Research Report

Allocation of Transportation Resources: Development of an Evaluation Method

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16. Abstract

The objective of this report is to develop an effective transportation resource allocation technique that is flexible and can be applied to various areas. Allocation procedures were developed and tested for apportioning resources to transportation services in relation to community transportation objectives. Procedures were developed and applied that measured the effectiveness of candidate transportation service proposals in terms of a transportation resource allocation index (TRAI). The extent to which a transportation proposal achieves the community objectives is defined as its effectiveness. The transportation index was computed on the basis of the projects scorings for eight selected determinants, multiplied by the weighting assigned to each determinant in accordance with their relative effectiveness.

The TRAI for eight transportation service proposals including transit, were computed as a pilot study and as a working test of the techniques in the Tri-Cities area of Richland, Kennewick and Pasco, WA. There appears to be no complication in implementing this technique for allocations in any local urban area providing the concepts are correctly evaluated and applied.

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A Study of the Allocation of Transportation Resources Through The Evaluation of the Effectiveness of Transportation Services

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In Cooperation with U.S. Department of Transportation
Federal Highway Administration

The contents of this report reflect the views of the authors who are responsible for the facts and the accuracy of the data presented herein. The contents do not necessarily reflect the official views or policies of the State of Washington, Department of Transportation. This report does not constitute a standard, specification, or regulation.

The population and employment forecasts for this study were estimated prior to the WPPSS 1 and 4 shut downs in 1982. However, the techniques suggested for the allocation process are still valid and applicable.

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A STUDY OF THE ALLOCATION OF TRANSPORTATION RESOURCES

I. Introduction

The objective of this study is to develop an effective transportation resource allocation technique that is flexible and can be applied to various areas. Basic to this objective is the need to develop and test procedures for determining the relative effectiveness of transportation service proposals as input to an area's transportation resource allocation decision process in the advance planning stages.

The study describes procedures developed for this purpose and applies these techniques to an identified test area. In addition to developing procedures it describes the results of an application of these techniques to the Tri-Cities Area of Richland, Kennewick and Pasco, Washington. Eight transportation proposals including public transit were considered and evaluated for relative benefits in terms of their effective contribution to community transportation goals. The Tri-Cities area was selected for the pilot study because most of the technical data needed were available from secondary sources.

This study does not distinguish between the allocation of funds for maintenance or capital outlays in the evaluation process, but is concerned only with competing transportation services within a region. Nor does it attempt to formulate procedures for adjusting funding to achieve maximum federal matching dollars.

In undertaking the study two reports were developed. The first report contains the development of the resource allocation technique and its application in the Tri-Cities area. Procedures were developed and applied that measured the effectiveness of candidate transportation service proposals. The extent to which a transportation proposal achieves the community objectives is defined as its effectiveness.

The second report contains background data covering the economic characteristics of the area, with forecasts to the year 2000 for population and employment. These were developed for the study before the 1982 changes occurred in the area's level of employment. However, these data served the purpose of the study for the development of the evaluation technique. A fiscal review was made of the funds available and expenditures on roads, streets and bridges for the period 1972 through 1979 for background information.

II. Summary

The evaluation process in this report is flexible, thereby allowing it to be responsive to changing community goals. The process considered the constantly changing physical, environmental and socio-economic conditions of a community. A list of 19 determinants that affect transportation proposals were used and screened for appropriate application to the particular area. Only those determinants that contribute to meeting the goals were used in the evaluation process. It seems clear that these would vary by community. The extent to which the determinants meet the transportation goals determines their weight in the scoring process. Each transportation proposal

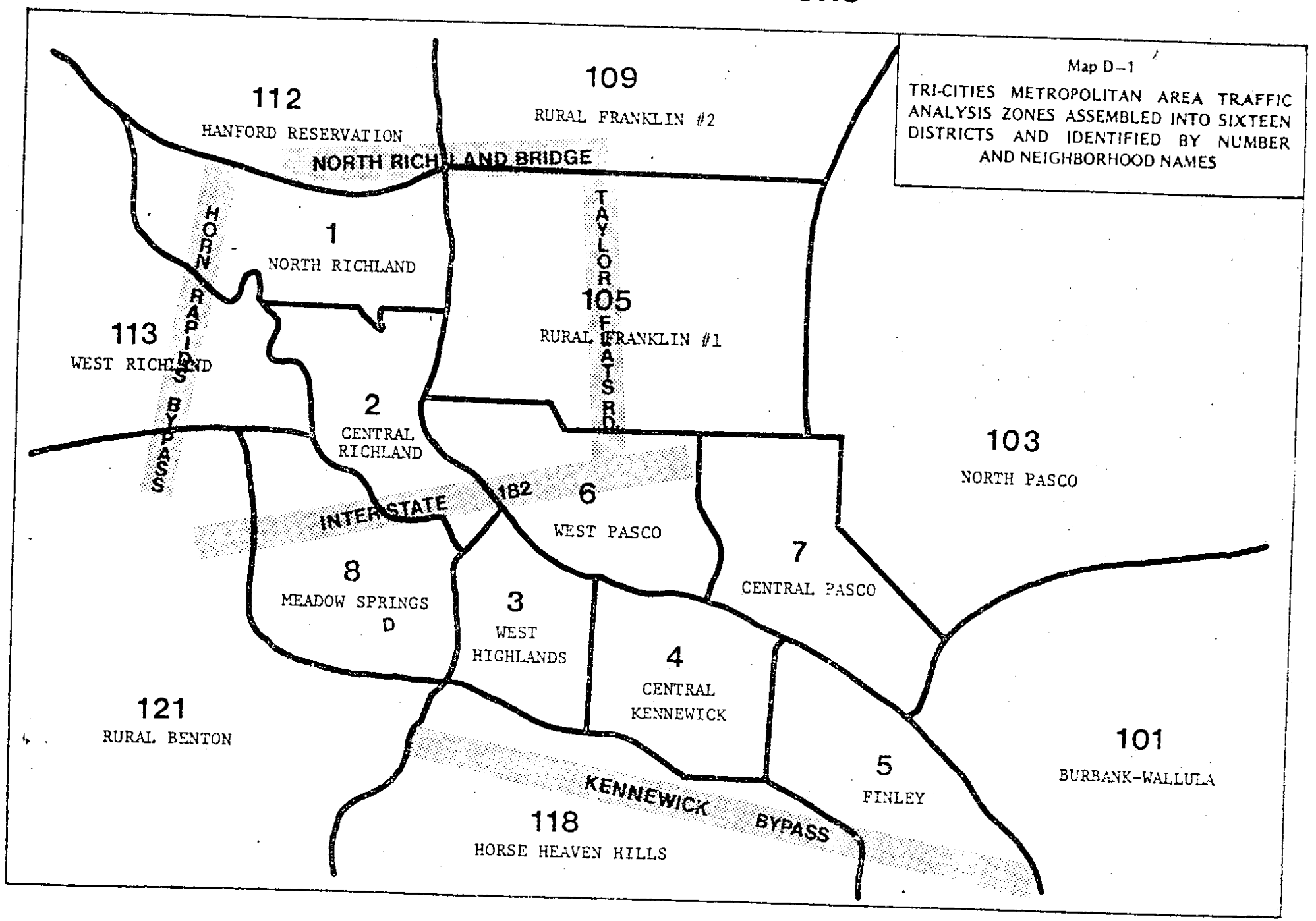
was rated using criteria established for the evaluation process and a Transportation Resource Allocation Index (TRAI) was computed for each proposal. The TRAI is a value that can be used with other considerations for the allocation of transportation resources.

The results of applying the technique to eight selected transportation proposals (Map D-1) within the study area resulted in the following allocation indices:

Transportation Resource Allocation Index

Proposal	Index	
Kennewick Bypass	21	(low end of scale)
I-182	83	(high end of scale)
North Richland Bridge	72	(without toll)
North Richland Bridge	63	(with toll)
Horn Rapids Road	60	(to SR 12)
Taylor Flats Road	55	(without bridge toll)
Taylor Flats Road	48	(with bridge toll)
Public Transit	46	(area system)

PROPOSAL CORRIDORS



III. Framework and Techniques for Evaluating the Effectiveness of Transportation Service Proposals

1. General Approach

This process of evaluating transportation proposals for the allocation of resources should occur in the advance planning stages. To be effective it should have certain quantifiable and non-quantifiable criteria. The process should consider social and economic determinants in relation to community goals.

It has been common in the past to evaluate the efficiency of transportation proposals with such things as sufficiency ratings and cost-benefit analysis. The consideration of the effectiveness, i.e., the degree to which goals and objectives are obtained, has been less common for evaluating the allocating of resources to transportation proposals. This study uses an effectiveness analysis approach. It is capable of being applied to virtually any set of transportation proposals.

Analyses of major indicators of transportation demand to the year 2000 in the study area were made using worker home to work trips, trip time, household to shopping center trips and the percent of truck trips. Matrix tables were then developed by area districts. The base road system for year 2000 included the 1980 network of roads plus Interstate 82, Interstate 182 and the North Richland Bridge. Various proposals were evaluated with and without these facilities in place.

Most of the technical data needed for this study were available in DOT files (North Richland Bridge Feasibility Study including population and employment forecasts, the gravity flow model, corridor vehicle counts, etc.). This information base and the inplace models were used to compute such needed measurements as worker home to work site travel need, trip time between and levels of congestion over sectors of the area's transportation system.

Although these data are for the study area, it is believed that similar data could be developed for other urban areas where the technique could be applied.

2. Selection of Transportation Determinants and Establishing Weights

- Selection of Determinants

A preliminary list of determinants was drawn up by the study team that could be used in evaluating transportation proposals. A basic assumption was made at this point that an environmental assessment and possibly a benefit/cost study would be completed later in the project development process for any transportation proposal. For this reason some of the determinants were not considered significant for this initial or advance planning stage of the process and were not used in the study. It was decided, however, to include most of them on the list of determinants so they could be used if it was felt necessary. This preliminary listing and screening resulted in 19 determinants.

- Establishing Weights

A matrix form was devised where each of the 19 determinants could be considered in relation to each transportation goal of the study area (Exhibit A). The goals used on the matrix are from the "Tri-Cities Metropolitan Area Transportation Study". Matching up the 19 determinants with the 11 transportation goals required a subjective rating process. It was decided therefore to use a version of the "delphi" technique among the study team members. Five people familiar with the study process independently rated the determinants in relation to the goals on a scale of 1 - 10.

The five ratings were totaled and averaged for each determinant. The deviation from the average for each determinant was first used to select which ones to use in the proposal evaluation. Any determinant with a score that exceeded the average was selected for use in the transportation evaluation process. This process reduced the 19 determinants to 8 for this study (Exhibit B).

The sum of the plus deviations were then converted to a base of 100 for the determinants weights (Exhibit B, column 2). These weights indicate the importance of the 8 selected determinants in relation to the 11 goals and were used as a constant for each transportation proposal.

IMPORTANCE OF DETERMINANTS IN RELATION TO COMMUNITY GOALS

(SCORE ON A SCALE OF 1 - 10)

TRANSPORTATION GOALS FOR THE TRI-CITIES URBANIZED AREA Goals are broad long range "continuous" policy statements which are supported and obtained through the implementation of short range objectives. The following goals are based on comprehensive plans published by the various jurisdictions which are involved in the Tri-Cities Metropolitan Area Transportation Study planning process:	DETERMINANT	Employee Home/ Work Trip Need 1	Reduction in Congestion 2	Household to Shopping Center Trips 3	Land Removed from Active Use (In acres) 4	Value of Land Lost 5	Land Opened for Development Per Land Use Plan 6	Net Tax Revenues 7	Impact on Environment 8	Cargo Flow Needs 9	Development of Intermodal Transit 10	Impact on Area's Economy 11	Fuel Consumed 12	Construction Cost per Mile 13	Maintenance Cost per Mile 14	User Travel Costs 15	Benefit/Cost Ratio 16	Substitutability Between Services 17	Potential for Service to be Directly Supportive of Any Other 18	Fit of Service Into Area Transportation Plan 19
A. Support the desired local, regional and state social, economic and land use policies																				
B. Provide maximized mobility on a regional scale for citizens within Tri-MATS																				
C. Distribute public transportation costs and benefits as equitably as possible																				
D. Maximize the efficiency of the existing public transportation system																				
E. Make the public transportation system responsive to the public																				
F. Maintain and protect the economic base of the existing adjacent agricultural areas																				
G. Maintain a high level of air quality																				
H. Encourage industrial development through the economical and efficient movement of goods and people																				
I. Avoid urban sprawl by controlling land use development through the use of a regional transportation network																				
J. Provide safe, secure and efficient travel of people and goods throughout the area																				
K. Fuel conservation																				
TOTAL																				

EXHIBIT B

COMPUTATION OF DETERMINANT WEIGHTS
USING DELPHI TECHNIQUE RESULTS

	DETERMINANT	Delphi Results	Average Deviation	Correlative Weights
1.	Employee Home/Work Trip Need	280	+101	17.5
2.	Reduction in Congestion	277	+98	17.0
3.	Household to Shopping Center Trips	269	+90	15.6
4.	Land Removed from Active Use (In acres)	88	-91	
5.	Value of Land Lost	102	-77	
6.	Land Opened for Development Per Land Use Plan	222	+43	7.5
7.	Net Tax Revenues	147	-32	
8.	Impact on Environment	152	-27	
9.	Cargo Flow Needs	234	+55	9.6
10.	Development of Intermodal Transit	221	+42	7.3
11.	Impact on Area's Economy	263	+84	14.6
12.	Fuel Consumed	163	-16	
13.	Construction Cost per Mile	80	-99	
14.	Maintenance Cost per Mile	87	-92	
15.	Reduction in User Travel Costs	242	+63	10.9
16.	Benefit/Cost Ratio	129	-50	
17.	Substitutability Between Services	133	-46	
18.	Potential for Service to be Directly Supportive of Any Other	133	-46	
19.	Fit of Service into Area Transportation Plan	-	-	-
	TOTAL	$\bar{X} = \frac{3222}{18} = 179$	+=576	100.0

The eight determinants selected are underlined and their weights indicated in Column 3, Exhibit B. These eight weighted determinants proved to be adequate in the Study Area for evaluating the effectiveness of transportation proposals in relation to the allocation of resources. It should be noted that this process could arrive at different determinants and weights in other communities where the goals are different.

3. Proposal Scoring

For the purpose of transportation resource allocation decisions the relative effectiveness of each proposed transportation service can be expressed by an index which is obtained by scoring each of the determinants, multiplying that score by each applicable weight, totaling the resultants and dividing by the hypothetical total had each determinant been scored as 100 (Exhibit C).

Using Exhibit C as a score sheet, each determinant was scored on a range of 1-100 as described in Section 4. The determinant scores were entered in the second column of the Scoring Form, multiplied by the indicated weight and the result entered in column 3 after which the weighted resultants were totaled. Moving the decimal place two places left produced a Transportation Resource Allocation Index for each transportation service under consideration. For example, had a transportation proposal scoring totaled 8,400 (Column 3 of Exhibit C), its TRAI (Transportation Resource Allocation Index) would have been 84.

The TRAI measures the relative effectiveness of each candidate transportation proposal. However, there can be modifying influences or constraints that should be considered in the planning process that could change the results. Although the process provides a measure of relative effectiveness, it does not necessarily indicate what should be done, but rather, provides support to the decision-making process in the advance planning stages.

In essence, these TRAI comparisons reflect the effective response of each proposal to the area's transportation needs and its likely contribution to the area's economic well being. While the indices are not the only items to be considered in resource allocation, their measures of relative effectiveness can assist in the selection process between proposals containing similar political and financial concerns.

A summary of the scoring for each proposal is on Table 1. The detailed scoring procedure is described in Section 4.

Transportation Service Proposal

EXHIBIT C

COMPUTATION OF TRANSPORTATION SERVICE EFFECTIVENESS SCORE

	DETERMINANT	DETERMINANT IMPORTANCE WEIGHT		*PROPOSAL SCORE 1-100	PROPOSAL WEIGHTED SCORE
1.	Employee Home/Work Trip Need	17.5	x	____	____
2.	Reduction in Congestion	17.0	x	____	____
3.	Household to Shopping Center Trips	15.6	x	____	____
4.	Land Removed from Active Use (In Acres)		x	____	____
5.	Value of Land Lost		x	____	____
6.	Land Opened for Development Per Land Use Plan	7.5	x	____	____
7.	Net Tax Revenues		x	____	____
8.	Impact on Environment		x	____	____
9.	Cargo Flow Needs	9.6	x	____	____
10.	Development of Intermodal Transit	7.3	x	____	____
11.	Impact on Area's Economy	14.6	x	____	____
12.	Fuel Consumed		x	____	____
13.	Construction Cost per Mile		x	____	____
14.	Maintenance Cost per Mile		x	____	____
15.	Reduction in User Travel Costs	10.9	x	____	____
16.	Benefit/Cost Ratio		x	____	____
17.	Substitutability Between Services		x	____	____
18.	Potential for Service to be Directly Supportive of Any Other		x	____	____
19.	Fit of Service into Area Transportation Plan		x	____	____
	TOTAL	100.0			

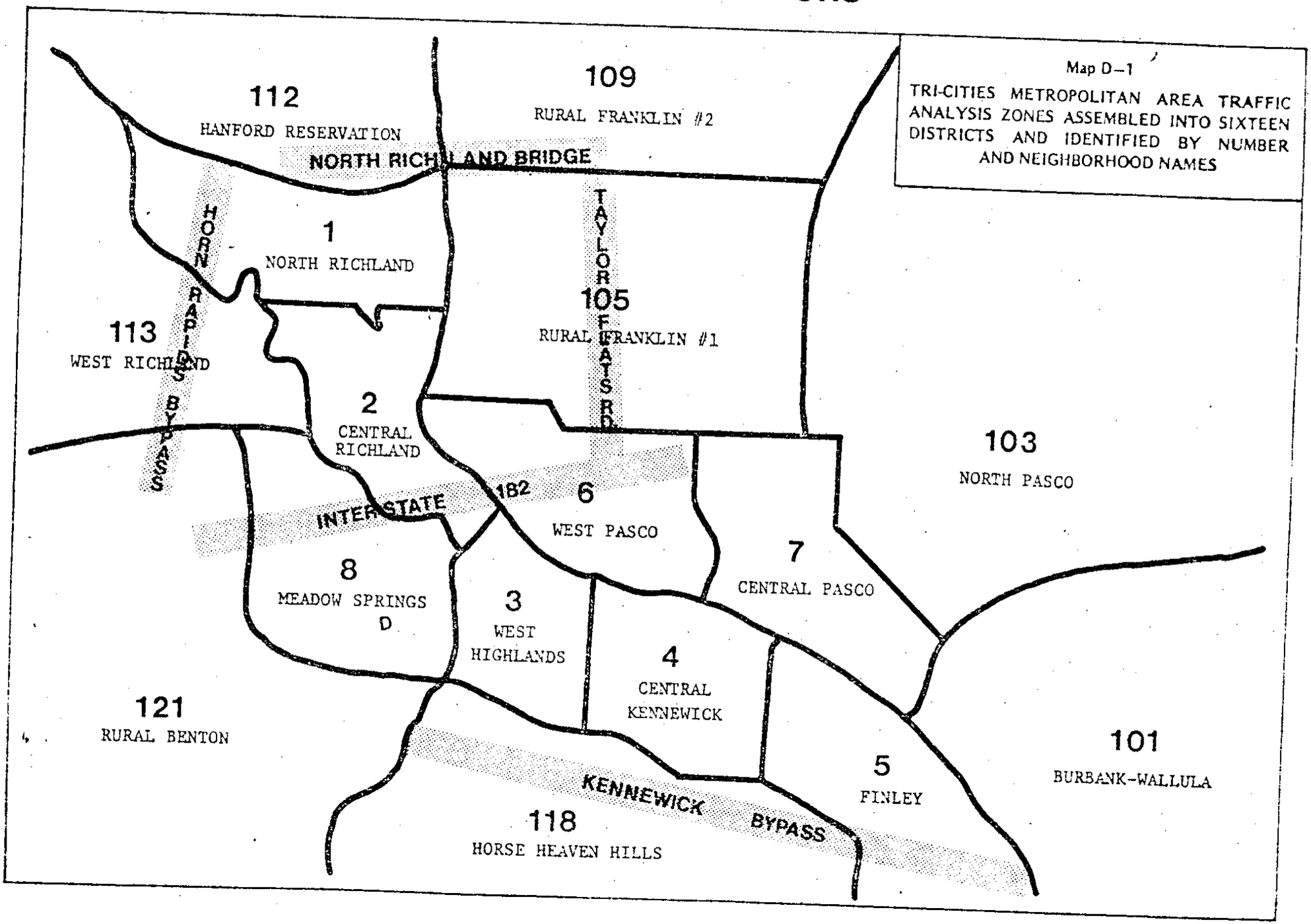
Note: $\frac{\text{Weighted Score}}{100}$ = Transportation Resource Allocation Index

*Compared to Benchmark Score of 100

TRANSPORTATION RESOURCE ALLOCATION INDEX

Determinant	PROPOSAL AND WEIGHTED SCORE							
	I-82	N.R. Bridge Without Toll	N.R. Bridge With Toll	Horn Rapid By-Pass	Taylor Flats Road		Public Transit	Kennewick By-Pass
					Without Toll on N.R. Bridge	With Toll On N.R. Bridge		
Employee Home/Work Trip Need	1,698	1,855	1,575	1,295	2,153	1,820	595	228
Reduction in Congestion	1,904	1,989	1,700	1,462	2,108	1,785	646	238
Household to Shopping Center Trips	1,123	94	78	1,248	16	16	1,560	16
Land Opened for Development	600	600	510	600	263	225	75	375
Cargo Flow Needs	720	192	163	19	0	0	0	144
Development of Intermodal Transit	694	584	621	402	438	475	730	365
Impacts on Area's Economy	1,241	1,095	920	1,022	511	438	730	730
Reduction in User Travel Costs	283	828	709	0	11	11	218	22
Total Score	8,263	7,237	6,276	6,048	5,500	4,770	4,554	2,118
Transportation Resource Allocation Index	83	72	63	60	55	48	46	21

PROPOSAL CORRIDORS



4. Suggested Procedure for Scoring

The scoring procedures decribed in this section apply to the eight weighted determinants underlined on Exhibit C. The suggested scoring for the other determinants is explained in Appendix A. Exhibit C is used as the proposal scoring form.

Description and Weight of Determinant

Employee Home/Work Trip Needs

Weight = 17.5

Using the study area district map with the Transportation Service routing superimposed identify the districts which would be served by the proposed Transportation Service, i.e.: 101 to 5; 101 to 7; 101 to 112; 101 to 2, etc. Do the same for worker flows in the opposite direction; 5 to 101; 7 to 101; 112 to 101, etc.

Using Table F3 accumulate the percentage total of all home to work trips between each set of identified districts.

For a transit proposal it is estimated that work trips inside an SMSA are 3.5 percent of total work trips within the districts served by transit.

Preliminary tests indicated that an accumulated percentage score of 10 percent would probably be in the high range. Therefore the value of 10 has been entered as the benchmark for Determinant #1 representing a score of 100. All candidate transportation service proposals will be scored on that basis. It does not matter if a higher accumulated total shows up as more proposals are scored. It only means that the highest scoring candidate could have a score of say 110 rather than 100.

Enter the result on the scoring form (Exhibit C, page 14) in the proposal score column and multiply by the 17.5 weight for the weighted score. For Interstate 182 the weighted score was: 17.5 x 97 = 1698.

YEAR 2000 PERCENT OF WORKER TRIPS BETWEEN DISTRICT OF RESIDENCE AND DISTRICT OF WORK

Table F3

District of Residence / District of Work	1	2	3	4	5	6	7	8	101	103	105	109	112	113	118	121		
1	3.341	0.975	0.200	0.155	0.073	0.010	0.253	0.034	0.015	0.009	0.018	0.010	2.190	1.867	0.006	0.017		
2	4.370	4.404	1.176	0.710	0.204	0.036	0.990	0.122	0.041	0.023	0.058	0.028	3.491	2.168	0.018	0.053		
3	0.830	1.145	3.038	1.800	0.231	0.043	0.904	0.075	0.024	0.016	0.038	0.013	0.688	0.606	0.043	0.036		
4	1.267	1.075	2.158	7.972	1.390	0.148	3.753	0.075	0.088	0.059	0.112	0.038	1.121	0.989	0.170	0.049		
5	0.135	0.077	0.073	0.370	0.944	0.016	0.545	0.006	0.017	0.008	0.015	0.006	0.125	0.106	0.005	0.004		
6	0.518	0.336	0.262	0.865	0.283	0.404	3.674	0.018	0.107	0.072	0.223	0.065	0.459	0.401	0.009	0.013		
7	0.391	0.305	0.271	1.137	0.409	0.202	8.773	0.019	0.180	0.113	0.174	0.030	0.355	0.298	0.013	0.005		
8	0.567	0.630	0.680	0.370	0.088	0.015	0.289	0.084	0.012	0.005	0.016	0.008	0.454	0.595	0.010	0.047		
101	0.043	0.027	0.016	0.063	0.027	0.011	0.560	0.001	0.154	0.019	0.017	0.005	0.040	0.035	0.002	0.001		
103	0.007	0.005	0.003	0.010	0.003	0.003	0.086	0	0.004	0.003	0.003	0	0.007	0.005	0	0		
105	0.104	0.056	0.030	0.080	0.005	0.034	0.474	0.005	0.019	0.010	0.124	0.025	0.091	0.080	0.001	0.003		
109	0.012	0.003	0.003	0.007	0.004	0.003	0.026	0	0.001	0.001	0.006	0.020	0.009	0.008	0.001	0		
112	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—		
113	1.60	0.183	0.183	0.163	0.078	0.014	0.273	0.104	0.015	0.010	0.020	0.010	1.025	6.412	0.007	0.054		
118	0.270	0.235	0.235	0.551	0.142	0.012	0.264	0.014	0.009	0.007	0.013	0.007	0.246	0.212	0.090	0.011		
121	0.160	0.103	0.103	0.078	0.029	0.002	0.070	0.027	0.003	0.002	0.009	0.003	0.139	0.195	0.003	0.020		
Total Percent	13.615	10.560	8.431	14.331	3.902	0.953	20.834	0.509	0.659	0.357	0.846	0.268	10.440	13.977	0.445	0.312	100.00	

Description and Weight of Determinant	Suggested Procedure for Scoring
Reduction in Congestion Weight = 17.0	Using the same district identifications developed in Determinant #1 but substituting Table F2, accumulate the number of employee home to work trips likely to be using a candidate transportation service or routing. The number of transit trips are estimated to be 3.5 percent of total work-trips for each district served by transit Preliminary tests indicated that 10,000 trips would probably be in the high range and this has been selected as the benchmark representing a score of 100. All candidate proposals will be scored on that basis. Any total over 10,000 trips would be represented by a score of more than 100. Enter the result on the proposal scoring form for determinant #2.
Household to Shopping Center Trips Weight = 15.6	Using Table S1 and the district boundary map with the candidate transportation service superimposed, identify the sets of districts likely to be served by the routing, i.e.; 2 to 113; 2 to 3; 2 to 4; 2 to 7, etc. (16 districts but only six shopping center districts.) Using Table S1 which contains the percent shares of total home to shopping center trips as computed by the specially developed gravity flow model for shopping centers, accumulate the percent share of trips between each of the 16 household districts and each of the six likely to be served by that routing or transportation service. It is estimated that transit would serve 10 percent of these shopping trips for each district served by transit. Ten percent could be a high range and will be used as a benchmark for a score of 100.

YEAR 2000 WORKER TRIPS BETWEEN DISTRICT OF RESIDENCE AND DISTRICT OF WORK

Table F2

District of Residence / Dest. Org.	District of Work 1	2	3	4	5	6	7	8	101	103	105	109	112	113	118	121	Total	
1	3846	1123	220	178	84	12	291	39	17	10	21	11	2521	2149	7	20	10,549	
2	5030	5069	1354	813	235	41	1024	140	47	27	67	32	4028	2495	21	61	20,484	
3	955	1318	3496	2071	266	50	1040	86	28	18	44	15	792	697	49	41	10,966	
4	1458	1237	2484	9175	1600	170	4319	86	101	68	129	44	1300	1138	196	55	23560	
5	156	89	84	425	1087	18	627	7	19	9	17	7	144	122	6	5	2822	
6	596	387	302	995	326	465	4229	21	123	83	257	75	528	461	10	15	8873	
7	450	351	312	1309	471	232	10,097	22	207	130	200	35	409	343	15	6	14589	
8	653	725	782	425	101	17	333	97	14	6	18	9	523	685	12	54	4,454	
101	50	31	18	73	31	13	645	1	177	22	20	6	46	40	2	1	1176	
103	8	6	3	12	4	3	99	0	5	4	4	0	8	6	0	0	162	
105	120	64	34	91	52	39	546	6	22	12	143	29	105	92	1	3	1359	
109	14	3	3	8	5	4	30	0	1	1	7	23	10	9	1	0	119	
112	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
113	1840	827	211	188	90	16	314	120	17	11	23	11	1,180	7,380	8	62	12,298	
118	310	185	271	634	164	14	304	16	10	8	15	8	283	244	104	13	2583	
121	183	132	119	90	33	2	80	31	3	2	10	3	160	225	3	23	1099	
Total	15,669	11,547	9,693	16,487	4549	1096	23978	672	791	411	975	308	12037	16,086	435	359		115,093

PERCENT OF SHOPPING TRIPS BETWEEN DISTRICT
OF RESIDENCE AND DESIGNATED SHOPPING CENTER DISTRICT

District of Residence	Shopping Center District (2) Downtown Richland	(3) Columbia Center	(4) Downtown Kennewick	(6) Rural Franklin	(7) Downtown Pasco	(113) West Richland
1	2.50	1.54	.26	.48	.20	1.88
2	5.65	4.21	.64	1.22	.46	8.35
3	1.10	.91	.18	.31	.14	1.15
4	1.75	6.59	15.52	1.92	2.42	.66
5	.12	.28	.14	.11	.24	.05
6	1.04	1.19	.26	1.39	.26	.34
7	1.63	3.51	2.44	2.73	9.00	.54
8	.68	5.48	.33	.23	.16	.22
101	.13	.25	.13	.16	.29	.05
103	.06	.02	.06	.01	.02	.01
105	.05	.07	.03	.06	.03	.03
109	.01	.01	.01	.01	.01	.01
112	0	0	0	0	0	0
113	2.07	1.80	.30	.56	.24	0
118	.10	.28	.23	.09	.74	.05
121	.07	.23	.05	.03	.02	0
TOTAL	16.89	26.38	20.52	9.32	13.56	13.33

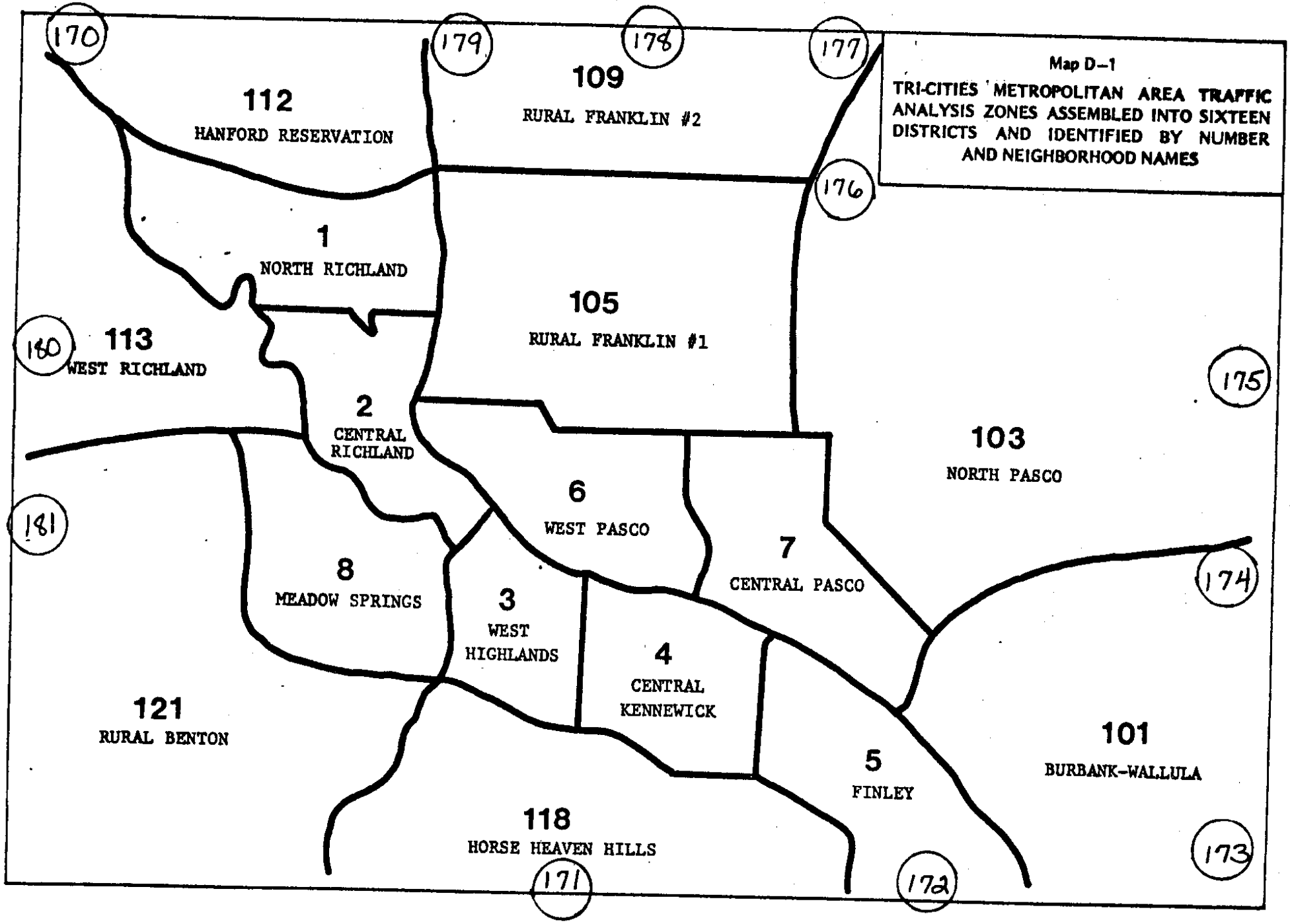
Description and Weight of Determinant	Suggested Procedure for Scoring
(Continued)	Enter the result on the proposal scoring form for determinant #3.
Land Opened for Development Per Land Use Plan Weight = 7.5	a) If believed "some" land will be opened for development, the percentage score can range between 1-49%. b) If believed "considerable" land will be opened for development, the percentage score can range between 50-74%. c) If believed "extensive" land will be opened for development, the percentage score can range between 75-100%.
Cargo Flow Needs Weight = 9.6	Using the District boundary map showing the project route superimposed, identify the districts affected by the proposed service. From Table CF1, accumulate the percentage of truck flows (trips) likely to be attracted by each candidate transportation service and divide by total trips. These are truck trips from selected "external points" to districts inside the Metropolitan Area. The external points are indicated on the map on page 25. Preliminary tests indicate that a accumulated percentage of 20 percent would be in the high range and the benchmark for a score of 100. As in the other determinants, any higher accumulated score would mean that that candidate project would carry a scoring higher than 100.

Table CF1

TRUCK TRIPS SUMMARY
(From Outside to Inside and Inside to Outside)

From → / To ↓	170	171	172	173	174	175	176	177	178	179	180	181						
1	8.58*	3.85*		5.64*	42.20		12.73	20.58			8.91	2.65*						
2	32.18	30.71		18.48*	20.98	3.61*	33.50	25.41	2.57*		24.64	34.57						
3	6.79*	(22.78)			6.69*			3.13*				6.82						
4	12.79	90.92	12.52*	18.96*	23.93		80.53	(8.12)			9.46	82.23						
5	2.25*											5.23*						
6	(4.40)	14.46				15.82	15.79	(6.38)	(4.98)	(3.10)		(7.62)						
7	44.03	171.86	23.50	70.34*	80.77	32.96	304.81	98.80	27.28	10.65*	15.58	141.61						
8							15.66					14.69						
101		10.49*	167.60*	89.64*	52.54	15.52*	101.34	3.13*										
103						16.16*	2.68*					(7.74)						
105							22.28	18.46*	8.63*	4.65*								
109						(12.63)	36.31	56.64	10.77 (13.63)			28.69						
112				6.98*			12.29			3.00*								
113				6.38*			(10.07)	5.66 (2.06)			3.37*	2.65*						
118		31.28	2.65*	12.68*	3.82*		5.79											
121							9.35*		5.04*									
Total	89.00	339.23	23.50	230.32	48.78		641.03	207.09	38.05		58.59	308.61	= 2716.91					

*Inside to Outside
( ) Outside to Inside



Map D–1

TRI-CITIES METROPOLITAN AREA TRAFFIC ANALYSIS ZONES ASSEMBLED INTO SIXTEEN DISTRICTS AND IDENTIFIED BY NUMBER AND NEIGHBORHOOD NAMES

Description and Weight of Determinant	Suggested Procedure for Scoring
Development of Intermodal Transit Weight = 7.3	Score 51-100 if there seems to be some potential for which the proposal contributes. Score 50 if little prospects even with projects in place. Score 1-49 if proposal detracts from area prospects for this.
Impact on Area's Economy Weight = 14.6	The analyst will judge how relevant the proposed transportation service is to the economy of the area; i.e.: a) If judged "some" the percentage score can range from 1-49 percent. b) If believed "considerable", the percentage score can range between 50-74 percent. c) If judged "critical", the percentage score can range between 75-100 percent.
Reduction in User Travel Costs Weight = 10.9	The time savings will be used for this determinent. The URS Company who conducted the North Richland Bridge Feasibility study used an average value per trip cost of 28.7 cents per minute. These figures will be used for this determinent as an indication of user travel costs. A savings of $50,000 will be considered as 100. For the transit proposal the difference between the 1980 economic cost per person for a 5 mile trip will be used*. The number of transit trips determined in No. 2 can be used. Automobile $3.87 Bus -1.35 $2.52 x no. of trips * Highway users Federation, Technical Study Memorandum No. 13, July 1975.

3/S&E14

5. Computation of Transportation Service Effectiveness Score

The eight tables in this section illustrate the scoring procedure and results for each transportation service proposal used for the pilot study within the study area.

Transportation Service Proposal

Interstate 182

TABLE R2

COMPUTATION OF TRANSPORTATION SERVICE EFFECTIVENESS SCORE

	DETERMINANT	DETERMINANT IMPORTANCE WEIGHT		*PROPOSAL SCORE 1-100	PROPOSAL WEIGHTED SCORE
1.	Employee Home/Work Trip Need	17.5	x	97	1698
2.	Reduction in Congestion	17.0	x	112	1904
3.	Household to Shopping Center Trips	15.6	x	72	1123
4.	Land Removed from Active Use (In Acres)		x	____	____
5.	Value of Land Lost		x	____	____
6.	Land Opened for Development Per Land Use Plan	7.5	x	80	600
7.	Net Tax Revenues		x	____	____
8.	Impact on Environment		x	____	____
9.	Cargo Flow Needs	9.6	x	75	720
10.	Development of Intermodal Transit	7.3	x	95	694
11.	Impact on Area's Economy	14.6	x	85	1241
12.	Fuel Consumed		x	____	____
13.	Construction Cost per Mile		x	____	____
14.	Maintenance Cost per Mile		x	____	____
15.	Reduction in User Travel Costs	10.9	x	26	283
16.	Benefit/Cost Ratio		x	____	____
17.	Substitutability Between Services		x	____	____
18.	Potential for Service to be Directly Supportive of Any Other		x	____	____
19.	Fit of Service into Area Transportation Plan		x	____	____
	TOTAL	100.0			8263

Note: $\frac{\text{Weighted Score}}{100}$ = Transportation Resource Allocation Index = 83

*Compared to Benchmark Score of 100

North Richland
Bridge Without Toll

TABLE R3

COMPUTATION OF TRANSPORTATION SERVICE EFFECTIVENESS SCORE

	DETERMINANT	DETERMINANT IMPORTANCE WEIGHT		*PROPOSAL SCORE 1-100	PROPOSAL WEIGHTED SCORE
1.	Employee Home/Work Trip Need	17.5	x	106	1855
2.	Reduction in Congestion	17.0	x	117	1989
3.	Household to Shopping Center Trips	15.6	x	6	94
4.	Land Removed from Active Use (In Acres)		x	____	____
5.	Value of Land Lost		x	____	____
6.	Land Opened for Development Per Land Use Plan	7.5	x	80	600
7.	Net Tax Revenues		x	____	____
8.	Impact on Environment		x	____	____
9.	Cargo Flow Needs	9.6	x	20	192
10.	Development of Intermodal Transit	7.3	x	80	584
11.	Impact on Area's Economy	14.6	x	75	1095
12.	Fuel Consumed		x	____	____
13.	Construction Cost per Mile		x	____	____
14.	Maintenance Cost per Mile		x	____	____
15.	Reduction in User Travel Costs	10.9	x	76	828
16.	Benefit/Cost Ratio		x	____	____
17.	Substitutability Between Services		x	____	____
18.	Potential for Service to be Directly Supportive of Any Other		x	____	____
19.	Fit of Service into Area Transportation Plan		x	____	____
	TOTAL	100.0			7237

Note: $\frac{\text{Weighted Score}}{100}$ = Transportation Resource Allocation Index = 72

*Compared to Benchmark Score of 100

North Richland
Bridge With Toll

TABLE R4

COMPUTATION OF TRANSPORTATION SERVICE EFFECTIVENESS SCORE

	DETERMINANT	DETERMINANT IMPORTANCE WEIGHT		*PROPOSAL SCORE 1-100	PROPOSAL WEIGHTED SCORE
1.	Employee Home/Work Trip Need	17.5	x	90	1575
2.	Reduction in Congestion	17.0	x	100	1700
3.	Household to Shopping Center Trips	15.6	x	5	78
4.	Land Removed from Active Use (In Acres)		x	____	____
5.	Value of Land Lost		x	____	____
6.	Land Opened for Development Per Land Use Plan	7.5	x	68	510
7.	Net Tax Revenues		x	____	____
8.	Impact on Environment		x	____	____
9.	Cargo Flow Needs	9.6	x	17	163
10.	Development of Intermodal Transit	7.3	x	85	621
11.	Impact on Area's Economy	14.6	x	63	920
12.	Fuel Consumed		x	____	____
13.	Construction Cost per Mile		x	____	____
14.	Maintenance Cost per Mile		x	____	____
15.	Reduction in User Travel Costs	10.9	x	65	709
16.	Benefit/Cost Ratio		x	____	____
17.	Substitutability Between Services		x	____	____
18.	Potential for Service to be Directly Supportive of Any Other		x	____	____
19.	Fit of Service into Area Transportation Plan		x	____	____
	TOTAL	100.0			6276

Note: $\frac{\text{Weighted Score}}{100}$ = Transportation Resource Allocation Index = 63

*Compared to Benchmark Score of 100

Horn Rapid
By-pass to SR 12

TABLE 5

COMPUTATION OF TRANSPORTATION SERVICE EFFECTIVENESS SCORE

	DETERMINANT	DETERMINANT IMPORTANCE WEIGHT		*PROPOSAL SCORE 1-100	PROPOSAL WEIGHTED SCORE
1.	Employee Home/Work Trip Need	17.5	x	74	1295
2.	Reduction in Congestion	17.0	x	86	1462
3.	Household to Shopping Center Trips	15.6	x	80	1248
4.	Land Removed from Active Use (In Acres)		x	____	____
5.	Value of Land Lost		x	____	____
6.	Land Opened for Development Per Land Use Plan	7.5	x	80	600
7.	Net Tax Revenues		x	____	____
8.	Impact on Environment		x	____	____
9.	Cargo Flow Needs	9.6	x	2	19
10.	Development of Intermodal Transit	7.3	x	55	402
11.	Impact on Area's Economy	14.6	x	70	1022
12.	Fuel Consumed		x	____	____
13.	Construction Cost per Mile		x	____	____
14.	Maintenance Cost per Mile		x	____	____
15.	Reduction in User Travel Costs	10.9	x	0	0
16.	Benefit/Cost Ratio		x	____	____
17.	Substitutability Between Services		x	____	____
18.	Potential for Service to be Directly Supportive of Any Other		x	____	____
19.	Fit of Service into Area Transportation Plan		x	____	____
	TOTAL	100.0			6048

Note: $\frac{\text{Weighted Score}}{100}$ = Transportation Resource Allocation Index = 60

*Compared to Benchmark Score of 100

Taylor Flats Road Improvement
Without Toll on
N. Richland Bridge

TABLE R6

COMPUTATION OF TRANSPORTATION SERVICE EFFECTIVENESS SCORE

	DETERMINANT	DETERMINANT IMPORTANCE WEIGHT		*PROPOSAL SCORE 1-100	PROPOSAL WEIGHTED SCORE
1.	Employee Home/Work Trip Need	17.5	x	123	2153
2.	Reduction in Congestion	17.0	x	124	2108
3.	Household to Shopping Center Trips	15.6	x	1	16
4.	Land Removed from Active Use (In Acres)		x	____	____
5.	Value of Land Lost		x	____	____
6.	Land Opened for Development Per Land Use Plan	7.5	x	35	263
7.	Net Tax Revenues		x	____	____
8.	Impact on Environment		x	____	____
9.	Cargo Flow Needs	9.6	x	0	0
10.	Development of Intermodal Transit	7.3	x	60	438
11.	Impact on Area's Economy	14.6	x	35	511
12.	Fuel Consumed		x	____	____
13.	Construction Cost per Mile		x	____	____
14.	Maintenance Cost per Mile		x	____	____
15.	Reduction in User Travel Costs	10.9	x	1	11
16.	Benefit/Cost Ratio		x	____	____
17.	Substitutability Between Services		x	____	____
18.	Potential for Service to be Directly Supportive of Any Other		x	____	____
19.	Fit of Service into Area Transportation Plan		x	____	____
	TOTAL	100.0			5500

Note: $\frac{\text{Weighted Score}}{100}$ = Transportation Resource Allocation Index = 55

*Compared to Benchmark Score of 100

Taylor Flats Road Improvement
With Toll on
N. Richland Bridge

TABLE R-7

COMPUTATION OF TRANSPORTATION SERVICE EFFECTIVENESS SCORE

	DETERMINANT	DETERMINANT IMPORTANCE WEIGHT		*PROPOSAL SCORE 1-100	PROPOSAL WEIGHTED SCORE
1.	Employee Home/Work Trip Need	17.5	x	104	1820
2.	Reduction in Congestion	17.0	x	105	1785
3.	Household to Shopping Center Trips	15.6	x	1	16
4.	Land Removed from Active Use (In Acres)		x	____	____
5.	Value of Land Lost		x	____	____
6.	Land Opened for Development Per Land Use Plan	7.5	x	30	225
7.	Net Tax Revenues		x	____	____
8.	Impact on Environment		x	____	____
9.	Cargo Flow Needs	9.6	x	0	0
10.	Development of Intermodal Transit	7.3	x	65	475
11.	Impact on Area's Economy	14.6	x	30	438
12.	Fuel Consumed		x	____	____
13.	Construction Cost per Mile		x	____	____
14.	Maintenance Cost per Mile		x	____	____
15.	Reduction in User Travel Costs	10.9	x	1	11
16.	Benefit/Cost Ratio		x	____	____
17.	Substitutability Between Services		x	____	____
18.	Potential for Service to be Directly Supportive of Any Other		x	____	____
19.	Fit of Service into Area Transportation Plan		x	____	____
	TOTAL	100.0			4770

Note: $\frac{\text{Weighted Score}}{100}$ = Transportation Resource Allocation Index = 48

*Compared to Benchmark Score of 100

Transportation
Service Proposal:
Public Transit

TABLE R8

COMPUTATION OF TRANSPORTATION SERVICE EFFECTIVENESS SCORE

	DETERMINANT	DETERMINANT IMPORTANCE WEIGHT		*PROPOSAL SCORE 1-100	PROPOSAL WEIGHTED SCORE
1.	Employee Home/Work Trip Need	17.5	x	34	595
2.	Reduction in Congestion	17.0	x	38	646
3.	Household to Shopping Center Trips	15.6	x	100	1560
4.	Land Removed from Active Use (In Acres)		x	____	____
5.	Value of Land Lost		x	____	____
6.	Land Opened for Development Per Land Use Plan	7.5	x	10	75
7.	Net Tax Revenues		x	____	____
8.	Impact on Environment		x	____	____
9.	Cargo Flow Needs	9.6	x	0	0
10.	Development of Intermodal Transit	7.3	x	100	730
11.	Impact on Area's Economy	14.6	x	50	730
12.	Fuel Consumed		x	____	____
13.	Construction Cost per Mile		x	____	____
14.	Maintenance Cost per Mile		x	____	____
15.	Reduction in User Travel Costs	10.9	x	20	218
16.	Benefit/Cost Ratio		x	____	____
17.	Substitutability Between Services		x	____	____
18.	Potential for Service to be Directly Supportive of Any Other		x	____	____
19.	Fit of Service into Area Transportation Plan		x	____	____
	TOTAL	100.0			4554

Note: $\frac{\text{Weighted Score}}{100}$ = Transportation Resource Allocation Index = 46

*Compared to Benchmark Score of 100

Transportation
Service Proposal:
Kennewick Bypass

TABLE R9

COMPUTATION OF TRANSPORTATION SERVICE EFFECTIVENESS SCORE

	DETERMINANT	DETERMINANT IMPORTANCE WEIGHT		*PROPOSAL SCORE 1-100	PROPOSAL WEIGHTED SCORE
1.	Employee Home/Work Trip Need	17.5	x	13	228
2.	Reduction in Congestion	17.0	x	14	238
3.	Household to Shopping Center Trips	15.6	x	1	16
4.	Land Removed from Active Use (In Acres)		x	____	____
5.	Value of Land Lost		x	____	____
6.	Land Opened for Development Per Land Use Plan	7.5	x	50	375
7.	Net Tax Revenues		x	____	____
8.	Impact on Environment		x	____	____
9.	Cargo Flow Needs	9.6	x	15	144
10.	Development of Intermodal Transit	7.3	x	50	365
11.	Impact on Area's Economy	14.6	x	50	730
12.	Fuel Consumed		x	____	____
13.	Construction Cost per Mile		x	____	____
14.	Maintenance Cost per Mile		x	____	____
15.	Reduction in User Travel Costs	10.9	x	2	22
16.	Benefit/Cost Ratio		x	____	____
17.	Substitutability Between Services		x	____	____
18.	Potential for Service to be Directly Supportive of Any Other		x	____	____
19.	Fit of Service into Area Transportation Plan		x	____	____
	TOTAL	100.0			2118

Note: $\frac{\text{Weighted Score}}{100}$ = Transportation Resource Allocation Index = 21

*Compared to Benchmark Score of 100

APPENDICES

APPENDIX A

Analysis of Major Indicators of Transportation Demand By Area

APPENDIX A

Major Indicators of Transportation Demand By Area

Table of Contents

List of Tables and Maps

List of Tables and Maps (cont.)

MAJOR INDICATORS OF TRANSPORTATION DEMAND BY AREA

A. Introduction

There is no clear-cut, totally equitable or simple method for allocating resources to individual transportation proposals. In this era of limited funds it is important that the most effective proposals be implemented in a way that will benefit as many people as possible.

A major part in the implementation of the evaluation process is the development, measurement and assessment of various criteria used to establish a scoring of proposals in the allocation process. These selection criteria reflect how the proposal satisfies certain determinants related to the transportation proposal and how it meets the overall community goals. The availability of this process will assist in making more orderly decisions that can be justified on the basis of specific decision criteria.

The implementation of this method for comparison of transportation proposal effectiveness therefore, could be one consideration in an area's transportation resource allocation decision process. Effectiveness could be expected to be a major contributor to any allocation plan. The process of transportation service effectiveness determination described in the study should be carried out by a professional analyst with continuing input from local contributors and authorities.

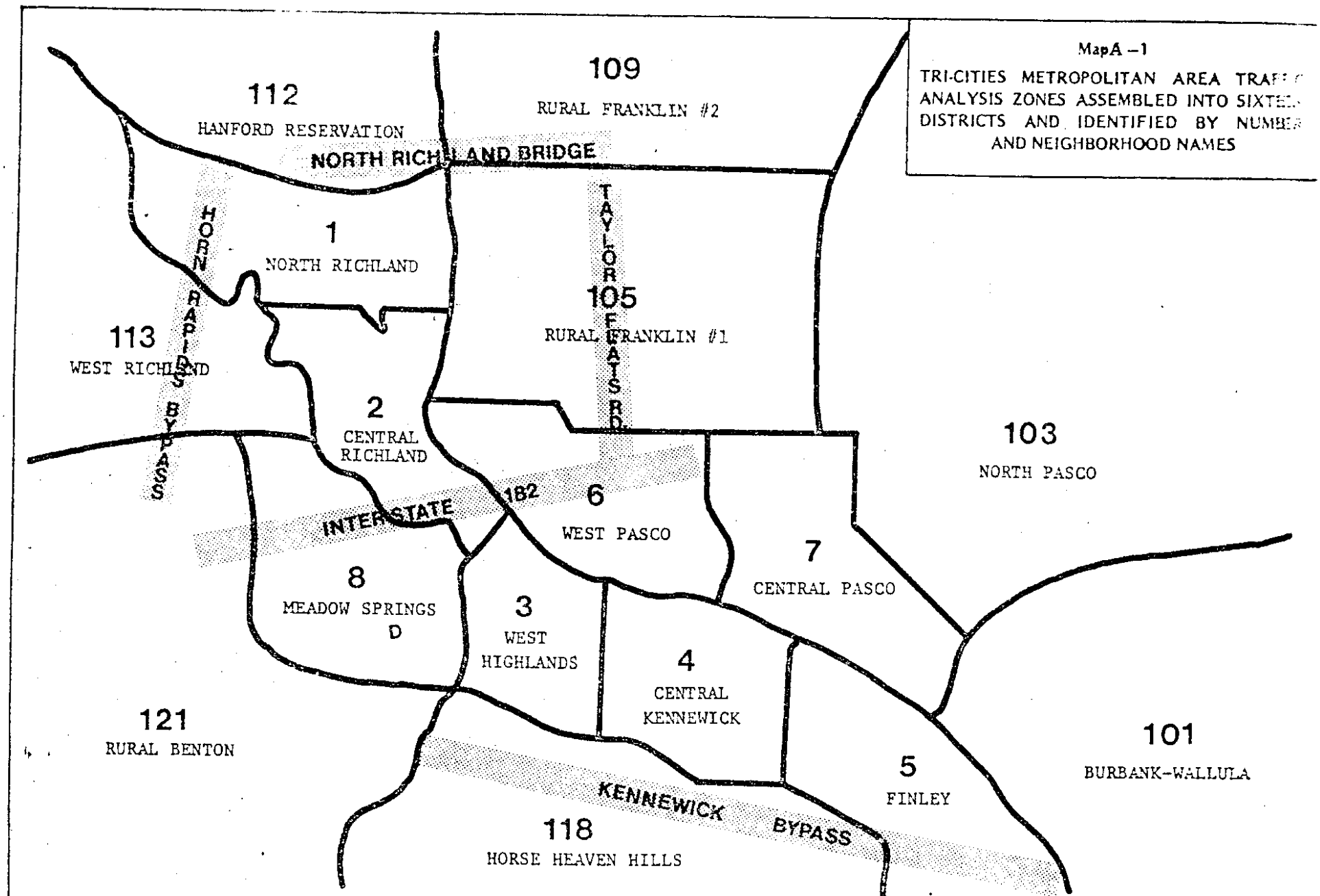
B. Analysis of Major Indicators of Transportation Demand in Area

1. Worker Home to Work Site Trips

For this study the assumption is made that worker home/work district trip estimates are acceptable indicators of the need for transportation systems capability between the 16 identified districts. That they are not the only measure of need does not lessen their usefulness. They represent peak transportation flows which if accommodated produces a transportation system which can effectively meet most of the area's transportation demands. Off peak trips such as shopping, visiting, school attendance, and recreation trips contribute to overall vehicle traffic, but their timing may be such that they will not add to corridor congestion and consequent trip time. Trip time and traffic congestion are further indicators of transportation facility demand and are inputs to the Transportation Resource Allocation Index determination process. Map A1 on the following pages identify study area districts by number and neighborhood name and the proposal corridors.

Worker 1980 travel patterns (trips) between home and work districts are shown in Table F1. This matrix of 256 separate cells was produced by the application of a DOT "gravity flow model" to the population and the employment data along with the distances and road system between each district. From these data the model calculated how many work trips there would be between each set of district residents traveling from home to job site. While these data are yearly averages the table expresses them as daily flows between home to work and back.

PROPOSAL CORRIDORS



WORKER TRIPS BETWEEN DISTRICT OF RESIDENCE AND DISTRICT OF WORK
1980

District of Residence / District of Work

Dest. / Org.	1	2	3	4	5	6	7	8	101	103	105	109	112	113	118	121	Total Round Trips	Percent
1	706	193	43	31	15	5	53	10	3	1	6	2	890	19	1	7	1,985	2.82
2	3429	4358	974	648	215	51	958	162	52	19	86	46	5797	252	25	71	17,143	24.39
3	509	760	2224	1484	204	46	853	88	27	17	43	21	924	47	43	48	7,338	10.44
4	891	904	1742	7693	1443	166	4078	118	106	65	170	65	1791	68	190	72	19,562	27.83
5	83	61	56	308	857	14	513	7	15	6	23	12	169	6	7	3	2,140	3.04
6	185	161	133	503	155	283	2310	12	72	39	177	52	372	15	7	11	4,487	6.38
7	193	191	170	792	311	155	7146	14	155	83	184	48	398	14	8	12	9,874	14.05
8	266	366	418	235	59	9	208	79	8	3	19	5	448	39	10	32	2,204	3.13
101	27	19	13	53	23	13	509	1	153	18	23	6	53	2	1	—	914	1.30
103	5	4	2	10	4	1	84	—	5	4	3	2	9	1	—	—	134	.19
105	30	25	10	32	21	19	227	2	9	4	87	20	63	3	2	—	554	.79
109	4	4	1	1	1	4	15	—	2	1	7	17	8	1	—	—	66	.09
112	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
113	392	319	81	61	30	7	110	69	7	2	11	7	661	157	3	25	1,942	2.76
118	141	106	128	426	122	13	228	15	11	5	19	7	293	10	82	9	1,615	2.30
121	52	44	31	26	10	—	30	20	2	1	5	1	99	15	1	14	351	.49
Total	6,913	7,515	6,026	12,303	3,470	786	17,322	597	627	268	863	311	11,975	649	380	304	70,309	100.00

Table F1

Districts of origin (residence) are identified in the stub column on the left of the table while districts of work site (destination) are identified in the top row across the table. Some worker trips stay within their district of residence. The "gravity flow model" assumes that resident home to work travel is a function of the number of persons residing within a district and the employment counts within each work district along with the distance between each of the 16 districts and the road system between them.

Since the Hanford Reservation (District #112) has the highest count of workers, it would be expected to generate the largest number of home to work site trips but it does not. That the Hanford Reservation 1980 trip count of 11,975 ranks third behind Central Pasco with 17,322 and Central Kennewick with 12,303 is understandably due to constraints in the model. It is explainable on the basis that the Departments gravity flow model is only able to consider and calculate home/work trips for persons residing in one of the 16 districts. This may not be a serious shortcoming in the worker home to work site trip analysis since most of this outside travel is to the Hanford Reservation and does not generally impact the Study Area's congested road corridors. Workers traveling from the Yakima, Prosser, Benton City areas, for example, reach the Hanford Site without adding to the usual travel congestion through Richland. A few of these non-area-resident workers probably travel to such work centers as Central Pasco, Central Kennewick and others but their impact on total traffic flow is probably minimal.

Other substantial home to work trip generators are: Central Richland with 7,515, North Richland with 6,913, West Highlands with 6,026, and Finley with 3,170. The remaining nine districts are generating home/work trips considerably below these levels ranging from 304 for District Rural Benton to 863 for District Rural Franklin.

Whereas Table F1 presented a preliminary measure of worker transportation needs in 1980. Table F2 presents comparable information for the year 2000. This later count includes new residents moving in and choosing to locate in a particular district and the increased work force traveling to their District of work over the highway routing expected to be operative by that date (I-82, and I-182) with its Columbia River Bridges at the Y area.

While the 1980 and 2000 series are nót directly comparable, each represents potential worker trip patterns for that period as based on the population/employment data and road systems put into the model and the assumptions by which the model operates.

The purpose of these counts of worker 1980 "home to work trips" in Table F1 was to provide familiarity with trip flow patterns and generally explore the capability of the gravity flow model in representing area's current transportation patterns. The ultimate purpose of the year 2000 forecasts of home to work trips (Table F2) is to serve as a mechanism for determining the percent of all home to work travel likely to be susceptable to potential use of a proposed transportation resource allocation project. In effect the more worker

trips likely to be served by a proposal, the higher that determinant's scoring will be. Table F3 presents Table F2 matrix cell counts in terms of percent share of total worker home/work site travel.

Year 2000 was chosen for this scoring determination since it represents work trip patterns based on foreseeable employment and population with most transportation systems in place and operating. Worker trips counts between districts remain the same no matter what candidate project is being scored, but trip time will probably change with each alternative project.

YEAR 2000 WORKER TRIPS BETWEEN DISTRICT OF RESIDENCE AND DISTRICT OF WORK

Table F2

District of Residence / Dest. Org.	District of Work 1	2	3	4	5	6	7	8	101	103	105	109	112	113	118	121	Total
1	3846	1123	420	178	84	12	291	39	17	10	21	11	2521	2149	7	80	10,549
2	5030	5069	1354	813	235	41	1024	140	47	27	67	32	4028	2495	21	61	20,484
3	955	1318	3496	2071	266	50	1040	86	28	18	44	15	792	697	49	41	10,966
4	1458	1237	2484	9175	1600	170	4319	86	101	68	129	44	1300	1138	196	55	23560
5	156	89	84	425	1087	18	627	7	19	9	17	7	144	122	6	5	2822
6	596	387	302	995	326	465	4229	21	123	83	257	75	528	461	10	15	8873
7	450	351	312	1309	471	232	10,097	22	207	130	200	35	409	343	15	6	14589
8	653	725	782	425	101	17	333	97	14	6	18	9	523	685	12	54	4,454
101	50	31	18	73	31	13	645	1	177	22	20	6	46	40	2	1	1176
103	8	6	3	12	4	3	99	0	5	4	4	0	8	6	0	0	162
105	120	64	34	91	52	39	546	6	22	12	143	29	105	92	1	3	1359
109	14	3	3	8	5	4	30	0	1	1	7	23	10	9	1	0	119
112	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
113	1840	827	211	188	90	16	314	120	17	11	23	11	1,180	7,380	8	62	12,298
118	310	185	271	634	164	14	304	16	10	8	15	8	283	244	104	13	2583
121	183	132	119	90	33	2	80	31	3	2	10	3	160	225	3	23	1099
Total	15669	11547	9693	16487	4549	1096	23978	672	791	411	975	308	12037	16086	435	359	115093

YEAR 2000 PERCENT OF WORKER TRIPS BETWEEN DISTRICT OF RESIDENCE AND DISTRICT OF WORK

Table F3

District of Residence \ District of Work	1	2	3	4	5	6	7	8	101	103	105	109	112	113	118	121		
1	3.341	0.975	0.200	0.155	0.073	0.010	0.253	0.034	0.015	0.009	0.018	0.010	2.190	1.867	0.006	0.017		
2	4.370	4.404	1.176	0.710	0.204	0.036	0.890	0.122	0.041	0.023	0.058	0.028	3.491	2.168	0.018	0.053		
3	0.830	1.145	3.038	1.800	0.231	0.043	0.904	0.075	0.024	0.016	0.038	0.013	0.688	0.606	0.043	0.036		
4	1.267	1.075	2.158	7.972	1.390	0.148	3.753	0.075	0.088	0.059	0.112	0.038	1.121	0.989	0.170	0.048		
5	0.135	0.077	0.073	0.370	0.944	0.016	0.545	0.006	0.017	0.008	0.015	0.006	0.125	0.106	0.005	0.004		
6	0.518	0.336	0.263	0.865	0.283	0.404	3.674	0.018	0.107	0.072	0.223	0.065	0.459	0.401	0.009	0.013		
7	0.391	0.305	0.271	1.137	0.409	0.202	8.773	0.019	0.180	0.113	0.174	0.030	0.355	0.298	0.013	0.005		
8	0.567	0.630	0.680	0.370	0.088	0.015	0.289	0.084	0.012	0.005	0.016	0.008	0.454	0.595	0.010	0.047		
101	0.043	0.027	0.016	0.063	0.027	0.011	0.560	0.001	0.154	0.019	0.017	0.005	0.040	0.035	0.002	0.001		
103	0.007	0.005	0.003	0.010	0.003	0.003	0.086	0	0.004	0.003	0.003	0	0.007	0.005	0	0		
105	0.104	0.056	0.030	0.080	0.005	0.034	0.474	0.005	0.019	0.010	0.124	0.025	0.091	0.080	0.001	0.003		
109	0.012	0.003	0.003	0.007	0.004	0.003	0.026	0	0.001	0.001	0.006	0.020	0.009	0.008	0.001	0		
112	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—		
113	1.60	0.183	0.183	0.163	0.078	0.014	0.273	0.104	0.015	0.010	0.020	0.010	1.025	6.412	0.007	0.054		
118	0.270	0.235	0.235	0.551	0.142	0.012	0.264	0.014	0.009	0.007	0.013	0.007	0.246	0.212	0.090	0.011		
121	0.160	0.103	0.103	0.078	0.029	0.002	0.070	0.027	0.003	0.002	0.009	0.003	0.139	0.195	0.003	0.020		
Total Percent	13.615	11.546	8.431	14.331	3.902	0.953	20.834	0.509	0.669	0.357	0.846	0.268	10.440	13.977	0.445	0.312	100.00	

2. Corridor Flow and Congestion

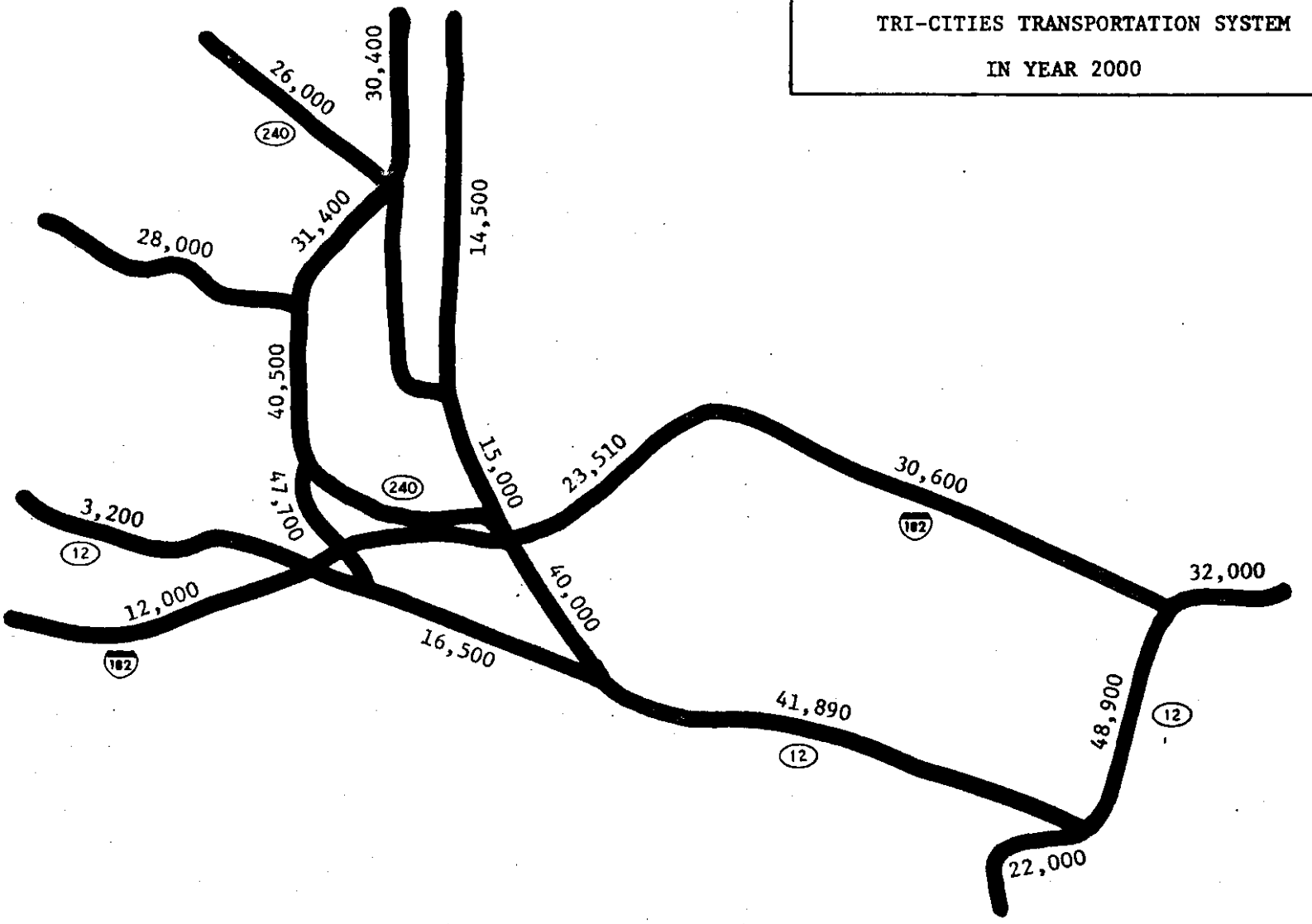
Map A2 on the following page shows the general pattern of year 2000 vehicle flows over major corridors between Pasco and the Hanford Area via the Blue Bridge, Highway #12, Columbia Center Junction, Causeway, 250 Junction, Richland Bypass, Van Giesen Intersection and Richland City Center. While the data shown on the map are not themselves input to Determinant #2 scoring, they provide the framework for estimating how much congestion might be alleviated by the implementation of a proposed transportation service. The extent to which potential congestion is likely to be lessened is a function of the number of work trips which could be attracted from these busy corridors flows to the new routing. This procedure is described in detail in Appendix B under Determinant #2 narrative. The greater the number of trips moving over a proposed service route and away from congested corridors the higher the relative determinant scoring for that proposed transportation service.

Map A-2

COMPUTED TYPICAL VEHICLE FLOWS ON

TRI-CITIES TRANSPORTATION SYSTEM

IN YEAR 2000



3. Household to Shopping Center Trips

In the early planning stages, it was assumed that home to work trips would be the major measure of travel flow between districts. Such a handy assumption proved to be only partially true and even that needs modification. This modicication is required in order to give more credit to transportation service proposals which respond effectively to BOTH worker and shopping trips even though they may not occur at the same time with resulting congestion.

In pilot tests of the scoring technique, the relatively high hypothetical score of the North Richland Bridge proposal resulted from largely worker travel only whereas that facility contributed little to household to shopping center travel. (Unless significantly large shopping areas are developed in West Richland and Rural Franklin County, a likely prospect.)

To offset this emphasis on work trips, some consideration of household/shopping center trips had to be put into the determination process. However, current DOT models do not generate such statistics. As an alternative, therefore, Table S1 presents the results of a specially designed gravity flow model which estimates year 2000 household trips to shopping center in terms of relative percent share of each set of districts. The assumption is made that six major shopping centers are operative; Downtown Pasco, Downtown Kennewick, Columbia Center Mall Area, Downtown Richland, Rural Franklin County, and West Richland. The model further assumes that the relative attractiveness

of any retail complex including the Shan-Na Pum Site (and therefore trip generator) is a function of the relative weight we have assigned to each of those six districts. Computations are made for each of the 16 residence districts whose population is a relative indicator of number of households likely to be attracted to each of the six shopping centers. The table shows these trips between the six shopping centers and the 16 districts in terms of percent of total. As in the case of the worker trips, the greater the potential percent share of household to shopping center trips over the proposed transportation service the higher its determinant score (Determinant #3).

The format developed for this calculation of household trips to shopping center is a modified variation of a gravity flow model in which the six candidate shopping center districts were assigned the relative attraction ratios shown within the parentheses -(1.5), -(2), -(1.5), -(1), -(1), and -(3) (to a base of 10) and these multiplied by resident population of each district. This resultant was divided by the square of the travel time between each set of residence and shopping districts and equated with the total of all district populations.

It would have been preferable to have used total shopping trips but lacking this the assumption was made that populations were a representative of relative district households and that each household in every district would make one shopping trip a day.

Table S1

PERCENT OF SHOPPING TRIPS BETWEEN DISTRICT
OF RESIDENCE AND DESIGNATED SHOPPING CENTER DISTRICT

District of Residence	Shopping Center District (2) Downtown Richland	(3) Columbia Center	(4) Downtown Kennewick	(6) Rural Franklin	(7) Downtown Pasco	(113) West Richland
1	2.50	1.54	.26	.48	.20	1.88
2	5.65	4.21	.64	1.22	.46	8.35
3	1.10	.91	.18	.31	.14	1.15
4	1.75	6.59	15.52	1.92	2.42	.66
5	.12	.28	.14	.11	.24	.05
6	1.04	1.19	.26	1.39	.26	.34
7	1.63	3.51	2.44	2.73	9.00	.54
8	.68	5.48	.33	.23	.16	.22
101	.13	.25	.13	.16	.29	.05
103	.06	.02	.06	.01	.02	.01
105	.05	.07	.03	.06	.03	.03
109	.01	.01	.01	.01	.01	.01
112	0	0	0	0	0	0
113	2.07	1.80	.30	.56	.24	0
118	.10	.28	.23	.09	.74	.05
121	.07	.23	.05	.03	.02	0
TOTAL	16.89	26.38	20.52	9.32	13.56	13.33

4. Worker Trip Time

As workers home to work trip flows provided a general measure of worker's transportation need, trip time between home and work districts is a further reflection of transportation need. Table tt80 presents trip times between districts based on 1980 travel routes. Table tt20 presents trip time between these same districts with foreseeable facilities in place (I-82, and I-182, with the Columbia River Bridge). The two serve as a basis for comparing worker trip times for the years 1980 and 2000. More importantly, however, the 2000 trip time series provides a base for estimating how much time could be saved by each proposed transportation service. The stub of each table identifies the districts being traveled from while the column headings identify the district they are traveling to.

Trip time calculations were developed by means of a DOT model which considered the distance betwen districts, and corridor routes available for worker travel from home to work.

WORKER TRIP TIME BETWEEN DISTRICT OF RESIDENCE AND DISTRICT OF WORK 1980

Table 1180

District of Residence

District of Work

Dest. / Org.	1	2	3	4	5	6	7	8	101	103	105	109	112	113	118	121		
1	0.0	7.9	7.2	23.0	32.7	33.4	22.3	18.1	28.1	28.1	42.3	41.0	6.9	13.1	29.6	24.8		
2	7.9	0.0	10.9	20.5	30.2	31.0	19.9	15.6	25.7	25.7	39.9	38.5	10.8	9.9	27.1	22.4		
3	7.2	10.9	0.0	28.0	37.7	38.4	27.3	23.1	33.1	33.1	47.4	46.0	7.5	16.1	34.6	29.8		
4	23.0	20.5	28.0	0.0	15.7	21.0	9.9	14.7	15.7	15.7	30.0	28.6	27.9	27.0	9.8	17.7		
5	32.7	30.2	37.7	15.7	0.0	30.7	18.1	26.3	22.4	22.4	39.7	37.7	37.6	36.7	21.8	31.4		
6	33.4	31.0	38.4	21.0	30.7	0.0	16.4	27.0	22.2	22.2	23.7	30.0	38.3	37.4	27.8	32.7		
7	22.3	19.9	27.3	9.9	18.1	16.4	0.0	15.9	9.7	9.7	24.8	22.5	27.3	26.4	16.8	21.6		
8	18.1	15.6	23.1	14.7	26.3	27.0	15.9	0.0	21.7	21.7	35.9	34.6	23.0	22.1	20.7	10.3		
101	28.1	25.7	33.1	15.7	22.4	22.2	9.7	21.7	0.0	5.8	27.7	25.4	33.1	32.2	22.6	27.4		
103	28.1	25.7	33.1	15.7	22.4	22.2	9.7	21.7	5.8	0.0	27.7	25.4	33.1	32.2	22.6	27.4		
105	42.3	39.9	47.4	30.0	39.7	23.7	24.8	35.9	27.7	27.7	0.0	10.4	47.3	46.4	36.8	41.6		
109	41.0	38.5	46.0	28.6	37.7	30.0	22.5	34.5	25.4	25.4	10.4	0.0	45.9	45.0	35.4	40.2		
112	6.9	10.8	7.5	27.9	37.6	38.3	27.3	23.0	33.1	33.1	47.3	45.9	0.0	16.0	34.5	29.7		
113	13.1	9.9	16.1	27.0	36.7	37.4	26.4	22.1	32.2	32.2	46.4	45.0	16.0	0.0	33.6	28.8		
118	29.6	27.1	34.6	9.8	21.8	27.8	16.8	20.7	22.6	22.6	36.8	35.4	34.5	33.6	0.0	22.1		
121	24.8	22.4	29.8	17.7	31.4	32.7	21.6	10.3	27.4	27.4	41.6	40.2	29.7	28.8	22.1	0.0		

YEAR 2000 WORK TRIP TIME BETWEEN DISTRICT OF RESIDENCE AND DISTRICT OF WORK

District of Residence

District of Work

Dest. / Org.	1	2	3	4	5	6	7	8	101	103	105	109	112	113	118	121		
1	0.0	7.9	7.2	23.0	28.7	19.7	20.0	19.9	25.7	25.8	29.2	35.4	6.9	9.1	29.5	24.8		
2	7.9	0.0	10.9	20.5	26.2	17.3	17.6	14.7	23.2	23.3	26.7	33.0	10.8	5.9	27.1	21.5		
3	7.2	10.9	0.0	28.0	33.7	24.7	25.0	22.2	30.7	30.8	34.2	40.4	7.5	12.1	34.5	28.9		
4	23.0	20.5	28.0	0.0	11.8	20.8	10.0	14.7	15.7	15.8	25.9	28.9	27.9	23.0	9.8	16.5		
5	28.7	26.2	33.7	11.8	0.0	26.5	14.1	22.3	18.4	18.5	31.6	33.9	33.6	28.7	17.8	26.5		
6	19.7	17.3	24.7	20.8	26.5	0.0	15.4	18.6	21.1	21.1	23.7	30.0	24.6	19.7	27.4	25.4		
7	20.0	17.6	25.0	10.0	14.1	15.4	0.0	16.0	9.7	9.8	20.5	22.8	25.0	20.1	16.6	21.4		
8	18.1	14.7	22.2	14.7	22.3	18.6	16.0	0.0	21.7	21.8	28.1	34.4	22.1	17.2	16.8	10.3		
101	25.7	23.2	30.7	15.7	18.4	21.1	9.7	21.7	0.0	7.4	26.2	25.7	30.6	25.7	22.3	27.1		
103	25.8	23.3	30.8	15.8	18.5	21.1	9.8	21.8	7.4	0.0	26.2	25.8	30.7	25.8	22.4	27.2		
105	29.2	26.7	34.2	25.9	31.6	23.7	20.5	28.1	26.2	26.2	0.0	10.4	34.1	29.2	32.5	34.9		
109	35.4	33.0	40.4	28.9	33.9	30.0	22.8	34.4	25.7	25.8	10.4	0.0	40.4	35.5	35.4	40.3		
112	6.9	10.8	7.5	27.9	33.6	24.6	25.0	22.1	30.6	30.7	34.1	40.4	0.0	12.0	34.4	28.8		
113	9.1	5.9	12.1	23.0	28.7	19.7	20.1	17.2	25.7	25.8	29.2	35.5	12.0	0.0	29.5	23.9		
118	29.5	27.1	34.5	9.8	17.8	27.4	16.6	16.8	22.3	22.4	32.5	35.4	34.4	29.5	0.0	17.4		
121	24.8	21.5	28.9	16.5	26.5	25.4	21.4	10.3	27.1	27.2	34.9	40.3	28.8	23.9	17.4	0.0		

Table 4420

5. Cargo Flows and Truck Movements

Table cf1 presents the results of a two year old truck survey for this area. It is the latest and most complete information available. The table column headings identify three external stations through which trucks pass on their way to or coming from a district. The table stub identifies the district to which the trucks are traveling to or coming from. To the extent possible these internal districts are the same as the TAZ accumulated districts. The bracketed entry in each table cell represents the count of trucks moving to an internal district that particular day. The unbracketed entries in each table cell represents the count of trucks coming from the district to the external station.

Unfortunately for this study's purpose, comparable data for truck movements between districts are not so available; i.e., truck movements from district #1 to district #112; from district #7 to district #113, etc. Arbitrarily, and on the basis of prudent judgment we assume that truck flows between external points and districts are in essence reasonable reflections of truck movements between districts. That is to imply that if transportation services are developed which best serve the cargo flows between external points and districts it follows that they are equally likely to best serve inter district flows.

These truck flow data are the basis for scoring determinant #9. Basically, the potential determinant score is a function of how much truck movement is likely to be attracted to the proposed service. While purposely hypothetical, such a measurement of potential truck flow is a

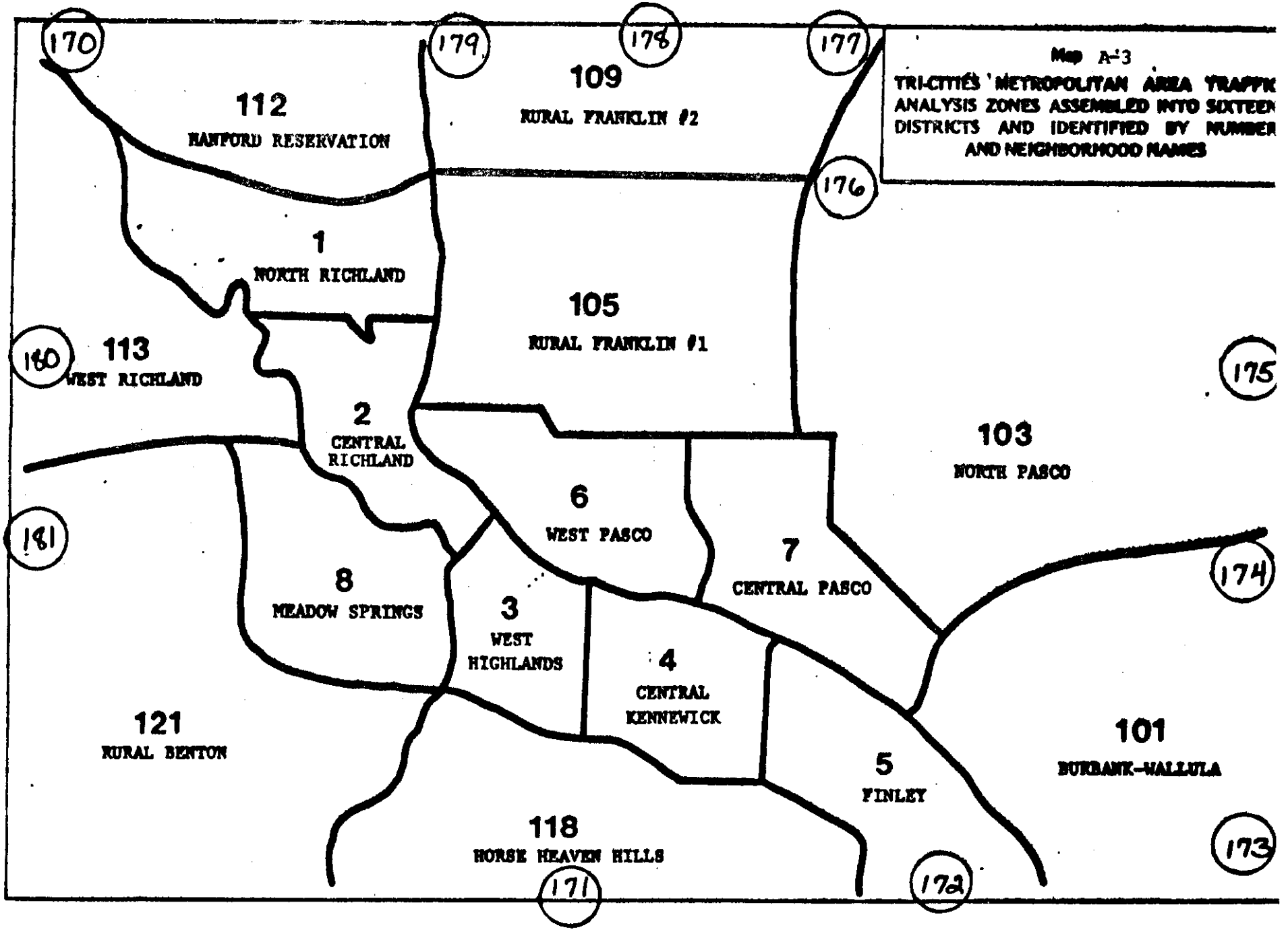
general and relative indication of the demand for transportation capability and how effectively the service responds to that demand.

TRUCK TRIPS SUMMARY
(From Outside to Inside and Inside to Outside)

From → To ↓	170	171	172	173	174	175	176	177	178	179	180	181						
1	8.58*	3.85*		5.64*	42.20		12.73	20.58			8.91	2.65*						
2	32.18	30.71		18.42*	20.88	3.61*	33.50	25.41	2.57*		24.64	34.57						
3	6.79*	(22.78)			6.69*			3.13*				6.82						
4	12.79	90.92	12.52*	18.96*	23.93		80.53	(8.12)			9.46	82.23						
5	2.25*											5.23*						
6	(9.40)	14.46				15.82	15.79	(6.38)	(4.98)	(3.10)		(7.62)						
7	44.03	171.86	23.50	70.34*	80.77	32.96	304.81	98.80	22.28	10.65*	15.58	141.61						
8							15.66					14.69						
101		10.49*	167.60*	89.14*	52.54	15.52*	101.34	3.13*										
103						16.16*	2.68*					(7.74)						
105							22.28	18.46*	8.63*	4.15*								
109						(12.63)	36.31	56.64	10.77			28.69						
112				6.98*			12.29		(13.63)	3.00*								
113				6.38*			(10.07)	5.66			3.37*	2.65*						
118		31.28	2.65*	12.68*	3.84*		5.79	(2.06)										
121							9.35*		5.04*									
Total	89.00	339.23	23.50	230.32	48.78		641.03	207.09	38.05		58.59	308.61	= 2716.91					

*Inside to Outside
( ) Outside to Inside

Table CF1


Map A-3
TRI-CITIES METROPOLITAN AREA TRAFFIC ANALYSIS ZONES ASSEMBLED INTO SIXTEEN DISTRICTS AND IDENTIFIED BY NUMBER AND NEIGHBORHOOD NAMES
112
HANFORD RESERVATION
109
RURAL FRANKLIN #2
1
NORTH RICHLAND
105
RURAL FRANKLIN #1
113
WEST RICHLAND
2
CENTRAL RICHLAND
103
NORTH PASCO
6
WEST PASCO
7
CENTRAL PASCO
8
MEADOW SPRINGS
3
WEST HIGHLANDS
4
CENTRAL KENNEWICK
121
RURAL BENTON
5
FINLEY
101
BURBANK-WALLULA
118
HORSE HEAVEN HILLS
170
179
178
177
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APPENDIX B

Procedures for Scoring Proposals

APPENDIX B

Procedures for Scoring Proposals

Table of Contents

APPENDIX B

1. Procedures for Scoring Proposals

For scoring each proposal it is necessary to use the study area district map to identify the districts that would be served by the proposed transportation service, the suggested procedure for scoring each determinant, the matrix tables referred to in the scoring procedure and the proposal scoring form, Exhibit C, page 14.

2. Description and Weight of Determinant	Suggested Procedure for Scoring
#1 Employee Home/Work Trip Needs Weight = 17.5	Using the study area district map with the Transportation Service routing superimposed identify the districts which would be served by the proposed Transportation Service, i.e.: 101 to 5; 101 to 7; 101 to 112; 101 to 2, etc. Do the same for worker flows in the opposite direction; 5 to 101; 7 to 101; 112 to 101, etc. Using Table F3 accumulate the percentage total of all home to work trips between each set of identified districts. For a transit proposal it is estimated that work trips inside an SMSA are 3.5 percent of total work trips within the districts served by transit. Preliminary tests indicated that an accumulated percentage score of 10 percent would probably be in the high range. Therefore the value of 10 has been entered as the benchmark for Determinant #1 representing a score of 100. All candidate transportation service proposals will be scored on that basis. It does not matter if a higher accumulated total shows up as more proposals are scored. It only means that the highest scoring candidate could have a score of say 110 rather than 100. Enter the result on the scoring form (Exhibit C, page 14) in the proposal score column and multiply by the 17.5 weight for the weighted score. For Interstate 182 the weighted score was: 17.5 x 97 = 1698.

Description and Weight of Determinant	Suggested Procedure for Scoring
#2 Reduction in Congestion Weight = 17.0	Using the same district identifications developed in Determinant #1 but substituting Table F2, accumulate the number of employee home to work trips likely to be using a candidate transportation service or routing. The number of transit trips are estimated to be 3.5 percent of total work-trips for each district served by transit Preliminary tests indicated that 10,000 trips would probably be in the high range and this has been selected as the benchmark representing a score of 100. All candidate proposals will be scored on that basis. Any total over 10,000 trips would be represented by a score of more than 100. Enter the result on the proposal scoring form for determinant #2.
#3 Household to Shopping Center Trips Weight = 15.6	Using Table S1 and the district boundary map with the candidate transportation service superimposed, identify the sets of districts likely to be served by the routing, i.e.; 2 to 113; 2 to 3; 2 to 4; 2 to 7, etc. (16 districts but only six shopping center districts.) Using Table S1 which contains the percent shares of total home to shopping center trips as computed by the specially developed gravity flow model for shopping centers, accumulate the percent share of trips between each of the 16 household districts and each of the six likely to be served by that routing or transportation service. It is estimated that transit would serve 10 percent of these shopping trips for each district served by transit. Ten percent could be a high range and will be used as a benchmark for a score of 100.

Description and Weight of Determinant	Suggested Procedure for Scoring
#3 (Continued)	Enter the result on the proposal scoring form for determinant #3.
#4 Land Removed from Active Use (In acres) Commercial Industrial Residential Agricultural Raw and Undeveloped	Score 51-100 if project land not in active use or undeveloped. 50 if determinant is irrelevant. Score 1-49 if some activity use other than raw land.
#5 Value of Land Lost	Score 51-100 if no lost production value (if residential use consider if alternate home sites are equally available). Score 50 if determinant irrelevant or Score 1-49 if loss of production revenue or use.
#6 Land Opened for Development Per Land Use Plan Weight = 7.5	a) If believed "some" land will be opened for development, the percentage score can range between 1-49%. b) If believed "considerable" land will be opened for development, the percentage score can range between 50-74%. c) If believed "extensive" land will be opened for development, the percentage score can range between 75-100%.
#7 Net Tax Revenue	Score 51-100 if net tax revenue is positive or irrelevant. Score 1-49 if net tax revenue negative.

Description and Weight of Determinant	Suggested Procedure for Scoring
#8 Impact on Environment	Score 51-100 if likely to improve it, i.e., air quality with less driving. Score 50 if no change or determinant irrelevant. Score 1-49 if project will detract from present quality.
#9 Cargo Flow Needs Weight = 9.6	Using the District boundary map showing the project route superimposed, identify the districts affected by the proposed service. From Table CF1, accumulate the percentage of truck flows (trips) likely to be attracted by each candidate transportation service and divide by total trips. These are truck trips from selected "external points" to districts inside the Metropolitan Area. Preliminary tests indicate that a accumulated percentage of 20 percent would be in the high range and the benchmark for a score of 100. As in the other determinants, any higher accumulated score would mean that that candidate project would carry a scoring higher than 100.
#10 Development of Intermodal Transit Weight = 7.3	Score 51-100 if there seems to be some potential for which the proposal contributes. Score 50 if little prospects even with projects in place. Score 1-49 if proposal detracts from area prospects for this.

Description and Weight of Determinant	Suggested Procedure for Scoring
#11 Impact on Area's Economy Weight = 14.6	The analyst will judge how relevant the proposed transportation service is to the economy of the area; i.e.: a) If judged "some" the percentage score can range from 1-49 percent. b) If believed "considerable", the percentage score can range between 50-74 percent. c) If judged "critical", the percentage score can range between 75-100 percent.
#12 Fuel Consumed	Recent investigations show that the gasoline consumed per unit distance in urban driving can be expressed as a linear function of the average trip time per unit distance. (Transportation Research Record 599, p. 25). Use Table with trip time and the estimated trip distance for each proposal.
#13 Construction Cost per Mile or Cost per Vehicle Mile	This item represents the total investment in capital funds needed to provide the final completed facility, as estimated by the Transportation Department. Divided by the project miles or vehicle miles.
#14 Annual Maintenance Cost Per Mile or Cost per Vehicle Mile	This item includes all costs of keeping the finished facility in good operating condition after it is built. It includes such items as physical repairs, snow removal, traffic control devices, street cleaning, mowing and landscape care. Total maintenance costs are divided by the project miles or vehicle miles.

Description and Weight of Determinant	Suggested Procedure for Scoring
#15 Reduction in User Travel Costs Weight = 10.9	The time savings will be used for this determinent. The URS Company who conducted the North Richland Bridge Feasibility study used an average value per trip cost of 28.7 cents per minute. These figures will be used for this determinent as an indication of user travel costs. A savings of $50,000 will be considered as 100. For the transit proposal the difference between the 1980 economic cost per person for a 5 mile trip will be used*. The number of transit trips determined in No. 2 can be used. Automobile $3.87 Bus -1.35 $2.52 x no. of trips * Highway users Federation, Technical Study Memorandum No. 13, July 1975.
#16 Benefit/Cost Ratio	Score 51-100 if general comparison of costs with foreseeable benefits are favorable. Score 50 if about even or determinant irrelevant. Score 1-49 if cost appears to exceed benefits (Note that this is a general observation, prior to a full scale cost benefit study).
#17 Substitutability Between Services	Again no hard numbers to go by but only judgment. 51-100 if this project could replace any other with about same result. Score 50 if substitutability irrelevant to project. Score 1-49 if project can be replaced by another.

Description and Weight of Determinant	Suggested Procedure for Scoring
#18 Potential for Service to be Directly Supportive of Any Other	Again no hard numbers, only judgments. Score 80-100 if appears to have excellent prospects for being supportive. Score 51-79 if only slightly supportive to other projects. Score 50 if determinant irrelevant to this project.
#19 Fit of Proposal Into Area Transportation Plan	Score 80-100 if already part of area plan. Score 51-79 if an indirect part of transportation plan. Score 50 if determined irrelevant to project. Score 1-49 if not a part of official area plan.

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