rehabilitating older buildings.

A second consideration affecting transit demand in the Central Eastside is parking policy. Strain on the existing parking supply comes from two sources: (1) Downtown workers using the area's limited on-street spaces as remote parking, walking or taking buses to Downtown jobs; and (2) the internal growth in employment in the Central Eastside itself.

4.3.3 Central Eastside Network Alternatives

Four future year alternatives are evaluated in the following sections. These are:

- Union/Grand Bus: This network serves the Central Eastside with two cross-town lines: the first on the 11th and 12th couplet--from the Milwaukie Transit Center in the south to north Portland; the second cross-town line would be on Union/Grand. This is the route which is replaced by LRT in some Central Eastside alternatives. This bus route runs from Clackamas Town Center in the south, through the Milwaukie Transit Center, on McLoughlin Boulevard to the Union-Grand couplet, to the Banfield LRT's Coliseum station, through to Interstate Avenue, terminating at Columbia Boulevard and Interstate Avenue. This bus line is in all the Milwaukie Corridor LRT networks, as well as the basic bus network.

- PTC with Central Eastside LRT: This alternative simulates the effect of a Central Eastside LRT alignment connecting the Milwaukie Corridor LRT (the PTC alternative used as an example). The network assumes an LRT route from the Milwaukie Transit Center to the Banfield LRT's Coliseum station, where transfers to the light rail and to north and northeast Portland bus lines are possible. In the south, a separate bus line between Clackamas Town Center and the Milwaukie Transit Center supplies the service provided by the Union-Grand trunk line in the basic bus network.

- Central Eastside LRT with a Downtown Shuttle: This alternative evaluates the role the Central Eastside LRT alignment would play if a Milwaukie Corridor LRT downtown alignment were not constructed. The alternative assumes a major bus transfer station at Hawthorne, where shuttle buses to Downtown Portland would connect with LRT at frequent intervals. The impact of this added transfer for Milwaukie Corridor to Downtown Portland riders is evaluated.

- Central Eastside LRT with an Inner-Eastside Parking Cost: This alternative is the same transit network configuration discussed as alternative 2 above (PTC with Central Eastside LRT). Added to this alternative is a moderate parking cost--one-third of that projected for Downtown Portland in 2000. This alternative is intended to provide an upper limit of feasible ridership to the Central Eastside.

4.3.4 Evaluation of Central Eastside Alternatives

Alternative Central Eastside alignments are evaluated from two perspectives: (1) How the LRT alignments affect the number of transit trips destined to the Central Eastside district, and (2) the use of the Central Eastside alignment to accommodate transit trips through the district.

Trips to the Central Eastside: Table 21 displays the transit trips projected to be attracted to the district, and those specifically from the Milwaukie Corridor (as defined in Section 4.1) for each alternative.

Between 1980 and the year 2000 alternatives, transit patronage to the Central Eastside increases by 20 percent (45 percent if a parking cost is assumed). Even with this increase, transit ridership accounts for less than 4 percent of total travel to the area (4.6 percent if a parking cost is applied).

Total ridership from the Milwaukie Corridor to the Central Eastside is projected to increase slightly faster than the region as a whole, but is still less than 4.5 percent of total person trips--or 5.2 percent with a parking cost assumed.

In general, Table 21 shows the Central Eastside as an important transit system destination, but because those transit trips are not heavily concentrated to or from the southern corridor alone, the impact of a Central Eastside LRT alignment connecting to a Milwaukie to Portland LRT trunk route is small.

Table 22 illustrates the effect of alternative 4 (downtown bus shuttle from the Central Eastside) on

TABLE 21

DAILY TRANSIT RIDERSHIP TO THE CENTRAL EASTSIDE

Alternative	Trips from All Areas of the Region	Trips from the Milwaukie Corridor[1]
1980: Transit Trips	5,610	550
% of Total	3.2%	3.2%
Year 2000 Alternatives		
1. Basic Bus Network		
Transit Trips	6,880	810
% of Total	3.8%	4.4%
2. PTC with Central Eastside LRT:		
Transit Trips	6,880	750
% of Total	3.8%	4.1%
3. Central Eastside LRT with a Downtown Shuttle		
Transit Trips	6,840	760
% of Total	3.8%	4.1%
4. Central Eastside LRT with Inner-Eastside Parking Cost		
Transit Trips	8,270	960
% of Total	4.6%	5.2%

[1] Districts 3, 9, 10, 11, 12, and 13.

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TABLE 22

Evening Peak Hour LRT Riders to Downtown:
Direct Downtown LRT
Service and Central Eastside Shuttle Bus

		PTC Direct to Downtown	Central Eastside LRT and Shuttle to Downtown
3:	Sellwood-Moreland	260	230
9:	Central Milwaukie	930	940
10:	Town Center Area	140	120
11:	South McLoughlin Area	790	750
12:	Oregon City Area	80	70
13:	Clackamas Area	80	80
	Others[1]	20	20
	TOTAL	2,300	2,210 (Down 4%)

[1] Trips from elsewhere in the region to the McLoughlin Corridor.

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Downtown patronage. Overall, the added travel time--approximately three minutes plus 2.5 minutes transfer time--reduces Downtown patronage 4 percent. These changes in travel time represent the most optimistic assumption considered possible for the operating characteristics of the shuttle buses.

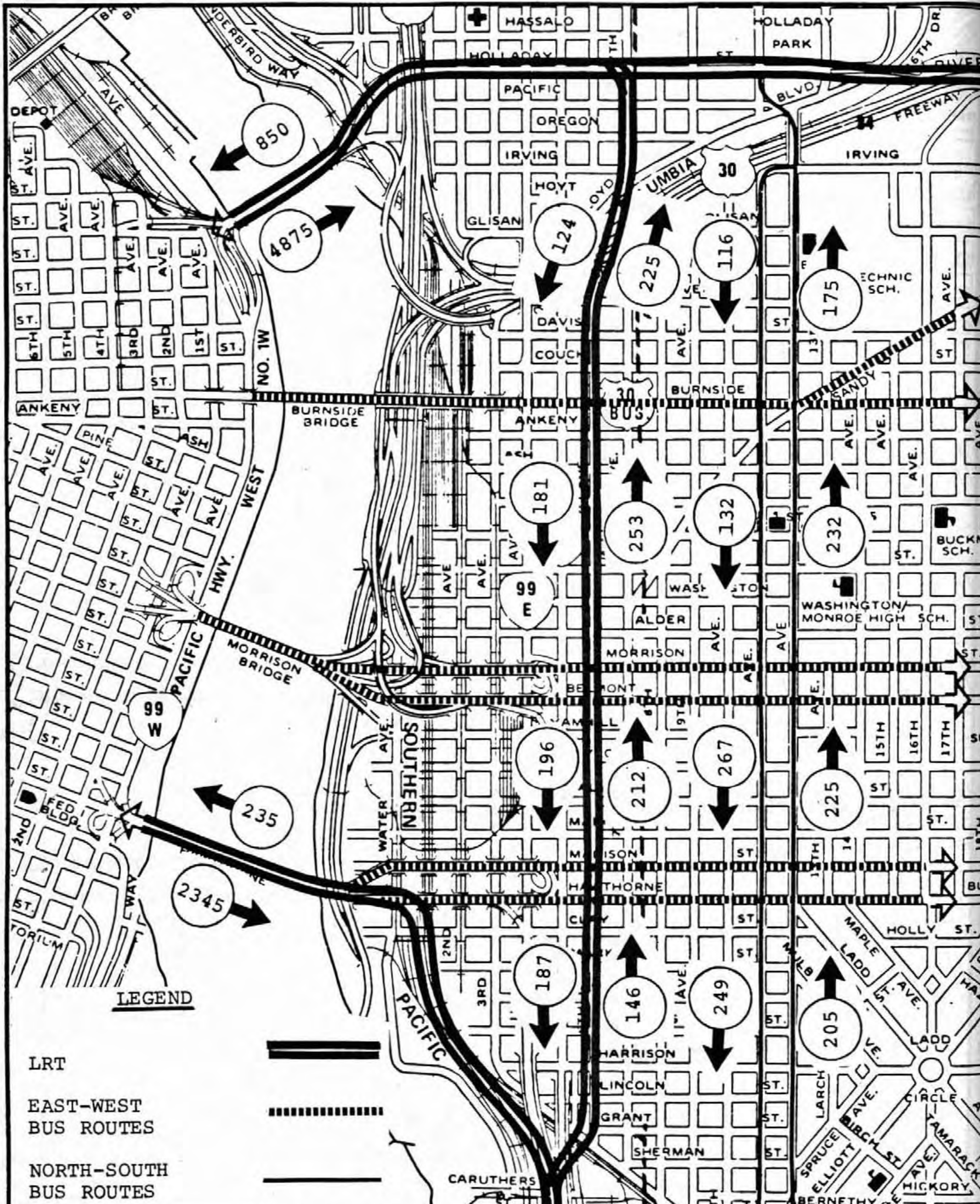
<u>Assessment of Through Trips Using The Central Eastside LRT</u>: In addition to serving trips destined to Downtown and the Central Eastside, the Central Eastside north-south link could provide a through line between north and south corridors without incurring Downtown traffic delays. This is evaluated through a number of transit assignments for each alternative, as shown on Figures 24 through 27.

In general, these assignments show little positive change resulting from the Central Eastside LRT alternatives as compared to the network without this LRT link. This is because--in the LRT alternatives--the Eastside trunk is broken into three routes: (a) Clackamas Town Center to Milwaukie; (b) Milwaukie to the Coliseum Transfer Station via LRT; and (c) Interstate Avenue bus trunk. In the networks without a Central Eastside LRT, all three routes are combined into one continuous north-south bus line. As an example of the impact of this, a trip between Interstate Avenue destinations and the Clackamas Town Center requires two transfers with the Central Eastside LRT, at Coliseum station and at the Milwaukie Transit Center, and no transfers in the networks without a Central Eastside LRT. These added transfers result in many Clackamas County riders choosing a different transit route rather than the Central Eastside LRT to reach destinations east of the Willamette River.

Even with the highest ridership alternative, the peak load point of 420--for the p.m. peak hour--suggests the Central Eastside can efficiently be served with high-quality bus service on the Union-Grand couplet rather than LRT. The peak load point indicates that a 15-minute frequency with articulated buses or 10-minute frequency with standard buses is adequate to handle projected year 2000 demand. LRT would provide more capacity than is likely to be needed.

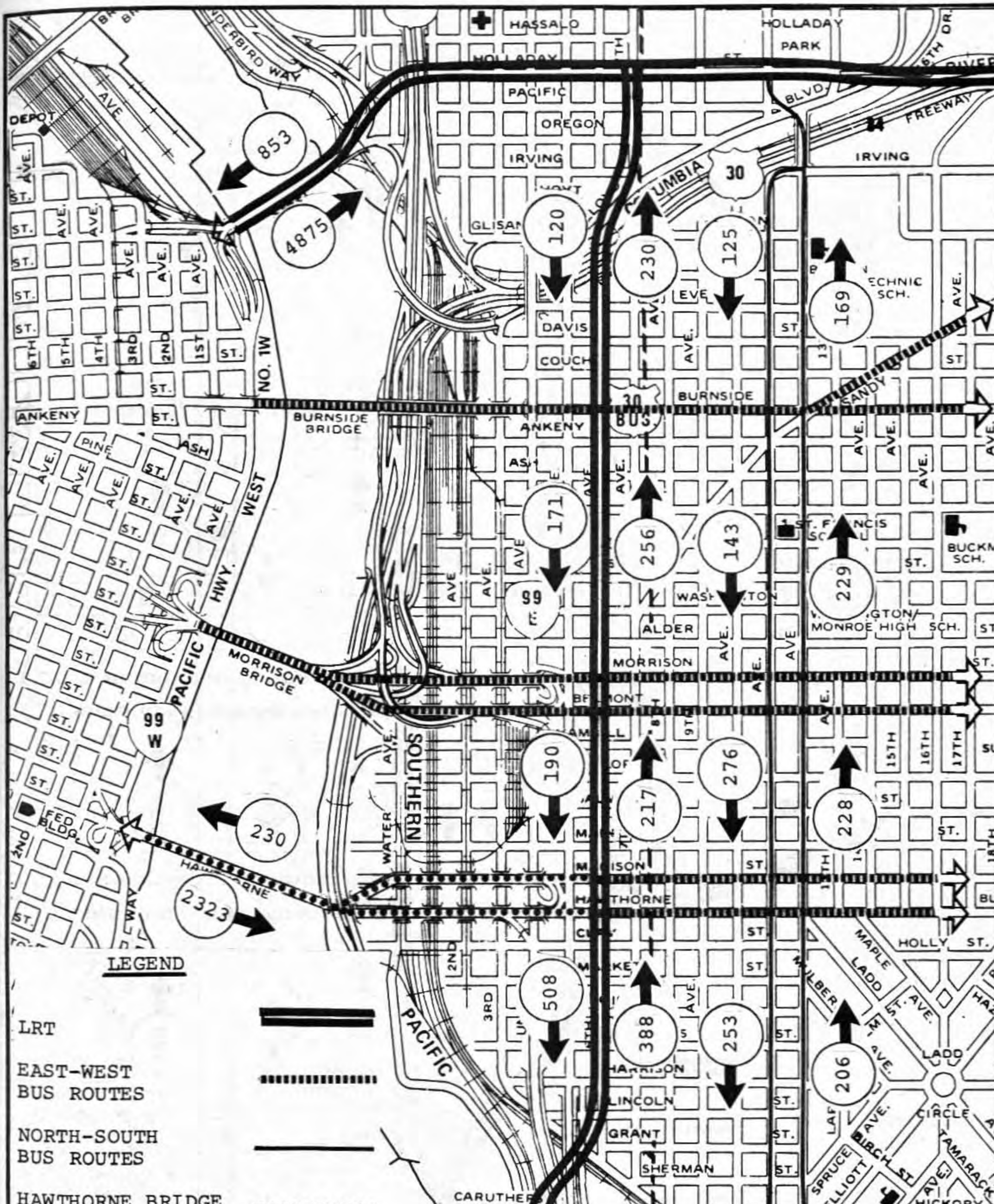
FIGURE 24: CENTRAL EASTSIDE

BASIC PTC NETWORK
P.M. PEAK HOUR TRANSIT VOLUMES



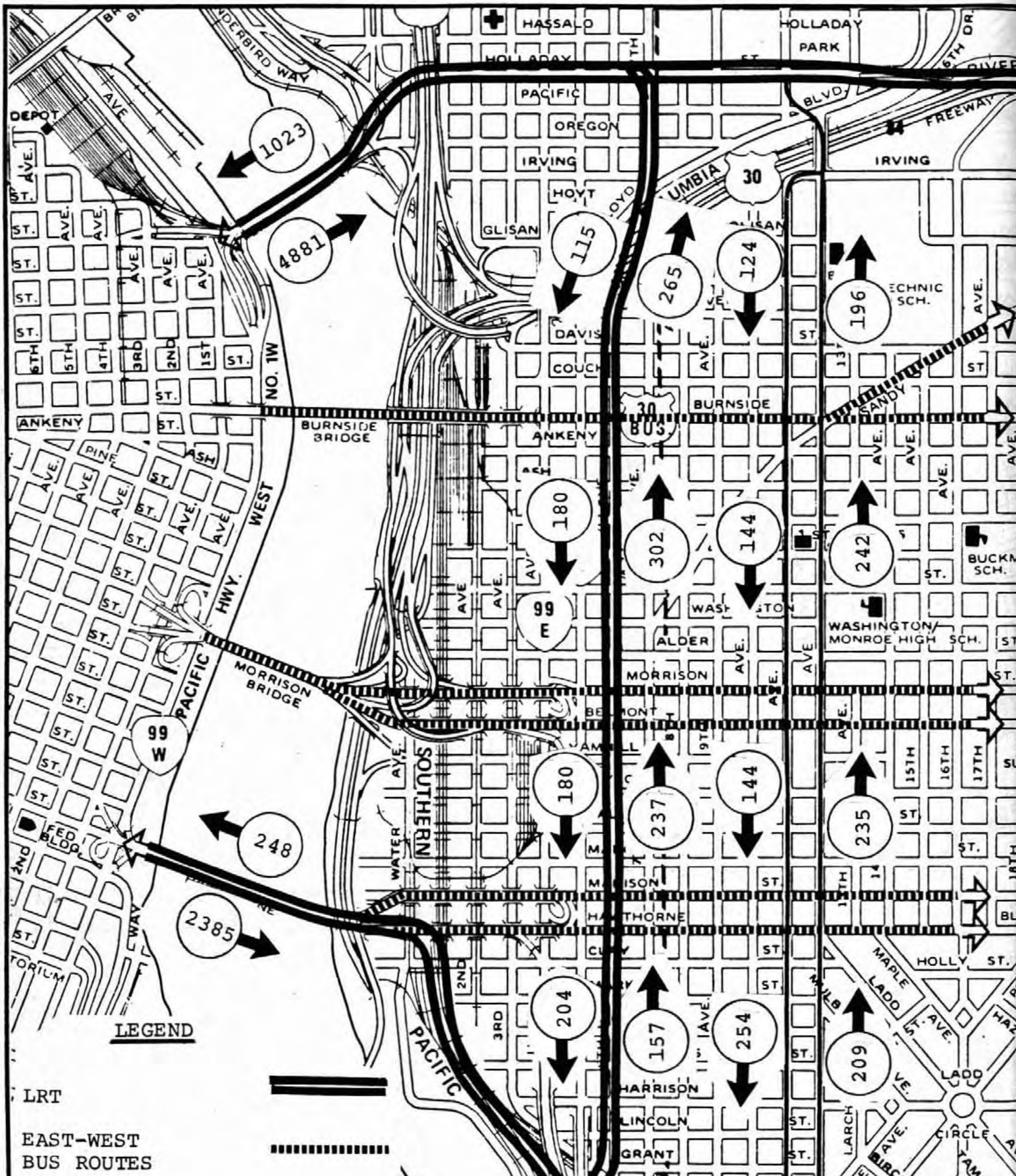
METRO

FIGURE 25: **CENTRAL EASTSIDE LRT**
WITH DIRECT DOWNTOWN LRT (PTC TRUNK)
P.M. PEAK HOUR TRANSIT VOLUMES



METRO

FIGURE 26: CENTRAL EASTSIDE LRT WITH DOWNTOWN SHUTTLE SERVICE P.M. PEAK HOUR TRANSIT VOLUMES



METRO

FIGURE 27: CENTRAL EASTSIDE LRT WITH CENTRAL EASTSIDE PARKING COST P.M. PEAK HOUR TRANSIT VOLUMES

5.0 MILWAUKIE CORRIDOR STAGING ANALYSIS

The Milwaukie Corridor staging analysis is intended to identify the proper timing for implementation of various elements of the McLoughlin Corridor Improvement Strategy--identified in Metro Staff Report 69. At issue are the various stages of the McLoughlin Boulevard highway improvement and a major transit expansion which could involve LRT. In particular, this analysis addresses the ability of an early phase-in of a major transit service expansion, such as LRT, to delay the need for all but Phase 1 (the McLoughlin/Tacoma intersection improvement) of the McLoughlin Boulevard highway project proposed by ODOT.

Background

Based on previous studies, the agencies principally involved in the McLoughlin Corridor have agreed that the first phase of the highway improvement--the McLoughlin and Tacoma intersection--should proceed. The exact scope of the improvement is still to be resolved.

The need for other phases of the highway project is reviewed in this chapter based on projected vehicle volume growth as compared to the capacity of the key intersection within each highway stage constraining McLoughlin Boulevard capacity. The McLoughlin highway project stages are summarized on Table 23 and discussed below:

> Stage 1: The Tacoma intersection: Design studies on the exact scope of this project are continuing. Because of heavy traffic volumes on both McLoughlin and Tacoma, this is the lowest capacity intersection on McLoughlin Boulevard. Stage 1 also includes the Harrison-River Road jughandle intersection in Milwaukie and disincentives for through traffic in the Sellwood-Moreland neighborhood.

> Stage 2: Harrison to Tacoma: This stage of the highway project involves a major widening from Tacoma south to River Road. This also involves construction of a two-lane ramp from Highway 224 westbound to McLoughlin Boulevard northbound. This two-lane ramp intends to attract traffic to McLoughlin and away from 17th. Capacity of this segment is controlled by the Ochoco intersection.

> Stage 3A: Union-Grand Viaduct: What was one highway project stage has been divided into two for the purpose of the staging study. Stage 3A is defined as the widening of the Union-Grand viaduct north of Powell Boulevard in Portland's Central Eastside Industrial District. One of the main purposes of this widening is to provide the connections to I-5 North (on and off) through the Marquam ramps project. Because there are no intersections along this section, capacity and the growth in vehicles over

TABLE 23

Proposed McLoughlin Boulevard
Improvement Project Stages

	Project Phase	Timing Determined By:
Stage 1:	Tacoma/McLoughlin Intersection	Capacity at Tacoma Intersection
Stage 2:	River Road to Tacoma	Capacity at Ochoco Intersection
Stage 3A:	Union-Grand viaduct	Construction of Marquam Ramps Project
Stage 3B:	Powell to Harold	Capacity at 17th Avenue Intersection
Stage 4:	Harold to Ochoco	Capacity at 17th Avenue Intersection

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time is not the major issue. Rather, the timing of this stage is assumed to be tied to the construction of the Marquam ramps project.

Stage 3B: Powell to Harold: This section of the highway project involves minor widening and re-striping for a reversible travel lane. The intersection constraining McLoughlin Boulevard capacity in this segment is at 17th Avenue.

Stage 4: Harold to Ochoco: This stage of the highway project involves widening McLoughlin Boulevard from four to six lanes. The intersection constraining this segment's capacity is 17th Avenue--assuming the Tacoma improvement will be a grade separation.

The actual capacities used to trigger the timing of highway project stages is shown on Table 24. For each critical intersection, the "No Build" or existing capacity is shown together with the "Build" capacity. At the S.E. 17th Avenue intersection, the "Build" capacities are shown separately for Stage 3B, and for the combination of 3B and 4. This differs due to the lane utilization of southbound traffic approaching 17th, which would improve if the downstream segment has three through lanes in each direction--as provided by Stage 4--rather than two.

Recent Trends

Over the recent past, traffic volumes on McLoughlin have grown on a daily basis, but have remained relatively stable during the peak hour. This is due presumably to the corridor's major highway facilities having reached capacity during the peak hour, thus constraining vehicle growth. This has also resulted in regional traffic being diverted off McLoughlin and onto local north-south streets in adjacent neighborhoods.

Transit ridership in the corridor increased from 1970 to 1980, but has remained static since 1980. Due to projected limitations in Tri-Met's operating budget, it is unlikely that any major service expansion could be implemented in the near future.

Methodology

The staging analysis results in a year-by-year description of highway and transit growth, providing a transition from today's traffic and transit demand to that projected for the year 2000. The staging analysis assumes that the growth in person movements--highway and transit--through the corridor follows a straight line. However, the proportion of total person trips on transit or in autos is evaluated based on two extremes, one based on an early surge in transit riders and resulting lower vehicle volumes, the other based on a late surge in transit

TABLE 24

Southbound Peak-Hour Capacities of Key McLoughlin Boulevard Intersections

Intersection	Status	Capacities @ .90 v/c	@ .95 v/c	@ 1.0 v/c
Holgate	No-Build	4,490	4,696	4,943
	Build (Stage 3B)	4,950	5,225	5,500
S.E. 17th	No-Build	3,288	3,471	3,654
	Build (Stage 3B)	3,528	3,724	3,920
	Build (Stages 3B & 4)	3,692	4,097	4,313
S.E. Tacoma	No-Build	2,016	2,128	2,240
	Build (Stages 1 & 2)	3,692	3,886	4,103
Ochoco	No-Build	2,160	2,280	2,400
	Build (Stages 1 & 2)	3,107	3,280	3,452

McLoughlin Project Phases

Stage 1: Tacoma Intersection
Stage 2: River Road to Tacoma
Stage 3A: Union-Grand viaduct
Stage 3B: Powell to Harold
Stage 4: Harold to Ochoco

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riders--with resulting higher vehicle volumes in the years between now and 2000. Both alternatives, however, assume slow transit growth over the next five years. These two extremes of transit growth were chosen to "bracket" the most reasonable range of transit ridership assumptions.

The staging analysis has been performed for two sections of the McLoughlin Corridor: north and south. The analysis performed for the north section involves highway project stages 3B and 4. The analysis performed for the south involves highway project Stages 1 and 2. Results and findings of the staging analysis are reported for the north segment and south segment of the McLoughlin Corridor below.

South Segment Results

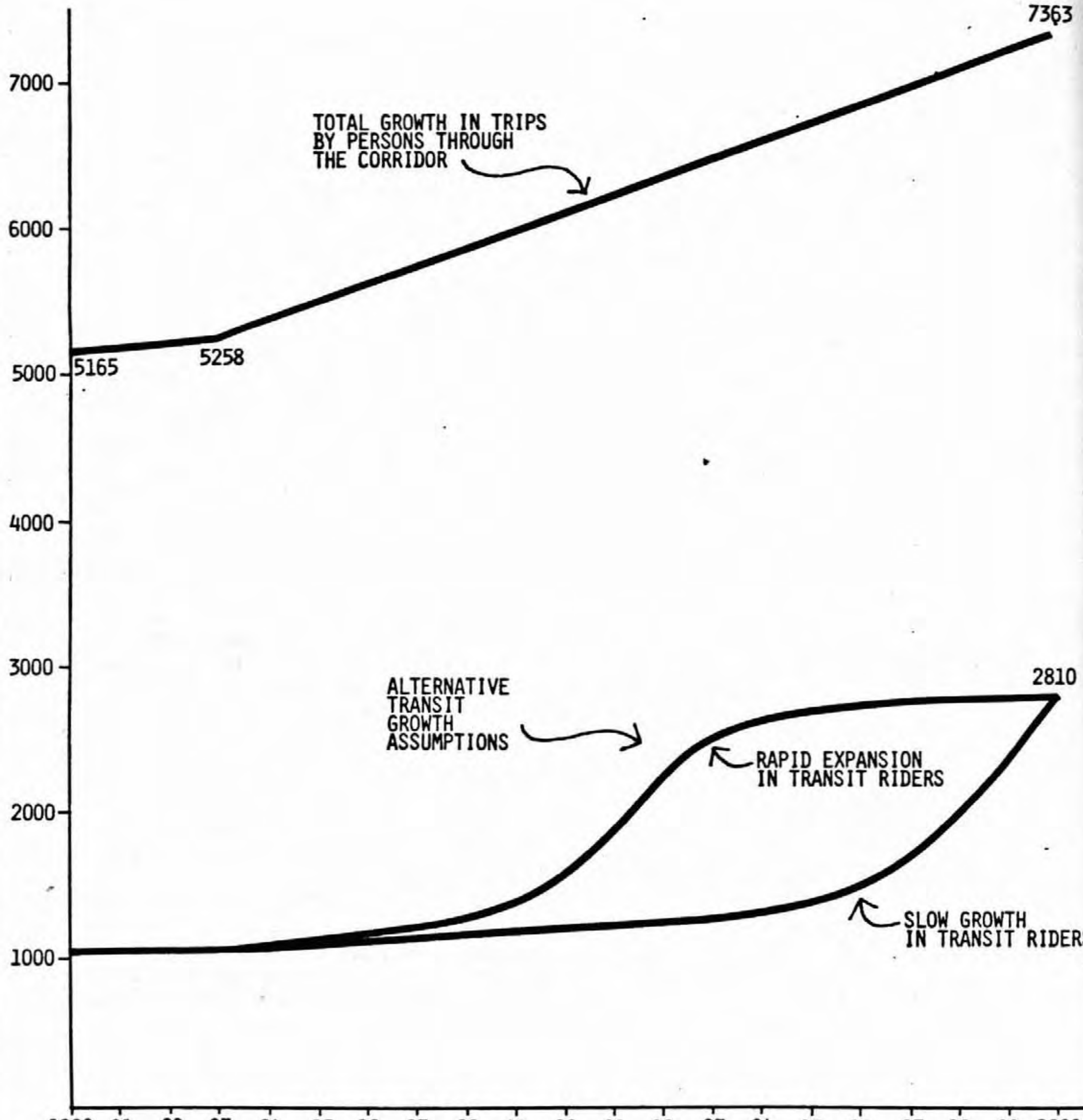
Figure 28 illustrates the total increase in corridor demand, measured in person trips, between 1983 and 2000. This demand increases 40 percent from 5,260 in 1983 to 7,363 in 2000. Also shown on Figure 28 are two curves of transit growth--both beginning and ending at the same points--but showing different rates of growth over time. The upper curve shows an early transit expansion in the 1990-1993 timeframe, while the lower curve shows a late expansion of transit--1996-2000.

Based on the two curves of transit expansion, Figure 29 shows the resulting levels of vehicle demand traveling through the corridor south of Tacoma. This traffic demand is distributed to individual facilities--based on the forecasted year 2000 demand for individual facilities--shown on Figures 30 and 31. Figure 30 shows the traffic demand given a late expansion in transit riders, while Figure 31 shows traffic demand with an early and rapid increase in transit riders. Each of these figures are discussed below.

Traffic Demand with Late Transit Expansion (Figure 30): Figure 30 displays for each year between 1983 and 2000 the total vehicle demand for McLoughlin and 17th, assuming slow growth in transit ridership until a major expansion occurs in the late 1990s.

At the completion of Stage 1 (Tacoma intersection)--shown in 1990 on Figure 30--McLoughlin capacity is constrained by the Ochoco intersection capacity. The Ochoco intersection capacity is only slightly greater than that of Tacoma. The Ochoco constraint is removed at the completion of Stage 2 (Tacoma to Highway 224)--shown in 1991 on Figure 30.

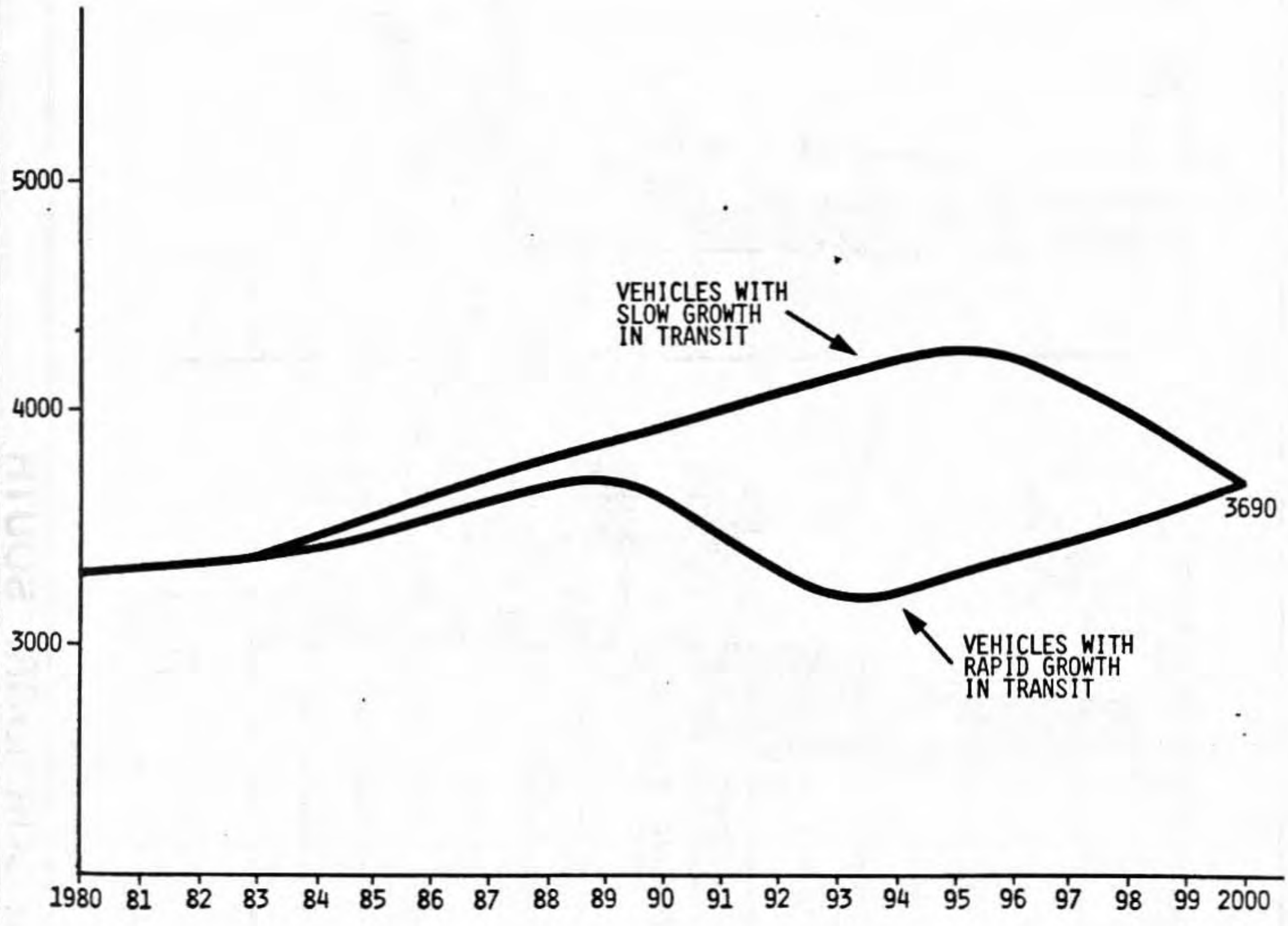
Similarly, 17th Avenue volumes are shown in two stages. First, from 1983 to 1990, capacity and volume are held constant. In 1991--it is assumed that the disincentives identified in the McLoughlin neighborhoods project are applied--thus reducing the attractiveness of 17th Avenue for regional traffic.



McLOUGHLIN CORRIDOR: SOUTH

RELATIONSHIP OF TOTAL TRAVEL DEMAND & TRANSIT RIDERSHIP GROWTH

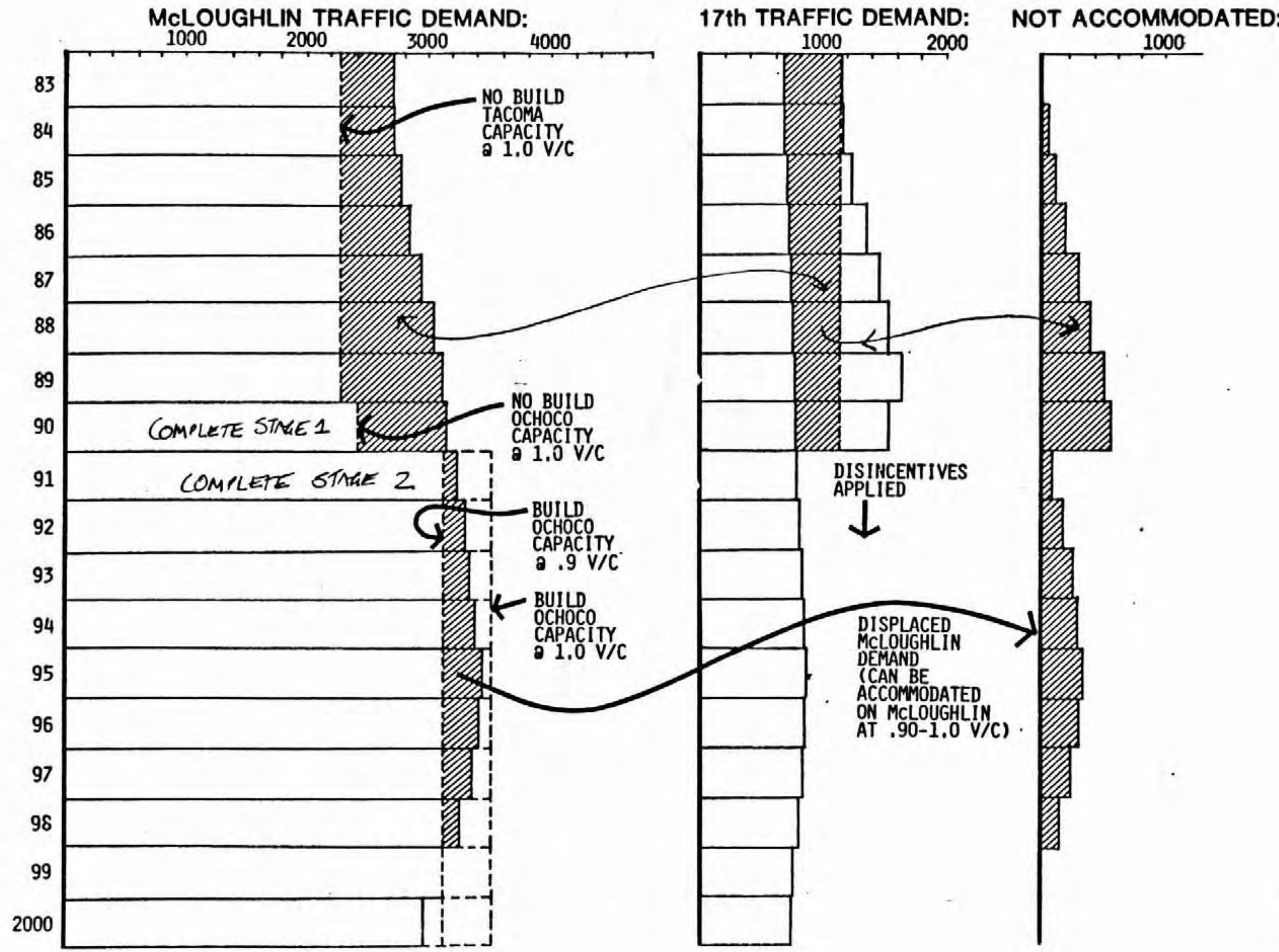
FIG. 28



McLOUGHLIN CORRIDOR: SOUTH

TOTAL VEHICLES TRAVELING THROUGH THE CORRIDOR

FIG. 29



McLOUGHLIN CORRIDOR: SOUTH
GROWTH IN TRAFFIC • SLOW GROWTH IN TRANSIT

FIG.30

Figure 30 illustrates that prior to the opening of Phases 1 and 2 of the McLoughlin highway project, significant demand will be shifted to 17th Avenue from McLoughlin (as indicated by the shaded pattern). Also, each year from 1984 until the opening of both highway project Stages 1 and 2, an increasing number of vehicles cannot be accommodated on either McLoughlin or 17th. This demand would be expected to find other routes such as 42nd, 60th, or 82nd, or shift to another time of day.

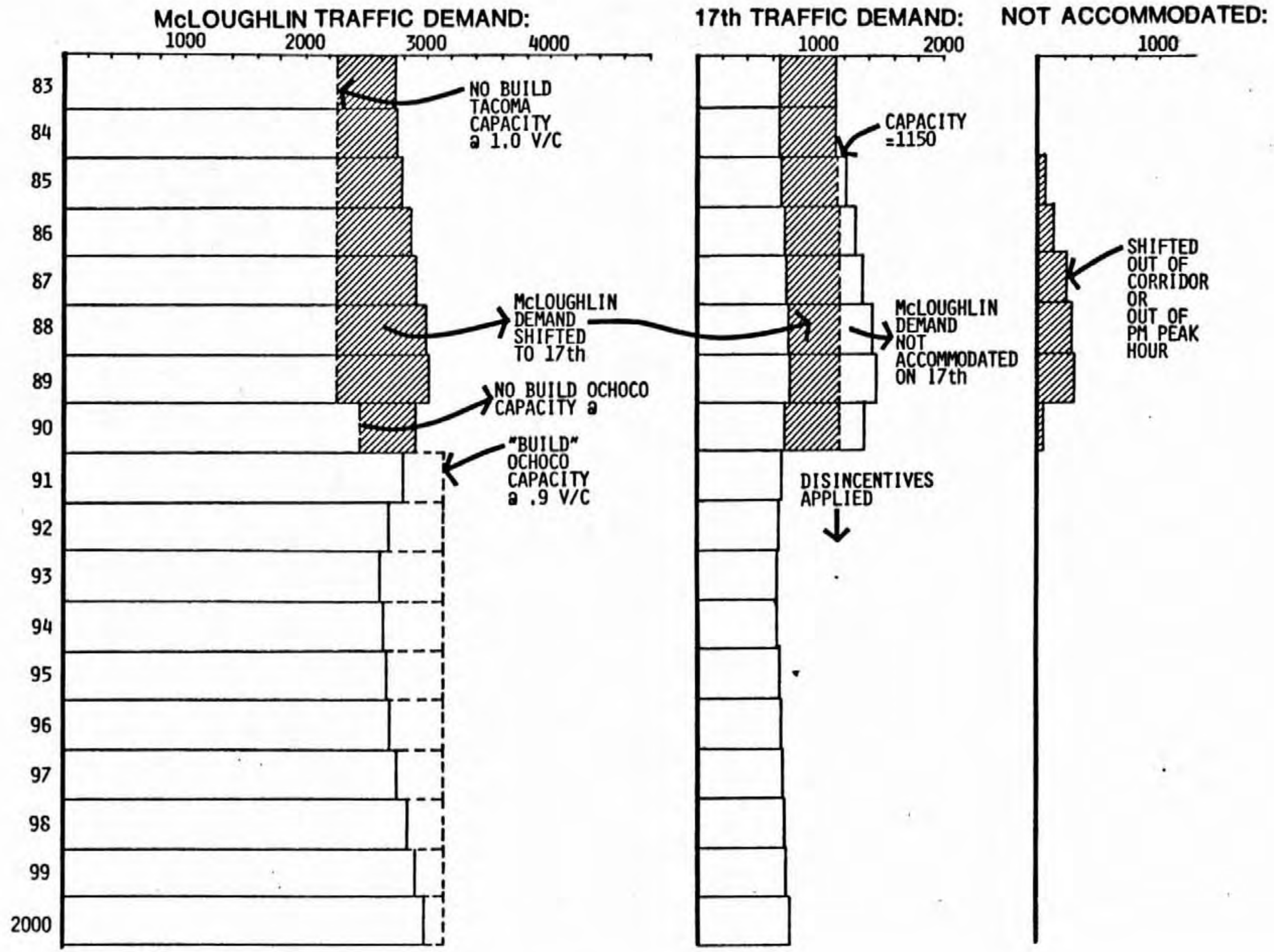
This analysis demonstrates that with a late expansion (1995+) in transit patronage in the corridor--traffic demand for McLoughlin Boulevard is expected to exceed capacity at accepted levels-of-service even after the opening of highway project Stages 1 and 2. This underscores the importance of an early, or at least gradual transit expansion to the proper operation of the improved McLoughlin Boulevard, as well as the implementation of 17th Avenue disincentives.

Traffic Demand with Early Transit Expansion (Figure 31): Illustrated on Figure 31 is the opposite extreme of traffic growth--that based on an early (1993 or sooner) increase in transit riders. In this situation, highway demand is mitigated by diversion of persons to transit, and as a result, a much more positive highway situation results. With an early increase in transit riders--the improved McLoughlin Boulevard meets demand from the time Stages 1 and 2 are complete (1991) until at least the year 2000. Early transit expansion does maintain proper levels-of-service on McLoughlin and provides capacity to allow the diversion of Clackamas County to Sellwood Bridge traffic from 17th Avenue to McLoughlin Boulevard. However, assuming the disincentives on 17th Avenue, both Stages 1 and 2 of the highway project are still required and cannot be postponed.

North Segment Results

McLoughlin Boulevard north of Tacoma presently has a significantly higher capacity than the section south of Tacoma. The proposed improvements in the north will add capacity for 500-600 vehicles per hour, while the improvements from Tacoma south will add capacity of 1,600 vehicles per hour.

The 17th Avenue/McLoughlin intersection is the key to the capacities of Stages 3B--Powell to Harold--and 4--Harold to Ochoco. (Stage 3A is assumed to be tied to the Marquam ramps project, and not to growth in traffic). The no-build capacity at 17th--during the p.m. peak hour southbound--represents the effect of narrowing McLoughlin to two lanes in each direction south of this intersection. Because of the third lane being dropped south of 17th in the no-build situation, the extra lane at the 17th intersection cannot be fully utilized--and, as such, the intersection's capacity is reduced.



McLOUGHLIN CORRIDOR: SOUTH
GROWTH IN TRAFFIC • RAPID GROWTH IN TRANSIT 1983-2000

FIG.31

Figure 32 illustrates the total growth in corridor demand for the northern half of the McLoughlin Corridor and two extremes of transit ridership growth. As with the south section, this results in two curves of vehicle growth, also shown on Figure 33.

The curve of total vehicle volumes results in the split of demand between McLoughlin and the local streets of 17th and Milwaukie shown on Figure 34 with a late or slow growth in transit patronage, and on Figure 35 assuming an early or rapid increase in transit patronage. Each of these figures are discussed below.

Traffic Demand with a Late Growth in Transit (Figure 34): With a delayed growth in transit ridership, resulting vehicle growth requires the construction of Stage 3B in 1991, and Stage 4 in 1993. Traffic on 17th and Milwaukie is not affected by Stages 3B and 4 of the highway project, but reaches a peak of nearly 1,200 vehicles/hour by 1996 due to the slower rate the transit system is absorbing its share of travel demand.

Traffic Demand Growth with an Early Growth in Transit: At the other extreme of vehicle volume growth from that discussed above, Figure 35 illustrates the vehicle volumes from 1983 to 2000 with an early expansion in transit riders. In this situation, Stage 3B (Powell to Harold) is not required until 1999, and Stage 4 is not required until after 2000. Because transit absorbs more demand in the corridor, the volumes on 17th Avenue and Milwaukie are reduced significantly from those shown in the late growth in transit situation.

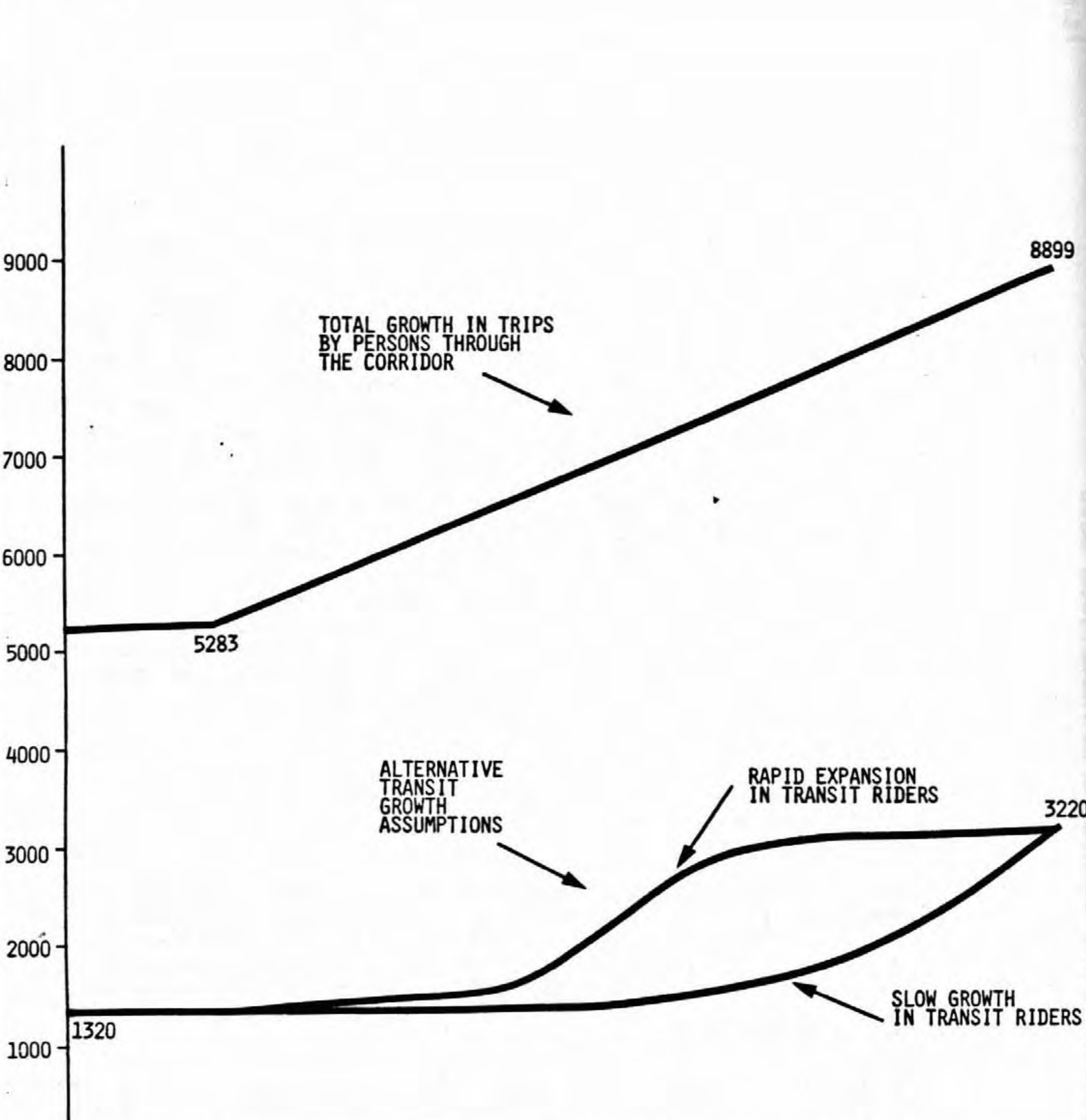
Conclusions

The staging analysis findings associated with the proposed McLoughlin highway project are summarized on Table 25 and discussed below:

- Stages 1--Tacoma--and 2--Tacoma to River Road--of the highway project are tied to meeting existing corridor demand. The timing of these two stages does not rely on growth in corridor travel or changes in travel habits (i.e., auto to transit shifts). Therefore, decisions on the timing of these two project stages are independent of transit timing decisions.

- Stage 3A (Union-Grand viaduct) is tied to construction of the Marquam ramps project, and not the growth in vehicle volumes through the corridor.

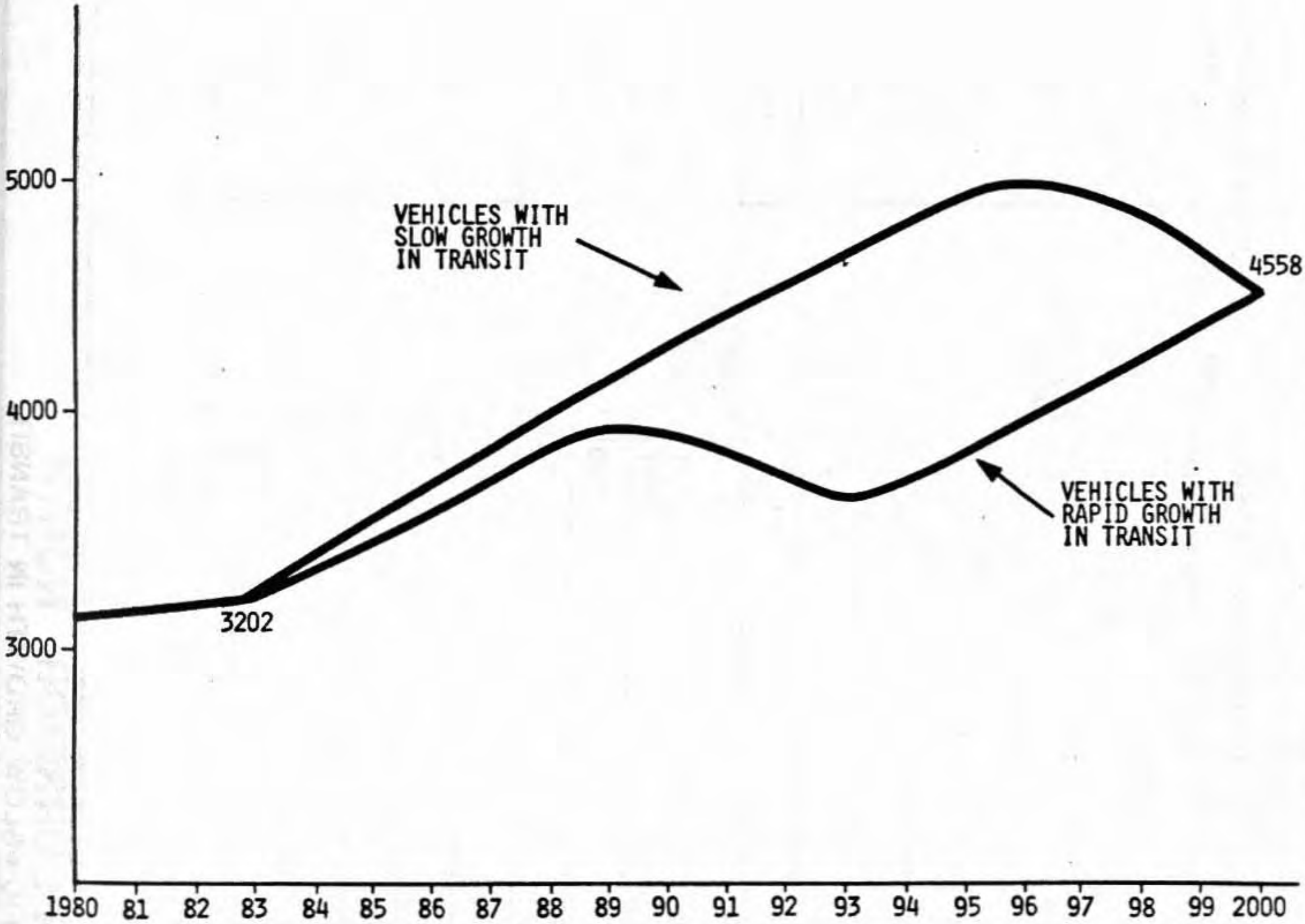
- Stage 3B (Powell to Harold reversible lane), Stage 4 (Harold to Ochoco widening), and major transit expansion (bus or LRT) are dependent on growth in travel, and their timing is interrelated. Specifically:



McLOUGHLIN CORRIDOR: NORTH

RELATIONSHIP OF TOTAL TRAVEL DEMAND & TRANSIT RIDERSHIP GROWTH

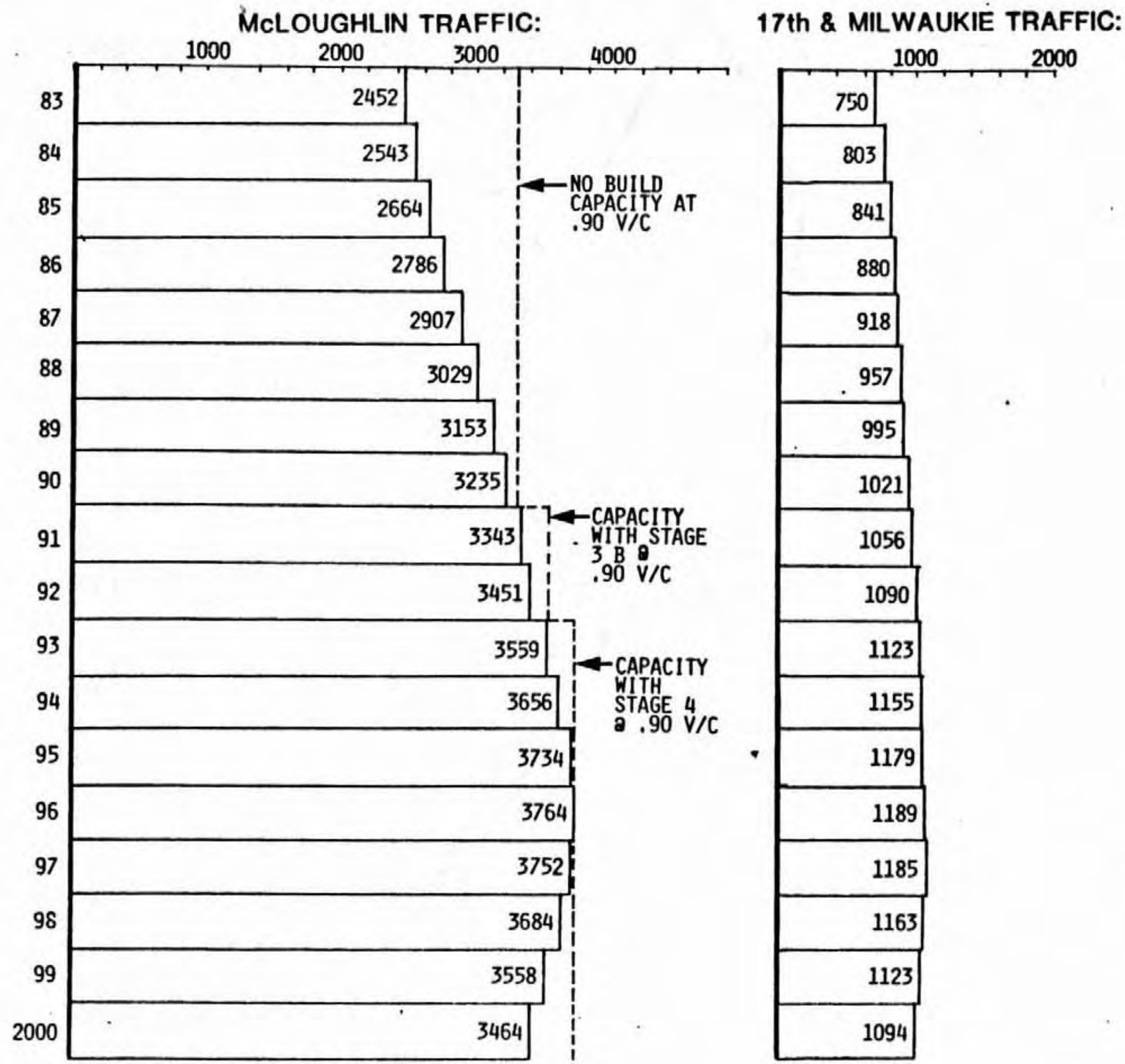
FIG. 32



McLOUGHLIN CORRIDOR: NORTH

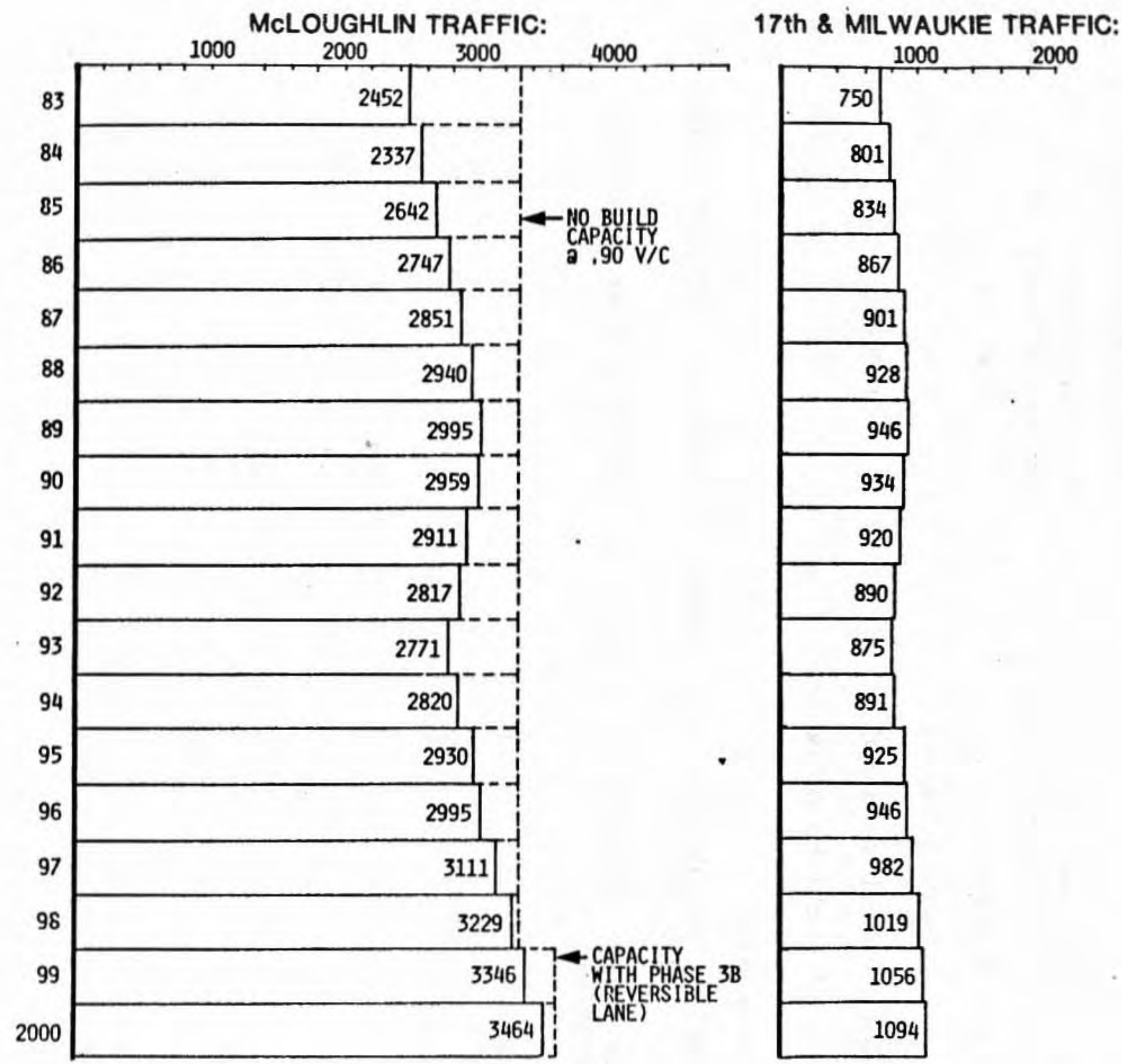
TOTAL VEHICLES TRAVELING THROUGH THE CORRIDOR

FIG. 33



McLOUGHLIN CORRIDOR: NORTH
GROWTH IN TRAFFIC • SLOW GROWTH IN TRANSIT

FIG. 34



McLOUGHLIN CORRIDOR: NORTH
GROWTH IN TRAFFIC • RAPID GROWTH IN TRANSIT 1983–2000

FIG. 35

TABLE 25

Findings of the
Milwaukie Corridor Staging Analysis

Proposed McLoughlin Highway Improvement Stage		Year Travel Demand Requires Project[1] With a Slow Expansion In Transit	Year Travel Demand Requires Project[1] With a Rapid Expansion In Transit
Stage 1:	Tacoma	Now	Now
Stage 2:	River to Tacoma	Now	Now
Stage 3B:	Powell to Harold[2]	1991	1999
Stage 4:	Harold to Ochoco	1993	2001

1 Based on the controlling intersection for ech project stage reaching a .90 v/c ratio.

2 Stage 3A: Union-Grand viaduct is tied to the Marquam ramp project.

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- Early implementation of transit defers the need for highway stages 3B and 4 by five to ten years.

- Early implementation of highway Stages 3B and 4 inhibits the ability to expand transit ridership by providing high-quality levels-of-service on McLoughlin Boulevard. This, in turn, reinforces the "slow growth" transit ridership curve.

- With a "slow growth" transit ridership curve, the improved Ochoco intersection, which controls McLoughlin capacity after Stages 1 and 2, is over desirable capacity from 1991 to at least 1998. This will make it difficult to divert Clackamas County to Sellwood Bridge traffic from 17th Avenue to McLoughlin. Therefore, the timely improvement of transit service is essential for the proper operation of the improved highway and the continued removal of regional traffic from the Sellwood neighborhood.

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APPENDIX A

NETWORK ROUTE LISTINGS

REGIONAL LIGHT RAIL STUDY -- BASIC BUS NETWORK - YEAR 2000

LINE # RT. #	ROUTE NAME	FROM	TO	HEADWAYS (MIN) PM PEAK	DAYBASE	VEHICLE	SERVICE	THROUGH ROUTE #	COMMENTS
1	Banfield LRT (long)	CBD	Gresham Term.	6	10	LRV (2)	Limited	--	On Mall
1	" " (short)	"	Gateway Sta.	4	--	" "	"	--	Cross Mall
3	Barbur (long)	"	Tigard TC	2	15	Artic.	Limited	--	Local from Tigard
3	" (short)	"	Barbur TC	4	--	"	"	--	
4	Lake Oswego	"	Lake Oswego TC	4	15	"	Local	--	
5	Interstate (long)	"	Vancouver TC	4	15	"	"	--	
5	" (short)	"	Columbia Blvd.	4	--	"	"	--	
6	Eastside	Columbia Blvd.	Clackamas Town C.	10	15	"	"	--	
7	McLoughlin (short)	CBD	Milwaukie TC	2.3	--	"	Limited	--	Limited between Mil. & CBD
7	" (medium)	"	Oregon City TC	20	30	"	Local	--	" " " " "
7	" (long)	"	Clackamas C.C.	20	30	"	"	--	" " " " "
8	Beaverton (long)	"	Beaverton TC	1.3	15	"	Limited		
8	Beaverton (short)	"	Sunset T.C.	3	--	"	"	--	
9	Sunset (long)	Sunset TC	Hillsboro	10	30	"	"	--	
9	" (short)	" "	Tanasbourne TC	10	30	"	"	--	
10	Division	CBD	Gresham Central	10	30	"	Local	76	
10	"	"	122nd & Division	10	15	"	"	76	
11	Powell	"	Gresham Central	10	30	"	"	21	
11	"	"	122nd & Powell	10	15	"	"	21	
12	12th Ave	Milwaukie TC	Linnton	20	30	Std.	"	--	
12	"	" "	U of Portland	20	30	"	"	--	
13	Sandy Blvd	CBD	Parkrose TC	5	10	Artic.	"	14	Proposed Trolley Bus
14	Hawthorne	"	I-205	5	10	"	"	13	" " "
15	15th Ave	"	Lombard & Interstate	7-1/2	10	Std.	"	50	
16	Union Ave	"	Expo Center	10	20	Artic.	"	--	
16	" "	"	Union & Lombard	10	20	"	"	--	
17	Holgate	"	Holgate & 136th	10	15	Std.	"	33	Via 11th-12th
18	Belmont	"	Market & 122nd	6	10	Artic.	"	23	Proposed Trolley Bus
19	Glisan	"	Gateway Sta.	10	15	"	"	--	
20	Burnside	Cedar Hills TC	Mt. Hood C.C.	--	30	Std.	"		
20	Burnside	" " "	Stark & 122nd	15	30	"	"	--	
20	"	23rd/Burnside	" " "	15		"	"	--	

LINE #	RT. #	ROUTE NAME	FROM	TO	HEADWAYS (MIN) PM PEAK	HEADWAYS (MIN) DAYBASE	VEHICLE	SERVICE	THROUGH ROUTE #	COMMENTS
	21	NW 21st-Yeon	CBD	St. Johns	10	20	Artic.	"	11	
	21	" " "	"	Kitridge Ave.	10	20	"	"	11	
	22	NW Industrial	SWTC	35th & Guam	10	15	Std.	"	30	via 11th & 12th
	23	23rd Ave	CBD	Gordon & Thurman	6	10	Artic.	"	18,	trolley bus
	24	E. 24th Ave	33rd/Columbia	I-205 & Foster	10	15	Std.	"	--	
	25	Front	CBD	St. Johns	10	30	"	"	35	via 1st-2nd
	26	Westover	23rd & Burnside	23rd & Burnside	30	30	"	"	--	
	27	Broadway-Halsey	11th & Morrison	Troutdale	20	30	"	"	--	
	27	" "	" "	Gateway Sta.	20	30	"	"	--	
	28	Zoo-OMSI	CBD	Zoo-OMSI	30	30	"	"	--	
	29	Council Crest	SWTC	Council Cr. Dr.	30	30	"	"	--	
	30	Corbett Ave-Ardenwald	SWTC	Clackamas Town C.	20	30	"	"	22	via 18th
	30	"	"	17th & Milwaukie Blvd.	20	30	"	"	--	
	31	--	--	--	--	--	--	--	--	
	32	Oatfield Rd.	Milwaukie TC	Molalla	30	60	"	"	--	
	32	" "	Milwaukie TC	Clackcmas C.C.	30	60	"	"	--	
	33	E. 33rd Ave.	CBD	33rd & Elrod	10	15	"	"	17	via 11th-12th
	34	River Rd.	Milwaukie TC	Clackamas C.C.	15	30	"	"	--	
	35	Woodstock	CBD	I-205 & Foster	10	15	"	"	25	via 1st-2nd
	36	Sellwood Local	32nd & Rex	6th & Tacoma	15	30	Mini	"	--	
	37	King Road	Milwaukie TC	142nd & Sunnyside	15	30	"	"	--	
	38	--	--	--	--	--	--	--	--	--
	39	E. 39th/Lombard	Milwaukie TC	Rivergate	10	30	"	"	--	
	39	E. 39th/Lombard	Johnson Cr. Blvd.	St. Johns	--	30	"	"	--	
	40	Lewis & Clark	Burlingame TC	Lake Oswego TC	15	30	"	"	--	
	41	Tigard Local	Barbur TC	Tigard TC	15	30	Mini	"	--	
	42	Capitol Hwy	Burlingame TC	Lake Oswego TC	15	30	Std.	"	--	
	43	Burlingame/Tigard	Beaverton TC	Washington Square	15	30	Mini	"	--	
	44	Sherwood	Tigard TC	Sherwood	15	30	Std.	"	--	
	45	Garden Home	Milwaukie TC	Beaverton TC	15	30	"	"	--	
	46	South Shore	Lake Oswego TC	Tualatin TC	15	30	"	"	--	
	47	North Shore	Lake Oswego TC	Tualatin TC	15	30	"	"	--	
	48	Boones Ferry Rd.	Burlingame TC	Meridian Pk. Hospital	15	30	"	"	--	
	49	Ore. City-West	Lake Oswego TC	Clackamas C.C.	15	30	"	"	--	
	50	Terwilliger Blvd	CBD	Burlingame TC	15	30	"	"	15	

LINE #	RT. #	ROUTE NAME	FROM	TO	HEADWAYS (MIN) PM PEAK	DAYBASE	VEHICLE	SERVICE	THROUGH ROUTE #	COMMENTS
	50	Terwilliger Blvd	CBD	Veterans Hospital	15	15	"	"	15	
	51	Dosch-Scholls Loop	11th/Morrison	Cameron Loop	10	15	Mini	Local	--	20 pk, 30 day - each leg
	52	Vermont	Burlingame TC	P.C.C.	15	30	Std.	"	--	
	53	Arnold	Burlingame TC	P.C.C.	15	30	Mini	"	--	
	54	Beaverton-Hillsdale	CBD	Beaverton TC	15	30	Std.	"	73	via 1st-2nd
	55	Hamilton	Burlingame TC	Cedar Hill TC	15	30	Mini	"	--	
	56	Scholls Ferry Rd	CBD	Tigard TC	15	30	Std.	"	73	via 1st-2nd
	57	--	--	--	--	--	--	--	--	--
	58	Beltline	Sunset TC	Lake Oswego TC	15	30	"	"	--	
	59	Canyon Rd.	CBD	Beaverton TC	15	30	"	"	75	
	60	Tanasbourne	Sunset TC	Tanasbourne TC	15	30	"	"	--	
	61	Baseline	Beaverton TC	Hillsboro	15	30	"	"	--	
	62	170th Ave.	Tanasbourne TC	Beaverton TC	15	30	Mini	"	--	
	63	W. 185th Ave.	Beaverton TC	Tanasbourne TC	15	30	Std.	"	--	
	64	W. 198th Ave.	Tanasbourne TC	179th & Farmington	15	30	Mini	"	--	
	65	Walker	PCC Rock Creek	Beaverton TC	15	30	Std.	"	--	
	66	Parkway	Sunset TC	Beaverton TC	15	30	Mini	"	--	
	67	Murray	Sunset TC	Beaverton TC	15	30	"	"	--	
	68	Taylors Fry Rd.	Barbur TC	Beaverton TC	15	30	Std.	"	--	
	69	TV Highway	Beaverton TC	Forest Grove	20	30	"	"	--	
	69	" "	Beaverton TC	Hillsboro	20	30	"	"	--	
	70	Columbia Blvd.	St. Johns	Gresham Central	15	30	"	"	--	
	71	Killingsworth	Phantom	Parkrose TC	10	15	"	"	--	
	72	Prescott	Channel	Parkrose TC	10	15	"	"	--	
	73	Fremont	CBD	Gateway Sta.	7-1/2	15	"	"	54 & 56	via 1st-2nd
	74	Knott St.	Interstate/Russell	Hollywood Sta.	15	15	Mini	"	--	
	75	Greeley	CBD	U of Portland	15	30	Std.	"	59	
	76	Fessenden	CBD	St. Johns	7-1/2	10	Artic.	"	10 locals	
	77	Hayden Is. Local	West End	East End	20	20	Mini	"		
	78	Gresham-Troutdale	Gresham Central	Troutdale	15	30	"	"		
	79	Gresham-Sandy	Gresham Central	Sandy	30	60	Std.	"		
	80	Market-Mill	Gateway Sta.	Gresham Central	15	30	"	"		
	81	E. 57th-60th	Airbase	Clackamas TC	15	15	"	"		
	82	E. 82nd Ave.	Parkrose TC	Clackamas Town C.	10	10	Std.	Local		
	83	E. Fremont local	Parkrose TC	Gateway Sta.	15	30	"	"		

LINE #	RT. #	ROUTE NAME	FROM	TO	HEADWAYS (MIN) PM PEAK	DAYBASE	VEHICLE	SERVICE	THROUGH ROUTE #	COMMENTS
	84	E. 102nd-112th Ave.	Gateway TC	Clackamas Town C.	15	15	"	"		
	85	--	--	--	--	--	--	--	--	--
	86	E. 148th Ave.	148th & Marine Dr.	I-205 & Foster	15	30	"	"		
	87	E. 182nd Ave.	185th & Marine Dr.	Gresham Central	15	30	"	"		
	88	E. 202nd Ave.	Parkrose TC	I-205 & Foster	15	15	"	"		
	88	"	201st & Sandy	Luster Rd.	15	30	Mini	"		
	89	E. Glisan-223rd Ave.	Gateway Sta.	Gresham Central	15	30	Std.	"		
	90	90-I-205	P.I.A.	Tigard TC	15	15	"	"		
	91	Jackson Bridge	Gateway Sta.	Vancouver Mall	10	30	Artic.	Limited		
	92	--	--	--	--	--	--	--	--	--
	93	Lake Road	Milwaukie TC	Oregon City TC	15	30	Std.	"		
	94	Estacada	Clackamas Town C.	Estacada	30	60	"	"		
	95	Thiessen Rd.	Oak Grove	Hwy 212 & 130th	30	30	Mini	"		
	96	Canby-Wilsonville	Oregon City TC	Tualatin TC	30	60	Std.	"		

Milwaukie Corridor
Working Paper "B"

ALIGNMENT DESCRIPTION REPORT

October 1984

METROPOLITAN SERVICE DISTRICT

TRI-MET

REGIONAL LRT SYSTEM PLAN
MILWAUKIE CORRIDOR WORKING PAPER "B"

ALIGNMENT DESCRIPTION REPORT

Prepared by
Tri-Met
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The Regional LRT System Plan
is being conducted in cooperation with:

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Portland, OR 97201
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FOREWARD

This is one in a series of working papers used to document results of the Milwaukie Corridor portion of the Regional LRT System Plan. Because it is one in a series, by itself this working paper does not cover all issues important to deciding on the long-term transit alternative for the Milwaukie Corridor. The series of working papers are:

A. Travel Forecasts
B. Alignment Description Report (this document)
C. Preliminary Benefit and Impact Assessment
D. Capital and Operating Costs and Economic Evaluation

In addition, a Summary Report for the Milwaukie Corridor has been prepared and is available for review.

At various locations in this report, summary discussions of structural features and their estimated costs reference the Conceptual Engineering Report. The Conceptual Engineering Report, prepared by a structural engineering consultant, presents the detailed findings of preliminary structural analysis, design, and cost estimating.

MILWAUKIE CORRIDOR: ALIGNMENT DESCRIPTION REPORT

The pre-engineering analysis for the Milwaukie Corridor has identified two basic alignments with many variations: 1) the Portland Traction Company (PTC) right-of-way (ROW), and 2) parallel to McLoughlin Boulevard. In association with impact assessment tasks, it has been decided that no engineering work will be performed for the 17th Avenue alignment or the Southern Pacific option of the McLoughlin alignment.

This paper describes the locations and engineering issues of these alignments and the variations. It discusses these alignments in three general parts: (1) Corridor alignments from the Hawthorne Bridge to Ochoco Street in Milwaukie, (2) Central Milwaukie alignments from Ochoco south, and (3) Downtown Portland alignments.

I. PTC AND MCLOUGHLIN LRT CORRIDOR ALIGNMENTS

The PTC Alignment

The following is a description of a LRT alignment within the existing PTC ROW from the Hawthorne Bridge to the proposed River Road station. Connections from the River Road station to alternative Milwaukie Transit Center locations are covered in Part II of this paper.

The alignment would cross the Hawthorne Bridge by occupying the center lanes with one or two tracks. After crossing the bridge, the tracks would extend down the Water Street ramp, turning south on the west side of Water Street to a station between Hawthorne and Clay Streets. The alignment would then enter the Portland Traction Company yards just south of Clay Street and continue south along the PTC right-of-way to a station under the Ross Island Bridge. This station would be accessible by stairs and elevators from the bridge. Bus pull-outs and stops would be built on this bridge, and a sidewalk added on the south side of the bridge to Powell Boulevard.

From this point, the alignment would follow the railroad right-of-way past Ross Island Sand and Gravel and Oaks Bottom to a station at Oaks Park, then on to another station below the east end of the Sellwood Bridge. This station would be accessible by sidewalk and stairs from Tacoma Street, as well as by buses at a track-level bus stop. The LRT, still in the PTC right-of-way, would curve to the east along the southern edge of Sellwood to a station just west of 13th Avenue. This is Golf Junction, where some former PTC carbarns are located. The alignment continues east on the railroad right-of-way to another station just west of S.E. 17th--or River Road. See Figure 1.

Major engineering issues accompanying this alignment were investigated by Tri-Met and their consulting structural engineer. The results of the structural engineers analysis are detailed in the Milwaukie Corridor Conceptual Engineering Report summarized below.

- Hawthorne Bridge and Water Avenue Ramp (Conceptual Engineering Report, Task A7 in Appendix A).

  Hawthorne Bridge: Without modifications, there must be load restrictions to carry LRT. An in-depth analysis is required to determine the extent and cost of possible modification. The load restrictions will likely reduce the bridge's traffic capacity. If the load restrictions are acceptable, only costs associated with trackwork and electrification will be required.

  Water Avenue Ramp: The Water Avenue ramp--currently a timber piling structure--will have to be rebuilt to accommodate LRT. The entire east-end approach to the bridge is scheduled for replacement in the near future regardless of LRT plans. Cost for a Water Avenue ramp accommodating LRT and mixed-traffic is estimated at between \$1.5 and \$1.9 million.

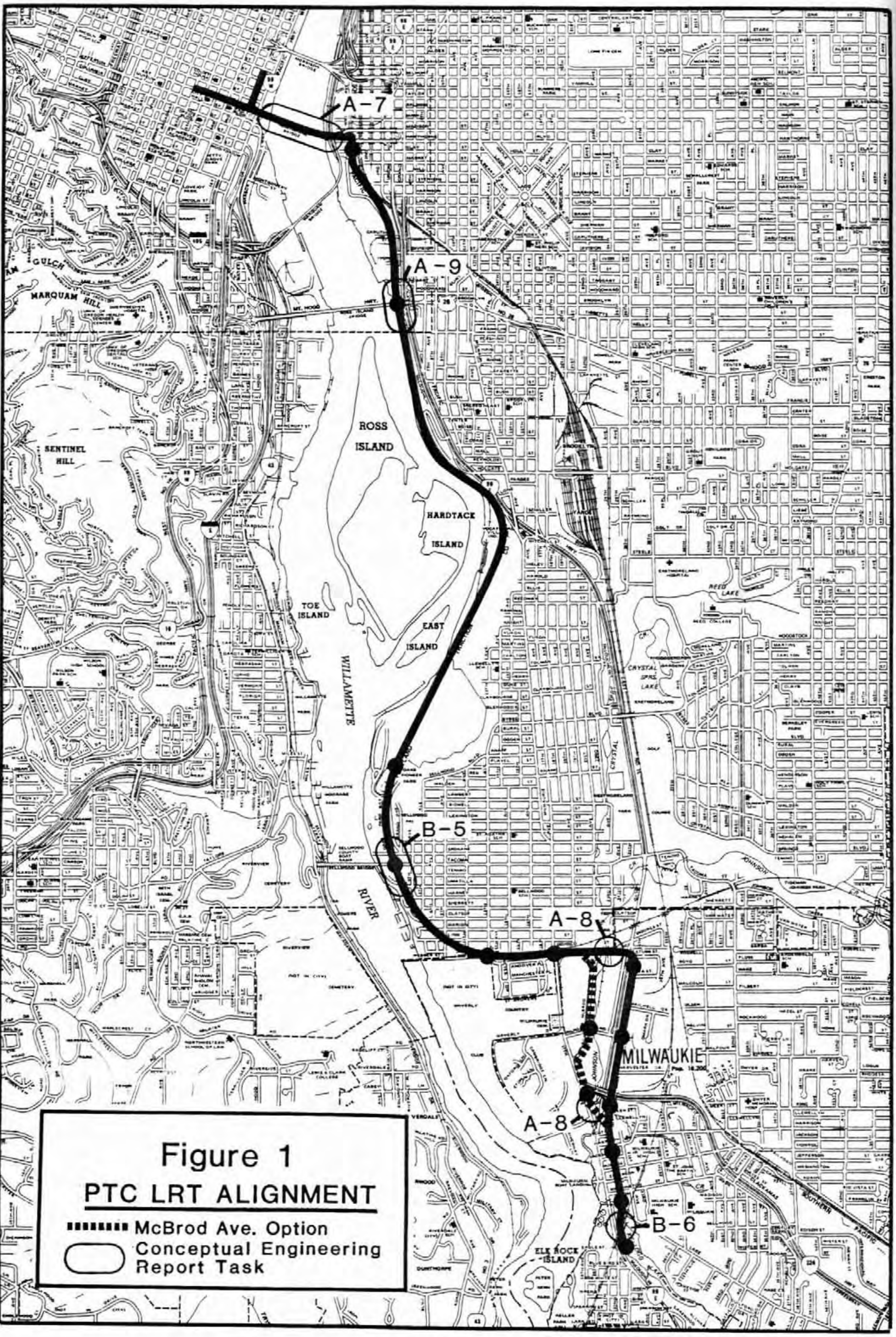

Figure 1
PTC LRT ALIGNMENT

- Ross Island Bridge Station (Conceptual Engineering Report, Task A9)

  The Ross Island Bridge station provides a link between east-west buses on Powell Boulevard and the LRT alignments on or adjacent to the PTC right-of-way. The total cost for developing bus turnout lanes on the bridge and a passenger transfer facility (elevator, stairs, shelters) was estimated to be $3.41 million to $4.00 million.

- Sellwood Bridge Station (Conceptual Engineering Report, Task B5)

  The Sellwood Bridge Station could be developed very inexpensively; however, a series of retaining walls would allow development of a circulation pattern around the station for local feeder buses. Short-term parking (for kiss-and-ride) could also be included. The cost of the retaining wall system to accomplish this is estimated at $514,100.

  The alignment south of the River Road station would follow one of two options--McBrod Avenue to River Road and into central Milwaukie, or Ochoco Street to Main Street and into central Milwaukie. These options are discussed in Part II of this report where central Milwaukie alignments are reviewed.

The McLoughlin Boulevard Alignment

Identifying a McLoughlin Boulevard LRT alignment is a somewhat controversial task, given that so many different assumptions can be made about how the proposed highway widening project relates to an LRT alignment. Five possible staging scenarios are shown in Table 1.

The McLoughlin Boulevard LRT alignment described as follows attempts to satisfy fully the needs of scenarios 2 and 4 and partially the needs of scenario 1. Although this alignment appears to best meet the goals of the Regional Light Rail Study, it does not preclude future decisions either to construct a joint project or to eliminate LRT or highway widening if either mode proves unnecessary. In addition, the described alignment allows for the continued operation of the PTC's freight service by the PTC even though some land acquisition would occur.

The proposed McLoughlin alignment would run north from the Milwaukie Transit Center on Main Street to the Clackamas Highway overpass. If the LRT line was constructed prior to the widening of McLoughlin, the alignment would be between McLoughlin and Main, north to Beta Street. If the LRT line was constructed after the widening of McLoughlin, the alignment would run with mixed traffic in Main Street, north to Beta Street. At Beta Street the alignment would turn east until it reached the Southern Pacific Railroad where it would turn north and parallel the SPRR all the way to S.E. Harold Street. The PTC bridge over the SPRR would have to be lengthened and a new Johnson Creek LRT bridge built. North of Harold Street the alignment would ascend on structure over the southbound lanes of McLoughlin Boulevard, and for a short distance along the south side of Mitchell Street. The alignment would then cross Milwaukie Avenue at grade and continue onto the embankment overlooking the PTC and the Willamette River. It would turn northward and descend along the side of the embankment to about Holgate Boulevard where it would cross the PTC on an elevated structure

Table 1

POSSIBLE STAGING SCENARIOS
MCLOUGHLIN BOULEVARD WIDENING/MCLOUGHLIN LRT

SCENARIO	STEP 1	STEP 2
1	Construct preferred highway alternative without easy LRT conversion capability	Construct LRT by rebuilding McLoughlin Boulevard as necessary (probably with LRT on its own ROW as much as possible)
2	Construct widened highway - modify highway plans to set aside LRT ROW	Add LRT tracks
3	Construct LRT in most cost-effective manner (independent of highway project)	Rebuild highway and LRT as necessary when/if widening occurs
4	Construct LRT preserving ROW for highway project	Add highway lanes
5	Joint LRT and highway project	Joint LRT and highway project

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and then continue north to the Ross Island Bridge at grade west of a realigned PTC track. The alignment would then continue at grade to the Hawthorne Bridge. See Figure 2.

The major variation of this alignment involves the section south of Beta Street, indicated by a dashed line on Figure 2. Instead of following Main Street the alignment would follow the Tillamook branch of the SPRR from the intersection of Main and Lake north to the junction with SP's main line.

The McLoughlin alignment would have stations located at Water Avenue, Powell Boulevard, Milwaukie Avenue, Bybee Boulevard, Tacoma Street, Beta Street, and on Main Street at Milport Road, south of Highway 224. LRT/bus transfers would occur at Powell Boulevard, Mitchell Street, Bybee Boulevard, and at Tacoma Street.

Major engineering issues addressed as part of the McLoughlin alignment evaluation are summarized below.

- Hawthorne Bridge and Water Avenue Ramp/Ross Island Bridge Station: These elements of the PTC alignment evaluation were considered to be the same for the McLoughlin alignment.

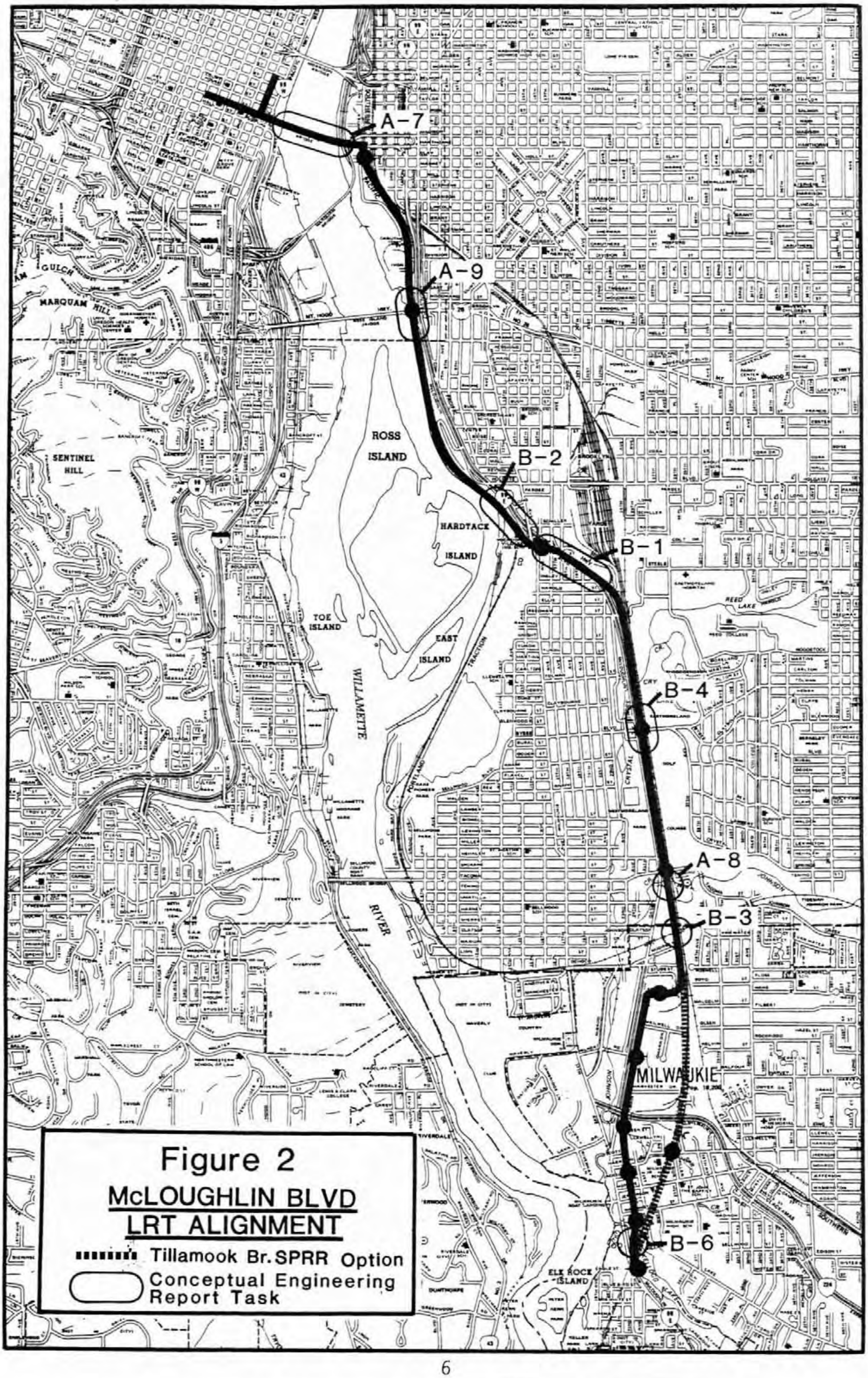
- Transition from McLoughlin Boulevard to the PTC (Conceptual Engineering Report, Tasks B1 and B2): A raised structure carrying the McLoughlin alignment from the east side of McLoughlin, over traffic lane to the west, and along the south side of McLoughlin until entering Mitchell Street has been estimated. The alignment would then cross Milwaukie Avenue at grade. This structure was found to be less costly than a cut and cover tunnel on the same general alignment. Total estimated cost is $8.54 million.

  Connecting with this alignment is a series of reinforced earth ramps, retaining walls, and structures to carry the alignment down the hillside between McLoughlin Boulevard and the PTC freight tracks (B2). From here north it is assumed that the McLoughlin alignment would parallel the PTC alignment. Total cost of this series of structures is estimated at $7.79 million.

- Bybee Boulevard Station (Conceptual Engineering Report, Task B4): A set of passenger transfer facilities to allow Woodstock (#19) bus patrons to transfer to the McLoughlin LRT was designed, and are estimate to cost $161,100.

- Johnson Creek Crossing (Conceptual Engineering Report, Task A8): Depending on the location of the McLoughlin LRT at this point in the corridor, one of two bridges over Johnson Creek would be necessary. The cost of either of these bridges is estimated at $171,300.

- PTC Overpass (Conceptual Engineering Report, Task B3): As with the Johnson Creek crossing, the McLoughlin alignment could be aligned adjacent to McLoughlin Boulevard or the Southern Pacific Railroad. In either of these positions, a new structure to carry the Johnson Creek branch of the PTC over



A-7
A-9
B-2
B-1
B-4
A-8
B-3
B-6
MILWAUKIE
ROSS ISLAND
HARDTACK ISLAND
TOE ISLAND
EAST ISLAND
WILLAMETTE
RIVER
SENTINEL HILL
MARQUAM HILL
GULCH
ELK ROCK ISLAND
REED LAKE
Figure 2
McLOUGHLIN BLVD
LRT ALIGNMENT
Tillamook Br. SPRR Option
Conceptual Engineering Report Task

the alignment would be necessary. Adjacent to the S.P. Railroad, this is projected to cost $147,000, while adjacent to McLoughlin Boulevard, the cost would be $161,000.

Low Priority Alternative Alignments

This section describes low priority alternatives to the three basic alignments and variations just presented. These alternatives include the 17th Avenue Alignment, a McLoughlin Boulevard median and an adjacent alignment, and a PTC alignment south of Golf Junction.

The 17th Avenue Alignment

The 17th Avenue alignment runs in River Road from its intersection with McBrod north to Ochoco where it enters 17th Avenue. It then continues in 17th Avenue through Sellwood to Insley Street or Mitchell Street where it would turn west and enter a tunnel under Milwaukie Avenue. From here north it would follow the McLoughlin alignment. Stations would be located at Water Avenue, Powell Boulevard, Milwaukie Avenue, Reedway Street, Tolman Street, Bybee Boulevard, Lambert Street, Tacoma Street, Ochoco Street, and Milport Road. See Figure 3.

This alignment would cause local access problems and substantially reduce parking along 17th Avenue. Some businesses would be displaced to obtain necessary right-of-way. Further, there is reason to question the compatibility of LRT with a neighborhood street environment.

McLoughlin Boulevard Median Alignment

From Downtown Milwaukie this alignment follows Main Street north to Beta Street and then to the intersection of Ochoco Street and McLoughlin Boulevard, where it enters the median of McLoughlin Boulevard. This alignment would be most reasonably built as a joint project in conjunction with the McLoughlin Boulevard widening project and the Marquam Bridge ramps project.

Heading north from Ochoco Street the median alignment would require land acquisition to Tacoma, rebuilding of the PTC overpass, modification of the Bybee Boulevard overpass, land acquisition from Reedway Street north to Ivon Street, reconstruction of the Milwaukie Boulevard overpass, widening of the McLoughlin Boulevard elevated structure, modification of the Ross Island bridgehead, widening the fill section between Woodward Street and Ivon Street and widening the Union/Grand Avenue viaduct, and designing the northbound Marquam Bridge ramp to accommodate parallel LRT to Water Avenue. See Figure 4.

The major disadvantages of the Median LRT alignment include excessive capital costs, coordination with two ongoing highway projects, and extensive traffic disruption during construction.

McLoughlin Boulevard Adjacent Alignment

This alignment runs south from the Hawthorne Bridge to the PTC freight yard and then parallels the SPRR beneath the Union/Grand Avenue viaduct. It then turns south and parallels McLoughlin Boulevard to the S.E. Woodward Street. See Figure 5.

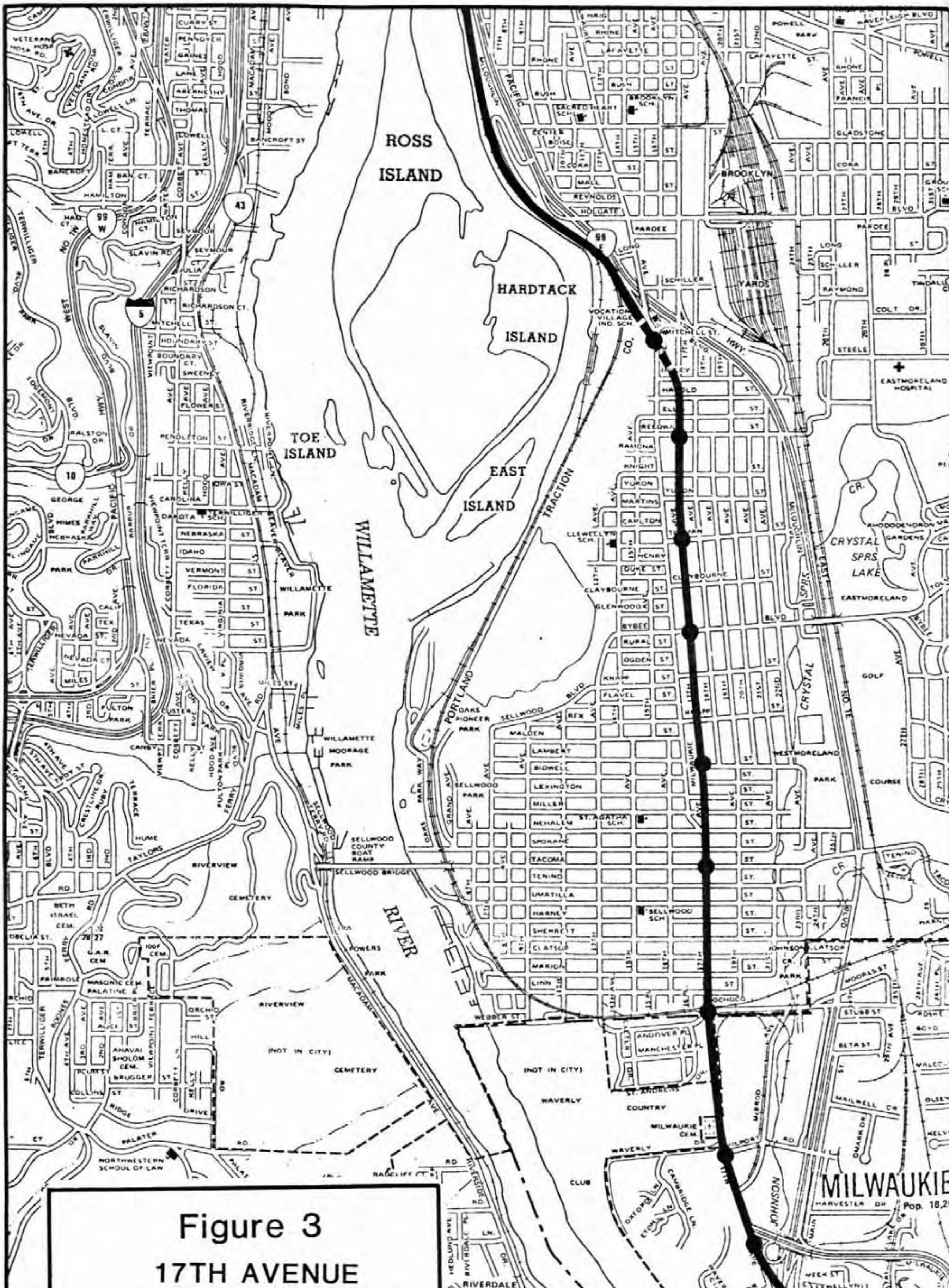


Figure 3

17TH AVENUE LRT ALIGNMENT

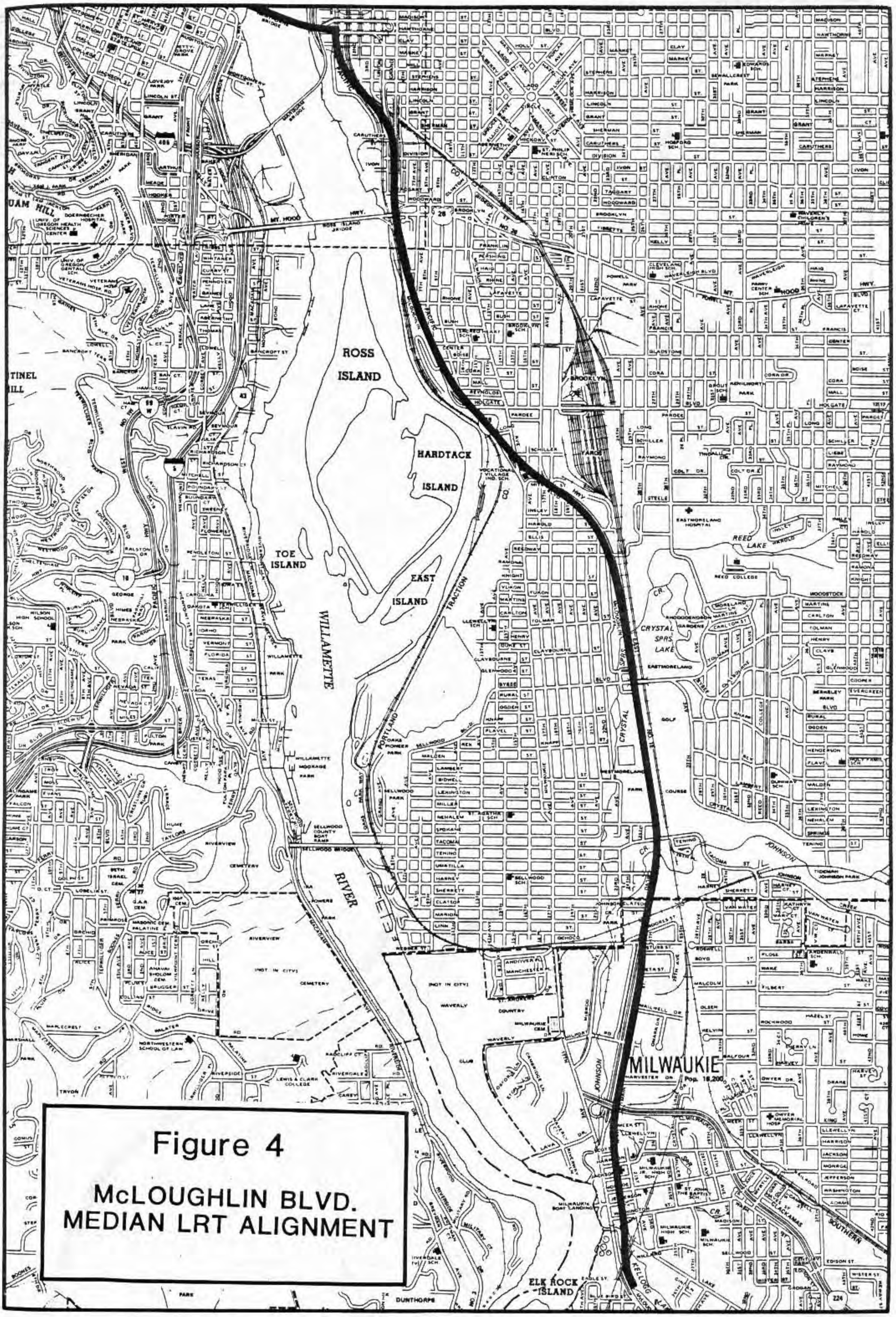


Figure 4

McLOUGHLIN BLVD. MEDIAN LRT ALIGNMENT

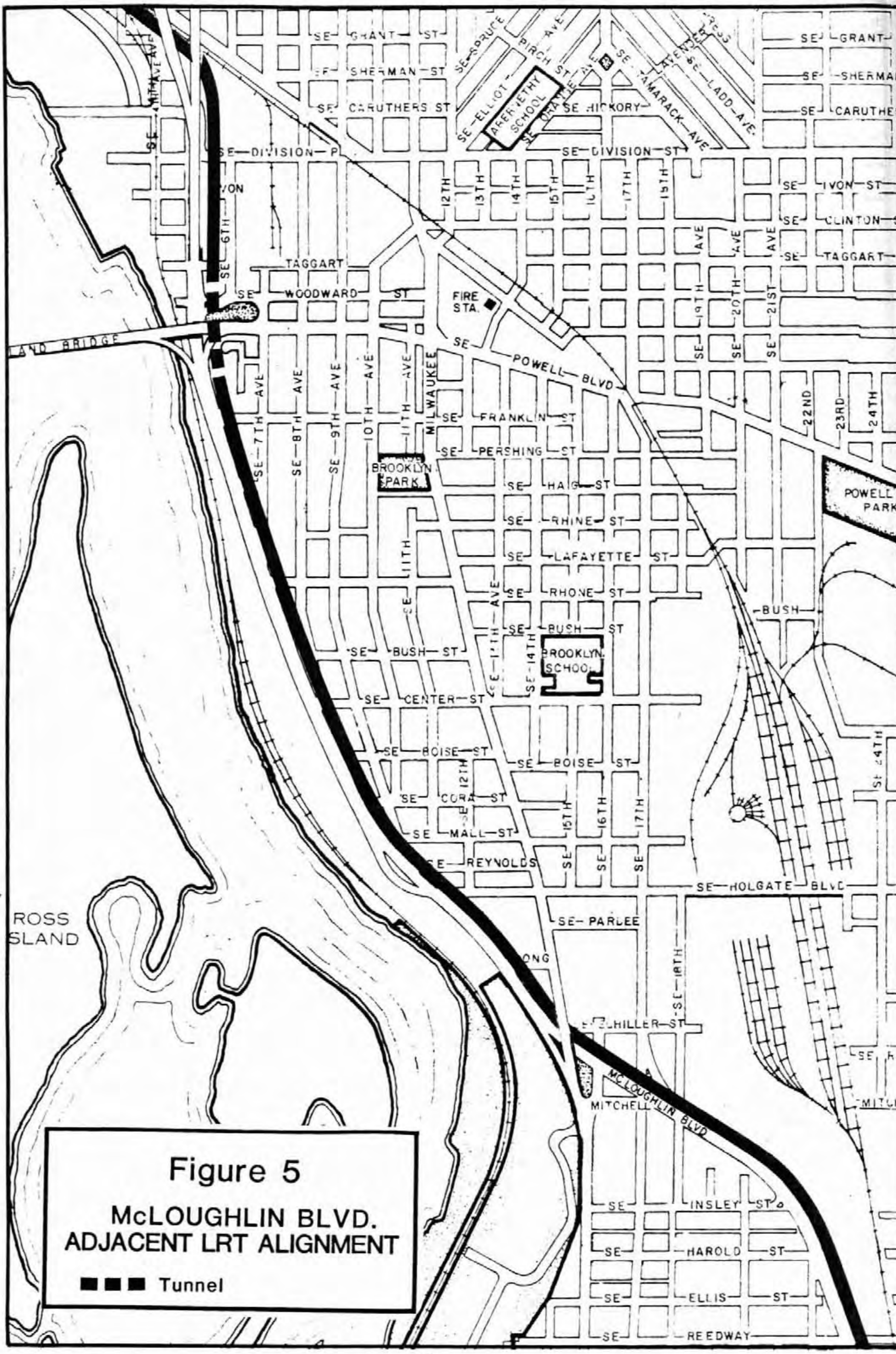


Figure 5

McLOUGHLIN BLVD. ADJACENT LRT ALIGNMENT

■ ■ ■ Tunnel

At S.E. Woodward Street the line would enter a cut and cover tunnel and pass beneath McLoughlin access ramps and Powell Boulevard. The alignment would then run just east of McLoughlin Boulevard to Reedway Street. This segment would require extensive land acquisition including a major building between Milwaukie Avenue and Harold Street, and building an underpass of Milwaukie Avenue.

From Reedway south the alignment would parallel the SPRR to Beta Street where it would proceed to Main Street in Milwaukie, as previously shown on Figure 2.

The major disadvantages of the adjacent alignment include excessive capital costs, traffic impacts near the viaduct, freight impacts at the PTC yard, and traffic disruption during construction of the northern half of the alignment.

PTC Alignment South of Golf Junction

South of Golf Junction at 13th and Andover the PTC ROW has been abandoned and is now part of the Waverly Country Club. See Figure 6. The major disadvantages of this alignment include adverse impacts on the golf course and residences adjacent to Lava Drive, and low density development near potential station sites.

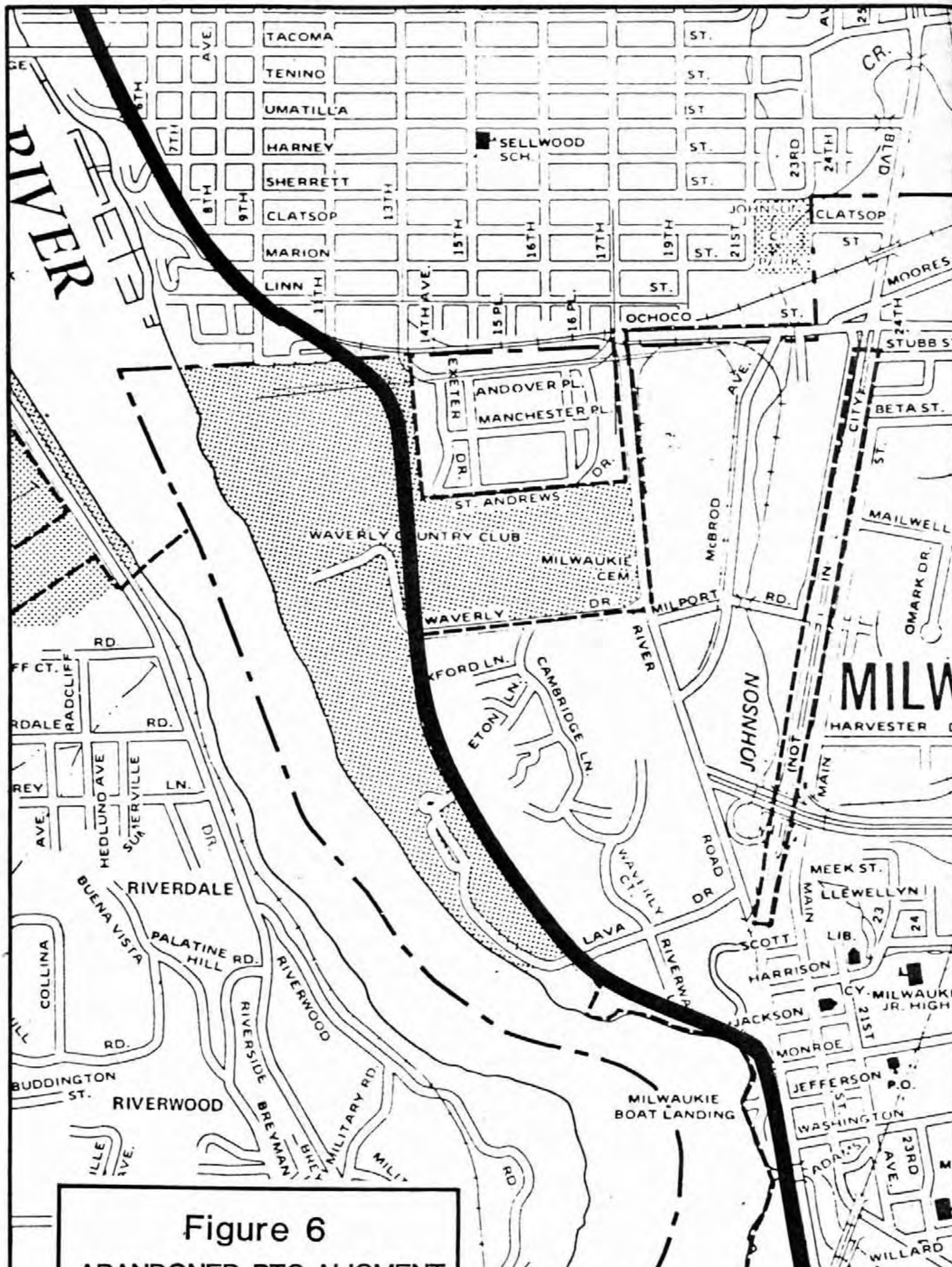


Figure 6

ABANDONED PTC ALIGMENT SOUTH OF GOLF JUNCTION

II. CENTRAL MILWAUKIE ALIGNMENTS

Part II addresses the alternative alignments through central Milwaukie. All potential alignments reviewed in this paper are shown on Figure 7. Pros and cons of each of these potential alignments are discussed for the following areas:

1. North approach into Milwaukie
2. Transit center locations, and
3. Extensions east of central Milwaukie to park-and-ride lots near Highway 224, and south of Milwaukie to a McLoughlin Boulevard park-and-ride.

North Approach to Milwaukie

The pros and cons of five alignments connecting central Milwaukie to the light rail alignments running north to Portland are discussed below and include: 1) River Road (connecting with the PTC or the 17th Avenue alignments to the north), 2) McBrod (also connecting with the PTC and the 17th Avenue alignments, 3) Ochoco/Main Street (connecting with the PTC, McLoughlin or 17th Avenue alignments), 4) the PTC west of McLoughlin, and 5) along the SPRR from Kellogg Lake to Beta Street.

1) River Road

Pros:
- Straight (minimum distance) connections to the PTC or Sellwood LRT alignments;
- Serves industrial parcels east of River Road and residential areas adjacent to Waverly Country Club;
- Crossing of McLoughlin is south of Highway 224 (minimizing traffic impacts on McLoughlin). This crossing could be integrated with River Road jug-handle project (creating intersection of Harrison and River Road).

Cons:
- Very constrained ROW, which is particularly tight north of Milport (cemetery to the west, warehouse/industrial buildings to the east). Widening the ROW between McBrod and Ochoco could affect up to two industrial buildings.

2) McBrod Avenue

Pros:
- ROW could likely be widened or made available adjacent to rail spur lines or road ROW without taking existing structures;
- Serves industrial area between River Road and Johnson Creek;
- Connects with River Road alignment south of River Road/McBrod intersection, allowing the opportunity to take advantage of the River Road/McLoughlin jug-handle intersection (minimizing traffic conflicts at McLoughlin crossing); and
- Serves potential park-and-ride lots near Milport and McBrod and west of River Road at terminus of Highway 224.

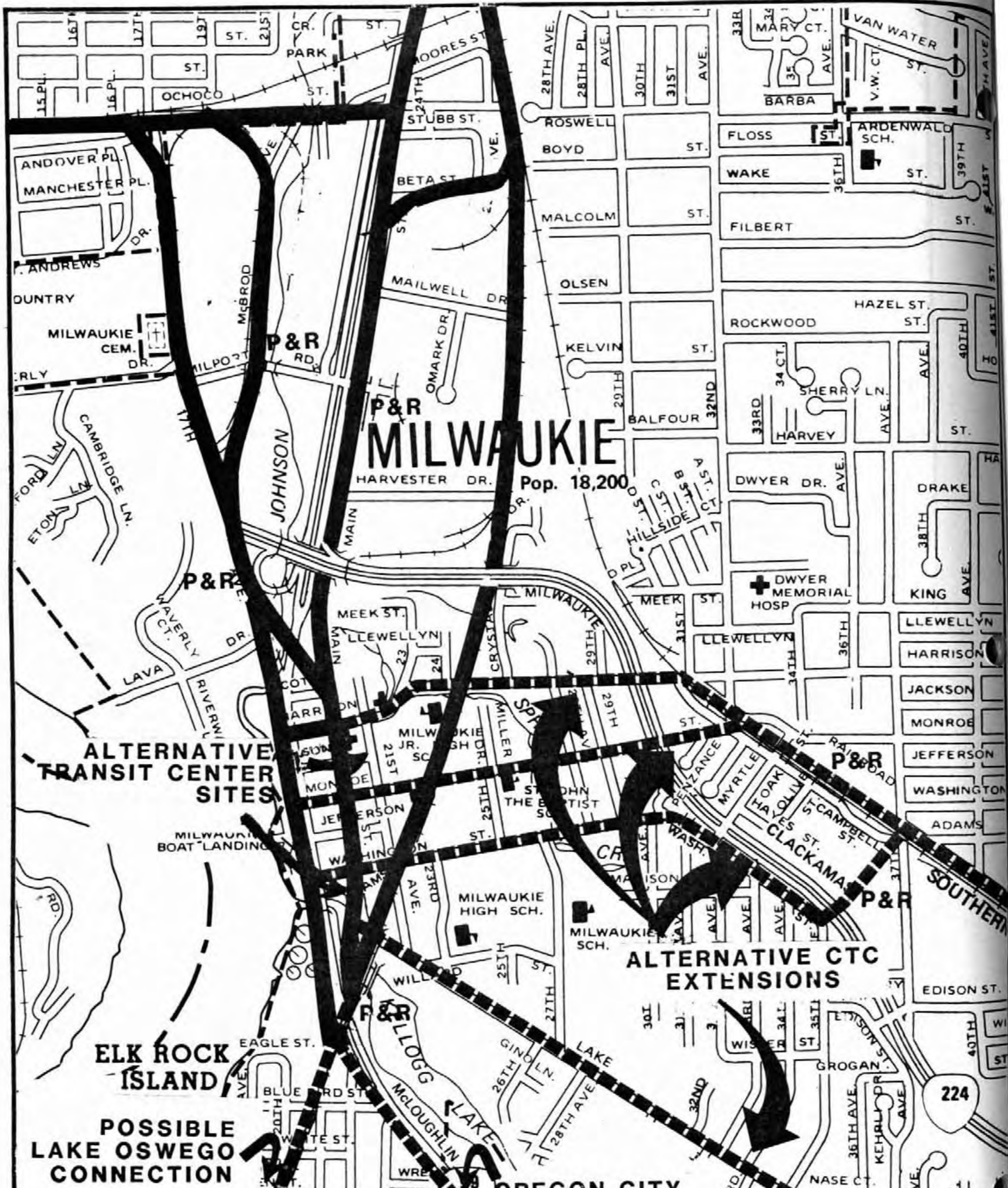


FIGURE 7 CENTRAL MILWAUKIE ALIGNMENTS CONSIDERED

Cons:
- Industrial properties along McBrod have PTC rail spur access. Development plan would have to provide this access or purchase rail access rights from property owners; and
- Grades at McBrod and River Road intersection will likely require large-scale rebuilding of both River Road and McBrod **or** creation of a separate LRT intersection with River Road south of McBrod. This new intersection and alignment between McBrod and River Road would require acquisition of a portion of industrial land planned for development.

3) Ochoco/Main Street

Pros:
- Serves industrial/manufacturing properties east of McLoughlin;
- Serves potential park-and-ride at theatre parking lot (just north of Highway 224); and
- ROW readily available only if double lane ramp from Highway 224 to McLoughlin is not developed. Acquiring ROW east of Main Street is likely to be necessary if ramp is implemented (this ROW acquisition would likely not involve any existing structures). An alternative to ROW acquisition is closing Main and developing a new access road for businesses in the area.

Cons:
- Crossing of McLoughlin at grade at Ochoco north of Highway 224 could add to delay at this intersection for McLoughlin traffic;
- Cost of added ROW or alternative access roads if double lane ramp from Highway 224 to McLoughlin is implemented,and
- Potentially severe disruption of Main Street businesses south of Highway 224 during construction.

4) PTC West of McLoughlin (following the PTC ROW, remaining west of McLoughlin through Central Milwaukie)

Pros:
- Generally the same as McBrod, with the added advantage of no McLoughlin Boulevard at-grade crossing; and
- Easy to extend alignment south along PTC until alignment enters median.

Cons:
- Likely to require a "split" transit station (LRT platform west of McLoughlin, bus transfer facilities east of McLoughlin);
- Does not serve Downtown Milwaukie well; and
- Displacement of businesses west of McLoughlin and south of Harrison.

Transit Center Locations

The Milwaukie Transit Center provides the key link between the feeder bus system in Clackamas County, a Milwaukie to Portland LRT, and a possible rail-bus line on the SPRR to Lake Oswego. The location of this center is important to economic development in central Milwaukie, efficient transit operations, and the ease of extending the corridor east to a park-and-ride near Highway 224 and the Clackamas Town Center (CTC), and/or south to a park-and-ride near McLoughlin Boulevard with a possible extension to Oregon City. Three transit center locations are discussed below: a) southwest corner of Harrison and Main; b) south end of Main Street; and c) split design: east and west of McLoughlin between Monroe and Jackson.

a) Southwest Corner of Harrison and Main (block bordered by McLoughlin, Harrison, Main and Jackson)

Pros:
- Central location on north edge of business district;
- Part of the site is in public ownership, and;
- Good "system" connections to Main and Lake, River Road, McLoughlin, and Harrison (connecting to the east with Railroad/Harmony).

Cons:
- Small site with limited development opportunities; LRT platform or some bus bays may be on-street;
- Possible displacement of Shell station;
- Less convenient connection to Lake Oswego railbus extension; and
- Displacement of parking leased to Downtown Milwaukie businesses.

b) South End of Main Street (between Washington, McLoughlin, and SPRR to Lake Oswego

Pros:
- Part of the site is in public ownership;
- Potential 200-300 car park-and-ride lot nearby (across Kellogg Creek adjacent to McLoughlin Boulevard);
- Large site vacant or available (building is for lease) offers opportunity for small adjacent park-and-ride and/or joint public/private development; and
- Good system connections to McLoughlin, Lake, Lake Oswego/SPRR.

Cons:
- Limits alternatives for an extension east to CTC, as the extension east via Harrison-Railroad-Harmony would not efficiently serve this site; and
- Reduction of parking on Main between Harrison and Washington by about 45 spaces (about 1/2). Of this 45, 23 would be replaced by spaces made available when the existing transit center moves off-street.

c) Split Design (LRT platform west of McLoughlin, most bus platforms east of McLoughlin between Harrison and Jackson)

Pros:
- Eliminates need for LRT crossing of McLoughlin Boulevard; and
- Opens opportunities for joint public/private development linking the Willamette riverfront and Downtown Milwaukie over McLoughlin Boulevard.

Cons:
- Inconvenient transfer between bus and LRT (some or all bus bays across McLoughlin);
- Access to any bus bays west of McLoughlin involves large bus volumes crossing that street, with attendant signal system complications and traffic conflicts; and
- Would involve acquisition and displacement of businesses fronting the west side of McLoughlin Boulevard.

Extension East and South

From the Milwaukie Transit Center location, extensions will be considered in two directions: east to serve the Highway 224 commuter market, and south to serve the McLoughlin Boulevard market. Initially, these extensions could be to park-and-ride lots on the outskirts of Downtown Milwaukie. Later, the alignments could be extended east to Clackamas Town Center or south to Oregon City. Alignments for each of these connections are reviewed below:

a) Washington Street East to Railroad/Harmony

Pros:
- Relatively minor grades;
- Wide (80') ROW;
- Serves neighborhood south of Washington (added transit walk-on market);
- Accesses large park-and-ride lot (500-600 cars) at 37th and Highway 224); and
- Serves the high school directly.

Cons:
- Passes through a quiet residential neighborhood;
- Passes three schools (St. John, Milwaukie, Milwaukie High School) with possible pedestrian conflicts;
- Rejected by Milwaukie City Council as routing for Railroad/Harmony bus connections to CTC;
- Grade crossing of Highway 224 difficult, box structure under Highway 224 is possible; and
- Park-and-ride site made accessible has poor soil conditions (peat bog).

b) Monroe Street East to Railroad/Harmony

Pros:
- Direct route to Railroad/37th park-and-ride lot, and ties in well to CTC extension.

Cons:
- Passes through a quiet residential neighborhood;
- Steep grades, rolling/hilly alignment with potential vertical curve constraints. Leveling the alignment would affect drastically the character of the street and the surrounding neighborhood;
- At-grade crossing of Highway 224 difficult due to the expressway's super-elevation, thus requiring major regrading and redevelopment of Monroe for a significant distance west into the residential neighborhood;
- With vertical curves considered, the grade-level crossing of the SPRR line to Lake Oswego would be difficult; and
- Railroad Avenue park-and-ride site made accessible is relatively expensive industrial land (with rail access).

c) Harrison Street East to Railroad/Harmony

Pros:
- Commercial land use appears more easily suited to LRT development than other alternatives;
- Grades are moderate;
- Flat intersection at Highway 224; and
- Accesses large (500-600 car) park-and-ride site.

Cons:
- At-grade crossing of SPRR mainline near Harrison intersection may be involved (the structure for the grade-separated crossing would begin west of Highway 224);
- The Railroad Avenue park-and-ride site is likely to be expensive, and would remove highway and rail-accessed industrial land from the market; and
- Two right-angle turns will slow operation and increase maintenance.

d) Main Street South to McLoughlin Boulevard or PTC Right-of-Way

Pros:
- Short extension from south-end transit station to potential park-and-ride;
- Serves Main Street with LRT;
- Allows convenient extension to Oregon City via PTC ROW or in the median of McLoughlin Boulevard;
- Accesses small park-and-ride (200-300 cars) at Kellogg Lake;
- Opportunity for pedestrian/bicycle path crossing Kellogg Lake; and
- With Kellogg Lake park-and-ride, opportunity for lakeshore park exists.

Cons:
- Railroad trestle over Kellogg Creek necessary;
- Alignment is in Willamette Greenway;
- From Harrison Transit Center south, removal of angled parking from Main is likely in order to accommodate LRT; and
- Disruption of Main Street business during construction.

e) PTC ROW South to McLoughlin Park-and-Ride

Pros:
- ROW available--potential for little or no impacts.

Cons:
- Pedestrian crossing of McLoughlin to park-and-ride site (over or underpass), **or** LRT crossing of McLoughlin.

f) Lake Road to Harmony Road

Pros:
- Can serve south-end transit center location efficiently;
- Grade separated from potential Lake Oswego rail-bus line and Highway 224, with grades allowing easy grade-separated crossing of SPRR mainline;
- Moderate grades;
- Adjacent vacant parcels with park-and-ride potential; and
- Efficient connection to CTC Transit Center, possible bus trunk line prior to LRT development.

Cons: • Widening of existing ROW likely to be necessary, with some displacement possible on the west end of Lake Road.

Major structural engineering tasks included in the conceptual engineering of central Milwaukie alignments are:

- Johnson Creek Bridge at Ochoco (Conceptual Engineering Report, Task A8): If the PTC alignment follows the Main Street alignment, a crossing of Johnson Creek will be necessary near the present Ochoco crossing. The cost of this crossing was estimated at $169,300.

- Flyover Structure River Road to Main (Conceptual Engineering Report, Task A8): This structure provides an alternative to a grade-crossing of McLoughlin Boulevard if the PTC alignment were to follow the McBrod option. The structure spans Johnson Creek and McLoughlin Boulevard, and lands LRT in the median of Main Street in Downtown Milwaukie. Total estimated cost is $4.03 million.

- Kellogg Lake Trestle (Conceptual Engineering Report, Task B6: At the south end of the PTC and McLoughlin LRT alignments--the alignment crosses a narrow portion of Kellogg Lake to reach a park-and-ride lot. A trestle to make this crossing, adjacent to the Southern Pacific's existing trestle, is estimated to cost between $.85 and $.93 million.

III. POSSIBLE DOWNTOWN PORTLAND ALIGNMENTS

An element of the Regional LRT System Plan is a central area LRT plan which will evaluate the central area LRT system, taking into account the alignment needs and impacts of all major corridors presently considered for eventual LRT development. Until this work is complete, all discussion of Downtown Portland alignments must be considered preliminary. For illustrative purposes, Downtown alignments for the Milwaukie corridor are described below (See Figure 1).

First Avenue to Cross-Mall

This alternative would align light rail tracks north on 1st Avenue from Madison (where the alignment would leave the Hawthorne Bridge) to the Yamhill and Morrison LRT "cross-mall" segment being constructed for the Banfield LRT.

The advantage of this alignment is that it minimizes construction, and therefore costs and impacts. It also works without jeopardizing the progression Downtown's signal system, and therefore minimizes serious traffic impacts.

Major disadvantages of this alignment are three. First, the Milwaukie and Banfield lines together may exceed the policy headway constraint of four minutes established for the Banfield alignment through Downtown's Yamhill Historic District. Second, parking and local access impacts along First from Madison to Yamhill are of concern. Third, the cross-mall alignment does not maximize coverage of Downtown's office core.

Madison to Mall

This alternative would connect the Milwaukie Corridor LRT with an LRT alignment on the Portland Transit Mall. A mall transit alignment is presently proposed as part of the Westside Corridor's preferred alternative. The Milwaukie Corridor LRT cost estimates include only the connection to this mall alignment--not the cost of constructing the mall alignment.

Advantages of this alternative include maximized coverage of Downtown's Government Center and the office core, and similar to the First Avenue alignment, minimized downtown construction. The alignment would bypass the Yamhill Historic District, and thus avoid policy constraints on headways. Development of Madison as a transit street could also improve travel times for the large number of buses using the Hawthorne Bridge.

Disadvantages of the alignment concern traffic impacts. Development of Madison as a two-way LRT street is likely to disrupt the signal progression pattern in Downtown Portland, with severe traffic impacts resulting. The alignment also assumes a mall LRT alignment and some concern about the impact of LRT on the mall's use for buses.

Other Downtown alignments are under consideration and will continue to be evaluated as part of the Central Area LRT Plan. Both of the alignments discussed would involve four blocks of Downtown LRT construction and trackwork to connect to existing alignments. This allows the costing work to analyze one "generic" alignment which could represent either of the options noted above.

Milwaukie Corridor
Working Paper "C"

PRELIMINARY IMPACT ASSESSMENT

October 1984

METROPOLITAN SERVICE DISTRICT

TRI-MET

REGIONAL LRT SYSTEM PLAN
WORKING PAPER "C"

MILWAUKIE CORRIDOR ALIGNMENTS: PRELIMINARY IMPACT ASSESSMENT

SEPTEMBER 1984

PREPARED BY:

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Introduction

The Preliminary Impact Assessment for Milwaukie Corridor alignments is intended to satisfy two objectives:

1. To determine any environmental or social impacts which could easily be a "fatal flaw" for an alignment--thus leading to a decision not to consider that alignment further; and

2. To detail major impacts associated with alignments worth studying further, thus leading to a more informed scoping for any future Environmental Impact Statement (EIS) associated with the project.

Primary impacts evaluated are: 1) Wetlands/Wildlife; 2) Noise; 3) Cultural Resources; 4) Willamette Greenway/Park Preservation requirements; and 5) Neighborhood Impacts, including local traffic circulation, right-of-way (ROW) impacts, and land use effects. These issues were determined to be most significant to the alignments under consideration.

It should be noted that this impact assessment is not intended to fulfill the requirements of an EIS. An EIS would cover many additional items, and would look at the issues discussed in this paper in much greater detail. Specific issues not evaluated as part of this Preliminary Assessment are: Water Quality; Flooding Impacts; Construction Impacts; Energy Impacts; Air Quality Impacts; Secondary Development; and Geology.

1.0 Wetlands/Wildlife

Overview

Potential impacts to wetlands and wildlife are greatest with the Portland Traction Company (PTC) alignment adjacent to Oaks Bottom. Over 100 species of birds and waterfowl are found in Oaks Bottom. However, the impact to wildlife from the introduction of light rail is not known at this time. Impacts to wetlands and wildlife in the other alignments appear to be minimal.

PTC Alignment: Oaks Bottom is a unique wildlife sanctuary because of its diverse habitat, vegetation and wildlife, as well as its location in a predominantly urban environment. It is composed of 120 acres located on the east bank of the Willamette River between the Sellwood and Ross Island Bridges.

Oaks Bottom is divided into six major sections. The wetland is the most sensitive, from the standpoint of the introduction of light rail, and is, therefore, the focal point of this analysis.

The 70 acres of wetland are affected by two different water systems. Water flows from the Willamette River through an eight-foot culvert under the railroad fill, which raises and lowers the water level in the wetlands as the river rises and falls. Rising waters from the Willamette flood the entire Oaks Bottom approximately every other year. In addition, a natural spring system that branches from Crystal Springs flows into the wetland even in the driest years.

The wetlands support a wide variety of trees, vines, and other vegetation including red alder, black cottonwood, Pacific willow, water lilies, bulrush, and cattails. They also contain a variety of fish. Together, they provide a diverse habitat and feeding area for the many species of birds found in the area.

Of primary concern in Oaks Bottom is the Great Blue Heron. A Great Blue Heron rookery is located near Oaks Bottom on Ross Island. On almost any day the herons can be seen flying to Oaks Bottom where several feeding grounds exist.

The introduction of light rail in the Oaks Bottom area could have an impact on the herons and other birds. The impacts may be positive, as well as adverse, but are difficult to specify at this time without further analysis. Following is a brief summary of the issues involved.

If the plans for the proposed Willamette Greenway bicycle trail are pursued in this corridor, it may be necessary to place fill in an additional 20-foot width of ROW along the existing railroad embankment. Options are to fill on the west slope adjacent to the Willamette or on the east slope along Oaks Bottom. (If it is determined that the Greenway Trail does not have to be at the track elevation, less fill would be required.) Discussions with the Corps of Engineers, the U.S. Fish and Wildlife Service, the Oregon Department of Fish and Wildlife, and the Audubon Society of Portland have indicated that filling along the Oaks Bottom side would be preferred over the west slope. These agencies feel that careful filling along the Oaks Bottom side may even enhance the wetland by helping to stabilize the water level, thus improving the quality of the habitat.

However, while there may be an opportunity to enhance the wetland as a habitat, there is concern by all agencies of the impact of light rail noise on the birds.

There are at least three possible scenarios:

1. The birds would get used to the noise and continue to use Oaks Bottom. There are many instances where new highways have intruded bird habitats. In most instances, the birds remained and rested alongside the highway, getting used to the constant noise. In some instances, there was a negative impact, however.

   Making the situation more difficult to assess in this instance, however, is that light rail noise is intermittent, while highway noise is constant and may become a "background" noise.

2. The birds would be negatively affected by the noise and limit their use of Oaks Bottom to areas at some distance from the tracks. The Oaks Bottom Wetland is fairly large, and nearly a quarter of a mile wide at its greatest width. There is a potential that the birds would become moderately accustomed to some noise and feed in the wetland away from the tracks.

3. The birds would be adversely affected by the noise and leave the wetland entirely. Where the birds would go is not clear.

An additional concern is how the introduction of light rail would affect access to Oaks Bottom by hikers and bird watchers. The railroad ROW currently has only one track. Adjacent to the track on the top of the fill is a graded strip of land which is used occasionally by maintenance vehicles and more often as a hiking trail, providing a viewpoint into Oaks Bottom. The Audubon Society has expressed a concern that such access be maintained. There is also concern that access to the Willamette River be maintained. These issues will be addressed if the corridor is advanced to the EIS stage.

In summary, the concerned federal, state, and local agencies have all expressed concern (not opposition at this point) regarding the PTC alignment. They view it clearly as the least preferable alignment from an environmental standpoint. However, the agencies also are transit supportive and acknowledge that environmental concerns must be weighed against other concerns such as cost or neighborhood impact.

Because of the sensitivity of Oaks Bottom, if an EIS is performed in the Southern Corridor, the potential impacts to Oaks Bottom must be thoroughly analyzed.

2.0 Cultural Resources

A preliminary reconnaissance and evaluation was made of the historic structures in the Southern Corridor alignments. The evaluation was made in cooperation with the Portland Planning Bureau and the Oregon Department of Transportation (ODOT).

The Portland Planning Bureau has recently concluded an inventory of historic buildings in Portland neighborhoods. The inventory was of great help in this reconnaissance. A cultural resource specialist from ODOT also provided valuable assistance by driving all three alignments and making a preliminary assessment of potential impacts.

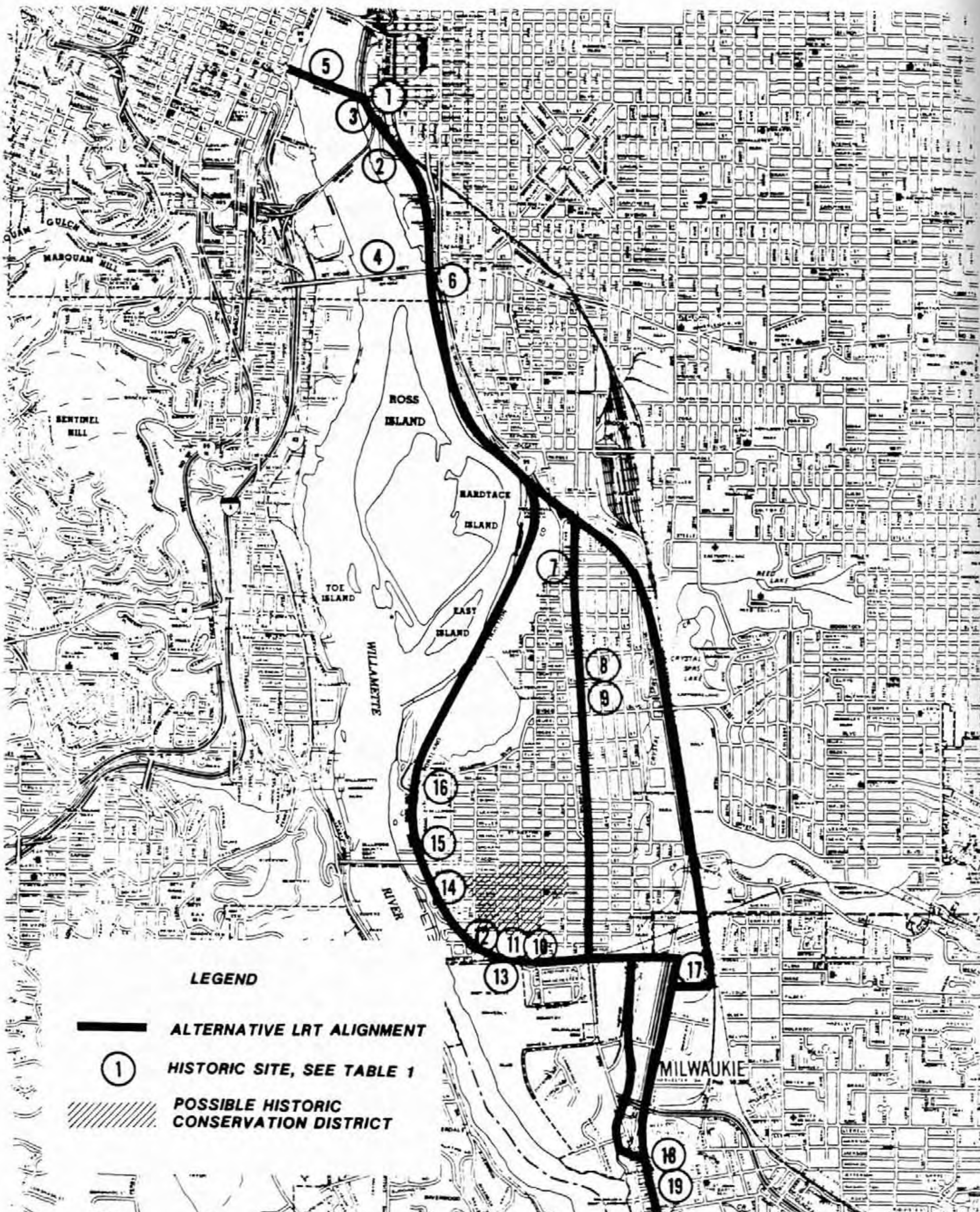
The attached map, Figure 1, shows the location of historic and potentially historic structures in the corridor. Table 1 gives a brief description of each structure. As the map shows, the structures are concentrated in the nothern end of the corridor from the Ross Island Bridge to the Hawthorne Bridge and along the PTC alignment in Sellwood. There are also a few historic or potentially historic structures shown in the 17th Avenue and McLoughlin Boulevard corridors.

In general, the introduction of light rail does not appear to have an adverse impact on historic buildings in any of the alignments. Many of the buildings are situated in commercial/industrial areas at some distance from the tracks. Others situated closer to the tracks, such as the railway station and car barns on the PTC alignment, are clearly compatible.

There are several potentially historic residences on the PTC alignment, in the proposed Sellwood historic district. Light rail may have some effect on them, but it is probably not of a significant magnitude to be considered adverse.

Of special concern in this corridor are the St. Johns Episcopal Church, the Moreland Bible Church, the Paulson House and the ODOT offices. These, as well as the other potentially historic structures, will be examined in more detail if alignments near these structures are advanced to the EIS stage.

It should also be noted that several potential alignments in downtown Portland run through the Yamhill Historic District. The City of Portland has placed a four-minute headway constraint on light rail vehicles passing through this district, as they have on Banfield trains passing through the Skidmore Old Town Historic District. Attention must be paid to this constraint as downtown alignments are evaluated.



PRELIMINARY SURVEY OF HISTORIC SITES IN THE VICINITY OF SOUTHERN CORRIDOR ALIGNMENTS

FIGURE 1:

TABLE 1

KEY TO FIGURE 1

PRELIMINARY SURVEY OF HISTORIC SITES IN THE SOUTHERN CORRIDOR

Map No.	Description	Preliminary Assessment of Historic Significance (City Ranking)*
1.	PEPCO Garage - 1927	Probably not historic, may be architecturally significant (no rank).
2.	PGE Building	Probably not historic, may be architecturally significant (no rank).
3.	Holman Transfer Building	Probably not historic, may be architecturally significant (no rank).
4.	Ross Island Bridge - 1926	Probably historic (not in City inventory).
5.	Hawthorne Bridge	Probably historic (not in City inventory).
6.	Paulson House	Definitely historic.
7.	Moreland Bible Church - 1924	Probably historic (Rank II).
8.	Residence: 6628 S.E. 17th	Architecturally unique, probably not historic (no rank).
9.	Residence: 6704 S.E. 17th	Architecturally unique, probably not historic (no rank).
10.	OWP & RY Co. Substation - 1905	Probably historic register eligible (Rank III).
11.	Car Barns	Probably historic register eligible (Rank II).
12.	Rail Station	Probably historic register eligible (Rank III).
13.	Residence: 8870 S.E. 11th	Possibly historic (no rank).
14.	Residence: 8328 S.E. 6th	Possibly historic (Rank III).

Map No.	Description	Preliminary Assessment of Historic Significance (City Ranking)*
15.	Original St. Johns Episcopal, 1851 (Marriage Chapel)	Definitely historic.
16.	Oaks Park	Possibly historic (not in City inventory).
17.	ODOT Offices	Historic register eligible, see DEIS.
18.	Masonic Hall	Possibly historic (not in City inventory).
19.	Milwaukie City Hall	Possibly historic (not in City inventory).
20.	2339 S.E. Grand (Early Times Restaurant)	Probably not historic (no rank).
21.	PGE Industrial Building/ Foundary	Possibly significant (not in City inventory).

Rank I - Individually the most important properties in the city, distinguished by outstanding qualities of architecture, historical values, and relationships to the environment. Highest priority for landmark designation; eligible for National Register.

Rank II - Propeties which are of individual importance by virtue of architectural, historical, and environmental criteria. Secondary priority for landmark designation; eligible for National Register.

Rank III - Buildings which provide the setting for more important buildings and which add richness and character to the neighborhood; properties associated with personages and events of secondary importance or which illustrate particular stages in the development of the city. These properties may be eligible for the National Register as part of a district.

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3.0 Noise

Overview

The most significant potential impacts associated with light rail noise are found along the Sellwood and PTC alignments. Each alignment has a markedly different affected population, however.

In the Sellwood alignment, the major areas of concern are the residences and businesses along 17th Avenue between Ochoco and Insley Streets. In the PTC alignment, the greatest concern is the noise impact on the birds and other wildlife in the Oaks Bottom area. Light rail noise in the McLoughlin Boulevard alignment was of lesser concern in this assessment because of the extensive noise analysis performed for the McLoughlin Boulevard highway improvement EIS and because the noise associated with light rail would probably be minimal in addition to the existing McLoughlin Boulevard traffic noise.

The evaluation methodology used for this assessment was the FHWA Highway Traffic Noise Prediction Nomograph. One should understand that this nomograph was not designed to predict noise in urban street situations, but was designed to predict freely flowing highway noise. However, noise specialists with ODOT have used these nomographs in urban situations and have reported very good results. To be cautious though, the real value of the nomographs in this assessment was not to ascertain absolute noise levels, but to describe relative changes in noise levels over time.

Sellwood Alignment: Two factors may occur between 1980 and the year 2000 which would affect noise levels along 17th Avenue. The first is that if proposed traffic diversions for 17th Avenue are implemented, buses will be removed and traffic volumes on 17th Avenue north of Tacoma will become similar to those of other residential streets in the neighborhood. This will decrease noise levels. The second is that if light rail were built on 17th Avenue, the noise from the vehicles would increase projected levels, as compared to conditions without the rail. Both scenarios were evaluated.

North of Tacoma, it is estimated that existing noise levels on 17th Avenue, at the first row of houses, are approximately 64 dBA. (All measurements are in terms of L_{eq}, which averages sound over time and indicates what the steady level would be if the sound had been held constant. The FHWA exterior L_{eq} design noise level is 67 dBA for residences, motels, hotels, schools, churches, libraries, and hospitals.) If the proposed traffic diversion is implemented, noise levels would fall to approximately 56 dBA. This drop of eight dBA would be noticeable and would be described as a moderate decrease.

Using information regarding light rail vehicle noise from the Banfield and Westside EIS's, the addition of light rail would increase L_{eq} noise levels in the year 2000 by approximately four dBA to 60 dBA. This would be approximately four dBA lower than today's noise levels.

Peak passby noise levels for residences in this alignment are estimated at approximately 68 dBA.

In the section of 17th Avenue between Tacoma and Ochoco Streets, existing noise levels are estimated at approximately 67 dBA. (This increase in levels, as compared to the section north of Tacoma, is due to higher traffic volumes.) In the year 2000, without the addition of light rail and with the City of Portland's proposed traffic diversions, predicted noise levels drop by one dBA to 66 dBA. This drop would not be perceptible to the human ear. The addition of light rail is projected to have minimal impact in this section, increasing L_{eq} noise levels by one dBA.

A potentially sensitive receptor in this Sellwood alignment is the Moreland Bible Church located at 17th and Ellis. Noise levels at the church would be similar to those of the other residences on 17th Avenue.

<u>PTC Alignment</u>: There are approximately 30 residences along the PTC alignment located between the Sellwood Bridge and 17th Avenue. Their distance from the track ranges from approximately 30 feet to 100 feet. As there is no automobile traffic in this section and very infrequent rail traffic, the introduction of light rail would change the noise ambience at these sites. Peak vehicle passby noise levels are estimated to range from 70 to 76 dBA at these residences. L_{eq} noise levels with light rail are estimated to be from 52 to 61 dBA, which is well within the FHWA design level, however. The noise impacts on these residences will be studied more extensively if an EIS is performed and mitigative measures will be analyzed where warranted.

A potentially sensitive receptor on the PTC alignment is the former St. Johns Episcopal Church located near the eastern terminus of the Sellwood Bridge. Peak passby noise levels at the church are estimated to be 70 dBA. The light rail contribution to the L_{eq} noise level is estimated to be 55 dBA. However, no estimate is made for the overall noise level at the church because of its proximity to the Sellwood Bridge and the Willamette River. A detailed analysis of noise impacts to the church would be made during the EIS phase of the project.

The most significant noise impacts of the PTC alignment may be on the birds and wildlife in the Oaks Bottom natural resource area. These impacts are discussed in section 1.0, Wetlands/Wildlife.

<u>McLoughlin Boulevard Alignment</u>: Noise impacts along McLoughlin Boulevard were detailed extensively in the McLoughlin Boulevard (highway improvements) Draft Environmental Impact Statement (DEIS). The DEIS found that in the year 2000, noise levels along McLoughlin were very high for all alternatives and exceeded exterior design levels at 46 residences and interior design levels at 62 residences. An analysis of the light rail impact on these residences was beyond the scope set for this environmental assessment, but will be performed if an EIS is initiated in this

corridor. However, at the noise levels projected from the highway alone, the addition of light rail would probably have a very minimal impact, if any.

4.0 Willamette Greenway/Parkland Preservation Requirements

Transportation facilities are generally a permitted use in the Willamette Greenway, but will require special permits to ensure Greenway standards and requirements are met. There are currently plans to develop a bicycle/pedestrian path adjacent to the Willamette River in the Greenway which will affect, to some extent, all three light rail transit (LRT) alignments (PTC, Sellwood and McLoughlin). The need to develop a pathway (with a specified ROW of 20') along any segment of these alignments using the PTC ROW will likely increase the cost and impact of these alignments. This is a factor for the PTC alignment from Oaks Park north to the Ross Island Bridge, and for the Sellwood and McLoughlin alignments, from north of S.E. Insley Street to the Ross Island Bridge (where these two alignments use the PTC ROW).

The McLoughlin and Sellwood alignments would both, as presently envisioned, require a taking of land now owned by the Portland Park Bureau to reach the PTC ROW. In preliminary discussions, the Park Bureau has indicated that this taking of undeveloped park bureau land is not a major concern to them. However, taking of park land will require meeting the U.S. Department of Transportation's (USDOT) 4(f) requirements (designed to ensure park land protection is given a high priority), and any future DEIS on this corridor must address this issue.

5.0 Neighborhood Impacts - North of Milwaukie

This section describes the results of an initial analysis of neighborhood impacts north of the Milwaukie city limits for each of the three alignments chosen for preliminary examination. This analysis is based on general concepts of how the alignments might look and the impacts of those alignments on local access, land use patterns and ROW requirements.

PTC ALIGNMENT

Local Access: In general, the PTC alignment has limited impacts on local access and circulation patterns. This is primarily because the PTC alignment would operate on ROW currently occupied by railroad tracks owned by the PTC. Any impacts on local access would, therefore, result from the increased frequency of trains along this route, not from creating a new transportation corridor through the area. Access to two restaurants, several condominium developments, marinas and an amusement park would most likely require crossings of the LRT tracks. Some of these crossings, particularly Spokane Street, would most likely require safety measures such as gates, signals and lighting improvements because of the increased frequency of trains.

There may be informal park and ride activities near the Sellwood Bridge, 13th, and 17th Avenue stations. Adequate sizing of nearby "formal" park and ride lots, together with limited parking restrictions near stations could, help minimize these impacts--which will need more thorough study in any future alternatives analysis/DEIS.

Land Use: The riverfront at the east end of the Sellwood Bridge has experienced a great deal of development in the past decade. Many transit-supportive uses such as apartments, condominiums and restaurants already exist within walking distance of the PTC ROW. Future developments in this area will be of a similar nature with or without light rail. The existence of light rail, however, could help promote these future commercial or residential projects. Elsewhere along the PTC alignment, light rail would have minimal land use impacts.

ROW: No ROW beyond the existing PTC rail line is needed for this alignment. One vacant parcel near the Sellwood Bridge may be desirable to create a more spacious station--but is not essential for the alignment's development.

Visual Impacts: Visual impacts of the PTC alignment are limited to the overhead wire used to provide power to the LRT vehicle.

SELLWOOD ALIGNMENT

Light rail has the potential to provide improved transit service to the Sellwood/Moreland neighborhood. However, a number of potentially significant impacts (i.e., parking loss, access restriction, and general neighborhood incompatibility) are associated with the Sellwood LRT alignment. The local neighborhood association--the Sellwood-Moreland Improvement League--has taken a position opposing the alignment (see Appendix D).

Two alternative alignments for a Sellwood LRT were originally considered, 17th Avenue and Milwaukie Avenue. 17th Avenue was chosen as a representative alignment for further study because it offered less traffic and access conflicts and lower ROW costs. A brief look at trip generation along both streets between S.E. Insley and S.E. Ochoco indicated that Milwaukie Avenue businesses and residences generate more than three times the daily trips as does 17th Avenue (8,500 vs. 2,700). This indicates that the potential for transit/auto conflicts and resulting delays in transit travel time are much greater on Milwaukie Boulevard.

The City of Portland, at the request of the local neighborhood association (SMILE), has developed a plan for reducing through traffic movements along 17th Avenue south of Nehalem Street, as described in the noise analysis. This is assumed to be the case in all discussions of impacts of a 17th Avenue LRT alignment, and is another reason why transit/auto conflicts would be minimized on 17th Avenue rather than Milwaukie Avenue.

For analysis, the 17th Avenue alignment can be divided into two segments, Insley to Nehalem and Nehalem to Ochoco. The Insley to Nehalem segment is primarily residential with a 60-foot ROW, while the Nehalem to Ochoco segment has a 58-foot ROW and has predominantly commercial uses. Design alternatives need to be examined when analyzing the impacts along both segments of 17th Avenue. Alternative design options include:

1. Two tracks in exclusive ROW: this would allow for a single local access traffic lane and limited on-street parking north of Nehalem, and would require widening 17th south of Nehalem to allow two traffic lanes (one in each direction), and no parking.

2. One track in exclusive ROW: this would allow for two travel lanes and limited on-street parking; however, one track would limit the flexibility of LRT operations.

3. Two tracks in mixed traffic: this would allow traffic patterns similar to existing, with restrictions on parking near station areas.

North of Nehalem, after leaving the PTC ROW north of Oaks Bottom, the proposed LRT would connect, via a tunnel under Milwaukie Avenue, with 17th Avenue near Mitchell Street. Stations along this portion of the route are proposed at Mitchell, Reedway, Tolman, Bybee and Lambert.

South of Nehalem, the 17th Avenue alignment continues south to Ochoco Street with stations at Tacoma/Spokane and near Ochoco. Due to higher traffic volumes on this segment of 17th Avenue, additional restrictions on auto movements may be necessary to allow LRT to operate efficiently.

Congestion problems at the intersection of 17th and Tacoma will result in some delay for the LRT, but passing through this intersection will be feasible for LRT in mixed traffic or in separate lanes, but not at a high level of service. The results of a capacity analysis of this intersection with and without LRT, as shown in Appendix A, is that LRT will degrade slightly the level-of-service at this very busy intersection. With the existing intersection design, the level-of-service would change from "E" without LRT to "F" with LRT. With modified intersection designs, it may be possible to raise the intersection level-of-service to "D" without LRT, but only to the "D-E" threshold with LRT. To summarize the traffic analysis of this intersection, LRT will make a poor level-of-service slightly worse for traffic, reducing the capacity of the intersection 3 to 5 percent. With signal preemption, this reduced level-of-service will have little impact on LRT operations, as the average delay will be less than 10 seconds for trains using the intersection.

Left turns across the tracks south of Tacoma would be permitted only at controlled intersections in order to minimize auto/light rail conflicts.

Local Access

North of Nehalem: Access to residences along 17th Avenue would be affected under any of the design alternatives, particularly near the station areas. Each station would likely block access to four or five driveways. This problem could possibly be addressed by providing a single access lane behind the stations along with appropriate pedestrian/auto barriers (Woonerf concept) or the development of alleys. Left turns across the LRT tracks present a potential safety problem, but would be manageable given the LRT's slow speed through the Sellwood neighborhood (20-25 mph peak speed).

On-street parking on 17th Avenue will be severely limited under the two exclusive ROW design alternatives. This is of particular concern because 17th Avenue is currently heavily used and, due to the length of the blocks (600 feet), the use of side streets is not, by itself, an adequate solution. Parking on the side streets along 17th Avenue could be further impacted through the intrusion of informal park-and-riders from outside the neighborhood.

The LRT line could also present a perceptual barrier for both pedestrian and auto traffic moving between the residential area to the east and the Milwaukie Avenue commercial district to the west. This barrier effect could be further amplified through the possible closure of some side streets at 17th Avenue.

South of Nehalem: Restricted access and parking removal, as well as any new ROW required for the 17th/Tacoma intersection, could have adverse impacts on businesses along 17th Avenue. While some businesses may be able to adapt and take advantage of the proximity to a light rail station, others which are more auto-oriented may suffer. Those businesses which depend upon on-street parking to attract customers may find that many customers would shop elsewhere. This would cause sales and profits to fall, with some businesses probably being forced to relocate or close.

Compatibility Issues: The 17th Avenue alignment brings with it issues of the compatibility of a regional transit trunk line with the local street it uses and adjacent land uses. This is particularly true north of Nehalem Street, where 17th Avenue is lined primarily with single-family residences. Present City policy establishes 17th north of Nehalem as a residential street (local service designation), a minor transit street, and as a bicycle route. While 17th is presently used as a through traffic route, the City of Portland has proposed projects to divert through traffic from 17th to the alternative routes of McLoughlin Boulevard and Milwaukie Avenue. Placing a major regional transitway on 17th would be inconsistent with existing City policy.

North of Nehalem, the use of Milwaukie Avenue for LRT has been considered as an alternative to 17th Avenue. Milwaukie Avenue is much more heavily used for access to business than is 17th Avenue (at least three times as many trips are generated from land uses on Milwaukie than 17th). Traffic congestion is thus a problem on Milwaukie, with particular problems at the intersection of Bybee and Milwaukie.

Because Milwaukie Avenue is lined with commercial uses and high density residential development, it is a more compatible street with a regional transitway, but this same intensity of use magnifies the problems of local access, circulation, and traffic congestion associated with developing a regional transitway to operate at a good level of service. Similarly, Milwaukie Avenue is categorized as a major city transit street and a neighborhood collector by the City of Portland, but not as a regional facility. Therefore, a Milwaukie Avenue alignment would also be incompatible with existing City policy.

Land Use: Overall, there is limited potential for developing major new job, housing or shopping opportunities along this alignment due to: 1) small lot sizes; 2) the level of existing development; and 3) a comprehensive plan which encourages the conservation of existing single family housing areas. However, redevelopment pressures along 17th Avenue would likely result from a Sellwood LRT. The segment between Yukon Street and Lambert St. is identified in the City's comprehensive plan as high density single family. Pressure toward higher densities could eventually alter the single family character of this neighborhood. The existing multi-family areas (north of Yukon) might also be redeveloped to higher densities. The commercial area (south of Nehalem) is likely to undergo changes in types of businesses, but would remain a commercial district consistent with the comprehensive plan designation. The City and the neighborhoods would need to address the density issues through the comprehensive planning process.

ROW: The impact of ROW acquisition for the Sellwood LRT differs among the different design scenarios and between the segment north of Nehalem Street and the segment south of Nehalem Street. In the northerly residential section, the only significant impact is near the stations where some additional ROW would be desirable for LRT development. This ROW could be taken from existing front yards and would not affect existing structures.

South of Nehalem, however, ROW impacts could be much more severe. As much as 25 feet of ROW would be required at stations under the two track, exclusive ROW design alternatives. The west side of 17th Avenue offers a better opportunity for ROW acquisition because of the presence of a high rise retirement home on the east side. ROW costs along either side of 17th Avenue would range between $500,000 and $1.0 million. Five to 10 businesses would be entirely displaced and as many as 15 could lose off-street parking.

Visual Impacts: Visual impacts would result from the overhead wire along the length of the route, and from the structure and/or fill required to bring the Sellwood alignment from Milwaukie and Mitchell Street to the PTC grade.

MCLOUGHLIN ALIGNMENT

Local Access: S.E. Mitchell Street between Milwaukie Avenue and 17th Avenue would likely be closed under this alternative. There are no homes or businesses which rely exclusively on this block for access. Informal park and ride activities near the Bybee Boulevard and Mitchell Street stations are a potential problem. Adequate developed park and ride lots together with some parking restrictions near stations could minimize this problem--which will need more thorough study in any future EIS work.

Land Use: This alignment is not expected to generate any land use changes north of Milwaukie.

ROW: A corner of Vocational Village, an alternative school operated by the Portland Public School District, could be displaced by this alignment. No other major ROW impacts are anticipated.

Visual Impacts: Visual impacts are expected to result from the overhead wire along the entire route, and from the structure and/or fill required to bring the McLoughlin alignment from Milwaukie and Mitchell Street to the PTC alignment grade.

ALL ALIGNMENTS - CENTRAL EASTSIDE IMPACTS

All three proposed LRT alignments would traverse the southwest corner of the Central Eastside Industrial District parallel to the existing PTC ROW. This ROW is lined with businesses from the Ross Island Bridge to Caruthers north. From Caruthers to the Hawthorne

Bridge, the alignment passes through the PTC rail yards until entering Water Avenue at Clay Street. From Clay Street north one block to the ramp to the Hawthorne Bridge, the alignment would be in the median of Water Avenue. Impacts associated with this section of the alignment are discussed below.

Land Use

One of the major land use opportunities in the Milwaukie Corridor--PGE's Station "L" site--is located directly adjacent to the proposed LRT alignment. This site, presently in low intensity warehousing and storage use, is wedged between the PTC rail yards and the Willamette River. The site is attractive for development due to its central location and access to the Willamette River. Its development is expected to be phased over the next 10 years. However, present access is very constrained--with no direct transit service and poor roadway connections to the highway system at-large.

The Portland General Electric Company has initiated a master plan process for the site. The transportation analysis prepared indicates the existing system can support only 500-600 daytime employees. With a series of transportation improvements committed to by the City of Portland and ODOT, this capacity will increase to 2,900 to 3,200 daytime employees. With a long-term improvement package--including light rail and an aggressive transportation management program--this holding capacity could easily increase up to 5,400 daytime employees. Thus, light rail could assist the full development of this opportunity parcel.

Local Access

While light rail access could help increase the usefulness of the Station "L" site, a light rail alignment through this portion of the Central Eastside could involve impacts to circulation and truck loading patterns--particularly in the area south of Caruthers Street. It is reported that at least one business in this area frequently shuttles materials across the PTC alignment (4th Street) between buildings. Impacts and mitigation measures in this area will need to be detailed if the corridor is advanced to the Alternatives Analysis/DEIS stage.

6.0 Local Impacts - Central Milwaukie

Benefits and impacts of light rail serving central Milwaukie are generally assessed on the following pages. Issues discussed include impacts of the LRT alignments on local access and parking, ROW impacts, and the opportunities for land use changes and general community economic development. Two geographic areas are the basis of this discussion--alignments south of Ochoco approaching downtown Milwaukie, and alignments in downtown Milwaukie itself.

A. Alignments South of Ochoco Approaching Downtown Milwaukie

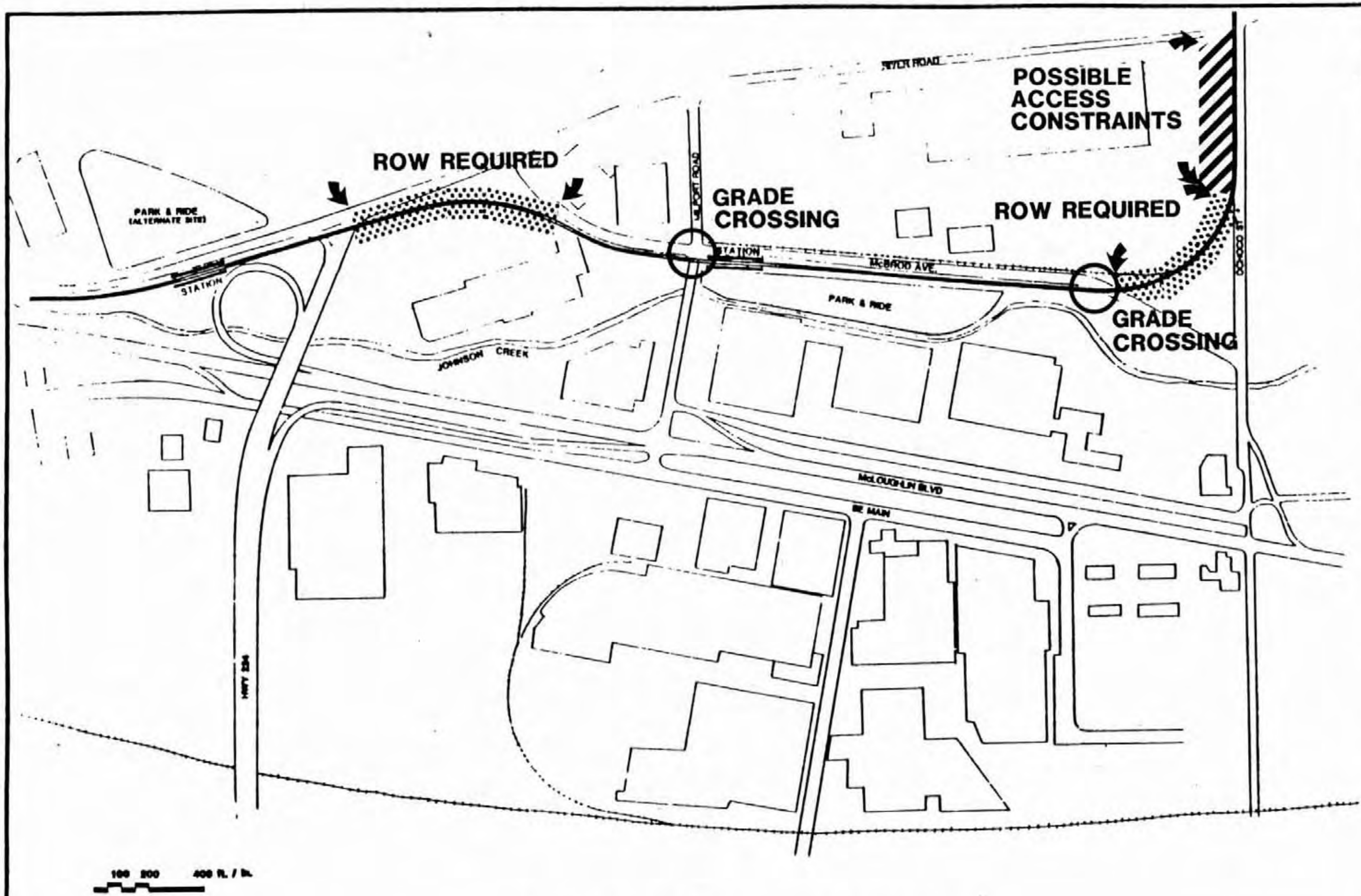
Two alignments approaching downtown Milwaukie from the north have been identified as the most reasonable for concept engineering and have been recommended for further study, the McBrod alignment and the Main Street alignment. At this phase of study, the alignments must be considered representative--and not firm proposals or recommendations.

McBrod Alignment (Figure 2)

The McBrod alignment would connect to either the Sellwood or the PTC alignments to the north, and would follow Ochoco to McBrod and along McBrod to River Road as shown on Figure 2. The alignment would enter downtown Milwaukie via a grade crossing of McLoughlin at Harrison or via an elevated structure over McLoughlin south of Highway 224. Stations could exist at McBrod and Milport Road, and at River Road just south of Highway 224. Park and ride lots could be developed at each of these stations, designed primarily to serve the Highway 224 commuter market.

Local Access: A number of industrial and warehouse firms are located adjacent to the alignment. Those accessing Ochoco could find driveway access affected by the LRT alignment. This may result in development of controlled accesses to limit car/truck/LRT conflicts. Alternative access to River Road or McBrod could help mitigate access problems for some of these firms. Along McBrod, the LRT alignment is presently envisioned as running adjacent to the east edge of the roadway--and since nearly all major development is located to the west--conflicts will not be a major problem. LRT grade crossings of McBrod just south of Ochoco and at Milport are easily controlled, and due to the low traffic volumes on each of these roads, should not affect local traffic circulation.

ROW: ROW may be required in two places for this alignment in order to develop proper LRT turn radii and to negotiate grades in the area. These would be at the curve from Ochoco to McBrod following the PTC rail spur; and 2) the curve from McBrod to River Road. Neither of these ROW strips (shown on Figure 2) would affect existing buildings.



MILWAUKIE LIGHT RAIL LINE
RIVER ROAD / McBROD AVENUE ALIGNMENT

FIGURE 2

Land Use: Land uses in this area are primarily established as low intensity industrial and warehousing, and within the short term, major changes would be unlikely. In the long term, however, with LRT access, the area could redevelop into higher intensity office or manufacturing uses.

Visual Impacts: Visual impacts are expected to be limited to the overhead wire used to provide power to the LRT.

Main Street Alignment (Figure 3)

The Main Street alignment north of downtown Milwaukie would connect to the Sellwood or PTC alignments via Ochoco, and would cross McLoughlin at grade to reach Main Street. The McLoughlin LRT alignment would join the Main Street alignment at Beta Street, where it would curve east until adjacent to the Southern Pacific ROW.

South of Ochoco, the Main Street alignment could be developed in three different ways, depending primarily upon the design of the McLoughlin highway widening project:

1. If McLoughlin Boulevard is not widened, LRT would be developed in the median strip between Main and McLoughlin;

2. If McLoughlin Boulevard is widened, two choices for the design of the LRT alignment exist:

    a. In mixed traffic on Main Street itself; or

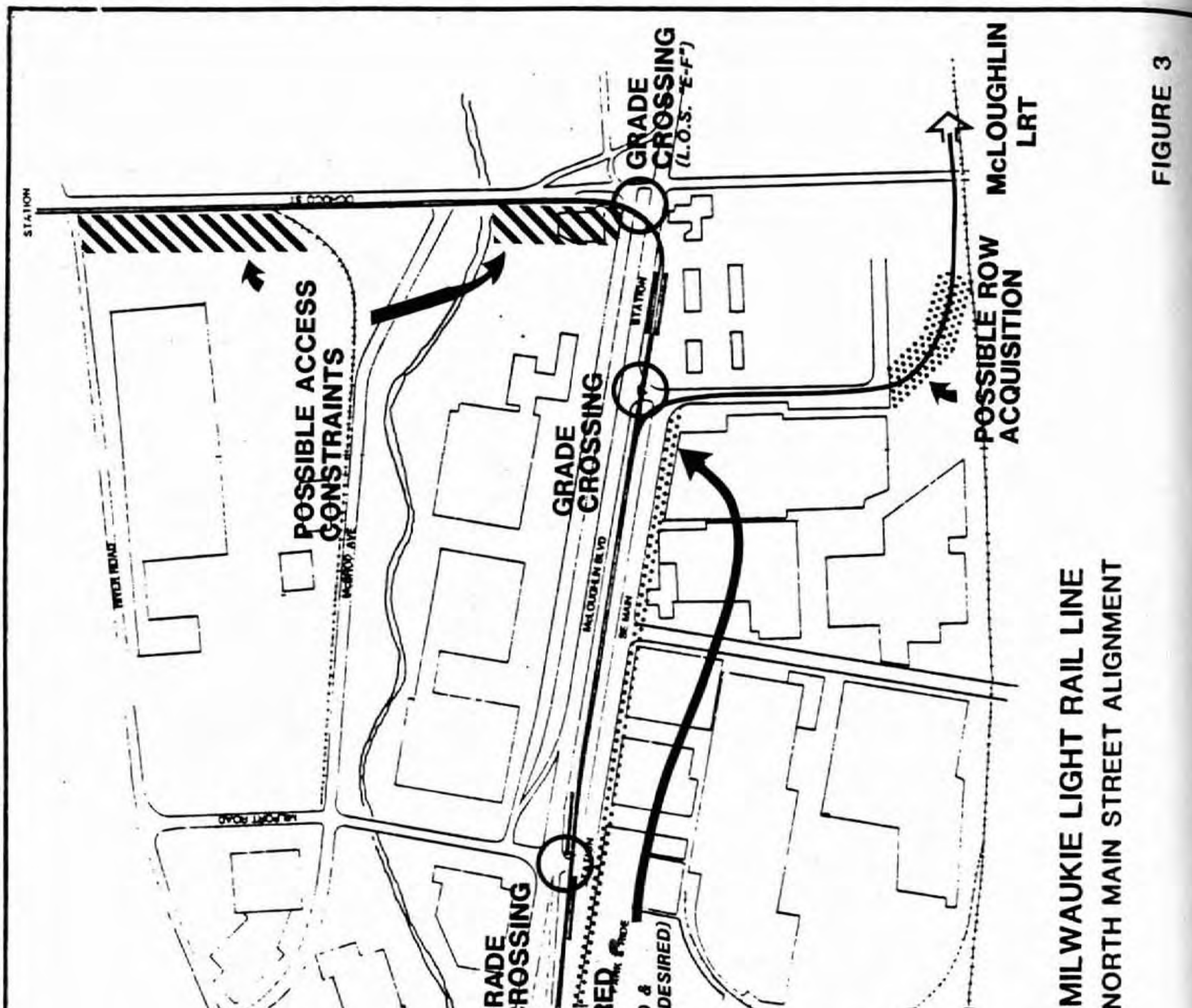
    b. In a new ROW to the east of the Main Street ROW.

Stations are proposed just south of Ochoco (near ODOT's Milwaukie offices); and at Milport Road (near the movie theater).

Local Access and Traffic Impacts: Along Ochoco west of McLoughlin--some driveway crossings of the LRT alignment may be unavoidable. Developing protected crossings or relocating driveways to alternative streets may be ways to mitigate any safety-related problems.

Local access concerns along Main Street itself (south of Ochoco) would exist if a new separate LRT ROW on the eastern edge of Main Street were developed--as businesses facing Main Street have their major driveways on Main. Few or no access conflicts would exist with the LRT in the median between Main and McLoughlin, or in Main Street mixed traffic.

One major grade crossing occurs at Ochoco and McLoughlin with the Main Street alignment. ODOT has projected that an LRT grade crossing at Ochoco will cause that intersection to operate below accepted standards (from "D" without LRT to "E-F" levels-of-service with LRT), as discussed in Appendix B. This



MILWAUKIE LIGHT RAIL LINE
NORTH MAIN STREET ALIGNMENT

FIGURE 3

analysis assumed an improved McLoughlin Boulevard. Other grade crossings exist at McBrod, Beta, and Milport. No traffic problems are anticipated at these intersections if basic safety standards are used in project design.

ROW: Major ROW acquisition would occur in two places: 1) near the ODOT offices to allow for alignment and station development; and 2) if a separate ROW were developed east of Main Street, that alignment would be on all new ROW.

If the McLoughlin Highway project is built as proposed, resulting in the relocation of Main Street east, then the exclusive LRT ROW east of the relocated Main Street would involve partial takings of a number of warehouse and industrial buildings. An alternative to this is running LRT in traffic on Main Street.

The connection between the McLoughlin LRT alignment and Main Street via Beta Street would also require a strip of ROW between the east end of Beta Street and the Southern Pacific Railroad. No structures would be affected by this ROW purchase.

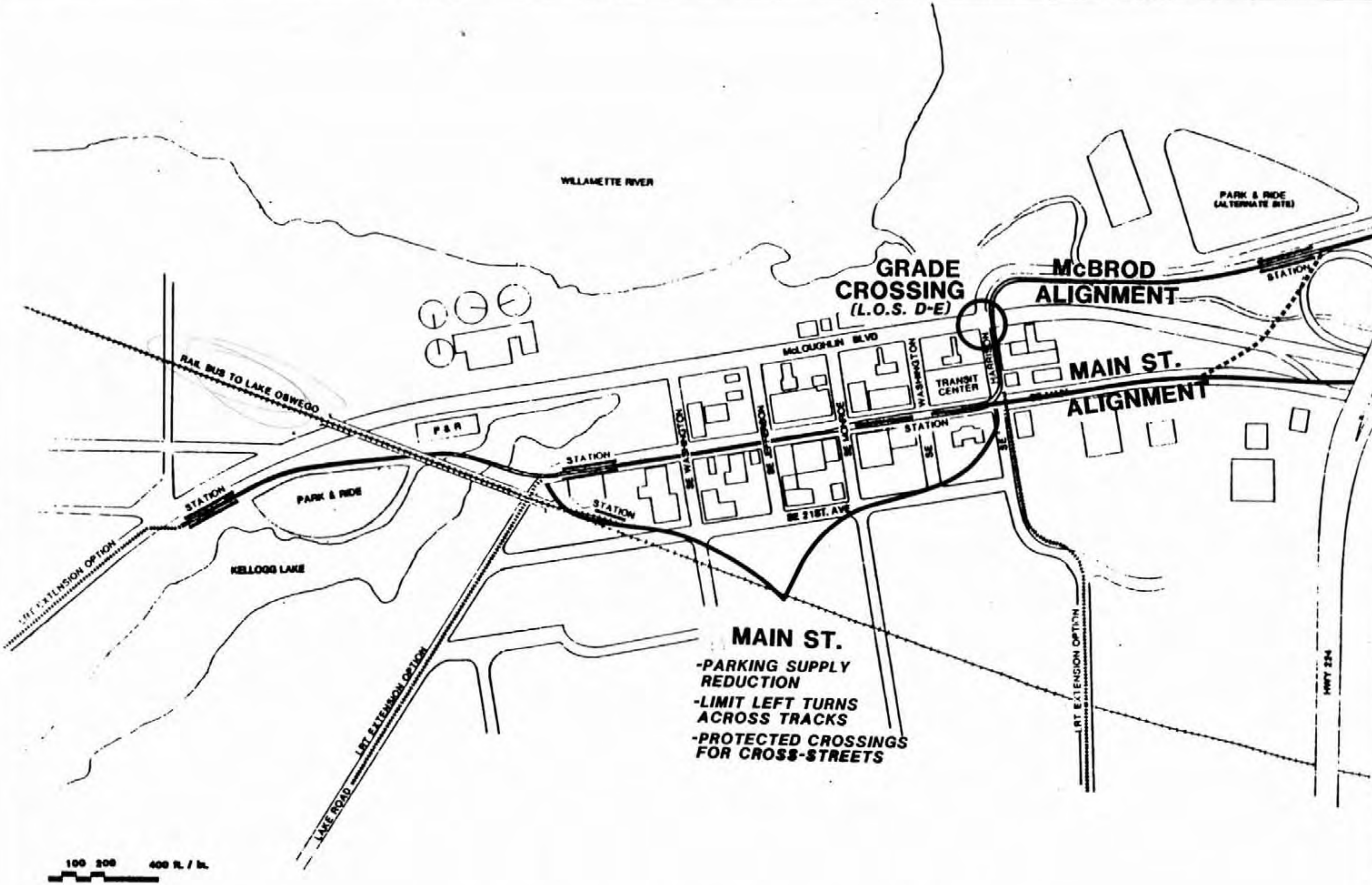
Land Use: The area surrounding the Main Street alignment is an established and fully developed industrial/warehousing area--and few, if any, short- or mid-range land use changes can be anticipated.

Visual Impacts: The only visual impact of the Main Street alignment would be the overhead wire used to provide power to the LRT.

B. Downtown Milwaukie Alignments

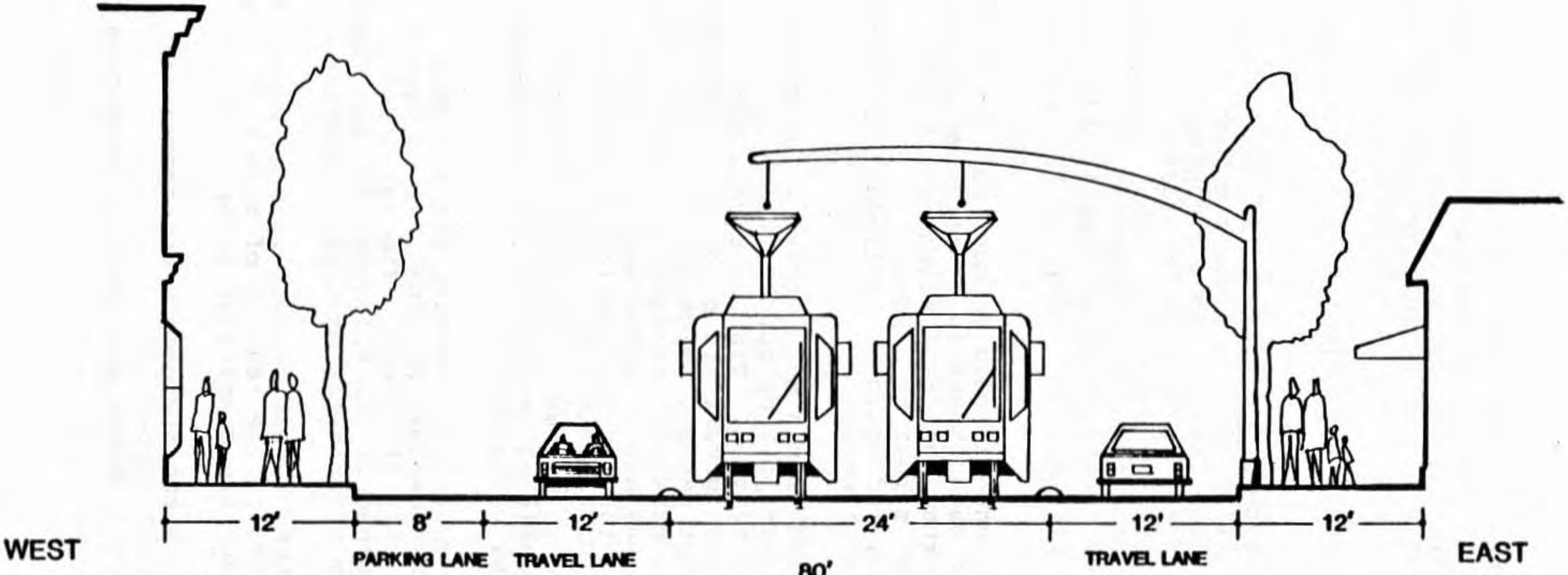
A representative downtown Milwaukie alignment is illustrated on Figure 4, with a likely cross-section shown on Figure 5. The alignment shown uses Main Street as the major link between the alignments to the north (McBrod or Main Street) and a park and ride lot south of Milwaukie adjacent to McLoughlin Boulevard. This alignment is most compatible with the vision of Main Street as a pedestrian/transit spine for downtown Milwaukie, with auto circulation emphasized on 21st Street to the east and McLoughlin Boulevard to the west. Other alignments considered in this phase of study include: 1) Adjacent to the west edge of McLoughlin Boulevard--which would require the acquisition of a number of businesses and minimize service to the most active part of downtown Milwaukie; and 2) Along 21st, which would disrupt access to the many parking lots along 21st, and route the LRT slightly further out of direction. Alternative alignments could be examined in greater detail as part of Alternatives Analysis/DEIS.

An important consideration in discussing downtown Milwaukie alignments is the location of the Milwaukie Transit Center. This transit center is the focus of the Southern Corridor's

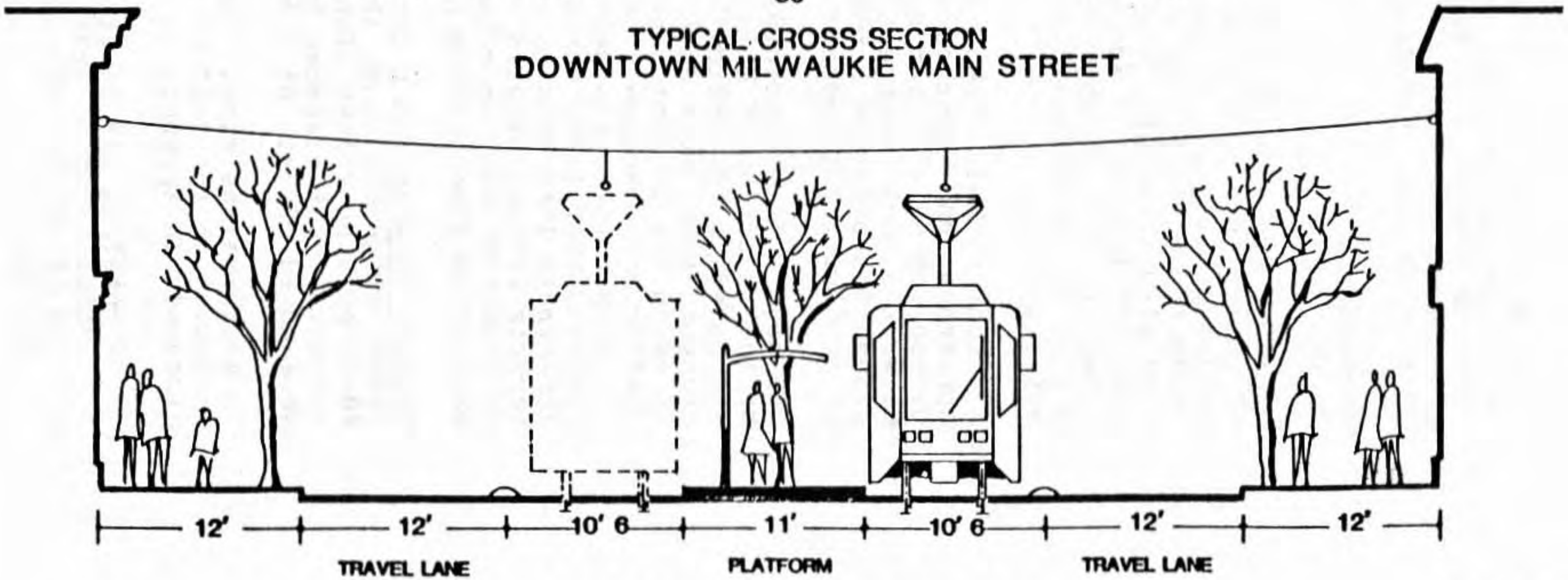


MILWAUKIE LIGHT RAIL LINE
RIVER ROAD TO MAIN STREET ALIGNMENT

FIGURE 4



TYPICAL CROSS SECTION
DOWNTOWN MILWAUKIE MAIN STREET



SCALE: 1 in. : 10 ft.

CROSS SECTION AT STATION BLOCKS

FIGURE 5

transit system, and its eventual location will affect the choice of the downtown alignment. The representative alignment shown is compatible with two transit center sites previously discussed, the south end site (north of Kellogg Lake) and the site at Main and Harrison (across from the Milwaukie City Hall).

Probable impacts of the Main Street alignment are discussed below.

Local Access and Traffic Circulation: As the McBrod Avenue alignment enters downtown Milwaukie, it crosses McLoughlin Boulevard at grade at Harrison Street. This crossing is projected to have little effect on McLoughlin traffic conditions, changing the level-of-service at that intersection from "D" to a still acceptable "D-E" (see Appendix B). Alternative grade-separated crossings of McLoughlin Boulevard are being investigated as part of the conceptual engineering effort.

A potential Main Street alignment could do much to change the appearance and function of Main Street in downtown Milwaukie. Developing Main Street as the light rail alignment through Milwaukie would change that street to a more pedestrian-oriented street, and would likely result in traffic being diverted to adjacent streets.

The major effect anticipated from a Main Street alignment would be the reduction of on-street parking supply, which is discussed in the following section. Traffic circulation changes from a Main Street alignment are expected to be minimal based on the present concept design, which maintains two-way traffic and some on-street parking. Changes in traffic control at cross-street intersections may be necessary to minimize LRT/auto conflicts, but at the LRT frequencies anticipated (15-minute intervals at mid-day, 7-1/2 during peak hours), impacts are anticipated to be minimal. Detailed review of alternative downtown Milwaukie alignments would be necessary as part of an Alternatives Analysis/EIS.

Parking Impacts: The conceptual engineering for the Main Street alignment shows that downtown Milwaukie would lose a net 40-45 parking spaces with this alignment. The net loss accounts for the spaces gained if the Milwaukie Transit Center were moved off street from its present on-street location.

To evaluate the significance of this loss, a parking survey was conducted in the fall of 1983. The results of this survey are discussed in Appendix C, and are summarized below:

- A total of 138 on-street and 552 off-street spaces are available on or near Main Street;
- 536 of the 552 off-street spaces are private, long-term parking lots;

- Of five time periods surveyed, the peak parking demand was found to be 12:15 p.m., where 65 percent of on-street spaces and 42 percent of off-street spaces were occupied;
- At the 12:15 p.m. survey, two blocks of Main Street parking spaces were 100 percent full: however, only one off-street lot was full.
- In general, on-street spaces were more heavily utilized than off-street spaces; and
- On-street parking appeared to have a rapid turnover serving short-term parkers (shoppers) while off-street lots tended to serve long-term parkers (employees).

The removal of parking from Main Street is an important issue to be looked at as part of any future Alternatives Analysis/EIS, and will necessarily involve the full participation and cooperation of the Downtown Milwaukie business community in addressing the trade-offs between the benefits, impacts, and necessary mitigation associated with this or other LRT alignments.

Economic Development Considerations in Downtown Milwaukie: Together with downtown Portland, downtown Milwaukie is likely to benefit the most from the added accessibility LRT provides. This accessibility could allow more intensive land uses to occur (such as office and commercial projects) without the traffic and parking problems which could otherwise result. While LRT by itself cannot cause revitalization of downtown Milwaukie, it can, together with other public and private programs, contribute to a positive atmosphere aimed at promoting downtown Milwaukie as a business center.

Current economic conditions in downtown Milwaukie have shown some signs of improving in recent months. However, the downtown area still has a number of vacant storefronts, indicating some softness in current market conditions. The area basically serves as a community-level shopping district, competing with shopping districts south of Milwaukie along McLoughlin Boulevard and in the Clackamas Town Center area east of Milwaukie.

Efforts to improve the existing businesses in downtown Milwaukie are presently underway, and are being coordinated by the Milwaukie Storefront Association, which is staffed by students from Portland State University. These efforts are aimed at improving the appearance and function of the downtown Milwaukie business district, which will hopefully result in the increased economic vitality of the area.

In the future, downtown Milwaukie is expected to continue as a major center of transit service in northern Clackamas County. Any expansion of service, whether by bus or LRT, is expected to be focused on a timed-transfer station in downtown Milwaukie as it is today. This expansion of service, together with the timed-transfer center, will continue to improve Milwaukie's transit service.

By the year 2000, over 10,000 people are projected to use the timed-transfer center in Milwaukie each day. This is a substantial increase from today's levels which could help promote more intensive uses in downtown Milwaukie, such as office and specialty commercial uses. However, this improvement in accessibility by itself will not automatically result in the improvement and revitalization of Milwaukie's downtown. Only though cooperative efforts of the City, businessmen, and property owners can the opportunities provided by light rail or other transit improvements be capitalized on. This may involve a focusing of public improvements together with private or public sponsored redevelopment of "opportunity" parcels.

One such area of opportunity appears to be west of McLoughlin Boulevard, adjacent to the Willamette River. This area, presently occupied by parking areas and small strip-commercial business along McLoughlin Boulevard, has been suggested for redevelopment as a riverfront commercial complex and/or as a hotel complex. Local efforts to study the potential of redeveloping this area have begun in Milwaukie. Redevelopment of the riverfront is seen by many as a catalyst for further revitalization of downtown Milwaukie east of McLoughlin Boulevard.

Transit expansion in general and light rail in particular could make projects such as riverfront redevelopment in downtown Milwaukie more attractive to private developers who must ultimately be attracted to the area. However, it is unlikely that light rail by itself is enough of an economic stimulus to accomplish revitalization of downtown Milwaukie without an accompanying public/private partnership designed to capitalize on the opportunities light rail could provide.

<u>ROW</u>: ROW purchase in Downtown Milwaukie will be limited to that required for developing an off-street transit center, based on ongoing studies being conducted by Tri-Met and the city of Milwaukie), and the Kellogg Lake Park and Ride south of Downtown Milwaukie adjacent to McLoughlin Boulevard.

<u>Visual Impacts</u>: The major visual impact of the LRT alignments under study in Central Milwaukie will be the LRT overhead wire.

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APPENDIX A

JHK & ASSOCIATES ANALYSIS
OF 17TH AND TACOMA
INTERSECTION WITH LRT

LRT AT 17TH AVENUE & TACOMA STREET

TRAFFIC IMPACT

December, 1983

TASK DESCRIPTION

This task involved an analysis of three alternatives for the 17th Avenue and Tacoma Street intersection in Southeast Portland. The alternatives included the present intersection configuration with year 2000 traffic volumes, the intersection with LRT in a separate pullout lane at station locations, and the intersection with LRT in the traffic lane.

Determinations to be made were the projected intersection level of service, the estimated LRT delay, reasonable congestion mitigation designs, and safety concerns.

The year 2000 PM peak hour traffic volumes used were those provided by Metro. LRT headways were assumed to be 7.5 minutes in each direction during the peak hour, and an average station dwell time of 20 seconds was used.

PROCEDURE

The 17th & Tacoma intersection was analyzed using projected year 2000 traffic volumes, assuming the present lane configuration and signal phasing. The projected demand was found to greatly exceed the capacity for level of service "D", so several alternative intersection designs were investigated. Those that appeared to result in a reasonable level of service were analyzed further.

The most likely train pre-emption sequence was determined for each of the design alternatives, using the two proposed track alignments. Based on these pre-emption sequences, the effect of the LRT on the intersection level of service was estimated, and the projected delay to LRT trains was calculated.

Throughout the analysis, it was kept in mind that 17th Avenue is not intended to be a regional trafficway, and that ultimately, much of the regional traffic presently using 17th will probably be shifted to McLoughlin Boulevard.

RESULTS

The primary results of the task analysis are as follows:

1. Based on the train delay analysis and the traffic level of service analysis, neither of the two proposed track alignments (LRT pullouts or LRT in traffic lane) appears to be superior to the other. Both would result in approximately equal train and traffic delays. The LRT in-traffic-lane alignment would, however, require a more sophisticated train pre-emption system.

2. It may not be possible, with reasonable street design mitigation measures, to provide the level of service that would be desirable for projected year 2000 traffic volumes. The best design would allow level of service D without LRT trains, and borderline D-E service with LRT trains.

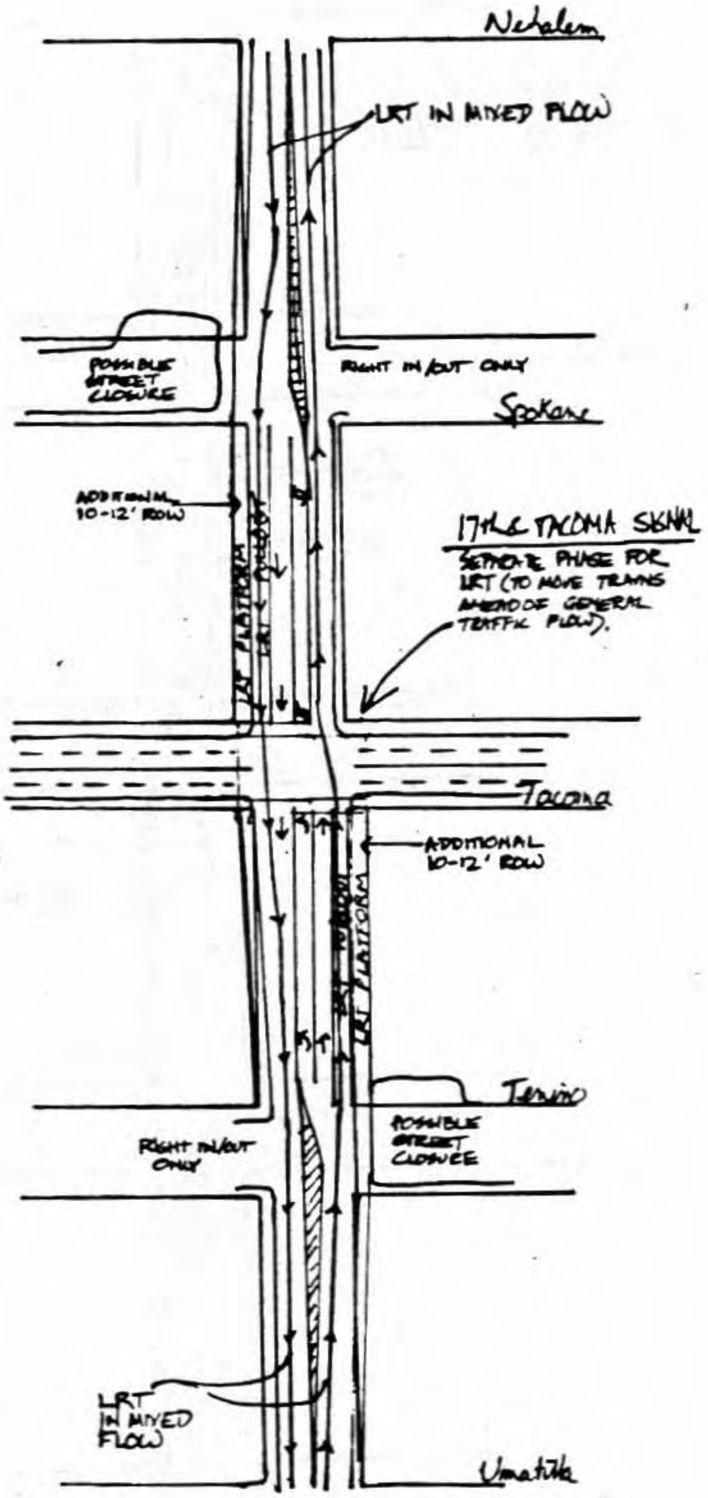
3. The operation of LRT trains, with signal pre-emption, will not have a serious adverse effect on vehicle capacity at the intersection. It is estimated that the trains will reduce capacity by 3 to 5 percent.

4. The average train delay at the intersection, with signal pre-emption, would be less than 10 seconds. The maximum possible delay could be as high as 40 seconds, but this would occur very infrequently.

5. There do not appear to be any serious safety problems which would result from the two track alignments that were analyzed.

6. The two track alignment alternatives are approximately equal in their effect on traffic capacity at the intersection. However, the station-pullout alternative would result in less delay to trains than the traffic lane alternative.

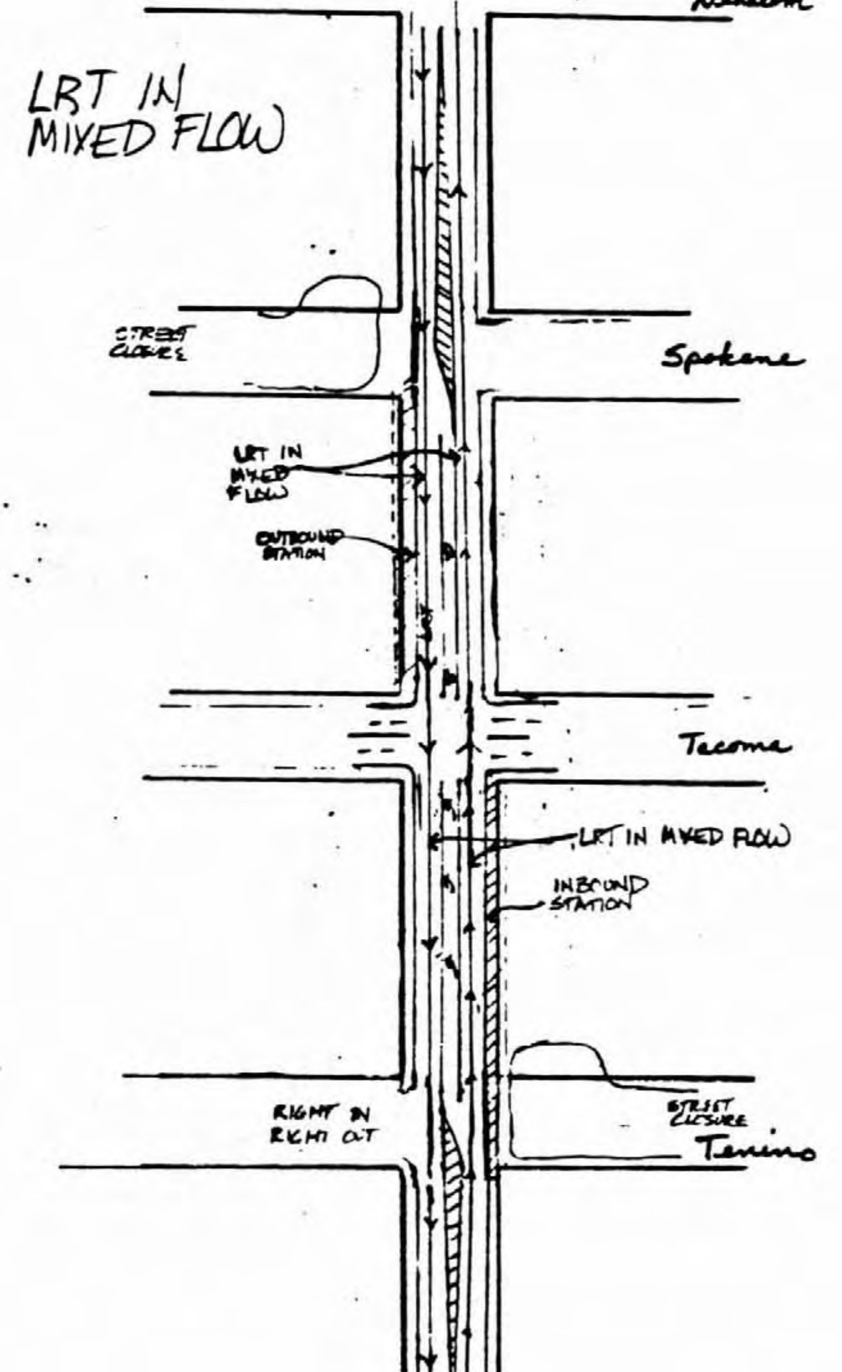
7. One of the street design alternatives is more suited than the others to traffic diversion from 17th to McLoughlin, because diversion will tend to improve the intersection level of service for that design.



Regional LRT System Plan

17th & TACOMA LRT PULLOUTS

FIGURE 1



17th & TACOMA
LRT IN MIXED FLOW

FIGURE 2

EVALUATION OF ALTERNATIVES

17th & Tacoma

	Intersection Alternatives			
	II	III	V	VI
Level of Service without LRT	E	D-E	D-E	D
Level of Service with LRT	F	E	E	D-E
Will Diversion Improve L of S ?	No	No	No	Yes

	LRT PULLOUTS				LTR IN TRAFFIC LANE			
	Intersection Alternative				Intersection Alternative			
	II	III	V	VI	II	III	V	VI
Average Train Delay	5"	5"	5"	5"	6"	6"	6"	6"
Maximum Train Delay	18"	18"	18"	18"	29"	29"	29"	39"

ANALYSIS

For the purposes of this analysis, it was assumed that the average signal cycle length would be 90" during the peak hour, and that the yellow intervals would be 4". It was also assumed the signal would be actuated rather than pretimed, for two reasons: (1) an actuated signal would be more efficient in adjusting phase splits from cycle to cycle, which would be particularly important when frequent pre-emption is involved, and (2) it would not be necessary to provide for pedestrian crossing time every phase.

Due to the neighborhood goal of diverting regional traffic from 17th to McLoughlin, it was assumed that no street widening should be done on 17th. All street widening considered in the intersection design alternatives was done on Tacoma.

The capacity calculations shown for the attached intersection design alternatives are based on a percentage of capacity for level of service D. The restriction on the widening of 17th precludes some improvements that might normally be made at this type of intersection. Consequently, it is not possible to design for a level of service C or D without major widening of Tacoma Street. This was not judged to be reasonable due to the presence of an established business area.

An analysis of the capacity calculations indicates that in most cases, a diversion of traffic from 17th to McLoughlin will not affect the calculations. The traffic movements are well-balanced, so that a reduction in traffic on one phase will simply increase traffic on another phase. The exception is for Design VI, which has an unbalanced lane flow. In this case, a diversion of traffic will tend to decrease to some extent the volume to capacity ratio.

The track alignment alternative which uses the through traffic lanes would require two signal pre-emption phases. One would be required as the train approaches the intersection, to clear vehicles which may be waiting at a red signal indication. A second sequence would be required to allow the train to enter the intersection as it leaves the station.

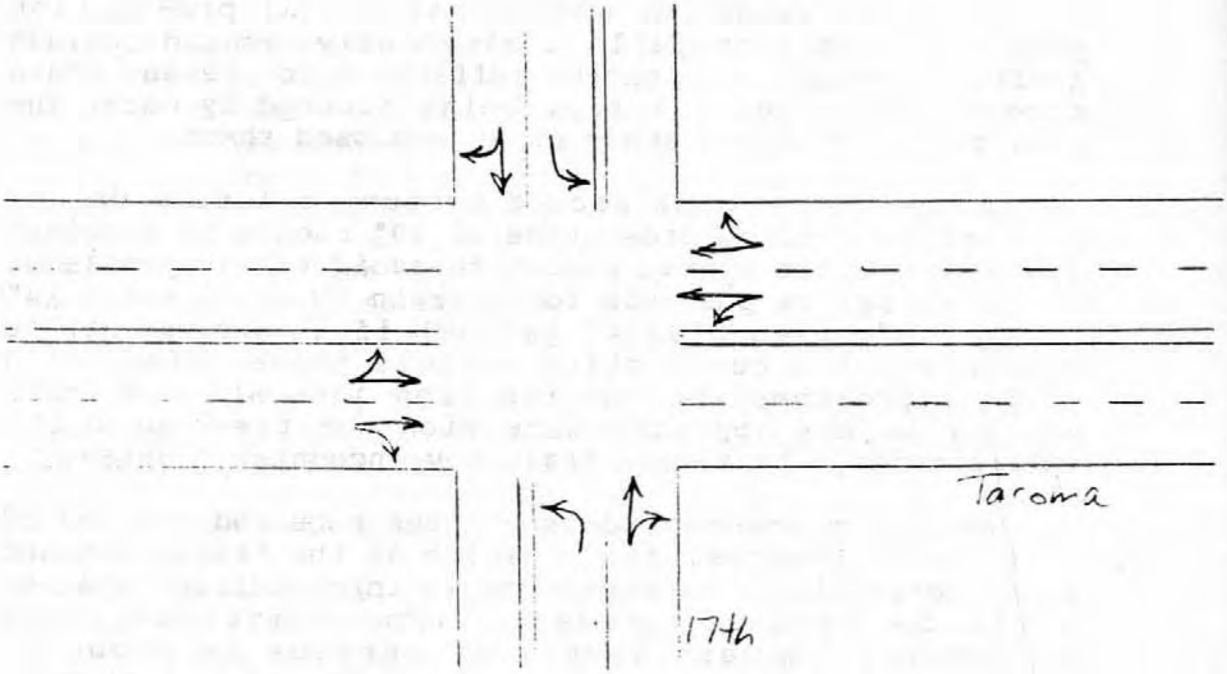
The other track alignment, which uses a pullout onto an exclusive lane at the station, will need a signal pre-emption only to enter the intersection after leaving the station. To avoid an additional signal pre-emption phase, the station-pullout alternative should include traffic lane storage lengths sufficient to prevent train access to the pullout from being blocked by cars. The required lengths are shown on an enclosed sheet.

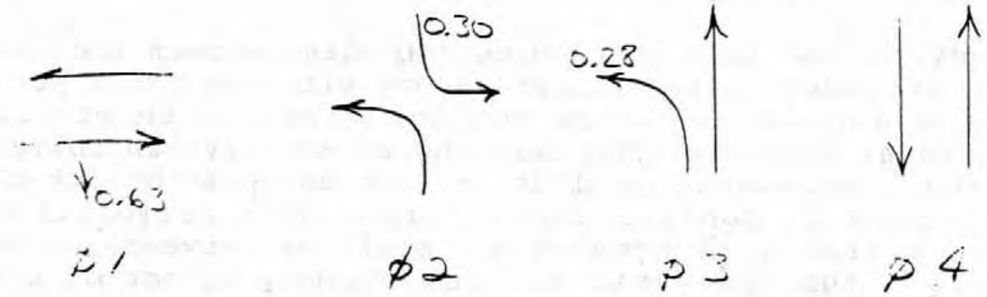
Normally, the trains should encounter little delay. However, a minimum green time of 10" should be provided for all vehicle signal phases to avoid safety problems. It is therefore possible for a train to encounter a 14" delay (10" green plus 4" yellow) if it arrives at the beginning of a conflicting vehicle phase. Also, if a train approaches the intersection just after a train moving in the opposite direction has pre-empted the intersection, the second train may encounter a delay.

If the train pre-emption sequences required the use of an all-red interval for vehicles as the trains crossed the intersection, the reduction in intersection capacity would be about 8 percent. (For comparison, the difference between levels of service is about 10 percent). However, in most cases, the signal phasing will allow some concurrent traffic movements during train pre-emption, so the net reduction in capacity is estimated to be 3 to 5 percent.

A study of the intersection design alternatives and the track alignment alternatives, along with the train pre-emption sequences, does not indicate any safety or operational problems. The existing separately-controlled left-turn movements on 17th prevent any possibility of left turns in conflict with trains. The pre-emption signal phases will prevent any conflict between trains and right-turning vehicles. The primary effect of the trains and the signal pre-emptions will be in the abrupt changes to the normal signal phasing sequence. If the signal is fully actuated, the sequence changes will reduce the efficiency of the signal, but will not have a significant adverse effect on the capacity or safety of the intersection.

DESIGN I Existing configuration





0.63 0.30 0.28 0.07

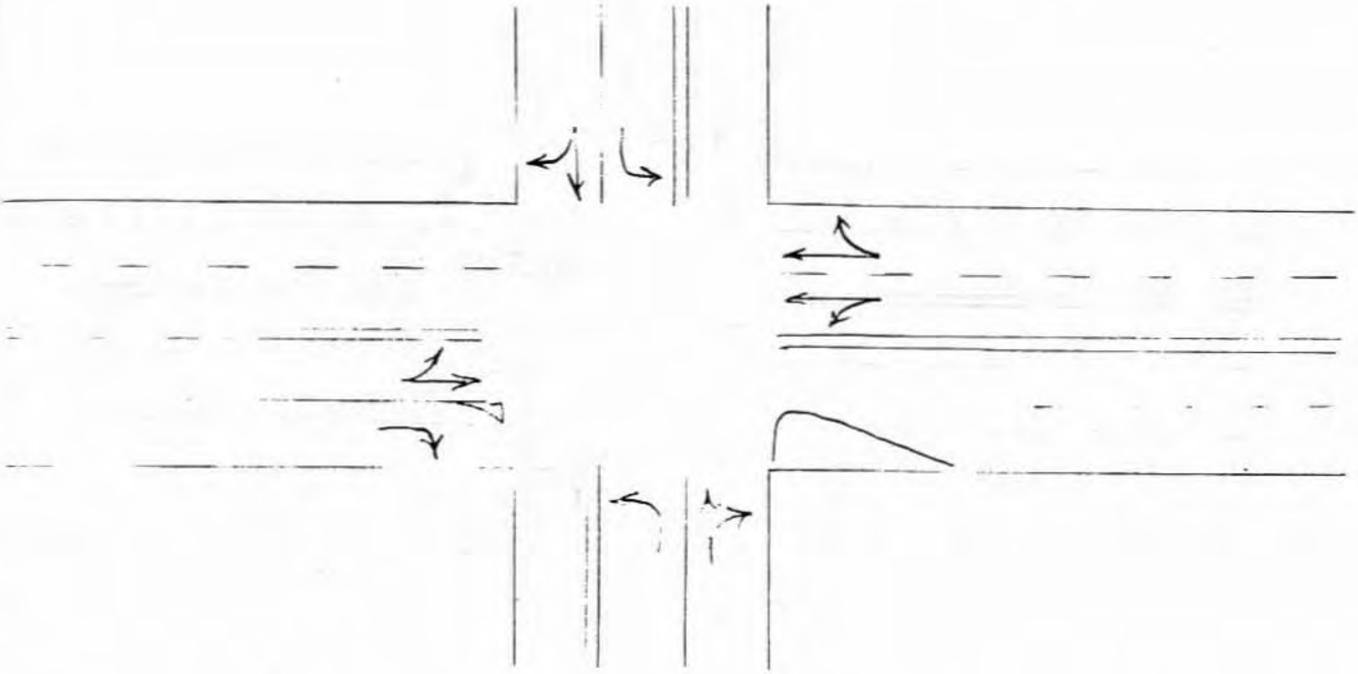
0.63
0.30
0.28
0.07
0.13 Y

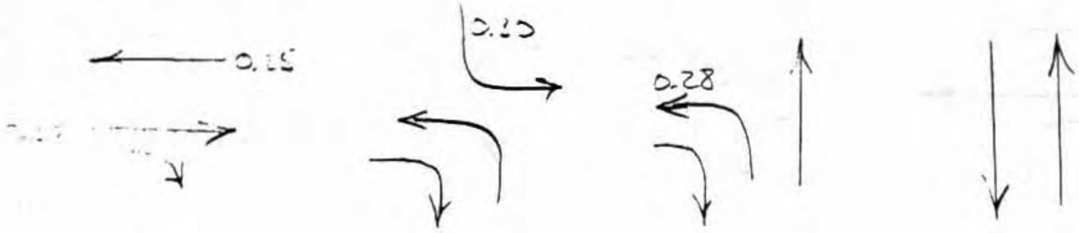
1.41

F

DESIGN II

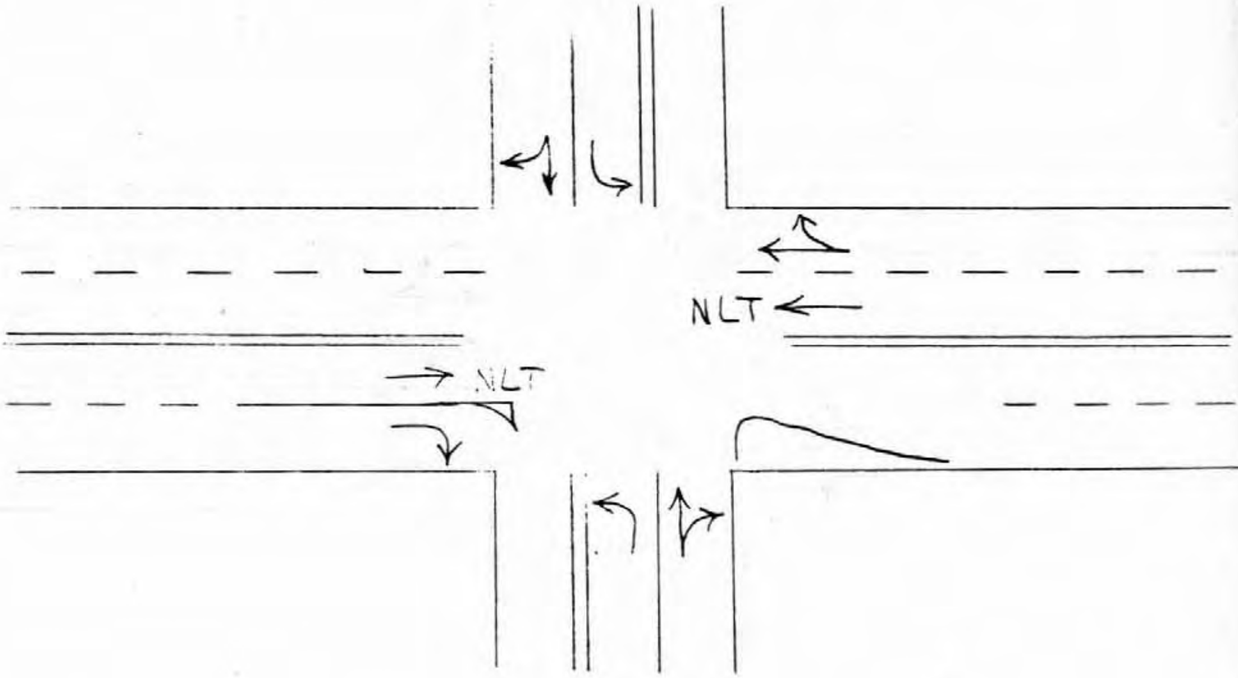
Existing configuration with right-turn lane, signal phase overlaps

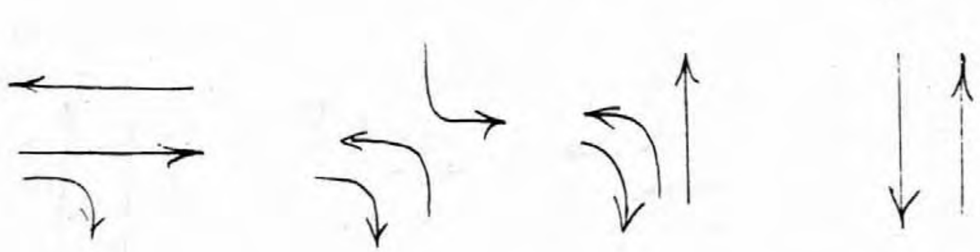




ϕ1	ϕ2	ϕ3	ϕ4	0.30 0.30 0.28 0.07 0.13Y 1.08
0.30	0.30	0.28	0.07	E

DESIGN III Existing configuration, right-turn lane, signal overlaps, no left turns



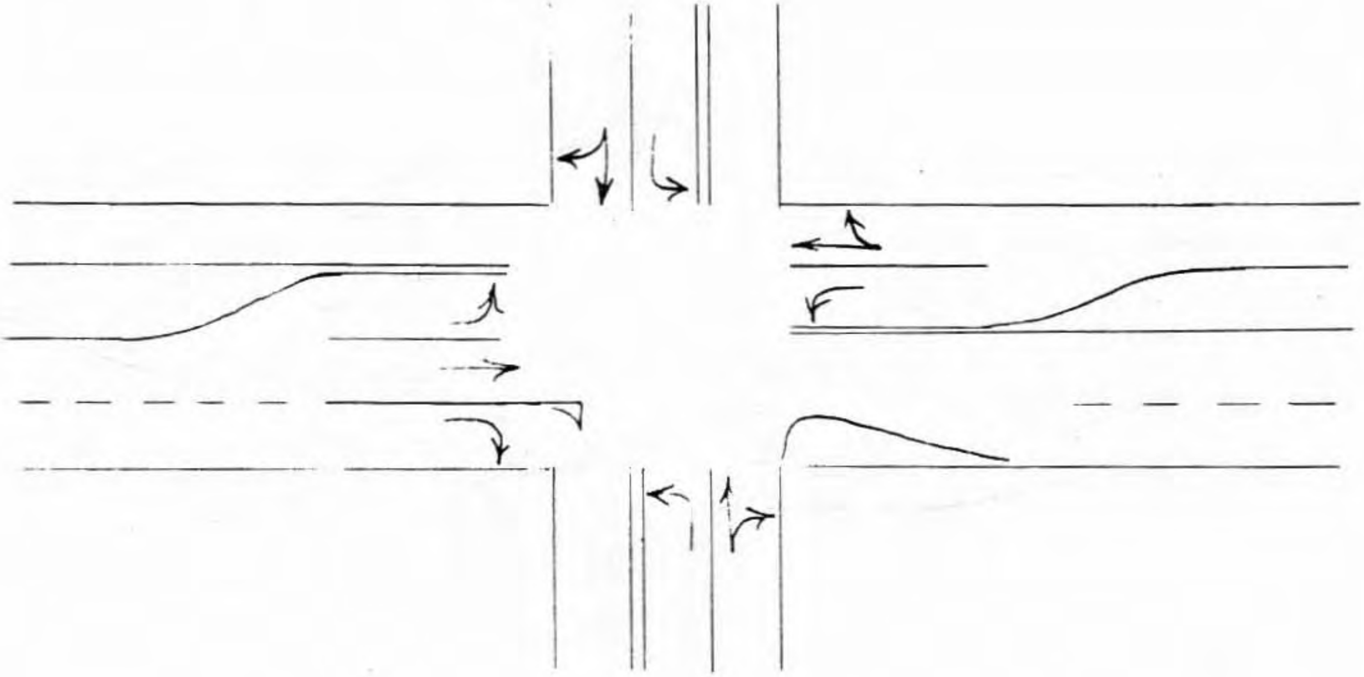


$\phi 1$	$\phi 2$	$\phi 3$	$\phi 4$
0.22	0.30	0.28	0.07

0.22
0.30
0.28
0.07
0.13 Y
1.00

D-E

DESIGN IV Restripe for left-turn lanes, right-turn lane

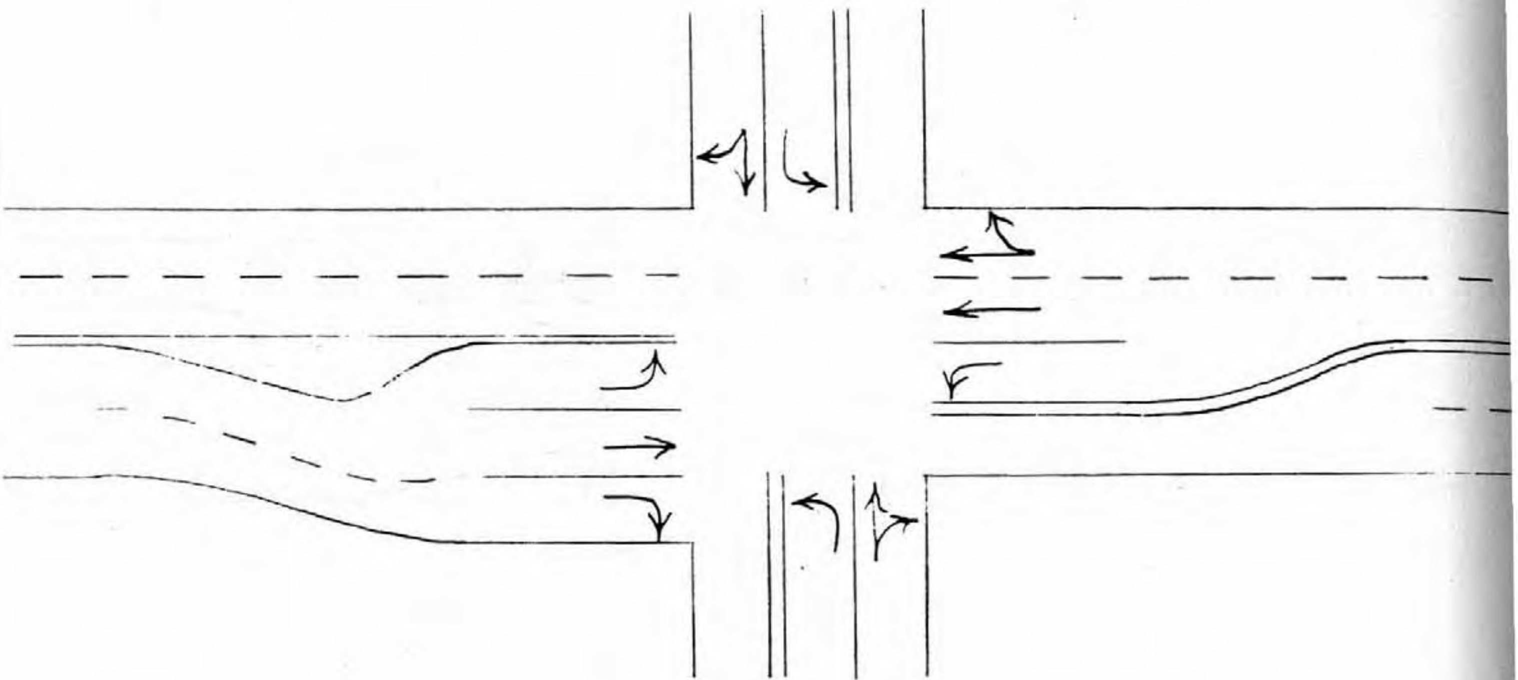


φ1	φ2	φ3	φ4	
0.41	0.30	0.28	0.07	

0.30
0.28
0.07
0.41
0.13 Y
1.19

F

DESIGN V — Widen west leg, add left-turn lanes



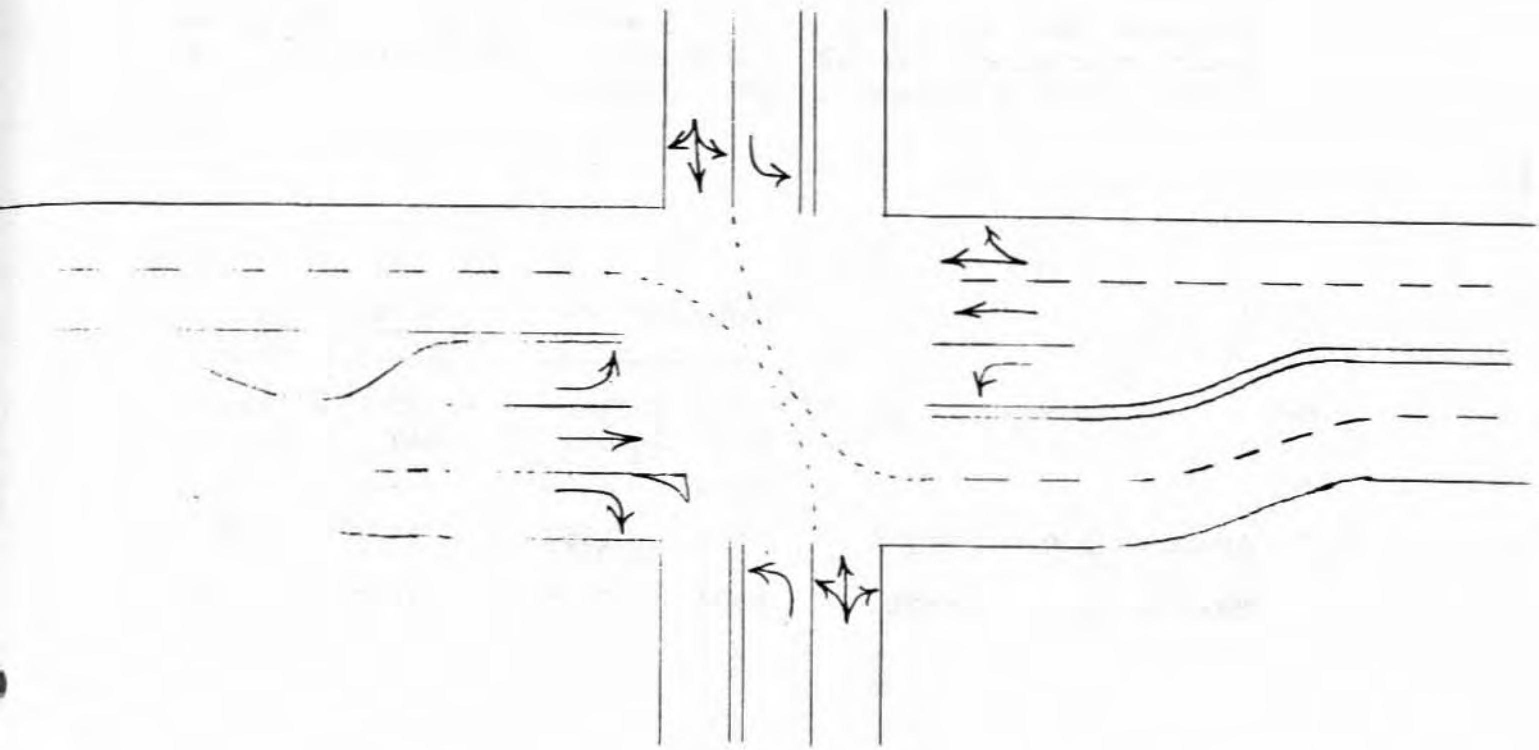
φ1	φ2	φ3	φ4
0.21	0.30	0.28	0.07

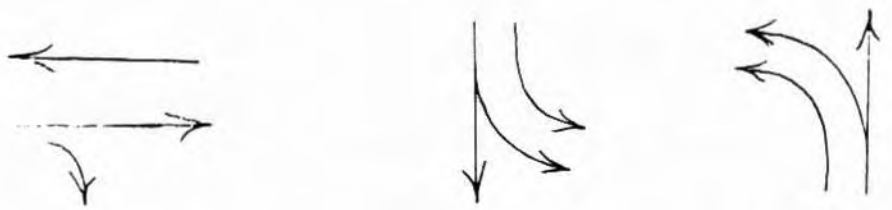
0.21
0.30
0.28
0.07
0.13 Y

0.99

D-E

DESIGN VI Widen east and west legs, use double turns





			0.28
			0.19
			0.35
			0.13 Y
φ1	φ2	φ3	0.95
0.28	0.19	0.35	D

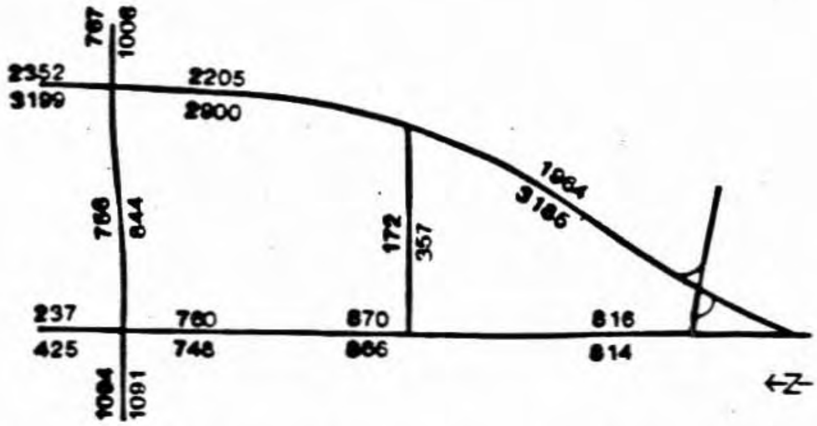
STORAGE LENGTHS

Storage length required for traffic lanes on north and south approaches for LRT Pullout Alternative (Fig. 1) to avoid blocking access to LRT pullout:

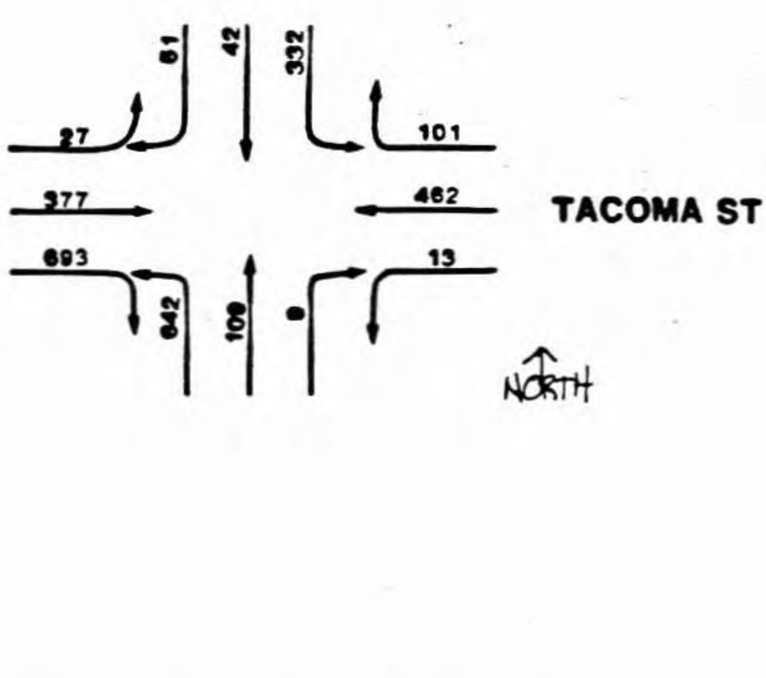
	Designs I-V		Design VI	
	S. Leg	N. Leg	S. Leg	N. Leg
Average Queue Length	200'	155'	190'	105'
Maximum Queue Length	400'	310'	380'	210'

17th & TACOMA

LEVEL 2 GOAL



LEVEL 2 - w/"FEASIBLE" TRAFFIC DIVERSION



YEAR 2000 P.M. PEAK HOUR TRAFFIC VOLUMES

FIGURE 3

APPENDIX B

ODOT TRAFFIC ANALYSIS

OF MCLOUGHLIN/LRT

AT-GRADE CROSSINGS

TRECEIVED JAN 4 1984

VICTOR ATIYEH
GOVERNOR

Department of Transportation
HIGHWAY DIVISION
Metro Region
9002 SE. McLOUGHLIN BLVD., MILWAUKIE, OREGON 97222 PHONE 653-3090

December 28, 1983

In Reply Refer To
File No.:
083-5121-
624-02

NEIL MCFARLANE
Metropolitan Service District
527 S.W. Hall Boulevard
Portland, Oregon 97201

Subject: Milwaukie LRT
Analysis of McLoughlin at-Grade
LRT Crossings

As requested, we have completed the traffic impact analysis for the two alternative LRT crossings of McLoughlin Boulevard. The level-of-service calculation was made for the intersection proper, assuming the LRT vehicles could proceed into and through the intersection without delay and free of conflicts at adjacent intersections.

It is found that an LRT crossing at Ochoco Street will reduce intersection operation from Service Level "D" to Service Level "E-F." A LRT crossing at Harrison Street would not be a drastic reduction in level-of-service. Since traffic movements are somewhat different at Harrison Street, a LRT located in the center or north side of Harrison would decrease level-of-service from "D" to approaching "D-E."

A complete evaluation of the impacts cannot be made until a sketch is made of the alignment for the LRT crossing. An at-grade LRT crossing of McLoughlin Boulevard at either location may result in greater impacts than calculated for intersection due to the short distance between McLoughlin and Main Street and the possible alignment of the LRT south along Main Street.

If you need additional information please do not hesitate to call.

Tom Schwab

THOMAS H. SCHWAB
Transportation Analysis Manager

pa

734-1850

TRAFFIC ANALYSIS

Milwaukie LRT

Feasibility of McLoughlin Blvd. At-Grade Crossing

An analysis of two alternative LRT crossings at McLoughlin Boulevard has been made. The purpose of this analysis is to evaluate the impacts of the two alternative LRT crossings at McLoughlin Boulevard: Alternative 1 at Ochoco Street, and Alternative 2, the Harrison/River Road jug-handle.

The analysis is requested to answer the following questions:

1. The resulting level-of-service from each of these two LRT crossings;
2. Any major delays or operational problems likely to be encountered with the McLoughlin Boulevard crossing at these two intersections; and
3. The special signals or other traffic mitigation measures which would be needed to accommodate these crossings.

Forecast 2000-Year p.m. peak-hour traffic volume and transit volume at the two intersections were provided by the Metropolitan Service District (MSD) for this analysis. (See Figures 1 & 2) An evaluation of traffic data provided compared with data used in prior analysis shows a slight discrepancy in traffic volumes on the Harrison/River Road jug-handle. Forecast traffic volumes supplied by MSD shows 831 vehicles-per-hour in the p.m. peak period approaching McLoughlin Boulevard. Traffic data developed by the Highway Division and previous analysis shows 600 vehicles-per-hour (VPH) on this jug-handle approach. Evaluation of the forecast traffic on the 17th/River Road and McLoughlin route shows that the 600 VPH is a more realistic value.

Although either the 831 VPH or the 600 VPH yield similar results, the 600 VPH on the Harrison jug-handle approach was used in this analysis.

Resulting Level-Of-Service

Calculations show the all-bus alternative would not affect the level-of-operation at either intersection. A service-level, volume/capacity (V/C) ratio of 0.85 was calculated for the Ochoco Street intersection. The upper range for service level "D" is 0.88. The Harrison Street intersection was calculated at service level "D", volume capacity ratio 0.83.

The LRT crossing alternative was calculated using a delayed-time of 27 seconds per light-rail vehicle-crossing of McLoughlin Boulevard. Analysis of the Ochoco intersection shows with the LRT alternative a level-of-service "E-F" (V/C ratio=0.98) can be expected.

The level-of-service at the Harrison Street/River Road intersection would be similar to the level-of-service calculated for the all-bus alternative. This analysis was made assuming the LRT travels on its own right-of-way, and that the LRT crossing on the Harrison/River Road jug-handle can be made in approximately the same time period as the cross-movement of traffic on Harrison Street. The LRT option would approach a service-level "D-E" at this intersection (V/C= 0.88).

In response to the question concerning any major delay or operational problem to the LRT trains crossing McLoughlin Boulevard at these two intersections, it is found that no major delays or operational problems can be expected for the

LRT at these two intersections at McLoughlin Boulevard assuming the standard pre-emption devices for the light rail operation. As stated earlier, delay to the motorist using McLoughlin Boulevard can be expected with the at-grade rail crossing at either of these two intersections.

Improvements in the level-of-operation of both highway and LRT traffic at either the Ochoco intersection or the River Road intersection could be accomplished with a grade separation of the railroad crossing over McLoughlin Boulevard.

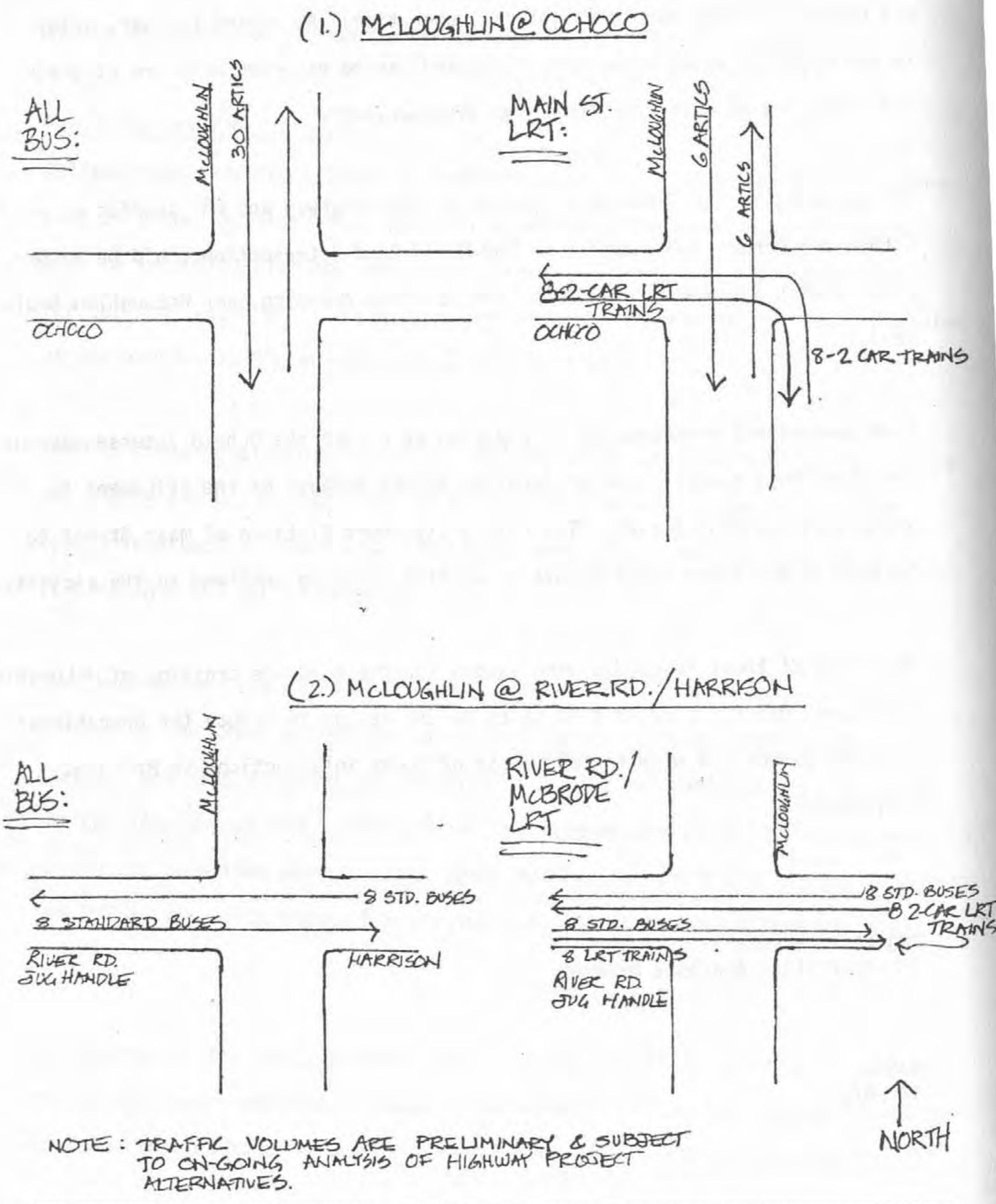
Some operational problems can be expected at either the Ochoco intersection or the River Road intersection at Harrison Street because of the alignment to swing south on Main Street. The relatively short distance of Main Street to McLoughlin Boulevard could result in traffic handling problems in the vicinity.

If either of these locations were chosen for the at-grade crossing of McLoughlin Boulevard, extreme care must be taken in the design to reduce the operational problems associated with the closeness of these intersections to McLoughlin Boulevard.

THOMAS H. SCHWAB
Transportation Analysis Manager

po

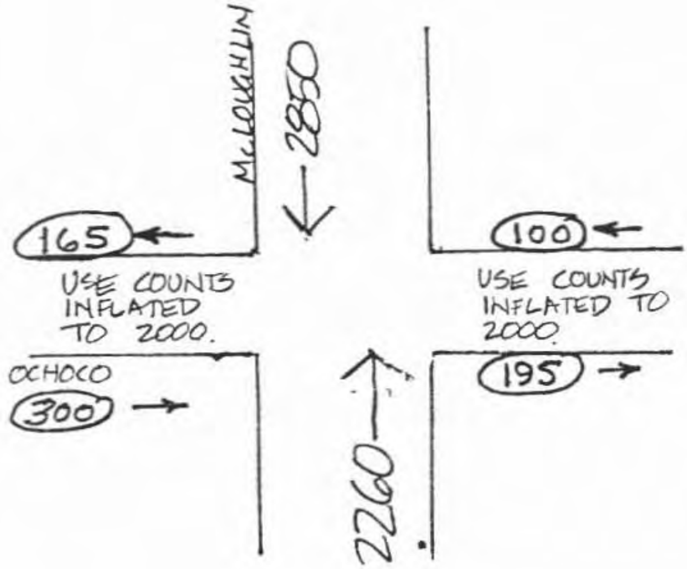
ODOT
12/28/83



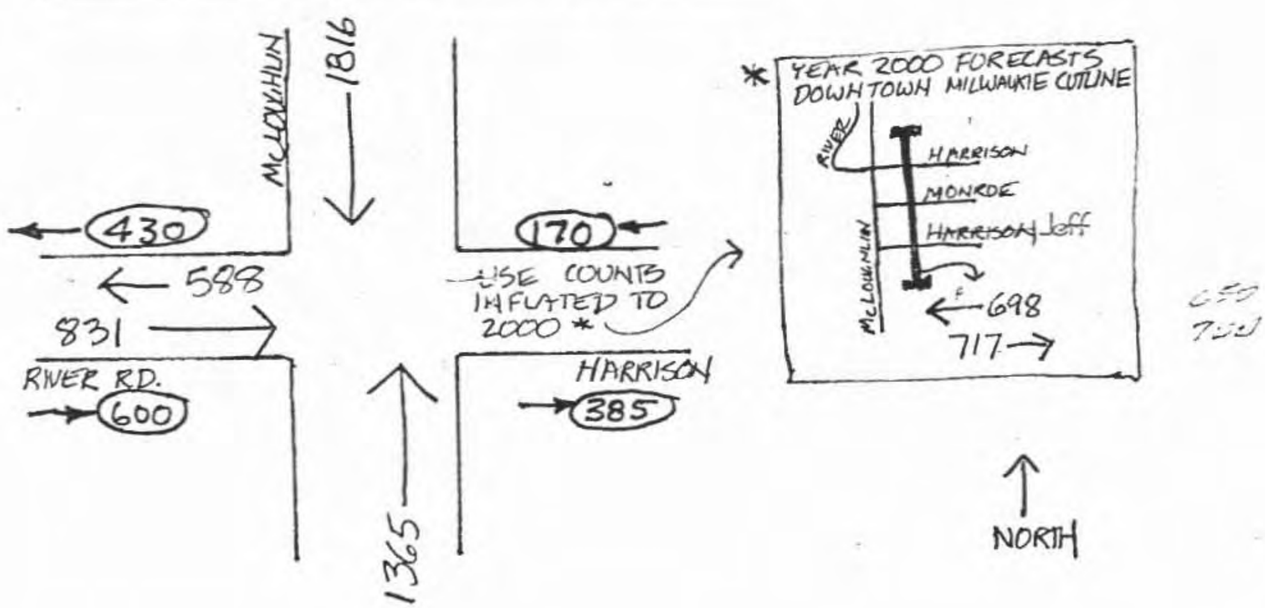
PM PEAK HOUR
TRANSIT VEHICLE VOLUMES (YR. 2000)

Figure 1

(1.) McLOUGHLIN @ OCHOCO



(2.) McLOUGHLIN @ RIVER RD./HARRISON



APPENDIX C

CENTRAL MILWAUKIE

PRELIMINARY PARKING ANALYSIS

CENTRAL MILWAUKIE LRT ALIGNMENT: PRELIMINARY PARKING ANALYSIS

A. INTRODUCTION

This paper summarizes results of data collected on parking availability and usage along a possible light rail alignment on Main Street in downtown Milwaukie. This is intended to be a preliminary analysis which will identify potential impacts of removing some on-street parking along this route to accommodate light rail transit.

This analysis did not attempt to define alternatives for replacement of lost parking. These would be developed after a preferred alignment is chosen in the corridor, and only after extensive input by local businesses and affected residents.

Data for the parking survey was collected on September 20 and 28, 1983. Parking usage was recorded at five different times of the day--8:30 a.m., 10:15 a.m., 12:15 p.m., 3:15 p.m. and 6:15 p.m. From this information, peak daily usage of parking spaces was determined. The specific area surveyed in Milwaukie was the appropriate seven-block area of Main Street from Kellogg Lake to Highway 224. The inventory and usage data is shown on Table C-1 and included the items noted below.

- Available on-street supply, number of long-term vs. short-term spaces, and the number in use at the times indicated; and
- Available off-street supply and the number in use at the time indicated.

Results of the survey are summarized below.

B. MAIN STREET SURVEY RESULTS

The inventory shows that along the length of Main Street, 138 on-street and 552 off-street spaces are available. All of the on-street spaces are short-term (in this case, two hour time limits), while 536 of the 552 off-street spaces (97 percent) are private, long-term parking lots.

Table C-1 shows that the 12:15 p.m. time period accounted for the highest percentage of occupied parking spaces (65 percent of on-street spaces and 42 percent of off-street spaces) along Main Street. All but two of the blocks surveyed had at least one-third of the available on-street spaces filled at this time. Two of the blocks were 100 percent full. The same was true for all but one block containing off-street lots; that is, they were at least one-third full, with only one lot 100 percent full.

The early morning (8:30 a.m.) and evening (6:15 p.m.) time periods account for the lowest usage rates. On-street spaces were only 15 percent occupied and off-street spaces were only

TABLE C-1

MAIN STREET PARKING INVENTORY AND USAGE SUMMARY

Block		8:30 a.m.	10:15 a.m.	12:15 p.m.	3:15 p.m.	6:15 p.m.
Kellogg Lake to Washington	On-Street:	0/32	3/32	12/32	5/32	1/32
	Off-Street:	21/72	22/72	30/72	26/72	9/72
Washington to Jefferson	On-Street:	6/15	9/15	14/15	10/15	4/15
	Off-Street:	1/16	5/16	11/16	6/16	0/16
Jefferson to Monroe	On-Street:	6/18	15/18	18/18	14/18	6/18
	Off-Street:	14/14	14/14	14/14	11/14	9/14
Monroe to Jackson	On-Street:	5/22	10/22	22/22	17/22	9/22
Jackson to Harrison	On-Street:	1/7	2/7	3/7	6/7	1/7
	Off-Street:	25/60	40/60	40/60	35/60	2/60
Harrison to Scott	On-Street:	0/12	4/12	5/12	5/12	4/12
	Off-Street:	10/100	40/100	35/100	36/100	60/100
Scott to Highway 224	On-Street:	3/32	6/32	16/32	12/32	17/32
	Off-Street:	89/290	97/290	101/290	87/290	72/290

TOTAL AVAILABLE ON-STREET SPACES = 138

TOTAL AVAILABLE OFF-STREET SPACES = 552

Key: TOTAL IN USE/TOTAL AVAILABLE

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01/30/84

18 percent occupied at 8:30 a.m. At 6:15 p.m., only 30 percent of available on-street spaces and 27 percent of available off-street spaces were occupied.

Conclusions from the Main Street Survey

- On-street spaces serve short-term parkers to a greater degree than off-street spaces (off-street spaces are, for the most part, private lots serving long-term parkers).

- On-street spaces were more heavily utilized than off-street spaces.

- A total net loss of 40-45 on-street spaces would be incurred by implementation of a Main Street LRT alignment.

Results of the survey indicate that a sufficient number of long-term, off-street spaces would be available to accommodate those lost to LRT. Since the majority of the lots are private, negotiations with local businesses would be necessary before determining this as an acceptable solution.

- The peak usage period for both on- and off-street spaces occurs at midday (12:15 p.m.). The lowest usage periods occur in the early morning (8:30 a.m.) and in the evening (6:15 p.m.).

For on-street spaces, the peak usage period may reflect the fact that these short-term spaces are serving customers of local businesses. The off-street lots have an average utilization rate of 39 percent during the day between 10:15 a.m. and 3:15 p.m., which may indicate use of these lots by employees of local businesses.

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APPENDIX D

SELLWOOD-MORELAND

IMPROVEMENT LEAGUE CORRESPONDENCE

Sellwood-Moreland Improvement League

SMILE

1436 S. E. SPOKANE STREET **PORTLAND, OREGON 97202**

February 15, 1984

Corky Kirkpatrick, Presiding Officer
Metropolitan Service District
527 S. W. Hall Street
Portland OR 97201

Dear Ms. Kirkpatrick:

Last February Andy Catugno made a presentation at our monthly meeting on the three alternatives being considered for a light-rail route in the southeast area. It has recently come to our attention that our reaction to these alternatives is not on record, and we wish to correct that oversight.

We feel the S. E. 17th Avenue alternative would be the least satisfactory of the three. It would disrupt livability of a residential area. It would force traffic onto Milwaukie Avenue, which already has a heavy load. It would require extensive and costly reinforcement of the street from S. E. Ellis to S. E. Rex to protect the five foot pipeline installed there two years ago to serve Washington County. It would be much slower than the other alternatives.

We have a great interest in Oaks Bottom as a wildlife preserve. Although the Portland Traction route would probably be the cheaper choice, frequent trains might drive away the wildlife. It would also provide very limited service to this area.

We feel that McLoughlin Boulevard is the best alternative. It would provide high speed service and some access by people of this community. We are hopeful that the McLoughlin Project will be completed by the time light rail to Oregon City is undertaken, and adequate planning could be included for eventual light rail service.

We would be pleased to receive information on the progress of this project.

Sincerely yours,

Thelma Skelton

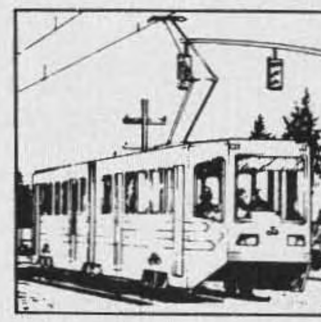
Thelma Skelton, President

TS:CS

Milwaukie Corridor
Working Paper "D"

CAPITAL & OPERATING COSTS & ECONOMIC EVALUATION

October 1984



METROPOLITAN SERVICE DISTRICT

TRI-MET

REGIONAL LIGHT RAIL TRANSIT SYSTEM PLAN

WORKING PAPER "D"

CAPITAL AND OPERATING COSTS

AND

ECONOMIC EVALUATION OF

MILWAUKIE CORRIDOR TRANSIT ALTERNATIVES

Prepared by:

Metropolitan Service District
527 S.W. Hall Street
Portland, Oregon 97201-5287

In cooperation with:

Tri-Met
4017 S.E. 17th Avenue
Portland, Oregon 97202

SUMMARY

The Metropolitan Service District (Metro) in association with Tri-Met and the cities and counties of the region have undertaken a Regional Long-Range Transitway Plan. This plan will study in each major travel corridor the feasibility of expanding transit service--as called for in the Regional Transportation Plan (RTP)--through either expanding bus service or building light rail.

Determining the nature of a future transit expansion generally involves two types of assessment: 1) an economic analysis which determines the most cost-effective, long-term transit alternative in each corridor; and 2) an impact and benefit analysis. This paper focuses only on reporting the capital and operating costs of alternatives serving the Portland to Milwaukie Corridor and, based on these cost estimates, an economic analysis of the alternatives. Other Working Papers document travel forecasts, engineering assumptions and alignment descriptions, and benefits and impacts to the community of each alternative.

A. Summary of Capital and Operating Costs

Capital and operating costs for the major transit alternatives providing trunk-line transit service between Milwaukie and downtown Portland are summarized below:

Alternative	Initial Trunk Route Capital Cost (in millions of 1984 dollars)	Year 2000 Corridor Annual Operating and Maintenance Cost (in millions of 1984 dollars)
• Basic Bus/TSM	\$16.47	\$22.87
• Portland Traction Company Light Rail	\$77.35-\$76.70[1]	\$21.75
• McLoughlin Light Rail	\$85.42	\$20.76-\$21.74[2]

1 Depending on the Main Street or McBrod Avenue alignment option.
2 Depending on the pattern of local bus service provided.

While the light rail alternatives obviously cost more to implement initially, they provide reduced annual operating costs over time--saving from \$1.12 to \$2.05 million annually in the year 2000 depending on the alternative. In addition, because of the longevity of light rail vehicles and facilities, the higher initial light rail capital costs provide for a longer operational life than the Basic Bus/TSM alternative. This difference in operational life requires a more thorough "economic analysis," which measures on a consistent basis the true cost of each alternative, as reported below.

B. Summary of the Economic Analysis

The purpose of an economic analysis is to present the financial implications of transit alternatives in a common form. Because some alternatives include higher initial capital costs, but lower operating costs over time, or vice versa, standard discounting procedures are used to create a "common denominator" by which to measure the alternatives.

The economic analysis provides a framework by which to view benefits or impacts, so that a true comparison of an alternative's worth can be made. It should be noted that a focus only on transit capital and operating costs of alternatives ignores important differences in capacity, service levels, patronage served, and external benefits or impacts. These are addressed in Working Paper No. 6 -- Preliminary Impact Assessment in the Milwaukie Corridor, and in the Milwaukie Corridor Summary Report.

Many different measures of the "economic cost" of alternatives are provided in this paper. Table A lists the present value of all operating and capital costs needed to operate an alternative over a 50-year period. Elsewhere in this paper, the equivalent uniform annual cost of the alternatives is shown. Both measures provide results which vary somewhat depending upon the discount rate used, as discussed below.

With no discounting, all but one light rail alternative is shown to "pay back" their initial capital cost as compared to the Basic Bus alternative. At a 3 percent discount rate, light rail--depending on the alternative--is expected to cost from 1 percent <u>less</u> than the basic bus to 3.3 percent <u>more</u> than the bus alternative. At the other extreme, a 10 percent discount rate results in all light rail alternatives being 9 percent to 12 percent more costly than the Basic Bus.

The McLoughlin Highway/Transit analysis indicated that early LRT implementation could delay Stage 3 of the McLoughlin Highway project for up to 10 years. Including the delay in Stage 3 of the highway project in the economic analysis narrows slightly the difference between the bus alternative and the light rail alternatives. Delay of Stage 3 of the highway project has a current economic benefit of \$1.51 to \$2.19 million--depending on the initial cost of the highway project. This translates to an equivalent uniform annual cost of \$.15 to \$.22 million based on a 10 percent discount rate.

TABLE A

SUM OF ALL CAPITAL, OPERATING AND MAINTENANCE COSTS OVER 50 YEARS
(millions of 1984 dollars)

	Without Discounting	With a 3% Discount Rate	With a 6% Discount Rate	With a 10% Discount Rate
a. Basic Bus/TSM	1,620.1	721.2	385.2	214.1
b. Portland Traction Co. (PTC) Light Rail (McBrod Option)	1,611.8	734.0	410.0	236.5
c. McLoughlin Light Rail[1]				
• With no local service changes	1,637.6	745.3	416.5	240.8
• Terminate Woodstock bus line at LRT station	1,585.0	726.6	408.4	237.5
• Re-route Woodstock bus to serve as LRT feeder and cross-town local service	1,553.1	714.4	402.8	235.0

---

1 Three options for providing local feeder service to the light rail line north of Milwaukie are shown. Other options may be possible.

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1.0 INTRODUCTION

This is one in a series of working papers used to document results of the Milwaukie Corridor portion of the Regional LRT System Plan. Because it is one in a series, by itself this working paper does not cover all issues important to deciding on the long-term transit alternative for the Milwaukie Corridor. Separate working papers covering travel forecasts, benefits and impacts and engineering issues are available. A report summarizing all these issues is also available.

This working paper presents an estimate of initial capital costs for alternative light rail transit (LRT) alignments in the McLoughlin Corridor. Also presented are the estimated annual transit operating costs associated with each alignment, and a comparative annual operating cost for equivalent, all bus transit service in the corridor. All costs, in 1984 dollars, are for comparative purposes. A more detailed estimating data base will be necessary to prepare the construction or operating budget for a specific corridor project.

This paper also presents an economic analysis of alternatives, comparing the economic efficiency of an LRT investment as compared to expanding the bus system in this corridor. Only by way of such a "net-present value" analysis which relates the useful life of capital facilities to the time-value of money invested in them can the real total costs of LRT or all-bus transit investments be fairly analyzed.

2.0 CAPITAL AND OPERATING COSTS

Capital Costs

The estimated initial cost to implement the alternatives, and a discussion of the methodology used to estimate capital costs, is presented below.

Findings

The capital cost estimates include construction of LRT transitway, park and ride lots, right-of-way, and the acquisition of buses or light rail vehicles. Cost estimates were prepared for three basic transit alternatives: 1) the Basic Bus service expansion, which serves as a transportation system management (TSM) alternative; (2) the Portland Traction Company (PTC) light rail alternative, with two alignment options at the south end following either McBrod Avenue or Main Street; and 3) the McLoughlin light rail alternative. The costs range from $16.4 million for the bus service expansion to $85.4 million for the McLoughlin light rail. Table 1 summarizes the initial costs associated with these three alternatives.

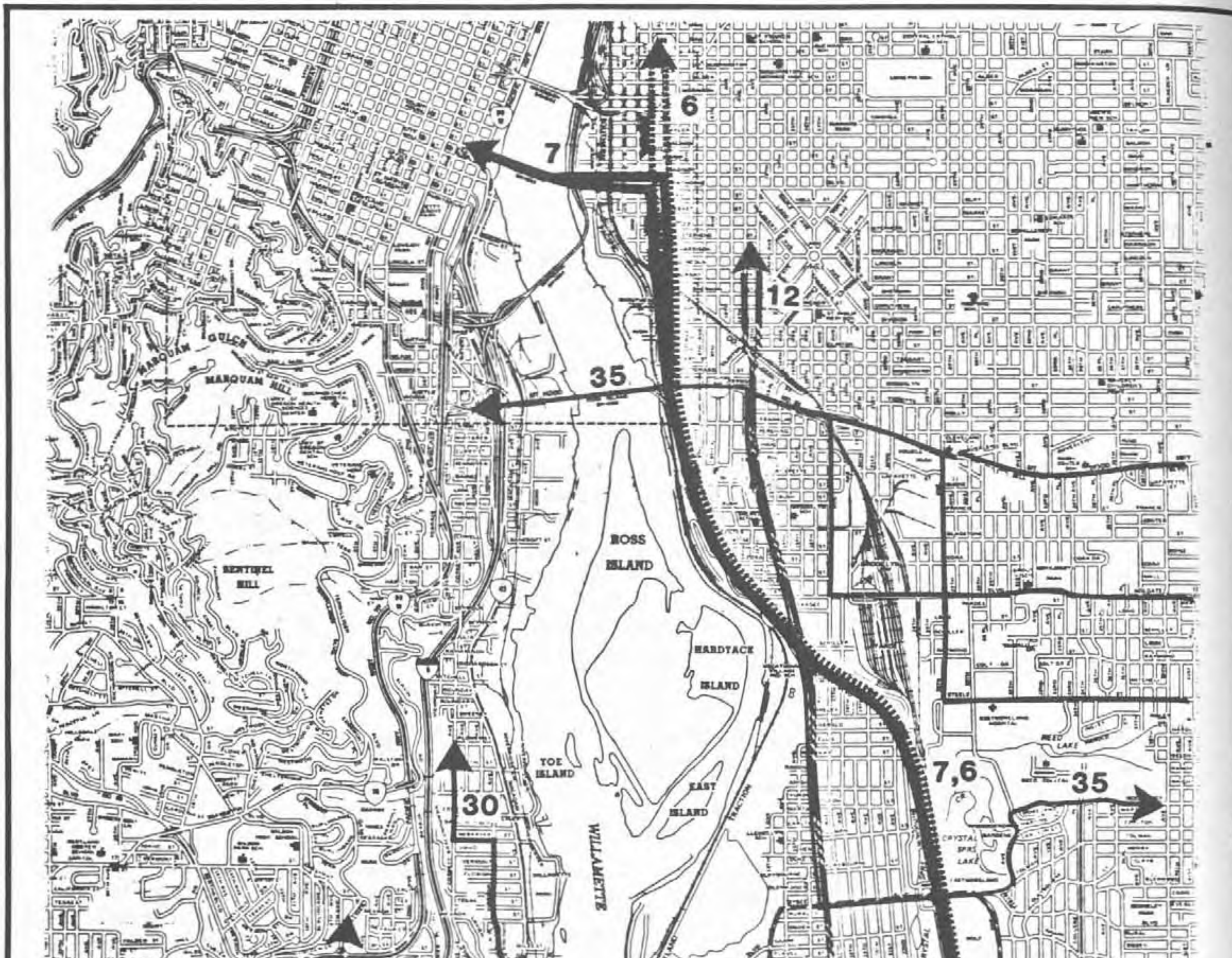
In addition to the capital costs associated with providing trunk route service from Portland to Milwaukie, service in the corridor assumes a feeder bus network which both supports the trunk route, and provides transit service for trips within the corridor. For this purpose, the corridor is defined generally as the area east of the Willamette River and south of S.E. Powell Boulevard. Cost of routes serving more than just this area are prorated based on travel time. The capital cost of buses to provide this service is constant for the Basic Bus/TSM alternative (see Figure 1), and the PTC light rail alternative (see Figure 2). However, because of the McLoughlin light rail alternative's central location in the corridor, added flexibility to restructure local routes is gained, which could result in lower capital and operating costs for the local bus system. Illustrating the potential of this restructuring are three local service options with the McLoughlin LRT. These options are illustrated on Figure 3, and described below:

1. Maintaining the local network as it is with the other alternatives;

2. Terminating the Woodstock line (#35 on Figure 3) at the Mitchell Street station, not continuing it to downtown Portland; and

3. Rerouting the Woodstock line (#35 on Figure 3) to serve as a cross-town Sellwood local and providing LRT feeder service at the Bybee station.

While these alternatives do not affect the McLoughlin alignment's initial capital costs, they do have a considerable effect on operating costs, as discussed in the next section. Other routing efficiencies are also possible with the Holgate bus line, but have not been analyzed separately. With added capital costs, the PTC



METRO

FIGURE 1

BASIC BUS NETWORK
IN PORTLAND TO MILWAUKIE CORRIDOR

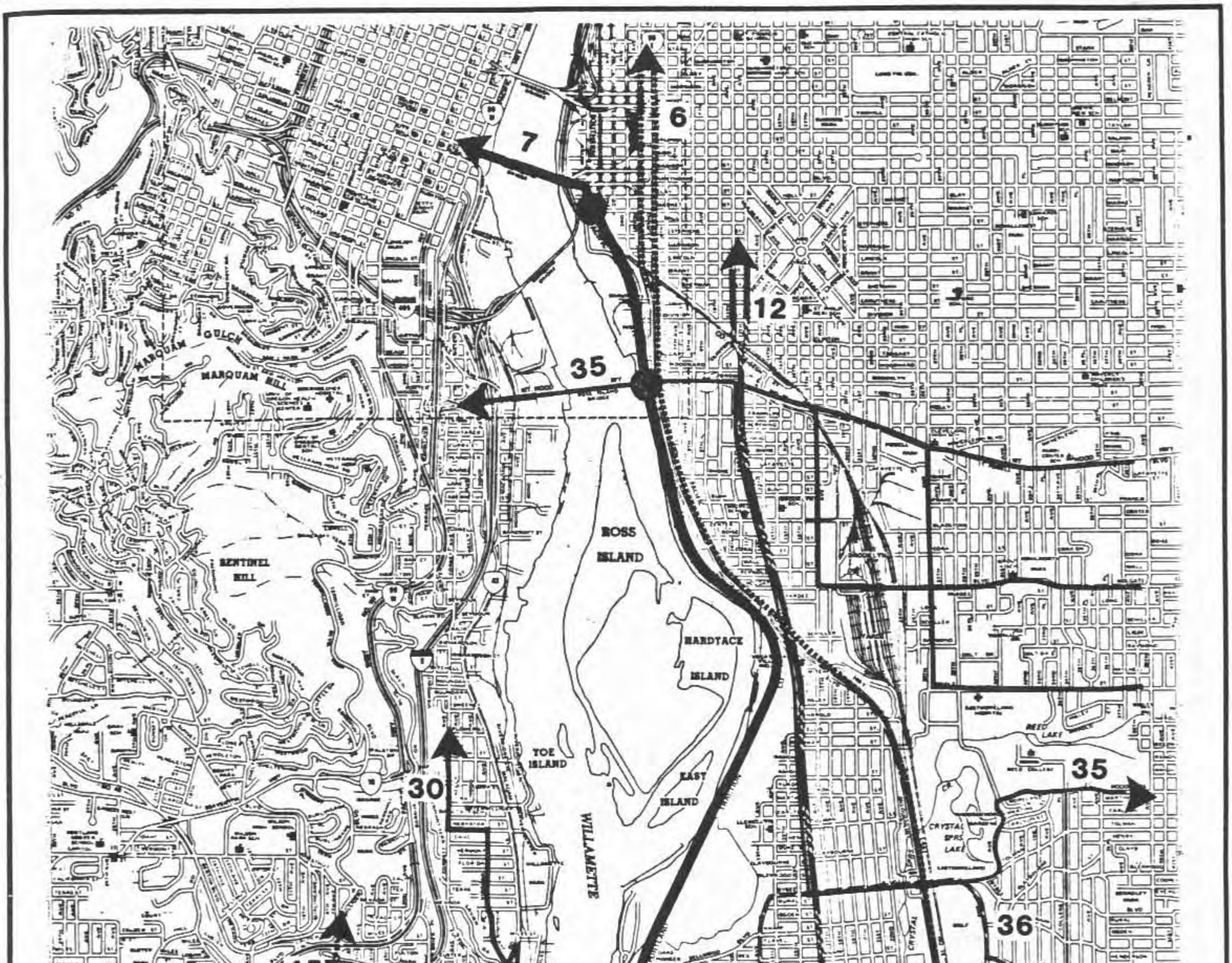
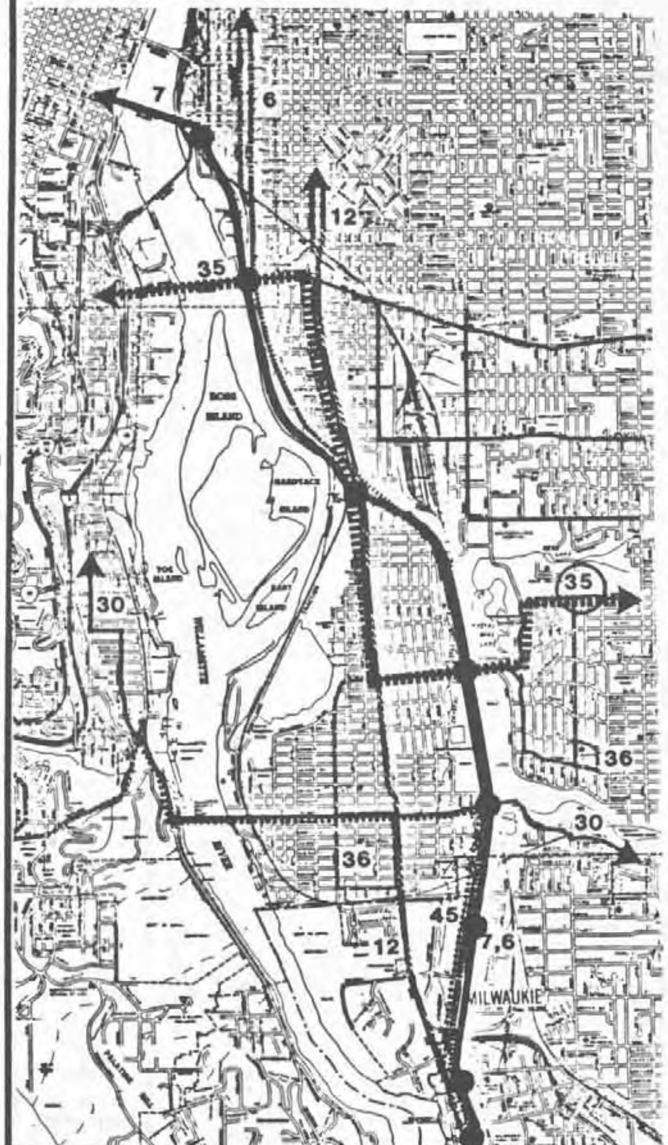


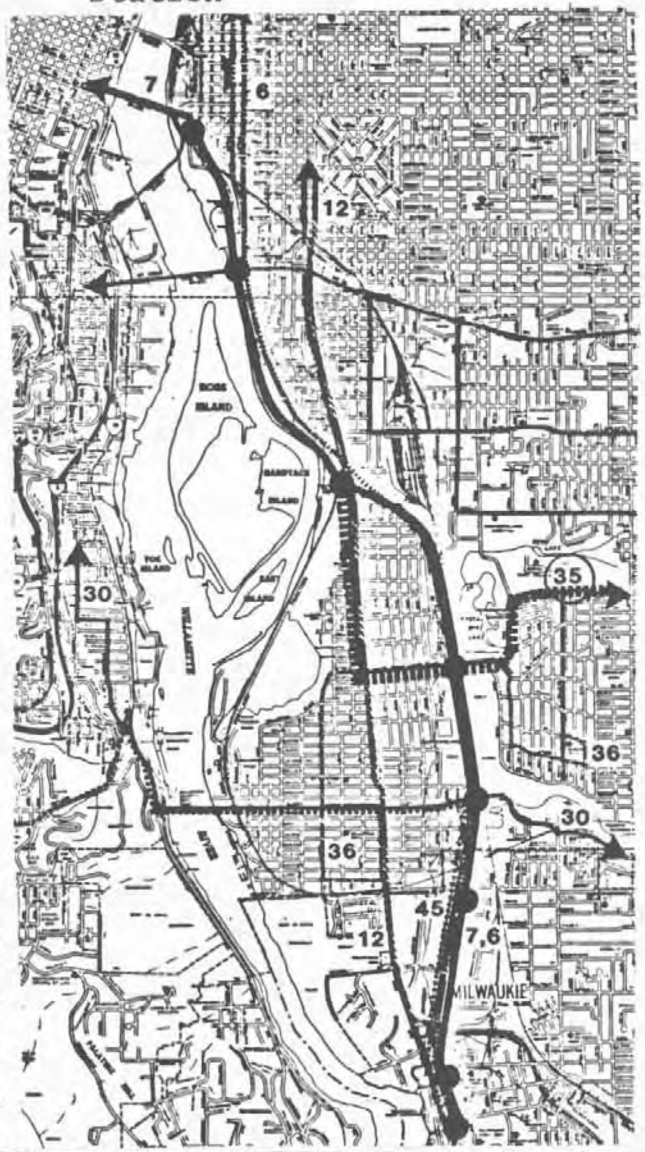
FIGURE 2

PORTLAND TRACTION CO. (PTC) LRT NETWORK

McLoughlin LRT
with no local
service changes



McLoughlin LRT
with the Woodstock (#35)
bus serving as an
LRT feeder,
terminating at
Mitchell St. LRT
station



McLoughlin LRT
with the Woodstock (#35)
bus rerouted to
serve as LRT feeder
and Sellwood local

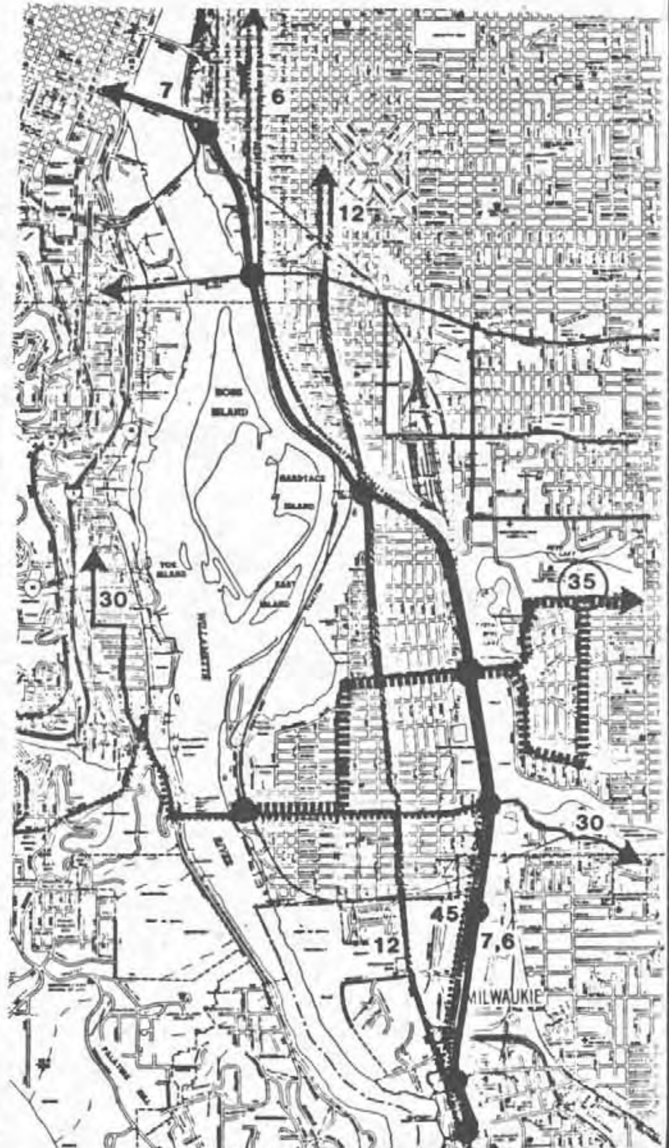


FIGURE 3 SOME McLOUGHLIN LRT FEEDER BUS ALTERNATIVES

TABLE 1

SUMMARY OF INITIAL CAPITAL COSTS
(in millions of 1984 dollars)

Alternative	Trunk Route Initial Capital Cost			
	Right-of-Way	Construction	Initial Vehicle Cost	Total
1. Basic Bus (TSM)	$ .18	$ 4.15	$12.14	$16.47
2. PTC LRT				
·McBrod Avenue Option	9.48	48.69	19.18	77.35
·Main Street Option	9.07	48.45	19.18	76.70
3. McLoughlin LRT	3.90	62.34	19.18	85.42

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TABLE 2

YEAR 2000 CORRIDOR LEVEL INITIAL CAPITAL COSTS
(in millions of 1984 dollars)

Alternative	Trunk Route Costs (Total from Table 1)	Supporting Network Bus Capital Costs	Total Corridor[1] Capital Costs
1. Basic Bus (TSM)	$16.47	$35.42	$51.89
2. PTC LRT			
·McBrod Avenue Option	$77.35	$35.42	$112.77
·Main Street Option	76.70	35.42	112.12
3. McLoughlin LRT			
·No Feeder Network Changes	$85.42	$35.42	$120.30
·Woodstock Bus Terminated at Mitchell Street-LRT Station	85.42	34.88	120.84
·Woodstock Bus Rerouted as Sellwood Local and LRT Feeder	85.42	34.34	119.76

[1]Corridor is defined generally as the area east of the Willamette River and south of S.E. Powell Boulevard.

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light rail could also support these routing changes. However, they would be difficult to achieve because of the PTC's physical separation from the Sellwood-Moreland and Eastmoreland neighborhoods served by the Woodstock and Holgate bus lines.

Methodology

Construction cost estimates for most alignment segments were derived by applying unit cost factors to lengths and areas measured from 1" to 100' scale plan and profile drawings of the alignments. The unit cost factors used here can be found in Appendix A. A contingency of 50 percent is applied in these cases. Where the alignments involve structures (e.g., new or modified over and under crossings, approach structures, retaining walls) the consulting firm, ABAM Engineers, Inc., designed them, prepared construction cost estimates, and specified appropriate contingency factors. Appendix B contains a table presenting cost estimates and contingencies, and figures identifying the structures evaluated or designed by ABAM Engineers, Inc. Appendix C contains a detailed initial capital cost estimate table for each of the three LRT alternatives costed and for the all-bus alternative.

Unit cost factors for vehicle-related costs can also be found in Appendix A. No contingency is applied since these unit costs are based on recent vehicle purchases by Tri-Met. The number of vehicles required is a function of 1) Tri-Met's passenger capacity standards for standard buses (64), articulated buses (111), and articulated light rail vehicles (166); 2) year 2000 p.m. peak-hour/peak-direction transit patronage forecasts from Metro; and 3) the transit service network design associated with each LRT alternative and the all-bus alternative.

Right-of-way costs for both the PTC and McLoughlin alignments are very uncertain, but have been estimated using county assessor records. The major uncertainty relates to valuation of railroad rights-of-way, which accounts for the overwhelming proportion of right-of-way costs for both the PTC and McLoughlin alignments. To "bracket" this uncertainty, high and low estimates of value--based on the value of surrounding land--have been used.

Additional uncertainty in right-of-way costs exists for the PTC alignment. The lowest possible right-of-way costs would assume purchasing only the segment of railroad land necessary to implement the alignment -- that between Portland and 17th Street. If, instead, purchase of the entire PTC system is required, the costs could be higher. A 1982 survey of the PTC estimated the railroad's value at between $1.97 and $2.29 million -- including land and the salvage value of existing improvements. The current "true cash value" as carried in the records of the Oregon Department of Revenue, Utility Section is $1,245,140. In general, this should be considered the lower end of possible value, as Tri-Met paid well in excess of this for the segment of the PTC utilized by the Banfield LRT. Over and above the valuations is a negotiated "additive" based on the value of the PTC property to the community above and beyond its business, real estate, or scrap value. This "additive" value will depend on the timing and the negotiating position of the public agency involved, as well as the short-term position of the PTC's owners -- the Union Pacific and the Southern Pacific Railroads. In the economic analysis of the PTC alignment which follows, a high-end estimate of the PTC's value is utilized in order to more vigorously test the alignment's economic viability.

Operating Costs

Findings

Transit operating costs are inclusive of expenses incurred for maintenance of way, maintenance of equipment, transportation, energy, insurance and claims, and administration. Annual operating cost estimates are presented in Table 3 for the PTC light rail alignment, the Basic Bus alternative, and for the three local service options analyzed with the McLoughlin LRT. Operating cost variations attributable to the three PTC alignment options in Milwaukie -- River Road, McBrod, and Main Street -- are insignificant and therefore not presented in these findings.

Each of the light rail alternatives produce significant operating cost savings as compared to the Basic Bus/TSM alternative. The PTC LRT saves $1.12 million annually as compared to the Bus/TSM, while the McLoughlin LRT saves $1.14 million with no changes in the corridor's bus system; $1.70 million with the Woodstock bus line terminated at the Mitchell Street station; and up to $2.11 million with the Woodstock bus line re-routed as the Sellwood local. Also, as transit ridership grows in the corridor past the year 2000, operating cost savings of the light rail alternatives will grow even larger.

Methodology

Total operating costs are the composite of all labor expenditures and materials and services expenditures for each of the functional components of transit operations mentioned above. Appendix E contains the criteria by which labor and materials and services requirements were determined. Staff wage/salary rates are based on Tri-Met's current pay scales and current unit costs are used for the types of materials and services identified in the criteria.

The amounts needed for most materials and services are based on annual miles operated by each transit vehicle type involved, the number of vehicles by type, number of stations, the miles of track and overhead, etc., as indicated in the criteria. The types and numbers of transit vehicles and annual miles of operation are based on Metro-generated peak hour, peak direction travel forecasts for the corridor, Tri-Met's passenger capacity standards for the types of transit vehicles involved, the alternative transit service networks of trunk and local/feeder routes for the corridor, and Tri-Met's base and peak period service frequency standards for trunk routes, urban local routes, and suburban local/feeder routes.

Appendix E presents detailed operating cost estimate tables for the three basic LRT alternatives and for the all-bus alternatives.

TABLE 3

MILWAUKIE CORRIDOR ALTERNATIVES YEAR 2000
ANNUAL OPERATING AND MAINTENANCE COSTS
(in millions of 1984 dollars)

Alternative	Trunk Route Cost Between Milwaukie & Downtown Portland	Supporting Corridor Bus Network Cost	Total Corridor Cost
1. Basic Bus (TSM) (Figure 1)	$3,208,100	$19,665,160	$22,873,260
2. PTC LRT (McBrod Avenue & Main Street Options) (Figure 2)	2,086,000	19,665,160	21,751,160
3. McLoughlin LRT			
·No Changes in Feeder Network (Figure 3)	2,071,380	19,665,100	21,736,540
·Shorten Woodstock Bus Line as LRT Feeder (Figure 4)	2,071,380	19,100,360	21,171,740
·Reroute Woodstock Bus (Figure 5) to be a Sellwood Local	2,071,380	18,691,960	20,763,340

NOTE: Bus operating costs are based on Tri-Met winter 1984 actual costs of $51.66/platform hour for articulated buses and $46.25 for standard buses.

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3.0 ECONOMIC EVALUATION OF MILWAUKIE CORRIDOR TRANSIT ALTERNATIVES

Purpose

The economic analysis of Milwaukie Corridor transit alternatives is designed to provide a basis for comparing the cost of major transit investments evaluated. The results are intended for use in the ranking of alternatives within the corridor, and may not easily be compared to proposed projects in other corridors due to changes in implementation schedules, life cycle assumptions, and the base year of the cost estimates, among other factors.

Economic cost is but one criteria for choosing a long-term transit improvement for the Milwaukie Corridor, as benefits or costs external to the transit system are also important decision criteria.

Methodology and Major Assumptions

This analysis relies on the evaluation methodology developed for the Westside Corridor project ("Westside Corridor Project, Financial Analysis Methodology," Tri-Met, April 1981), which is based on standard discounted cash flow analysis methods. Two major discounting-based measures are used. First is the sum of all capital and operating costs over 50 years, discounted at three different discount rates to current year dollars. Second is the equivalent uniform annual capital and operating costs for an alternative. Formulas for these measures are described in Appendix D.

Major Assumptions

Any economic analysis requires several key assumptions. These assumptions are held constant for all alternatives and, therefore, are not likely to bias the ranking of alternative transit investments. Major assumptions discussed below are: 1) discount rates; 2) life cycle of capital items; and 3) the project implementation schedule.

1. Discount Rates: A discount rate is used in an economic analysis to measure the opportunity cost of investing in a transit alternative instead of elsewhere in the economy at a more certain rate of return. This rate of return is generally thought of as the prevailing long-term interest rate less the long-term inflation rate. Because this is difficult to predict over the life of a project, discount rates of 3 percent, 6 percent and 10 percent are evaluated to identify any sensitivity in the ranking of alternatives at different discount rates.

   The Urban Mass Transportation Administration (UMTA) requires that a 10 percent discount rate be used in evaluating alternatives. A 10 percent discount rate is generally considered on the high side, but is representative of conditions in the early 1980s when interest reates peaked near 20 percent.

Historically, over the long-term, the discount rate has been closer to 3 percent. With current interest rates at 10-12 percent, the current short-term discount rate is probably near 6 percent. The discount rate is integral to determining the net present value over 50 years of the alternatives, and in determining the equivalent uniform annual cost.

2. Life Cycle: The economic analysis takes into account the economic life of capital portions of the alternatives. The life cycle assumed for major capital items in the study are:

   - Buses (standard and articulated): replaced every 12 years;
   - Light rail vehicles: replaced every 25 years; and
   - Facilities (excludes right-of-way): replaced every 40 years.

3. Schedule: Because this corridor is presently in a Phase I alternatives analysis, it is assumed that at least five years will be needed to complete the Phase II alternatives analysis and preliminary engineering phases of work for the light rail alternatives. As a result, the earliest transitway implementation expenditures would occur in the sixth year (i.e., in this case, 1990 is the sixth year from 1984). Major light rail expenditures are assumed to be phased over four years, as shown below in the schedule summary:

   - Right-of-way purchase: 1/3 each in years 6, 7 and 8;
   - LRT vehicle purchase: 1/3 each in years 6, 7 and 8;
   - Facility construction: 1/3 each in years 7, 8 and 9; and
   - Project implementation: at the end of year 9.

   The purchase of buses to implement the bus service expansion alternative was assumed to occur in equal annual increments between 1989 and 2000. The expansion of local feeder service in the bus and light rail alternatives similarly assumes the purchase of buses gradually between 1989 and 2000.

   A gradual growth in operating expenses is assumed for each alternative in calculating equivalent uniform annual operating costs. The profile of costs used assumes constant operating costs from 1984 to 1989 of $12.83 million annually--the 1984 level of expenditure. From 1990 to 2000, operating costs are expected to grow in a straight line from current levels to the year 2000 operating cost estimated for each alternative. From the year 2000 on, operating costs were assumed to grow, but at a reduced gradient which assumes continuation of a straight line created by connecting 1984 and 2000 totals.

   The implementation schedule for an alternative has a significant impact on the present value of its costs since the further in the future the expenditure occurs, the less its present value. In this analysis, a similar schedule for all light rail alternatives has been assumed.

Findings

The results of the economic analysis of Milwaukie Corridor alternatives are shown on Tables 4, 5 and 6 where a number of different measures are shown. These measures are compared on Tables 7 and 8, which display cost differences between each light rail alternative and the All Bus/TSM alternative. Table 7 shows this difference for measures summarized over 50 years, while Table 8 shows the difference in annualized cost measures.

Each of these measures is discussed below.

Non-Discounted Cost Over 50 Years: First, Table 4 displays the non-discounted sum of all operating and capital expenses, including the replacement of equipment and facilities as they reach their useful life. Using this measure, the ranking of alternatives show the light rail options to be generally less costly than the Basic Bus option. For example, the PTC alternative is over $8 million less expensive than the Basic Bus/TSM, while the McLoughlin LRT alternatives range from $67 million less than the Bus/TSM with the Woodstock re-routed, to $17 million more than the bus with no local service changes. Table 7 details the differences in cost between the light rail and Bus/TSM alternatives. However, this measure does not take into account the "time-value of money," which is integral to the next two measures shown.

Present Value of Alternatives Over 50 Years: Table 4 also summarizes the discounted sum of all operating and capital expenses necessary to run the alternatives over a 50-year period. Three discount rates are utilized (3 percent, 6 percent, and 10 percent), and the difference in cost between the bus and rail alternatives grows with the higher discount rates. At a 3 percent discount rate, the McLoughlin light rail with the Woodstock bus re-routed is cheaper than the Bus/TSM by $6.8 million, while two other light rail alternatives, the McLoughlin with the Woodstock line shortened and the PTC, are within 2 percent of the bus alternative's discounted total costs. In actual dollars, this difference ranges from $5.4 for the McLoughlin LRT with the Woodstock line shortened to $12.8 million with the PTC. At the other extreme, with a 10 percent discount rate, light rail alternatives are between 10 percent, or $20.9 million, and 12 percent, or $22.4 million, more costly than the bus alternative over the 50-year analysis period. Table 7 details these cost differences.

Equivalent Uniform Annual Cost: The equivalent uniform annual cost (EUAC) summarizes the capital and operating cost profile over time of alternatives into an annual payment. As shown on Table 5, this measure is also sensitive to the discount rate used, and mirrors the findings of the present value measure. This measure shows light rail to be slightly more costly than the Bus/TSM alternative. The light rail alternatives exhibit between 2.5 percent, or $.56 million more, and 5 percent, or $1.21 million, greater EUAC than the bus alternative at a 3 percent discount. With a 10 percent discount rate, the light rail alternatives are from 12 percent, or

TABLE 4

PRESENT VALUE OVER 50 YEARS OF MILWAUKIE CORRIDOR
TRANSIT ALTERNATIVES
(in millions)

Alternative	Initial Trunk Route Capital Cost	Year 2000 Operating Cost	Non-Discounted Total Costs Over 50 Years: Capital	Operating	Total	Alt. Discount Rates	Present Value Over 50 Years: Capital	Operating	Total
1. Basic Bus/TSM	$16.47	$22.87	$201.3	$1,418.8	$1,620.1	3%	$104.7	$616.5	$721.2
						6%	61.4	323.8	385.2
						10%	39.5	174.6	214.1
2. PTC LRT (McBrod Avenue Option)	76.70	21.75	281.7	1,330.1	1,611.8	3%	150.9	583.1	734.0
						6%	99.7	310.3	410.0
						10%	67.1	169.4	236.5
3. McLoughlin LRT - Trunk Service Change Only	85.42	21.74	303.5	1,331.1	1,637.6	3%	162.1	583.1	745.3
						6%	106.2	310.3	416.5
						10%	71.5	169.3	240.8
- Shorten Woodstock Bus as LRT Feeder	85.42	21.17	300.4	1,284.6	1,585.0	3%	160.4	566.2	726.6
						6%	105.3	303.1	408.4
						10%	70.9	166.6	237.5
- Re-route Woodstock Bus to Serve as Sellwood Local/LRT Feeder	85.42	20.76	297.3	1,255.8	1,553.1	3%	158.8	555.6	714.4
						6%	104.3	298.5	402.8
						10%	70.3	164.7	235.0

Notes: - Current corridor operating cost is $12.83 million.
- Initial capital cost includes trunk route facilities and vehicles, and buses required for the Woodstock and Sellwood local bus lines.

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TABLE 5

EQUIVALENT UNIFORM ANNUAL COST OF
MILWAUKIE CORRIDOR ALTERNATIVES
(in millions)

Alternative	Initial Capital Cost	Year 2000 Operating Cost	Alt. Discount Rates	Equivalent Uniform Annual Cost		
				Capital	Operating	Total
1. Basic Bus/TSM	$16.47	$22.87	3%	$3.90	$18.34	$22.24
			6%	3.85	17.26	21.11
			10%	3.81	16.18	19.99
2. PTC LRT (McBrod Avenue Option)	76.70	21.75	3%	5.46	17.65	23.11
			6%	6.08	16.77	22.85
			10%	6.63	15.81	22.44
3. McLoughlin LRT - Trunk Service Change Only	85.42	21.74	3%	5.81	17.64	23.45
			6%	6.48	16.77	23.25
			10%	7.06	15.81	22.87
- Shorten Woodstock Bus as LRT Feeder	85.42	21.17	3%	5.75	17.34	23.09
			6%	6.42	16.51	22.93
			10%	7.03	15.62	22.65
- Re-Route Woodstock Bus to Serve as Sellwood Local/LRT Feeder	85.42	20.76	3%	5.69	17.11	22.80
			6%	6.37	16.33	22.70
			10%	6.99	15.48	22.47

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$2.45 million, to 14 percent, or $2.88 million, more costly. These cost differences are detailed on Table 8. It is important to remember that the light rail alternatives provide non-financial community benefits, and any extra cost attributable to light rail must be balanced against the benefits provided.

Year 2000 Cost: Table 6 shows a final economic based measure--which is the total cost of an alternative in the year 2000. This measure is the sum of the capital EUAC of an alternative and its year 2000 operating and maintenance cost. This measure, also dependent on discounting for the equivalent uniform annual capital cost, shows at a 3 percent discount rate the McLoughlin light rail with the Woodstock bus re-routed to be $.32 million cheaper annually than the bus, and two others no more than 1.6 percent, or from $.15 to $.44 million more costly than the bus. Similar to the previous two measures, this difference grows with a 10 percent discount rate so that light rail is between 4 percent, or $1.07 million, and 8 percent, or $2.12 million, more costly than the bus alternative. Cost differences between the bus and light rail alternatives are detailed on Table 8. Once again, any extra cost attributed to the light rail alternatives must be measured against benefits derived from them.

Highway Project Stage 4 Delay: The preliminary findings of the staging analysis of McLoughlin Boulevard highway and transit projects found that implementation of light rail in the corridor by the early 1990s could delay the need for Stage 4 of the proposed McLoughlin highway project from 1993 to 2001. This stage of the highway project, widening from four to six lanes from Harold to Ochoco, is projected to cost between $6.7 and $9.7 million ($6.7 million if Stage 1 of the highway project is an overpass at Tacoma, $9.7 million if it is a four-lane flyover). The net present value of delaying this project is $1.51 million -- at a $6.7 million initial cost -- or $2.19 million -- at a $9.7 million cost, based on a 10 percent discount rate. This translates to a relatively small EUAC of 15 million or .22 million depending on the project cost and based on a 10 percent discount rate. This small increment of EUAC would not generally change the ranking of alternatives, but may be an added benefit attributable to building light rail in the Milwaukie Corridor.

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TABLE 6

YEAR 2000 COST TO OPERATE
(in millions of 1984 dollars)

		Capital Equivalent Uniform Annual Cost	Year 2000 Operating & Maintenance Cost	Total Cost in the Year 2000
1. Basic Bus/TSM	3%	$3.90	$22.87	$26.77
	6%	3.85	22.87	26.72
	10%	3.81	22.87	26.68
2. PTC LRT	3%	$5.46	$21.75	$27.21
	6%	6.08	21.75	27.83
	10%	6.63	21.75	28.38
3. McLoughlin LRT				
·No Local Service Changes	3%	$5.81	$21.74	$27.55
	6%	6.48	21.74	28.22
	10%	7.06	21.74	28.80
·Woodstock Bus Terminated at Mitchell Street Station	3%	$5.75	$21.17	$26.92
	6%	6.42	21.17	27.59
	10%	7.03	21.17	28.20
·Woodstock Bus Rerouted as Sellwood Local and LRT Feeder	3%	$5.69	$20.76	$26.45
	6%	6.37	20.76	27.13
	10%	6.99	20.76	27.75

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TABLE 7

DIFFERENCE IN COST OVER 50 YEARS
OF THE LIGHT RAIL ALTERNATIVES
AND THE ALL BUS/TSM
(in millions of 1984 dollars)

	Difference in Cost Over 50 Years from the All Bus/TSM:			
		Present Value of All Costs Over 50 Years		
	Sum of All Costs Over 50 Years - No Discounting	@ 3% Discount Rate	@ 6% Discount Rate	@ 10% Discount Rate
o PTC LRT (McBrod Option)	-$8.3	+$12.8	+$24.8	+$22.4
o McLoughlin LRT				
- Trunk route changes only	+17.5	+23.8	+31.3	+26.7
- Shorten Woodstock Bus as LRT Feeder	-35.1	+5.4	+23.2	+23.4
- Re-Route Woodstock Bus to Serve as Sellwood Local and LRT Feeder	-67.0	-6.8	+17.6	+20.9

Note: "+" Indicates the LRT alternative is more costly than the Bus/TSM.
"-" Indicates the LRT alternative is less costly than the Bus/TSM.

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TABLE 8

DIFFERENCE IN ANNUAL COST MEASURES OF THE LIGHT RAIL ALTERNATIVE AND THE ALL BUS/TSM
(in millions of 1984 dollars)

	Annual Cost Difference from the All Bus/TSM						
		Equivalent Uniform Annual Cost (EUAC)			Year 2000 Total Costs (Capital EUAC & Operating)		
	Year 2000 Operating Costs	@ 3% Discount Rate	@ 6% Discount Rate	@ 10% Discount Rate	@ 3% Discount Rate	@ 6% Discount Rate	@ 10% Discount Rate
• PTC LRT (McBrod Option)	-$1.12	+$.87	+$1.74	+$2.45	+$.44	+$1.11	+$1.7
• McLoughlin LRT							
- Trunk route changes only	-1.13	+1.21	+2.14	+2.88	+.78	+1.5	+2.12
- Shorten Woodstock Bus as LRT Feeder	-1.7	+.85	+1.82	+2.66	+.15	+.87	+1.52
- Re-Route Woodstock Bus to Serve as Sellwood Local and LRT Feeder	-2.11	+.56	+1.59	+2.48	+.32	+.41	+1.07

Note: "+" Indicates the LRT alternative is more costly than the Bus/TSM.
"-" Indicates the LRT alternative is less costly than the Bus/TSM.

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APPENDIX A

UNIT COST DATA

UNIT COST DATA FOR
THE REGINAL LRT SYSTEM PLAN

The unit cost data which is summarized here has been developed for comparing the transit alternatives which have been defined for evaluation as part of the regional LRT system plan study. This data is for estimating the comparative capital costs of various alignments and conceptual designs. A more detailed estimating base will be needed for preparing detailed budgets for specific corridor projects.

The unit costs given here are all for preparing constant dollar estimates based on prices in effect during January 1984. Many of the unit prices are based on July 1980 unit prices from the Westside Corridor Project data base escalated by 31%. In general, Westside unit costs were derived from Oregon Department of Transportation cost records and Banfield Light Rail Project preliminary cost estimates. In instances where historical data was unavailable from Tri-Met, ODOT or otheer participating agencies, other appropriate industry cost data sources were employed. The 31% escalation factor is consistent with the factor used by Tri-Met's structural consultant (ABAM) and is derived from the "Means Historical Cost Index" and the "Engineering News Record, Construction Cost Index."

1. Vehicles (including contingency)

Standard Bus	$180,000 ea.
Articulated Bus	$340,000 ea.
Articulated LRV's	$1,180,000 ea.
Spare Parts	8% of the above
Support Vehicles	$4,000 per LRV
	$550 per bus

2. Stations

Platforms - concrete	$9.80 per sq. ft.
- brick covered	$13.10 per sq. ft.
Furnishings	$80,000 per station
Elevators	$130,000 per station
Landscaping	$50,000 per station
Signs & Graphics	$13,000 per station
E&H Lifts	$26,000 per station
Fare Collection Equipment	$52,000 per station
Sidewalks	$4.20 per sq. ft.
Elevated Walkways	$80 per sq. ft.
Tunnel Walkways	$80 per sq. ft.
Surface Parking Spaces	$1800 per space

3. Trackwork

Open	$100 per single track foot
In Pavement	$145 per single track foot
On Structure	$160 per single track foot
Upgrade Existing	$13 per single track foot
Turnout	$10,500 ea.
Crossover	$22,500 ea.
Track-track Crossing	$13,000 ea.
Double Crossover	$57,500 ea.
Grade Crossings	$8 per sq. ft.
Lateral Fence	$13 per linear ft.

4. Pavement

Downtown Street Reconstruction 40' width	
- On Mall	$525 per linear ft.
- Off Mall	$320 per linear ft.
Other Street Reconstruction	$8 per sq. ft.

5. Maintenance Facilities

Site Clearing	$3,900 per acre
Grading	$21,200 per acre
Miscellaneous Excavation, Drainage	$6,000 per acre
Roads & Parking	5% of site at $8 per sq. ft.
Perimeter Fence	$20 per linear ft.
Buildings	$80 per sq. ft.
Shop Equipment	$650,000 per facility
Site Electrification & Utilities	$650,000 per facility

6. Electrification — $750,000 per route mile

7. Signalling — $235,000 per route mile

8. Route Grading & Drainage

Removal of Obstructions	Varies
Heavy Clearing	$7,850 per acre
Light Clearing	$3,950 per acre
General Excavation	$6.50 per cu. yd.
Barrow Excavation	$11.00 per cu. yd.
Drainage	Allow 10% of above

9. Route Structures

   To be estimated by ABAM or from unit costs developed by ABAM

10. Traffic Signals

Modify Intersection	$70,000 ea.

11. Utilities

   Special Lines > $200,000 (see Attachment 1)

   Typical for each linear foot of trackway

- Downtown	$525 per linear ft.
- Low Urban	$130 per linear ft.
- Rural	$25 per linear ft.

12. Detours

   14% of stations & utilities

13. Engineering & Contingencies

   50% of items 2 through 8 and 10 through 12 inclusive.

APPENDIX B

STRUCTURAL DESIGN/ANALYSIS TASKS AND COST ESTIMATES

Table B-1

MCLOUGHLIN CORRIDOR STRUCTURE COST ESTIMATES[1]

I.D. No.[2]	Description	Est. Cost ($ mil.)	Composite (Risk Factor)	At-Risk Cost ($ mil.)
A.7	Hawthorne Bridge and approaches			
	(1) LRT only	$1.49	1.28	$1.90
	(2) mixed traffic	1.52	1.28	1.95
A.8	LRT structures over Johnson Creek			
	(1) bridge at Ochoco Street			
	.new deck (LRT in mixed traffic)	0.01	NA	0.17
	.new bridge (LRT only)	0.12	1.00	0.12
	(2) bridge at McLoughlin Blvd.	0.17	1.00	0.17
	(3) bridge at SPRR	0.17	1.00	0.17
	(4) flyover, River Rd. to Main St.	4.03	NA	NA
A.9	Ross Island Bridge Station	2.07	1.16	2.40
B.1	North exit from McLoughlin Blvd.	8.54	NA	NA
B.2	Connection from McLoughlin to west side of the PTC	7.79	NA	NA
B.3	PTC overpass structures			
	(1) at McLoughlin Blvd.	0.16	NA	NA
	(2) at SPRR	0.15	1.00	0.15
B.4	Bybee Blvd. Station	0.16	1.00	0.16
B.5	Sellwood Bridge Station	0.46	1.12	0.51
B.6	Kellogg Lake trestle	0.85	1.09	0.93

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[1]ABAM Engineers, Inc., March 1984. Costs do not include trackwork, electrification, and other appurtenances.

[2]I.D. numbers are keyed to Figures B.1. and B.2.

Figure B1 : Regional LRT Conceptual Engineering Sites

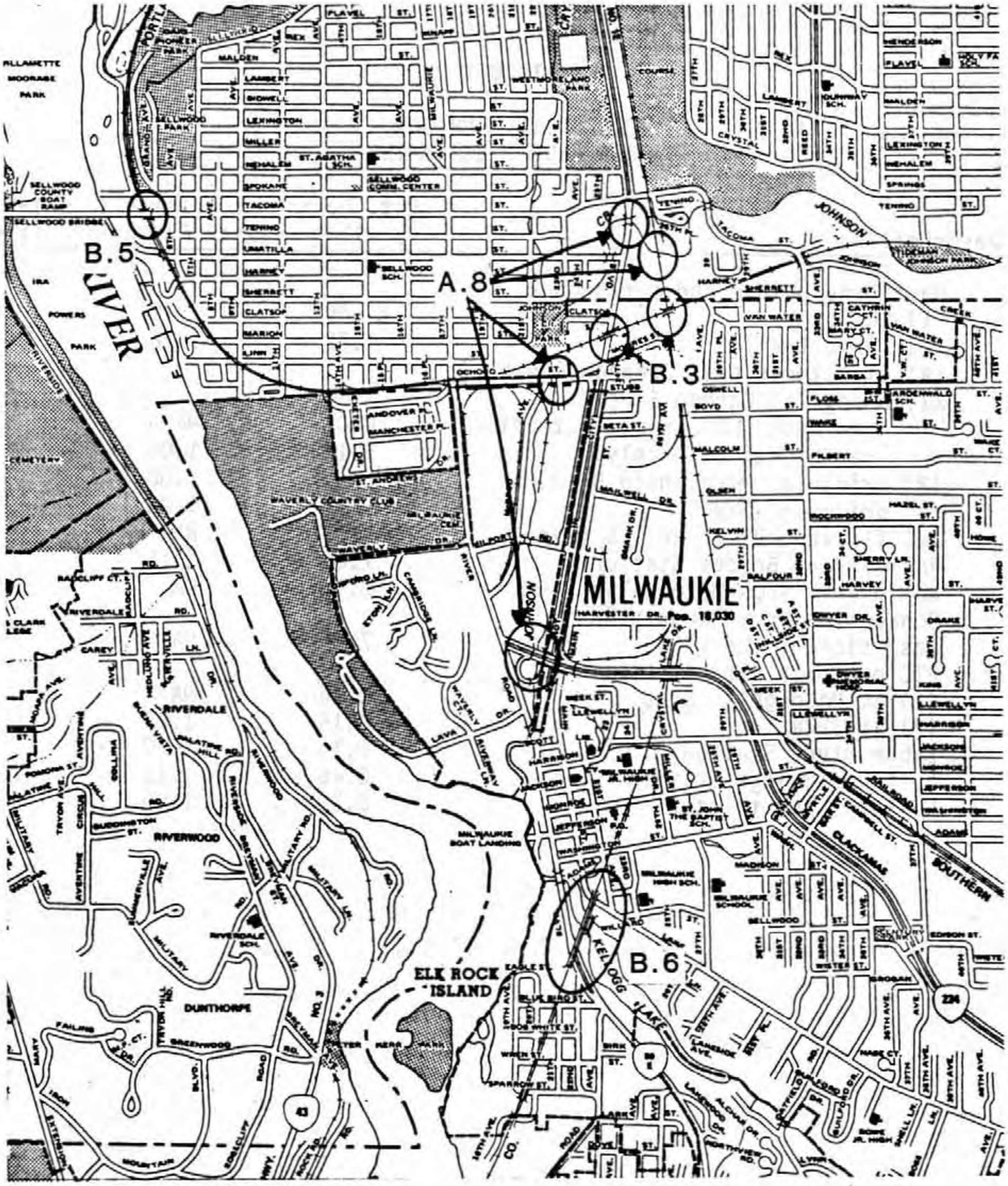
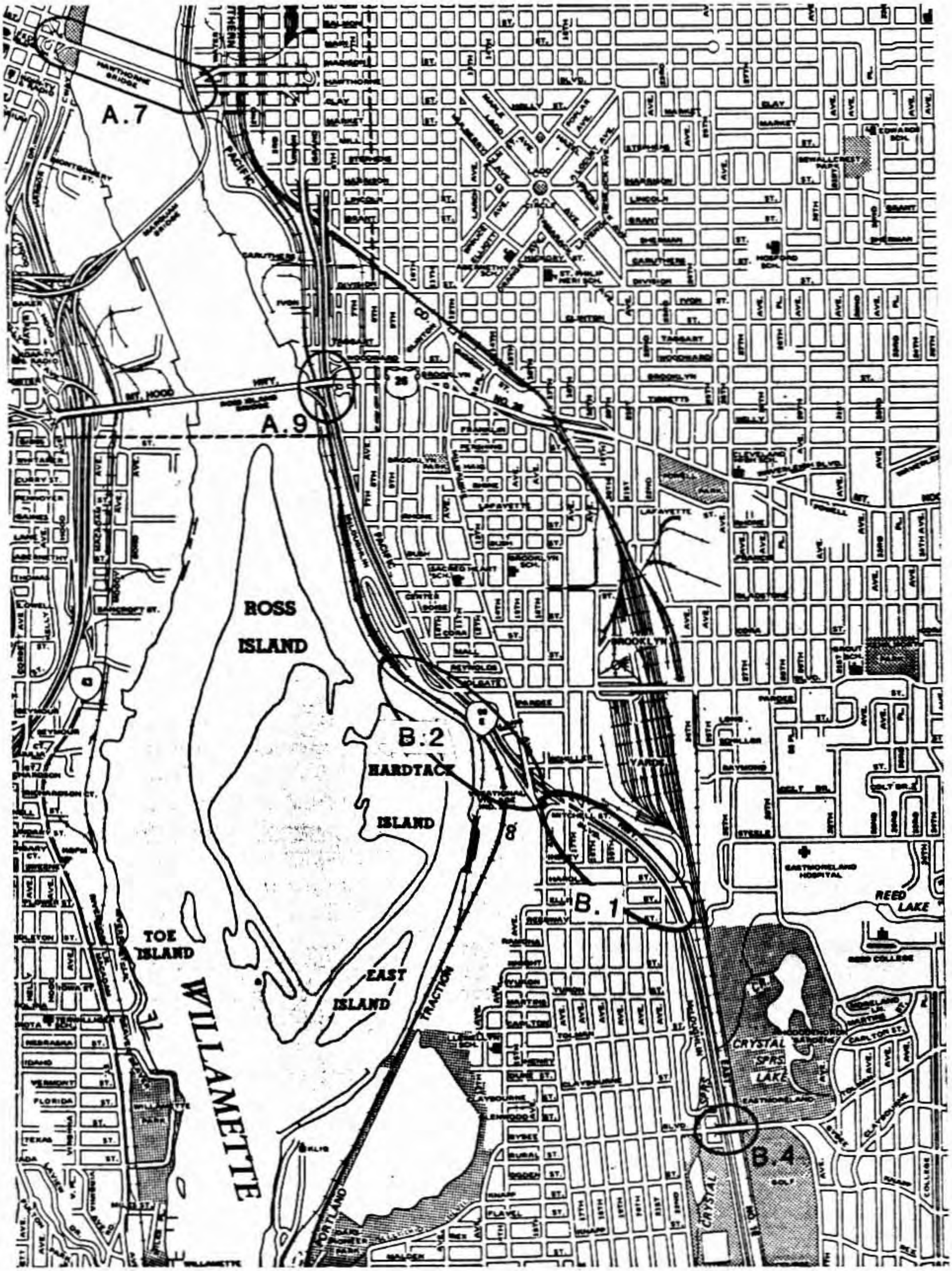


Figure B2 : Regional LRT Conceptual Engineering Sites



APPENDIX C
DETAILED CAPITAL COST ESTIMATES

Table C-1

CAPITAL COST ESTIMATE FOR THE MILWAUKIE LIGHT RAIL CORRIDOR

PTC ALIGNMENT, N. MAIN ST. OPTION

WORK ITEM / SEGMENT	DOWNTOWN – FIRST AV. I	HAWTHORNE – BRIDGE & RAMPS II	WATER AV. – ~~HOLGATE~~ BOISE VIA PTC III^A	~~HOLGATE~~ BOISE – SE 17TH VIA PTC IV^A	SE 17TH ~~&~~ MAIN & BETA VIA OCHOCO IV^B	MAIN & ~~COURT~~ HARRISON BETA – VIA MAIN V^A	~~COURT~~ HARRISON – MIL P&R VIA MAIN VI	TOTAL COSTS (X 1,000)
RIGHT OF WAY *								
REAL ESTATE								
RELOCATION								
DEMOLITION								
SUBTOTAL								$9.07
CONSTRUCTION								
GRADING & DRAINAGE	—	—	—	—	24.	45.	96.	165.
UTILITIES	735.	—	130	78.	310.	373.	559.	2185
DETOURS	136.	20.	104.	82	82	50.	100.	574
TRACKWORK	489.	640.	1,821.	3,687.	722.	933.	822.	9114.
PAVEMENT	448.	—	125.	312.	288	504.	1,320	2997
ELECTRIFICATION	199.	313	1,080.	2,355.	383	570.	398	5298
SIGNALLING	62.	98.	338.	738	117.	179.	125	1657
TRAFFIC SIGNAL/GATES	420.	—	210.	490.	350	140.	420.	2030
STATIONS (INCLUDES BUS TRANSFER FACILITIES)	239	—	613.	781.	273.	581.	819.	3306.
MISC. STRUCTURES	—	1,950.	2,395.	514.	123.	—	929	5911
OTHER	—	—	—	—	—	—	—	1.55 *
ENG. & CONTINGENCIES	1,364.	535	2,211	4,261.	1,276	1,687	2330	13664.
SUBTOTAL	4,092.	3,556	9,027	13,298	3,948	5,062	7,918	45.35
TOTAL FIXED FACILITIES								54.52
VEHICLES								
TRANSIT VEHICLES (15)								17,700
SPARE PARTS								1,416
SUPPORT VEHICLES								60
ENG. & CONTINGENCIES								—
SUBTOTAL								19,176
GRAND TOTAL								$ 76.70

* PARK & RIDE FACILITIES NEAR MAIN & MILPORT

Table C-2

CAPITAL COST ESTIMATE FOR THE MILWAUKIE LIGHT RAIL CORRIDOR

PTC ALIGNMENT, McBROD AVE. OPTION

WORK ITEM / SEGMENT	I DOWNTOWN - FIRST AV.	II HAWTHORNE - BRIDGE & RAMPS	III A WATER AV. - ~~HOLGATE~~ BOISE VIA PTC	IV A ~~HOLGATE~~ BOISE - SE 17TH VIA PTC	V B SE 17TH - SCOTT VIA McBROD & RIVER RD.	VI SCOTT - MIL. P&R VIA MAIN	TOTAL COSTS (X 1,000)
RIGHT OF WAY *							
REAL ESTATE							
RELOCATION							
DEMOLITION							
SUBTOTAL							9.48
CONSTRUCTION							
GRADING & DRAINAGE	—	—	—	—	110	96	206
UTILITIES	735	—	130	78	476	559	1978
DETOURS	136	20	104	82	70	100	512
TRACKWORK	489	640	1,821	3687	1335	822	8,794
PAVEMENT	448	—	125	312	184	1320	2,389
ELECTRIFICATION	199	313	1,080	2355	795	398	5,140
SIGNALLING	62	98	338	738	249	125	1,610
TRAFFIC SIGNAL/GATES	420	—	210	490	350	420	1,890
STATIONS (INCLUDES BUS TRANSFER FACILITIES)	239	-	613	781	538	819	2990
MISC. STRUCTURES	-	1950	2395	514	4031	929	9819
OTHER	-	—	—	—		-	.61 *
ENG. & CONTINGENCIES	1364	535	2211	4261	2054	2330	12,755
SUBTOTAL	4092	3556	9027	13,298	10,192	7918	48,69
TOTAL FIXED FACILITIES							
VEHICLES							
TRANSIT VEHICLES							17,700
SPARE PARTS							1,416
SUPPORT VEHICLES							60
ENG. & CONTINGENCIES							
SUBTOTAL							19,176
GRAND TOTAL							77.35

*PARK & RIDE LOT: RIVER RD. NEAR LAVA DR.

Table C-3

CAPITAL COST ESTIMATE FOR THE MILWAUKIE LIGHT RAIL CORRIDOR

McLOUGHLIN ALIGNMENT

WORK ITEM / SEGMENT	DOWNTOWN - FIRST AV. I	HAWTHORNE - BRIDGE & RAMPS II	WATER AV. - ~~HOLGATE~~ B-13M VIA PTC III B	~~HOLGATE~~ B-13M - BETA VIA McLOUGHLIN IV C	MAIN & BETA - SCOTT VIA MAIN V A	SCOTT - MIL. P&R VIA MAIN VI	TOTAL COSTS (X 1,000)
RIGHT OF WAY *							
REAL ESTATE							
RELOCATION							
DEMOLITION							
SUBTOTAL							3.90
CONSTRUCTION							
GRADING & DRAINAGE	—	—	—	196	45	96	337
UTILITIES	735	—	130	650	373	559	2,447
DETOURS	136	20	104	230	50	100	640
TRACKWORK	489	640	1821	3859	933	822	8,564
PAVEMENT	448	—	125	300	504	1320	2,697
ELECTRIFICATION	~~199~~	313	1080	2355	570	398	4,915
SIGNALLING	62	98	338	738	179	125	1,540
TRAFFIC SIGNAL/GATES	420	—	210	210	140	420	1,400
STATIONS (INCLUDES BUS TRANSFER FACILITIES)	239	—	613	1007	581	819	3,259
MISC. STRUCTURES	—	1950	2395	16,817	—	929	22,091
OTHER	—	—	—	—	—	—	1.55 *
ENG. & CONTINGENCIES	1364	535	2211	4773	1,687	2330	12,900
SUBTOTAL	4092	3556	9027	31,135	5,062	7918	62.34
TOTAL FIXED FACILITIES							
VEHICLES							
TRANSIT VEHICLES (15)							17,700
SPARE PARTS							1,416
SUPPORT VEHICLES							60
ENG. & CONTINGENCIES							
SUBTOTAL							19,176
GRAND TOTAL							85.42

* PARK & RIDE FACILITIES: MILPORT NEAR MAIN

Table C-4

Capital Cost Estimate for Milwaukie Corridor
Equivalent, All-Bus System[1]

Item	Cost ($000's)
Right-of-Way	$ 180
Construction	4,150
Vehicles	
Transit Vehicles[2]	11,220
Spare Parts	898
Support Vehicles	18
SUBTOTAL	$12,136
TOTAL COST	$16,466

[1]Cost estimate reflects replacement of LRT trunk service with bus trunk service of equal, peak-hour, peak-direction capacity and meeting Tri-Met's base service standards.

[2]Thirty-three articulated buses.

NM:lmk
8-6-84

APPENDIX D

ECONOMIC ANALYSIS METHODOLOGY

Excerpted from
Westside Corridor Project Financial Analysis Methodology
Tri-Met, April 1981

III. ECONOMIC ANALYSIS

The economic analysis of the Westside Corridor Project will provide a basis for evaluating the relative cost effectiveness of the corridor alternatives. For this analysis, only Westside Corridor costs will be considered. Annual operating costs and periodic capital costs (including life cycle cost of replacement) will be converted to a common denominator of equivalent uniform annual costs for comparison of options. This will be accomplished using standard discounted cash flow methods.

The cash flow diagram on the following page illustrates a schematic projected schedule comparing equivalent uniform annual costs with actual cash flow in 1980 dollars. The project is assumed to begin in fiscal year 1980, with startup of operations in fiscal year 1988. All operating and capital costs for each alternative transit system are in addition to the costs of the null alternative. For simplicity, the schematic omits special variations such as differential inflation rates and gradient costs.

METHODOLOGY

The economic analysis requires as input, two primary cash flow tables for each alternative -- one for operating costs and one for capital costs. These tables represent a chronological flow of expenditures necessary to implement a transit system alternative and operate it continuously.

Capital Costs

Capital cost requirements are to include vehicles and equipment/facilities costs (1980 dollars), year of expenditure, life cycle, and salvage values (if any) through project completion. (Appendix A present Capital Cost tables.) These costs will first be converted to present value as follows:

$$\text{(eqn. 1)} \qquad PV = \frac{FV}{(1+i)^n}$$

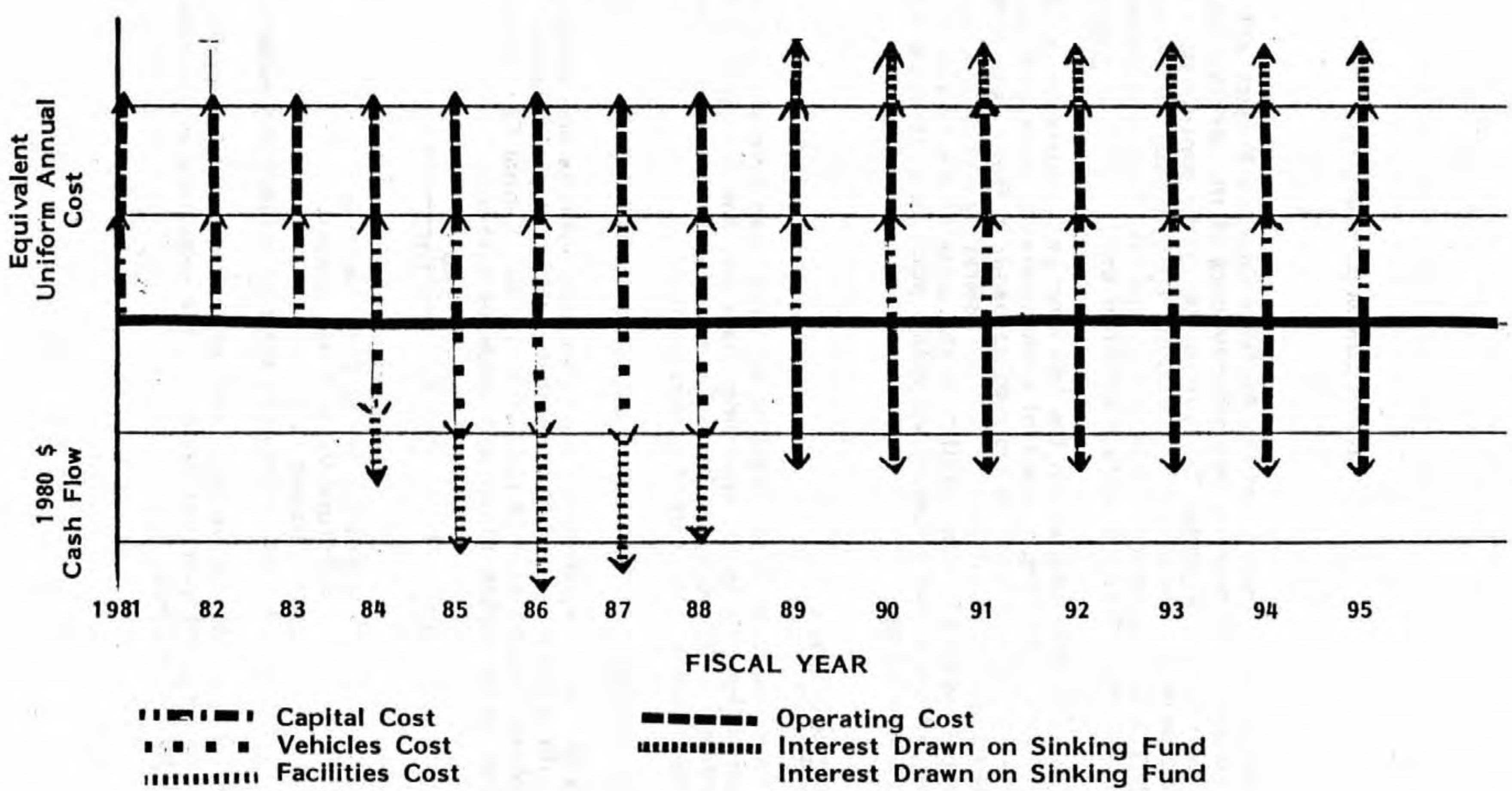
PV = Present Value (1980 dollars)
FV = Future Value (1980 dollars)
i = discount rate
n = years between start of project and expenditure

In terms of this actual cash flow of annual costs, expenditures will be assumed to be incurred over the project at the same rate as projected for the Banfield Light Rail Project.

WESTSIDE TRANSITWAY

SCHEMATIC CASH FLOW PROJECTION

THROUGH 1995



These present value costs will then be converted to equivalent uniform annual costs (EUAC) for each major capital item, and spread over the perpetual life of the system using the following formula:

(eqn. 2) $$EUAC = PV \frac{(i(1+i)^n)}{((1+i)^n-1)}$$

PV = Present Value
FV = Future Value
n = life cycle
i = discount rate

The EUAC value will represent the equivalent constant capital cost incurred each year throughout the life cycle, beginning in fiscal year 1980.

Operating Costs

Annual operating costs for each of the alternatives, provided by consultants, will be programmed beginning in fiscal year 1988. When converted to equivalent annual dollars, costs will be scheduled starting in fiscal 1980, with the first five years accounting for a "sinking fund." Beginning in fiscal 1988 when the system will assume operation, the annual operating cost (1980 dollars) which continues in perpetuity, will equal the equivalent annual cash flow sum of the constant EUAC (of operating costs) plus interest drawn on the "sinking fund." The procedure for determining the EUAC, taking into consideration a "sinking fund," is as follows:

(eqn. 3) $$FV = EUAC_{ops} \frac{(1+i)^n - 1}{i}$$

Where FV = future value of "sinking fund"

$EUAC_{ops}$ = Equivalent Uniform Annual Cost of operations from start of project period (1980)

n = Number of years between start of project (1980) and start of operations

(eqn. 4) $FV \times (i) + EUAC_{ops}$ = Operations Cost in 1980 dollars (OC) from start of transitway operation (1988)

(eqn. 5) $$FV = \frac{OC - EUAC_{ops}}{i}$$

Combining equation 3 and equation 5,

$$\text{(eqn. 6)} \qquad EUAC_{ops} \doteq \frac{OC}{\frac{(1+i)^n - 1}{i} \times i + 1} = \frac{OC}{(1+i)^n}$$

This $EUAC_{ops}$ will serve as a basis for comparison, computed for each of the alternattives.

APPENDIX E

OPERATING COST CRITERIA

TABLE E-1

Staffing--LRT Maintenance of Way and Structures

Position	Remarks
Foreman-Way & Structures	1 per LRT system
Lead Track Maintainer	1 per LRT branch
Track Maintainer	1 per 7 track-miles
Equipment Operator	1 per LRT system
Structures Maintainer	1 per 12 stations (carpentry, masonry, general repair
Electrician	1 per 12 stations
Station Cleaner	1 per 9 stations (except sidewalk platforms
ROW Maintainer	1 per 10 route-miles
Foreman-Power & Signals	1 per LRT system
Substation Maintainer	1 per 12 substations
Lead Overhead Lineman	1 per 15 route-miles
Helper	1 per 15 track-miles
Signal Maintainer1	1 per 15 track-miles
Equipment Technician	1 per 15 route-miles

Table E-1 (cont'd)

Staffing--LRT Maintenance of Equipment

Position	Remarks
Maintenance Manager	1 per LRT system
Engineer	1 per shop; 1 additional for main shop (Banfield)
Storeman	1 per LRT system
Partsman	1 per shop
Janitor	1 per shop
Foreman-Mechanical	1 per shift; assume 2 shifts for Banfield & Mult.
Vehicle Mechanic	1 per 5 cars
Machinist	1 per 30 cars
Welder	1 per LRT system
Helper	1 per 25 cars
Foreman-Electrical	1 per shop
Electrician	1 per 8 vehicles
Electronic Tech-Vehicle	1 per 12 vehicles
Electronic Tech-Fare Collection	1 per 50 ticket vendors; assume 2 vendors/station
Lead Vehicle Cleaner	1 per shop
Vehicle Cleaner	1 per 9 vehicles

Table E-1 (cont'd)

Staffing--LRT Transportation

Position	Remarks
Station Manager	1 per LRT system
Station Agent	1 per staging area (storage yard)
Cleark/Typist	1 per staging area
Crew Supervisor/Scheduler	1 per shift; 2 shifts per week-day; main staging area
Crew Supervisor	1 per shift; 2 shifts per week-day; aux. staging area
Timekeepr	1 pere LRT system
Dispatcher	1 per shift; main staging area (Banfield)
Yardmaster	1 per shift; main staging area (Banfield)
Dispatcher/Yardmaster	1 per shift; aux. staging area (Westside)
Operator	1 per 1,605 revenue train-hours
Fare Inspector/Road Supervisor	1 per 10 cars
Rev. Collector/Serviceman	2 per LRT branch
Central Control Operator	1 per shift; main staging area
Security	1 per shift per staging area

Source: Louis T. Klauder & Associates, 1981.

APPENDIX F

DETAILED LRT OPERATING COST ESTIMATES

Table F-5
REGIONAL LIGHT RAIL STUDY
ANNUAL OPERATING AND MAINTENANCE COST ESTIMATE
SUMMARY (1984 Dollars)

		PTC		McLoughlin		17th Avenue	
Maintenance of Way	Personnel	(6-1/2)	235,370	(6-1/2)	235,370	(6-1/2)	235,370
	Materials & Serv.		206,050		195,290		188,390
	TOTAL COST		441,420		430,660		423,760
Maintenance of Equipment	Personnel	(9)	333,990	(9)	333,990	(11-1/2)	426,710
	Materials & Serv.		245,980		244,780		261,460
	TOTAL COST		579,970		578,770		688,170
Transportation	Personnel	(15-1/2)	587,930	(15-1/2)	587,930	(20)	759,270
	Materials & Serv.		28,660		28,660		28,660
	TOTAL COST		616,590		616,590		787,930
Energy	MWH	10,500		10,393		10,594	
	TOTAL COST		441,000		436,510		444,950
Claims			96,000		96,000		96,000
TOTAL STAFF		(31)		(31)		(38)	
TOTAL COST			2,174,980		2,158,530		2,440,810

Table F-1

Regional Light Rail Study
Annual Operating and Maintenance Cost Estimate
Maintenance of Way and Structures (1984 Dollars)

			PTC		MCLOUGHLIN		17TH AVE.	
STAFFING								
Description		Average Rate $	No. Empl.	Total Cost ($)	No. Empl.	Total Cost ($)	No. Empl.	Total Cost ($)
Lead Track Maintainer		30,240	1	30,240	1	30,240	1	30,240
Track Maintainer		27,240	2	54,480	2	54,480	2	54,480
Structures Maintainer		27,240	1	27,240	1	27,240	1	27,240
Electrician		27,240	1	27,240	1	27,240	11	27,240
Lineman Helper		27,480	1/2	13,740	1/2	13,740	1/2	13,740
Signal & Equip. Maintainer		29,520	1	29,520	1	29,520	1	29,520
STAFFING SUBTOTAL			6-1/2	182,460	6-1/2	182,460	6-1/2	182,460
Labor Additives at 24%				43,790		43,790		43,790
Overtime at 5%				9,120		9,120		9,120
TOTAL STAFFING COST				235,370		235,370		235,370
MATERIALS & SERVICES								
Description	Units	Unit Cost ($)	Quant.	Total Cost ($)	Quant.	Total Cost ($)	Quant.	Total Cost ($)
Building & Maint.	stations	3,600	9	32,400	8	28,800	7	25,200
Track & roadbed	MGTM	2.28	39,000	88,920	38,800	88,460	39,800	90,740
Substations	each	420	6	2,520	6	2,520	6	2,520
Overhead	track-mi.	1,560	14.16	22,090	12.94	20,190	12.44	19,410
Station clean & supp.	each	4,800	9	43,200	8	38,400	7	33,600
Parking lot maint.	spaces	36	270	9,720	270	9,720	270	9,720
Serv. veh. running	veh/mi.	.60	8,000	4,800	8,000	4,800	8,000	4,800
Office Sup. & equip.	L.S.	2,400	--	2,400	--	2,400	--	2,400
TOTAL MATERIAL & SERVICES				206,050		195,290		188,390
TOTAL ANNUAL COST				441,420		430,660		423,760

Table F-2
REGIONAL LIGHT RAIL STUDY
ANNUAL OPERATING AND MAINTENANCE COST ESTIMATE
MAINTENANCE OF EQUIPMENT (1984 Dollars)

STAFFING Description	Average Rate $	PTC No. Empl.	PTC Total Cost ($)	MCLOUGHLIN No. Empl.	MCLOUGHLIN Total Cost ($)	17TH AVE. No. Empl.	17TH AVE. Total Cost ($)
Vehicle Mechanic	29,160	3	87,480	3	87,480	4	116,640
Helper	27,480	1/2	13,740	1/2	13,740	1/2	13,740
Electrician	29,520	2	59,040	2	59,040	2	59,040
Electronic Tech-vehicles	29,520	1	29,520	1	29,520	2	59,040
Electronic Tech-fare col.	29,520	1	29,520	1	29,520	1	29,520
Vehicle cleaner	26,400	1-1/2	39,600	1-1/2	39,600	2	52,900
STAFFING SUBTOTAL		9	258,900	9	258,900	11-1/2	330,780
Labor Additives at 24%			62,140		62,140		79,390
Overtime at 5%			12,950		12,950		16,540
TOTAL STAFFING COST			333,990		333,990		426,710

MATERIALS & SERVICES Description	Units	Unit Cost ($)	PTC Quant.	PTC Total Cost ($)	MCLOUGHLIN Quant.	MCLOUGHLIN Total Cost ($)	17TH AVE. Quant.	17TH AVE. Total Cost ($)
Trucks & Wheels	car mi.	.23	796,150	183,110	791,610	182,070	812,750	186,930
Car body	cars	1,800	15	27,000	15	27,000	20	36,000
Car propulsion	car mi.	.019	796,150	15,130	791,610	15,040	812,750	15,440
Other mech. repairs	car mi.	.006	796,150	4,780	791,610	4,750	812,750	4,880
Other elect. repairs	car mi.	.010	796,150	7,960	791,610	7,920	812,750	8,130
Car clean. supplies	cars	60	15	900	15	900	20	1,200
Fare collection	L.S.	--	(16%BAN)	2,880	(16%BAN)	2,880	(20%BAN)	3,600
Office sup. & equip.	L.S.	--	(16%BAN)	1,920	(16%BAN)	1,920	(20%BAN)	2,400
Laundry	L.S.	--	(16%BAN)	2,300	(16%BAN)	2,300	(20%BAN)	2,880
TOTAL MATERIALS & SERVICES				245,980		244,780		261,460
TOTAL ANNUAL COST				579,970		578,770		688,170

Table F-3
REGIONAL LIGHT RAIL STUDY
ANNUAL OPERATING AND MAINTENANCE COST ESTIMATE
TRANSPORTATION (1984 Dollars)

			PTC		MCLOUGHLIN		17TH AVE.	
STAFFING								
Description		Average Rate $	No. Empl.	Total Cost ($)	No. Empl.	Total Cost ($)	No. Empl.	Total Cost ($)
Operator		28,800	13	374,400	13	374,400	17	489,600
Fare Insp/Rd. Supv.		31,200	1-1/2	46,800	1-1/2	46,800	2	62,400
Rev. Coll. Serv. Pers.		27,600	1	27,600	1	27,600	1	27,600
STAFFING SUBTOTAL			15-1/2	448,800	15-1/2	448,800	20	579,600
Labor Additive at 24%				107,710		107,710		139,100
Overtime at 7%				31,420		31,420		40,570
TOTAL STAFFING COST				587,930		587,930		759,270
MATERIALS & SERVICES								
Description	Units	Unit Cost ($)	Quant.	Total Cost ($)	Quant.	Total Cost ($)	Quant.	Total Cost ($)
Uniforms	Oper.	128	13	1,660	13	1,660	17	2,180
Ticket supply	each	.006	3,000,000	18,000	3,000,000	18,000	3,000,000	18,000
Office sup/equip.	L.S.	(25%BAN)		4,500		4,500		4,500
Auto operating costs	Veh/Mi	.36	12,500	4,500	12,500	4,500	12,500	4,500
TOTAL MATERIALS & SERVICES				28,660		28,660		28,660
TOTAL TRANSPORTATION				616,590		616,590		787,930

Table F-4
REGIONAL LIGHT RAIL STUDY
ANNUAL OPERATING AND MAINTENANCE COST ESTIMATE
ELECTRICAL ENERGY (1984 Dollars)

			PTC		MCLOUGHLIN		17TH AVE.	
Description	Units	MWH/ Unit	Quantity	Total MWH	Quantity	Total MWH	Quantity	Total MWH
Propulsion	car miles	.012	796,150	9,554	791,610	9.499	812,750	9,753
Lighting								
stations	each	52.6	9	473	8	421	7	368
parking	spaces	1.75	270	473	270	473	270	473
ANNUAL ELECT. CONSUMPTION				10,500		10,393		10,594
ANNUAL COST ($42.00/MWH)				$441,000		$436,510		$444,950

Milwaukie Corridor
Working Paper "E"

INITIAL EVALUATION OF CENTRAL EASTSIDE ALTERNATIVES

October 1984

METROPOLITAN SERVICE DISTRICT

TRI-MET

DRAFT

REGIONAL LIGHT RAIL TRANSIT SYSTEM PLAN

MILWAUKIE CORRIDOR

WORKING PAPER "E"

INITIAL EVALUATION OF CENTRAL EASTSIDE ALTERNATIVES

SEPTEMBER 1984

Prepared by:

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SUMMARY AND RECOMMENDATION

Conclusions from the initial analysis of a Central Eastside Light Rail Transit (LRT) connection are:

- LRT from Milwaukie to the Central Eastside by itself is not projected to increase transit patronage to the Central Eastside Industrial District, as bus alternatives can also provide excellent transit service;

- The LRT alignments analyzed do not serve the district as well as through-routed bus service because the LRT systems require more transfers for long-distance trips;

- The transit volumes projected to be attracted to and/or through the Central Eastside are not within the range necessary to justify the alignment as part of the regional LRT system. This conclusion could change if land uses in the Central Eastside intensify, or if the area's parking costs increase in the future;

- Both Central Eastside alignments for which conceptual designs were prepared include high cost elements. The 6th Avenue alignment contains two major structures, one over the Southern Pacific Railroad and Division Place, and one over Sullivan's Gulch (the Banfield Freeway). The Water Avenue alignment would require three vertical stations (connecting to bridgehead viaducts), as well as a structure over the Union Pacific Railroad;

- Because of the expected capital costs associated with the alignments evaluated, little cost savings could be expected from developing a Central Eastside alignment instead of a Downtown alignment for a Milwaukie Corridor LRT. This conclusion could change based on the analysis of costs and impacts associated with the McLoughlin Corridor's Downtown alignment.

Based on these conclusions, preliminary recommendations concerning the Central Eastside alignments are:

- The Central Eastside LRT alignment should be eliminated from further study during this initial Regional LRT System Plan study phase; and

- A Central Eastside alignment should be examined further as part of the overall Central Area circulation system as part of the City of Portland's proposed Central Area Plan. In addition to regional travel demand, the Central Area Plan could evaluate the impact of different Central Eastside land use and parking policies--integrated with the entire Central Area--on the proposed alignment. While the alignment may not be essential to accommodate regional travel demand, it may be important to connect points within the Central Area (Lloyd Center, Downtown, and the Central Eastside) and to capitalize on land use opportunities in the Central Eastside.

1.0 Central Eastside Alignments - Background

The Central Eastside LRT alignment has been proposed for evaluation as an extension of the Southern Corridor LRT. This extension, providing through north-south LRT service in the Central Eastside, could operate on a number of streets in the area, including Water, 6th or 7th Avenues with bus transfers available at all bridgehead streets.

Three alternative roles the Central Eastside LRT could play as part of the regional transit system were analyzed. These roles are:

1. A Central Eastside LRT could serve as a regional north-south link on the east side of the Willamette River. In this role, the Central Eastside alignment would split from the main Southern Corridor alignment and continue north to its terminus at the Banfield LRT's Coliseum Station where northbound bus transfers would be available.

   In the future, this LRT route could continue north along an Interstate/I-5 Corridor LRT alignment, thus providing through LRT service from North Portland to Central Milwaukie.

2. A Central Eastside LRT could be part of a Central Area circulation system, providing stations at Lincoln/Harrison, Hawthorne/Madison, Belmont/Morrison, Oak/Pine and Burnside/Couch, and connecting Lloyd Center, Central Eastside, Inner Northwest and Downtown. This has the potential to improve transit access to Central Eastside jobs and to commercial activities in the Union/Grand Corridor and could provide an important link in a Central Area circulation system.

3. A Central Eastside alignment could also be a replacement for a Downtown rail alignment for the Milwaukie Corridor LRT, supplemented with shuttle buses providing Downtown connections. This use of the Central Eastside alignment could be advantageous if the Hawthorne Bridge required major reconstruction or if a Downtown alignment proved exceedingly expensive or disruptive. This way of serving Downtown transit demand must be weighed against the added transfer time added to rail trips destined Downtown (the major transit destination in the region) the added operating costs incurred by the shuttle bus system, as well as the capital costs of a Central Eastside alignment.

2.0 Evaluation of Central Eastside LRT Alignment Ridership

This section reviews travel forecasts prepared to evaluate ridership on a Central Eastside alignment. The forecasts assume that bus transfer stations would exist for alignments as they cross bridgehead streets (Hawthorne, Morrison, and Burnside). This analysis focuses on the role a Central Eastside connection would play in the regional transit system, and not on the comparison of alternative Central Eastside alignments (analysis thus far has found little or no ridership difference between alternative alignments).

2.1 Central Eastside Industrial District

Affecting the ridership forecasts are assumptions on the character and growth potential of the Central Eastside Industrial Area. Employment forecasts for the Central Eastside show a slow to moderate level of employment growth, due primarily to the area's lack of available vacant land in comparison to competing industrial areas in the region. Other market factors affecting location decisions which could change these forecasts include: 1) the escalating cost of public improvements, in suburban areas and the extent to which private developers are expected to provide these improvements; and 2) tax credits for rehabilitating older buildings.

A second consideration affecting transit demand in the Central Eastside is parking policy. Strain on the existing parking supply comes from two sources: (1) Downtown workers using the area's limited on-street spaces as remote parking, walking or taking buses to Downtown jobs; and (2) the internal growth in employment in the Central Eastside itself.

2.2 Central Eastside Network Alternatives

Four future year alternatives are evaluated in the following sections. These are:

- Union/Grand Bus: This network serves the Central Eastside with two cross-town lines: the first on the 11th and 12th couplet (from the Milwaukie Transit Center in the south to North Portland); the second cross-town line would be on Union/Grand. This route is key to this analysis, as it is the bus route which is replaced in the LRT networks. This bus route runs from Clackamas Town Center in the south, through the Milwaukie Transit Center, on McLoughlin Boulevard to Union-Grand, to the Banfield LRT's Coliseum Station, through to Interstate Avenue, terminating at Columbia Boulevard and Interstate Avenue. This bus line is in all the Milwaukie Corridor LRT networks (PTC, McLoughlin, and Sellwood LRT), as well as the Basic Bus network. The simulation reported assumed the PTC LRT provided the Portland to Milwaukie trunk service.

- PTC with Central Eastside LRT: This alternative simulates the effect of the Central Eastside LRT alignment, connecting to the Milwaukie Corridor LRT (the PTC alternative used as illustrative). The network assumes an LRT route from the Milwaukie Transit Center to the Banfield LRT's Coliseum Station, where transfers to the light rail and to North and Northeast Portland bus lines are possible. In the south, a separate bus line between Clackamas Town Center and the Milwaukie Transit Center supplies the service provided by the Union-Grand trunk line in the Basic Bus network.

- Central Eastside LRT with a Downtown Shuttle: This alternative evaluates the role the Central Eastside connector would play if a Downtown alignment for the Milwaukie Corridor LRT were not constructed. The alternative assumes a major bus transfer station at Hawthorne, where shuttle buses to Downtown would connect with LRT at frequent intervals. The impact of this added transfer for Milwaukie Corridor to Downtown riders is evaluated.

- Central Eastside LRT with an Inner-Eastside Parking Cost: This alternative is the same transit network configuration discussed as alternative 2 above (PTC with Central Eastside LRT). Added to this alternative is a moderate parking cost (one-third of that projected for Downtown Portland in 2000). This alternative is intended to provide an upper limit of feasible ridership to the Central Eastside.

2.3 Evaluation of Central Eastside Alternatives

Alternative Central Eastside alignments are evaluated from two perspectives: (1) How the LRT alignments affect the number of transit trips destined to the Central Eastside district, and (2) the use of the Central Eastside alignment to accommodate transit trips through the district.

- Trips to the Central Eastside: Table 1 displays the transit trips projected to be attracted to the district, and those specifically from the Milwaukie Corridor for each alternative.

  Between 1980 and the year 2000, transit patronage to the Central Eastside increases by 20 percent (45 percent if a parking cost is assumed). Even with this increase, transit ridership accounts for less than 4 percent of total travel to the area (4.6 percent if a parking cost is applied).

TABLE 1

DAILY TRANSIT RIDERSHIP TO THE CENTRAL EASTSIDE

Alternative	Trips from All Areas of the Region	Trips from the Milwaukie Corridor[1]
1980: Transit Trips	5,610	550
% of Total	3.2%	3.2%
Year 2000 Alternatives		
1. Basic Bus Network		
Transit Trips	6,880	810
% of Total	3.8%	4.4%
2. PTC with Central Eastside LRT		
Transit Trips	6,880	750
% of Total	3.8%	4.1%
3. Central Eastside LRT with a Downtown Shuttle		
Transit Trips	6,840	760
% of Total	3.8%	4.1%
4. Central Eastside LRT with Inner-Eastside Parking Cost		
Transit Trips	8,270	960
% of Total	4.6%	5.2%

[1]Districts 3, 9, 10, 11, 12, and 13.

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Ridership from the Milwaukie Corridor to the Central Eastside is projected to increase slightly faster than for the region as a whole, but is still less than 4.5 percent of total person trips (or 5.2 percent with a parking cost assumed).

In general, Table 1 shows that the Central Eastside is an important transit destination, but because those transit trips are not heavily concentrated to or from the Southern Corridor alone, the impact of a Central Eastside LRT alignment connecting to a Milwaukie to Portland LRT trunk route is small.

Table 2 illustrates the effect of alternative 4 (downtown bus shuttle from the Central Eastside) on Downtown patronage. Overall, the added travel time (approximately 3 minutes plus 2.5-minute transfer time) reduces Downtown patronage 4 percent. These changes in travel time represent the most optimistic assumption considered possible for the operating characteristics of the shuttle buses.

- <u>Assessment of Through Trips Using The Central Eastside LRT</u>: In addition to serving trips destined to Downtown and the Central Eastside, the Central Eastside north-south link could provide a through route between north and south corridors without incurring Downtown traffic delays. This is evaluated through a number of transit assignments for each alternative, as shown on Figures 1 through 4.

  In general, these assignments show little positive change resulting from the Central Eastside LRT alternatives as compared to the network with a Union-Grand bus line. The network without a Central Eastside LRT line shows the highest transit assignment for the following reasons:

  - In the LRT alternatives -- the Eastside trunk is broken into three routes: (a) Clackamas Town Center to Milwaukie; (b) Milwaukie to the Coliseum Transfer Station via LRT; and (c) Interstate Avenue Bus trunk. In the networks without a Central Eastside LRT, all three routes are combined into one continuous north-south bus line. As an example of the impact of this, a trip between Interstate Avenue destinations and the Clackamas Town Center requires two transfers with the Central Eastside LRT (at Coliseum Station and at the Milwaukie Transit Center), and no transfers in the networks without a Central Eastside LRT. These added transfers outweigh travel-time savings of the LRT and result in many Clackamas County

TABLE 2

EVENING PEAK HOUR LRT RIDERS TO DOWNTOWN:
DIRECT DOWNTOWN LRT
SERVICE AND CENTRAL EASTSIDE SHUTTLE BUS

		PTC Direct to Downtown	Central Eastside LRT and Shuttle to Downtown
3:	Sellwood-Moreland	260	230
9:	Central Milwaukie	930	940
10:	Town Center Area	140	120
11:	South McLoughlin Area	790	750
12:	Oregon City Area	80	70
13:	Clackamas Area	80	80
	Others[1]	20	20
	TOTAL	2,300	2,210 (Down 4%)

[1]Trips from elsewhere in the region to the McLoughlin Corridor.

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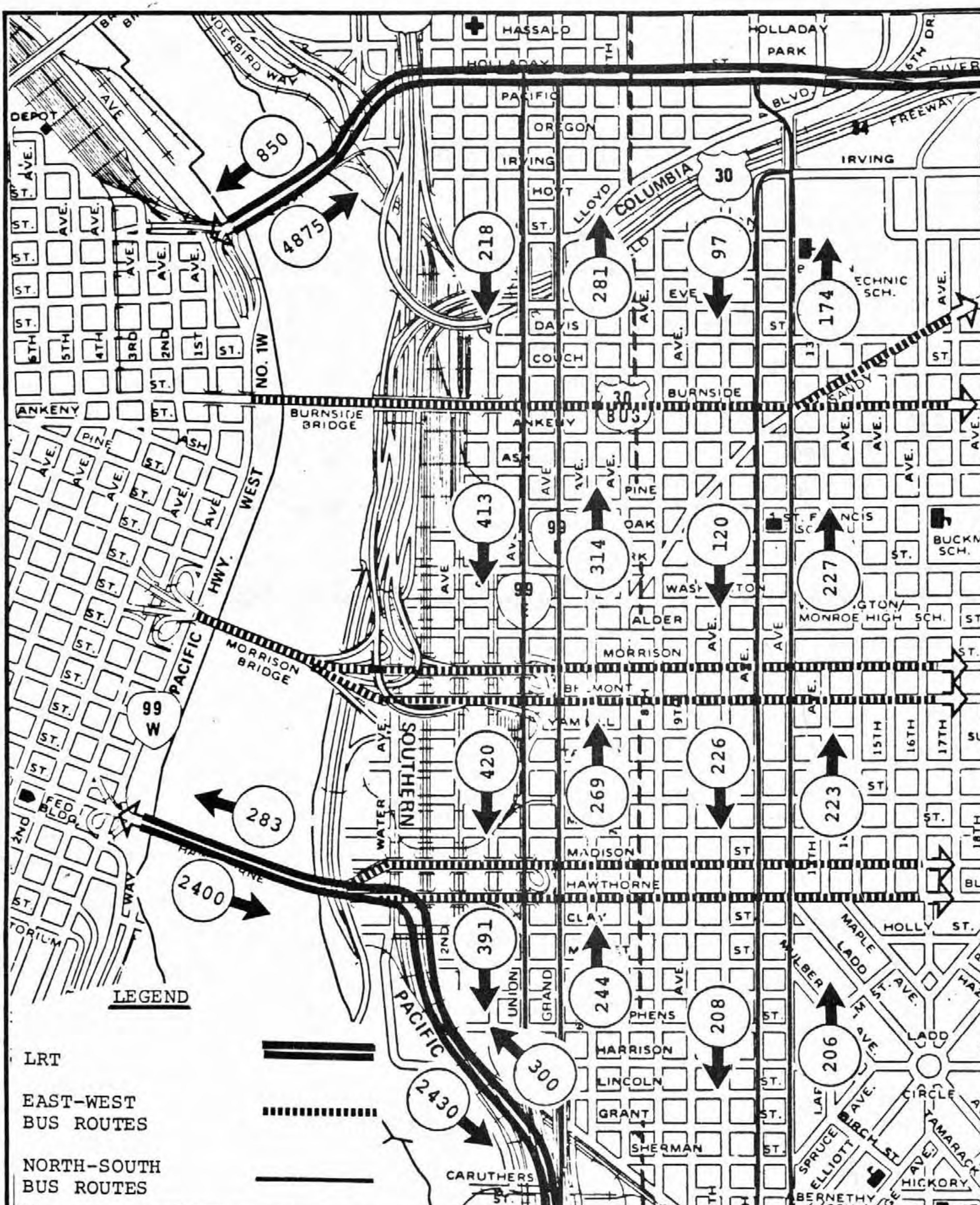

FIGURE 1

CENTRAL EASTSIDE

BASIC PTC NETWORK
P.M. PEAK HOUR TRANSIT VOLUMES

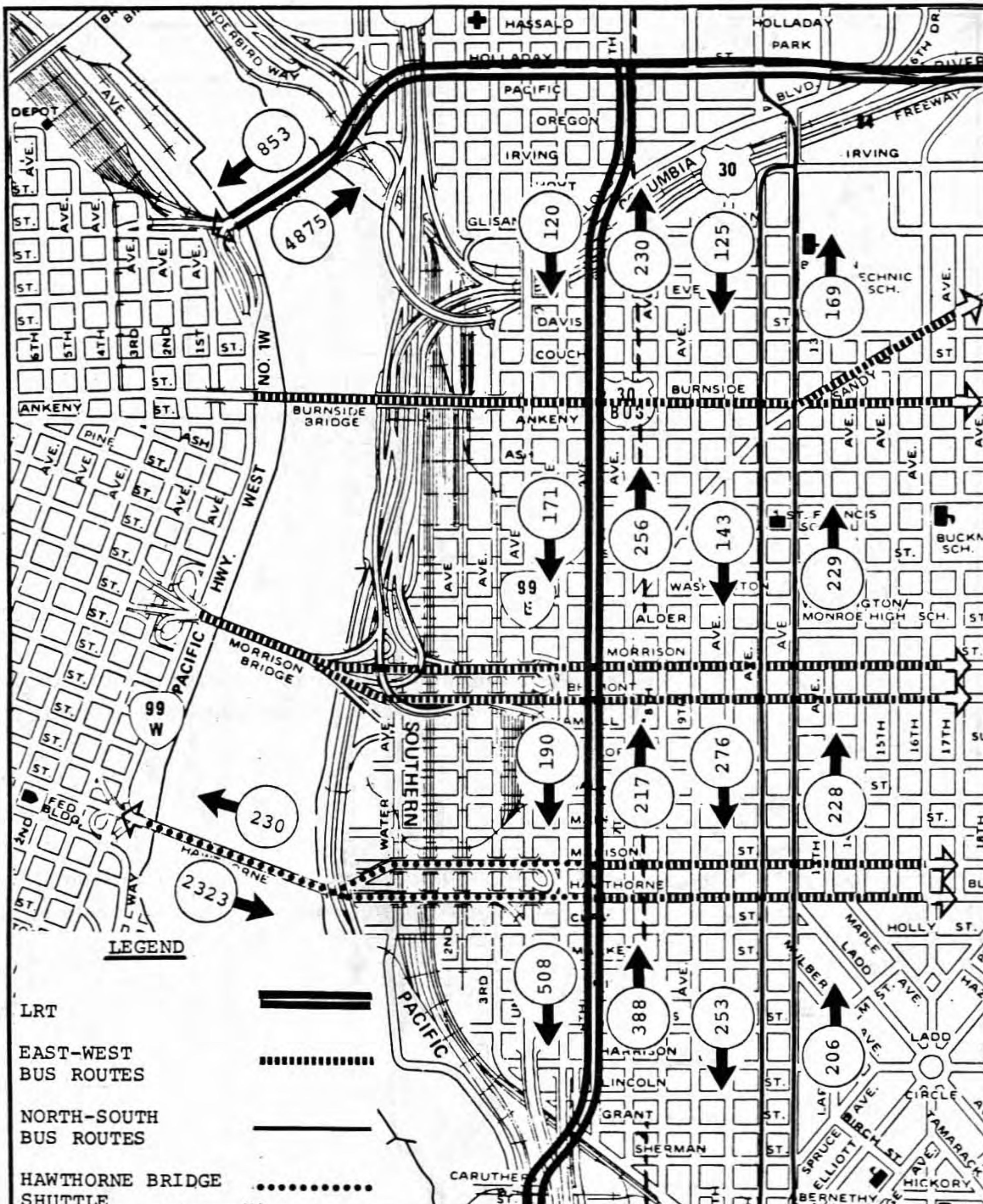

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FIGURE 2

CENTRAL EASTSIDE LRT
WITH DOWNTOWN SHUTTLE SERVICE
P.M. PEAK HOUR TRANSIT VOLUMES

FIGURE 3

CENTRAL EASTSIDE LRT
WITH DIRECT DOWNTOWN LRT (PTC TRUNK)
P.M. PEAK HOUR TRANSIT VOLUMES

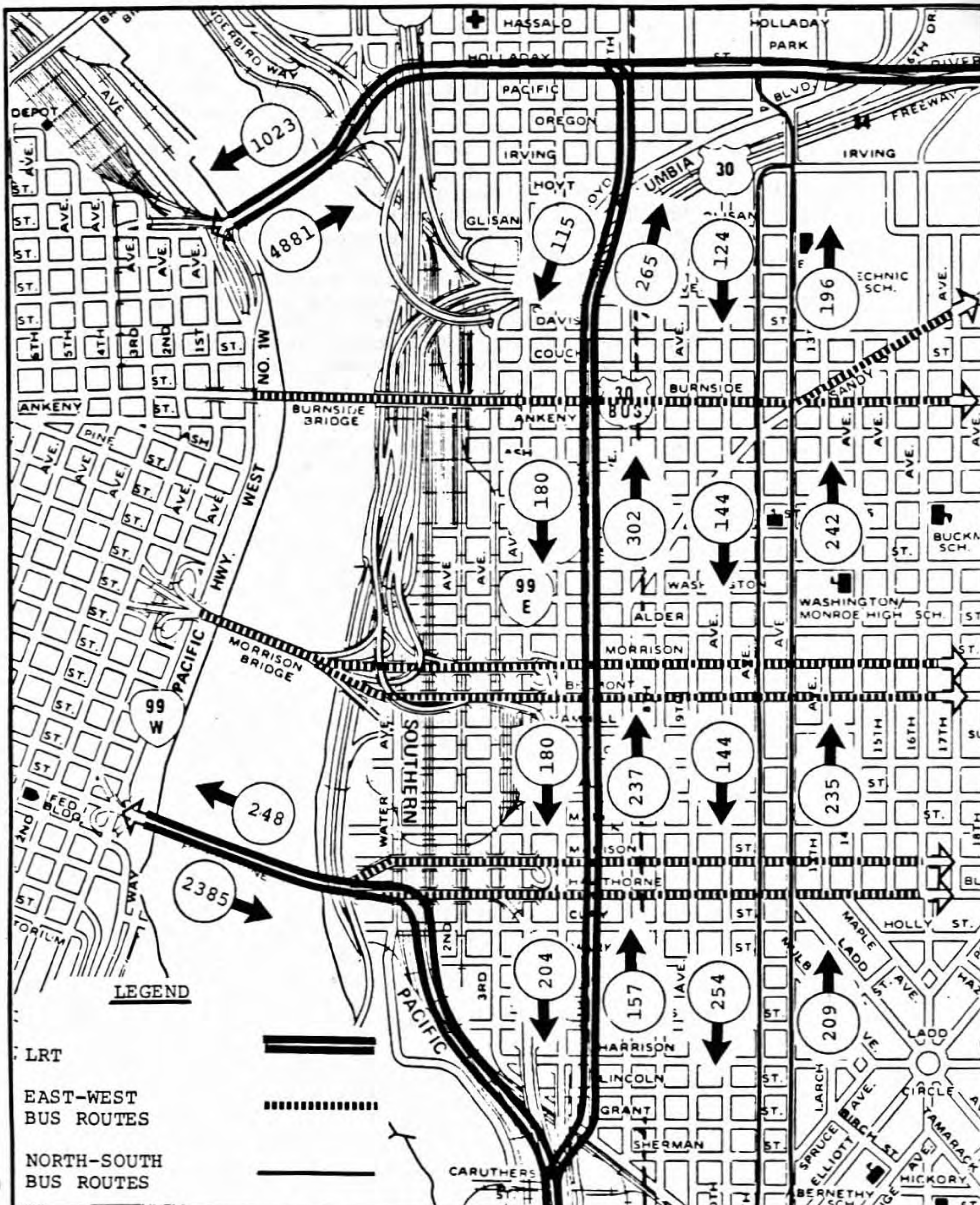


FIGURE 4

CENTRAL EASTSIDE LRT
WITH CENTRAL EASTSIDE PARKING COST
P.M. PEAK HOUR TRANSIT VOLUMES

riders choosing a different transit path to destinations in the City of Portland east of the Willamette River.

- Even with the highest ridership alternative, the peak load point of 420 (P.M. peak hour) suggests the Central Eastside can efficiently be served with high-quality bus service on the Union-Grand couplet rather than LRT. The peak load point indicates that a 15-minute frequency with articulated buses or 10-minute frequency with standard buses is adequate to handle projected year 2000 demand. LRT would provide more capacity than could reasonably be used.

3.0 Conceptual Engineering of Representative Alignments

The pre-engineering analysis of Central Eastside north-south LRT routes has identified four potential alignments: (1) 7th Avenue; (2) 6th Avenue; (3) Union/Grand complet; and (4) Water Avenue. Each of these are discussed in Appendix A. Two of these, 6th Avenue and Water Avenue, had conceptual engineering tasks performed. The 7th Avenue alternative was not pursued at this time due to concern over traffic impacts between Hawthorne Boulevard and Stark Street where additional right-of-way (ROW) may be needed to accommodate both LRT and heavy traffic volumes. ROW is not easily available along 7th Avenue. The Union/Grand LRT couplet also was not pursued due to impacts on parking and access for the many small retail businesses adjacent to both Union and Grand Avenue. The two alignments which underwent conceptual engineering, 6th Avenue and Water Avenue, are discussed below. It must be emphasized that choosing these two alignments for conceptual engineering gives them no special status over the other alignments discussed above or in Appendix A. They were chosen to provide a representative design to help focus the discussion of impacts and costs of any Central Eastside alignment.

3.1 6th Avenue Alignment

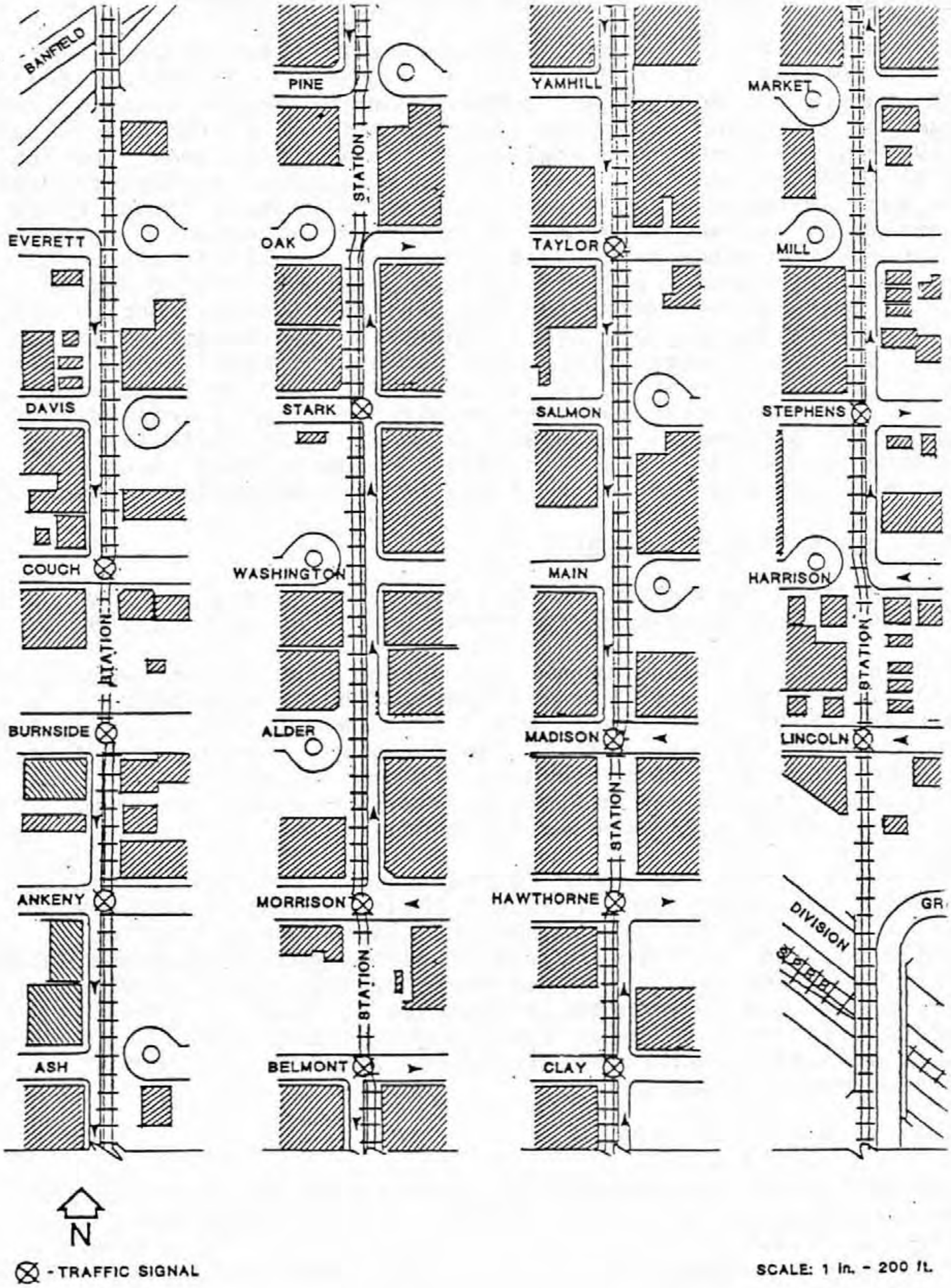
A conceptual design for the 6th Avenue alignment is shown on Figure 5, with possible cross-sections shown on Figure 6.

Presently, 6th Avenue is a local access street with two-way traffic together with parking and loading on each side of the street. Light rail could be developed within the existing ROW by limiting local traffic to one lane, with two lanes (24 feet) devoted to light rail. However, in station blocks, of which five are proposed, no vehicle access is proposed so as to minimize LRT/traffic/pedestrian conflicts.

Two major structures would be required to gain access to 6th Avenue: (1) from the Portland Traction Company (PTC) ROW to 6th Avenue over Division Place and the Southern Pacific Railroad; and (2) across the Banfield Freeway (Sullivans Gulch) from 6th Avenue to 7th Avenue north of the freeway. These structures are documented in Appendix A. Both of these structures would be major capital cost items associated with this alignment. However, little ROW would be required with a 6th Avenue alignment.

3.2 Water Avenue Alignment

The conceptual engineering of the Water Avenue alignment is shown on Figure 7, with possible cross-sections shown on Figure 8. The cross-sections shown illustrate LRT in the median of a reconstructed Water Avenue; however, developing LRT in its own ROW to the west of Water Avenue may also be possible if conflicts with the I-5/Water Avenue ramps project can be avoided. In either case, an additional 20 feet of ROW is likely to be required in order to maintain two-way traffic on



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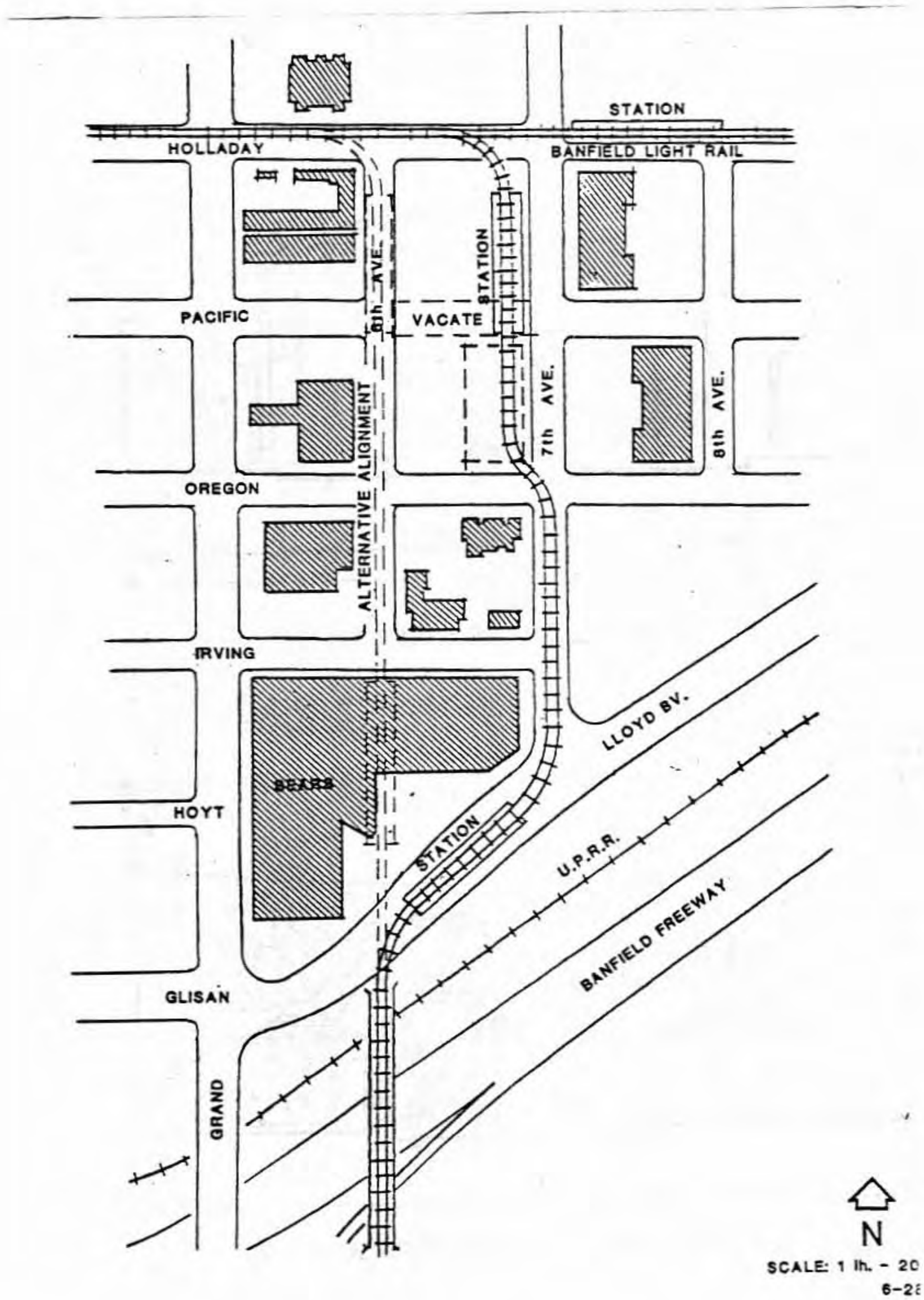
CENTRAL EASTSIDE ALIGNMENT 6th AVENUE OPTION

FIG. 5
SHEET 1 OF 2



CENTRAL EASTSIDE ALIGNMENT
6th AVENUE OPTION

FIG. 5
SHEET 2 OF 2

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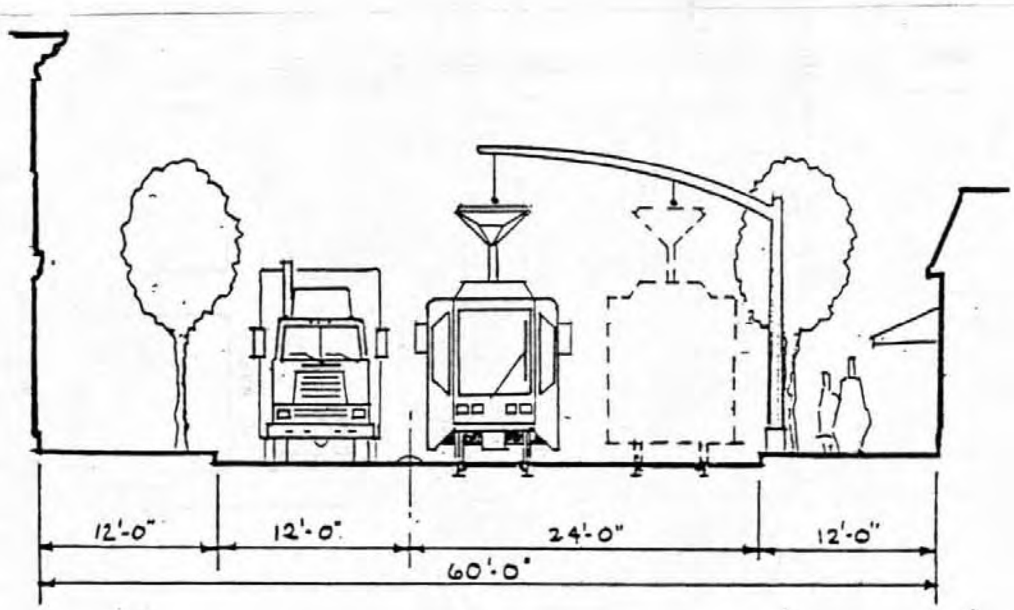
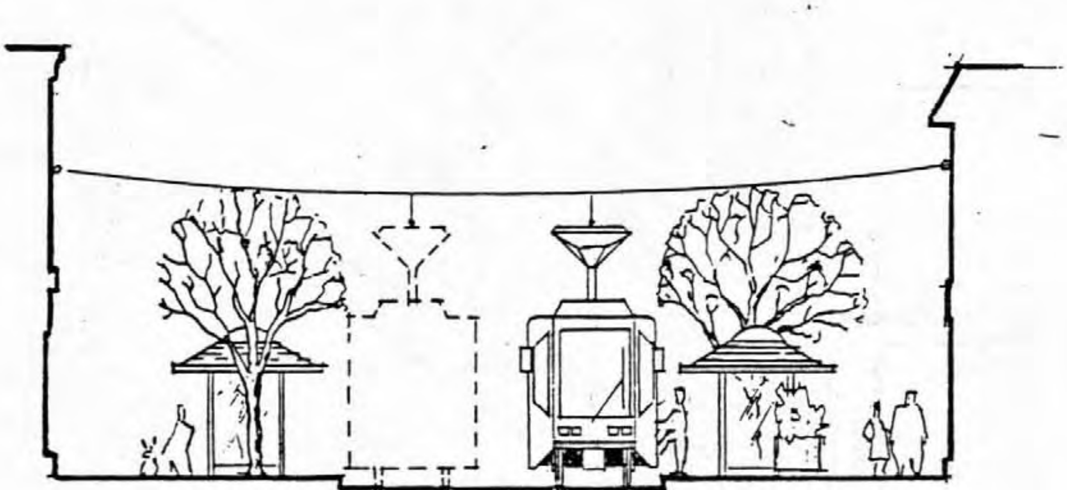


TYPICAL CROSS SECTION



CROSS SECTION AT STATION BLOCKS

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6th AVENUE CROSS-SECTIONS

FIG. 6

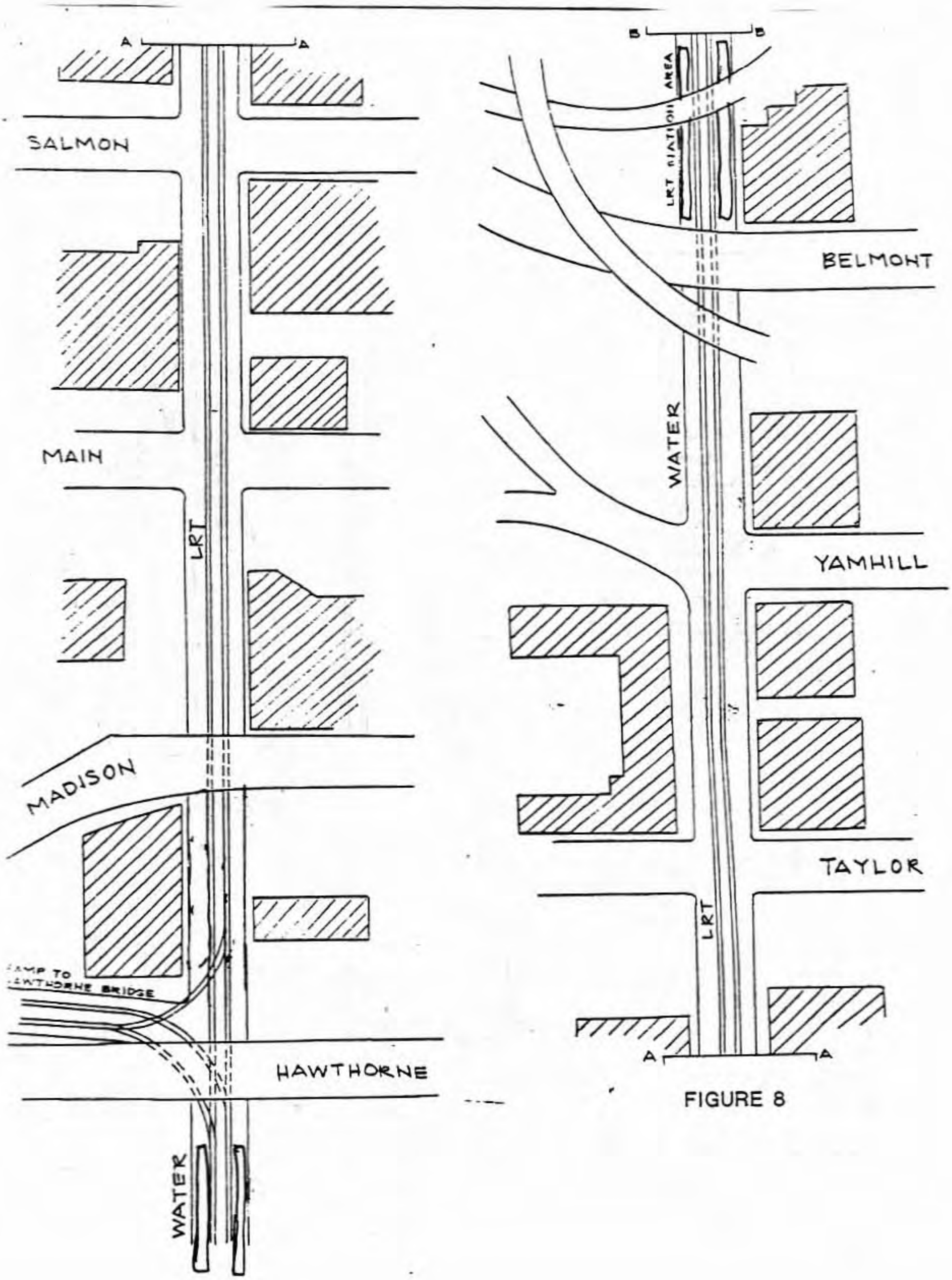
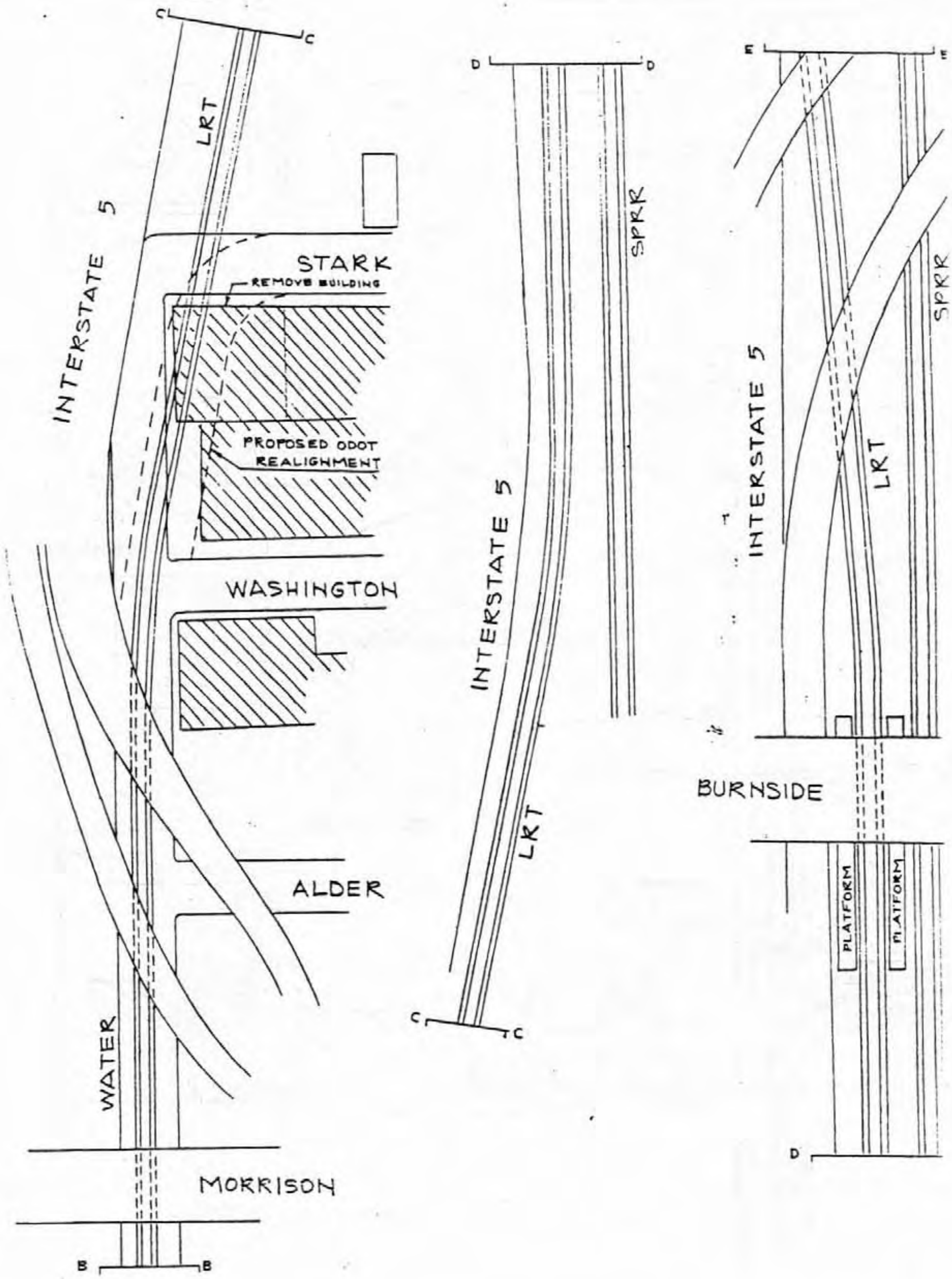


FIGURE 8

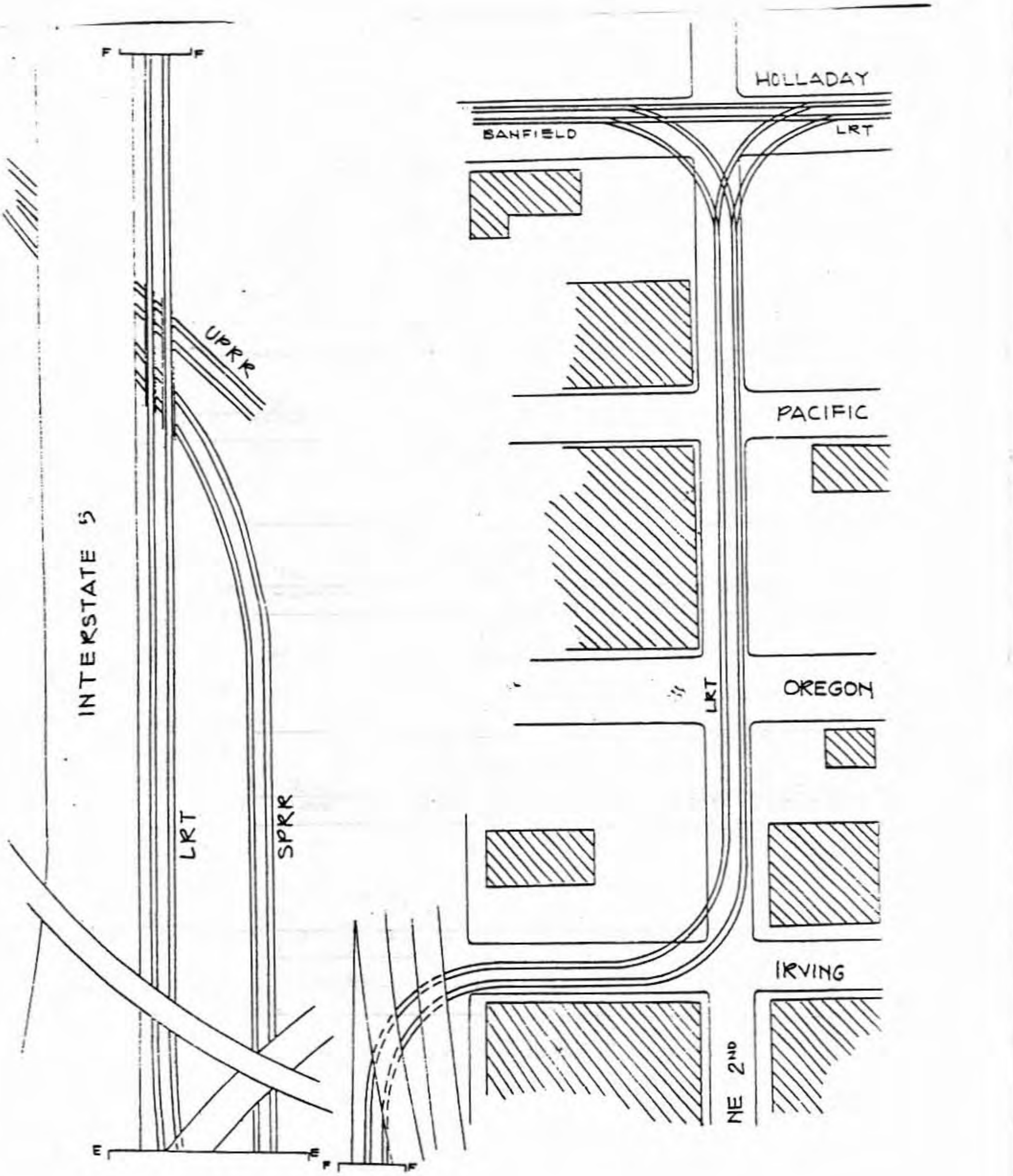
CENTRAL EASTSIDE ALIGNMENT
WATER AVE OPTION

FIG. 7
SHEET 1 OF 3



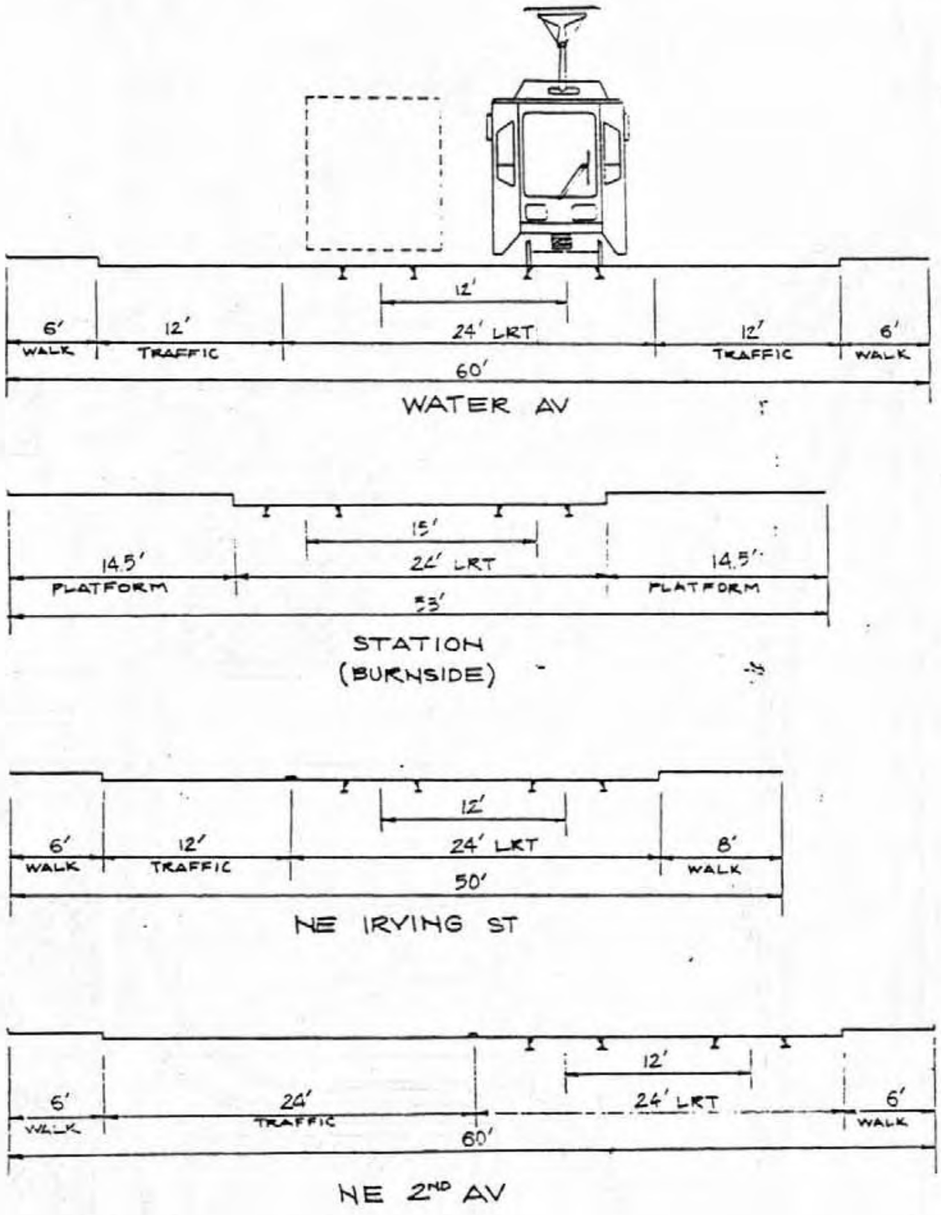
CENTRAL EASTSIDE ALIGNMENT
WATER AVE OPTION

FIG. 7
SHEET 2 OF 3



CENTRAL EASTSIDE ALIGNMENT WATER AVE OPTION

FIG. 7
SHEET 3 OF 3



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WATER AVENUE CROSS-SECTIONS

FIG. 8

Water Avenue. This will impact two to three of the warehouse/distribution businesses now located to the west of Water Avenue, and will increase the costs of the alignment.

Another complication associated with the Water Avenue alignment is the need to provide vertically separated stations at the viaducts leading to each bridge (the Hawthorne Bridge, the Morrison Bridge, and the Burnside Bridge) to allow transfers to east-west buses. These stations could involve construction of bus pullouts on viaducts leading to the bridges, as well as elevators and stairways to facilitate pedestrian movements between the buses on the bridge viaducts and the Water Avenue LRT. These three stations will represent major capital cost items for the Water Avenue alignments.

4.0 Central Eastside Alignment Impacts

Major impacts related to the 6th Avenue and Water Avenue alignments concern parking, access, and local circulation. Impacts such as noise or air quality have not been considered here, as the Central Eastside district is bisected by many busy arterials, and as an industrial district, is not likely to be sensitive to the relatively low noise levels generated by light rail.

Parking and truck access impacts of the 6th Avenue and Water Avenue alignments are summarized below.

6th Avenue Alignment

Conclusions from the 6th Avenue parking survey are:

- The on-street spaces, which appear to serve short-term parkers, were more heavily utilized than off-street spaces; and

- A total of 313 on-street spaces would likely be lost due to implementation of a 6th Avenue LRT alignment.

The analysis of access, loading and truck circulation found that the 6th Avenue alignment would eliminate three loading zones in station blocks (where all vehicular access would be eliminated), and would eliminate another 12 loading zones in non-station blocks. Another 12 loading zones located on cross-streets proposed for circulation changes would also be affected.

In addition to direct impacts on truck loading zones, the conceptual design for the 6th Avenue LRT proposes the closure of up to 12 east-west streets as they cross 6th Avenue in order to allow for more efficient LRT operation. While the final design of any LRT alignment on 6th Avenue is subject to many changes, the impact of the closures are likely to be important to businesses located between Grand on the west and 7th on the east. Bridgehead streets, which provide major east-west circulation for the District as a whole, would remain unaffected by the 6th Avenue LRT.

Water Avenue Alignment

Conclusions from the Water Avenue parking survey are:

- Of the 609 spaces within one block east or west of Water Avenue, 72 percent were occupied on the day of the survey; and

- A total of 112 parking spaces would be lost due to implementation of the Water Avenue alignment.

The survey of Water Avenue also found five truck loading zones directly on Water Avenue which would be affected by light rail development.

Because the Water Avenue LRT is proposed to be in its own ROW, traffic impacts are expected to be limited. This is essential due to the importance of Water Avenue to local circulation in the industrial district west of Union Avenue, and because of the access Water Avenue provides to the proposed freeway ramps to I-5 south.

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APPENDIX A

CONCEPTUAL ENGINEERING REVIEW
OF CENTRAL EASTSIDE ALIGNMENTS

CENTRAL EASTSIDE ALIGNMENTS

The pre-engineering analysis for the inner-eastside LRT route has identified four potential alignments: 1) 7th Avenue, 2) 6th Avenue, 3) Union/Grand, and 4) Water Avenue. Each of these alignments is shown on Figures 1-4.

This paper identifies some preliminary pros and cons of these four alignments and presents a conceptual engineering plan for the Sixth Avenue and Water Avenue Alignments, and a work program specifying tasks necessary to complete the analysis.

I. NEED FOR A CENTRAL EASTSIDE ALIGNMENT

Assuming that a Milwaukie-Portland LRT Line is constructed, there are two primary reasons to construct a Central Eastside connector. Such a connector between the Milwaukie Line and the Banfield Line east of the Coliseum Station would: 1) provide LRT access to the Central Eastside Industrial area and Lloyd Center without going through downtown, and 2) provide an emergency route for either Milwaukie or Banfield trains during bridge closures. Upon the completion of an Interstate Avenue or I-5 LRT line, through trains could operate from Hayden Island or Vancouver to Milwaukie via the Central Eastside connector, reducing transfers still further.

A very different scenario would assume the existence of a Westside-Banfield through line and then the construction of a Vancouver-Milwaukie through line with the connector as an integral portion of that line. As demand increased and downtown alignment consensuses were reached, a direct downtown connection over the Hawthorne Bridge from Milwaukie would be built.

II. PROS AND CONS OF ALTERNATIVE ALIGNMENTS

1. 7th Avenue

The 7th Avenue alignment can be discussed in three segments: Division Street to Hawthorne, Hawthorne to Stark, and Stark to the Banfield Freeway. It is illustrated on Figure 1. From Division Street to Hawthorne, 7th has a right-of-way width of approximately 80 feet, presently allowing two travel lanes and curbside parking and loading on each side of the street. In this segment there is adequate ROW to develop light rail in the median and maintain two travel lanes (removing parking and curbside loading on at least one side). Removing curbside loading could be a serious impact to at least one business located along this segment of 7th. Also, additional ROW would need to be acquired to accommodate station platforms in this segment.

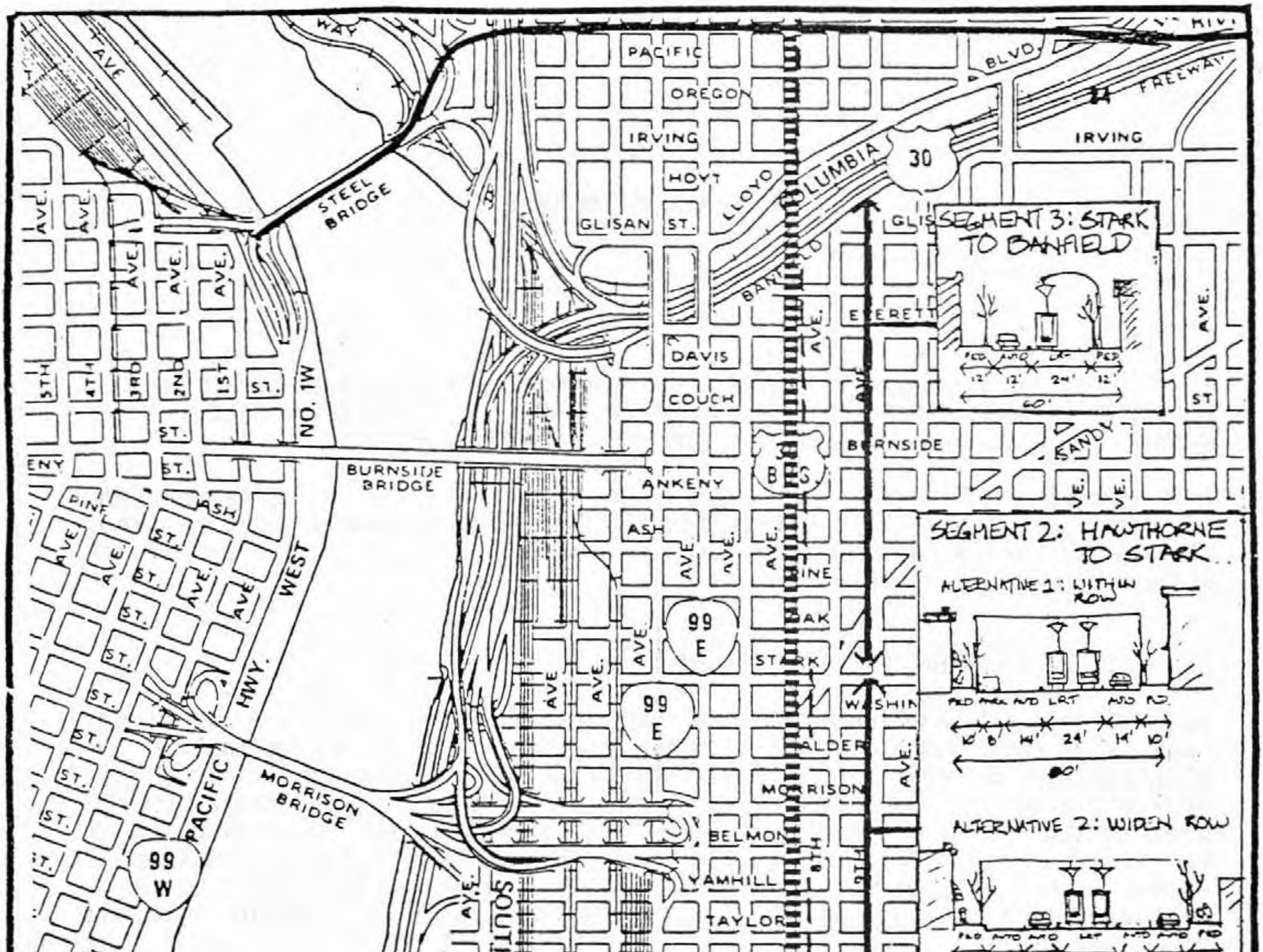

FIGURE 1

7th AVENUE ALIGNMENT

From Hawthorne to Stark, 7th Avenue is heavily travelled, and its 80 feet of right-of-way is striped to accommodate four travel lanes, with curbside parking on each side of the street. This segment of 7th may prove the most difficult for LRT development. To develop LRT in the median of 7th in this segment, parking and curbside loading would need to be removed on at least one side, and the number of travel lanes would be reduced from four to two. The alternative to this reduction in traffic capacity would be widening this segment, which would then impact a number of businesses located directly adjacent to the 7th Avenue ROW. Also, additional ROW would be required for station blocks, whether or not the street segment is widened.

The third segment of 7th Avenue, from Stark to the Banfield Freeway, has a narrower ROW (60'), but 7th in this segment is used primarily for local access. Developing LRT in this segment would involve removing parking and curbside loading, removing the two through travel lanes, leaving one traffic lane for local circulation in between station blocks. In station blocks, the street would be closed to all but LRT and pedestrians. Local cross-streets could be selectively cul-de-saced, or looped, or signalized crossings could be developed so as to allow LRT to maintain reasonable speeds in the area. The alternative to this configuration is to widen this segment of 7th Avenue to accommodate two, rather than one, travel lanes. Such a widening would impact a number of businesses.

Conclusion: A 7th Avenue LRT alignment would either reduce traffic capacity significantly between Hawthorne and Stark, or require a costly widening. Seventh, between Stark and the Banfield Freeway would be open to limited local traffic circulation only. Seventh is two blocks removed (400+ feet) from the Central Eastside's main commercial street (Grand), but serves the upper segment of the district well. Because of the difficulty of LRT development in the Hawthorne to Stark segment, the 7th Avenue alignment will not be considered in greater depth at this time.

2. 6th Avenue

Sixth Avenue is presently used primarily for local access, is striped with two lanes, and also allows curbside parking or loading on each side of the street. Light rail could be developed within the existing right-of-way by limiting traffic to one lane for local access only (similar in configuration to the Portland Mall). Within station blocks, no local access would be allowed. This alignment may involve closure of many cross-streets which are not used for through traffic. Signalized intersections would be developed at all major through streets. The major impact of this alignment may be loss of some local access and of all on-street parking. Local access losses may be mitigated somewhat by maintaining one service/local circulation lane open on 6th. Sixth Avenue is located only one block (200') from the main commercial street in the Central Eastside District, and can serve the upper portion (east of 7th) of the district fairly well. The 6th Avenue alignment has generated the least amount of opposition from the Central Eastside Industrial community.

Conclusion: Because 6th appears to be one of the most reasonable alternatives, it is recommended to undergo conceptual engineering to illustrate how light rail can work on the Central Eastside.

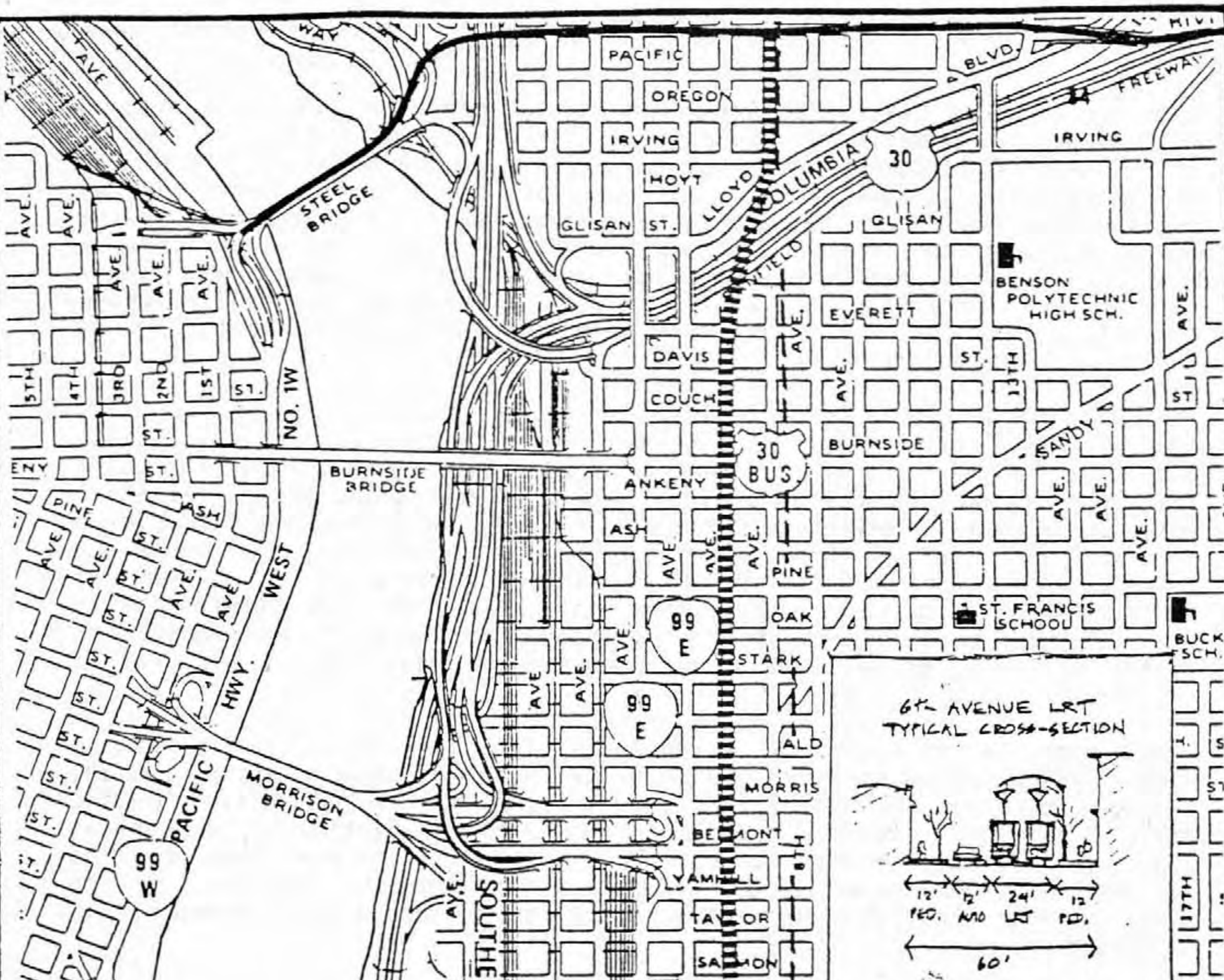

FIGURE 2

6th AVENUE ALIGNMENT

3. Union/Grand LRT Couplet

The Union Avenue/Grand Avenue couplet provides the major north-south traffic streets through the Central Eastside, and LRT development on this couplet would be difficult due to the heavy traffic volumes. LRT could be developed within the existing right-of-way by either removing parking or by removing one traffic lane. Removing a traffic lane would likely cause traffic impacts on streets already congested. The Central Eastside Industrial Council has emphasized that removing parking, especially on Grand, would cause a severe hardship on the many small commercial outlets along these streets which depend to a large extent on easy auto access.

Another disadvantage of a Union/Grand LRT alignment would be the added cost of two overhead electrical systems (Union and Grand); also, the grade separation between Union and the bridgehead streets providing east-west bus connections would necessitate expensive transfer stations, or planning for all transfers to occur at Grand Avenue 200+ feet from Union.

On the positive side, Grand Avenue is the commercial center of the Inner Eastside area, and there may be some advantage to serving it directly with LRT rather than bus. Union/Grand is also in the geographic center of the Central Eastside employment district.

Conclusion: The Union/Grand LRT alignment is perceived by the local business community as having serious traffic and parking impacts which would be difficult to mitigate. Because of these impacts, other alternatives will be considered as part of the Banfield LRT System Plan.

4. Water Avenue/Waterfront

An LRT alignment parallel to Water Avenue through the Central Eastside Industrial Area may be possible to develop either in the median of a widened Water Avenue, or on its own right-of-way west of Water Avenue. Stations would be developed only at bridgeheads and possible joint-development sites. The bus transfer stations would be expensive due to the vertical separation of any LRT alignment on Union and the major bus streets. The proposed alignment which will require an elevated and cut section near the UPRR and I-5 is shown on Figure 4. The cross-sections shown in Figure 4 assume widening the right-of-way from 60 to 80 feet.

To provide needed ROW for this alignment, 2-3 warehouse properties west of Water Avenue could be impacted (beyond those already impacted by the Water Avenue/Marquam ramps project). Also, because of the new freeway ramps, it appears infeasible to develop LRT without added ROW--as the new Water Avenue I-5 ramps will increase the importance of traffic flow on Water Avenue.

This alignment is physically removed from the center of the Central-Eastside employment district, and as such will not provide a high level of service to the district, thereby increasing the need for bus service on Union/Grand. It will, however, provide a Central Eastside connection with a low level of impact to the district as a whole (except those businesses directly west of Water Avenue which could be impacted).

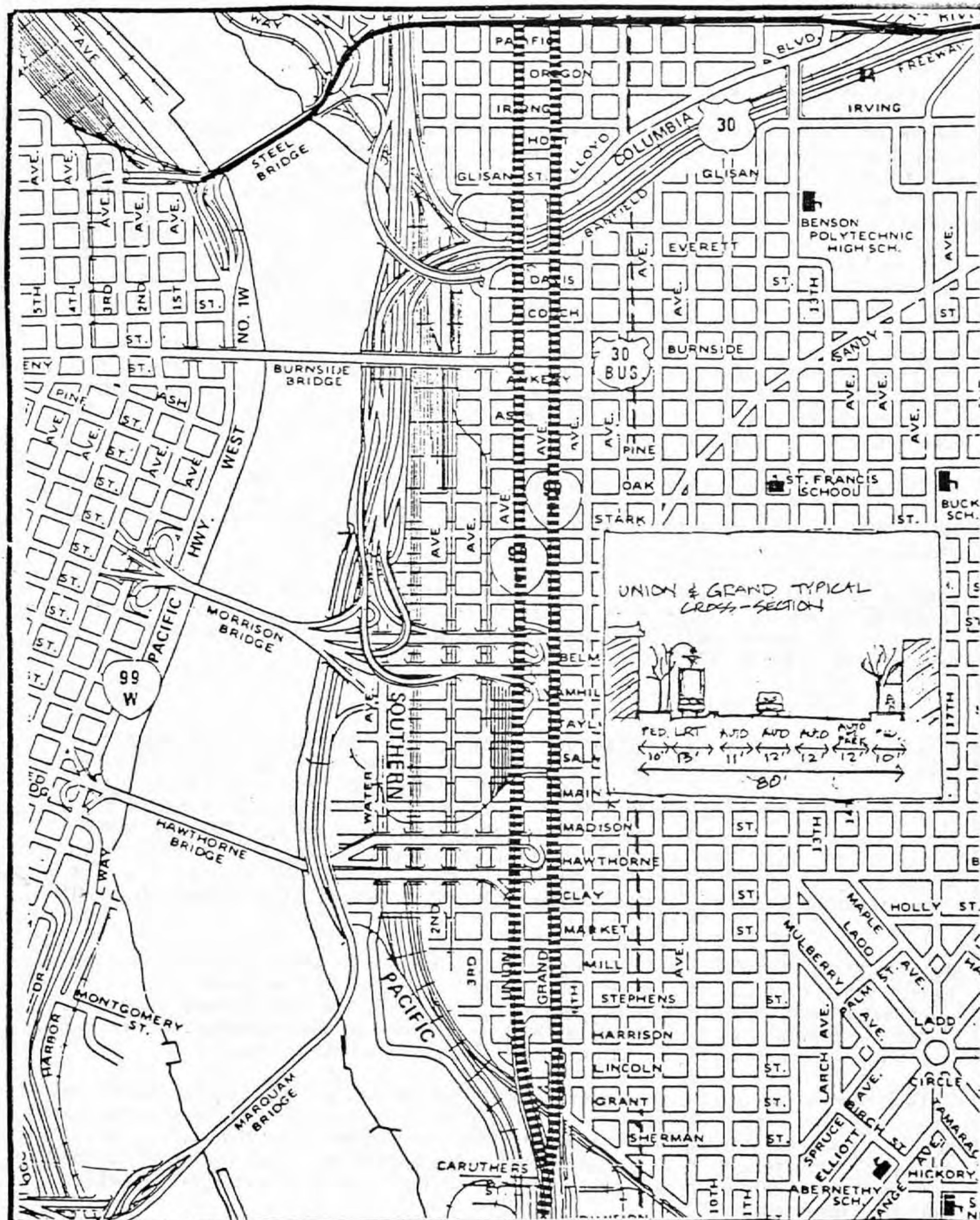

FIGURE 3 UNION/GRAND ALIGNMENT

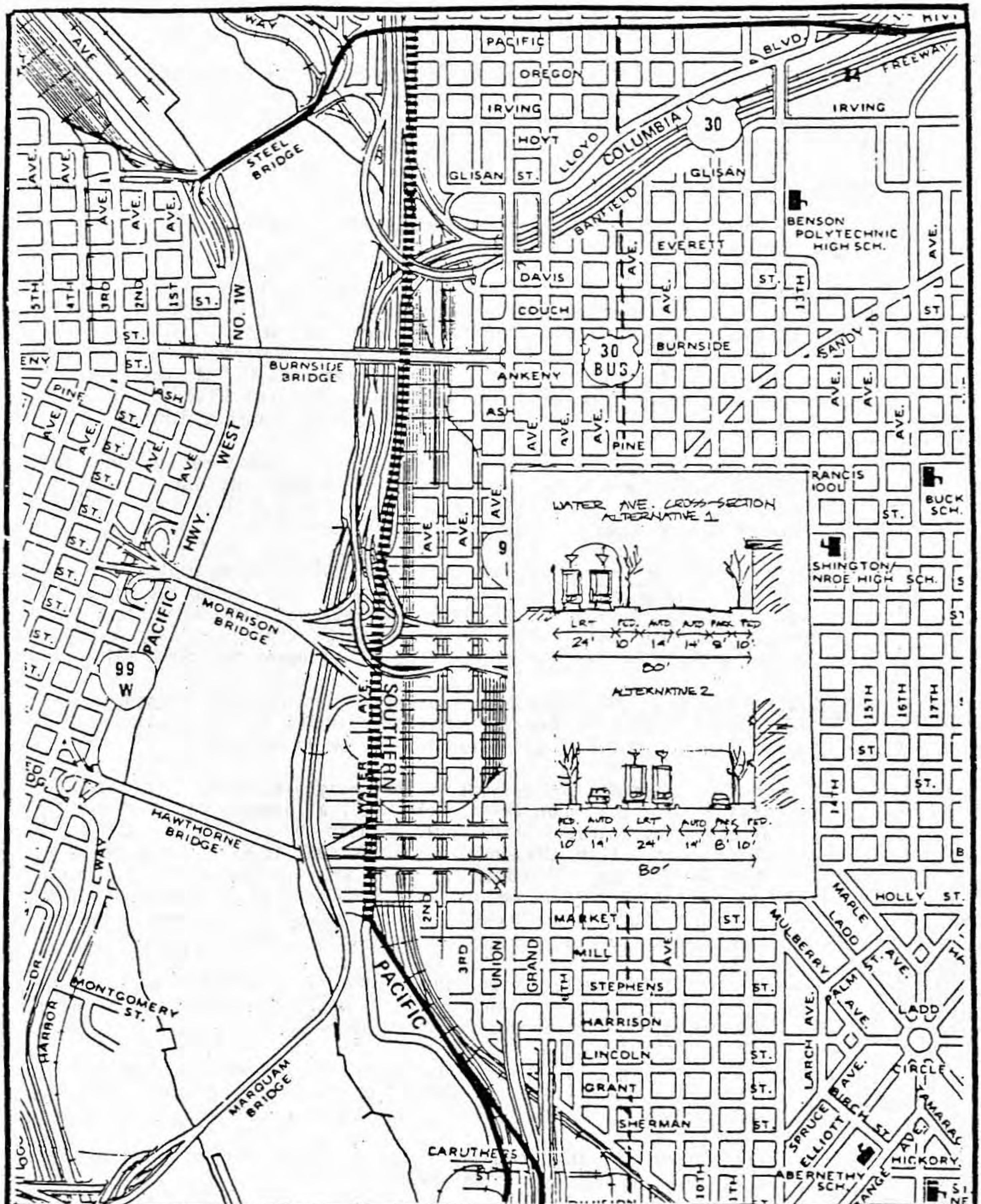

FIGURE 4

WATER AVE. ALIGNMENT

Conclusion: Because of the business relocation caused by the Marquam ramps/Water Avenue project, an alignment can be developed in the vicinity of Water Avenue with less impact to the local businesses. Because of this, this alignment is recommended to undergo conceptual engineering.

5. Low Priority Alternative Alignments

A number of other streets were initially considered, but were eliminated due to the reasons indicated.

1st Avenue. The Southern Pacific mainline (2-tracks) and two rail-siding tracks serving adjacent buildings are on 1st Avenue through the Central Eastside. The difficulty of dealing with and operating along the SP, and the assumed reluctance of building owners to give up rail access are reasons for not considering 1st in great detail. If, however, the other alignments prove even more difficult, initial discussions with the SP may be called for to allow pursuit of this street further.

2nd & 3rd Avenues. Because these streets provide both rail sidings for freight loading and truck freight loading for adjacent businesses, it would appear nearly impossible to implement light rail on these streets without severe impacts on surrounding businesses.

Grand Avenue/Union Avenue Two-way Operation. This option would turn auto operation two-way on Union and Grand Avenues, and develop two-way light rail on Grand Avenue. This alternative was not considered because of uncertainty over the traffic feasibility of this plan, and lack of definite plans by the City of Portland to implement this proposal.

11th/12th Avenues. A preliminary evaluation of a Central Eastside alignment on the 11th/12th Avenue couplet resulted in a decision not to pursue the alignment further, for the following reasons:

- Southern corridor connections to this alignment would be reasonable only from a Sellwood or McLoughlin LRT alignment, not from the PTC alternative. Streets which could connect the Sellwood or McLoughlin LRT's to the 11th/12th couplet from McLoughlin Blvd. north (such as 17th Avenue or Milwaukie Avenue) are narrow and lined with businesses--implying major impacts on traffic and property access between McLoughlin and Powell. A crossing of the S.P. would also be necessary to gain access to the 11th/12th couplet.
- The 11th/12th couplet is outside of the major employment area for the Central Eastside, and hence narrowly misses serving a major employment district in the metropolitan area.
- Grade crossing of the Sandy/Burnside intersection would be necessary--adding a major complication to an already congested intersection.
- The alignment would require two overhead electrical systems (11th and 12th), increasing capital costs.
- Traffic impact and structural adequacy issues exist for the 12th Avenue structure over the Banfield Freeway.