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LAND USE IMPACT OF IMPROVING SECTION ONE OF WESTHEIMER
ROAD IN A DEVELOPING AREA IN HOUSTON, TEXAS

by

Cary W. Herndon, Jr.
Research Associate

and

Jesse L. Buffington
Research Economist

Research Report 225-12
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Economics of Highway Design Alternatives

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PREFACE

The authors wish to acknowledge the assistance that others have given in conducting this study. Special thanks are due Mr. James W. Barr and Mr. James R. Farrar of the Texas State Department of Highways and Public Transportation. Also, Mr. Robert Todd, Mr. Merwyn Hirsh, and Mr. Chris Olavson of the Houston-Galveston Regional Transportation Study were helpful in providing materials and data sources.

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Members of the Texas Transportation Institute staff have rendered valuable assistance. Mrs. Pamela J. Cosby provided guidance in the collection of data and in the writing of the manuscript. Special assistance was given by Ms. Karen Spohr in typing and reviewing this manuscript.

The contents of this report reflect the views of the authors who are responsible for the facts and the accuracy of the data presented within. The contents do not necessarily reflect the official views or policies of the Federal Highway Administration. This report does not constitute a standard, specification, or regulation.

ABSTRACT

The majority of previous land use impact studies have been devoted to investigating the effects that new highway construction has on land use change and development. In view of the new emphasis placed upon upgrading and redesigning existing facilities rather than building new ones, highway planners need information relative to the influence that existing facility improvement has on area land uses. This report relates the findings of such an improvement which occurred in Houston, Texas when Section One of Westheimer Road (F.M. 1093), between Chimney Rock and Hillcroft-Voss, was upgraded from a two-lane rural type road to a six-lane divided thoroughfare. Prior to the improvement, the study area was described as a developing area in which the predominant land use was unimproved. Abutting and nonabutting properties were analyzed to determine the impact that the Westheimer Road improvement had on land development relative to location of property within the Study Area. Land use inventory data were collected for four study period years: 1962, the first "before" year; 1964, the last "before" year and first "construction" year; 1970, the last "construction" year and first "after" year; and 1978, the last "after" year. The 16-year study period includes two "before" years, six "construction" years, and eight "after" years. Comparisons of the type and rate of land use change were made between each of the three analysis periods to determine the impact of the improvement on area development. The results are reported in narrative, graphic, and tabular form.

Other factors affecting land development were also investigated and included in this report. Highway planners should be able to implement this and subsequent reports of this study to make more accurate predictions of land use change relative to specific highway improvement projects.

SUMMARY OF FINDINGS

Land use data were collected for the Westheimer Road (F.M. 1093), Section One Study Area (located in Houston, Texas) to determine the probable impact of upgrading Westheimer Road, between Chimney Rock and Hillcroft-Voss, from a two-lane, undivided road with open drainage to a six-lane, divided street with raised median and curbs and gutters. The effects on the amount, rate, and type of land use change in this developing urban-fringe area were studied. An inventory of land uses was collected for four selected years during a 16-year study period, 1962-78, which includes: two years prior to construction, six years in which construction took place, and eight years after construction was completed.

Summarizing the findings:

- (1) The 659.3 acre Study Area has undergone many changes in land use. The percentage of developed acreage in the area has increased considerably during the overall period, from 49.9% in 1962 to 93.3% in 1978.
 - (a) The stage of development in the Study Area has changed from developing to developed.
 - (b) The predominant type of land use has also changed. Unimproved land was the predominant land use during the first study period years but by 1978, multi-family residential use had become the most plentiful land use category.
 - (c) Multi-family residential use recorded the highest absolute increase (195.90 acres) while public use experienced the greatest percentage increase (494.12%) between 1962 and 1978. Acreage increases were also found in the commercial (122.82 acres), streets and roads (13.16 acres), and semi-public (5.11 acres) categories during the same time span.

- (d) Unimproved acreage underwent the greatest absolute decrease (285.80 acres) and the greatest percentage decrease (100%) was experienced in the industrial use category. Single-family residential use also recorded a decline in acreage (53.29 acres) during the overall period.
- (2) Properties defined as abutting Westheimer Road, 174.98 acres, experienced many changes in land use between 1962 and 1978, during which the percentage of developed acreage has grown from 46.0% to 91.2%.
- (a) The predominant abutting land use changed from unimproved to commercial during the 16-year period.
 - (b) Commercial acreage increased from 34.24 acres in 1962 to 101.13 acres in 1978, or by 66.89 acres, which was the greatest absolute increase in development recorded by land use category. Multi-family residential use also experienced an increase from 0 to 19.84 acres over the total study period.
 - (c) Unimproved acreage was being developed steadily throughout the analysis period. A total of 79.15 acres of unimproved land were developed during the 16-year span, which was the greatest absolute decrease recorded for the Study Area. Redevelopment of single-family residences into commercial uses occurred during each of the three periods until all of the single-family residential tracts (10.38 acres) had become commercial acreage.
 - (d) Over 58% of the abutting acreage recorded a change in land use of which 83% was the development of previously unimproved land. The

redevelopment of single-family residential tracts was the most important type of land use change on previously improved land.

- (3) The remaining 484.32 acres in the Study Area were defined as nonabutting property. Considerable amounts of land use change and development were recorded on nonabutting acreage, and the percentage of developed land increased from 51.3% in 1962 to 94% in 1978.
- (a) The predominant nonabutting land use evolved from unimproved to multi-family residential during the study period.
 - (b) Multi-family residential acreage increased from 0 acres in 1962 to 176.06 acres in 1978. Approximately 67.2% of the multi-family residential development occurred on previously unimproved acreage. The remaining increase was attributed to the redevelopment of single-family residential tracts in the southeastern portion of the Study Area.
 - (c) Nonabutting commercial development also increased from 0 acres in 1962 to 55.93 acres in 1978 with 77.5% occurring on previously unimproved land. Small acreage increases were also recorded in the streets and roads, public, and semi-public land use categories during the study period.
 - (d) Unimproved acreage experienced the greatest absolute decrease (206.65 acres) while industrial land experienced the greatest percentage decrease (100%). The redevelopment of single-family residential tracts has resulted in a decrease of 43.01 acres between 1962 and 1978.

- (4) The percentage of the Study Area acreage experiencing a change in land use fluctuated during the three time periods. In the "before" period (1962-64), almost 13.1% underwent a change; in the "construction" period (1964-70), 12% changed land uses; and in the "after" period (1970-78), over 32.4% of the area recorded a land use change.
- (a) The average annual percentage of total Study Area land use change was 3.59% during the 16-year overall period. The average annual rate of change was 6.54% for the "before" period, 1.99% for the "construction" period, and 4.06% for the "after" period. The annual rate of change was expected to be higher in the "construction" and "after" periods than for the "before" period. However, this does not mean that the street improvement failed to influence land development in the area. If the facility had not been improved, it is quite probable that land development in the area would have been even slower in the last two periods.
- (b) Somewhat surprisingly, the average annual rate of land use change during the overall period was similar for both the abutting (3.64%) and nonabutting (3.57%) properties. Abutting properties were expected to experience a considerably higher rate of change than nonabutting properties.
- (c) As expected, the average annual rate of change for the entire analysis period was much higher in the previously unimproved acreage (2.76%) than in previously improved property (0.83%).
- (5) Several factors have facilitated land use change and development in the Westheimer Road, Section One Study Area.

- (a) The growth of Houston toward the west, the availability of large tracts of undeveloped land, and the fact that Westheimer Road is the major traffic artery providing access to the developing area has made property in the Study Area some of the most attractive land in the state for commercial and multi-family residential development.
- (b) Greater accessibility to the general region provided by the completion and improvement of the area's thoroughfare network, including Westheimer Road, has influenced Study Area land development.

IMPLEMENTATION STATEMENT

This report relates the findings of a case study on land use changes that have occurred after an existing street was improved. The findings can be implemented immediately by highway agencies in predicting what might happen as a result of a similar street improvement in a comparable area elsewhere.

This case study is one of several being done in Texas cities. The predictive capabilities will be increased after analysis and comparison of data from all areas is accomplished. Those findings will be described in other reports.

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INTRODUCTION

Purpose and Objectives of Study

The near completion of the Interstate Highway System, the completion of many urban freeways, and the increasing shortage of funds for future highway construction have caused state highway agencies to turn to upgrading and expanding the vehicular capacity of existing streets and highways as a means of improving the transportation network. Much of the land use impact research conducted in the past investigated the effect of new location highway construction, while very little research was devoted to studying the impact of upgrading an existing facility in an urban area. In order to optimize public benefits, highway agencies need information concerning the effect of existing facility improvements to assist in making decisions on highway funding alternatives. The overall purpose of this report is to provide data to state highway agencies concerning the impact of improving the existing highways on area environment.

One important factor in determining the impact of any highway construction is the changes that occur in adjacent land use. The specific task of this analysis is to investigate land use changes in areas where an existing street or highway has been upgraded. In conjunction, land use changes in the specified areas are compared to general land use plans and/or zoning maps to determine their importance to the evolution of area land use development. Traffic volume changes are also reviewed to ascertain the effects of various types of existing facility improvements. Many other economic and social factors are included in the study to assist in measuring the impact of existing street or highway improvement on urban land use.

Specifically, this report relates the findings of an investigation conducted in an area located in Houston, Texas, where a portion of Westheimer Road had been widened and repaved through a developing section of the city. The Westheimer Road, Section One Study Area is one of eighteen sites located in different Texas cities which have been or are now being studied. The study sites have undergone various types of highway improvements and were in differing stages of land development and had various predominant land uses prior to the highway's design change. Reports of findings in those areas are available or will be forthcoming.

Objectives of this study are as follows:

- (1) To determine the initial and long-range land use impacts of different highway design changes on existing highways with a minimum of data collection.
- (2) To determine traffic volume changes resulting from various types of improvements.

Method of Study

A "before and after" study approach was employed in this analysis to identify land use changes in the Westheimer Road Area. Since land use changes may have been affected by the public's anticipation of a better roadway, data were collected for a time before formal planning for the specific project began as well as for the planning and construction years and the years afterwards through to the end of 1978 (the applicable time periods are described in the Definitions section).

The amount of land (acres) in various uses was determined for the selected "before and after" years, and then average annual rates of land use change were calculated for each of the time periods. In addition, changes in improved and unimproved properties' land use were established separately for each period.

Finally, the differences in the annual rates of change between periods were analyzed to indicate the impact of the improvement on land use change and development.

The land in the Study Area was segregated into abutting land and nonabutting properties to permit further analysis. Abutting properties are identified as those with frontage along Westheimer Road, and for larger undeveloped tracts with frontage, an arbitrarily determined section of land 300 feet back from the facility is designated as abutting property. The remaining properties in the Study Area are defined as nonabutting tracts (see Definition Section). These two categories of properties were studied separately to determine the differences in land uses and rates of development brought about by the improvement project.

In order to obtain background information about land use changes and development, several knowledgeable people were interviewed concerning the impact of the Westheimer Road project. Real estate people and area residents who are familiar with the area provided information on land sales and developments, and about past and present land use. These individuals also provided insight into considerations given to the street improvement in making land development decisions in the Study Area.

Various factors which might have influenced land use changes were also investigated to provide additional background data about the social, economic, and environmental make-up of the area studied. The factors are: traffic volume, population characteristics, area land use plans, and area growth statistics.

Location of Street Improvement

The improved portion of Westheimer Road (F.M. 1093) being studied is located within the incorporated city limits of Houston. Houston, the nation's fifth largest city and largest city in the South and Southwest, is the business and population center of a dynamic metropolitan area situated on the upper Gulf Coast of Texas, located approximately 50 miles from the Gulf of Mexico. The growth of Houston, Harris County, and the Houston SMSA has been phenomenal in recent decades, as is illustrated in Table 1. The 1978 Houston population has been estimated at 1,623,000 by the Houston Chamber of Commerce, and when compared to the 1970 census figure of 1,232,000 represents an increase of 31.7%.

Several industries have contributed to the extraordinary growth of the Houston-Gulf Coast region, but the chemical and petrochemical industries have played an extremely important part in the city's growth. The discovery of oil and gas in Southeast Texas and the opening of the Houston Ship Channel in the early 1900's stimulated development of petroleum refining in the area to the extent that today over 50% of the nation's major petrochemical manufacturing capacity is located in the region. The Houston SMSA has long been the nation's leading producer of refined petroleum and petrochemicals, and, as a result, various allied industries have also located in the metroplex.

The Houston-Gulf Coast region possesses an excellent transportation network to both the international and national business market. The Port of Houston is the third largest seaport in the United States in total tonnage and ranks second in total dollars of foreign trade. The major import products are steel, petroleum, and passenger cars, while the port's leading export commodities are agricultural products, petroleum equipment, and chemicals. Also serving the

Table 1. Population and Percent Changes of Area Population for the Houston SMSA, Harris County, City of Houston, and Census Tract 422 and 423, 1950-1978.

Area	1950	% Change Overall & Average Annual 1950-1960	1960	% Change Overall & Average Annual 1960-1970	1970	% Change Overall & Average Annual 1970-1975	Dec. 31, 1975 ^a	% Change Overall & Average Annual 1975-1978	1978 ^a
Houston SMSA	947,500	+51.0% +5.1%	1,430,394	+39.8% +4.0%	1,999,316	+25.8% +5.2%	2,516,000	+5.8% +1.9%	2,661,000
Harris County	806,701	+54.1% +5.4%	1,243,158	+40.1% +4.0%	1,741,912	+24.3% +4.9%	2,165,301	+6.4% +2.1%	2,304,000
City of Houston	596,163	+57.4% +5.7%	938,219	+31.4% +3.1%	1,232,793	+19.8% +4.0%	1,477,022	+9.9% +3.3%	1,623,000
Census Tract 422 (Includes Northern Portion of Study Area)	NA ^c		5,622 ^b	+193.2% +19.3%	16,486	+51.5% +10.3%	24,977	+12.3% +4.1%	28,039
Census Tract 423 (Includes Southern Portion of Study Area)	NA ^c		7,875 ^d	+124.0% +12.4%	17,616	+42.9% +8.6%	25,173	+33.6% +11.2%	33,633

(a) Houston Chamber of Commerce Population Estimates

(b) Census Tract 91-E in 1960 is identical to Census Tract 423 in 1970.

(c) Census Tract Information in 1950 was not applicable for comparative analysis.

(d) Census Tract 91-F in 1960 is similar to Census Tract 423 in 1970.

international market, air passenger and freight service is provided through two large airport terminals in the Houston area. The national business market is served well through a variety of transport modes. Low-cost barge transportation is available via the Intracoastal Waterway which connects Houston to the midcontinent regions of the Mississippi River and its tributary systems. Rail and motor freight operations are provided by six major railroad companies and a large number of common-carrier, specialty-carrier, and local delivery trucking firms. Houston is also a major center of oil and gas transmission for pipeline companies which operate 13 crude oil and products pipelines and 21 gas pipelines which serve almost every section of the nation.

The favorable industrial, transportation, and energy environment of the Houston-Gulf Coast area has led to an increasingly diversified economic structure during the past 20 years. During the 1960's, Houston's growth as a corporate center expanded tremendously. Since 1970, over 200 major companies have moved their headquarters, divisions, or subsidiaries to Houston making the city an important center of international economic activity.

The substantial business activity and population growth and the subsequent growth of Houston as a marketing center has generated increasing amounts of traffic and has made greater demands on the street and highway system to provide adequate access to developed and developing urban areas. The improvement of Westheimer Road was accomplished to meet the traffic needs of an area (Census Tracts 422 and 423) that experienced population increases of 152% between 1960 and 1970, and 80.8% between 1970 and 1978, as shown in Table 1.

The Study Area, as shown in Figure 1, is situated about 6.1 miles west of Houston's central business district (CBD) and is approximately 0.8 miles north of the Southwest Freeway, the closest freeway and major traffic carrier. The Study Area is located in a section of Houston described by the Houston Planning

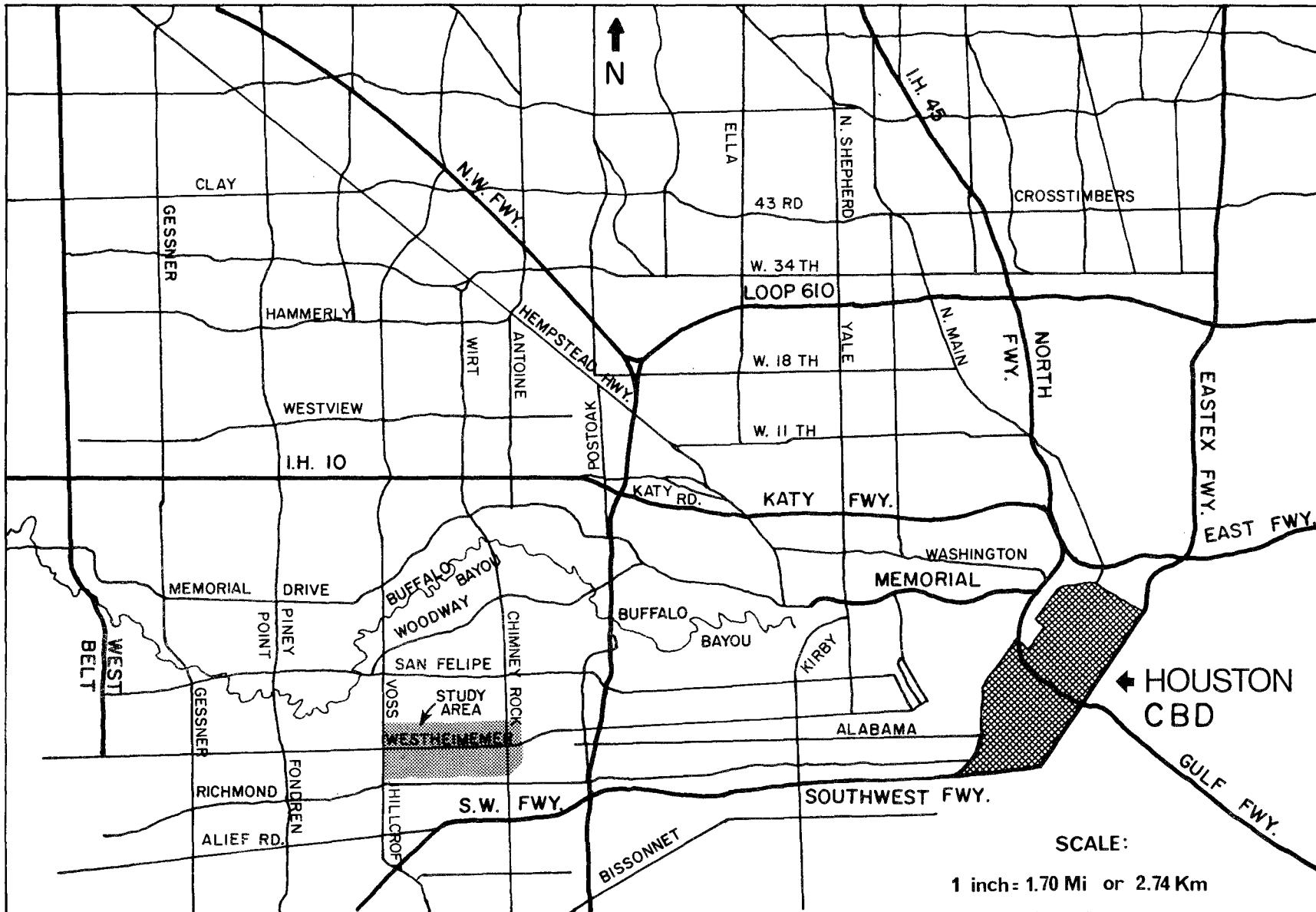


Figure 1. Map of the Northwest Houston Area Showing the Location of Westheimer Road Study Area

Commission as medium density residential (i.e. composed of primarily single-family, multi-family residential and commercial developments). Most of the residences are 20 to 30 years old and are of brick construction, the multi-family developments are 0 to 15 years old, and the commercial developments are 30 years old.

Key Characteristics of Street Improvement

The Westheimer Road Section One Study Area is one of six Houston study sites and one of three areas along Westheimer Road chosen for analysis of land use changes relative to street improvements. The study areas were chosen according to the following characteristics:

- (1) The stage of area development,
- (2) Type of highway or street,
- (3) The predominant land use, and
- (4) The type of setting (urban or suburban).

These factors were determined during the period of time prior to the beginning of the street improvement project. Using these characteristics, different types of study sites have been selected that will permit comparative analyses of various design changes and the resulting impact on land use changes.

In the "before" period, 1962-1964, the Study Area was a developing area with unimproved land being the predominant land use category. Prior to the improvement, the road was a two-lane, undivided rural-type facility without curbs and gutters situated in an urban-fringe setting.

Due to the phenomenal growth of Houston, the trend of Houston's expansion to the west and north, and to the characteristics of the Study Area, extensive amounts of land development were expected to occur during the study period.

This analysis attempts to ascertain the impact that the street improvement had on accelerating or facilitating land use change.

Sources of Data

The major source of planning information concerning the improvement of Westheimer Road was obtained from the Houston City Planning Department, while construction and street design data were collected from the Houston Public Works Department, Paving Division.

Land use data were available through several sources, but the most applicable information was provided by the City Planning Department (CPD). Other sources of valuable land use data were the District Office of the State Department of Highways and Public Transportation (SDHPT), Harris County Agricultural Stabilization and Conservation Service Office, and Houston-Galveston Regional Transportation Study (H-GRTS). Most of the land use data were collected from colored (Lambert) maps, aerial photographs, and on-site inspections of the area.

Background land use information was collected from city directories of Houston, from Sanborn (fire insurance) maps, from subdivision platting records maintained by Harris County, and from personal interviews with real estate developers and brokers, city planners and officials, and property owners and area residents. Information about city-wide and regional land use plans was obtained from CPD reports and Houston-Harris County Metropolitan Transportation Study publications.

Traffic volume data were provided by the Houston Traffic and Transportation Department for city streets and relevant state and federal highways. H-GRTS was also a source of traffic volume information. The Houston Chamber of Commerce provided historical U.S. census and population projections along with housing

information for Houston and its metropolitan area. Socio-economic data were collected from U.S. Bureau of the Census publications found in the City of Houston's Public Library.

Definitions

The following land use categories and time periods were used to identify properties within the arbitrarily defined study area:

Abutting Properties - improved tracts with frontage along Westheimer Road; and for large unimproved tracts, a section of land extending 300 feet back from the street.

Nonabutting Properties - all tracts in an arbitrarily defined Study Area not defined as abutting Westheimer Road; i.e. improved tracts without frontage along Westheimer Road and unimproved tracts over 300 feet from the upgraded street.

Single-Family Residential - tract improved with occupiable house for one family.

Multiple-Family Residential - tract improved with duplex or apartment complexes designed to house two or more families.

Commercial - tract improved with a commercial business.

Educational - tract improved with an elementary, middle or high school, or property owned by a school district.

Public-Governmental - tract improved with a governmental office, park, public owned utility, etc.

Semi-Public-Nonprofit - tract with improvements such as churches, non-profit clubs, or other non-profit organizations.

Industrial - tract improved for manufacturing, product storage, etc.

Streets and Roads - land improved with a street or road; includes land dedicated as right-of-way.

Unimproved - land which has not been developed for any particular use; also includes previously developed land that is presently vacant or unused and land used for agricultural purposes.

Before Period - the time period which ends the year prior to the initiation of formal planning and construction. For Westheimer Road (Section One) the "before" period includes the years 1962 to 1964.

Construction Period - the time period in which final planning, funding and construction processes occur. In this report (due to the lack of proper data), the "construction" period includes two years after the improvement was complete, or 1969 and 1970. The "construction" period consists of the years 1964 to 1970.

After Period - the time period which includes the first full year after the improvement is complete up to the present, but due to the problem described above, includes the years 1970 to 1978.

CHARACTERISTICS OF AREA STREETS BEFORE AND
AFTER THE IMPROVEMENT OF WESTHEIMER ROAD

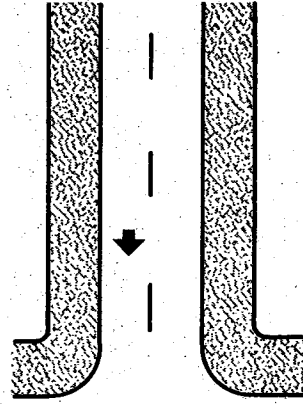
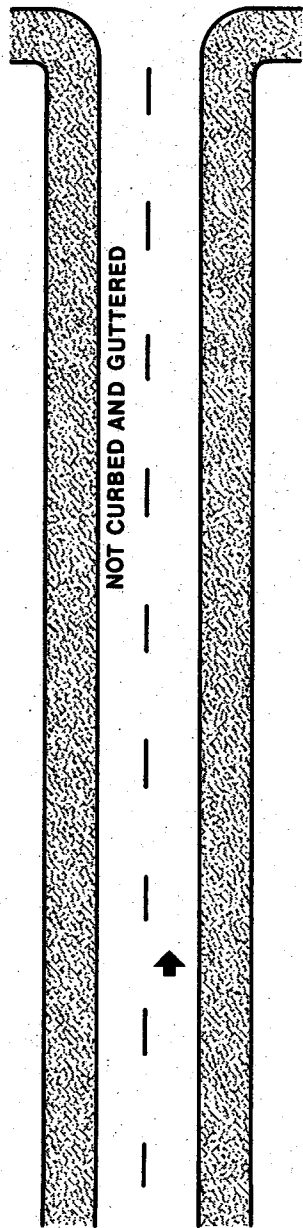
Westheimer Road

Westheimer Road is a major east-west thoroughfare which extends from the central business district (CBD) of Houston west approximately 20 miles to the Harris-Fort Bend county line. Westheimer Road, or FM 1093 (a state facility), extends beyond the county line another 43 miles west to Eagle Lake, Texas. This report focuses on a section of Westheimer Road located between Chimney Rock and Hillcroft-Voss Road that was improved during 1966-67. FM 1093 carries the highest traffic volume of any farm-to-market road in Texas.

The 1.5 mile section of Westheimer under investigation is the western portion of a 2.5 mile state-funded improvement project. The project was funded through the 1965 Farm-to-Market Improvement Program and work began in February 1966 and was completed in March 1967. The "before" design of the study section was a 24-foot wide, two-lane, undivided asphalt roadway with six-foot wide shoulders and open drainage (Figure 2). This section was upgraded to a six-lane divided thoroughfare with two 36-foot road surfaces, a raised median, and curbs and gutters. The right-of-way width remained 120 feet since no additional acreage was acquired for the improvement.

The eastern portion of the improvement project contiguous to the Study Area, from Chimney Rock east to South Post Oak Road, was improved to the same "after" design as the study section, but the "before" design was a four-lane, divided facility with two 24-foot roadways, a raised median, and curbs and gutters in some portions. The portion of Westheimer just west and contiguous to the study section was a two-lane, undivided road with open drainage prior to 1966. During 1966-68, Westheimer Road, between Hillcroft-Voss and

Before Period Design



After Period Design

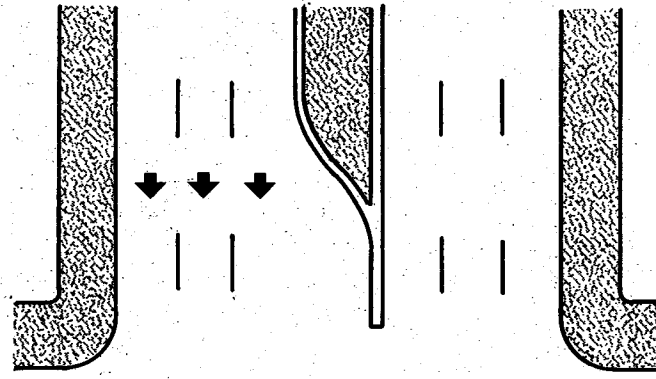
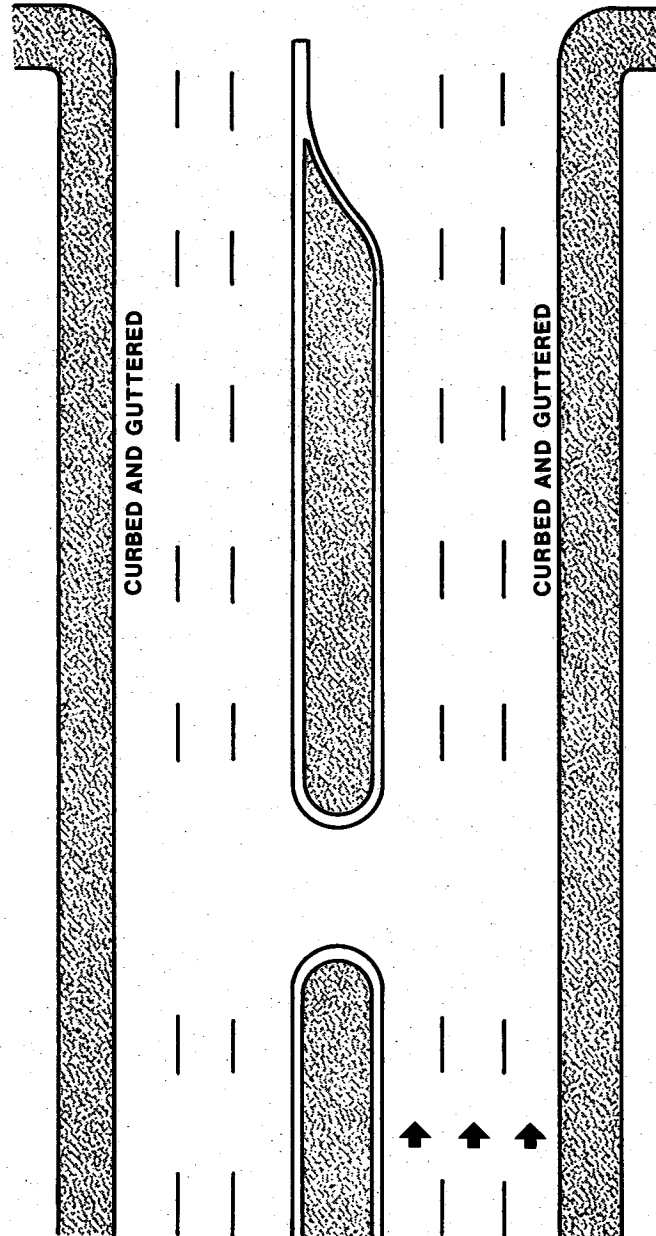


Figure 2. Street Design

1003

Fondren-Piney Point, was improved to the same "after" design as the section under investigation in this report.

As shown in Table 2, traffic count data collected by the City of Houston and the SDHPT indicate a dramatic increase in vehicular traffic on Westheimer Road during the overall study period; i.e. Westheimer at Chimney Rock, 165% (10.3% per year); Westheimer at Briargrove, 266% (16.6% per year); and Westheimer at Hillcroft-Voss, 186% (12.4% per year). Further analysis of data by the three time periods reveals that at the intersection of Westheimer and Briargrove traffic volume increased 48% (16.1% per year) during the "before" period, 1961-64; 18% (4.6% per year) during the "construction" period, 1964-68; and 109% (12.1% per year) during the "after" period, 1968-77. The other two traffic data collection sites experienced similar increases in traffic volume; with the only exception being during the "before" period at the Westheimer and Chimney Rock intersection, which decreased 6% (1.5% per year) between 1961 and 1965.

Intersecting Streets

The two major thoroughfares which intersect Westheimer Road within the Study Area are Chimney Rock and Hillcroft-Voss (Figure 1). Chimney Rock Road, located in the eastern portion of the Study Area is a major street which extends south from Memorial Drive approximately 14 miles to South Main Street (U.S. 90-A). Hillcroft-Voss Road forms the western boundary of the Study Area. Hillcroft Avenue, which is about 7.5 miles long, is situated between Westheimer (to the north) and South Main Street (to the south) while Voss Road is located between Westheimer Road north to Katy Freeway (IH 10), or more than three miles.

Within the Study Area, Chimney Rock Road has two different street designs. North of Westheimer, Chimney Rock is a two-lane, undivided street with curbs and

Table 2. Twenty-Four Hour Traffic Counts by Street Location and Year

Location	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977
<u>Westheimer Road</u>																	
(a) Briargrove	14,090	20,460	20,500	20,880	19,540	15,450	16,490	24,700	31,120	32,600	36,640	42,280	40,460	39,540	41,250	43,300	51,600
(a) Chimney Rock	19,452	21,417	17,049		18,284		20,278						42,628	47,844	49,822		51,598
(a) Hillcroft-Voss	15,314	16,208	24,319	22,113	22,046	15,000	19,427	23,654					41,439	45,094		43,800	
<u>INTERSECTING STREETS</u>																	
<u>Chimney Rock</u>																	
(a) Westheimer		12,329		10,288		13,184		11,150			15,889		14,412	17,311	18,536	19,029	
(a) San Felipe		6,486		3,195		3,680		4,283			6,007		5,716	6,787	6,649	6,912	7,503
(a) Richmond														27,286	28,368	29,502	28,538
<u>Hillcroft-Voss</u>																	
(a) Westheimer	5,634		17,601		17,807		17,300		22,669		26,459		27,629	31,389	31,513	27,197	
(a) Buffalo Bayou		13,577		12,998		15,396	13,069	14,056		17,516		20,917		18,340		20,665	
(a) Richmond													32,345	33,024	33,586	34,590	36,092
<u>PARALLEL STREETS</u>																	
<u>Richmond</u>																	
(a) Chimney Rock											11,734		22,044	24,052	25,199	24,078	
(a) Fondren													13,727	16,763	19,830		29,542
(a) S. Post Oak									19,173		23,875		31,404	27,012	33,850	31,050	
<u>San Felipe</u>																	
(a) Sage								11,049						23,856	27,233	31,088	
(a) Hillcroft-Voss														20,043	20,519		23,008

gutters (improved by residential developers in the 1950's). According to the 1976-80 Recommended Thoroughfare Improvement Program published by H-GRTS, it is scheduled to be upgraded to a six-lane, divided facility with raised median and curbs and gutters. As of August 1978 no construction on the planned improvement had been initiated by the City of Houston. The street design south of Westheimer is a four-lane, divided arterial with raised median and curbs and gutters which was improved by the city during 1964-65.

Traffic count data, shown in Table 2, indicates that vehicular traffic has increased on Chimney Rock during the overall period. At the intersection of Chimney Rock and Westheimer Road, the 24-hour traffic count has increased 54% (3.9% per year) overall between 1962 and 1976. Volume decreased 17% (8.3% per year) during the "before" period, increased 85% (2.1% per year) during the "construction" period, and increased 71% (8.8% per year) during the "after" period. Traffic data collected at two other points along Chimney Rock (near the Study Area) have experienced growth in traffic volume, especially during the "after" period.

Hillcroft-Voss Road, which forms the western boundary of the study area, is a four-lane, divided, curbed and guttered thoroughfare with raised median. Hillcroft Avenue, from Westheimer south to Westpark, was improved to its present design during 1962-63 and Voss Road was improved to its present design from Westheimer north to San Felipe during 1966-67.

Traffic volume on Hillcroft-Voss has also increased during the study period, as illustrated by the 383% (25.5% per year) growth in traffic count recorded at its intersection with Westheimer Road between 1961 and 1976 (Table 2). Reviewing the data by time periods for the intersection described above; from 1961 to 1965, the "before" period, traffic volume jumped by 216% (54.0% per year), for the "construction" period, 1965-69, the traffic count grew 27% (6.8%

per year), and during the "after" period, 1969-76, vehicular traffic increased 20% (2.9% per year). Traffic counts collected along Hillcroft-Voss at locations north and south of Westheimer indicate that, as was the case for Chimney Rock, 24-hour traffic volume has increased over the study period.

Other important area freeways and streets which intersect Westheimer Road included: IH 610 (West Loop), South Post Oak Road, Sage Road, Fountain View Drive, and Fondren-Piney Point Road (see Figure 2). Many of these facilities were upgraded during the analysis period and as a result have influenced traffic volume and land use change and development within the Study Area and the vicinity.

Parallel Streets

The major thoroughfares immediately adjacent and parallel to Westheimer Road are San Felipe Road and Richmond Avenue (Figure 1). Located over eight-tenths of a mile north of Westheimer and outside the Study Area, San Felipe is about 6 miles in length and is situated between Shephard Drive (to the east) and merges with Memorial Drive just west of Voss Road. Also situated outside the Study Area, Richmond Avenue is located four-tenths of a mile south of Westheimer and extends from near downtown Houston west approximately 11 miles to Beltway 8 (West Belt). Both facilities are alternate routes for traffic in the Westheimer Road area.

San Felipe Road, between Chimney Rock and Voss, was improved to a four-lane, divided, raised median street with curbs and gutters under two projects contracted by the city. Both projects were completed during 1962-63. Although the street width does vary between Chimney Rock and Fountain View, the street design has not changed since 1963. Traffic count data for San Felipe were available for only the "after" period. The available data does indicate an

increase of 181% (22.7% per year) along San Felipe just east of the Study Area between 1968 and 1976 and an increase of 15% (4.9% per year) from 1974 to 1977 at the intersection of San Felipe and Voss Road. No traffic count data for years prior to 1968 were available for this section of San Felipe.

Richmond Avenue was also upgraded to a four-lane, divided, curbed and guttered thoroughfare with raised median from Chimney Rock west to Hillcroft under a single city project. The improvement was accomplished during 1968-69. Plans in H-GRTS Recommended Thoroughfare Improvement Program indicate that this section of Richmond will be widened to a six-lane, divided facility. As was the case for San Felipe Road, traffic volume data for Richmond Avenue are available only for the "after" period. The traffic counts for Richmond Avenue do indicate vehicular traffic had increased dramatically; i.e. traffic had increased 105% (21.0% per year) along Richmond near Chimney Rock during 1971-76, and at its intersection with Fondren (west of the Study Area) an increase of 115% (28.8% per year) was recorded between 1973 and 1977. Finally, near Richmond and South Post Oak Road (east of the Study Area) the 24-hour traffic count increased 62% (8.9% per year) during the "after" period.

Other parallel streets which can be utilized as alternate routes for Westheimer are Woodway Drive, Memorial Drive, West Park Drive, Gulfton Drive, and Bellaire Boulevard.

CHARACTERISTICS OF THE STUDY AREA BEFORE AFTER THE IMPROVEMENT OF WESTHEIMER ROAD

Size and Boundaries of Study Area

The Westheimer Study Area, from Chimney Rock to Hillcroft-Voss, is approximately 3,400 feet wide and 8,600 feet long and contains 659.3 acres. The Study Area was delineated to include an equivalent of three blocks on either side of the improved facility. With Westheimer Road bisecting the area, the southern portion of the Study Area is about 1,800 feet wide with the southern boundary formed by Fairdale Lane. The northern portion extends some 1,600 feet from Westheimer and the area's northern border is formed by Piping Rock (eastern part) and Burgoyne Road (western part). The eastern border is formed by McCulloch Circle (south of Westheimer) and a set of property lines in the Braircroft subdivision (north of Westheimer). Hillcroft-Voss Road forms the western boundary of the Study Area. Major freeways in close proximity to the Study Area include the Southwest Freeway (U.S. 59) and the West Loop (IH 610), as illustrated in Figure 1.

Land Use Characteristics

A detailed account of land use characteristics in the Study Area were collected for four selected years: 1962, 1964, 1970, and 1978. Figures 3 and 4 represent the land use configuration in the first and last years of the "before" period, or 1962 and 1964, respectively. The "long-run after" period land use characteristics are illustrated in Figure 5 (1970) and Figure 6 (1978). The number of acres devoted to each land use category and the percentage change in acreage between time periods for each category are listed in Table 3.

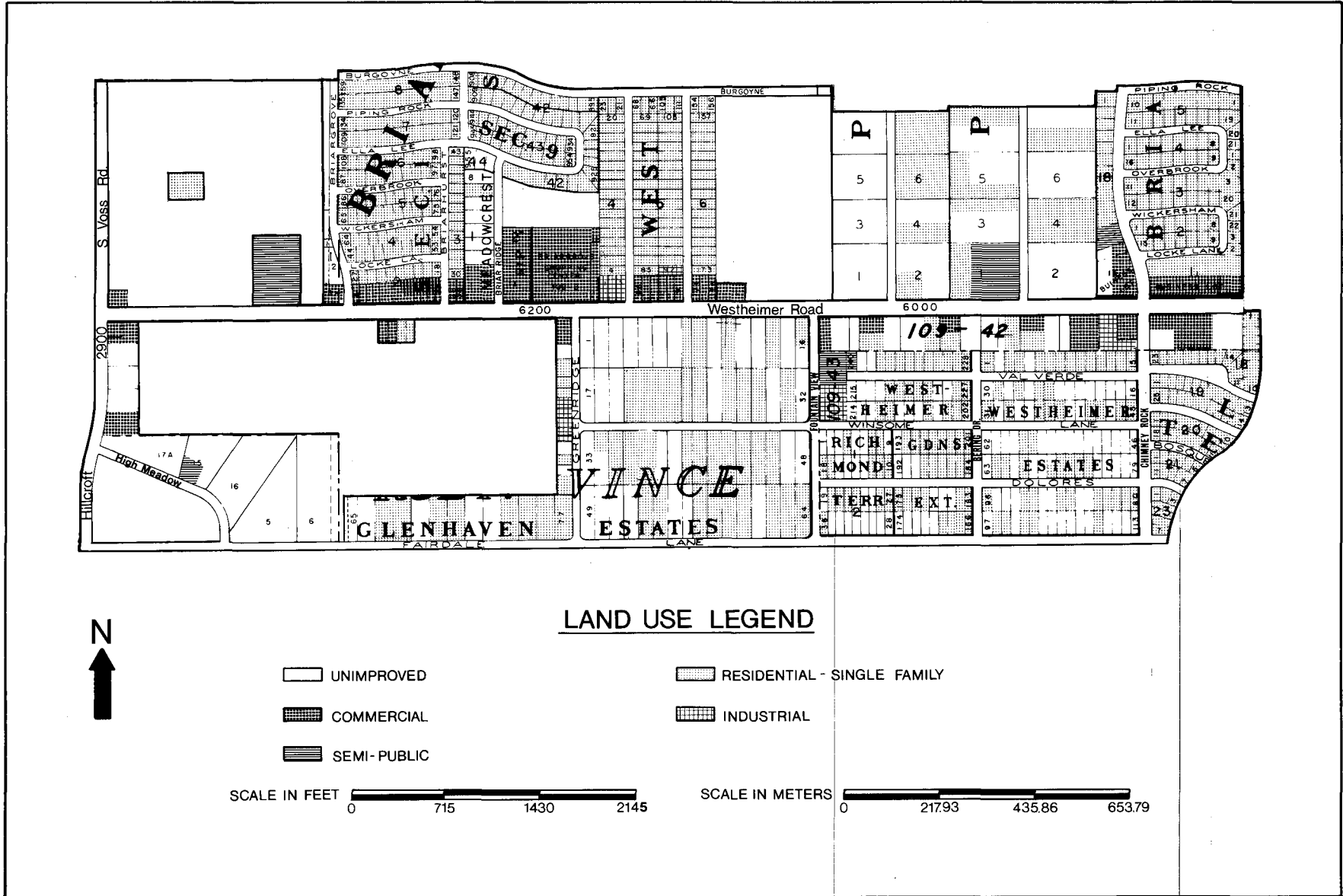


Figure 3. Map of Land Use in the Westheimer Road Study Area in 1962

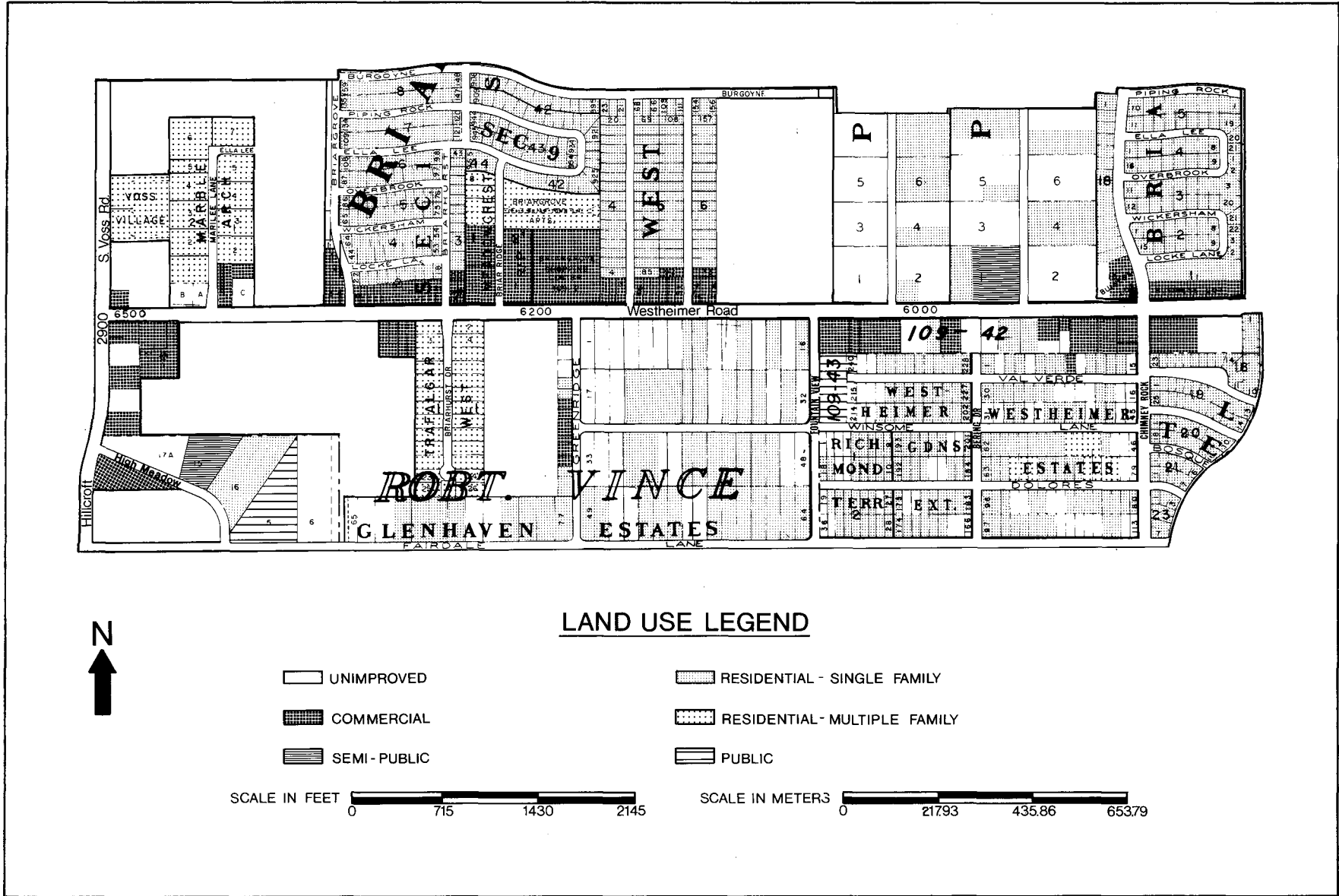


Figure 4. Map of Land Use in the Westheimer Road Study Area in 1964.

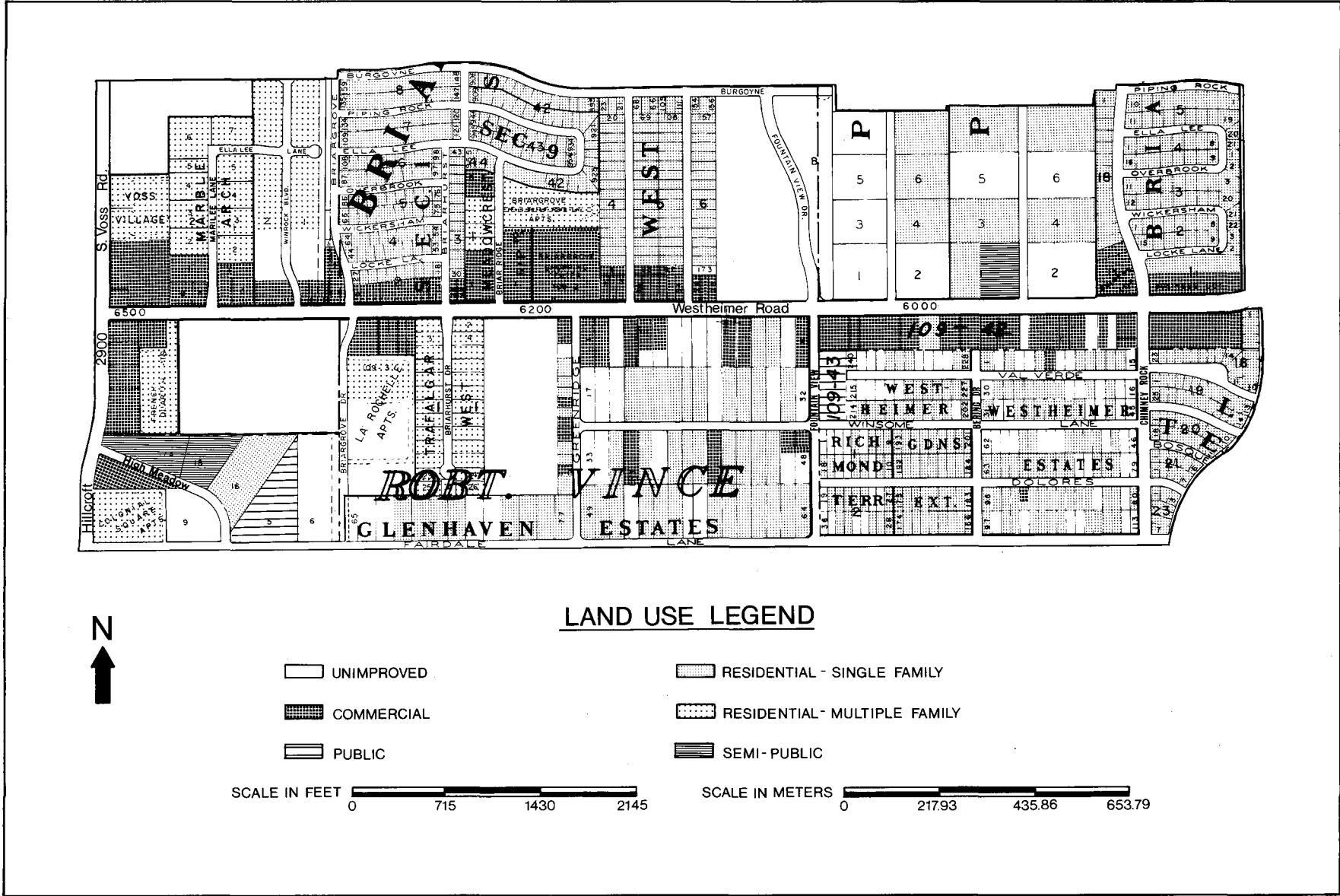
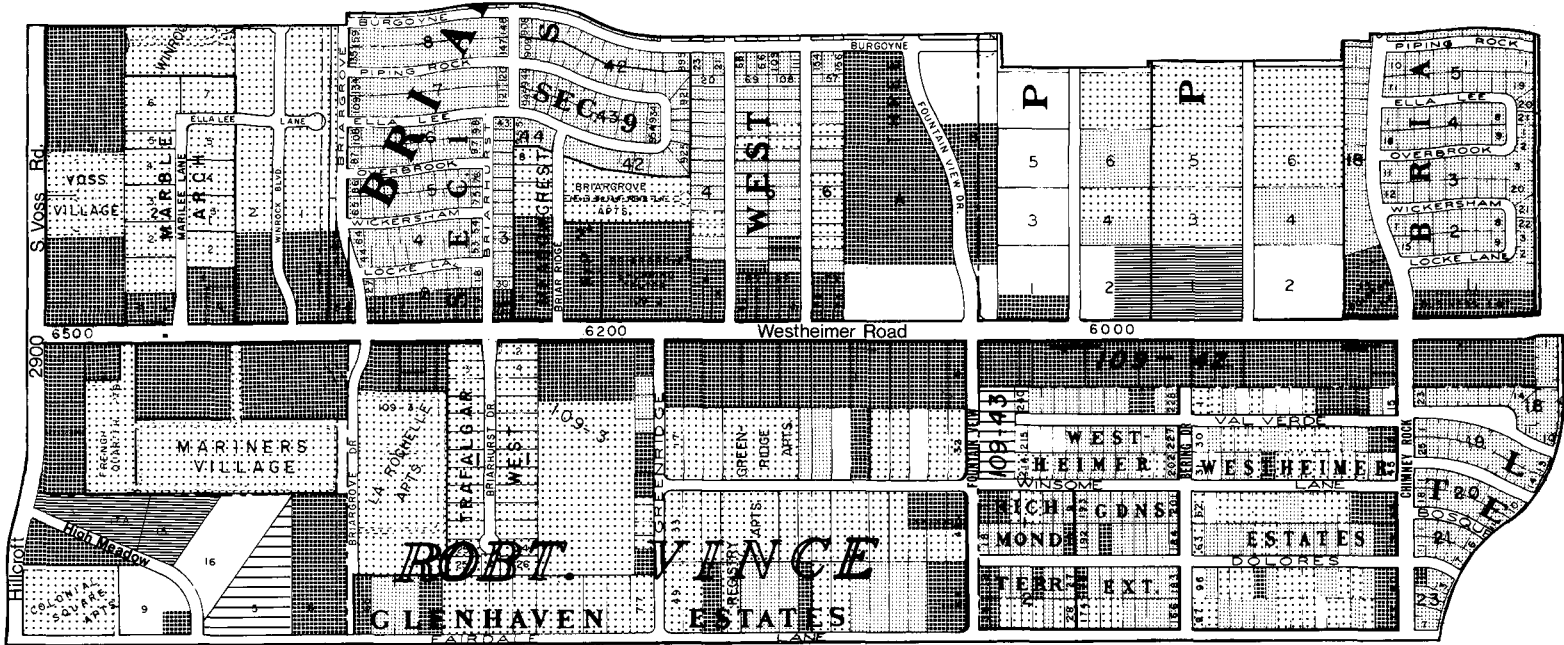








Figure 5. Map of Land Use in the Westheimer Road Study Area in 1970



LAND USE LEGEND

- | | |
|---|---|
|  UNIMPROVED |  RESIDENTIAL - SINGLE FAMILY |
|  COMMERCIAL |  RESIDENTIAL - MULTIPLE FAMILY |
|  SEMI-PUBLIC |  PUBLIC |

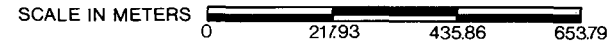
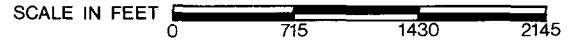


Figure 6. Map of Land Use in the Westheimer Road Study Area in 1978

In 1962, the first year of available land use data, the Study Area was described as a developing area with the predominant land use being unimproved. Table 3 shows that of the 659.3 total area acres (266.8 hectares) 50.1%, or 330.13 acres (133.6 hectares), were undeveloped in 1962. Of the remaining 329.17 developed acres (133.2 hectares), the major developments were single-family residential (197.35 acres) and streets and roads (83.43 acres). The percentage breakdown of the 1964 total Study Area by land use category is as follows: single-family residential, 29.9%; commercial, 5.2%; industrial, 0.06%; public, 0.02%; semi-public, 1.2%; streets and roads, 12.7%; and unimproved, 50.1%.

By 1978, the last "after" year, much of the unimproved land had been developed and the predominant land use had become multi-family residential. Developed acreage then constituted 93.3%, or 614.97 acres (248.9 hectares), of the total area while unimproved acreage dropped to 6.7%, or 44.33 acres (17.9 hectares). Multi-family and single-family residential and commercial developments dominated the improved acreage. The percentage breakdown by land use categories for the entire Study Area in 1978 was: single-family residential, 21.8%; multi-family residential, 29.7%; commercial, 23.8%; public, 1.2%; semi-public, 2.0%; streets and roads, 14.7%; and unimproved, 6.7%.

Land Use Changes

The Westheimer Study Area reviewed in this report has experienced considerable amounts of change in land use during the 16-year study period. The analyses of land use change and development are discussed first on an overall basis and second in terms of the proximity of property relative to Westheimer Road.

Table 3. Total Study Area Land Use Inventory by Time Period and Land Use Category

Land Use Change By Time Period	Before		Construction		After		Overall Period	
	1962		1964		1970		1978	1962 - 1978
Single-Family Residential Total Acres Absolute Change Percent Change	197.35	+12.33 +6.25%	209.68	+2.5 +1.22%	212.23	-68.27 -32.17%	143.96	-53.39 -27.05%
Multi-Family Residential Total Acres Absolute Change Percent Change	0	+36.97 -	36.97	+27.33 +73.92	64.30	+131.60 +204.67	195.90	+195.90 -
Commercial Total Acres Absolute Change Percent Change	34.24	+16.64 +48.60	50.88	+28.24 +55.50	79.12	+77.94 +98.51	157.06	+122.82 +358.70%
Industrial Total Acres Absolute Change Percent Change	4.52	-4.52 -100.00	0	0 0	0	0 0	0	-4.52 -100.00%
Public Total Acres Absolute Change Percent Change	1.36	+6.72 +494.12	8.08	+0.10 +1.24	8.18	-0.10 -1.22	8.08	+6.72 +494.12%
Semi-Public Total Acres Absolute Change Percent Change	8.27	-2.16 -26.12	6.11	+2.93 +47.95	9.04	+4.34 +48.01	13.38	+5.11 +61.79%
Streets & Roads Total Acres Absolute Change Percent Change	83.43	+3.78 +4.53	87.21	+9.38 +10.76	96.59	0 0	96.59	+13.16 +15.77%
Unimproved Total Acres Absolute Change Percent Change	330.13	-69.76 -21.13	260.37	-70.53 -27.01	189.84	-145.51 -76.65	44.33	-285.80 -86.57
Total Study Area Acres	659.3		659.3		659.3		659.3	

Overall Study Area

The predominant land use has changed several times during the study period. Table 3 illustrates that in 1962 and 1964 unimproved land was the predominant land use; in 1970, single-family residential development replaced unimproved acreage as the predominant use; and by 1978, the predominant land use category had become multi-family residential. Generally speaking, most of the Study Area's unimproved acreage had been developed as either multi-family residential or commercial uses. All of the land use categories have experienced some amount of change between 1962 and 1978.

Analyzing Table 3 reveals that multi-family residential development realized the greatest absolute (195.90 acres) increase and public acreage recorded the greatest percentage (494.1%) growth in acreage of the land use categories. Multi-family residential development increased by 36.97 acres (undefined percentage) between 1962 and 1964, by 27.33 acres (73.9%) between 1964 and 1968, and by 131.60 acres (204.7%) between 1968 and 1978. Commercial acreage also recorded a sizeable increase in development, as illustrated by the 122.82 acre (358.7%) gain during the overall study period. Commercial development grew steadily throughout the period; specifically, 48.6% during the "before" period, 55.5% during the "construction" period, and 98.5% during the "after" period. Other land use categories experiencing growth during the 16-year period were: public (6.72 acres, 494.1%), semi-public (5.11 acres, 61.8%), and streets and roads (13.16 acres, 15.8%).

Unimproved acreage experienced the greatest absolute decrease (285.80 acres, 86.57%) from 1962 to 1978. Percentage decline in unimproved acreage for the three analysis periods was 21.1% between 1962 and 1964, 27.0% between 1964 and 1968, and 76.6% between 1968 and 1978. Although single-family residential

development increased during the "before" (6.3%) and "construction" (1.2%) periods, the decrease of 32.1% during the "after" period more than offset the increases recorded in the first two periods and, as a result, single-family residential acreage decreased 27% (53.39 acres) from 1962 to 1978. Industrial development experienced the greatest percentage decrease (100%, 4.52 acres) of the land use categories, due mainly to the changing the industrial acreage to commercial use. Total Study Area change in land use by category and time period is illustrated in Figure 7.

Proximity to Westheimer Road

The Study Area properties have been segregated into two separate categories according to their location relative to Westheimer Road in order to facilitate a comparative analysis. Dividing the properties into either the abutting or non-abutting land category allows a study approach to be implemented to determine the influence of the street improvement on the location of land use changes. Abutting properties normally are expected to undergo relatively more land use changes than nonabutting properties as a result of the street improvement; however, several factors may exist that could alter the anticipated results (i.e. availability of developable land, predominant land use, etc.). Therefore, an analysis of the land use changes occurring in each location category is reviewed to confirm or reject the above hypothesis.

Abutting Properties. Abutting properties are defined as those tracts with frontage along the subject facility, which is Westheimer Road. For developed properties, if an abutting tract was improved as a single development, all of the land development was included to avoid arbitrary division of the tract. For larger unimproved tracts with frontage on the subject facility, a section of land 300 feet (91.44 meters) deep from the right-of-way was defined as abutting.

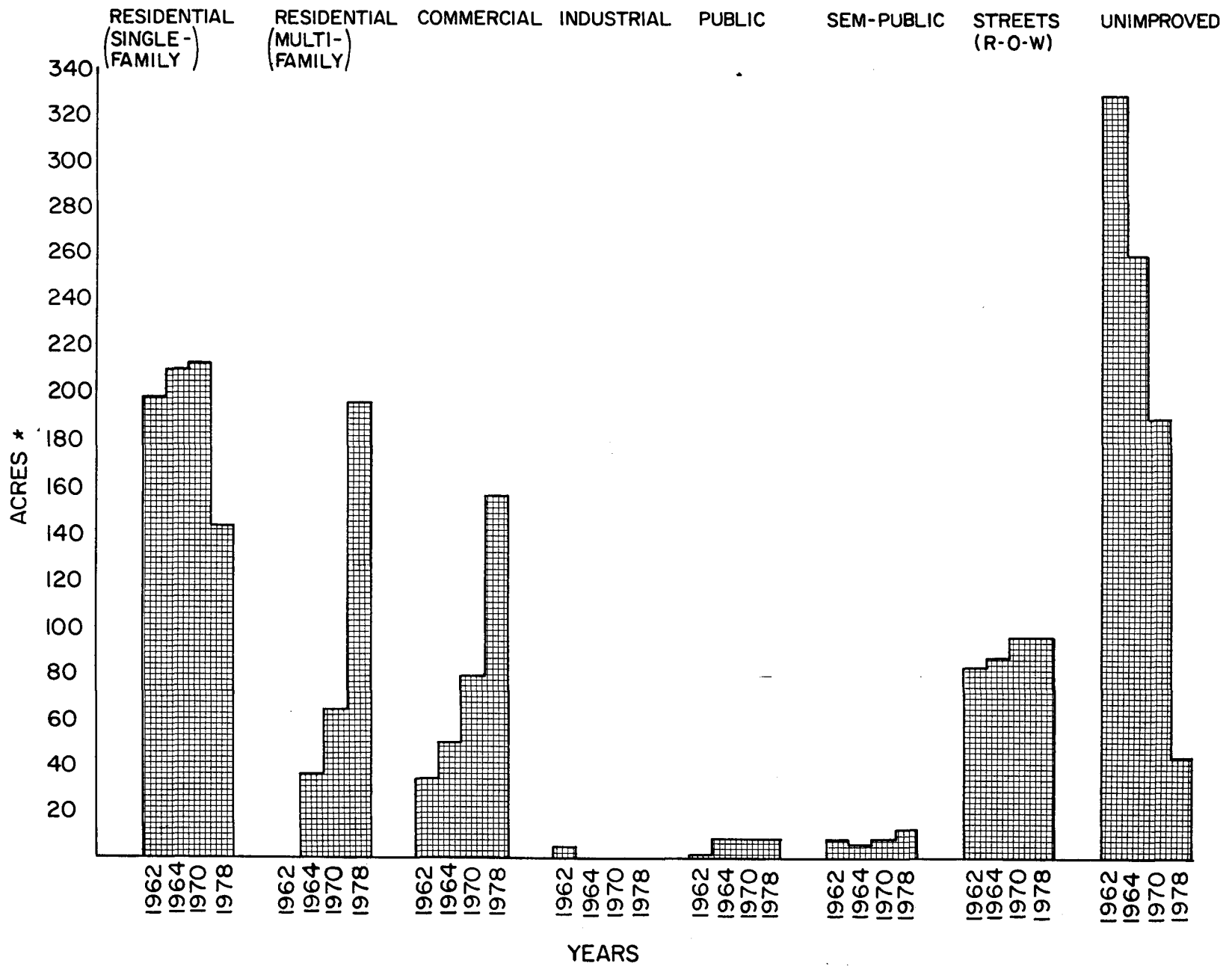


Figure 7. Change in Total Land Uses in the Westheimer Road Study Area by Category and Selected Years

*One acre equals 0.4046856 hectares.

The 300-foot distance was arbitrarily chosen but is consistent with the other case studies of this project (see Definitions). Abutting property in the Study Area was defined according to land use configuration in 1978, the last "after" year of the analysis period, and remained consistent for the preceding years of the 16-year time period.

According to the above description, 174.98 acres (70.8 hectares) were defined as abutting property in the Study Area. In 1962, unimproved land was the predominant abutting land use, or approximately 54% (94.52 acres) of the total abutting acreage (Table 4). The remaining 46% (80.46 acres) were improved, and commercial developments made up 42.6% (34.24 acres) of the improved acreage. The percentage of abutting property by land use category in 1962 is as follows: single-family residential, 5.9%; multi-family residential, 0%; commercial, 19.6%; industrial, 1%; semi-public, 4%; streets and roads, 15.6%; and unimproved, 54% (Figure 4).

About 16% (28.04 acres) of the abutting acreage experienced land use change between 1962 and 1964. Multi-family residential development recorded the greatest absolute (14.53 acres) increase and commercial use the greatest percentage (33.8%) increase, while unimproved and industrial acreage experienced the greatest absolute (22.31 acres) and percentage (100%) decrease, respectively (Table 4). Notable growth in the "before" period when commercial acreage increased by 33.8% (11.59 acres) and street and roads acreage increased by 7.0% (1.92 acres). However, there was a decline in semi-public acreage by 55.08% (3.90 acres). Also, single-family residential acreage declined by 3.95% (0.41 acres). By 1964, improved acreage made up 58.7% of the 174.98 abutting acres compared to 46% in 1962.

Table 4. Abutting Property Land Use Inventory by Time Period and Land Use Category

Land Use Change By Time Period	Before		Construction		After		Overall Period	
	1962		1964		1970		1978	1962 - 1978
Single-Family Residential Total Acres Absolute Change Percent Change	10.38	-0.41 +3.95	9.97	-5.16 -51.76	4.81	-4.81 -100	0	-10.38 -100%
Multi-Family Residential Total Acres Absolute Change Percent Change	0	+14.53 -	14.53	+5.31 +36.55	19.84	0 0	19.84	+19.84 -
Commercial Total Acres Absolute Change Percent Change	34.24	+11.59 +33.85	45.83	+23.23 +50.69	69.06	+32.07 +46.44	101.13	+66.89 +195.36%
Industrial Total Acres Absolute Change Percent Change	1.42	-1.42 -100	0	0 0	0	0 0	0	-1.42 -100%
Public Total Acres Absolute Change Percent Change	0	0 0	0	+0.10 -	0.10	-0.10 -100	0	- -
Semi-Public Total Acres Absolute Change Percent Change	7.08	-3.90 -55.08	3.18	0 0	3.18	+4.34 +136.48	7.52	+0.44 +6.21%
Streets & Roads Total Acres Absolute Change Percent Change	27.34	+1.92 +7.02	29.26	+1.86 +6.36	31.12	0 0	31.12	+3.78 +13.83%
Unimproved Total Acres Absolute Change Percent Change	94.52	-22.31 -23.60	72.21	-25.34 -35.09	46.87	-31.50 -67.21	15.37	-79.15 -83.75%
Total Abutting Acres	174.98		174.98		174.98		174.98	

During the "construction" period, the pace of land use change seemed to accelerate slightly but with some differences. Commercial acreage realized the greatest absolute (23.23 acres) and percentage (50.7%) growth between 1964 and 1970, most of which was strip-commercial developments. As was the case in the "before" period, the greatest absolute decrease was recorded in the unimproved category (25.34 acres) but single-family residential replaced industrial as the category experiencing the greatest percentage decline (51.8%). Other categories which experienced growth were multi-family residential (36.5%), public (undefined), and streets and roads (6.4%). Over 17.4% of the abutting property recorded a land use change during the "construction" period and developed acreage in 1970 composed 73.2% of the total 174.98 abutting acres (Table 4).

The trend of developing unimproved land into either commercial and multi-family residential uses continued in the "after" period. Approximately 20.8% of the abutting acreage changed land uses between 1970 and 1978 and in 1978, 91.2% had been developed. Commercial and semi-public developments recorded the greatest absolute (32.07 acres) and percentage (136.5%) increases, respectively (Table 4). The greatest absolute decrease was again experienced in unimproved acreage (31.50 acres), while single-family residential and public uses realized the greatest percentage decline (100%). None of the other land use categories experienced any change in acreage during the 1970 to 1978 period.

Reviewing the overall land use change from 1962 to 1978, about 52% (90.95 acres) of the 174.98 total abutting acres changed uses during the 16-year study period. Of the 90.95 acres, 87% (79.15 acres) were previously unimproved land, as shown in Table 4, while only 13% of the acreage experiencing change were previously improved acreage. Commercial development recorded the greatest absolute (66.89 acres) and percentage (195.4%) increase. Conversely, unimproved acreage experienced the greatest absolute decrease (79.15 acreage), while the

greatest percentage decrease was recorded by both the single-family residential and industrial categories (100%). Large amounts of abutting land have changed use during the study and Figure 8 illustrates the acreage devoted to each abutting land use category in each of the selected study years.

Nonabutting Properties. Nonabutting properties are defined simply as those Study Area tracts not defined as abutting properties (see Definitions). Following this definition, 484.32 acres (196.0 hectares) were classified as nonabutting property in the Study Area. Table 5 indicates that in 1962 the predominant nonabutting land use was unimproved, as was the case for abutting property during the same year. Approximately 48.6% (235.61 acres) of nonabutting property were undeveloped in 1962, and correspondingly, 51.4% (248.71 acres) of the land had been improved prior to the study period. Of the improved 248.41 acres (9100.6 hectares), 75.2% (186.97 acres) were devoted to single-family residential use, 22.6% (56.09 acres) were improved as streets and roads, while the remaining 2.2% were divided among industrial, public, and semi-public developments. The nonabutting portion of the Study Area could be described as a developing residential area because of the above land use configuration.

By 1964, improved acreage had increased from 51.4% (in 1962) to 61.1% and single-family residential development had become the predominant land use with 41.2% (199.71 acres) of the total nonabutting land (Table 5). Unimproved acreage recorded the greatest absolute (47.45 acres) decrease and industrial development realized the greatest percentage (100%) decline during the "before" period. On the other hand, multi-family residential development increased by 22.44 acres and public acreage grew by 494.1%, the greatest absolute and percentage increase between 1962 and 1964, respectively. Over 10.4% (50.55

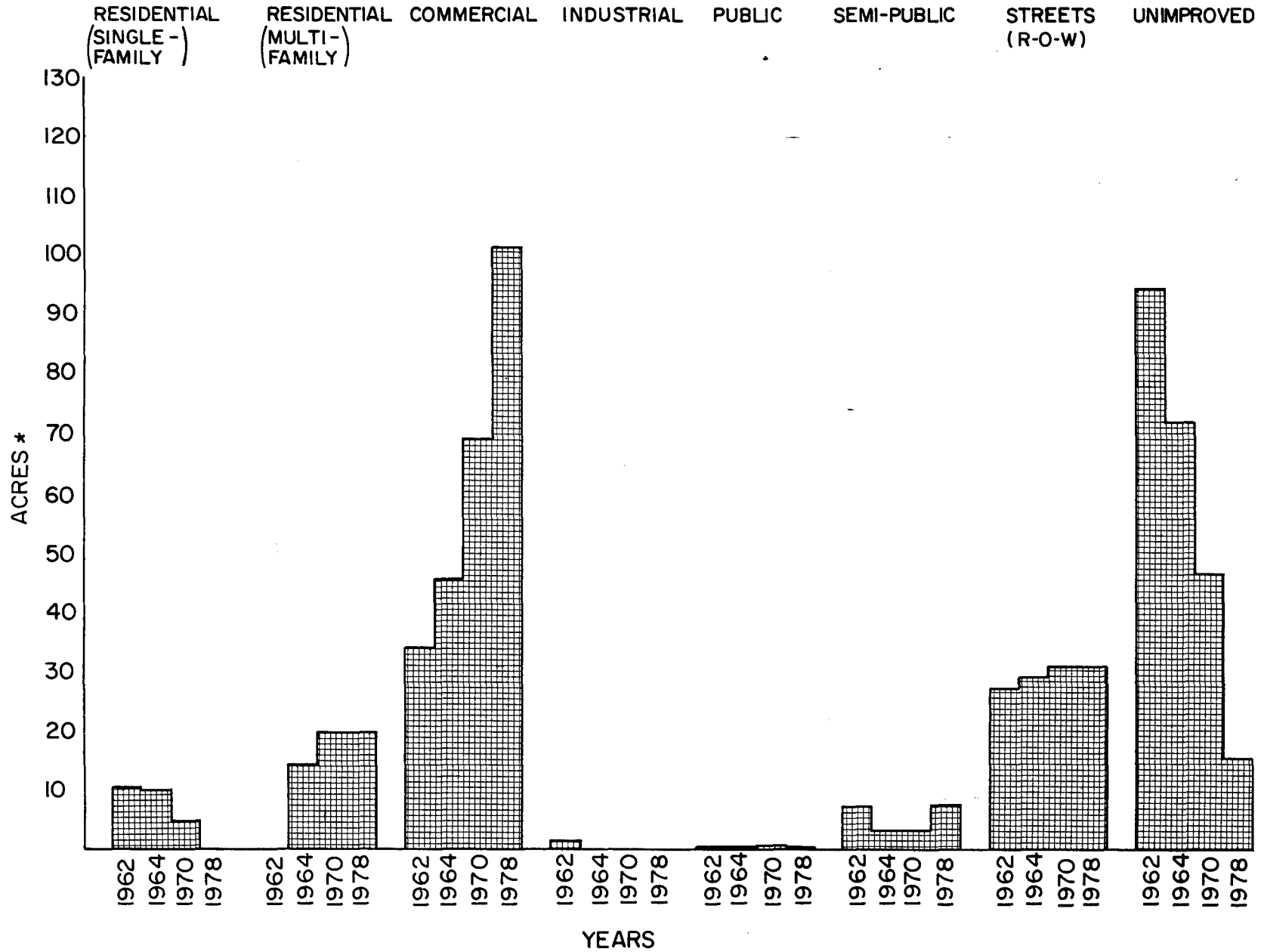


Figure 8. Changes in Abutting Land Uses in the Westheimer Road Study Area by Category and Selected Years

*One acre equals 0.4046856 hectares.

acres) of the nonabutting property experienced some types of land use change with unimproved acreage constituting 93.9% of the total acreage change.

During the "construction" period, the trend of unimproved acreage becoming developed continued as shown by the growth of improved land to 70.5% of total nonabutting property in 1970 (Table 5). The greatest absolute (45.19 acres) and percentage (24.0%) decrease between 1964 and 1970 was found in unimproved acreage, while the greatest absolute increase was discovered in multi-family residential development (22.02 acres) and semi-public land underwent the greatest percentage increase (100.0%). About 9.3% (45.19 acres) of the total 484.32 nonabutting acres changed land use, all of which was previously unimproved land. By 1978, 94% of the nonabutting acres were developed and only 6% remained unimproved and between 1970 and 1978 114.01 acres of previously unimproved land were improved. As was the case in the previous periods, unimproved acreage experienced the greatest absolute (114.01 acres) and percentage (79.7%) decrease while multi-family residential development enjoyed the greatest absolute increase (131.60 acres) during the "after" period. The greatest percentage growth was recorded in the commercial use category (456%). Single-family residential acreage declined by 30.6% (63.46 acres) due to the redevelopment of some tracts to multi-family residential and commercial use.

Reviewing the overall land use change during the entire study period, almost 53% (273.21 acres) of the total nonabutting acreage underwent some type of land use change. Table 5 indicates that unimproved land constituted 75.6% of the acreage change and, as a result, experienced the greatest absolute (206.65 acres) and percentage (87.7%) decrease from 1962 to 1978. Multi-family residential development realized the greatest absolute increase (176.06 acres) and public acreage enjoyed the greatest percentage increase (494.1%). All of the land use categories recorded a change in acreage due to development. Figure 9

Table 5. Nonabutting Property Land Use Inventory by Time Period and Land Use Category

Land Use Change By Time Period	Before		Construction		After		Overall Period	
	1962		1964		1970		1978	1962 - 1978
Single-Family Residential Total Acres Absolute Change Percent Change	186.97	+12.74 +6.81	199.71	+7.71 +3.86	207.42	-63.46 -30.59	143.96	-43.01 -23.00%
Multi-Family Residential Total Acres Absolute Change Percent Change	0	+22.44 -	22.44	+22.02 +98.13	44.46	+131.60 +296.00	176.06	+176.06 -
Commercial Total Acres Absolute Change Percent Change	0	+5.05 -	5.05	+5.01 +99.21	10.06	+45.87 +455.96	55.93	+55.93 -
Industrial Total Acres Absolute Change Percent Change	3.10	-3.10 -100	0	0 0	0	0 0	0	-3.10 -100%
Public Total Acres Absolute Change Percent Change	1.36	+6.72 +494.12	8.08	0 0	8.08	0 0	8.08	+6.72 +494.12%
Semi-Public Total Acres Absolute Change Percent Change	1.19	+1.74 -146.62	2.93	+2.93 +100	5.86	0 0	5.86	+4.67 +392.44%
Streets & Roads Total Acres Absolute Change Percent Change	56.09	+1.86 +3.32	57.95	+7.52 +12.98	65.47	0 0	65.47	+9.38 +16.71%
Unimproved Total Acres Absolute Change Percent Change	235.61	-47.45 -20.14	188.16	-45.19 -24.02	142.97	-114.01 -79.74	28.96	-206.65 -87.71%
Total Nonabutting Acres	484.32		484.32		484.32		484.32	

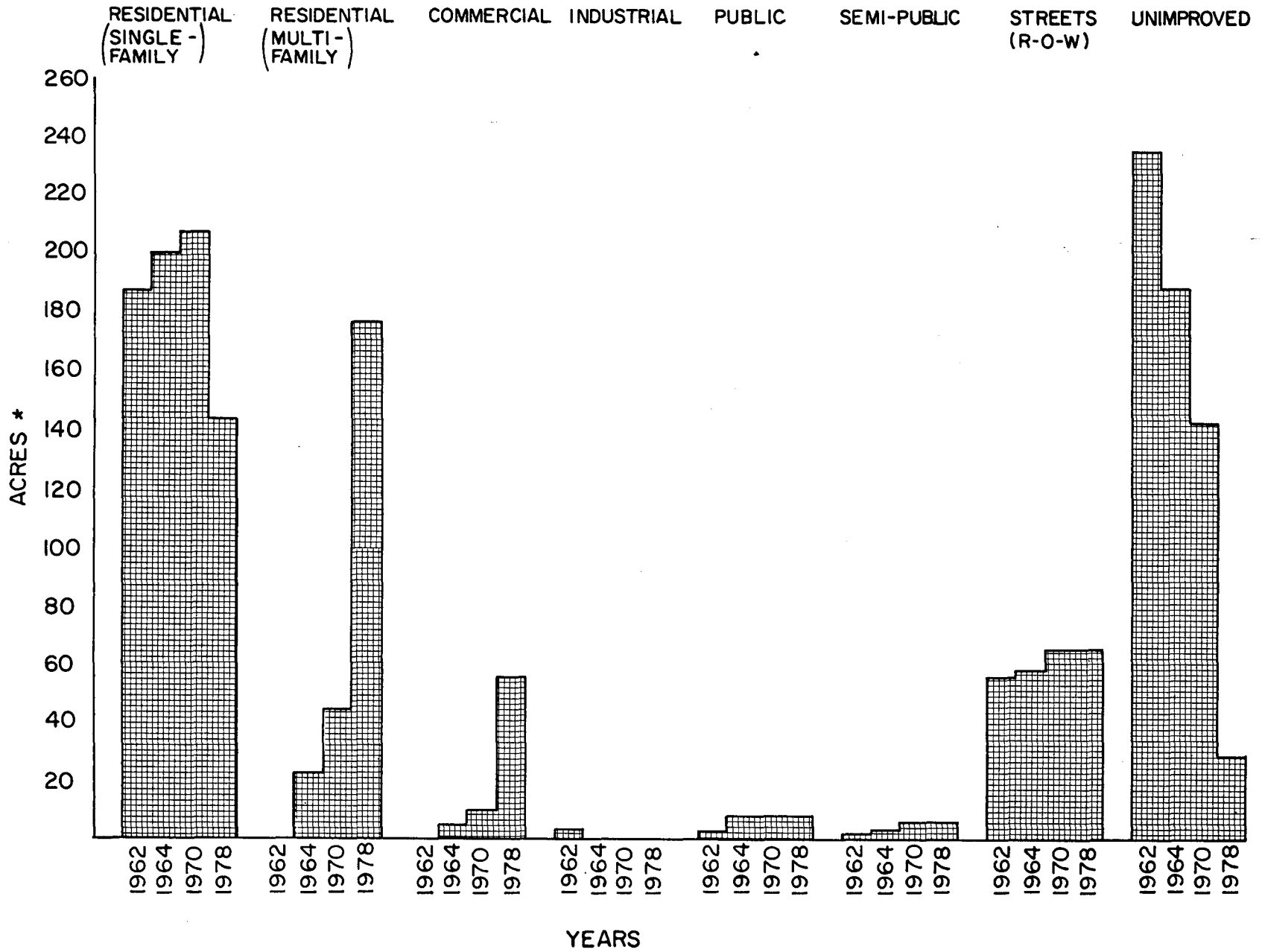


Figure 9. Changes in Nonabutting Land Uses in the Westheimer Road Study Area by Category and Selected Years

*One acre equals 0.4046856 hectares.

illustrates the acreage for each nonabutting category during each of the project years.

Land Use Impediments

Many factors can alter the rate and type of land use development in an area besides the improvement of a single thoroughfare. Zoning laws, subdivision (deed) restrictions, comprehensive land use plans, regional developments, area accessibility, and property ownership could have dictated how development and land use change occurred in the impacted area. These factors were investigated to determine the extent these factors influenced land development in the area.

Land Use Plans and Controls

The City of Houston does not have zoning laws and, therefore, has no legal means of enforcing or controlling land use. The process through which the city may influence land use development is by approving or rejecting plats submitted by land developers. When approving plats, the city has the authority to impose certain restrictions, e.g. location and number of access points to major thoroughfares, type and width of local streets, and set-back distance of buildings from street; but the city cannot dictate the type of land development. Deed restrictions are the only legal method of controlling land use in Houston, but area property owners, not the city government, must instigate the action to prevent a nonconforming land use.

Although land use planners in Houston have no power to enforce land use controls, comprehensive land use plans have been developed to reflect general trends in land development. In 1960, the Houston Metropolitan Area Transportation Study published a 1980 land use plan for Harris County that forecasted that

the Westheimer Road, Section One Study Area would evolve into a predominantly single-family residential area with strip commercial developments abutting Westheimer Road and multi-family residences concentrating at the intersection of Westheimer and Hillcroft-Voss Road. The 1980 plan also forecasted that strip commercial establishments would be located along Hillcroft-Voss Road and along portions of Chimney Rock Road within the Study Area. The Houston City Planning Commission published in 1972 a plan entitled, "Houston General Study Plan for 1990" which described the Study Area as almost exclusively as medium density residential. A small portion, just north of Westheimer and east of Chimney Rock was expected to be commercial. This plan did not address, or account for strip commercial developments; only regional and neighborhood shopping centers and business establishments were identified in the 1990 general land use plan.

These general land use plans are based on existing land use, land development trends, age of existing improvements, and amenities offered for the various types of developments. The land use configuration in the Westheimer Road, Section One Study Area has basically conformed to the prediction found in the general land use plans, especially the 1980 Houston Metropolitan Area plan. The only difference between the actual and forecasted land use are that multi-family residential development has been more widespread in the Study Area than previously expected. The redevelopment of single-family residential tracts into multi-family residences in the mid-section of the area has resulted in these differences. Generally, the land use plans were correct in forecasting strip commercial development along Westheimer and other major streets, multi-family residences in the western portion of the Study Area, and single-family development throughout the undeveloped portions of the selected area. Although the land use plans are too general to account for block by block land uses, land

use development trends in Houston-Harris County have been effectively forecasted by comprehensive land use plans.

Other Factors Influencing Land Use Change

Due to the lack of land use controls and the availability of unimproved property, there has been practically no impediments to land use change or development. Factors which may have influenced (encouraged) the development of strip-commercial establishments along Westheimer Road were the existence of a major regional shopping center and office building complexes near the intersection of Westheimer and IH 610 just east of the Study Area, the characteristic of Westheimer as the major traffic artery in the area, and the growth trend of Houston toward the west. Construction of multi-family residential complexes were facilitated by the availability of large unimproved tracts of land in the Westheimer vicinity and the completion and improvement of the thoroughfare network (i.e. San Felipe, Richmond, Hillcroft-Voss and Fountain View).

In general, there were no factors which were determined to have inhibited land use change and development in the Study Area; but, on the other hand, several factors were identified which probably encouraged commercial and multi-family residential development along and near Westheimer Road.

Socio-Economic Characteristics

The socio-economic characteristics of an area may have an important influence on the regional land use development. Factors such as population growth, median family income, educational level, and labor force characteristics were investigated to determine their possible significance to land use development trends in Section One of the Westheimer Road area.

Table 6 enumerates the 1960 and 1970 Bureau of the Census population and labor force data for Census Tracts 91-E/422 and 91-F/423 and the City of Houston. These data were analyzed to detect if any significant differences existed in the above characteristics between the City of Houston and the census tracts during the two years of interest. Since Census Tracts 91-E/422 and 91-F/423 encompass the entire 660 acre Study Area, a comparative analysis between the two sets of data may be implemented. (Census Tracts 91-E and 91-F were the 1960 census identification codes for Census Tracts 422 and 423 in the 1970 census, respectively.)

From Table 6, it can be determined that the population in Census Tracts 91-E/422 and 91-F/423 increased by 152.7% from 1960 to 1970, while the City of Houston population increased 31.4% during the same time frame. Also, the median school years completed and the percent of high school graduates in both the 1960 and 1970 censuses were noticeably higher for the census tracts, when compared to the city-wide data. Correspondingly, the median family income was higher in Census Tracts 91-E/422 (132.9% in 1960 and 75.7% in 1970) and 91-F/423 (16.0% in 1960 and 27.1% in 1970) than in Houston; in addition, the median value of owner-occupied residences of the two census tracts was higher than the comparable Houston median value in both the 1960 and 1970 census. Further analysis of the above differences indicate that generally the gap between the city-wide data and the data for Census Tract 91-E/422 has remained the same (in absolute terms) for 1960 and 1970, but the gap between the Houston and Census Tract 91-F/423 figures has increased (in both absolute and percentage terms) between the 1960 census and 1970 census (i.e., percent high school graduates, median family income, median value of owner-occupied residences, and median rent paid by tenants).

Table 6. Comparison of 1960 and 1970 Socio-Economic Characteristics of Houston and Census Tracts 91-E/422 and 91-F/423

Socio-Economic Characteristics	1960			1970		
	Houston	Tract 91-E	Tract 91-F	Houston	Tract 422	Tract 423
<u>Population</u>	938,219	5,622	7,875	1,232,793	16,486	17,616
Median School Years Completed	11.3	14.6	12.4	12.1	15.5	13.2
Percent High School Graduates	45.2	84.6	60.2	51.8	88.5	75.3
Median Family Income	\$5,902	\$13,744	\$6,848	\$9,876	\$17,354	\$12,551
Median Income of Families and Unrelated Individuals	\$5,093	\$13,197	\$6,606	\$8,055	\$16,877	\$10,221
Median Value of Owner Occupied Residences	\$10,900	\$25,000+	\$13,800	\$14,400	\$41,400	\$22,100
Median Rent Paid by Tenants	\$67	\$--	\$93	\$96	\$178	\$158
Percent Families Below Poverty Level	NA ^(a)	NA ^(a)	NA ^(a)	10.7	3.0	6.3
<u>Occupation</u>						
Total Employed, 16 Years and Over	363,636 ^(b)	1,894 ^(b)	2,929 ^(b)	515,619	9,288	8,657
Percent Professional, Technical, and Kindred Workers	12.49	28.62	18.13	16.53	35.61	27.11
Percent Managers and Administrators, Except Farm	9.97 ^(c)	28.88 ^(c)	13.21 ^(c)	8.78	18.14	10.80
Percent Sales Workers	8.08	14.15	11.67	8.97	15.83	15.46
Percent Clerical and Kindred Workers	16.56	12.88	14.44	20.09	20.53	22.89
Percent Craftsmen, Foremen, and Kindred Workers	12.72	3.75	6.79	13.10	3.60	6.88
Percent Operatives, Except Transport	13.79 ^(d)	2.06 ^(d)	9.15 ^(d)	9.29	1.18	4.13
Percent Transport Equipment Operatives	NA ^(d)	NA ^(d)	NA ^(d)	4.24	0.34	1.13
Percent Laborers, Except Farm	5.74	1.64	9.53	5.19	0.61	3.26
Percent Farm Workers	NA ^(c)	NA ^(c)	NA ^(c)	0.24	0.08	0.10
Percent Service Workers	9.44	2.22	4.92	11.14	3.38	6.58
Percent Private Household Workers	4.21	2.27	6.76	2.09	0.61	1.64

- (a) Percent Families Below Poverty Level was not calculated by the Bureau of the Census in the 1960 census.
- (b) In the 1960 census, Total Employed included all employed persons 14 years old and over.
- (c) In the 1960 census, the percent total for managers and administrators included farm workers; therefore, a separate percent total for Farm Workers was Not Available.
- (d) In the 1960 census, the percent total for Operatives include transport equipment operatives; therefore, a separate percent total for Transport Equipment operatives was Not Available.

An analysis of the labor force characteristics indicated that the persons living in the two census tracts were employed in higher paying occupations than those in Houston in 1960 and 1970. For example, Census Tracts 91-E/422 and 91-F/423 contained a relatively higher proportion of people employed as professional and technical workers, managers and administrators, and sales workers and a smaller proportion of craftsmen and foremen, laborers, service workers, and private household workers than Houston, city-wide. As was the case above, Census Tract 91-F/423 has widened the gap in the occupational characteristics between 1960 and 1970. The differences in the labor force's occupational traits and the corresponding differences in educational level, median family income, and value of housing suggest that there is a correlation between the occupational and population characteristics.

The socio-economic data found in Table 6 indicates that the Study Area and the surrounding region has experienced marked changes in population and that the characteristics of the Census Tracts are somewhat different than Houston as a whole. The differences in the above data suggest that the Study Area's census tracts have had an economic base more conducive to continued land development than perhaps Houston in general.

IMPACT OF THE STREET IMPROVEMENT ON LAND USE IN THE STUDY AREA

Two approaches were implemented to estimate the impact of the Westheimer Road improvement on land use change and development in the Study Area. The two approaches utilized two different types of data to indicate probable impact of the improvement are: (1) actual land use change by type and location, and (2) the opinions of knowledgeable people.

Actual Land Use Changes

During the overall study period, the percentage of developed land (including streets and roads) increased from 49.9% in 1962 to 93.3% in 1978 while, correspondingly, the percent of unimproved acreage dropped from 50.1% to 6.7% for the same time period. Of the 659.3 acre Westheimer Road, Section One Study Area, approximately 291.56 acres (118.0 hectares) of previously unimproved land were developed in some manner and 87.40 acres (35.4 hectares) of previously improved land experienced some type of land use change between 1962 and 1978 (Table 7).

The Study Area property was classified as abutting or nonabutting property. Abutting acreage constituted 174.98 acres (70.8 hectares), or 26.5% of the total area, and the remaining 484.32 acres (196.0 hectares), 73.5% were defined as nonabutting land. Almost 58.3% (101.96 acres) of the abutting property changed land uses during the 16-year analysis period; and of the 101.96 acres, 84.91 acres (83.3%) were previously unimproved land and 17.05 acres (16.7%) were previously improved land. Nonabutting property also experienced a similar degree of land use change; over 57.2% (277.00 acres) of total nonabutting property recorded a change in land use. Previously unimproved land made up 74.6% (206.65 acres) and previously improved property totalled approximately 25.6% (70.35

Table 7. Absolute Change in Land Use of Abutting and Nonabutting Acreage by Time Period and Type of Land Use Change

Type of Land Use Change	Before Period		Construction Period		Long-Run After Period		Overall Period	
	1962-1964		1964-1970		1970-1978		1962-1978	
	Abutting	Nonabutting	Abutting	Nonabutting	Abutting	Nonabutting	Abutting	Nonabutting
	----- Acres ^a -----							
Single-Family Residential to Commercial	0.41	0	5.16	3.16	4.81	6.34	10.38	9.50
Single-Family Residential to Multi-Family Residential	0	0.63	0	0	0	57.12	0	57.75
Industrial to Commercial	1.42	3.10	0	0	0	0	1.42	3.10
Commercial to Unimproved	1.35	0	0	0	0	0	1.35	0
Semi-Public to Unimproved	3.90	0	0	0	0	0	3.90	0
Unimproved to Single-Family Residential	1.76	13.37	0	10.86	0	0	1.76	24.23
Unimproved to Multi-Family Residential	14.53	21.81	5.31	22.02	0	74.48	19.84	118.31
Unimproved to Commercial	9.76	1.95	18.07	1.85	27.26	39.53	55.09	43.33
Unimproved to Public	0	6.72	0.10	0	0	0	0.10	6.72
Unimproved to Semi-Public	0	1.74	0	2.93	4.34	0	4.34	4.67
Unimproved to Streets and Roads	1.92	1.86	1.86	7.52	0	0	3.78	9.38
Total Acreage Changing Use	35.05	51.18	30.50	48.35	36.41	177.47	101.96	277.00
Previously Improved	7.08	3.73	5.16	3.16	4.81	63.46	17.05	70.35
Previously Unimproved	27.97	47.45	25.34	45.19	31.60	114.01	84.91	206.65
Total Acreage Not Changing Use	139.93	433.14	144.48	435.97	138.57	306.85	73.02	207.32
Total Acreage	174.98	484.32	174.98	484.32	174.98	484.32	174.98	484.32

^aOne acre equals 0.4046856 hectares.

acres) of the total nonabutting acreage change. Both abutting and nonabutting properties experienced similar degrees (percentages) of land use development and redevelopment between 1962 and 1978.

Tables 7 and 8 were prepared to illustrate the extent of land use change that occurred in the study area according to property location (abutting vs. nonabutting). Table 7 indicates the period by period acreage changing land use. Table 8 shows the period by period average annual percentage change in land use calculated to adjust for the difference in the number of years between time periods. Both tables also indicate the previous and new use categories for each change recorded. This approach will permit a comparative analysis to be done between abutting and nonabutting property change and, therefore, determine the impact of the Westheimer Road improvement relative to property location.

Of the 101.96 abutting acres experiencing change or development during the 16-year span, the amount of change was evenly distributed between the three time periods, i.e. 35.05 acres in the "before" period, 30.50 acres during the "construction" period, and 36.51 acres in the "after" period (Table 7). Previously unimproved land which was developed as commercial property constituted over 54% (55.09 acres) and new multi-family residential developments constructed on previously unimproved land made up approximately 19.5% (19.84 acres) of the total acreage change. New developments on previously unimproved land also included: single-family residential (1.76 acres), public (0.10 acres), semi-public (4.34 acres), and streets and roads (3.78 acres). The most important type of redevelopment occurred in the single-family residential to commercial change which totalled 10.2% (10.38 acres) of the overall change. Other types of changes recorded on previously improved property were: industrial to commercial (1.42 acres), commercial to unimproved (1.35 acres), semi-public to unimproved (3.90 acres).

Table 8. Average Annual Percentage Changes in Abutting and Nonabutting Acreage by Time Period and Type of Land Use Change.

Type of Land Use Change	Before Period		Construction Period		Long-Run After Period		Overall Period	
	1962-1964		1964-1970		1970-1978		1962-1978	
	Abutting	Nonabutting	Abutting	Nonabutting	Abutting	Nonabutting	Abutting	Nonabutting
	-----Percent ^a -----							
Single-Family Residential to Commercial	0.12	0	0.49	0.11	0.34	0.16	0.37	0.12
Single-Family Residential to Multi-Family Residential	0	0.07	0	0	0	1.47	0	0.75
Industrial to Commercial	0.41	0.32	0	0	0	0	0.05	0.04
Commercial to Unimproved	0.39	0	0	0	0	0	0.04	0
Semi-Public to Unimproved	1.11	0	0	0	0	0	0.14	0
Unimproved to Single-Family Residential	0.50	1.38	0	0.37	0	0	0.06	0.31
Unimproved to Multi-Family Residential	4.15	2.25	0.51	0.76	0	1.92	0.71	1.53
Unimproved to Commercial	2.79	0.20	1.72	0.06	1.95	1.02	1.97	0.56
Unimproved to Public	0	0.69	0.01	0	0	0	0.01	0.09
Unimproved to Semi-Public	0	0.18	0	0.10	0.31	0	0.16	0.06
Unimproved to Streets and Roads	0.55	0.19	0.18	0.26	0	0	0.14	0.12
Total Acreage Changing Use	10.01	5.28	2.90	1.66	2.60	4.58	3.64	3.57
Previously Improved	2.02	0.38	0.49	0.11	0.34	1.64	0.61	0.90
Previously Unimproved	7.99	4.90	2.41	1.55	2.26	2.94	3.03	2.67

^aDerived from the absolute acreages in Table 7. For example, the individual acreages changing use during the "before" period are divided by the total abutting or nonabutting acreage at bottom of Table 7 to obtain the corresponding percentages for that period. Then each percentage figure is divided by the number of years represented by the "before" period. This procedure is repeated for each period.

Table 8 illustrates that the overall annual percentage change in abutting land use was 3.64% per year. This figure represents that on average during the 16-year period, 3.64% (6.37 acres) of the 174.98 acres of abutting property underwent some type of development or redevelopment in each of the years. Previously unimproved land development constituted 3.03% of the total acreage annual percentage change; and of the 3.03%, commercial developments made up 1.97%. The redevelopment of previously improved abutting property was also dominated by the influx of commercial establishments. The most important types of land use changes recorded during the overall period and, in most instances, during each of the three study periods were from: (1) unimproved to commercial, (2) unimproved to multi-family residential, and (3) single-family residential to commercial (see Table 8).

The nonabutting property, like the abutting property in the Study Area, underwent a great deal of land use change and development during the overall study period. Unlike the abutting acreage, the amount of land use change recorded in each of the three study periods was not evenly distributed. Reviewing Table 7, 277.0 acres of the nonabutting property changed land uses during the 16-year period; and of that total, 51.18 acres experienced a change in the "before" period, 48.35 acres changed uses during the "construction" period, and 177.47 acres changed uses in the after period. These totals include land that underwent some type of development or redevelopment during the 16-year period. Previously unimproved acreage constituted 74.6% (206.65 acres) of the total acreage which changed use, while previously unimproved acreage constituted the remaining 25.4% (70.35 acres) of the total acreage which changed use.

The most prominent type of land use change recorded on nonabutting property during the overall period was the development of 118.31 acres of unimproved land into multi-family residences, almost 63% (74.48 acres) of which occurred during

the "after" period. Another important change that was recorded in the "after" period was the redevelopment of 57.12 acres of single-family residential property to multi-family residential. Commercial acreage also increased from 0.0 acres to 55.93 acres during the analysis period, most of which (43.33 acres) were previously unimproved land and the remaining 12.60 acres were redeveloped from either single-family residential or industrial uses. All of the improved nonabutting land use categories, with the exception of industrial and single-family residential, recorded an increase in acreage between 1962 and 1978.

Table 8 illustrates somewhat surprisingly that the overall 16-year period average annual percentage change in land use was virtually the same for abutting (3.64% per year) and nonabutting (3.57% per year) property. For the nonabutting property, the table reveals that although the acreage experiencing change was the highest in the "after" period, the average annual percentage change was the highest in the "before" period being compared to the six-year "construction" period and the eight-year "after" period. The highest rate of change on previously unimproved property occurred in the "before" period (4.90% per year) and the highest rate of change on previously improved property was recorded in the "after" period (1.64% per year).

The evidence illustrated in Tables 7 and 8 seems to indicate that the improvement of Westheimer Road facilitated the continued development of previously unimproved acreage in the Study Area. The abutting tracts have evolved from unimproved and single-family residences into strip-commercial developments, while the majority of the nonabutting unimproved tracts and redeveloped single-family residences have become multi-family residences. It would be difficult to claim that the Westheimer Road improvement accelerated land use change in the Study Area, but it is easy to see that the improvement encouraged the continued

land use change and land use trends which had already been set in motion in the Study Area.

Opinions of Knowledgeable People

Interviews were conducted with local real estate personnel, area property owners, and city government officials in an effort to obtain relevant background information that would provide additional insight as to the impact on area land use change and development by the Westheimer Road, Section One, improvement project. These persons felt that in general the widening and paving of Westheimer Road had facilitated and accelerated land development in the Study Area but did not alter the land use trends that existed prior to the improvement.

Real estate personnel pointed out that Westheimer Road was the only major east-west traffic arterial, prior to the extension of Richmond Road, that provided access to large amounts of acreage being developed between the Southwest Freeway (U.S. 59) and Katy Freeway (IH 10) during the 1960's and 1970's (Figure 1). As a result, Westheimer Road became one of the most traveled thoroughfares in Houston and the abutting and adjacent properties became some of the most attractive commercial and multi-family residential land in Harris County. The improvement of Westheimer Road as a six-lane, raised median facility improved access to the developing area and coupled with the growth trend of Houston toward the west and north, only accelerated the existing land use development trends. Real estate developers indicated that strip-commercial developments which sprang up along Westheimer were probably influenced most by the widening and paving project. The multi-family residential complexes which located along and near Westheimer were, in most cases, also affected by the improvement of other area streets, i.e., Richmond, San Felipe, Hillcroft-Voss and Fountain

View. Developers and brokers agreed that the abutting property along Westheimer was prime strip-commercial land, while the nonabutting acreage was prime multi-family residential property. They claimed that this is evidenced by the redevelopment of abutting single-family residential tracts into business establishments and nonabutting single-family residential tracts into apartment complexes.

City government officials were in agreement with real estate people in that the improvement of Westheimer Road did not alter development trends in the area. In fact, one official felt that pressures placed on Westheimer as a traffic artery by increased population and new developments in the area resulted in the improvement of the facility. Officials also said that the combination of Westheimer Road being one of Houston's most important streets and Houston's phenomenal growth resulted in the types of land uses that have developed in the Study Area. Government officials felt that the Westheimer Road improvement project accelerated the land use development trends which existed in the area.

The opinions of real estate developers and brokers, property owners, and government officials were that the improvement of Westheimer Road, Section One, accelerated and facilitated land use change and development. Basically, these opinions are in general agreement with the findings of the land use analysis of the Study Area.

CONCLUSIONS

The Westheimer Road, Section One, Study Area has experienced a great deal of land use change and development during the 16-year study period. The improvement of Westheimer Road, from a point just east of Chimney Rock to Hillcroft-Voss Road, from a two-lane undivided asphalt rural-type road with open ditches to a six-lane divided (raised median) thoroughfare with curbs and gutters has affected the development and redevelopment of property into commercial and multi-family residential uses. The Study Area's predominant type of land use has evolved from unimproved to multi-family residential (with commercial and single-family residential developments also being important uses) between 1962 and 1978.

Approximately 58.3% of the abutting acreage experienced a land use change during the overall study period. The abutting predominant land use was unimproved in 1962, but by 1978, commercial property dominated the abutting acreage. The redevelopment of abutting single-family residential tracts continued through the study period until none remained in 1978. The percentage of unimproved land in the Study Area steadily declined between 1962 (54%) and 1978 (8.8%), while the amount of commercial and multi-family residential acreage increased, correspondingly.

Nonabutting properties also underwent a similar degree of land use change as did the abutting tracts. About 57.2% of the 484.32 nonabutting acres recorded some type of land use change during the overall period, and as was the case for the abutting land, unimproved acreage was the predominant land use in 1962. By 1978 multi-family residential developments had become the predominant land use category. The availability of large unimproved tracts and the

redevelopment of single-family residential property into multi-family residential property has facilitated the change in the predominant nonabutting land use. However, most of the acreage change has occurred between the unimproved to multi-family residential categories. For instance, the percentage of unimproved property has declined from 48.6% in 1962 to 6.0% in 1978 while the percentage of multi-family residential acreage has grown from 0.0% in 1962 to 36.4% in 1978. Each of the three time periods recorded a decrease in unimproved property and an increase in multi-family residential and commercial acreage, but the largest amount of acreage change occurred in the "after" period, 1970 to 1978.

The land use changes and developments that were recorded in the Study Area have been attributed to the general growth trends of Houston and to the characteristics of Westheimer Road. The growth of Houston toward the north and west coupled with the fact that Westheimer Road is one of the most heavily traveled thoroughfares has brought about new land developments in the Study Area. The type of developments locating in the area have generally conformed with the land use projections of published comprehensive land use plans by area governments, and the improvement of Westheimer Road, Section One, has not altered the land use characteristics of the region. In summary, the Westheimer Road improvement has aided in the development of previously unimproved land and the redevelopment of single-family residences into either commercial or multi-family residential uses. Abutting acreage has evolved into primarily commercial property while the nonabutting property has become dominated by multi-family and single-family residential development during the overall analysis period, 1962-1978.

The high average annual rate of land use change that occurred in the "before" period, as opposed to the "construction" and "after" periods, may have been due to developers anticipating the Westheimer Road improvement. Also, this

area was ripe for the continued expansion or development of a rapidly growing area. The Westheimer Road improvement apparently aided in this continued expansion.