

**ATTITUDES CONCERNING
TWO-WAY AND ONE-WAY FRONTAGE ROADS**

Research Report 402-1

by

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**Warrants for One-Way Frontage Roads
Research Study Number 2-8-86-402**

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16. Abstract This report presents the results of an attitude survey concerning one-way and two-way freeway frontage roads. This research was part of a two-year study for developing warrants for conversion from two-way to one-way frontage roads. Interviews were conducted with 121 individuals in 15 different small and medium-sized cities in Texas. All of the 15 cities have freeways with two-way or one-way frontage roads. The results of the attitude survey showed that the increased safety associated with one-way frontage roads is universally recognized by all interest groups. Operational considerations, such as capacity, are much less understood. The survey found that city staff and city council members exhibit some views compatible with SDHPT interests. However, the results of the survey also suggest that city council members desire analyses of one-way versus two-way operation which are specific to the frontage roads in their city. On the other hand, and not unexpectedly so, the survey indicates that many persons with real estate or business interests are very "localized" in their views. Working closely with city staff and councilpersons may facilitate needed frontage road conversions to one-way.			
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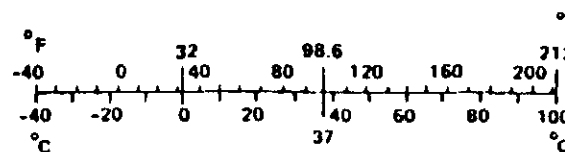
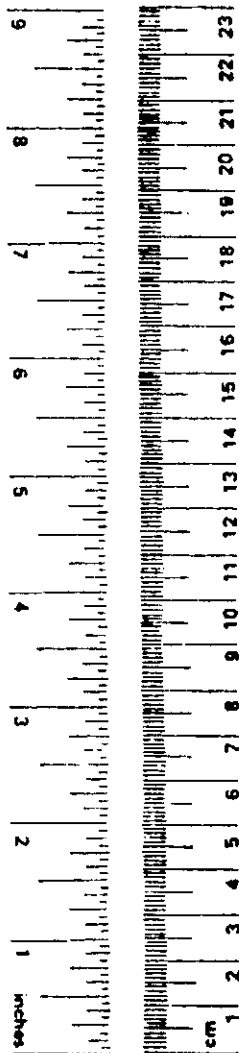
METRIC CONVERSION FACTORS

Approximate Conversions to Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
LENGTH				
in	inches	*2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
AREA				
in ²	square inches	6.5	square centimeters	cm ²
ft ²	square feet	0.09	square meters	m ²
yd ²	square yards	0.8	square meters	m ²
mi ²	square miles	2.6	square kilometers	km ²
	acres	0.4	hectares	ha
MASS (weight)				
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2000 lb)	0.9	tonnes	t
VOLUME				
tsp	teaspoons	5	milliliters	ml
Tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	l
pt	pints	0.47	liters	l
qt	quarts	0.95	liters	l
gal	gallons	3.8	liters	l
ft ³	cubic feet	0.03	cubic meters	m ³
yd ³	cubic yards	0.76	cubic meters	m ³
TEMPERATURE (exact)				
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

Approximate Conversions from Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
LENGTH				
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi
AREA				
cm ²	square centimeters	0.16	square inches	in ²
m ²	square meters	1.2	square yards	yd ²
km ²	square kilometers	0.4	square miles	mi ²
ha	hectares (10,000 m ²)	2.5	acres	
MASS (weight)				
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	tonnes (1000 kg)	1.1	short tons	
VOLUME				
ml	milliliters	0.03	fluid ounces	fl oz
l	liters	2.1	pints	pt
l	liters	1.06	quarts	qt
l	liters	0.26	gallons	gal
m ³	cubic meters	35	cubic feet	ft ³
m ³	cubic meters	1.3	cubic yards	yd ³
TEMPERATURE (exact)				
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F



* 1 in = 2.54 (exactly). For other exact conversions and more detailed tables, see NBS Misc. Publ. 286, Units of Weights and Measures, Price \$2.25, SD Catalog No. C13.10:286.

ABSTRACT

This report presents the results of an attitude survey concerning one-way and two-way freeway frontage roads. This research was part of a two-year study for developing warrants for conversion from two-way to one-way frontage roads. Interviews were conducted with 121 individuals in 15 different small and medium-sized cities in Texas. All of the 15 cities have freeways with two-way or one-way frontage roads.

The results of the attitude survey showed that the increased safety associated with one-way frontage roads is universally recognized by all interest groups. Operational considerations, such as capacity, are much less understood.

The survey found that city staff and city council members exhibit some views compatible with SDHPT interests. However, the results of the survey also suggest that city council members desire analyses of one-way versus two-way operation which are specific to the frontage roads in their city. On the other hand, and not unexpectedly so, the survey indicates that many persons with real estate or business interests are very "localized" in their views. Working closely with city staff and councilpersons may facilitate needed frontage road conversions to one-way.

KEY WORDS: Frontage Roads, One-Way Frontage Roads, Two-Way Frontage Roads, Land Use Development

SUMMARY

Attitudes of various interest groups toward one-way and two-way frontage roads were obtained during 1986 and 1987 through extensive interviews with 121 individuals in 15 Texas cities. The locations were selected from information needs and operational criteria provided by the Study's Advisory Panel. These cities were: Abilene, Bryan, College Station, Denton, Garland, Georgetown, Huntsville, Lancaster, McKinney, New Braunfels, Orange, Rockwall, Round Rock, San Marcos, and Wichita Falls. These 15 cities all have at least one freeway facility with two-way and/or one-way frontage roads. The number and type of individuals interviewed were:

City staff	19
City council members	34
Real estate appraisers	11
Real estate and development interests	24
Owners and managers of abutting businesses	<u>33</u>
TOTAL	121

Semantic scaling techniques were used to measure attitudes toward a variety of issues regarding freeway frontage roads. This procedure produces results which can be quantitatively analyzed. Open ended questions were also employed in order to provide respondents with the opportunity to express any opinion or observation relative to one-way or two-way freeway frontage roads.

Chi-square tests for statistical independence were used to test for differences in attitudes between the different groups. Ninety percent confidence limits were also calculated for the various responses.

The survey results show that almost everyone recognizes that one-way frontage roads are safer than two-way. However, there is a low understanding by non-highway professionals of the capacity and operational advantages of one-way traffic flow on frontage roads to the general public as a whole.

City staff, council members, and real estate appraisers tend to hold the opinion that freeway frontage roads in urban areas should be one-way when first built. City staff, council members, and real estate appraisers also indicate that the presence of two-way frontage roads contributes to the failure to develop a supporting system of streets which offer alternative routes to the use of the frontage roads in the freeway corridor. A majority

of businesspersons and real estate interests hold an opposite view on both topics.

There is a general feeling that the longer the frontage roads remain two-way, the greater the opposition to conversion to one-way traffic (93% of the interviewees expressed this opinion). A majority indicated that TEMPORARY TWO-WAY TRAFFIC signs influence land use and development decisions. However, some individuals stated that they believe the effectiveness of such signs diminishes with time. The lack of standard signing for temporary two-way traffic may also reduce the effectiveness of these types of signs.

Most respondents (90%) indicated that conversion from two-way to one-way operation will be detrimental to businesses located along the frontage road downstream from an on-ramp or upstream from an off-ramp. About 40% expressed the opinion that conversion to one-way traffic will be detrimental to businesses located downstream of an off-ramp and upstream of an on-ramp. Those locally - oriented businesses located immediately downstream from an on-ramp and without a backup local street circulation system will likely be the most severely impacted by the frontage road conversion process.

The responses indicate that the existence of traffic engineering guidelines would be helpful when considering a conversion from two-way to one-way traffic. City staff and city council members exhibit some views compatible with SDHPT interests. Working closely with city staff and council members may facilitate needed frontage road conversions to one-way. However, it is important to note that city council members will likely want to know how the guidelines will apply to their specific situations. On the other hand, owners and managers of businesses abutting the frontage roads indicated that such guidelines would have very little influence on them.

IMPLEMENTATION

The attitude study has several implications relative to implementation of a conversion of freeway frontage roads from two-way to one-way traffic. These are as follows:

1. City staff and city council members hold opinions and have attitudes which are often comparable with SDHPT interests. This suggests that the establishment of a coordinated SDHPT - city effort may facilitate the conversion of frontage roads to one-way traffic where there is a reasonable need.

2. Freeway frontage roads should be made one-way at the earliest possible time. Opposition to change increases the longer the frontage roads remain two-way.
3. The development of traffic engineering guidelines will be helpful. Nevertheless, city council members will want to know how the guidelines apply to their situation. Such guidelines will have little influence on the owners and managers of abutting businesses.
4. Addressing the specific fears and objections of individuals in a factual and concerned manner is effective in dealing with opposition.

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I. INTRODUCTION

BACKGROUND

Freeway design practice in Texas often includes frontage roads along both sides of the freeway. Almost all frontage roads are one-way in large urban areas. Outside of the urban developed areas, the frontage roads usually have two-way traffic, with both entry and exit ramps connecting the frontage roads with the main lanes. As time passes, many types of land development will often occur along the frontage roads in rural areas adjacent to large urban centers, taking advantage of the access and mobility provided by the freeway frontage road system. Such development includes commercial, industrial and residential. Traffic volumes on an undeveloped frontage road are usually low, but subsequent land development creates increased traffic volumes.

Two-way frontage roads attract development, leading to suburban and urban traffic situations with increasing safety and congestion problems. The traffic situations created by higher volumes on two-way frontage roads include congestion at frontage road intersections with crossing streets, and a potential for accidents where the freeway ramps have the right-of-way when intersecting with the two-way frontage road.

To alleviate the operational and safety problems in developing suburban areas, proposals to change to one-way operation on the frontage roads many draw protests from local individuals who feel that the proposed change will have a detrimental affect on them. As the following literature survey will show, minimal information is available regarding the perceptions of operational and safety tradeoffs with design features. In addition, there is little information available on the perceived economic impacts of various frontage road options by local business people. Some particular types of businesses may prefer one-way or two-way frontage roads under some locational situations and not prefer them in other cases.

PREVIOUS RESEARCH

The State Department of Highways and Public Transportation (SDHPT) and Texas Transportation Institute (TTI) have cooperatively performed a series of research projects over the past three decades that have examined several relevant issues. As the following brief literature survey will note, the impacts of basic freeway design on both the traditional motor vehicle user and on adjacent land uses are among the issues which have been addressed.

Changes in land use and land values as related to the provision of freeway access have been examined. In 1957 Adkins (1) used a parallel band approach (offset distances to the freeway) to determine the effect of a new radial expressway (North Central) on property values in Dallas.

In the late 1960's, Franklin (2) studied the effects of access on right-of-way costs and the determination of special benefits accruing to the property. This TTI study developed several statistical relationships that related cost of right-of-way acquisitions to geographic and access variables. A series of ten case studies were examined to test and evaluate the models. Stover et al. (3) performed an analysis of the general and specific benefits which accrue to property as a result of highway improvements. Benefits to highway user as well as nonuser groups were investigated. The influences of access and the proximity to freeway interchanges on land values and land use patterns also were summarized.

Buffington (4) et al in 1978 conducted a study of non-user impacts of different highway designs as measured by land use and land value changes. A series of over twenty reports were prepared by TTI on this subject.

A study of freeway ramp and frontage road operations was recently completed by Woods (5) at TTI. Operational and safety effects at ramp terminals were emphasized. Data were collected at nine frontage road sites where frontage roads had been converted from two-way to one-way operations. Forty-five ramps were operationally examined. Erratic maneuvers were recorded and accident experience obtained. It was determined that ramp type was not a significant influence on the accident data. Degree of roadside development and frontage road ADT (total of both directions) were the only statistically significant factors determined. Based on the accident analysis and the erratic maneuver data, the following warranting conditions for conversion from two-way to one-way frontage road operations were suggested:

1. Volume Warrant

Rural: 7,500 VPD (total of both frontage roads)

Intermediate: 6,000 VPD (total of both frontage roads)

Urban: 5,000 VPD (total of both frontage roads)

2. Accident Warrant

20 accidents/mile per year, average of three years

30 accidents/mile, for any one year

None of these studies combined the impacts on traffic with local business

impacts to formulate an overall strategy for addressing SDHPT's short-range or long-range needs, both administratively and operationally. Alternative analyses were not suggested nor were significant economic considerations included. Analytic modeling of traffic impacts was very limited in scope. However, the general accident analysis conducted by Woods in Study 288 (5) was as complete as the Texas SDHPT before-after data base permitted.

SCOPE OF RESEARCH

In an attempt to better define the problems associated with frontage road conversion from two-way to one-way operations and to ultimately propose effective solutions, SDHPT requested TTI to conduct Study 402, "Warrants for One-Way Frontage Roads." The study is a two-year effort and contains the following five objectives:

1. Identify specific problems encountered by SDHPT in converting from two-way to one-way frontage road operations.
2. Identify the circumstances and the groups making requests for converting existing frontage road flow from one design condition to the other case.
3. Develop guidelines for examining typical frontage road operational situations from the traffic and business community viewpoints.
4. Develop strategies for ameliorating the positions of local interest groups that may conflict with proposed frontage road warrants.
5. Determine the traffic conditions required for converting existing two-way frontage roads to one-way operations to improve the level of service along the facility and to improve safety through accident and conflict reductions.

A prime research need of Study 402 was the identification of opinions and attitudes pertaining to "suburban" freeway frontage roads and their possible conversion to one-way operation. This report, the first in a series of reports produced to address the objectives of Study 402, provides the documentation of our efforts to obtain the needed socioeconomic information. All proposed implementation actions should be considered as preliminary since the study's Final Report will contain our final conclusions and recommendations. Guidelines and warrants for conversion from two-way to one-way frontage road operations will also be provided in the Final Report.

DEVELOPMENT OF SURVEY

A Project Advisory Panel, composed of SDHPT staff, was formed to help the TTI research team identify issues and concerns of SDHPT relative to

directional conversion of freeway frontage roads. The Panel was instrumental in identifying locations which were and were not suitable for the collection of attitude information and traffic data. Since the focus of this research project is on the conversion of frontage roads from two-way to one-way operations, the Panel suggested that the attitude surveys should be primarily focused in the following types of locations where conversion to one-way frontage road operations is likely to occur or has recently occurred in Texas:

1. Municipalities in the urbanizing fringe of large metropolitan areas (i.e. McKinney), and
2. Small and medium-size stand alone urban areas (i.e. Bryan).

In order to better define the nature of the perceptions and attitudes relative to freeway frontage roads, informal interviews were conducted with professional staff, council members, and developers in selected communities. A limited number of interviews were also made in urban areas where the freeway frontage roads have always been one-way.

A survey questionnaire was then developed using a combination of semantic scaling techniques and open ended questions. The semantic scaling procedure asks the participants to respond by expressing levels of agreement or disagreement to a specific statement. Experience has indicated that a five-point scale (strongly agree, agree, no opinion/no preference, disagree, and strongly disagree) is most appropriate. A lesser number of points (three) fails to measure the strength of the respondent's feeling. A larger number (seven or nine points) produces confusion and indecision since the respondent is asked to differentiate between positions that are similar. The categorical responses produced by semantic scaling permit a statistical analysis of the attitudes of the different interest groups.

Open-ended questions were also employed in the survey to follow up on certain topics and to provide the respondents with the opportunity to express any opinion or observation relative to the subject of two-way and one-way freeway frontage roads.

In addition to conducting the interviews with people from various Texas cities, the interview was also administered to the Project Advisory Panel. The responses of the Panel were compared with those of the statewide interviews. This comparison offers insight as to how the attitudes of highway professionals agree with or differ from the attitudes of the public with which the SDHPT personnel may interact when dealing with this issue.

The assistance of the Texas Real Estate Research Center was solicited in review of the survey instrument as well as for any information concerning attitudes regarding frontage roads. The center personnel indicated that they knew of no related research.



II. SURVEY METHODOLOGY

DEVELOPMENT OF QUESTIONNAIRE

Development of the survey questionnaire proceeded thru the following steps:

1. The pertinent issues were identified through preliminary interviews with selected city staff, council members, and real estate interests. Those residing in the Bryan/College Station area were interviewed in person. Those in other cities were interviewed by telephone;
2. A draft questionnaire was prepared;
3. The questionnaire was field pretested;
4. Based upon the pretests, the questionnaire was revised; and,
5. The questionnaire was administered primarily through personal interviews. A few were completed by telephone or by mail.

A total of 121 opinion interviews were conducted in the Summer and Fall of 1986 and Winter of 1987. Overall, people from 15 Texas cities participated in the survey questionnaire. These cities are either in the developing fringe of a large metropolitan area, or are mid-sized "stand alone" cities. The frontage roads found in these cities can be categorized as follows:

1. Have either all or a substantial amount of two-way frontage roads in the city:
Bryan, College Station, Denton, Garland, Georgetown, Huntsville, New Braunfels, Rockwall, San Marcos;
2. Have converted the frontage roads in the central portion of the city to one-way:
Abilene, McKinney, Lancaster, Round Rock; or
3. Have always had one-way frontage roads on almost all segments:
Orange, Wichita Falls.

For opinion survey purposes, Denton, Round Rock, and Abilene could have been classified as either two-way or as one-way conversion cities. Denton was categorized as a two-way because additional conversion to one-way is a current issue in Denton. Since substantial conversions were made a few years ago in both Round Rock and Abilene, they were classed as a "conversion" in order to obtain reactions to the conversion. The focus of the surveys in Abilene and Round Rock was on the already converted frontage roads.

The following groups of citizens were surveyed:

City staff	19
City council members	34
Real estate appraisers	11

Real estate and development interests	24
Owners and managers of abutting businesses	<u>33</u>
TOTAL	121

By October 1986, 47 interviews had been completed and the results tabulated for presentation to the Advisory Panel and inclusion in the interim report. As additional interviews were conducted, the results were periodically compared. This procedure indicated that the results were not changing with additional interviews. While a larger sample size would provide somewhat greater precision in confidence limits on the statistical proportions of responses, the increase was not considered to be worth the considerable expense that would have been involved to obtain an even larger sample. For example, a total of 200 interviews (an additional 79 interviews) would have reduced the 90% lower and upper confidence limits by only about one percent. Such a difference would not affect the principal conclusions that could be drawn from the existing data.

INTERVIEWS

Interviewees were identified through contact with the city staff. City staff were asked to name those individuals who represented the leadership within their area of interest and the community. For example, a city staff member was asked to identify city council persons who exhibited a substantial interest in traffic and circulation issues and to whom other council members generally "defer" on such matters. Similarly, the city staff member was asked to name those individuals in business and real estate who are most visible in their area and whose lead typically is followed by others. In some cases, a city council person also had a business or real estate interest or was a developer. In these cases, their attitude as a council member was solicited.

Owners and managers of businesses abutting the freeway frontage road were interviewed by TTI staff. These businesses included service stations, restaurants, motels, and automobile dealerships, to name a few. The interviews were made with actual owners or managers with authority, such as the local manager of a national motel chain.

The vast majority of the interviews were conducted in person by TTI staff. In a few cases a selected individual was not available on the days that TTI staff were interviewing in the municipality. In these cases, a copy of the questionnaire was left at the individual's office and the interview was

completed later by telephone or the interview form was completed and mailed back to TTI.

III. ANALYSIS OF SURVEY RESPONSES

This chapter contains a question-by-question summary analysis of the interviews. Each question is presented in sequence as it appeared on the interview form. Table 1 presents a statistical summary of the issues addressed and attitudes evaluated. Respondents are categorized by type of frontage roads found in the city. Table 2 is a similar summary by type of survey participant. SDHPT responses are also provided for comparison. Detailed survey data and statistical analyses are provided in the Appendices.

Preference for one-way/two-way frontage roads

- 1a. How do you classify your preference for one-way compared to 2-way traffic on freeway frontage roads in urban areas?

Strongly favor one-way	Somewhat favor one-way	No preference	Somewhat favor 2-way	Strongly favor 2-way
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- 1b. Why? _____

A slight, but not statistically significant, majority of all respondents (52%) indicated a preference for one-way frontage roads (see Table 1). The percentage preferring one-way frontage roads is not significantly different for locations where the frontage roads are two-way and those which are one-way. The percentage (92%) of the Project Advisory Panel who favor one-way is much higher than the persons interviewed in the 15 cities.

Analysis of the responses by category of respondents indicate that there is a significant difference between the attitudes of the different groups of individuals (see Appendix C). As Table 2 depicts, the majority of city staff (90%) and council members (68%) favor one-way freeway frontage roads. Their proportions favoring one-way frontage roads are significantly larger than 50%.

Appraisers indicated a preference for one-way freeway frontage roads. However, business people, real estate people, and developers generally prefer two-way operation.

These survey results suggest that city staff and city council members might be encouraged as strong allies where a change to one-way operation is contemplated.

TABLE 1
SUMMARY COMPARISON OF ATTITUDES

Statement	Proportion Agreeing (Disagreeing) With Statement						Panel %
	All respondents		Two-way ⁽¹⁾		One-way ⁽²⁾		
	%	limits ⁽³⁾	%	limits ⁽³⁾	%	limits ⁽³⁾	
1. Favor One-way	52	45-59	50	40-60	55	43-66	92
2a. One-way detrimental to businesses	90	85-95	89	83-95	90	83-97	58
2b. One-way detrimental to businesses	39	22-46	31	22-40	50	38-62	8
3. Two-way safer	85	80-90	83	75-90	88	81-96	83
4. One-way higher capacity	54	47-62	54	44-64	55	43-66	83
5. One-way when constructed	57	50-64	67	58-76	47	36-58	100
6. Opposition increases with time	93	89-97	93	88-98	92	86-98	92
7. Build w/o frontage roads	78	73-84	81	74-89	72	62-83	83
8. Failure to develop backup system	56	49-64	57	48-66	55	33-66	75
12. Use TE guidelines	NA(4)		89	82-95	NA(4)		
13. Temporary two-way helps	NA(4)		70	61-79	NA(5)		83
15/18 Acceptance of one-way	NA(5)		NA(5)		56	45-68	58

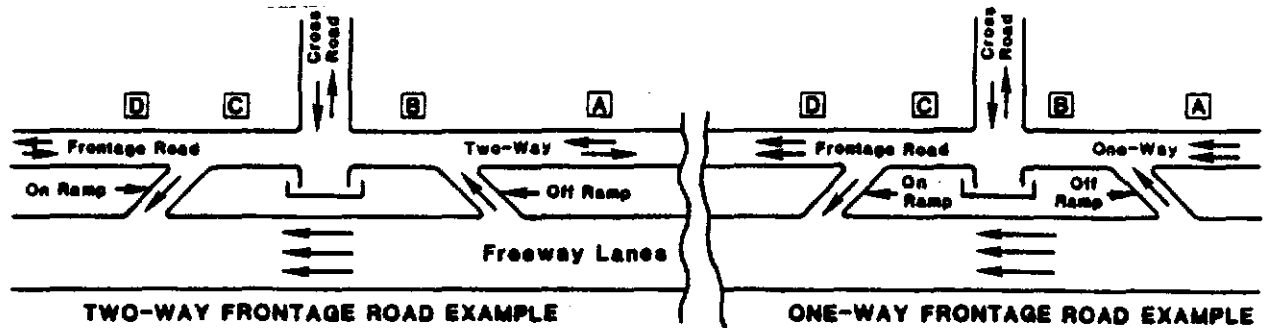
- (1) Respondents where some or all freeway frontage are two-way
(2) Respondents where freeway frontage roads have been converted to one-way or have always been one-way
(3) Lower and upper 90% confidence limits
(4) Not Applicable, response not solicited where frontage roads are one-way
(5) Not Applicable, response not solicited where frontage roads are two-way

**TABLE 2
COMPARISON OF SDHPT ADVISORY PANEL
RESPONSES AND THOSE OF INTERVIEWEES**

Statement	SDHPT Advisory Panel %	Interviewees			
		Total %	City Staff %	City Council %	All Others %
1a Favor one-way frontage roads	92	52	90	68	34
2a Agree, businesses upstream/downstream of ramp will be hurt	58	90	68	88	96
2b Agree, businesses between off-ramp and on-ramp will be hurt	8	39	21	38	44
3 Agree, two-way is safer	17	3	0	0	4
4 Agree, one-way has higher capacity	83	55	84	62	43
5 Agree, frontage road should be one-way when first constructed	100	57	79	71	44
6 Agree, the longer two-way is maintained, the more opposition to one-way	92	92	100	82	96
7 Agree, build freeways without frontage roads	17	14	31	15	9
8 Agree, two-way frontage roads lead to failure to develop alternate routes	75	56	68	59	52
13 Agree, Temporary Two-way signs affect land development	83	70	64	68	73
15/18 One-way frontage roads are accepted	58	56	63	67	48

Effect of Conversion on Business

2. In reference to the following sketch:



2a. Conversion of a two-way frontage road to one-way will have a detrimental effect on "highway oriented" businesses (service stations, motels and restaurants) at locations A and D.

Strongly Agree Agree No Opinion Disagree Strongly Disagree

The vast majority (90%) of all respondents believe that conversion to one-way operation will be detrimental to businesses located downstream from an on-ramp or upstream from an off-ramp. There is little if any difference between the groups of respondents. Further, those residing in areas where the frontage roads are two-way have views which are similar to those where they are one-way. During the interviews, 21 interviewees offered the unsolicited comment that the site upstream of the freeway exit ramp would be hurt worse than the site downstream of the entrance ramp. It is possible that others of the 108 that agreed or strongly agreed with this statement also share the same opinion but did not make the statement.

Only 39% believe that the conversion from two-way to one-way frontage roads would have a detrimental affect on businesses located downstream of an off-ramp or upstream from an on-ramp. There is a significant difference in the opinion of the respondent groups. Owners and managers differ from the other groups in their opinion that conversion to one-way traffic will be detrimental to businesses in these locations. It is interesting to note that the proportion of developers and appraisers who are of the opinion that conversion to one-way will be detrimental is less than that of city council members. Where the frontage roads always were one-way, or were converted to one-way, a slightly higher proportion (50%) believe that one-way traffic is detrimental to businesses located between off and on-ramps. However, the difference between one-way and two-way locations is not significantly different at the 90% confidence level.

The percentage of the Advisory Panel who feel that one-way operation will be detrimental to businesses is much smaller than the public. This is especially true regarding businesses located between an off-ramp and an on-ramp. This suggests that department personnel may need to be sensitive in the manner in which responses to concerned individuals are phrased.

Two-way Frontage Roads are Safer

3. Two-way frontage roads are safer than one-way frontage roads.

Strongly Agree	Agree	No Opinion Don't Know	Disagree	Strongly Disagree
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An overwhelming and statistically significant majority of respondents (85%) recognize that one-way freeway frontage roads are safer than two-way; the lower and upper 90% confidence limits are 80% and 90%, respectively. The Chi-square analysis indicated that there is no significant difference between the different groups of respondents. Most persons, including those who prefer two-way frontage roads, recognize that one-way is safer.

The recognition that one-way frontage roads are safer, combined with a general public concern for safety, suggests that considerable effort should be directed toward the traffic safety issue when conversion to one-way operation is being considered. City staff, as well as council members, recognize potential hazards involved in two-way operation. Thus, location specific data such as conflict analysis, erratic maneuvers, and "near misses" may be convincing evidence in addition to accident data.

One-way Frontage Roads Have Higher Capacity at Intersections

4. The intersection of a frontage road and a cross street can carry more traffic after the frontage road is changed from two-way to one-way traffic.

Strongly Agree	Agree	No Opinion Don't Know	Disagree	Strongly Disagree
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A slight majority (54%) agree that the intersection of a frontage road and a cross street can carry more traffic when the frontage roads are one-way. The lower and upper 90% confidence limits (47% and 62%, respectively) indicate that the capacity advantage of one-way frontage roads is much less appreciated than the safety advantages. The Chi-square test indicated that there is a significant

difference between the different groups of respondents. City staff and, to a lesser extent, city council members tend to recognize the capacity issue. The other groups appear to have no general recognition of the increase in capacity with one-way operation compared to two-way.

In the process of conducting the interviews, it was apparent to the TTI staff that the concept of intersection capacity is not readily understood by many, if not most, individuals who do not have a technical background in traffic engineering or traffic planning. This impression, supported by the survey results, indicates that: (1) capacity information alone will have little impact upon most people; and (2) capacity impacts on delay should be identified and presented in a clear and non-technical manner.

The percentage of the Advisory Panel holding the opinion that capacity is higher with one-way frontage roads (83%) is significantly higher than the survey participants (54%).

Frontage Roads Should be Constructed As One-Way

5. Frontage roads in urban areas should be one-way when first constructed.

Strongly Agree	Agree	No Opinion	Disagree	Strongly Agree
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A majority (57%) responded that freeway frontage roads in urban areas should be one-way when first constructed. Where frontage roads are two-way, a statistically higher percentage holds this view than where they are one-way. In cities having one-way frontage roads, 47% thought frontage roads should be one-way when first constructed. However, 67% of those in cities with two-way frontage roads thought frontage roads should be one-way initially.

There is a statistically significant difference (at the 10% significance level) between the various groups of respondents. City staff, council members, and appraisers tend to hold the opinion that frontage roads should be one-way to begin with. Businessmen and developers hold divergent views (See Appendix A) with slightly less than half agreeing that freeway frontage roads in urban areas should be one-way when first constructed.

Opposition To Change Increases With Time

6. The longer that two-way traffic is maintained on a freeway frontage road, the more opposition there is to a change to one-way.

Strongly Agree

Agree

No Opinion

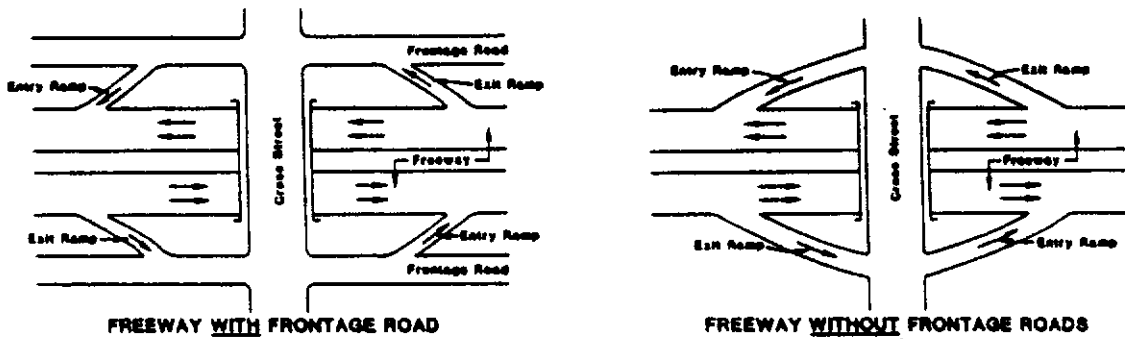
Disagree

Strongly Disagree

Nearly 93% of the total survey responded that the longer that two-way traffic is maintained, the more opposition there is to a change to one-way flow. There is a 95% probability that at least 89% hold this opinion. There is no significant difference between the different groups of respondents or between locations where frontage roads are one-way or two-way. This result clearly suggests that a change from two-way to one-way traffic should be undertaken as soon as possible as opposition will increase with time.

Freeways Should Be Built With Frontage Roads

- 7. Freeways should be built with entry and exit ramps but without frontage roads.



Strongly Agree

Agree

No Opinion Don't Know

Disagree

Strongly Disagree

A sizable proportion (78%) of the respondents indicated that freeways should originally be built with frontage roads. There was no significant difference between the groups of respondents although some staff, council members and business people expressed a preference for diamond interchanges without frontage roads. Although the difference is not statistically significant at the 10% significance level, freeways without frontage roads are more acceptable in areas where frontage roads are two-way than where they are one-way.

Failure To Develop Backup Street System

- 8. The presence of two-way frontage roads will lead to a failure to develop a supporting street system of alternative routes to using the frontage road.

Strongly Agree Agree No Opinion Don't Know Disagree Strongly Disagree

Explain _____

A slight, but not statistically significant, majority (56%) indicated that the presence of two-way frontage roads will lead to a failure to develop a supporting street system of alternate routes to the frontage road. However, a sizable majority of the real estate people/developers (71%) and city staff (68%) were of the opinion that two-way frontage roads do indeed retard the development of a supporting street system. City council members (59%) also expressed this view. The views of these three groups suggest that the Texas SDHPT should take a greater interest in planning the total urban street system along the freeway corridor.

Effects of Conversion on Land Values

9. What effect does the conversion from two-way to one-way traffic have on the value of properties along the frontage road?

Responses can be categorized as follows:

	City		Land		Total
	#	%	#	%	#
1. Conversion will be detrimental	11	21	27	40	38
2. Conversion will cause a short-term decline	11	21	6	09	17
3. Conversion will hurt some but not others	9	17	13	19	22
4. Conversion will hurt some, benefit others	9	17	9	13	18
5. Conversion will have little or no effect	7	13	8	12	15
6. Conversion will benefit	2	04	1	01	3
7. Don't know	3	06	4	06	7
8. No response	1	02	0	00	1
Total	<u>53</u>		<u>68</u>		<u>121</u>

The "land" interest (abutting owners, real estate and development interests, real estate appraisers) were much more likely to predict a detrimental effect on real estate values due to conversion than were the "city" interests (staff and council). Among owners, 16 of 33 (48%) felt conversion would be detrimental; among realtors and appraisers, 11 of 35 (31%) felt this way.

Traffic Engineering Guidelines

12. What influence would traffic engineering guidelines for the conversion from 2-way to one-way traffic have on your decision to make the change?

Would follow the guidelines	Considerable influence	Some influence	No influence
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This question was asked only in the localities classified as having two-way frontage roads. A very small portion indicated that they would automatically follow traffic engineering guidelines regarding the conversion from two-way to one-way operation. Sixty-four percent said that they would follow the guidelines or that the guidelines would have considerable influence on their decision. There is a 95% chance that the actual percentage holding this view is at least 58%. In all, about 89% indicated that such guidelines would have some or considerable influence on their decision to accept one-way operation. Owners and managers of businesses abutting a frontage road indicated that guidelines would have the least influence on them.

The responses to this question and the nature of the comments made by many respondents during the interview indicate traffic engineering guidelines will be helpful. However, they also indicate that it will be necessary to work closely with the local officials and the affected individuals to convince them of the applicability of the guidelines to their specific situation. The nature of the city staff responses suggests that the city staff could be effective in helping to apply the guidelines.

Effectiveness of Temporary Two-Way Signs

13. Does the presence of "TEMPORARY TWO-WAY" signing along the frontage road affect land development and business decisions?

Yes No Explain _____

This question was asked only in the localities classified as having two-way frontage roads. Most respondents (70%) are of the opinion that TEMPORARY TWO-WAY TRAFFIC signs do affect land development and business decisions. The lower and upper 90% confidence limit are 61% and 79%, respectively. There is no significant difference in the opinions of the different groups of respondents.

Several individuals commented that they believed that the effectiveness of the TEMPORARY TWO-WAY TRAFFIC signs decrease with time. The longer they are displayed, the less effective they become. The lack of standard signing (see Figure 1) may also contribute to a diminished effectiveness. Information as to where to obtain information concerning the temporary nature of the two-way traffic



Most respondents indicated that the use of signs which indicate that the two-way traffic is temporary is of some help in influencing development decisions. However, many respondents indicated that the influence diminishes when the frontage roads remain two-way for several years. As these photographs indicate, a variety of signing is presently used. Standardization may help make such signing more effective.

SIGNS INDICATING THAT TWO-WAY TRAFFIC IS TEMPORARY
Figure 1

might enhance the effectiveness.

Acceptance of One-Way Frontage Roads

In cities where the frontage roads were always one-way or were converted to one-way, the respondents were asked to judge the acceptance of the one-way operation. A surprisingly low 56% indicated that there was a good acceptance or extremely good acceptance; the lower 90% confidence limit is 45% and the upper limit is 68%. As might be expected, a higher percentage of the owners/managers and real estate people/developers expressed the opinion that there was some or high opposition to one-way operation. Opinions differ as to whether opposition to one-way frontage roads is strong.

Citizen involvement techniques which have been found to be effective in "ameliorating opposition" may be effective where a change to one-way frontage roads is being considered. However, there is probably a small but persistent undercurrent of opposition, especially from abutting property owners.

Comparing Urban Fringe With Stand-Alone Responses

A separate Chi-square analysis was performed for each question comparing the responses of those in urban fringe cities with those in stand-alone cities. These tests were performed in order to determine if there were any differences of opinion or outlook between those in the two categories of cities. For instance, one might suppose that those in stand-alone cities might have a different preference for two-way frontage roads than those in urban fringe cities.

The cities were grouped as follows:

<u>Urban Fringe</u>	<u>Stand Alone</u>
Denton	Abilene
Garland	Bryan
Lancaster	College Station
McKinney	Huntsville
Rockwall	New Braunfels
Round Rock	Orange
	San Marcos
	Wichita Falls

Due to uncertainty about the proper category, Georgetown responses were excluded from this analysis.

The data were grouped in the following manner:

City Group	Position	Responses
Stand Alone	Staff & Council	-----
	Others	-----
Urban Fringe	Staff & Council	-----
	Others	-----

Responses were aggregated in order to achieve a minimum theoretical frequency of at least five per cell where possible. The "Strongly Agree" and "Agree" were combined, as were the "Disagree" and "Strongly Disagree" responses. In some cases, the "No Opinion" responses were dropped because the theoretical frequency was less than five. All tests were performed at the 10% significance level (90% confidence).

For the following two questions, the theoretical frequency in one or more cells was less than five and the Chi-square test could not be performed.

- 2A. Conversion of a two-way frontage road to one-way will have a detrimental effect on "highway oriented" businesses (service stations, motels and restaurants) at locations A and D.
- 3. Two-way frontage roads are safer than one-way frontage roads.

The Chi-square test indicated that there was no significant difference between the responses of those in urban fringe areas with those in stand-alone areas for the following eight questions.

- 2B. Conversion of a two-way frontage road to one-way will have a detrimental effect on "highway oriented" businesses (service stations, motels, and restaurants) at locations B and C.
- 4. The intersection of a frontage road and a cross street can carry more traffic after the frontage road is changed from two-way to one-way traffic.
- 6. The longer that two-way traffic is maintained on a freeway frontage road, the more opposition there is to a change to one-way.
- 7. Freeways should be built with entry and exit ramps but without frontage roads.
- 8. The presence of two-way frontage roads will lead to a failure to develop a supporting street system of alternative routes to using the frontage road.
- 12. What influence would traffic engineering guidelines for the conversion from 2-way to one-way traffic have on your decision to make the change?
- 13. Does the presence of "TEMPORARY TWO-WAY" signing along the frontage road affect land development and business decisions?

15/18 Now that the frontage roads are one-way, how would you judge their acceptance? / How would you judge the acceptance of the one-way frontage roads in your area?

The Chi-square test indicated that there was a significant relationship for the two following questions.

- 1A. How do you classify your preference for one-way compared to 2-way traffic on freeway frontage roads in urban areas?
5. Frontage roads in urban areas should be one-way when first constructed.

However, the analysis indicated that the statistical significance was due to a difference in responses between city staff and council versus all other respondents, and not a difference between those in the urban fringe and those in stand-alone cities. The responses of city staff and council in the stand-alone cities and the urban fringe cities were similar. And the responses of the other respondents (appraisers, real estate and development interests, and owners of abutting businesses) in the stand-alone cities were similar to those in the urban fringe cities. In other words, the difference was between responses from city officials (staff and council) and responses from all other respondents (appraisers, real estate and development interests, and owners of abutting businesses). In summary, no significant differences were found between the responses of those in urban fringe cities and those in stand-alone cities.

Advisory Panel Opinions

During a Project Advisory Panel meeting held in October 1986, the survey questionnaire was administered to the 12 SDHPT members who were present. The responses of the panel are compared with those of the individuals interviewed around the state, with the comparison data presented in Table 2.

It is interesting to note that the SDHPT Advisory Panel Members and city staff have similar views in their preference for one-way frontage roads (Question 1a), affect on businesses (Question 2a), safety (Q3), capacity (Q4), two-way frontage roads leading to a failure to develop a "back up" street system (Q8), and the acceptance of one-way frontage roads (Q15 and 18).

The portion of the Panel members who agree that the longer a frontage road is two-way, the more opposition there is to a change to one-way is similar to the other respondents. However, the Panel members are optimistic about the effectiveness of the TEMPORARY TWO-WAY TRAFFIC signs. The difference between the

Panel and the combined city staff and city council is statistically significant (0.10 significance level).

IV. SELECTED COMMENTS FROM THE SURVEY

The survey included open-ended questions to follow up on some of the semantically-scaled questions and to obtain individual opinions and comments at the end of the interview. The following verbatim comments were selected to provide additional insight into the public's view of freeway frontage roads in Texas.

Influence in Making the Decision to Change

The decision to convert a two-way frontage road to one-way is not only an engineering decision; it is also a political one. Various interests impacted by the conversion will form opinions about the proposed conversion, then express those opinions to their political leaders. A council member may then arrive at a position based on the pressure from various interest groups.

The following comments express a range of attitudes which affect political realities in Texas.

- o On the question: "What information would you like in making a decision on conversion from two-way to one-way frontage road operation", a realtor responded: "Survey of people traveling the frontage road -- see how change would affect them." A city planner responded: "Case studies, example of the impact on existing businesses."
- o "Two-way would be nice, but I hope I'm not so mercenary over the dollar". Comment from an abutting owner favoring one-way.
- o "I can see that there is a need to change to one-way when development builds up". Comment from an abutting owner favoring one-way.
- o "I get more pressure from people who pay taxes [abutting property owners] than from people that drive". Comment by a council member favoring two-way.
- o The planning director of a medium-sized city along an interstate highway commented: "When local developers come in and are informed that the frontage roads may change (to one-way) they are surprised. Outsiders seem to be aware of this."
- o "If you didn't have property owners along the frontage road, then the State would not have worries about conversion". Comment from a realtor favoring two-way.

The State's Role

Some interviewees made comments about the role of the State in operating frontage roads. The following selection of comments reflect a wide range of philosophical perspectives.

- o "SDHPT should establish some standards as to when one-way or two-way frontage roads are to be used." Comment by a businessman.
- o "If the frontage road is going one-way, then (SDHPT) should have done it from the beginning." Comment by a council member (a professor).
- o "Eliminate uncertainty; set up frontage road, then don't change it." Comment by a developer.
- o "The State builds a part of the local arterial system when they build a frontage road." Comment by a staff person favoring one-way.
- o "Cities are used to having the Highway Department develop their arterial street systems." Comment by a real estate developer.
- o "The idea of a freeway is to move traffic, not to develop a business." Comment by a council member favoring one-way.
- o "Highways should be built to address future problems instead of existing (problems). The Highway Department should act instead of react." Comment by a mayor who also is a realtor.

Negative Attitudes

Comments made by business owners and others in opposition to conversion to one-way show that one-way operation is perceived to be, and in fact may be, detrimental to some businesses in given situations.

- o "If I had known that this frontage road was going to be converted to one-way [in the future], I would not have opened up here." Comment by an abutting owner favoring two-way.
- o "I developed this business under two-way frontage road conditions and want it to stay two-way." Comment by an abutting owner favoring two-way.
- o "People have complained about getting to my business [which is on a one-way frontage road]." Comment by an abutting owner favoring two-way.
- o "I did not locate my business office along the frontage road because it is one-way." Comment from a realtor favoring two-way.
- o "I know of a location rejected by a motel because the frontage road was one-way." Comment from a realtor favoring two-way.
- o "I have seen conversion to one-way cause a child care business to fail." Comment from an appraiser favoring two-way.

One owner of a local restaurant located along a frontage road which had been converted to one-way did not want to be interviewed, but did complain about the conversion. He believed that a sizeable portion of his patrons had previously reached the restaurant by coming on the frontage road in the contraflow direction, and now no longer came because of the extra distance down to the next crossover and back.

Positive Attitudes

The comments of some abutting owners or others who had experienced or observed conversion to a one-way frontage road operation show that the perception of potential problems in advance of conversion may be much worse than the actual reality after conversion.

- o "We thought that the change to one-way would hurt (business) but it didn't." Comment by an auto dealer on a frontage road that was changed from two-way to one-way traffic.
- o "Conversion to one-way does not hurt (detrimental to business/property value) as much as people think." Comment by a real estate appraiser.
- o "Our business does not suffer due to one-way frontage roads because we are a speciality business." Comment by an abutting owner on a one-way section who favors two-way.
- o "One-way traffic doesn't hurt this dealership, since we are close to the corner." Comment from an automobile dealer favoring one-way.
- o In response to the open-ended question on opposition to one-way frontage roads, a council member (an attorney by profession) stated: "Before conversion, business people complained. Have not had any opposition (after conversion)."
- o "Previous conversion to one-way didn't affect the price of the site bought just after conversion". Comment by an abutting owner who favors two-way.

Back-up Street System

Comments about the absence and presence of back-up or alternative street systems when frontage roads are present reveal a variety of perceptions. Some of the interviewees do believe that the presence of frontage roads inhibits development of the street circulation system, while others do not.

- o "Relating to statement #8--part of the problem is that we have relied on two-way frontage roads too much." Comment by a council member favoring one-way.
- o "If the bypass frontage roads were one-way, the street (a proposed parallel, minor arterial) would have been built." Similar statements were made by two city council members. A similar statement was made by the developer of one of the attached subdivisions.
- o "The problem with converting from two-way is that the paralleling supporting roadways were not planned for." Comment from a council member favoring one-way.
- o "When the frontage roads are initially one-way, then development is planned accordingly." Comment by a council member favoring one-way.
- o "It is hard to get people to vote money [for a backup road] when the frontage road exists." Comment from a developer favoring one-way.
- o "The internal part of the street system develops with or without the presence of frontage roads." Comment by a council member favoring two-

way.

- o "If there is enough traffic, then supporting streets will be built."
Comment from a realtor favoring two-way.

In one city, the development of a back-up street seemed to be inhibited in part by various competing development interests wanting the back-up road to go by their site and not those of other developers. The result has been that it goes by nobody's site, since it hasn't been built.

Freeway Affects on Circulation

In addition to comments about the backup street system, a number of survey participants offered unsolicited comments about the state of ramp configurations, frequency of streets crossing the freeway, and the effects of the freeway upon vehicular circulation.

- o "Freeways create an urban barrier, interrupting the circulation patterns." Comment by a staff person favoring two-way.
- o "I'm concerned with the excessive distance between crossing streets, especially in urban areas." Comment by a council member favoring one-way.
- o "The infrastructure is not there for traffic movement [on a one-way frontage road]." Comment from a developer favoring two-way.
- o "In urban areas with plenty of crossovers, one-way would not have a great impact." Statement by a mayor.
- o "Discontinuous frontage roads are a problem; continuity makes one-way more acceptable." Comment by a council member favoring one-way.
- o "Sometimes the ramps need to be relocated to accomodate changes in traffic patterns over the years." Comment from a realtor favoring two-way.
- o "Need to give consideration to spacing of ramps to cross street interchanges (not too close), limit curb cuts to frontage roads." Statement by a mayor.

A number of interviewees expressed concern with the availability of roads crossing the freeway. A higher frequency of crossovers makes one-way frontage roads more acceptable.

Comfort and Safety

Motorists may feel vaguely uncomfortable or outright unsafe when driving on two-way frontage roads with connecting entry and exit ramps. Motorists from out-of-state or from large metropolitan areas may be used to only one-way frontage roads, and taken by surprise when encountering a two-way frontage

road. In addition, a few comments indicate that some motorists deliberately drive the wrong way on a one-way frontage road to avoid the indirection present in the one-way system. In the two cities where this comment was made backup or alternative circulation routes are sorely lacking.

- o "I try to avoid the frontage roads if there is a back way." Comment by a council member favoring two-way in a city with two-way.
- o "Two-way is more convenient but more dangerous." Comment by a council member favoring one-way.
- o "You have to be a native of the area to know which frontage roads are two-way and which are one-way." Comment by a staff person favoring one-way.
- o "Out of town drivers have trouble with two-way frontage roads." Comment by a council member favoring one-way.
- o "More one-way signs are needed at business drives; motorists see the signal at a nearby intersection [which is "upstream" on a one-way frontage road] and then proceed to go the wrong way up to the signalized intersection." Comment from an automobile dealer on a one-way frontage road favoring one-way.
- o "The ill or elderly [coming to the hospital] do not need the confusion [of a two-way frontage road]." Comment from an abutting hospital administrator favoring one-way.
- o "A number of bad experiences with two-way can cause people to change their minds and favor one-way." Comment from an appraiser favoring one-way.

In one city, an unfortunate fatal accident related to two-way operation seemed to be a major factor in convincing local leaders to choose conversion to one-way operation.

V. CONCLUSIONS AND RECOMMENDATIONS

The attitude survey indicates that conversion of frontage roads from two-way to one-way operation will be controversial. Traffic safety is a substantial concern and most people recognize that one-way operation of freeway frontage roads is safer than two-way operation. Also, accident information is readily understood by most individuals. On the other hand, capacity and operational advantages of one-way frontage roads do not appear to be generally understood. This means that such data should be presented in as simple and nontechnical manner as possible.

The survey results indicate that traffic engineering guidelines for the conversion of frontage roads from two-way to one-way operation would be useful. Most council members indicated that traffic engineering guidelines would have at least some influence upon their decision to approve the change from two-way to one-way. However, it became clear during the interviews that council members will want to see how these guidelines apply to their specific situation. Most business people, developers, and others impacted by the change can be expected to take a vested-interest view; many will not be satisfied by an overall analysis and benefits to the public in general.

Consequently, where a change from two-way to one-way freeway frontage roads is contemplated, it will be beneficial to demonstrate to the city council how the traffic engineering guidelines relate to their specific section(s) of frontage road and how the change will be of benefit in each situation. Comments about the experience of various cities when converting frontage roads to one-way reveal that the opposition to the proposed change will be more active than the supporters. In one city, the supporters telephoned their opinions to the city council, but the opposition showed up for the council hearing. Minutes of various council hearings show more speaking in opposition than in support. If the public officials can identify those supporting conversion and encourage them to be as active as the opposition, the political environment may be more conducive to conversion.

It also will be desirable, if not essential, to make those individuals who believe that the change will adversely affect them feel that they received a fair hearing and that their individual concerns were addressed. Based upon experiences involving public works projects, it appears that the following are essential in dealing effectively with the portion of the public who have a vested interest in a change from two-way to one-way frontage road operations:

1. Provide the opportunity for individuals to freely express their concerns and develop a feeling on their part that their concerns are appreciated. Experience indicates this is best accomplished in an open, informal meeting where it is made clear that the purpose is to obtain information and for individuals to express their concerns and that no decision has yet been made.
2. Address the concerns of each individual in a factual, easy-to-understand manner.
3. Proceed to a formal, public hearing only after a thorough study has been made of the problems and advantages of one-way versus two-way frontage road operations.

Such a procedure has been found to be effective in ameliorating opposition where the decision is controversial to a few individuals and the general public has not become involved. It is recommended that a manual on public participation principles and techniques be developed to assist SDHPT personnel in dealing with the situations involved in the conversion of freeway frontage roads from two-way to one-way traffic.

The attitude survey indicates that, in general, city officials have many views which are compatible with SDHPT interests regarding the conversion of freeway frontage roads. These include: (1) a general favoring one-way frontage roads; (2) safety; (3) affect on businesses; (4) some awareness of the capacity advantage - especially by city staff; and, (5) the longer the frontage roads are two-way, the greater the opposition becomes to the change to one-way.

This suggests that SDHPT should work closely with city staff and city council members with the objective of developing stronger support for conversion and in dealing with opposition. While considerable SDHPT staff time will be required, such an approach should help avoid "the highway department is telling us what we will do" attitude. The manual on public participation techniques recommended above could include a section on how SDHPT personnel might interface with city officials.

The survey results indicate that the potential for the greatest negative impact resulting from one-way frontage road conversion is to those tracts of land located downstream of an entry ramp and upstream of an exit ramp (i.e., outside of the diamond interchange area). It seems that businesses which are unique or which have relatively little competition will not be greatly impacted even if they are situated in the area outside of the diamond interchange. An automobile dealership situated upstream of an exit ramp would be expected to fare better than a local restaurant if the frontage road were

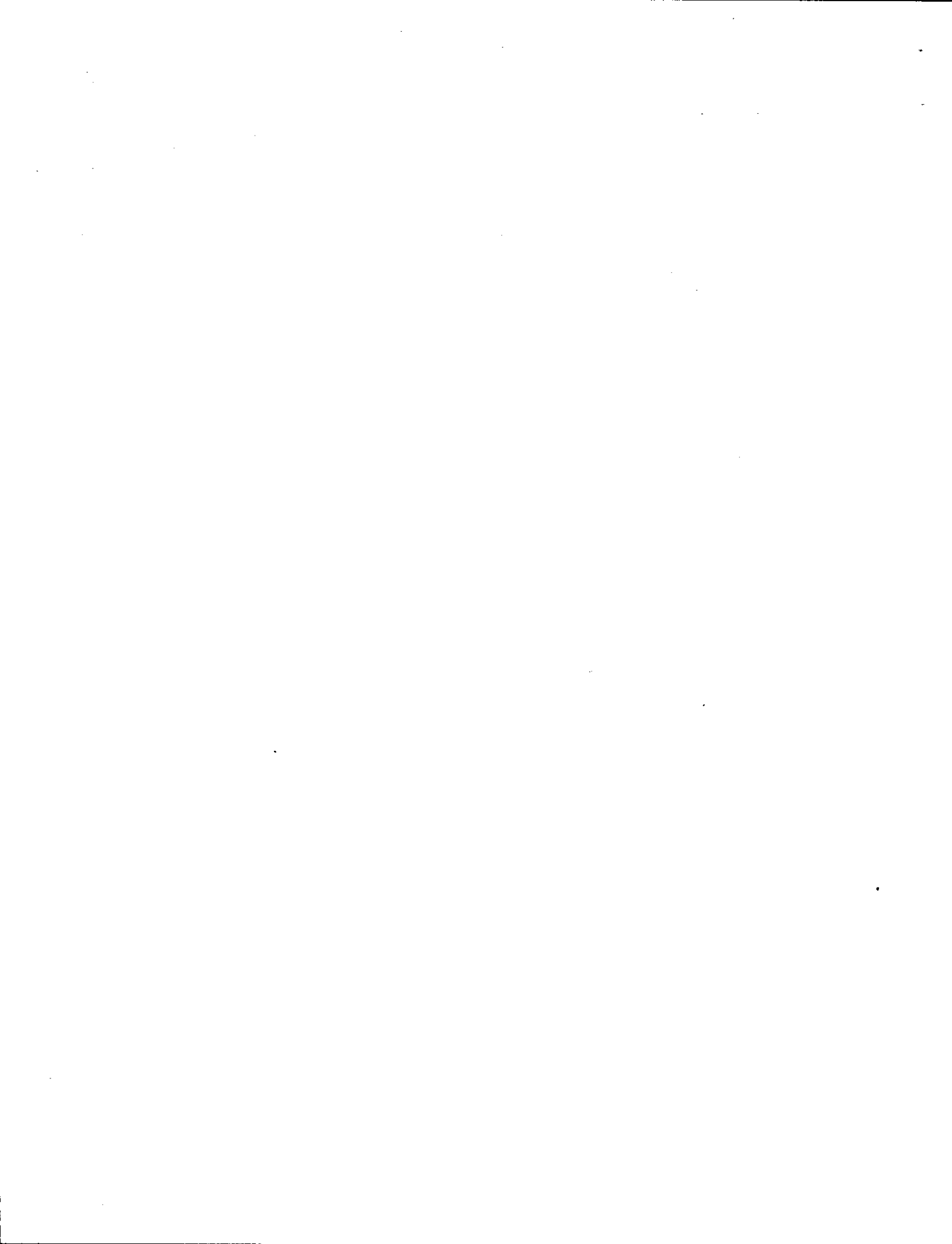
converted to one-way.

Actions involving land planning and land development along the freeway corridor could produce long-term benefits. Needed conversions to one-way frontage roads would be more acceptable to various interest groups if the area is not totally reliant on the frontage road for access and circulation. Advance planning and regulation are necessary to insure that these alternate circulation routes are in place when needed. The process for governmental approval of land plats or building permits along a two-way frontage road should provide for written notification to the applicant that the frontage road may be converted to one-way in the future. This notification should be on record, in the event of future questions. The SDHPT may need to work with local governments to bring about these recommended actions.



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3. Stover, V. G., W. G. Adkins, and J. C. Goodknight. Guidelines for Median and Marginal Access Control on Major Roadway. NCHRP Report 93. Highway Research Board, 1970.
4. Buffington, J.L., C. W. Herndon, and M. E. Weiss. Non-user Impacts of Different Highway Designs As Measured by Land Use and Land Value Changes. Research Report 225-2, Texas Transportation Institute, March 1978.
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APPENDIX A
ATTITUDE SURVEY INSTRUMENT



SURVEY OF ATTITUDES TOWARD FREEWAY FRONTAGE ROADS

Date _____
 City _____
 Name of Interviewee _____
 Affiliation _____

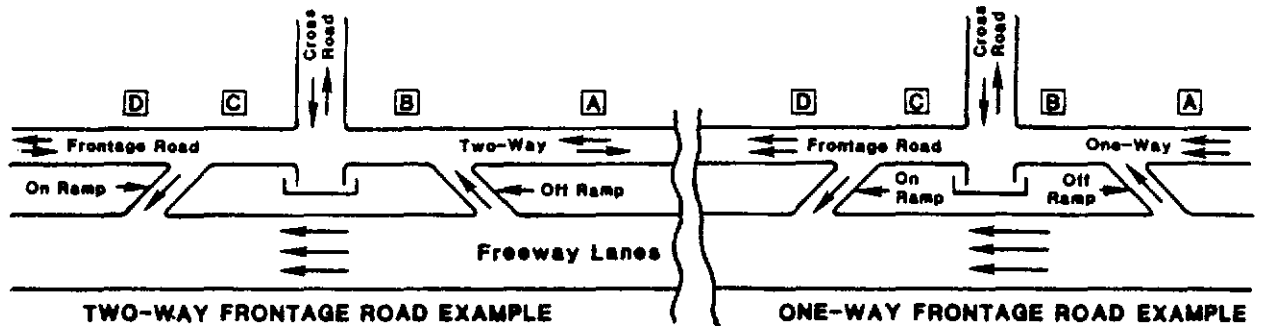
Interviewer _____
 in person _____; telephone _____.
 Frontage roads are currently:
 one-way _____; two-way _____.

1a. How do you classify your preference for one-way compared to 2-way traffic on freeway frontage roads in urban areas?

Strongly favor one-way	Somewhat favor one-way	No preference	Somewhat favor 2-way	Strongly favor 2-way
------------------------------	------------------------------	------------------	----------------------------	----------------------------

1b. Why? _____

2. In reference to the following sketch:



2a. Conversion of a two-way frontage road to one-way will have a detrimental effect on "highway oriented" businesses (service stations, motels and restaurants) at locations A and D.

Strongly Agree	Agree	No Opinion	Disagree	Strongly Disagree
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2b. Conversion of a two-way frontage road to one-way will have a detrimental effect on "highway oriented" businesses (service stations, motels, and restaurants) at locations B and C.

Strongly Agree	Agree	No Opinion	Disagree	Strongly Disagree
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3. Two-way frontage roads are safer than one-way frontage roads.

Strongly Agree	Agree	No Opinion Don't Know	Disagree	Strongly Disagree
-------------------	-------	--------------------------	----------	----------------------

4. The intersection of a frontage road and a cross street can carry more traffic after the frontage road is changed from two-way to one-way traffic.

Strongly Agree Agree No Opinion Don't Know Disagree Strongly Disagree

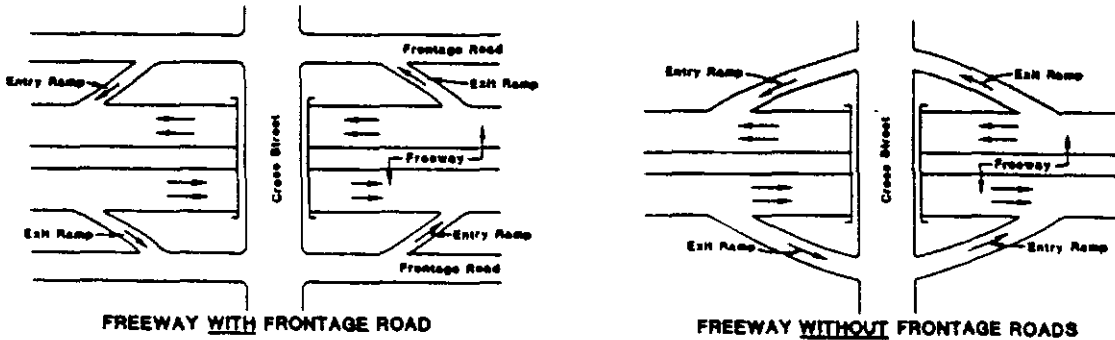
5. Frontage roads in urban areas should be one-way when first constructed.

Strongly Agree Agree No Opinion Disagree Strongly Disagree

6. The longer that two-way traffic is maintained on a freeway frontage road, the more opposition there is to a change to one-way.

Strongly Agree Agree No Opinion Disagree Strongly Disagree

7. Freeways should be built with entry and exit ramps but without frontage roads.



Strongly Agree Agree No Opinion Disagree Strongly Disagree

8. The presence of two-way frontage roads will lead to a failure to develop a supporting street system of alternative routes to using the frontage road.

Strongly Agree Agree No Opinion Don't Know Disagree Strongly Disagree

Explain _____

9. What effect does the conversion from two-way to one-way traffic have on the value of properties along the frontage road?

If the frontage roads, or some sections, in your city are presently two-way, then please respond to questions 10 thru 14.

10. What information would you like to have in making a decision on conversion from 2-way to one-way frontage road operation? _____

11. What would influence you most in making the decision to retain the 2-way operation or to convert to one-way? _____

12. What influence would traffic engineering guidelines for the conversion from 2-way to one-way traffic have on your decision to make the change?

Would follow the guidelines	Considerable influence	Some influence	No influence
--------------------------------	---------------------------	-------------------	-----------------

13. Does the presence of "TEMPORARY TWO-WAY" signing along the frontage road affect land development and business decisions?

Yes No Explain _____

14. What other comments do you have concerning freeway frontage roads?

If the frontage roads in your city are presently one-way, then please respond to questions 15 thru 17:

15. Now that the frontage roads are one-way, how would you judge their acceptance?

_____ Extremely high acceptance

_____ Good acceptance

_____ No opinion, No difference

_____ Some opposition

_____ Extremely high opposition

16. If there is opposition to the one-way operation, what interest groups are in opposition? What are their complaints? _____

17. What other comments do you have concerning freeway frontage roads?

If the frontage roads in your city have always been one-way, then please respond to questions 18 thru 20:

18. How would you judge the acceptance of the one-way frontage roads in your area?

- _____ Extremely high acceptance
- _____ Good acceptance
- _____ No opinion, No difference
- _____ Some opposition
- _____ Extremely high opposition

19. Has anyone proposed changing the frontage roads to two-way? If so, what interest groups have made the proposal, and for what reason?

20. What other comments do you have concerning freeway frontage roads?



Appendix B
TABULATION OF RESULTS

1. HOW DO YOU CLASSIFY YOUR PREFERENCE FOR ONE-WAY COMPARED TO 2-WAY TRAFFIC ON FREEWAY FRONTAGE ROADS IN URBAN AREAS?

CITY STAFF

Frontage road description	Strongly favor one-way	Somewhat favor one-way	No preference	Somewhat favor 2-way	Strongly favor 2-way	Totals
Some or always two-way	5	5	0	1	0	11
Converted to one-way	3	1	0	0	0	4
Always one-way	<u>2</u>	<u>1</u>	<u>0</u>	<u>0</u>	<u>1</u>	<u>4</u>
Staff total	10	7	0	1	1	19

CITY COUNCIL MEMBERS

Frontage road description	Strongly favor one-way	Somewhat favor one-way	No preference	Somewhat favor 2-way	Strongly favor 2-way	Totals
Some or always two-way	8	4	0	2	5	19
Converted to one-way	7	1	0	1	1	10
Always one-way	<u>1</u>	<u>2</u>	<u>1</u>	<u>1</u>	<u>0</u>	<u>5</u>
Council total	16	7	1	4	6	34

APPRAISERS

Frontage road description	Strongly favor one-way	Somewhat favor one-way	No preference	Somewhat favor 2-way	Strongly favor 2-way	Totals
Some or always two-way	1	3	1	1	2	8
Converted to one-way	2	1	0	0	0	3
Always one-way	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
Appraiser total	3	4	1	1	2	11

REAL ESTATE AND DEVELOPERS

Frontage road description	Strongly favor one-way	Somewhat favor one-way	No preference	Somewhat favor 2-way	Strongly favor 2-way	Totals
Some or always two-way	6	0	1	6	2	15
Converted to one-way	2	0	0	3	1	6
Always one-way	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>3</u>	<u>3</u>
Real/devel total	8	0	1	9	6	24

OWNERS/MGRS OF ABUTTING BUSINESSES

Frontage road description	Strongly favor one-way	Somewhat favor one-way	No preference	Somewhat favor 2-way	Strongly favor 2-way	Totals
Some or always two-way	2	1	0	3	11	17
Converted to one-way	1	2	0	1	6	10
Always one-way	<u>2</u>	<u>0</u>	<u>0</u>	<u>1</u>	<u>3</u>	<u>6</u>
Owner total	5	3	0	5	20	33
TOTAL	42	21	3	20	35	11

2. In reference to the following sketch:

2a. CONVERSION OF A TWO-WAY FRONTAGE ROAD TO ONE-WAY WILL HAVE A DETRIMENTAL EFFECT ON "HIGHWAY ORIENTED" BUSINESSES (SERVICE STATIONS, MOTELS AND RESTAURANTS) AT LOCATIONS A AND D.

CITY STAFF

Frontage road description	Strongly Agree	Agree	No Opinion	Disagree	Strongly Disagree	Totals
Some or always two-way	1	7	1	2	0	11
Converted to one-way	0	2	0	1	0	3
Always one-way	<u>0</u>	<u>3</u>	<u>0</u>	<u>1</u>	<u>0</u>	<u>4</u>
Staff Total	1	12	1	4	0	18

CITY COUNCIL MEMBERS

Frontage road description	Strongly Agree	Agree	No Opinion	Disagree	Strongly Disagree	Totals
Some or always two-way	4	13	0	1	1	19
Converted to one-way	2	7	0	1	0	10
Always one-way	<u>0</u>	<u>4</u>	<u>0</u>	<u>1</u>	<u>0</u>	<u>5</u>
Council Total	6	24	0	3	1	34

APPRAISERS

Frontage road description	Strongly Agree	Agree	No Opinion	Disagree	Strongly Disagree	Totals
Some or always two-way	2	5	0	1	0	8
Converted to one-way	1	2	0	0	0	3
Always one-way	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
Appraiser Total	3	7	0	1	0	11

REAL ESTATE AND DEVELOPERS

Frontage road description	Strongly Agree	Agree	No Opinion	Disagree	Strongly Disagree	Totals
Some or always two-way	4	9	0	1	1	15
Converted to one-way	3	3	0	0	0	6
Always one-way	<u>2</u>	<u>1</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>3</u>
Real/devel Total	9	13	0	1	1	24

OWNERS/MGRS OF ABUTTING BUSINESSES

Frontage road description	Strongly Agree	Agree	No Opinion	Disagree	Strongly Disagree	Totals
Some or always two-way	7	10	0	0	0	17
Converted to one-way	3	7	0	0	0	10
Always one-way	<u>1</u>	<u>5</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>6</u>
Owner total	11	22	0	0	0	33
TOTAL	30	78	1	9	2	120

2b. CONVERSION OF A TWO-WAY FRONTAGE ROAD TO ONE-WAY WILL HAVE A DETRIMENTAL EFFECT ON "HIGHWAY ORIENTED" BUSINESSES (SERVICE STATIONS, MOTELS, AND RESTAURANTS) AT LOCATIONS B AND C.

CITY STAFF

Frontage road description	Strongly Agree	Agree	No Opinion	Disagree	Strongly Disagree	Totals
Some or always two-way	0	1	2	8	0	11
Converted to one-way	0	1	0	1	1	3
Always one-way	<u>0</u>	<u>2</u>	<u>0</u>	<u>0</u>	<u>2</u>	<u>4</u>
Staff Total	0	4	2	9	3	18

CITY COUNCIL MEMBERS

Frontage road description	Strongly Agree	Agree	No Opinion	Disagree	Strongly Disagree	Totals
Some or always two-way	0	7	1	5	6	19
Converted to one-way	1	3	0	5	1	10
Always one-way	<u>0</u>	<u>2</u>	<u>0</u>	<u>2</u>	<u>1</u>	<u>5</u>
Council Total	1	12	1	12	8	34

APPRAISERS

Frontage road description	Strongly Agree	Agree	No Opinion	Disagree	Strongly Disagree	Totals
Some or always two-way	0	1	0	7	0	8
Converted to one-way	0	1	0	1	1	3
Always one-way	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
Appraiser Total	0	2	0	8	1	11

REAL ESTATE AND DEVELOPERS

Frontage road description	Strongly Agree	Agree	No Opinion	Disagree	Strongly Disagree	Totals
Some or always two-way	0	2	0	10	3	15
Converted to one-way	0	2	0	4	0	6
Always one-way	<u>0</u>	<u>2</u>	<u>0</u>	<u>1</u>	<u>0</u>	<u>3</u>
Real/level Total	0	6	0	15	3	24

OWNERS/MGRS OF ABUTTING BUSINESSES

Frontage road description	Strongly Agree	Agree	No Opinion	Disagree	Strongly Disagree	Totals
Some or always two-way	4	7	0	6	0	17
Converted to one-way	2	5	0	2	1	10
Always one-way	<u>1</u>	<u>3</u>	<u>0</u>	<u>2</u>	<u>0</u>	<u>6</u>
Owner Total	7	15	0	10	1	33
TOTAL	8	39	3	54	16	120

3. TWO-WAY FRONTAGE ROADS ARE SAFER THAN ONE-WAY FRONTAGE ROADS.

CITY STAFF

Frontage road description	Strongly Agree	Agree	No Opinion Don't Know	Disagree	Strongly Disagree	Totals
Some or always two-way	0	0	1	4	6	11
Converted to one-way	0	0	0	2	2	4
Always one-way	<u>0</u>	<u>0</u>	<u>1</u>	<u>2</u>	<u>1</u>	<u>4</u>
Staff Total	0	0	2	8	9	19

CITY COUNCIL MEMBERS

Frontage road description	Strongly Agree	Agree	No Opinion Don't Know	Disagree	Strongly Disagree	Totals
Some or always two-way	0	0	2	9	8	19
Converted to one-way	0	0	2	3	5	10
Always one-way	<u>0</u>	<u>0</u>	<u>0</u>	<u>2</u>	<u>3</u>	<u>5</u>
Council Total	0	0	4	14	16	34

APPRAISERS

Frontage road description	Strongly Agree	Agree	No Opinion Don't Know	Disagree	Strongly Disagree	Totals
Some or always two-way	1	0	1	3	3	8
Converted to one-way	0	0	0	2	1	3
Always one-way	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
Appraiser Total	1	0	1	5	4	11

REAL ESTATE AND DEVELOPERS

Frontage road description	Strongly Agree	Agree	No Opinion Don't Know	Disagree	Strongly Disagree	Totals
Some or always two-way	0	0	3	6	6	15
Converted to one-way	0	0	0	4	1	5
Always one-way	<u>1</u>	<u>0</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>4</u>
Real/devel Total	1	0	4	11	8	24

OWNERS/MGRS OF ABUTTING BUSINESSES

Frontage road description	Strongly Agree	Agree	No Opinion Don't Know	Disagree	Strongly Disagree	Totals
Some or always two-way	0	1	3	10	3	17
Converted to one-way	0	0	1	7	2	10
Always one-way	<u>0</u>	<u>0</u>	<u>0</u>	<u>5</u>	<u>1</u>	<u>6</u>
Owner Total	0	1	4	22	6	33
TOTAL	2	1	15	60	43	121

4. THE INTERSECTION OF A FRONTAGE ROAD AND A CROSS STREET CAN CARRY MORE TRAFFIC AFTER THE FRONTAGE ROAD IS CHANGED FROM TWO-WAY TO ONE-WAY TRAFFIC.

CITY STAFF

Frontage road description	Strongly Agree	Agree	No Opinion Don't Know	Disagree	Strongly Disagree	Totals
Some or always two-way	2	8	0	1	0	11
Converted to one-way	0	3	1	0	0	4
Always one-way	<u>0</u>	<u>3</u>	<u>1</u>	<u>0</u>	<u>0</u>	<u>4</u>
Staff Total	2	14	2	1	0	19

CITY COUNCIL MEMBERS

Frontage road description	Strongly Agree	Agree	No Opinion Don't Know	Disagree	Strongly Disagree	Totals
Some or always two-way	2	10	5	2	0	19
Converted to one-way	1	4	2	3	0	10
Always one-way	<u>0</u>	<u>4</u>	<u>1</u>	<u>0</u>	<u>0</u>	<u>5</u>
Council Total	3	18	8	5	0	34

APPRAISERS

Frontage road description	Strongly Agree	Agree	No Opinion Don't Know	Disagree	Strongly Disagree	Totals
Some or always two-way	0	4	2	2	0	19
Converted to one-way	0	3	0	0	0	3
Always one-way	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
Appraiser Total	0	7	2	2	0	11

REAL ESTATE AND DEVELOPERS

Frontage road description	Strongly Agree	Agree	No Opinion Don't Know	Disagree	Strongly Disagree	Totals
Some or always two-way	2	6	3	4	0	15
Converted to one-way	1	3	0	2	0	6
Always one-way	<u>1</u>	<u>0</u>	<u>1</u>	<u>1</u>	<u>0</u>	<u>3</u>
Real/devel Total	4	9	4	7	0	24

OWNERS/MGRS OF ABUTTING BUSINESSES

Frontage road description	Strongly Agree	Agree	No Opinion Don't Know	Disagree	Strongly Disagree	Totals
Some or always two-way	1	3	6	4	3	17
Converted to one-way	0	4	4	2	0	10
Always one-way	<u>0</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>0</u>	<u>6</u>
Owner Total	1	8	12	9	3	33
TOTAL	10	56	28	24	3	121

5. FRONTAGE ROADS IN URBAN AREAS SHOULD BE ONE-WAY WHEN FIRST CONSTRUCTED.

CITY STAFF

Frontage road description	Strongly Agree	Agree	No Opinion	Disagree	Strongly Disagree	Totals
Some or always two-way	5	4	1	1	0	11
Converted to one-way	0	4	0	0	0	4
Always one-way	<u>0</u>	<u>2</u>	<u>0</u>	<u>1</u>	<u>1</u>	<u>4</u>
Staff Total	5	10	1	2	1	19

CITY COUNCIL MEMBERS

Frontage road description	Strongly Agree	Agree	No Opinion	Disagree	Strongly Disagree	Totals
Some or always two-way	3	11	1	4	0	19
Converted to one-way	2	4	1	3	0	10
Always one-way	<u>0</u>	<u>4</u>	<u>1</u>	<u>0</u>	<u>0</u>	<u>5</u>
Council Total	5	19	3	7	0	34

APPRAISERS

Frontage road description	Strongly Agree	Agree	No Opinion	Disagree	Strongly Disagree	Totals
Some or always two-way	1	5	0	1	1	8
Converted to one-way	0	2	0	1	0	3
Always one-way	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
Appraiser Total	1	7	0	2	1	11

REAL ESTATE AND DEVELOPERS

Frontage road description	Strongly Agree	Agree	No Opinion	Disagree	Strongly Disagree	Totals
Some or always two-way	2	8	0	3	2	15
Converted to one-way	0	1	0	5	0	6
Always one-way	<u>0</u>	<u>0</u>	<u>0</u>	<u>1</u>	<u>2</u>	<u>3</u>
Real/level Total	2	9	0	9	4	24

OWNERS/MGRS OF ABUTTING BUSINESSES

Frontage road description	Strongly Agree	Agree	No Opinion	Disagree	Strongly Disagree	Total
Some or always two-way	2	4	1	6	4	17
Converted to one-way	0	3	4	2	1	10
Always one-way	<u>0</u>	<u>2</u>	<u>0</u>	<u>3</u>	<u>1</u>	<u>6</u>
Owner Total	2	9	5	11	6	33
TOTAL	15	54	9	31	12	121

6. THE LONGER THAT TWO-WAY TRAFFIC IS MAINTAINED ON A FREEWAY FRONTAGE ROAD, THE MORE OPPOSITION THERE IS TO A CHANGE TO ONE-WAY.

CITY STAFF

Frontage road description	Strongly Agree	Agree	No Opinion	Disagree	Strongly Disagree	Totals
Some or always two-way	8	3	0	0	0	11
Converted to one-way	2	2	0	0	0	4
Always one-way	<u>2</u>	<u>2</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>4</u>
Staff Total	12	7	0	0	0	19

CITY COUNCIL MEMBERS

Frontage road description	Strongly Agree	Agree	No Opinion	Disagree	Strongly Disagree	Totals
Some or always two-way	8	8	0	3	0	19
Converted to one-way	6	3	0	1	0	10
Always one-way	<u>2</u>	<u>1</u>	<u>2</u>	<u>0</u>	<u>0</u>	<u>5</u>
Council Total	16	12	2	4	0	34

APPRAISERS

Frontage road description	Strongly Agree	Agree	No Opinion	Disagree	Strongly Disagree	Totals
Some or always two-way	2	6	0	0	0	8
Converted to one-way	2	1	0	0	0	3
Always one-way	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
Appraiser Total	4	7	0	0	0	11

REAL ESTATE AND DEVELOPERS

Frontage road description	Strongly Agree	Agree	No Opinion	Disagree	Strongly Disagree	Totals
Some or always two-way	6	9	0	0	0	15
Converted to one-way	2	4	0	0	0	6
Always one-way	<u>2</u>	<u>1</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>3</u>
Real/devel Total	10	14	0	0	0	24

OWNERS/MGRS OF ABUTTING BUSINESSES

Frontage road description	Strongly Agree	Agree	No Opinion	Disagree	Strongly Disagree	Totals
Some or always two-way	7	8	0	1	1	17
Converted to one-way	5	4	0	0	1	10
Always one-way	<u>1</u>	<u>5</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>6</u>
Owner Total	13	17	0	1	2	33
TOTAL	55	57	2	5	2	121

7. FREEWAYS SHOULD BE BUILT WITH ENTRY AND EXIT RAMPS BUT WITHOUT FRONTAGE ROADS.

CITY STAFF

Frontage road description	Strongly Agree	Agree	No Opinion	Disagree	Strongly Disagree	Totals
Some or always two-way	2	1	1	6	1	11
Converted to one-way	0	1	1	1	1	4
Always one-way	<u>1</u>	<u>1</u>	<u>0</u>	<u>2</u>	<u>0</u>	<u>4</u>
Staff Total	3	3	2	9	2	19

CITY COUNCIL MEMBERS

Frontage road description	Strongly Agree	Agree	No Opinion	Disagree	Strongly Disagree	Totals
Some or always two-way	0	2	2	3	12	19
Converted to one-way	0	2	2	4	2	10
Always one-way	<u>0</u>	<u>1</u>	<u>0</u>	<u>4</u>	<u>0</u>	<u>5</u>
Council Total	0	5	4	11	14	34

APPRAISERS

Frontage road description	Strongly Agree	Agree	No Opinion	Disagree	Strongly Disagree	Totals
Some or always two-way	0	1	0	4	3	8
Converted to one-way	0	0	0	3	0	3
Always one-way	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
Appraisers Total	0	1	0	7	3	11

REAL ESTATE AND DEVELOPERS

Frontage road description	Strongly Agree	Agree	No Opinion	Disagree	Strongly Disagree	Totals
Some or always two-way	0	0	1	7	7	15
Converted to one-way	0	0	1	3	2	6
Always one-way	<u>0</u>	<u>0</u>	<u>0</u>	<u>2</u>	<u>1</u>	<u>3</u>
Real/devel Total	0	0	2	12	10	24

OWNERS/MGRS OF ABUTTING BUSINESSES

Frontage road description	Strongly Agree	Agree	No Opinion	Disagree	Strongly Disagree	Totals
Some or always two-way	0	3	0	6	8	17
Converted to one-way	1	0	2	2	5	10
Always one-way	<u>1</u>	<u>0</u>	<u>0</u>	<u>2</u>	<u>3</u>	<u>6</u>
Owner Total	2	3	2	10	16	33
TOTAL	5	12	10	49	45	121

8. THE PRESENCE OF TWO-WAY FRONTAGE ROADS WILL LEAD TO A FAILURE TO DEVELOP A SUPPORTING STREET SYSTEM OF ALTERNATIVE ROUTES TO USING THE FRONTAGE ROAD.

CITY STAFF

Frontage road description	Strongly Agree	Agree	No Opinion Don't Know	Disagree	Strongly Disagree	Totals
Some or always two-way	3	5	1	2	0	11
Converted to one-way	1	1	0	2	0	4
Always one-way	<u>1</u>	<u>2</u>	<u>1</u>	<u>0</u>	<u>0</u>	<u>4</u>
Staff Total	5	8	2	4	0	19

CITY COUNCIL MEMBERS

Frontage road description	Strongly Agree	Agree	No Opinion Don't Know	Disagree	Strongly Disagree	Totals
Some or always two-way	2	9	1	6	1	19
Converted to one-way	1	4	1	4	0	10
Always one-way	<u>0</u>	<u>4</u>	<u>0</u>	<u>1</u>	<u>0</u>	<u>5</u>
Council Total	3	17	2	11	1	34

APPRAISERS

Frontage road description	Strongly Agree	Agree	No Opinion Don't Know	Disagree	Strongly Disagree	Totals
Some or always two-way	0	3	1	4	0	8
Converted to one-way	0	3	0	0	0	3
Always one-way	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
Appraisers Total	0	6	1	4	0	11

REAL ESTATE AND DEVELOPERS

Frontage road description	Strongly Agree	Agree	No Opinion Don't Know	Disagree	Strongly Disagree	Totals
Some or always two-way	0	12	1	0	2	15
Converted to one-way	0	3	1	2	0	6
Always one-way	<u>0</u>	<u>2</u>	<u>0</u>	<u>0</u>	<u>1</u>	<u>3</u>
Real/Devel Total	0	17	2	2	3	24

OWNERS/MGRS OF ABUTTING BUSINESSES

Frontage road description	Strongly Agree	Agree	No Opinion Don't Know	Disagree	Strongly Disagree	Totals
Some or always two-way	1	5	3	7	1	17
Converted to one-way	0	3	2	5	0	10
Always one-way	<u>0</u>	<u>3</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>6</u>
Owner Total	1	11	6	13	2	33
TOTAL	9	59	13	34	6	121

12. WHAT INFLUENCE WOULD TRAFFIC ENGINEERING GUIDELINES FOR THE CONVERSION FROM 2-WAY TO ONE-WAY TRAFFIC HAVE ON YOUR DECISION TO MAKE THE CHANGE?

	Would Follow	Considerable Influence	Some Influence	No Influence	Totals
CITY STAFF	1	8	2	0	11
CITY COUNCIL MEMBERS	0	14	4	1	19
APPRAISERS	2	4	2	0	8
REAL AND DEVELOPERS	0	7	7	1	15
OWNERS/MGRS OF ABUTTING BUSINESSES	0	6	5	6	17
TOTAL	3	39	20	8	70

13. DOES THE PRESENCE OF "TEMPORARY TWO-WAY" SIGNING ALONG THE FRONTAGE ROAD AFFECT LAND DEVELOPMENT AND BUSINESS DECISIONS?

CITY STAFF

	YES	NO	DON'T KNOW	TOTAL
Some or always two-way	7	2	2	11
Converted to one-way	0	0	0	0
Always one-way	7	2	2	11
Staff Total	7	2	2	11

CITY COUNCIL MEMBERS

	YES	NO	DON'T KNOW	TOTAL
Some or always two-way	13	4	2	19
Converted to one-way	0	0	0	0
Always one-way	0	0	0	0
Council Total	13	4	2	19

	APPRAISERS			TOTAL
	YES	NO	DON'T KNOW	
Some or always two-way	6	1	1	8
Converted to one-way	0	0	0	0
Always one-way	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
Appraisers Total	6	1	1	8

	REAL ESTATE AND DEVELOPERS			TOTAL
	YES	NO	DON'T KNOW	
Some or always two-way	12	3	0	15
Converted to one-way	0	0	0	0
Always one-way	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
Real/devel Total	12	3	0	15

	OWNERS/MGRS OF ABUTTING BUSINESSES			TOTAL
	YES	NO	DON'T KNOW	
Some or always two-way	11	4	2	17
Converted to one-way	0	0	0	0
Always one-way	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
Owner Total	11	4	2	17
TOTAL	49	14	7	70

15. and 18. HOW WOULD YOU JUDGE THE ACCEPTANCE OF THE ONE-WAY FRONTAGE ROADS IN YOUR AREA?

CITY STAFF

	Extremely High Acceptance	Good Acceptance	No Opinion No Difference	Some Opposition	Extremely High Opposition	Total
Some or always two-way	na	na	na	na	na	na
Converted to one-way	0	2	2	0	0	4
Always one-way	<u>0</u>	<u>3</u>	<u>0</u>	<u>1</u>	<u>0</u>	<u>4</u>
Staff Total	0	5	2	1	0	8

CITY COUNCIL MEMBERS

	Extremely High Acceptance	Good Acceptance	No Opinion No Difference	Some Opposition	Extremely High Opposition	Total
Some or always two-way	na	na	na	na	na	na
Converted to one-way	0	5	0	4	1	10
Always one-way	<u>0</u>	<u>5</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>5</u>
Coun. Total	0	10	0	4	1	15

APPRAISERS

	Extremely High Acceptance	Good Acceptance	No Opinion No Difference	Some Opposition	Extremely High Opposition	Total
Some or always two-way	na	na	na	na	na	na
Converted to one-way	0	1	1	4	1	2
Always one-way	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>5</u>
Appr. Total	0	1	1	0	0	2

REAL ESTATE AND DEVELOPERS

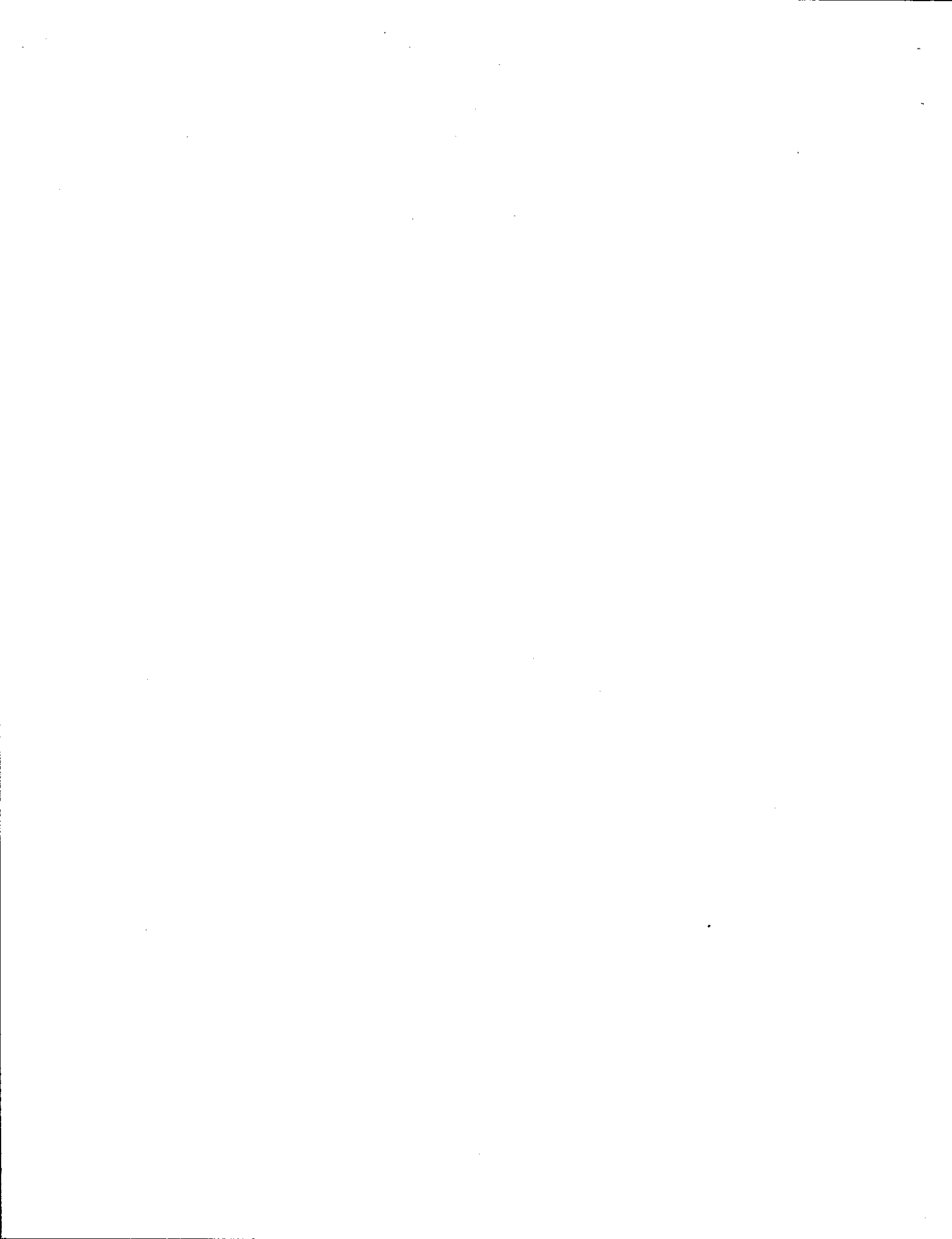
	Extremely High Acceptance	Good Acceptance	No Opinion No Difference	Some Opposition	Extremely High Opposition	Total
Some or always two-way	na	na	0	na	0	na
Converted to one-way	1	4	0	1	0	6
Always one-way	<u>0</u>	<u>1</u>	<u>0</u>	<u>2</u>	<u>0</u>	<u>3</u>
Real/devel Total	1	5	0	3	0	9

OWNERS/MGRS OF ABUTTING BUSINESSES

	Extremely High Acceptance	Good Acceptance	No Opinion No Difference	Some Opposition	Extremely High Opposition	Total
Some or always two-way	na	na	na	na	na	na
Converted to one-way	0	4	0	3	3	10
Always one-way	<u>1</u>	<u>1</u>	<u>0</u>	<u>4</u>	<u>0</u>	<u>6</u>
Owner Total	1	5	0	7	3	16
TOTAL	2	26	3	15	4	50

* na = not applicable

APPENDIX C
STATISTICAL ANALYSIS
OF
TOTAL INTERVIEW RESPONSES



TOTAL INTERVIEW RESPONSES

INTRODUCTION

The Chi-square statistical test is used to determine whether, for a given set of responses, it is probable that the responses are independent of response group. If the responses are not independent, the inference is that one group of respondees holds a different view than another group.

A minimum theoretical cell frequency of 5 is needed when applying the Chi-square test. It will be observed that the theoretical frequency is less than 5 in some cells. The resulting inflation in the Chi-square value was taken into account in interpreting the results and in drawing conclusions.

1. How do you classify your preference for one-way compared to 2-way traffic on freeway frontage roads in urban areas?

Observed Frequency, (Theoretical Frequency)

Group	Prefer & Strongly Prefer One-Way	No Preference	Prefer & Strongly Prefer Two-Way	Total	Proportion
Council	23 (17.7)	1 (0.84)	10 (15.5)	34	0.281
Staff	17 (9.9)	0 (0.48)	2 (8.6)	19	0.157
Owners/Mgrs	8 (17.2)	0 (0.82)	25 (15.0)	33	0.273
Developers & Appraisers	15 (18.8)	2 (0.87)	18 (15.9)	35	0.299
Total	63	3	55	121	
Proportion	0.521	0.025	0.454	1.000	1.000

H_0 : Responses are independent of response group

H_a : Responses are not independent of response group

$$\alpha = 0.10$$

The theoretical frequencies for "No Opinion" are all less than 5.00; therefore, the Chi-square test was performed for "agree" and disagree" as follows:

TOTAL INTERVIEW RESPONSES

Group	Agree or Strongly Agree	Disagree or Strongly Disagree	Total	Proportion
Council	23 (17.6)	10 (15.4)	33	0.28
Staff	17 (10.2)	2 (8.9)	19	0.16
Owners/Mgrs	8 (17.6)	25 (15.4)	33	0.28
Developers & Appraisers	15 (17.6)	18 (15.4)	33	0.28
Total	63	55	118	
Proportion	0.53	0.47		1.000

$$\chi^2 = 25.48 > \chi_{3,0.10}^2 = 6.25$$

$$\chi^2 \text{ calculated} = 29.12 > \chi_{6,0.10}^2 = 10.64$$

There is a statistically significant correlation between responses and respondent groups (at the 10% significance level.) Owners and managers of businesses and developers favor two-way frontage roads, city council members and city staff favor one-way.

The 90% confidence limits on the proposition preferring one-way frontage roads are:

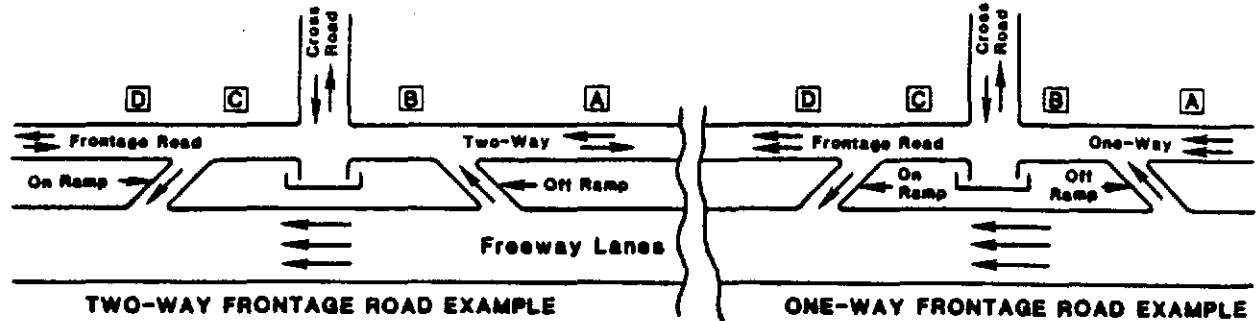
$$\begin{aligned} \text{CL } 0.90 &= 0.521 \pm (1.645) \frac{(0.521)(0.479)}{121}^{1/2} \\ &= 0.521 \pm 0.074 \end{aligned}$$

$$\text{LCL} = 0.447, \text{ UCL} = 0.594$$

The proportion of the population favoring one-way frontage roads could be as low as 45%.

TOTAL INTERVIEW RESPONSES

2. In reference to the following sketch:



2a Conversion of a two-way frontage road to one-way will have a detrimental effect on "highway oriented" businesses (service stations, motels and restaurants) at locations A and D.

Observed Frequency, (Theoretical Frequency)

Group	Agree or Strongly Agree	No Opinion	Disagree or Strongly Disagree	Total	Proportion
Council	30 (30.60)	0 (0.28)	4 (3.12)	34	0.283
Staff	13 (16.20)	1 (0.15)	4 (1.65)	18	0.150
Owners/Mgrs	33 (29.70)	0 (0.29)	0 (3.02)	33	0.275
Developers & Appraisers	32 (31.50)	0 (0.29)	3 (3.21)	35	0.292
Total	108	1	11	120	
Proportion	0.900	0.008	0.912		1.000

Several cells have a theoretical frequency of less than 5.0. Therefore it was necessary to aggregate the data and perform the Chi-square test as follows:

TOTAL INTERVIEW RESPONSES

Group	Agree or Strongly Agree	Disagree or Strongly Disagree	Total	Proportion
Council and Staff	43 (46.3)	8 (4.7)	51	0.43
Owners/Mgrs., Developers and Appraisers	65 (61.7)	3 (6.3)	68	0.57
Total	108	11	119	
Proportion	0.91	0.09		1.000

$$\chi^2 = 4.46 > \chi^2_{1,0.10} = 2.71$$

H₀: Responses are independent of group

H_a: Responses are not independent of group

$$\alpha = 0.10$$

There is statistical evidence, at the 10% significance level, that city council members and city staff may hold a different opinion than owners, managers, developers, and appraisers as to the detrimental effect of one-way traffic on businesses located upstream of an off-ramp or downstream from an on-ramp. The calculated and critical values of Chi-square are nearly equal, therefore any correlation between opinions and respondent group is not of practical significance.

The 90% confidence limits on the proportion agreeing are:

$$\begin{aligned} \text{CL } 0.90 &= 0.900 \pm (1.645) \frac{(0.900)(0.100)}{120}^{1/2} \\ &= 0.90 \pm 0.045 \end{aligned}$$

$$\text{LCL} = 0.855 \quad \text{UCL} = 0.945$$

Conversion of a two-way frontage road to one-way at locations A and D are considered to have a detrimental effect on "highway oriented" business by at least 85% of respondents.

TOTAL INTERVIEW RESPONSES

2b Conversion of a two-way frontage road to one-way will have a detrimental effect on "highway oriented" businesses (service stations, motels, and restaurants) at locations B and C.

Observed Frequency, (Theoretical Frequency)

Group	Agree or Strongly Agree	No Opinion	Disagree or Strongly Disagree	Total	Proportion
Council	13 (13.32)	1 (0.85)	20 (19.83)	34	0.283
Staff	4 (7.05)	2 (0.45)	12 (10.50)	18	0.150
Owners/Mgrs	22 (12.92)	0 (0.83)	11 (19.25)	33	0.275
Developers & Appraisers	8 (13.71)	0 (0.88)	27 (20.42)	35	0.292
Total	47	3	70	120	1.000
Proportion	0.392	0.025	0.583		

Several cells have a theoretical frequency of less than 5.0. Therefore it was necessary to aggregate the data and perform the Chi-square tests as follows:

Group	Agree or Strongly Agree	Disagree or Strongly Disagree	Total	Proportion
Council	13 (13.3)	20 (19.7)	33	0.28
Staff	4 (6.4)	12 (9.6)	16	0.14
Owners/Mgrs.	22 (13.3)	11 (19.7)	33	0.28
Developers & Appraisers	8 (14.0)	27 (20.9)	35	0.30
Total	47	70	117	
Proportion	0.40	0.60		1.000

$$\chi^2 = 15.40 > \chi^2_{3,0.10} = 6.25$$

H_0 : Responses are independent of response group.

H_a : Responses are not independent of response group.

$$\alpha = 0.10$$

$$\chi^2 \text{ calculated} = 23.03 > \chi^2_{6,0.10} = 10.64$$

TOTAL INTERVIEW RESPONSES

At the 10% significant level there is a statistically significant correlation between responses and respondent group. All groups except owners and managers disagree with the statement; they are of the opinion that conversion to one-way traffic will not have a detrimental effect on businesses located between an off-ramp and an on-ramp. It is interesting to note that most developers and appraisers are of this opinion.

The 90% confidence limits on the proportion agreeing are:

$$CL\ 0.90 = 0.392 \pm (1.645) \frac{(0.392)(0.608)}{121}^{1/2}$$

$$= 0.392 \pm 0.073$$

$$LCL = 0.219 \quad UCL = 0.465$$

The proportion of the population who believe that the conversion of two-way frontage road to one-way at locations B and C will have a detrimental effect on "highway oriented" business could be as low as 22%.

3. Two-way frontage roads are safer than one-way frontage roads.

Observed frequency, (Theoretical Frequency)

Group	Agree or Strongly Agree	No Opinion	Disagree or Strongly Disagree	Total	Proportion
Council	0 (0.84)	4 (4.21)	30 (28.94)	34	0.281
Staff	0 (0.47)	2 (2.36)	17 (16.17)	19	0.157
Owners/Mgrs	1 (0.82)	4 (4.09)	28 (28.09)	33	0.273
Developers & Appraisers	2 (0.87)	5 (4.34)	28 (29.79)	35	0.289
Total	3	15	103	121	
Proportion	0.025	0.124	0.851		1.000

Several cells have a theoretical frequency of less than 5.0. Therefore the data were aggregated as follows:

TOTAL INTERVIEW RESPONSES

Group	Agree, Strongly Agree or No Opinion	Disagree or Strongly Disagree	Total	Proportion
Council	4 (5.05)	30 (28.94)	34	0.281
Staff	2 (2.83)	17 (16.17)	19	0.153
Owners/Mgrs	5 (4.91)	28 (28.09)	33	0.273
Developers & Appraisers	7 (5.21)	28 (29.79)	35	0.289
Total	18	103	121	
Proportion	0.149	0.851		1.000

H_0 : Responses are independent of group.

H_a : Responses are not independent of group.

$$\alpha = 0.10$$

$$X^2 \text{ calculated} = 1.35, X^2_{3,0.10} = 6.25$$

There is no significant relationship between responses and respondent group. All groups of respondents are of the opinion that one-way frontage roads are safer than two-way frontage roads.

The 90% confidence limits on the proportion disagreeing are:

$$\begin{aligned} CL \ 0.90 &= 0.851 \pm (1.645) \frac{(0.851)(0.149)}{121} \\ &= 0.851 \pm 0.053 \end{aligned}$$

$$LCL = 0.798, UCL = 0.904$$

One-way frontage roads are considered to be safer than two-way by at least 80% of respondents.

TOTAL INTERVIEW RESPONSES

4. The intersection of a frontage road and a cross street can carry more traffic after the frontage road is changed from two-way to one-way traffic.

Observed Frequency, (Theoretical Frequency)

Group	Agree or Strongly Agree	No Opinion	Disagree or Strongly Disagree	Total	Proportion
Council	21 (18.5)	8 (7.9)	30 (28.94)	34	0.281
Staff	16 (10.4)	2 (4.4)	17 (16.17)	19	0.157
Owners/Mgrs	9 (18.0)	2 (7.6)	28 (28.09)	33	0.273
Developers & Appraisers	20 (19.1)	6 (8.1)	9 (7.8)	35	0.289
Total	66	28	27	121	
Proportion	0.545	0.231	0.223		1.000

H₀: Responses are independent of response group.

H_a: Responses are not independent of response group.

$\alpha = 0.10$

$\chi^2 \text{ calculated} = 18.67 > \chi^2_{6,0.10} = 10.64$

There is a statistically significant relationship between responses and response group (at the 10% significance level). Business owners and managers exhibited a lower than expected level of agreement, while city staff had a higher than expected agreement.

The 90% confidence limits on the proportion disagreeing are:

$$CL \ 0.90 = 0.545 \pm (1.645) \frac{(0.545)(0.455)}{121}^{1/2}$$

$$= 0.545 \pm 0.074$$

LCL = 0.471, UCL = 0.619

The proportion who believe that one-way frontage roads result in greater capacity than two-way may be as low as 47%.

TOTAL INTERVIEW RESPONSES

5. Frontage roads in urban areas should be one-way when first constructed.

Observed Frequency, (Theoretical Frequency)

Group	Agree or Strongly Agree	No Opinion	Disagree or Strongly Disagree	Total	Proportion
Council	24 (19.4)	3 (2.5)	7 (12.1)	34	0.281
Staff	15 (10.8)	1 (1.4)	3 (6.8)	19	0.157
Owners/Mgrs	11 (18.8)	5 (2.5)	17 (11.7)	33	0.273
Developers & Appraisers	19 (20.0)	0 (2.6)	16 (12.4)	35	0.289
Total	69	9	43	121	
Proportion	0.570	0.074	0.356		1.000

The theoretical frequencies for "No Opinion" are all less than 5.00, therefore, the Chi-square test was performed for "agree" and "disagree" as follows:

Group	Agree, Strongly Agree or No Opinion	Disagree or Strongly Disagree	Total	Proportion
Council	24 (19.1)	7 (11.9)	31	0.28
Staff	15 (11.1)	3 (6.9)	18	0.16
Owners/Mgrs	11 (17.2)	17 (10.8)	28	0.25
Developers & Appraisers	19 (21.6)	16 (13.4)	35	0.31
Total	69	43	112	
Proportion	0.62	0.38		1.000

H₀: Responses are independent of response group.

H_a: Responses are not independent of response group.

$\alpha = 0.10$

$X^2 \text{ calculated} = 13.56 > X^2_{3,0.10} = 6.25$

At the 0.10 significance level, there is a statistically significant difference between responses and response group. Council and staff favor frontage roads being one-way initially, while owners, managers, and land interests oppose this.

TOTAL INTERVIEW RESPONSES

The 90% confidence limiting on the proportion agreeing are:

$$CL\ 0.90 = 0.570 \pm (1.645) \frac{(0.570)(0.430)}{121}^{1/2}$$

$$LCL = 0.496\ UCL = 0.644$$

The proportion of people favoring one-way traffic when frontage roads are favored constructed is about 50%.

6. The longer that two-way traffic is maintained on a freeway frontage road, the more opposition there is to a change to one-way.

Observed Frequency, (Theoretical Frequency)

Group	Agree or Strongly Agree	No Opinion	Disagree or Strongly Disagree	Total	Proportion
Council	28 (31.5)	2 (2.0)	4 (2.0)	34	0.281
Staff	19 (17.6)	0 (0.3)	0 (1.1)	19	0.157
Owners/Mgrs	30 (30.5)	0 (0.5)	3 (1.9)	33	0.273
Developers & Appraisers	35 (32.4)	0 (0.6)	0 (2.0)	35	0.289
Total	112	2	7	121	1.000
Proportion	0.926	0.016	0.058	1.000	

H₀: Responses are independent of response group.

H_a: Responses are not independent of response group.

$$\alpha = 0.10$$

Most cells have a theoretical frequency of less than 5.0. Since all the data cannot be aggregated in a meaningful manner, the Chi-square test cannot be performed. However inspection of the data shows that there is no relationship between responses and response groups.

The 90% confidence limits on proportion agreeing are:

$$CL\ 0.90 = 0.926 \pm (1.645) \frac{(0.926)(0.074)}{121}^{1/2}$$

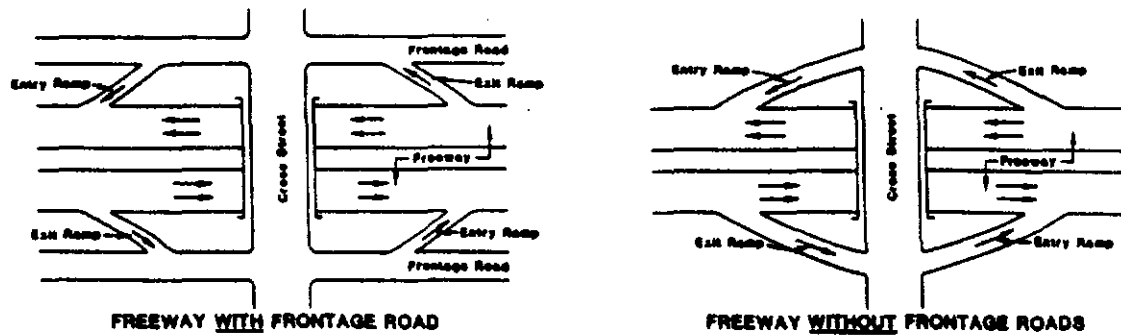
$$= 0.926 \pm 0.039$$

$$LCL = 0.895,\ UCL = 0.965$$

TOTAL INTERVIEW RESPONSES

At least 90% of the populations are of the opinion that the larger frontage roads are two-way, the more opposition there is to a change to one-way.

7. Freeways should be built with entry and exit ramps but without frontage roads.



Observed Frequency, (Theoretical Frequency)

Group	Agree or Strongly Agree	No Opinion	Disagree or Strongly Disagree	Total	Proportion
Council	5 (4.8)	4 (2.8)	25 (26.4)	34	0.281
Staff	6 (2.7)	2 (1.6)	11 (14.8)	19	0.157
Owners/Mgrs	5 (4.6)	2 (2.7)	26 (25.6)	33	0.273
Developers & Appraisers	1 (4.9)	2 (2.9)	32 (27.2)	35	0.289
Total	17	10	94	121	
Proportion	0.140	0.083	0.777		1.000

Only the Disagree/Strongly Disagree cells have theoretical values of 5.0 or greater. The small cell frequencies in "agree" column precludes performing the test on "agree" and "disagree". Therefore the agree, strongly agree, and no opinion were combined. While this aggregation is not conceptually desirable, it does permit some statistical evaluation of the correlation between responses and response groups.

TOTAL INTERVIEW RESPONSES

Group	Agree, Strongly Agree or No Opinion	Disagree or Strongly Disagree	Total	Proportion
Council	9 (7.6)	25 (26.4)	34	0.281
Staff	8 (4.3)	11 (14.8)	19	0.157
Owners/Mgrs	7 (7.3)	26 (25.6)	33	0.273
Developers & Appraisers	3 (7.8)	32 (27.2)	35	0.289
Total	27	94	121	
Proportion	0.223	0.777		1.000

H_0 : Responses are independent of response group.

H_a : Responses are not independent of response group.

$$\alpha = 0.10$$

$$X^2 \text{ calculated} = 5.11 < X^2_{3,0.10} = 6.25$$

At the 10% significance level, there is no statistically significant relationship between responses and response groups.

The 90% confidence limiting on proportion disagreeing are:

$$\begin{aligned} CL \ 0.90 &= 0.777 \pm (1.645) \frac{(0.777)(0.223)}{121}^{1/2} \\ &= 0.777 \pm 0.062 \end{aligned}$$

$$LCL = 0.725 \quad UCL = 0.839$$

At least 72% of the population are of the opinion that urban freeways should be constructed with frontage roads (90% confidence).

TOTAL INTERVIEW RESPONSES

8. The presence of two-way frontage roads will lead to a failure to develop a supporting street system of alternative routes to using the frontage road.

Observed Frequency, (Theoretical Frequency)

Group	Agree or Strongly Agree	No Opinion	Disagree or Strongly Disagree	Total	Proportion
Council	20 (19.1)	2 (3.7)	12 (11.2)	34	0.281
Staff	13 (10.7)	2 (2.0)	4 (6.3)	19	0.157
Owners/Mgrs	12 (18.5)	6 (3.5)	15 (10.9)	33	0.273
Developers & Appraisers	23 (19.7)	3 (3.8)	9 (11.6)	35	0.289
Total	68	13	40	121	
Proportion	0.562	0.107	0.331		1.000

All "no opinion" cells have a theoretical frequency of less than 5.0. Therefore the Chi-square test was performed on "agree" and disagree as follows:

Group	Agree, Strongly Agree or No Opinion	Disagree or Strongly Disagree	Total	Proportion
Council	20 (20.1)	12 (11.9)	32	0.30
Staff	13 (10.7)	4 (6.3)	17	0.16
Owners/Mgrs	12 (17.0)	15 (10.0)	27	0.25
Developers & Appraisers	23 (20.1)	9 (11.9)	32	0.30
Total	68	40	108	
Proportion	0.63	0.37		1.000

H_0 : Responses are independent of response group.

H_a : Responses are not independent of response group.

$$\alpha = 0.10$$

$$\chi^2 \text{ calculated} = 6.43 < \chi^2_{3,0.10} = 6.25$$

At the 10% significance level, there may be a statistically significant relationship between responses and response group. In view of the small difference in the calculated and critical values of Chi-Square, the difference is considered to be insignificant.

TOTAL INTERVIEW RESPONSES

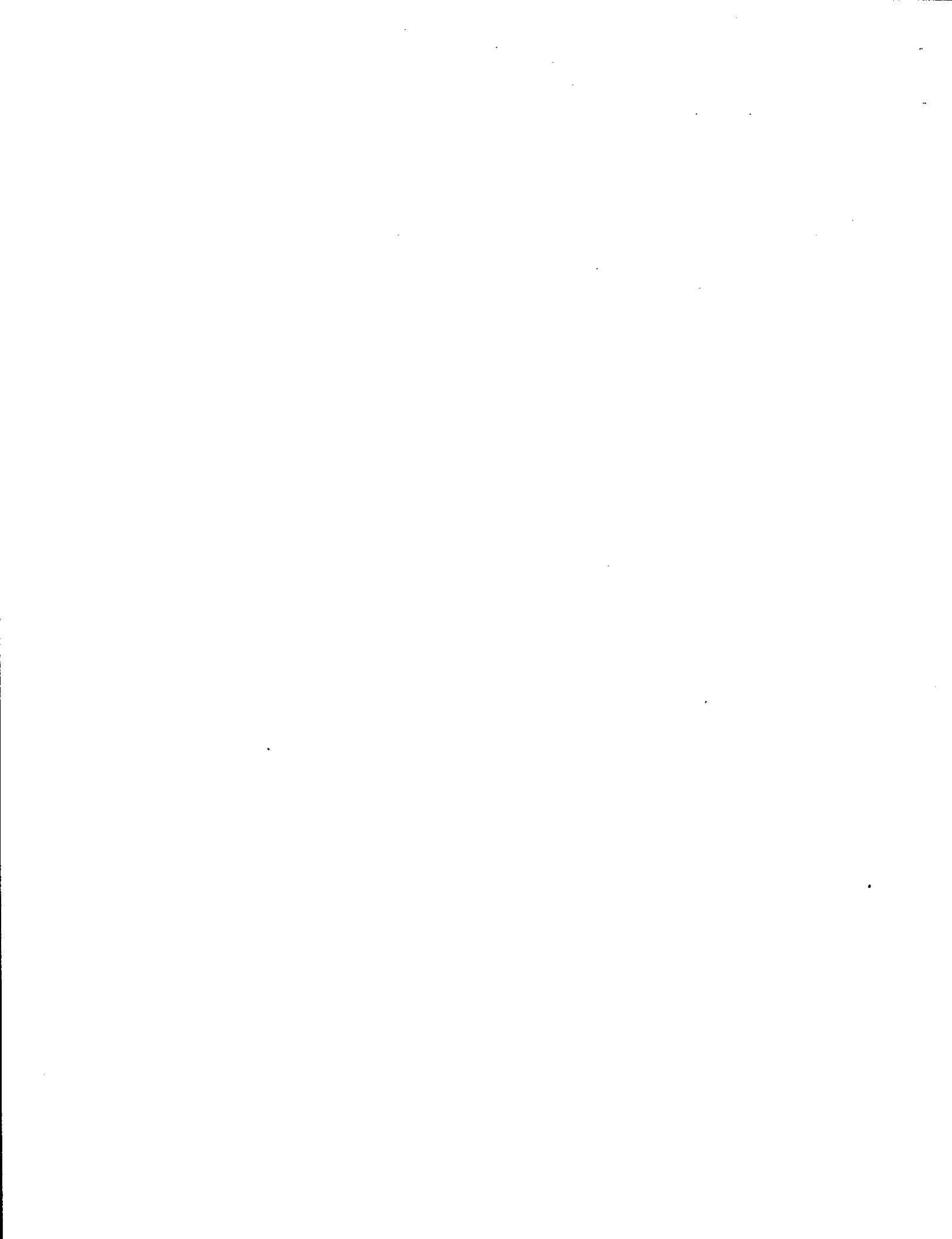
The 90% confidence limits on the proportion agreeing are:

$$\begin{aligned} \text{CL } 0.90 &= 0.562 \pm (1.645) \frac{(0.562)(0.438)}{121}^{1/2} \\ &= 0.562 \pm 0.074 \end{aligned}$$

$$\text{LCL} = 0.488 \quad \text{UCL} = 0.636$$

At least 49% of the population are of the opinions that two-way frontage roads result in a failure to develop an alternate street system.

APPENDIX D
STATISTICAL ANALYSIS
OF
RESPONSES WHERE SOME OR ALL
FRONTAGE ROADS ARE TWO-WAY



RESPONSES WHERE SOME OR ALL FRONTAGE ROADS ARE TWO-WAY

The Chi-square tables in this appendix are shown after adjustment to obtain a minimum cell frequency of 5.0. In many cases this was done by deleting the "no opinion" response. Therefore, the total number of responses will differ from question to question even though there were 70 respondents.

1a How do you classify your preference for one-way compared to 2-way traffic on freeway frontage roads in urban areas?

Observed Frequency, (Theoretical Frequency)

Group	Favor One-Way	Favor Two-Way	Total	Proportion
Council & Staff	22 (15.0)	8 (14.1)	30	0.429
Others	13 (20.0)	25 (18.9)	40	0.571
Total	35	33	70	
Proportion	0.500	0.471		1.000

H_0 : Responses are independent of response group.

H_a : Responses are not independent of response group.

$$\alpha = 0.10$$

$$X^2 \text{ calculated} = 10.40 > X^2_{1,0.10} = 2.71$$

There is a statistically significant relationship between responses and response group (at the 0.10% significance level). Council and staff favor one-way, other respondents favor two-way frontage roads.

The 90% confidence limits on the proportion agreeing are:

$$\begin{aligned} \text{CL } 0.90 &= 0.500 \pm 1.645 \frac{(0.500)(0.500)^{1/2}}{70} \\ &= 0.500 \pm 0.098 \end{aligned}$$

$$\text{LCL} = 0.402, \text{ UCL} = 0.598$$

RESPONSES WHERE SOME OR ALL FRONTAGE ROADS ARE TWO-WAY

2. In reference to the following sketch:

(See Appendix A, Attitude Survey Instrument)

2a Conversion of a two-way frontage road to one-way will have a detrimental effect on "highway oriented" businesses (service stations, motels and restaurants at locations A and D.

Observed Frequency

Group	Agree or Strongly Agree	Disagree or Strongly Disagree	Total	Proportion
Council & Staff	25 (26.1)	4 (2.9)	29	0.420
Others	37 (35.9)	3 (4.1)	40	0.580
Total	62	7	69	
Proportion	0.899	0.101		1.000

H_0 : Responses are independent of response group.

H_a : Responses are not independent of response group.

$$\alpha = 0.10$$

$$\chi^2 \text{ calculated} = 0.50 < \chi^2_{1,0.10} = 2.71$$

Accept H_0 : there appears to be no relationship between responses and response group at the 10% significant level.

The 90% confidence limits on the proportion agreeing are:

$$\begin{aligned} \text{CL } 0.90 &= 0.886 \pm 1.645 \frac{(0.886)(0.104)}{70}^{1/2} \\ &= 0.886 \pm 0.060 \end{aligned}$$

$$\text{LCL} = 0.826, \text{ UCL} = 0.946$$

RESPONSES WHERE SOME OR ALL FRONTAGE ROADS ARE TWO-WAY

2b Conversion of a two-way frontage road to one-way will have a detrimental effect on "highway oriented" businesses (service stations, motels, and restaurants) at locations B and C.

Group	Agree or Strongly Agree	Disagree or Strongly Disagree	Total	Proportion
Council & Staff	8 (9.4)	19	30	0.429
Others	14 (12.6)	26 (25.7)	40	0.571
Total	22	45	70	
Proportion	0.314	0.643		1.000

H_0 : Responses are independent of response group.

H_a : Responses are not independent of response group.

$$\alpha = 0.10$$

$$X^2 \text{ calculated} = 4.30 < X^2_{2,0.10} = 4.61$$

Reject H_0 : There is no statistically significant relationship between responses and response group (at the 10% significant level).

The 90% confidence limits on proportion disagreeing are:

$$\begin{aligned} \text{CL } 0.90 &= 0.314 \pm 1.645 \frac{(0.314)(0.686)}{70}^{1/2} \\ &= 0.314 \pm 0.091 \end{aligned}$$

$$\text{LCL} = 0.223, \text{ UCL} = 0.405$$

RESPONSES WHERE SOME OR ALL FRONTAGE ROADS ARE TWO-WAY

3. Two-way frontage roads are safer than one-way frontage roads.

Group	Agree or Strongly Agree	Disagree or Strongly Disagree	Total	Proportion
Council & Staff	3 (0.9)	27 (24.9)	30	0.429
Others	9 (6.8)	31 (33.1)	40	0.571
Total	12	58	70	
Proportion	0.172	0.828		1.000

H_0 : Responses are independent of response group.

H_a : Responses are not independent of response group.

$\alpha = 0.10$

$X^2 \text{ calculated} = 1.95 < X^2_{1,0.10} = 2.71$

Reject H_a : There is no statistically significant relationship between responses and response group (at the 10% significant level).

The 90% confidence limits on proportion disagreeing are:

$$CL \ 0.90 = 0.828 \pm 1.645 \frac{(0.828)(0.172)}{70}^{1/2}$$

$$= 0.828 \pm 0.074$$

LCL = 0.754, UCL = 0.903

RESPONSES WHERE SOME OR ALL FRONTAGE ROADS ARE TWO-WAY

4. The intersection of a frontage road and a cross street can carry more traffic after the frontage road is changed from two-way to one-way traffic.

Group	Agree or strongly Agree	No Opinion	Disagree or Strongly Disagree	Total	Proportion
Council & Staff	22 (16.3)	5 (6.9)	3 (6.9)	30	0.429
Others	16 (21.7)	11 (9.1)	13 (9.1)	40	0.571
Total	38	16	16	70	
Proportion	0.542	0.229	0.229		1.000

H_0 : Responses are independent of response group.

H_a : Responses are not independent of response group.

$$\alpha = 0.10$$

$$X^2 \text{ calculated} = 8.29 > X^2_{1,0.10} = 2.71$$

Accept H_a : There is a statistically significant relationship between responses and response group (at the 10% significance level). Owners, managers, and developers do not appreciate the capacity advantage of one-way frontage roads.

The 90% confidence limits on proportion agreeing are:

$$CL \ 0.90 = 0.542 \pm 1.645 \frac{(0.542)(0.458)}{70}^{1/2}$$

$$= 0.542 \pm 0.098$$

$$LCL = 0.444, \ UCL = 0.640$$

RESPONSES WHERE SOME OR ALL FRONTAGE ROADS ARE TWO-WAY

5. Frontage roads in urban areas should be one-way when first constructed.

Group	Agree or strongly Agree	Disagree or Strongly Disagree	Total	Proportion
Council & Staff	23 (18.8)	5 (9.2)	28	0.418
Others	22 (26.9)	17 (12.6)	39	0.582
Total	45	22	67	
Proportion	0.672	0.328		1.000

H_0 : Responses are independent of response group.

H_a : Responses are not independent of response group.

$$\alpha = 0.10$$

$$X^2 \text{ calculated} = 4.91 > X^2_{1,0.10} = 2.71$$

Accept H_a : There is a statistically significant relationship between responses and response group (at the 10% significance level).

The 90% confidence limits on the proportion agreeing are:

$$\begin{aligned} CL_{0.90} &= 0.671 \pm (1.645) \frac{(0.671)(0.329)}{70}^{1/2} \\ &= 0.671 \pm 0.092 \end{aligned}$$

$$LCL = 0.579, UCL = 0.763$$

RESPONSES WHERE SOME OR ALL FRONTAGE ROADS ARE TWO-WAY

6. The longer that two-way traffic is maintained on a freeway frontage road, the more opposition there is to a change to one-way.

Group	Agree or Strongly Agree	Disagree or Strongly Disagree	Total	Proportion
Council & Staff	27 (27.9)	3 (2.1)	30	0.429
Others	38 (37.1)	2 (2.9)	40	0.571
Total	65	5	70	
Proportion	0.929	0.071		1.000

H_0 : Responses are independent of response group.

H_a : Responses are not independent of response group.

$$\alpha = 0.10$$

$$X^2 \text{ calculated} = 0.72 < X^2_{1,0.10} = 2.71$$

Reject H_a : There is no statistically significant relationship between responses and response group (at the 10% significance level).

The 90% confidence limits on the proportion agreeing are:

$$\begin{aligned} \text{CL } 0.90 &= 0.929 \pm 1.645 \frac{(0.929)(0.071)}{70}^{1/2} \\ &= 0.929 \pm 0.050 \end{aligned}$$

$$\text{LCL} = 0.879, \text{ UCL} = 0.979$$

RESPONSES WHERE SOME OR ALL FRONTAGE ROADS ARE TWO-WAY

7. Freeways should be built with entry and exit ramps but without frontage roads.

(See Appendix A, Attitude Survey Instrument)

Group	Agree or Strongly Agree	Disagree or Strongly Disagree	Total	Proportion
Council & Staff	5 (3.7)	22 (23.3)	27	0.409
Others	4 (5.3)	35 (33.7)	39	0.591
Total	9	57	66	
Proportion	0.136	0.864		1.000

H_0 : Responses are independent of response group.

H_a : Responses are not independent of response group.

$$\alpha = 0.10$$

$$X^2 \text{ calculated} = 0.90 < X^2_{1,0.10} = 2.71$$

There is no statistically significant relationship between responses and response group (at the 10% significance level).

The 90% confidence limits on the proportion agreeing are:

$$\begin{aligned} \text{CL } 0.90 &= 0.814 \pm 1.645 \frac{(0.814)(0.186)}{70}^{1/2} \\ &= 0.814 \pm 0.076 \end{aligned}$$

$$\text{LCL} = 0.738, \text{ UCL} = 0.890$$

RESPONSES WHERE SOME OR ALL FRONTAGE ROADS ARE TWO-WAY

8. The presence of two-way frontage roads will lead to a failure to develop a supporting street system of alternative routes to using the frontage road.

Group	Agree or strongly Agree	Disagree or Strongly Disagree	Total	Proportion
Council & Staff	19 (17.8)	9 (10.2)	28	0.444
Others	21 (22.2)	14 (12.8)	35	0.556
Total	40	23	63	
Proportion	0.635	0.365		1.000

H_0 : Responses are independent of response group.

H_a : Responses are not independent of response group.

$$\alpha = 0.10$$

$$X^2 \text{ calculated} = 0.40 < X^2_{1,0.10} = 2.71$$

There is no statistically significant relationship between responses and response group (at the 0.10% significance level).

The 90% confidence limits on the proportion agreeing are:

$$\begin{aligned} CL \ 0.90 &= 0.571 \pm 1.645 \frac{(0.571)(0.429)}{70}^{1/2} \\ &= 0.571 \pm 0.093 \end{aligned}$$

$$LCL = 0.478, \ UCL = 0.664$$

RESPONSES WHERE SOME OR ALL FRONTAGE ROADS ARE TWO-WAY

12. What influence would traffic engineering guidelines for the conversion from 2-way to one-way traffic have on your decision to make the change?

Observed Frequency, (Theoretical Frequency)

Group	Follow or Considerable Influence	Some Influence or No Influence	Total	Proportion
Council & Staff	15 (18.0)	7 (12)	30	0.429
Others	19 (24.0)	21 (16)	40	0.571
Total	42	28	70	
Proportion	0.600	0.400		1.000

H_0 : Responses are independent of response group.

H_a : Responses are not independent of response group.

$$\alpha = 0.10$$

$$X^2 \text{ calculated} = 5.19 > X^2_{1,0.10} = 2.71$$

Accept H_a : There is a statistically significant relationship between responses and response group (at the 10% significance level). Council members and city staff are more receptive to traffic engineering guidelines than other groups.

The 90% confidence limits on at least some influence are:

$$\begin{aligned} CL \ 0.90 &= 0.886 - 1.645 \frac{(0.886)(0.114)}{70}^{1/2} \\ &= 0.886 - 0.062 \end{aligned}$$

$$LCL = 0.824, \ UCL = 0.948$$

Traffic engineering guidelines would have some influence on at least 82% of those in areas where frontage roads are two-way.

RESPONSES WHERE SOME OR ALL FRONTAGE ROADS ARE TWO-WAY

13. Does the presence of "TEMPORARY TWO-WAY" signing along the frontage road affect land development and business decisions?

Observed Frequency, (Theoretical Frequency)

Group	Yes	No	Don't Know	Total	Proportion
Council & Staff	20 (21.0)	6 (6.0)	4 (3.0)	30	0.429
Others	29 (28.0)	8 (8.0)	3 (4.0)	40	0.571
Total	49	14	7	70	
Proportion	0.700	0.200	0.100		1.000

H_0 : Responses are independent of response group.

H_a : Responses are not independent of response group.

$$\alpha = 0.10$$

$$\chi^2 \text{ calculated} = 0.67 < \chi^2_{8,0.10} = 3.49$$

Reject H_a : There appears to be no significant relationship between responses and response group.

The 90% confidence limits on the yes response are:

$$\begin{aligned} CL_{0.90} &= 0.700 - (1.645) \frac{(0.700)(0.300)}{70}^{1/2} \\ &= 0.700 - 0.090 \end{aligned}$$

$$LCL = 0.610, UCL = 0.790$$

At least 61% of those residing in areas where the frontage roads are two-way are of the opinion that "TEMPORARY TWO-WAY" signs have an affect on development and business decisions.

APPENDIX E
STATISTICAL ANALYSIS
OF
RESPONSES WHERE FRONTAGE ROADS
HAVE BEEN CONVERTED TO ONE-WAY
OR HAVE ALWAYS BEEN ONE-WAY

RESPONSES WHERE FRONTAGE ROADS HAVE BEEN CONVERTED TO ONE-WAY OR HAVE ALWAYS BEEN ONE-WAY

In some cases the "no opinion" responses were eliminated because of low theoretical cell frequencies. In other cases, the responses were aggregated. Therefore the total number of responses vary from question to question.

1. How do you classify your preference for one-way compared to 2-way traffic on freeway frontage roads in urban areas?

Observed Frequency, (Theoretical Frequency)

Group	Favor One-Way	Favor Two-Way	Total	Proportion
Council & Staff	18 (12.3)	4 (9.7)	22	0.440
Others	10 (15.7)	18 (12.3)	28	0.560
Total	28	22	50	
Proportion	0.560	0.440		1.000

H_0 : Responses are independent of response group.

H_a : Responses are not independent of response group.

$$\alpha = 0.10$$

$$\chi^2 \text{ calculated} = 9.53 > \chi^2_{1,0.10} = 2.71$$

Accept H_a : There is a statistically significant relationship between responses and response group (at the 10% significance level). Council and staff favor one-way, while others favor two-way.

The 90% confidence limits on proportion favoring one-way are:

$$\begin{aligned} \text{CL } 0.90 &= 0.549 \pm (1.645) \frac{(0.549)(0.451)}{51}^{1/2} \\ &= 0.549 \pm 0.115 \end{aligned}$$

$$\text{LCL} = 0.431, \text{ UCL} = 0.664$$

RESPONSES WHERE FRONTAGE ROADS HAVE BEEN CONVERTED TO ONE-WAY OR HAVE ALWAYS BEEN ONE-WAY

2. In reference to the following sketch:
(See Appendix A, Attitude Survey Instrument)

2a. Conversion of a two-way frontage road to one-way will have a detrimental effect on "highway oriented" businesses (service stations, motels and restaurants) at locations A and D.

Observed Frequency, (Theoretical Frequency)

Group	Agree or Strongly Agree	Disagree or Strongly Disagree	Total	Proportion
Council & Staff	18 (20.7)	5 (2.3)	23	0.451
Others	28 (25.3)	0 (2.7)	28	0.549
Total	46	5	51	
Proportion	0.902	0.098		1.000

H₀: Responses are independent of response group.
H_a: Responses are not independent of response group.

$$\alpha = 0.10$$

The Chi-square test can not be applied because aggregation to a theoretical cell frequency of 5 or more would result in less than two cells in each row and column. However, there appears to be little or no relationship between responses and response group.

The 90% confidence limits on proportion agreeing are:

$$\begin{aligned} CL\ 0.90 &= 0.902 \pm (1.645) \frac{(0.902)(0.098)}{51}^{1/2} \\ &= 0.902 \pm 0.068 \end{aligned}$$

$$LCL = 0.834, UCL = 0.970$$

RESPONSES WHERE FRONTAGE ROADS HAVE BEEN CONVERTED TO ONE-WAY OR HAVE ALWAYS BEEN ONE-WAY

2b. Conversion of a two-way frontage road to one-way will have a detrimental effect on "highway oriented" businesses (service stations, motels, and restaurants) at locations B and C.

Observed Frequency, (Theoretical Frequency)

Group	Agree or Strongly Agree	Disagree or Strongly Disagree	Total	Proportion
Council & Staff	9 (11.0)	13 (11.0)	22	0.440
Others	16 (14.0)	12 (14.0)	28	0.560
Total	25	25	50	
Proportion	0.500	0.500		1.000

H_0 : Responses are independent of response group.

H_a : Responses are not independent of response group.

$$\alpha = 0.10$$

$$X^2 \text{ calculated} = 1.30 < X^2_{1,0.10} = 2.71$$

Reject H_a : There is no statistically significant relationship between responses and response group (at the 10% significance level).

The 90% confidence limits on proportion agreeing are:

$$\begin{aligned} CL \ 0.90 &= 0.500 \pm (1.645) \frac{(0.500)(0.500)^{1/2}}{50} \\ &= 0.500 \pm 0.116 \end{aligned}$$

$$LCL = 0.384, \ UCL = 0.616$$

RESPONSES WHERE FRONTAGE ROADS HAVE BEEN CONVERTED TO ONE-WAY OR HAVE ALWAYS BEEN ONE-WAY

3. Two-way frontage roads are safer than one-way frontage roads.

Observed Frequency, (Theoretical Frequency)

Group	Agree or strongly Agree	No Opinion	Disagree or Strongly Disagree	Total	Proportion
Council & Staff	0 (0.5)	3 (2.3)	20 (20.3)	23	0.451
Others	1 (0.5)	2 (2.7)	25 (24.7)	28	0.549
Total	1	5	45	51	
Proportion	0.020	0.098	0.882		1.000

H_0 : Responses are independent of response group.

H_a : Responses are not independent of response group.

$$\alpha = 0.10$$

The Chi-square test cannot be applied because aggregation to a theoretical cell frequency of 5 or more would result in less than two cells in each row and column. However, there appears to be little or no relationship between responses and response group.

The 90% confidence limits on proportion disagreeing are:

$$\begin{aligned} CL\ 0.90 &= 0.882 \pm (1.645) \frac{(0.882)(0.118)}{51}^{1/2} \\ &= 0.882 \pm 0.074 \end{aligned}$$

$$LCL = 0.808, UCL = 0.956$$

RESPONSES WHERE FRONTAGE ROADS HAVE BEEN CONVERTED TO ONE-WAY OR HAVE ALWAYS BEEN ONE-WAY

4. The intersection of a frontage road and a cross street can carry more traffic after the frontage road is changed from two-way to one-way traffic.

Observed Frequency, (Theoretical Frequency)

Group	Agree or Strongly Agree	No Opinion	Disagree or Strongly Disagree	Total	Proportion
Council & Staff	15 (12.6)	5 (5.4)	3 (5.0)	23	0.451
Others	13 (15.4)	7 (6.6)	8 (6.0)	28	0.549
Total	28	12	11	51	
Proportion	0.549	0.235	0.216		1.000

H_0 : Responses are independent of response group.

H_a : Responses are not independent of response group.

$$\alpha = 0.10$$

$$X^2 \text{ calculated} = 2.35 < X^2_{2,0.10} = 4.61$$

Reject H_a : There is no statistically significant relationship between responses and response group (at the 10% significance level).

The 90% confidence limits on proportion agreeing are:

$$\begin{aligned} CL_{0.90} &= 0.549 \pm (1.645) \frac{(0.549)(0.451)}{51}^{1/2} \\ &= 0.549 \pm 0.115 \end{aligned}$$

$$LCL = 0.434, UCL = 0.664$$

RESPONSES WHERE FRONTAGE ROADS HAVE BEEN CONVERTED TO ONE-WAY OR HAVE ALWAYS BEEN ONE-WAY

5. Frontage roads in urban areas should be one-way when first constructed.

Observed Frequency, (Theoretical Frequency)

Group	Agree or Strongly Agree	Disagree or Strongly Disagree	Total	Proportion
Council & Staff	16 (11.2)	5 (9.8)	21	0.467
Others	8 (12.8)	16 (11.2)	24	0.533
Total	24	21	45	
Proportion	0.533	0.467		1.000

H_0 : Responses are independent of response group.

H_a : Responses are not independent of response group.

$$\alpha = 0.10$$

$$\chi^2 \text{ calculated} = 8.27 > \chi^2_{1,0.10} = 2.71$$

Accept H_a : There is a statistically significant relationship between responses and response group at the 10% significance level. Council and staff favor one-way frontage roads from the outset, while others do not.

The 90% confidence limits on proportion agreeing are:

$$\begin{aligned} \text{CL } 0.90 &= 0.470 \pm (1.645) \frac{(0.470)(0.530)}{51}^{1/2} \\ &= 0.470 \pm 0.115 \end{aligned}$$

$$\text{LCL} = 0.355, \text{ UCL} = 0.585$$

RESPONSES WHERE FRONTAGE ROADS HAVE BEEN CONVERTED TO ONE-WAY OR HAVE ALWAYS BEEN ONE-WAY

6. The longer that two-way traffic is maintained on a freeway frontage road, the more opposition there is to a change to one-way.

Observed Frequency, (Theoretical Frequency)

Group	Agree or Strongly Agree	No Opinion	Disagree or Strongly Disagree	Total	Proportion
Council & Staff	20 (21.2)	2 (0.9)	1 (0.9)	23	0.451
Others	27 (25.8)	0 (1.1)	1 (1.1)	28	0.549
Total	47	2	2	51	
Proportion	0.922	0.039	0.039		1.000

H_0 : Responses are independent of response group.

H_a : Responses are not independent of response group.

$$\alpha = 0.10$$

The Chi-square test cannot be applied because aggregation to a theoretical cell frequency of 5 or more would result in less than 2 cells in each row and column.

However, by inspection, there appears to be no relationship between responses and response group.

The 90% confidence limits on proportion agreeing are:

$$\begin{aligned} CL\ 0.90 &= 0.922 \pm (1.645) \frac{(0.922)(0.078)}{51}^{1/2} \\ &= 0.922 \pm 0.062 \end{aligned}$$

$$LCL = 0.860, UCL = 0.984$$

RESPONSES WHERE FRONTAGE ROADS HAVE BEEN CONVERTED TO ONE-WAY OR HAVE ALWAYS BEEN ONE-WAY

7. Freeways should be built with entry and exit ramps but without frontage roads.

Observed Frequency, (Theoretical Frequency)

Group	Agree Strongly Agree or No Opinion	Disagree or Strongly Disagree	Total	Proportion
Council & Staff	9 (6.3)	14 (16.7)	23	0.451
Others	5 (7.7)	23 (20.3)	28	0.549
Total	14	37	51	
Proportion	0.275	0.725		1.000

H_0 : Responses are independent of response group.

H_a : Responses are not independent of response group.

$$\alpha = 0.10$$

$$X^2 \text{ calculated} = 2.90 > X^2_{1,0.10} = 2.71$$

Accept H_a : There is a statistically significant relationship between responses and response group (at the 10% significance level).

The 90% confidence limits on proportion disagreeing are:

$$\begin{aligned} CL \ 0.90 &= 0.725 \pm (1.645) \frac{(0.725)(0.275)}{51}^{1/2} \\ &= 0.725 \pm 0.102 \end{aligned}$$

$$LCL = 0.623, \ UCL = 0.827$$

RESPONSES WHERE FRONTAGE ROADS HAVE BEEN CONVERTED TO ONE-WAY OR HAVE ALWAYS BEEN ONE-WAY

8. The presence of two-way frontage roads will lead to a failure to develop a supporting street system of alternative routes to using the frontage road.

Observed Frequency, (Theoretical Frequency)

Group	Agree or Strongly Agree	Disagree or Strongly Disagree	Total	Proportion
Council & Staff	14 (13.1)	7 (7.9)	21	0.467
Others	14 (14.9)	10 (9.1)	24	0.533
Total	28	17	45	
Proportion	0.622	0.378		1.000

H_0 : Responses are independent of response group.

H_a : Responses are not independent of response group.

$$\alpha = 0.10$$

$$X^2 \text{ calculated} = 0.31 < X^2_{1,0.10} = 2.71$$

Reject H_a : There is no statistically significant relationship between responses and response group (at the 10% significance level).

The 90% confidence limits on proportion agreeing are:

$$\begin{aligned} \text{CL } 0.90 &= 0.549 \pm (1.645) \frac{(0.549)(0.451)}{51}^{1/2} \\ &= 0.549 \pm 0.115 \end{aligned}$$

$$\text{LCL} = 0.334, \text{ UCL} = 0.664$$

RESPONSES WHERE FRONTAGE ROADS HAVE BEEN CONVERTED TO ONE-WAY OR HAVE ALWAYS BEEN ONE-WAY

15/18 Now that the frontage roads are one-way, how would you judge their acceptance?

Observed Frequency

Group	Acceptance	Opposition	Total	Proportion
Council & Staff	15 (12.9)	6 (8.5)	21	0.447
Others	13 (15.1)	13 (10.5)	26	0.533
Total	28	19	47	
Proportion	0.596	0.404		1.000

H_0 : Responses are independent of response group.

H_a : Responses are not independent of response group.

$$\alpha = 0.10$$

$$X^2 \text{ calculated} = 2.23 < X^2_{1,0.10} = 2.71$$

Reject H_a : There is no statistically significant relationship between responses and response group at the 10% significance level.

The 90% confidence limits on proportion indicating acceptance are:

$$\begin{aligned} \text{CL } 0.90 &= 0.560 \pm (1.645) \frac{(0.560)(0.440)}{50}^{1/2} \\ &= 0.560 \pm 0.115 \end{aligned}$$

$$\text{LCL} = 0.445, \text{ UCL} = 0.675$$

Where frontage roads have been converted to one-way or have always been one-way operation, the percentage of the population accepting the change may be as low as 45%.

APPENDIX F

PERSPECTIVE OF A NATIONAL CHAIN

Our interviews with local developers led to a contact with a representative of a major fast-food restaurant chain. We interviewed the representative, who is responsible for selecting sites for new stores over a large part of the state. (The representative is not one of the 121 interviewees.)

This company has made a science out of site selection. They study traffic patterns, access to the site, and the potential for changes in the future.

The representative favored the presence of frontage roads, and preferred two-way for maximum access to the store. The representative noted that in visiting company operations in other parts of the county, different development methods were observed.

When choosing a site for a new store, barriers to the street circulation system that would limit access to the store are identified. The representative said that a site would not be chosen if it did not have other access in addition to a frontage road.

Some have stated that on radial freeways the "going home" side is better situated from a business point of view. The representative stated that they have found that the side does not matter; customers will cross over the freeway to come to them. What does matter is intersection congestion. It is also important that the store be downstream of the freeway exit ramp.

The representative noted that other types of businesses will have different needs and perspectives. Local restaurants may not be able to attract the thru traveler like the national chains can, so the local restaurant will have to draw customers who come from the local area. Other businesses, such as motels, may have different customer attraction traffic patterns.

