Increasing Bus Transit Ridership: Dynamics of Density, Land Use, and Population Growth

Final Report
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Metrans Project

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Disclaimer

Abstract

The study explores the possibilities of revitalizing existing urban communities, increasing transit ridership, decreasing jobs-housing imbalance, and mitigating the impacts of sprawl from transit corridor development or TCD, a variant of the more general class of TOD or transit-oriented development. We present findings of a study that focuses on the relationship between transit ridership and density and mixed land use developments along major arterial corridors in Los Angeles. Our research focuses on Ventura Boulevard and Vermont Avenue as a comparative study of two heavily subscribed transit corridors. Our analysis suggests that the predominant land use around these corridors is low-density automobile-oriented development which remains transit-unfriendly. However, the City's policy environment has undergone favorable changes with the introduction new zoning ordinances. In light of these changes, we develop and recommend spatial and urban design strategies that productively utilize surplus and marginal space along transit corridors to accommodate future population growth. It is our expectation that the densification of the underutilized commercial corridors will create vibrant local economies, increase opportunities for market and affordable housing, revitalize retail, and lead to a fuller use of transit lines and increased ridership, a trend that we have already observed in higher density bus station areas.

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Chapter 1: Introduction & Executive Summary

Los Angeles region has the largest network of bus transit system covering an area of 1,400 sq. miles with 1,433 of road miles of local transit and commuter lines, and 96 miles of Rapid Transit lines.[1] The integrated network currently serves a transit dependent population of 1.4 million daily. The Southern California Association of Governments (SCAG) estimates a continued growth in population, housing, and employment density in the region. Rapid immigration, increase in youth and senior population, and the addition of lower income workers are contributing to an increase in the transit dependent population. This trend is expected to continue as congestion costs and the cost of auto ownership continue to escalate driven largely by Southern California's sprawling development patterns. With current levels of utilization of bus transit (seat miles) at 34% in Los Angeles there is room for increasing ridership with the promotion of more compact developments.[2]

We introduce the concept of Transit Corridor Development (TCD) to channel population growth and density along the existing transit network. We find that most transit corridors have underutilized commercial land use, vacant lots, or low density residential developments that present a viable alternative to accommodate new growth. TCD focuses on developing the underutilized properties and grey fields to its full potential. The introduction of several ordinances such as Residential Accessories Services (RAS), Location Efficient Mortgages (LEMs) and density bonuses in Los Angeles provides scope for increasing density. Further, the introduction of mixed use, infill development, adaptive reuse, grey field development along the corridor present opportunity to enhance the physical environment without affecting the surrounding residential areas or existing community character. Our analysis shows that there is an increase in transit ridership with increase in density and land use mix, thereby increasing the likelihood of TCDs becoming locations for new housing thus increasing transit ridership.

1.1 The Regional Context

Table 1.1 shows the expected population, households, and employment in the City of Los Angeles for 2030. Population is expected to grow by 19.4%, households by 30.4%, and employment by 22.8% between 2000 and 2030. The SCAG Regional Housing Needs Assessment (RHNA) estimates 60,280 additional units to be built by 2005 in the City of Los Angeles alone. This presents an opportunity to accommodate future housing needs through efficient land use and better integration of transit.

[1] http://www.metro.net/board/agendas/05_may/planning/item6.pdf
[2] Source: SCAG, 2004 Draft Regional Transportation Plan, March 2004 P.58 ,Federal Transit Administration (FTA) National Transit Database

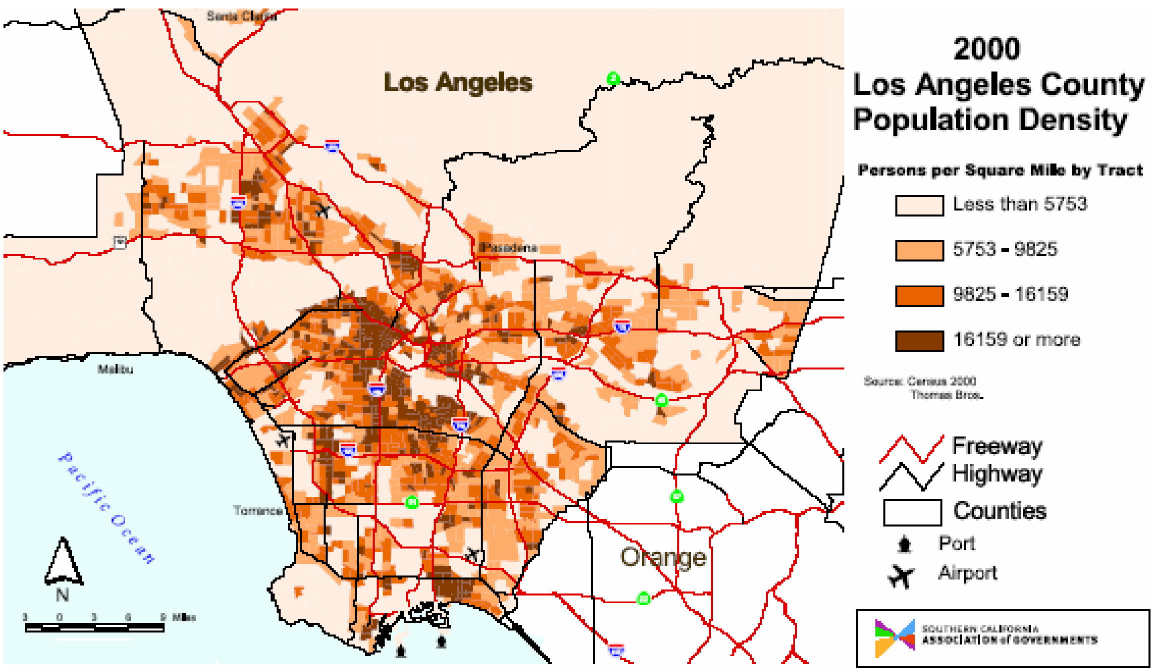
Table 1.1: Forecast Of Population, Households, And Employment For The City Of Los Angeles

City of Los Angeles	Census 2000	Forecast for 2030 Plan Forecast in Growth Vision Plus Plan Effect[3]	Percentage Change
Population	3,694,834	4,413,000	19.4%
Households	1,275,412	1,663,000	30.4%
Employment	1,747,420[4]	2,265,000	22.8%

Source: Draft 2004 RTP Population, Households, Employment Growth in 2030

Existing population density distribution in the region shows presence of pockets of low density along major transit corridors that can potentially be the location of future housing. (Refer to Figure 1.1).

Figure 1.1: Population Density In Los Angeles County



Source: SCAG

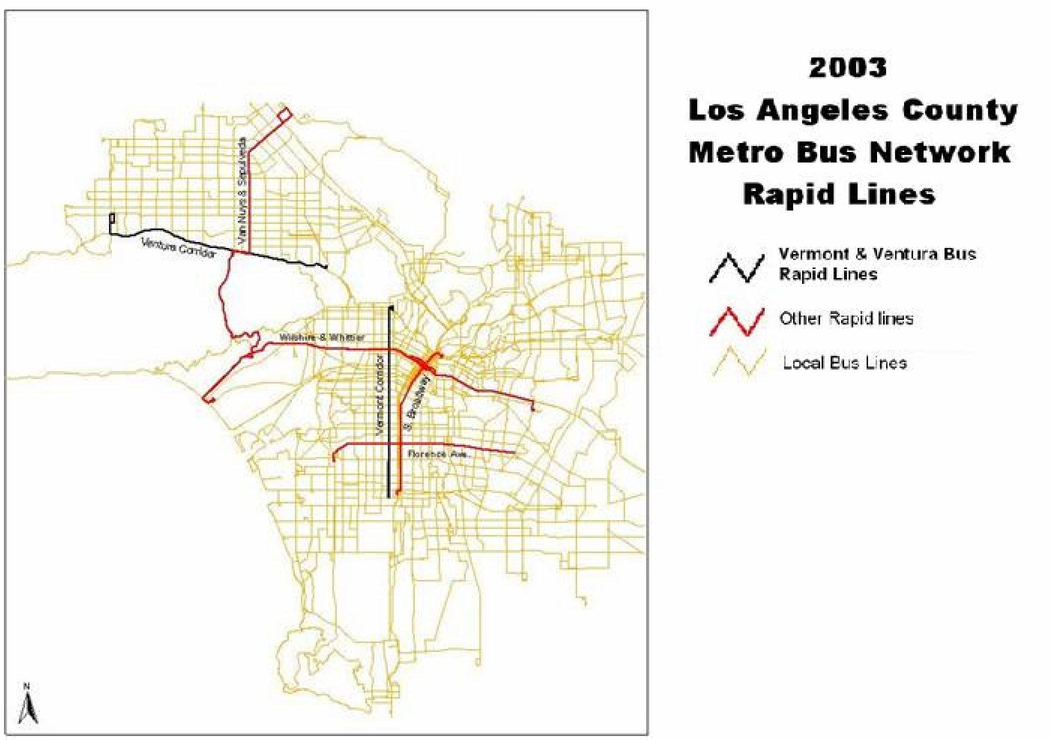
1.2 The Concept of Transit Corridor Development

TCD offers communities an alternative to the impacts of low-density suburban sprawl and automobile-dependent land use patterns. New in-fill, mixed use and higher density

[3] http://www.scag.ca.gov/rtp/2004draft/ch2.pdf
[4] Source : Employment Development Department, California

development along existing transit corridors can make significant progress towards improving mobility options and quality of life. Yet, a recent California Department of Transportation study suggests that the predominant land use around significant bus corridors and stations remains low-density automobile-oriented development.[5] Moreover, local zoning and development codes (FAR, parking requirements, allowable uses and densities) remain transit-unfriendly. With the introduction of four new ordinances in the Los Angeles including RAS 3 and 4, we see a potential to increase density within the rapid transit corridors. Our study focuses on examining the dynamics of land use and density changes among other factors in the areas along transit corridors.[6]

Figure 1.2: Map Showing The Metro Rapid And Other Bus Lines In Los Angeles County



Source: Los Angeles County Metropolitan Transportation Agency

TCD is a variant of the more general class of transit-oriented developments (or TODs), which are associated with the development around transit stations or so called transit villages. We believe increasingly, developments along transit corridors will be seen as a strategy to help mitigate effects of future sprawl, and improve California's environment and quality of life. TOD offers communities an alternative to the impacts of low-density suburban sprawl and automobile-dependent land use patterns. Moreover, TOD can help answer California's urgent need for more affordable housing by creating opportunities for infill development at higher densities. Such developments can make significant progress towards improving mobility options and quality of life by coordinating investments in

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[5] Statewide Transit-Oriented Development Study: Factors for Success in California (May 2002),

[6] Refer to figure 1.2 for the key map showing the rapid bus corridors

land use and transportation projects. Optimal transit system design, community partnerships, comprehensive understanding of the local real estate market, innovative urban design concepts, coordination among local, regional, and state agencies, and the right mix of planning and financial incentives are some of the key elements required for successful implementation of developments. The increasing demand for urban housing (at higher densities) that offers reduced commute times and access to urban amenities, points to increasing demand for TCD projects.

While a number of new TODs have been planned and built across the state, there are also major barriers that limit their implementation in California. One of the major challenges to TOD is the underlying zoning and land use along transit stations and corridors. The predominant land use around the majority of significant bus and rail stops remain low-density automobile-oriented development as local zoning is transit-unfriendly, antiquated, and protected by NIMBYism.

Competition for sales tax dollars has left many cities with under performing retail strips, malls, and commercial corridors. The success of one city is the loss of another. This zero sum game has led to a gradual cannibalization of space leaving inner city corridors littered with underutilized and marginal retail. There are many examples in Los Angeles and Gateway Cities where these commercial corridors abut communities and neighborhoods with significant transit dependent populations or potential transit riders. Compounding the problem are local development codes (FAR, parking requirements, allowable uses and densities) around stations and corridors that often tend to favor low-density, auto-oriented uses. Creating and implementing transit friendly zoning becomes an additional challenge.

1.3 Objectives of the Study

We want to understand the dynamics of population growth and density and determine to what extent supporting land use and zoning have kept pace with the underlying change in these bus transit corridors. Specifically, the objectives of this project are to:

- Assess the dynamics of demographic, socio-economic, density, and land use changes in these transit corridors, and their interactions.
- Document the environmental, institutional, market, and social factors that are contributing to change in the bus transit corridors.
- Identify major obstacles and opportunities for higher density and mixed-use development in transit corridors.
- Review lessons learned from this analysis that could lead to specific policy recommendations.
- Develop and recommend planning and urban design strategies that productively utilize surplus and marginal space along transit corridors to accommodate future growth in higher densities, and mixed-use developments, thereby increasing bus transit ridership.

1.4 The Study Corridors

For this study we chose to focus on two distinctly different bus transit corridors with some of the higher transit ridership as identified by MTA. These are Ventura Boulevard, approximately 16 miles long, from Lankershim Blvd. on the east to Topanga Canyon Blvd. on the west, and Vermont Avenue a length of 11.5 miles from Sunset Blvd. on the north to Imperial Highway on the south. For the purposes of this study walkable distance of half-a-mile from transit routes and stops on both sides define the width of the transit corridors and our study area.

The corridors exhibit diverse service, ridership, land use, travel, retail sales, demographic, and socio-economic patterns. According to MTA, total bus ridership has increased by nearly 40 percent on the 26-mile Wilshire/Whittier and 16-mile Ventura Boulevard corridors since the initiation of the Metro Rapid Program in June 2000. Nearly one third of the increase has come from passengers new to public transit. Metro Rapid is slated to expand in 24 corridors over the next five years in 34 cities and 11 Los Angeles County unincorporated communities.

The Ventura corridor running east-west has relatively higher income level and low density residential development than the Vermont corridor, which runs north-south showing differences in spatial, built form characteristics, and income diversity. The common features among the two corridors are the high transit ridership and under utilization of sites with respect to allowable densities for development.

Figure 1.3: Study Area Vermont Corridor

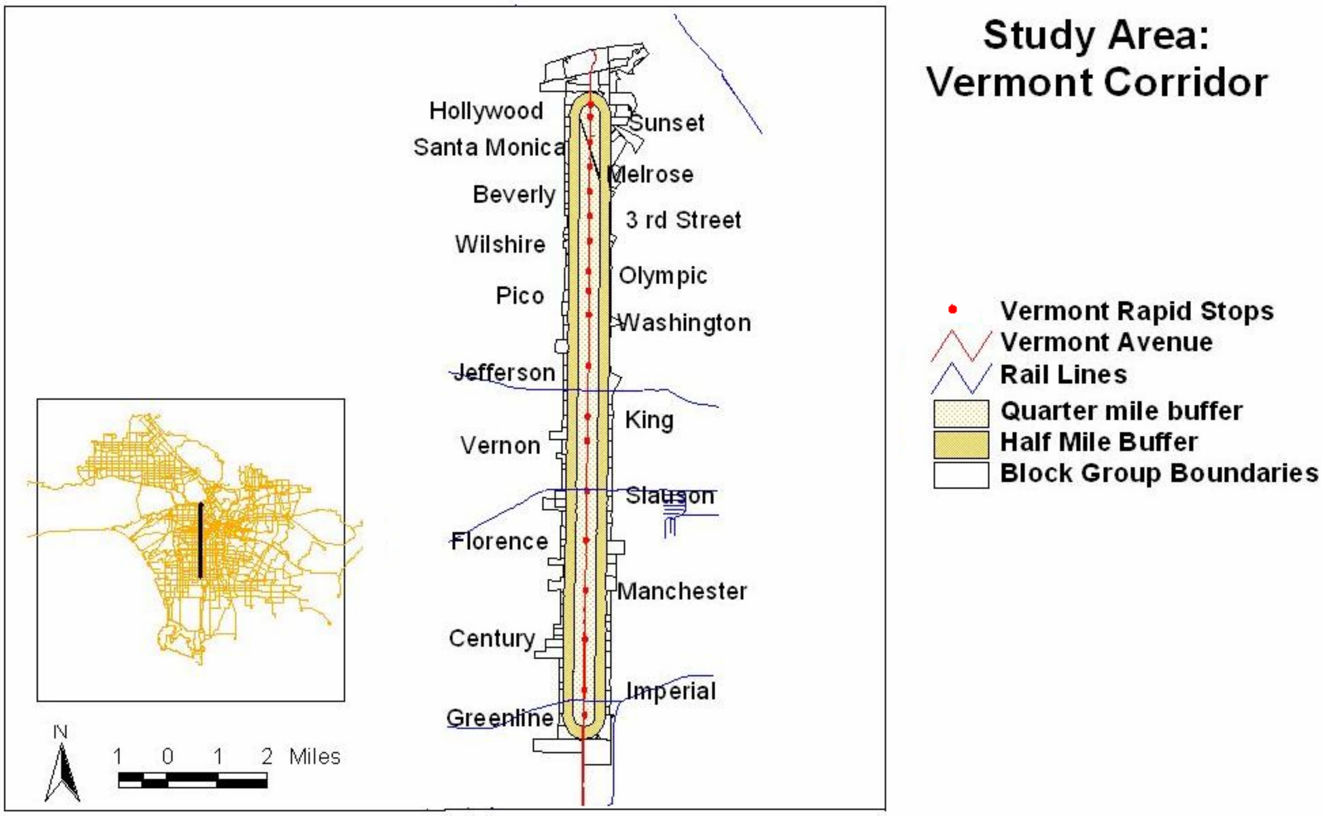
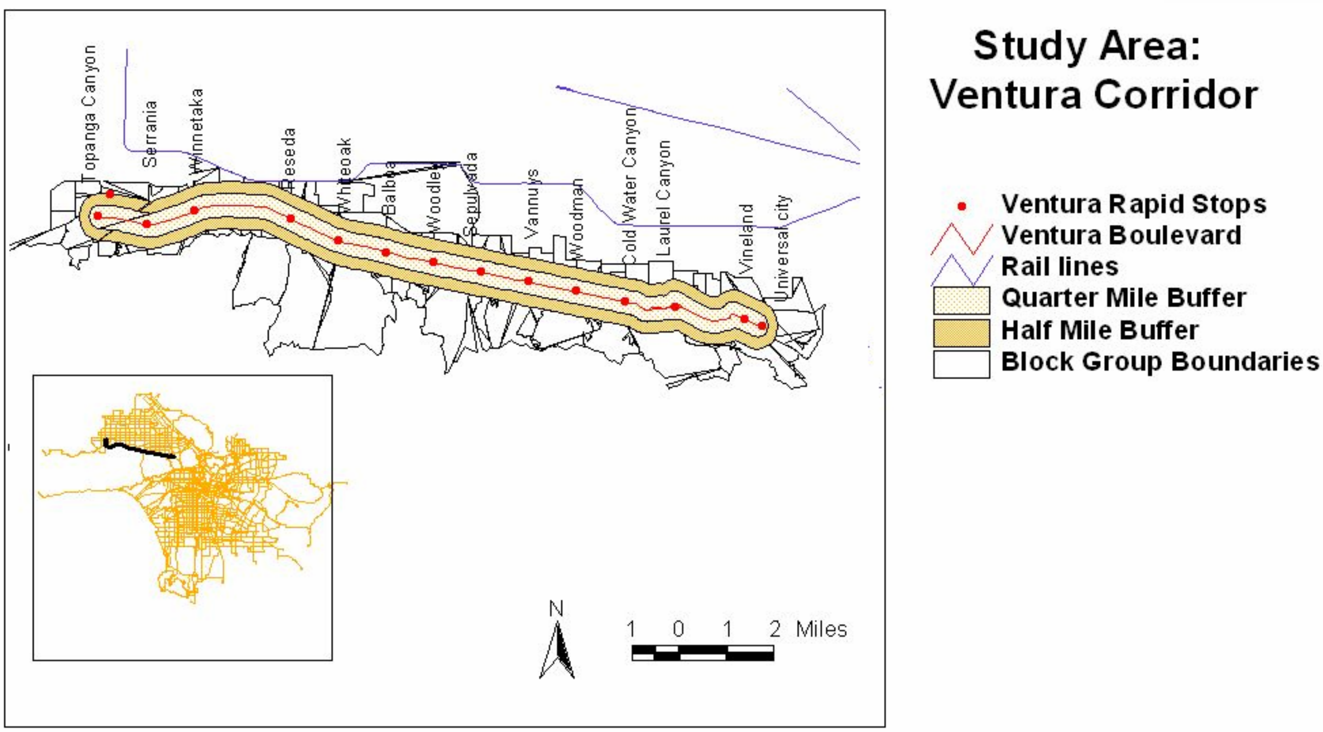


Figure 1.4: Study Area Ventura Corridor



1.5 Data Sources

We chose to use publicly available 1990 and 2000 Census data for population and housing analysis. Census bock groups that intersected the one mile width of the two corridors were considered as the units of analysis. Rapid bus stop areas were a subset of the corridor units of analysis and consisted of block groups that intersected a one mile diameter of major rapid bus stop intersection.

Employment data from SCAG was used to create the multiple regression models to predict ridership. Here the census tracts that intersected the one mile diameter of Rapid bus stop areas were the individual units of analysis.

We also used SCAG's 2000 land use data to perform land use analysis. In determining total ridership within the transit corridors, we used Metro (formerly MTA), weekday boarding and alighting data for all bus lines that passed through the corridor and its intersections. Mapping of demographics was done using Census block group shape files. Maps of bus lines and bus stops were created using Metro shape files.

We have used parcel level data from Zimas - City of Los Angeles website to calculate total existing built area in four selected bus stops areas chosen as a case study. They are Florence and Wilshire in Vermont corridor, and Van Nuys and Laurel Canyon Blvd. in Ventura corridor. In case of missing information, site visits were made to estimate the likely built area. Simulation of future higher density development was done for two station areas; Florence bus stop area in Vermont corridor, and Van Nuys bus stop area in Ventura corridor.

1.6 Methodology

GIS was used in defining the boundaries and mapping of the study corridors. We have included a separate note for the data and the boundaries considered for each analysis undertaken within the corresponding chapters. Block groups were used as units of analysis for the different demographic variables.

We have analyzed data by:

- Preparing maps, tables, charts, line, and scatter plots
- Running various regression models for understanding relationship between key variables and multiple regression models for predicting future transit ridership

1.7 Major Findings

In comparing the demographic, land use, and urban form changes in the two corridors, we find different factors underpinning the relationship of population growth and density to transit ridership, and the role of land use and zoning changes that reflect the building and land use characteristics.

1. Socio-economic and housing profile

Vermont and Ventura corridors are unique and exhibit public transit ridership patterns consistent with their housing and population characteristics.

- In terms of ethnicity, population in Vermont corridor is predominantly Hispanic, followed by Blacks, Asians, and Whites in both 1990 and 2000, while population in Ventura is predominantly White followed by Hispanics, Asians, and Blacks.

- A comparison of the median income of population living in different block groups in the two corridors shows that Vermont corridor has household annual income levels lower than $25,000 in certain pockets while in Ventura corridor the median income overall was higher than $25,000 in the year 2000.

- As for the mode of travel among workers 16 years and older in the two corridors only 2.5% of workers in Ventura corridor use public transport to work while nearly 22% used public transport in Vermont corridor.

- The density in the two corridors shows a difference as well. Population density in Vermont is 33 persons per acre and housing density approximately 11 units per acre and significantly higher than Ventura corridor. Ventura corridor has an average density of 6.6 persons per acre and 3.2 housing units per acre. The corridors show marginally higher growth in housing density compared to Los Angeles during 1990 to 2000.

- The housing ownership rate is much higher in Ventura corridor compared to Vermont corridor. In 2000, almost 50% of the households were homeowners compared to 13% in Vermont corridor.

- Vermont corridor has more than twice the stock of multifamily housing compared to Ventura. Nearly 68% of the housing stock was multifamily in Vermont corridor compared to 31.5% for Ventura corridor in 2000. Ventura corridor has larger developments (or number of units in structure) in multifamily housing; 65% of housing units are in structures larger than 20 units, while Vermont corridor has smaller structures in multifamily housing with 60% of units accommodated in structures having less than 20 units.

- In 2000, land area under single family residential density of less than 5 units per acre comprises 80% of total area in Ventura corridor, while in Vermont corridor it is less than 20% of total land area.

Meeting housing demand

According to SCAG's 2000-05 RHNA, Los Angeles would require 60,280 additional housing units to accommodate new population growth. If we were to use the existing corridors along rapid bus lines, 96 miles in all, for accommodating these additional units within the one mile band area, it would require an increase of approximately one unit per acre only. The corresponding share for Vermont and Ventura corridors will be 7,222 and 10,050 housing units. Of course, the density distribution of housing developments may vary along the corridor based on the existing land use patterns.

Factors that influence transit ridership

Some of the main patterns of ridership follow conventional wisdom:

- There is a positive relationship between population density and percentage of workers 16 years and over using public transit, especially in the Vermont corridor.

- Ethnicity of population, in this case increased percentage of Hispanics contributes to increased transit ridership among workers 16 years and over in both the corridors.

- As is expected, transit ridership among workers 16 years and over decreases with increasing median household income.

- All of these relationships hold true, especially for Vermont corridor, as almost 22% of total worker population use public transport.

2. Land use analysis

A comparison of land use distribution for 2000 in the two corridors shows mild differences in terms of distribution within a half mile and one mile band of the corridors.[7]

- The land use within one mile band is predominantly residential - 67% in case of Vermont corridor and 73% in case of Ventura corridor. Commercial land use varies from a high of 31.5 % within a half mile band and 25% within a one mile band in Vermont corridor to 27.2% within a half mile band and 16.7% within a one mile band in Ventura corridor. The amount of land under vacant and open spaces is limited in both corridors; about 1.6% of Vermont corridor and 1.1% of

[7] The entire length of corridors were considered for calculating the total area and not the area under the block group which remain the units of analysis for census data and for calculating land use distributions within station areas.

Ventura corridor land is open space and recreation. Within a one mile band, Vermont has about 0.2% of vacant land while Ventura corridor has 3.2% of acerage as vacant land.

- The distribution of land use under various subcategories of residential and commercial areas show significant differences between the two corridors. Vermont corridor has 30.2% under mixed residential, 19.9 % under single family residential, and the rest multifamily residential land use. Ventura corridor has negligible mixed residential area but 58% under single family residential area and the rest as multifamily residential area consisting of duplexes, low rise apartments, and medium rise apartments. In Vermont corridor 16.9% of land area is in retail and 1.4% in general office uses, whereas in Ventura corridor 18.4% of land area is retail and 4.5 % general office uses within the half mile band of the corridor. Other commercial, public facilities, educational and special use facilities account for 13% of Vermont corridor and 4.5% of the Ventura corridor within the half mile band.

- The land use mix around bus stop areas shows wide variation among the two corridors. There are predominantly residential station areas such as Century, Vernon, Slauson, Florence, Manchester, and Imperial in the Vermont corridor. Similarly, Winnetka, Woodley, Van Nuys, Vineland, White Oak, and Balboa are the residential station areas in the Ventura corridor. The predominantly commercial, services, and industrial station areas are Wilshire, Olympic, and King in Vermont corridor, and Topanga, Serrania, Reseda, Van Nuys, and Universal in the Ventura corridor.

- A comparison of land use under different housing typologies shows differences among station areas. Some station areas are predominantly high density, mixed residential, multifamily station areas with less than 10% of acerage as single family residential. Examples of this typology include Santa Monica, Melrose, Beverly, 3rd Street, Wilshire, Olympic, Pico, Jefferson, and King in Vermont corridor. Reseda, Topanga, and Van Nuys stations in the Ventura corridor which have predominant multifamily residential are less intense and contain around 10% of the acreage.

- The mixed commercial retail and general office station areas are Wilshire, Olympic, and 3rd Street in Vermont corridor, and Topanga, Serrania, Woodley, Sepulveda, Winnetka, Reseda, White Oak, Balboa, Van Nuys, and Universal City in the Ventura corridor.

- Our interest in infill development focuses our attention on older strip retail development areas. Almost all station areas present potential for increased development in this front. The high potential station areas are Santa Monica, Pico and Washington in Vermont corridor, and Topanga, Reseda and Van Nuys in the Ventura corridor.

- Open space recreation areas that support pedestrian friendly use and community focus vary widely among the many station areas. Open space rich station areas in the Vermont corridor have nearly 8% land area dedicated to such uses. Pico and Washington bus stop areas are open space poor with less than 3% or 1% dedicated to such uses. Ventura corridor fares only slightly better relying more on private open space within the large tracts of single family neighborhoods. Balboa station area has 19.9% of land area dedicated to open space and recreation, and Universal City about 7.7% of land area. Topanga, Serrania, Winnetka, and Reseda bus stop areas lack sufficient open spaces.

- We also consider the reuse of parking lots and surrounding vacant areas to be included in increasing development potential.

3. Transit ridership and transit linkages analysis

The findings of the study relate the total ridership calculated as the average weekday boardings in all lines within a rapid bus stop intersection to the presence of transit linkages, bus stops, and metro stations near the intersection.

- We find as expected an increase in overall transit ridership with increase in rapid transit ridership for the bus stop area. This relationship is maintained when the two corridors are viewed separately as well.

- We find that the northern bus stop areas such as Santa Monica, 3rd Street, and Wilshire in the Vermont corridor, and Universal City in the Ventura corridor, close to metro rail stations show significantly high bus activity levels (total boardings on all lines). Further increase in rapid bus connectivity and other bus lines around bus stop areas show medium to high activity levels for Van Nuys and Sepulveda in the Ventura corridor. Reseda bus stop area in the Ventura corridor shows high transit activity due to the presence of more multifamily housing.

- Rapid buses show high ridership on the northern section of the Vermont corridor and the eastern section of the Ventura corridor.

- The bus stop density is higher closer to metro rail stations and rapid line transfer points as in the case of northern station areas on the Vermont corridor, and the Green line station area on the southern part. Ventura corridor bus stop areas with higher bus stop densities are Sepulveda, Van Nuys, and Reseda, along with Topanga (rapid bus transfer point) and Universal city (metro rail station & rapid bus transfer point).

- Ventura corridor has areas that lack sufficient bus stops and lie further from rapid bus stops such as the area between Winnetka and Reseda, and Laurel Canyon and Vineland.

- While we regard that bus stop and other transit infrastructure relate to demand, we see merit in increasing these facilities while we consider new developments along the corridor to enhance ridership and transit development potential.

We find Vermont rapid bus route catering to both people living within and outside the corridor. We would call it a transit commuter generating corridor. Ventura rapid route on the other hand caters to riders mainly living outside the corridor; we would call it a transit commuter destination or passing-through corridor. Most destinations tend to be towards the eastern section between Sepulveda/Van Nuys and Universal City.

4. Results from the models

We ran several OLS models for determining the relationship of total weekday boardings of all bus lines passing the rapid bus stop areas at the intersection, with housing density, employment density, transit linkages and availability of metro rail connection, and vehicle ownership.

- Considering station areas in both corridors population density remains a significant variable effecting transit ridership. However looking at the corridors separately, population density remains a significant variable for Vermont station areas.

- Housing density remains a significant variable having an effect on transit ridership in both corridors.

- Employment density is significant variable affecting transit ridership in station areas Vermont corridor alone.

- Presence of metro rail station shows a strong correlation with significant increase in transit ridership.

- As vehicles per household decreased, station areas showed increase in transit ridership. The relationship holds for both Vermont and Ventura corridor station areas.

5. Design and development potential in rapid bus stop areas

Our study compared existing cases of transit oriented developments and found variations in housing and employment densities within the one mile radii developments around the station areas. High employment or housing density does not consistently contribute to increased use of transit. Other location factors such as city, suburb mattered along with the mode of transit—heavy rail, light rail, or bus.

The station areas included varied type of uses- mixed use low density commercial and residential both horizontal and vertical at community, neighborhood level to high density mixed use with retail, office, and entertainment at regional and city level.

We also found variations based on the levels of transit infrastructure (multimodal transit hubs to single mode) in TOD cases and location (city center or suburban) affecting the relationship. Volume of boardings in these stations increased with presence of heavy rail or city center location.

For our corridor study, with significantly high boardings in bus stops close to metro rail stations compared to bus stops that were not, two types of strategies had to be considered.

One for stop areas close to rail stations and the other outside rail station areas. Further we include differences between stations that are close to city center and that are closer to regional centers.

Of the four station areas considered for detailed study with respect to existing development potential, we demonstrate possible improvements of mobility and increased housing density and mixed use on two sites – Vermont/Florence and Ventura/Van Nuys.

The design proposals show possibility of increase in current housing density. Hypothetically for Vermont/Florence intersection density is increased from 11 units per acre to 55 to 120 units per acre. Density for Ventura/Van Nuys intersection is increased from 26 to 28 units per acre to 59 to 130 units per acre depending on an FAR of 2.0 or 3.0.

Further we introduce street edge built form to the developments adding street frontage, increased site coverage, adding stories to existing buildings, parking reduction and reduced areas under parking lots to achieve the maximum FAR possible. The proposals show on-site density achievable using different building typologies- Vermont/ Florence housing densities increase from average 11 units to 28 to 55 units per acre (46.7 average), Ventura/Van Nuys intersection from average 27 units to 73 units.

1.8 Recommendations

Through our study we determine the benefits of locating housing and increasing density increase within the transit corridor, first in accommodating future housing demand for the City, and second to increase transit ridership within existing rapid bus corridors.

Due to the uniqueness of the two corridors, the strategies to increase density in the two corridors differ.

- Vermont corridor with relatively high density and high transit use will benefit from increased mixed use developments. Additionally, it will benefit from increased variety of housing types in suitable locations. We have suggested three to four storey courtyard apartments and terraced condominium housing, in addition to mixed-use developments for the Florence intersection as an example.

- Ventura corridor, on the other hand, is a relatively low density, low commuter origin corridor, and a high destination corridor. The corridor will benefit from moderate increases and also compatible built form. For example, adaptive reuse of existing single storey strip malls into new mixed use developments and infill development of vacant lots can serve as a strategy for intensifying land use.

The development potential in residential areas can be unlocked by introducing granny flats that could open up housing for the elderly and small households, at times significantly increasing the housing capacity in selected areas. This may have to be reviewed on a parcel by parcel basis.

Currently the full utilization of multifamily zoned areas within the bus stop areas is considered for analysis to accommodate higher density developments. On an average, we achieve 1.9 to 2.0 FAR in medium rise, three to four storey developments and we increase average density to 47 units per acre.

We realized parking is a major area for reform, although not within the scope of this study. Many a communities have reduced parking requirements from 2 parking spaces per household to 1 parking space per household in transit efficient locations. Reduction of parking reduces development costs and such developer incentives have stimulated residential developments. The City must consider reducing current parking requirements in both corridors to support new infill development. Other strategies include introduction of parking district and transferring on-street parking revenue to the community for upkeep of pedestrian, and transit amenities and facilities. Providing parking garages with high density mixed use developments may be some of the design strategies adopted in tandem to increase density and also shaping a transit friendly environment around the bus-station areas.

Transit Corridor Development includes some or all of the above strategies depending on the station location. Specific zoning guidelines need to be provided for adaptive reuse and infill development. We are able to achieve mixed use developments within current regulation with more specific guidelines on building placement, street furniture, signage guidelines which will enhance quality of built and pedestrian environment.

Chapter 2: Demographic and Socio-Economic Analysis

2.1 Purpose

The following chapter looks at the population and housing characteristics of the study areas, including the mode of transport to work in the two corridors. The purpose of the study is to compare differences within the corridor in terms of population, density, ethnicity, income, use of public transit, housing type, ownership pattern, and vehicle ownership, so that the impact of those factors on transit ridership can be elucidated.

2.2 Units of Analysis

The unit of analysis chosen for our study includes all of the census block groups that lie within and intersect the one mile band along the corridors, Vermont and Ventura. There are a total of 304 block groups, of which 196 block groups are in Vermont corridor, 108 block groups are in Ventura corridor (2000 Census).[1] The study examines the effect of population growth, density, socio-economic and mode choice, and also of housing density, housing characteristics at the aggregate corridor level and the distribution within block groups through maps.

2.3 Key Findings

The existing demographic pattern in the corridor shows variation and diversity in the population characteristics in terms of age group, ethnicity, public transit use to work, and housing characteristics. There is also diversity in population and housing density in the two corridors. Even as the two corridors show high bus transit ridership, Vermont corridor draws on the people living within the corridor, as more than 22% of the workers aged 16 years and above use public transit, compared to Ventura which serves more as a link or a destination point for commuters since less than 3% workers living within the corridor use public transit.

2.4 Growth Within Corridor And Effect On Ridership

- The population growth rate of the two corridors during 1990-2000 at 4.04% has been less than the City of Los Angeles as a whole which has grown by 6.01%. The growth in housing density has been 0.2 housing units per acre in the two corridors compared to 0.125 housing units per acre in the City of Los Angeles.

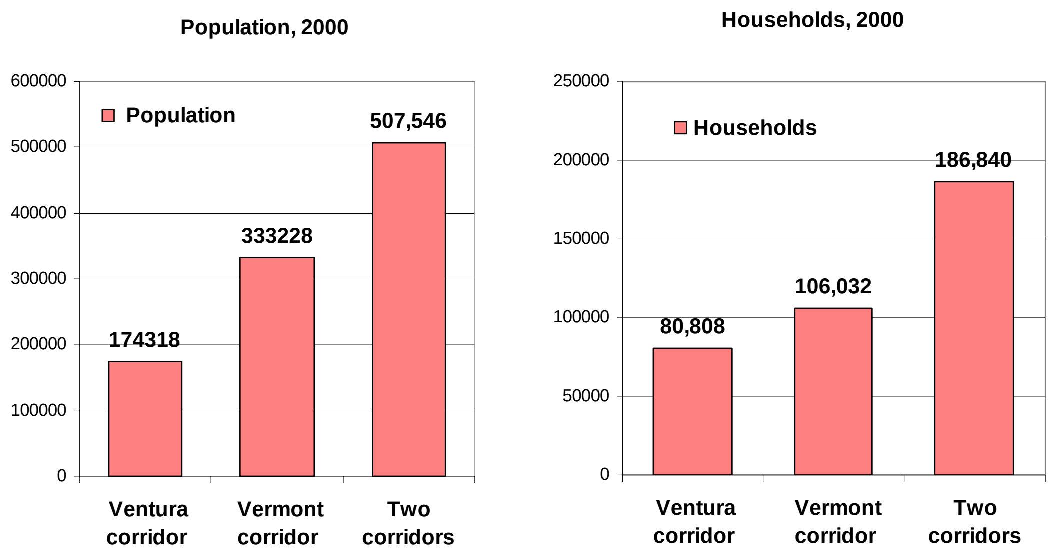
- The public transit use of workers in the corridors does not show increase as the number of workers decreased in the two corridors between 1990 and 2000. However there has been an overall increase in ridership in the two corridors, due to increase in low income population using public transit and increase in households with no vehicles and non-work trips not reflected in census survey.

[1] While comparing 1990, 2000 certain block groups had to be omitted following changes in their boundaries.

2.5 Characteristics Of Population And Households

The total population in the two corridors was 507,546. There were 186,840 households in 2000.

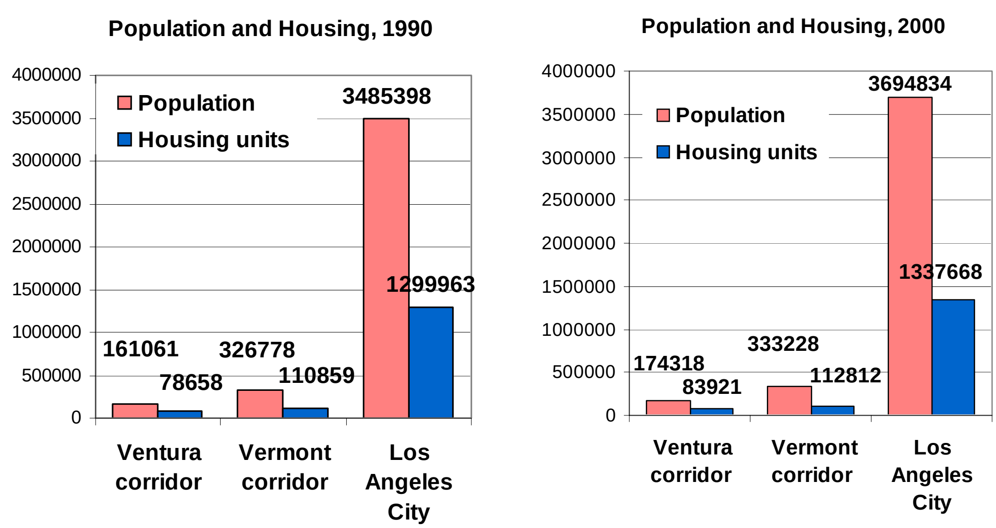
Figure 2.1: Comparison Of Corridors, Population & Households, 2000



Source: Census 2000

There has been a moderate growth in population in the two corridors between 1990 and 2000. The figures 2.1 and 2.2 show a comparison between the two corridors and Los Angeles during the same period.

Figure 2.2: Comparison Of Corridors, Population & Housing Units, 1990 & 2000

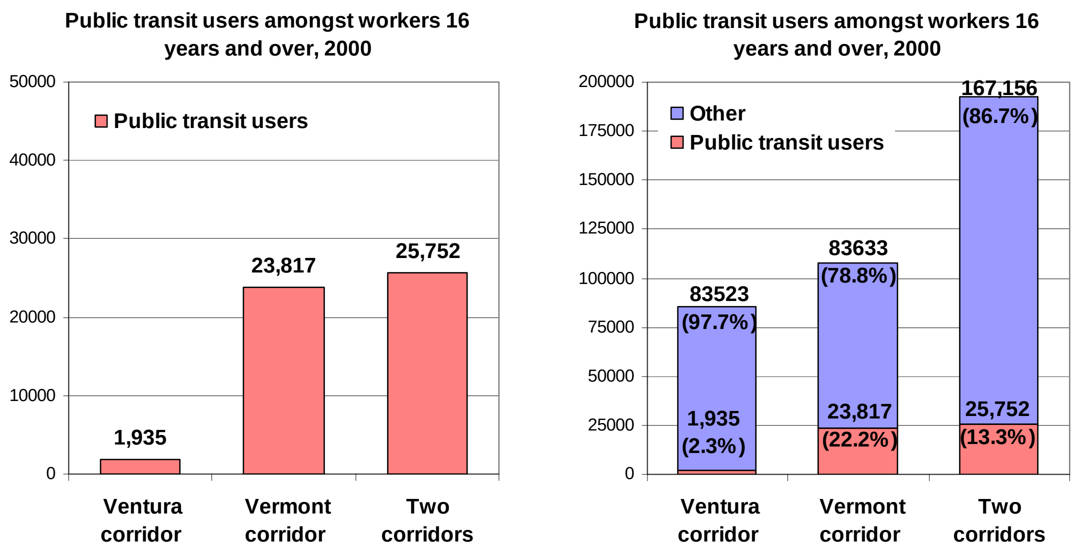


Source: Census 2000, 1990, SF1

2.6 Public Transit (Among Workers 16 Years And Over)

In 2000, there were fewer transit riders in the Ventura corridor compared to the Vermont corridor. As an aggregate, there were 25,752 transit users among commuting worker population or 13.3% of workers 16 years and over in the two corridors. In comparing the two corridors Figure 2.3 indicates that more than one-fifth of the working population in Vermont corridor uses public transit compared to only 2.3 % in Ventura corridor.

Figure 2.3: Comparison Of Corridors, Public Transit Users Among Workers 16 Years And Above



Source: Census 2000, SF1

Table 2.1: Demographic Characteristics Of Ventura And Vermont Corridors, 2000

2000	Ventura corridor	Vermont corridor	Two corridors	Los Angeles City
Population	174318	333228	507546	3694834
Housing units	83921	112812	196733	1337668
Occupied Housing units	80808	106032	186840	1275358
Land sq.mts.	106474889	40943979	147418868	1214897958
Land Acres	26299.30	10113.16	36412.46	300079.80
Non-Hispanic or Latino	159076	140372	299448	1974918
Hispanic or Latino	15242	192856	208098	1719916
Workers 16 years and over total	92350	110338	202688	1494895
Workers 16 years + commuting	85458	107450	192908	1433200
Car; truck; or van	81395	75913	157308	1203143
Car; truck; or van; Drove alone	74887	56791	131678	982735
Car; truck; or van; Carpooled	6508	19122	25630	220408
Public transportation	1935	23817	25752	152435
Bus or trolley bus	1630	22631	24261	144973
Streetcar or trolley car (publico in Puerto Rico)	20	96	116	804
Subway or elevated	66	749	815	3054
Railroad	81	123	204	1730
Ferryboat	20	5	25	136
Taxicab	118	213	331	1738
Total Other	2128	7720	9848	77622
Bicycle	152	900	1052	9052
Walked	1358	5579	6937	53386
Motorcycle	139	83	222	2474
other	479	1158	1637	12710
Worked at home	6892	2888	9780	61695
Median Income				
15,000 & less		25673	25673	265869
15,000-25,000		197193	197193	182068
25,000-50,000	59200	104590	163790	349375
50,000-75,000	55308	2758	58066	198145
75,000-100,000	27866	1253	29119	107198
100,000 &above	31944	1761	33705	173954
Population 5 yrs & below	9078	30427	39505	285976
Population 5_17 yrs	21317	71518	92835	695335
Population 18_64 yrs	116961	207862	324823	2356380
Population 65 yrs & above	27039	23808	50847	357129

Source: Census 2000

2.7 Socio-Economic Characteristics

Ethnicity

The corridors show differences in the share of Hispanic population. In the year 2000 compared to Los Angeles, Ventura corridor has a lower percentage of Hispanic population, less than 10%, and Vermont corridor reflects a higher percentage of Hispanic population at 42%. There has been an increase in the share of Hispanics in Ventura corridor since 1990 when the percentage of Hispanic population was 7%. In contrast, share of Hispanics declined in the Vermont corridor from 47% in 1990 to 42% in 2000.

The distribution of population among various ethnic groups shows the largest ethnic group to be White in the Ventura corridor and Latino in the Vermont corridor. There is larger Black or African-American community in the Vermont corridor compared to Ventura corridor. The proportion of Asian community is also higher in the Vermont corridor than in the Ventura corridor. There is a larger proportion of mixed ethnicity in the Ventura corridor compared to Vermont corridor.

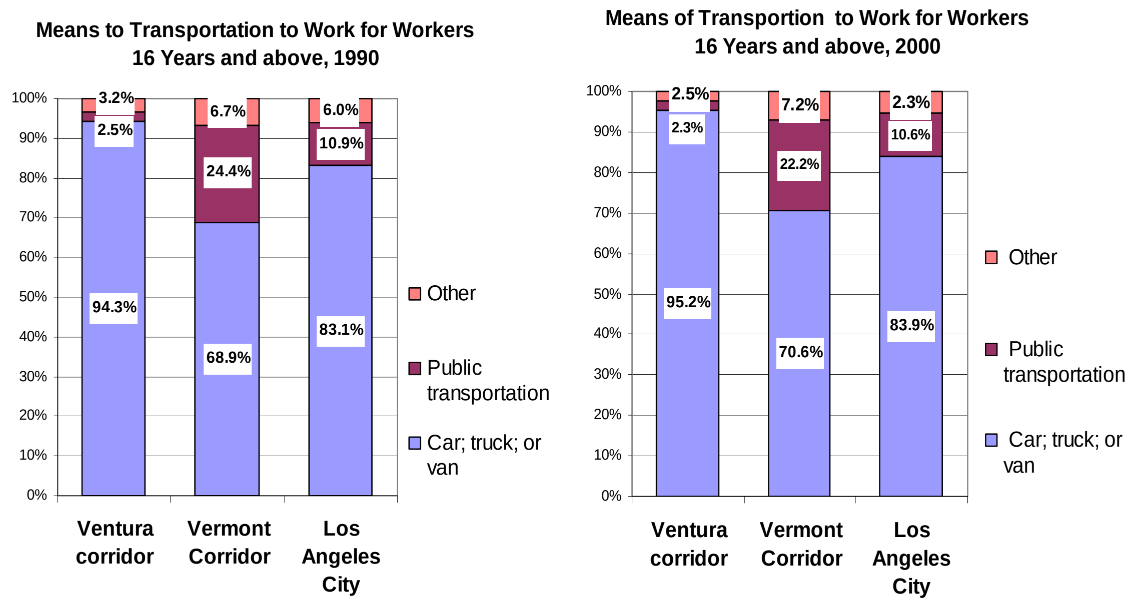
Workers and Means of Transport to Work

The working population who traveled to work in the two corridors varies considerably. In Ventura corridor about 53.1% of the population is workers, in the Vermont corridor only 34.1% are workers, compared to Los Angeles which has 40.4% workers.

The means of transport to work shows variation; Vermont corridor has 22.2% of workers using public transportation to work. In contrast, Ventura corridor has just 2.3% of public transit use, significantly lower than Vermont.

There has been an increase in transit ridership in the corridors; however the census sample data reveals a decrease in the proportion of workers using public transit between 1990 and 2000. In Ventura corridor the decrease is about 0.4 %, in Vermont corridor the decrease is about 1.5 % and in City of Los Angeles it is about 0.3 %. In some ways this indicates the need to integrate other sources of information such as the transit survey information to reveal the pattern in transit ridership. Some of the other factors for increases in transit ridership could be related to non-work trips. The increase in the number of workers in the population also shows increases in household income levels which are linked to decrease in transit commute.

Figure 2.4: Comparison Of Corridors, Percentage Public Transit Users Among Workers 16 Years And Above, 1990 & 2000

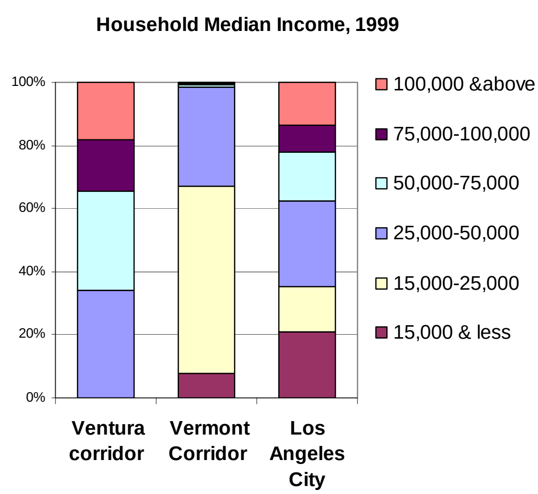


Source: Census 1990, 2000, SF 3 sample data

Household Median Income

The two corridors display varying income levels. For 1999, Ventura corridor has household median income greater than $25,000 and Vermont corridor has pockets with median household income below $25,000. In Vermont corridor, 70% of population living in block groups has income less than $25,000, and in addition 7.7 % have median household income below $15,000 which is less than 20% in case the City of Los Angeles

Figure 2.5: Comparison Of Two Corridors, Percentage Of Population Living In Block Groups With Median Household Income, 1999

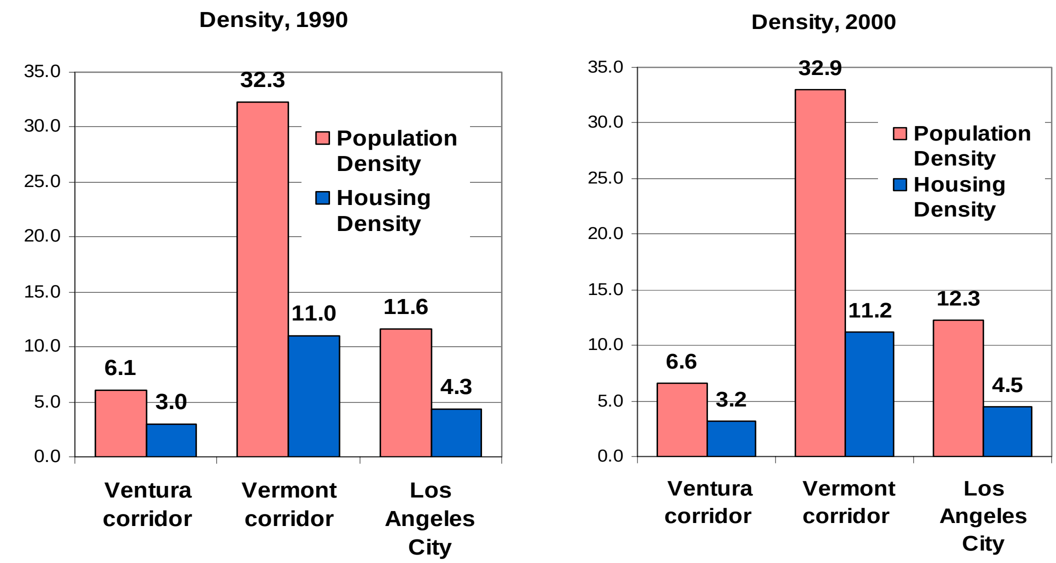


Source: Census 2000, SF 3 sample data

2.8 Density, Population, and Housing

The densities in the two corridors are considerably different. For 2000, Ventura corridor had lower densities of population and housing, 6.6 persons per acre and 3.2 housing units per acre. Vermont corridor had higher density levels than the City of Los Angeles with population density of 32.9 persons per acre and 11.2 housing units per acre.[2]

Figure 2.6: Comparison Of Corridors, Population And Housing Density, 1990 & 2000



Source: Census 1990, 2000 SF1

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[2] City of Los Angeles had population density of 12.3 persons per acre and housing density of 4.5 housing units per acre.

2.9 Housing Characteristics

Table 2.2: Housing Characteristics Of The Two Corridors For The Year 2000

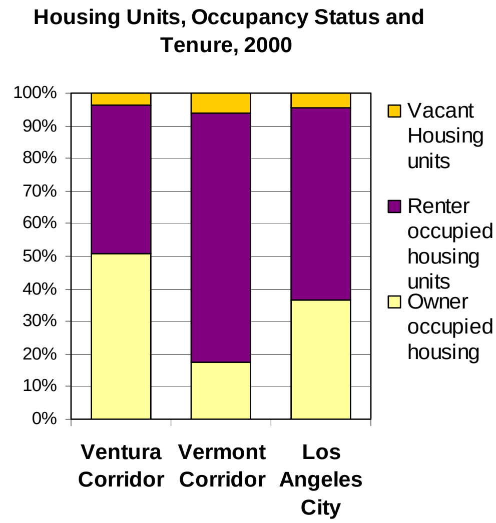
2000	Ventura corridor	Vermont corridor	Two corridors	Los Angeles City
Population	174318	333228	507546	3694834
Housing units	83921	112812	196733	1337668
Occupied Housing units	80808	106032	186840	1275358
Owner occupied housing units	42613	19681	62294	491836
Renter occupied housing units	38195	86351	124546	783522
Vacant Housing units	3113	6780	9893	62310
Single family occupied	41084	32912	73996	588581
Single family Owners	36056	16697	52753	428535
Single family renters	5028	16215	21243	160046
Single Family vacant	1465	2592	4057	23982
Single family total	42549	35504	78053	612563
Multi-family occupied	39709	73106	112815	686149
Multi-family Owners	6550	2984	9534	62944
Multi-family renters	33159	70122	103281	623205
Multifamily vacant	1566	3724	5290	29874
Multifamily units in structure	41275	76830	118105	716023
2 units	488	4967	5455	42814
3 or 4 units	1555	12042	13597	86253
5 to 9 units	4575	14220	18795	126263
10 to 19 units	7900	16218	24118	138634
20 to 49 units	12718	18158	30876	171633
50 or more units	14039	11225	25264	150426
Others_occupied	15	14	29	628
Others_Owners	7	0	7	357
Others_renters	8	14	22	271
Other vacant- Mobile home, Boat; RV; van; etc	82	464	546	8454
Others	97	478	575	9082
Mobile home	82	458	540	8222
Boat; RV; van; etc.	15	20	35	860
Aggregate vehicles	133212	115114	248326	1842106
Households with no vehicles	4433	32145	36578	210770
Owner Occupied no vehicles	1173	2076	3249	25653
Renter Occupied no Vehicles	3260	30069	33329	185117

Source: Census 2000

Occupancy & Tenure

The total number of housing units in Vermont corridor is more than the Ventura corridor with higher densities.[3] The ownership rates of housing are higher in Ventura corridor, which is about 50.8%, compared to 17.4% in Vermont corridor. Vacancy rate in Vermont corridor is 6.0% compared to 3.7% for Ventura corridor. Los Angeles in comparison had an ownership rate of 36.8% and a 4.7% vacancy rate.

Figure 2.7: Comparison Of Corridors, Occupancy Status And Tenure, 2000



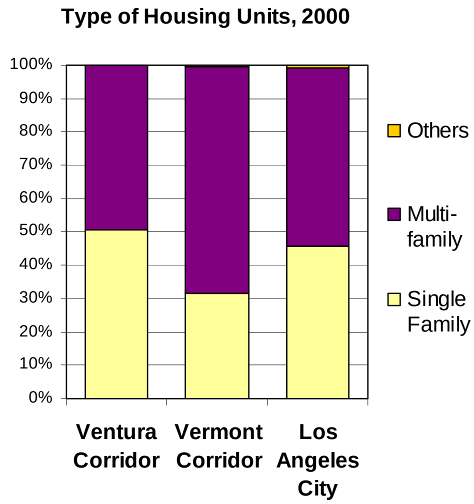
Source: Census 2000

Single Family and Multifamily

The proportion of multifamily units shows considerable variation between the two corridors. Ventura corridor has 51% of total housing units as single family, and 49.5% of housing units as multifamily, compared to Vermont corridor which has 31.5% of housing units as single family and 68.1% of housing units as multifamily. Vermont corridor shows a higher proportion of multifamily housing units compared to Los Angeles, which has 46% as single family housing units, 53.5% as multifamily and less than 1% mobile homes and others.

[3] Census definition of housing unit: A house, an apartment, a mobile home or trailer, a group of rooms, or a single room occupied as separate living quarters, or if vacant, intended for occupancy as separate living quarters. Separate living quarters are those in which the occupants live separately from any other individuals in the building and which have direct access from outside the building or through a common hall. For vacant units, the criteria of separateness and direct access are applied to the intended occupants whenever possible.

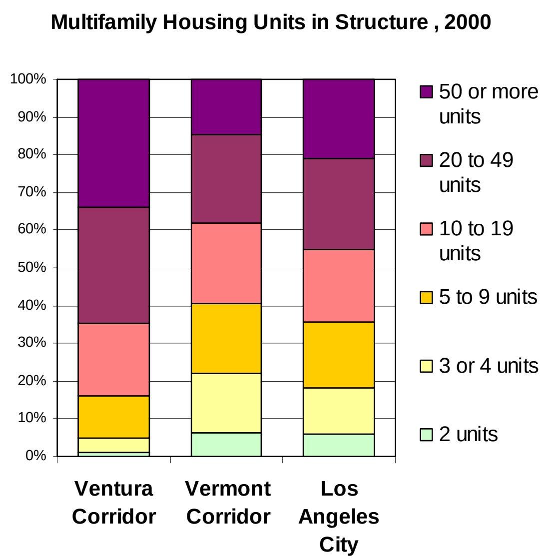
Figure 2.8: Comparison Of Corridors, Housing Typology, 2000



Source: Census 2000, SF3

The size of housing developments varies in the two corridors as reflected by the housing units in structure among the multifamily units. Larger developments occur in Ventura corridor compared to Vermont corridor. Ventura corridor has 64% of housing units comprised in developments of 20 and above units in structure. Further the proportion of developments 50 and above units in structure is about 33.5 % in Ventura corridor. The number of developments above 3 units in structure and less than 20 units in structure comprises of 55% of housing units in the Vermont corridor.

Figure 2.9: Comparison Of Corridors, Housing Units In Multifamily Structures, 2000



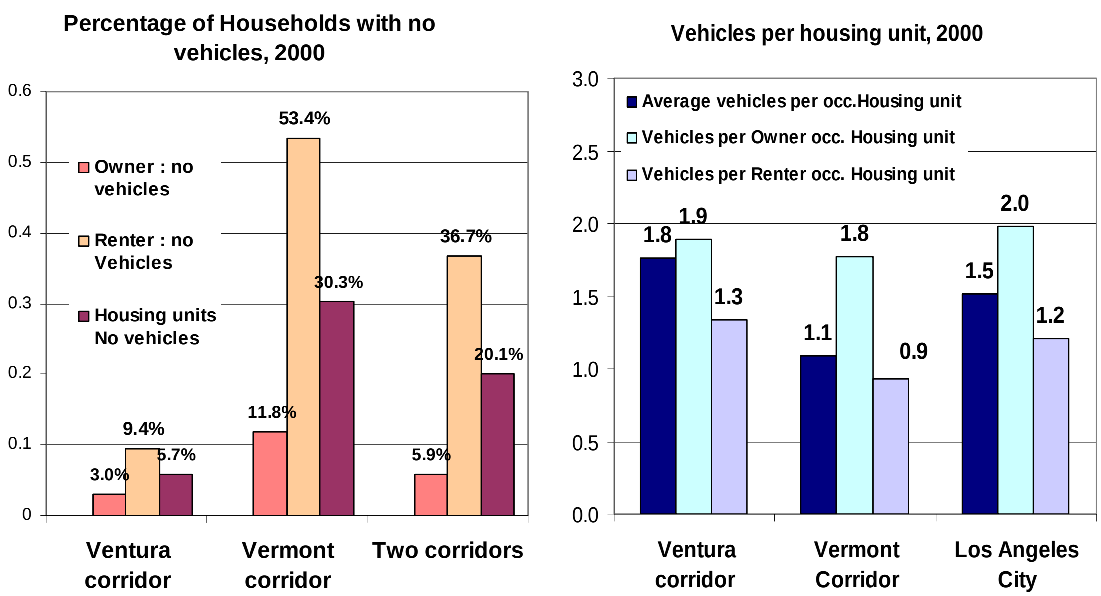
Source: Census 2000, SF3

2.10 Vehicle Ownership

Nearly one third of households have no vehicles in Vermont contributing to the high transit riders, while Ventura corridor has relatively low percentage of households without vehicles.

The average vehicles per households is 1.8 in Ventura corridor and 1.1 in Vermont corridor showing an inverse impact on transit riders. As vehicles per households' increases, transit ridership decreases. The multiple regression models in Chapter 5, proves this relationship.

Figure 2.10: Comparison Of Corridors, Vehicle Ownership 2000

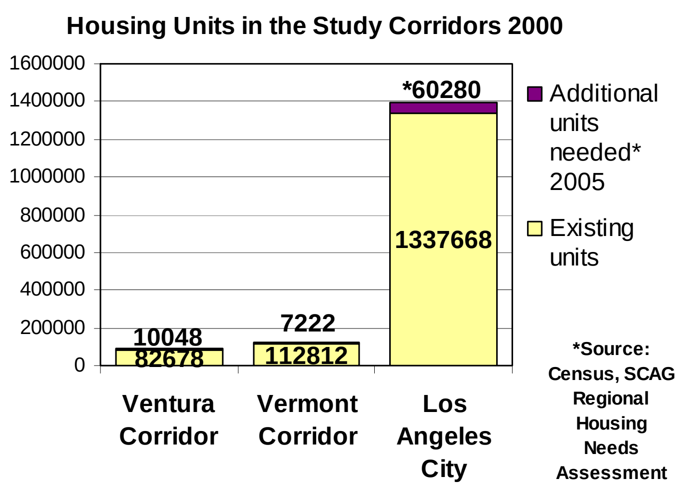


2.11 Meeting Housing Demand

The current estimate of the number of additional housing units needed in Los Angeles as of 2005 is 60,280 units according to SCAG RHNA. The City currently has a housing inventory of 1,337,668 units. The corridors currently accommodate 227,312 units, which represents 17% of City's housing stock. If the total length of transit corridors in the city of Los Angeles is taken to be 96.5 miles, the total length of the two transit corridors in our study is 27.5 miles and therefore proportionately needs to accommodate 17,720 housing units. The housing stock in the Ventura corridor is 86,205 housing units and will have to accommodate 10,048 additional units in 2005 and the Vermont corridor is 112,812 housing units and will have to accommodate an additional 7,222 housing units by 2005.

In terms of density this means an addition of one unit per acre within the one mile corridor.

Figure 2.11: Housing Needs Estimate For Corridors



Source: Census 2000 & SCAG

Table 2.3: Meeting Housing Demand In The Two Corridors For 2005

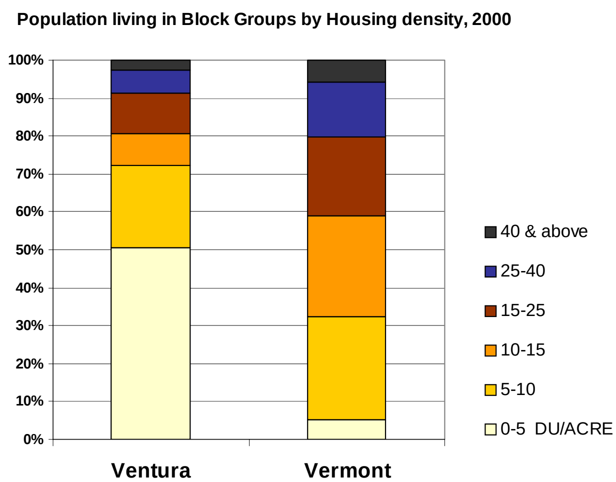
Total Housing units	Ventura Corridor	Vermont Corridor	Two corridors	Los Angeles City
Existing units	83921	112812	196733	1337668
Additional units needed* 2005	10047	7221	17268	60280
Area in acres	26310	10117	36428	300207
Total length of Rapid lines in miles	16	11.5	27.5	96
Existing housing density per acre	3.19	11.15	5.40	4.46
Additional units needed per acre**	0.98	0.98	0.98	0.98
*SCAG, Regional Housing Needs Assessment for 2005				

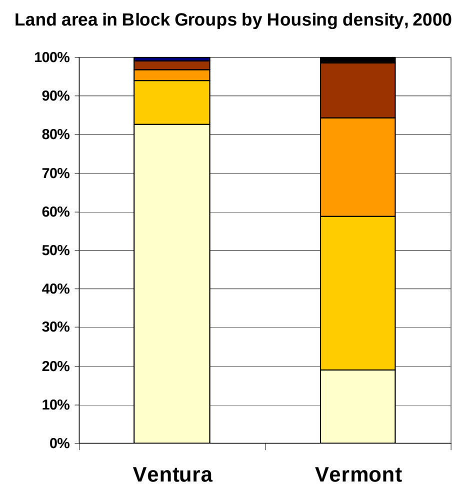
2.12 Housing Density Distribution in Ventura and Vermont Corridors

Population and Housing Density

There is a difference between the Ventura and Vermont corridors in terms of distribution of housing densities in block groups. Taking average housing densities of the block group and their population in the year 2000, Ventura corridor has almost half of the population living in housing density of 0-5 dwelling units (DU) per acre and Vermont corridor has only one-eighth of the population living in densities lower than 5 DU per acre. Ventura corridor has another one-fifth of population living in housing density of 5-10 DU per acre, Vermont corridor has one-third of population living in the 5-10 DU per acre. Further, Ventura has less than one-fifth of its population in housing density above 15 DU per acre and Vermont has less than a one-third of its population in housing density above 15 DU per acre.[4]

Figure 2.12: Comparison Of Corridors, Population, Land Area, In Block Groups Within Different Housing Density Distributions





Source: Census 2000

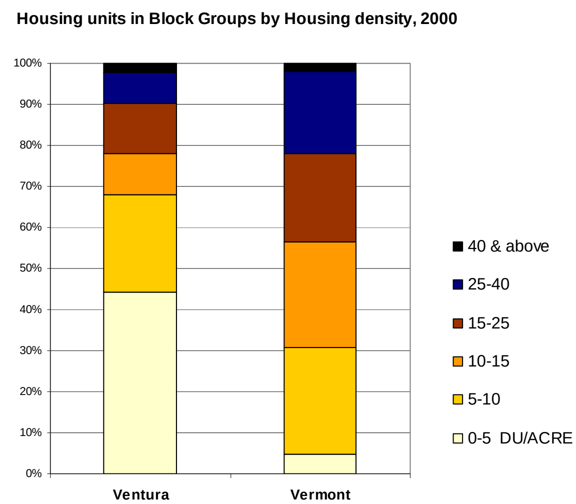
Land Area and Housing Density

Looking at the land area occupied by the block groups with different average housing density, Ventura has almost 83% of land area with less than 5 DU per acre; Vermont corridor has about 17.8 % land area with less than 5 DU per acre. Ventura corridor has another 10 % of the land area with housing density between 5-10 DU per acre, and Vermont has 37.5% land area with housing density 5-10 DU per acre. Ventura corridor

[4] Ventura has 8.5% population living in housing density of 10-15 DU per acre and Vermont has 26.3% population living in housing density of 10-15 DU per acre. Ventura has another 10.6% of population living in housing density of 15-25 DU per acre, Vermont has 21.1% of population living in housing density of 15-25 DU per acre. For housing density of 25-40 DU per acre, Ventura corridor has 6.2% of population and Vermont corridor has 14.4% population living in them, for housing density 40 and above DU per acre, Ventura has 2.5% population and Vermont has 5.7 % population living in them.

has less than 5% of its land area with housing density more than 10 DU per acre; Vermont corridor on the other hand has 44.6% of its land area with density more than 10 DU per acre. The distribution of number of housing units with average housing density in block groups is similar to that of population within the two corridors.

Figure 2.13: Comparison of Corridors, Housing Units in Block Groups Within Different Housing Density Distributions



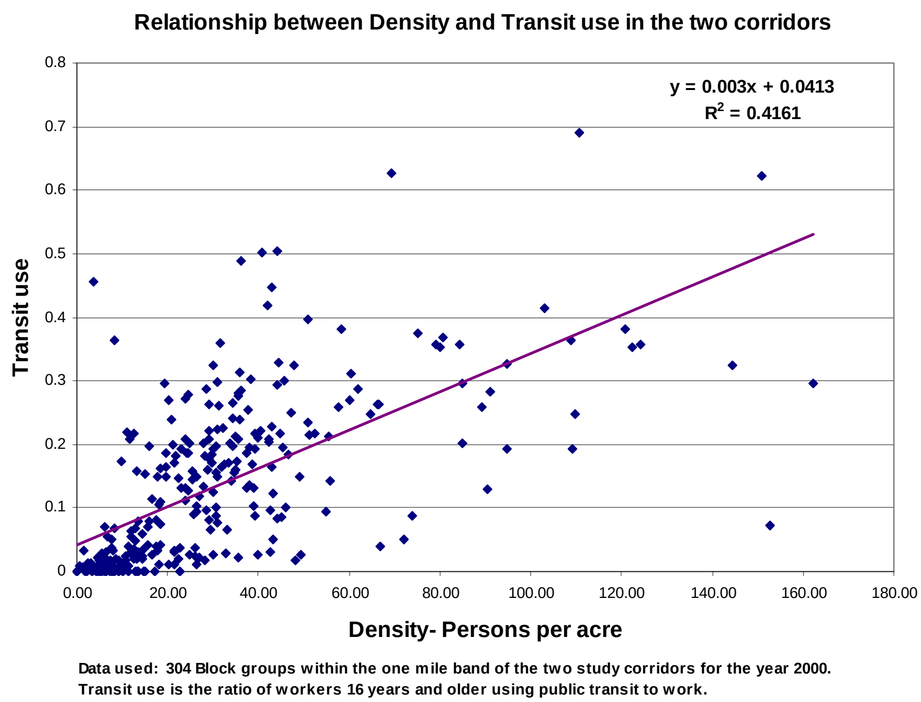
Source: Census 2000

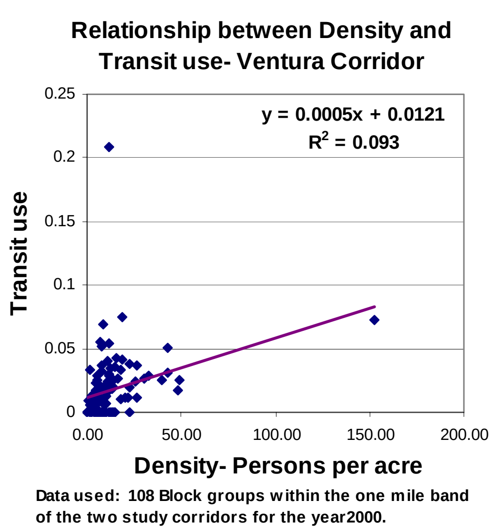
2.13 Study Of Relationship Of Worker Population Using Public Transit With The Population Characteristics In Ventura And Vermont Corridors

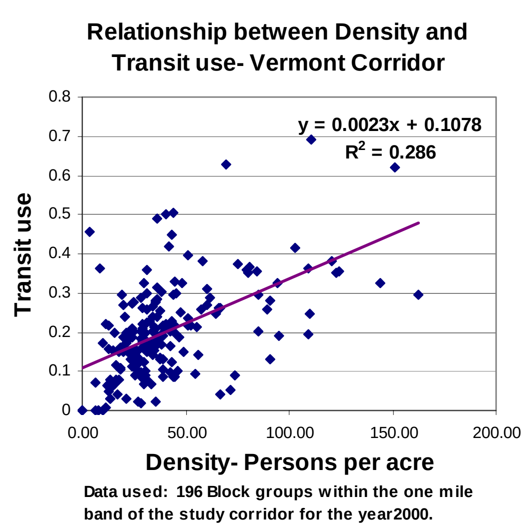
Population Density and Use of Public Transit

There is a non-trivial relationship between the workers using transit and population density in the two corridors. There is an increase in transit use among workers with increase in density; however there are considerable differences between the two corridors.

Figure 2.14: Scatter Plot Showing Population Density And Percentage Of Workers Using Public Transit





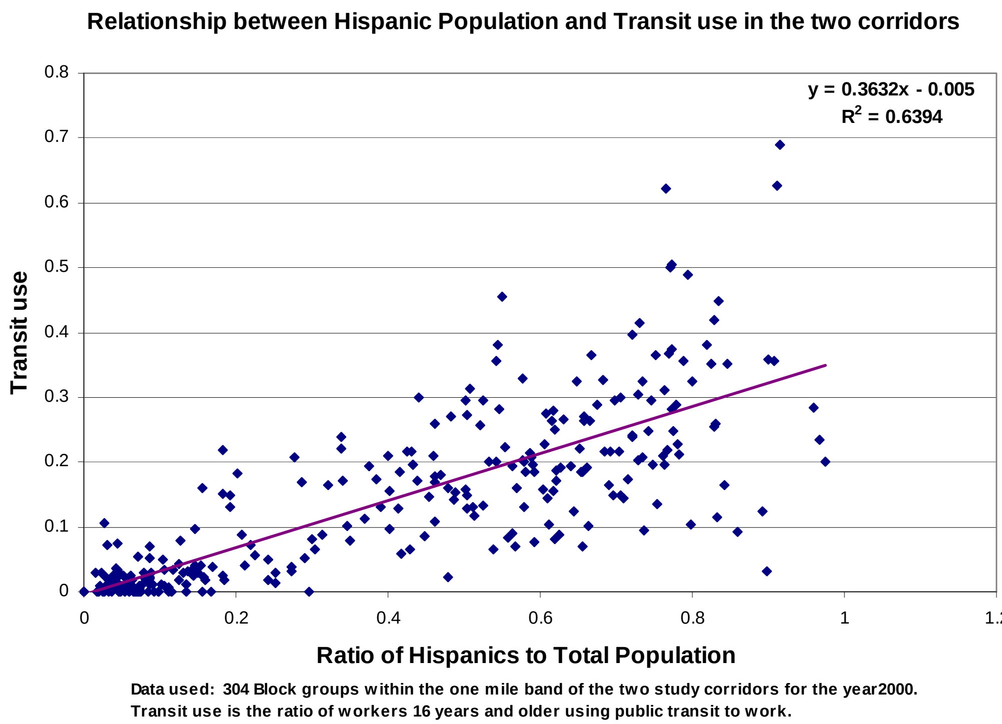


The Vermont corridor displays a relationship between increasing population density and increasing work related transit use; however, Ventura corridor displays no such relationship. There are two reasons: First, most of the transit users traveling along this corridor do not live within this corridor.[5] Second, the corridor has very low percentage of public transit use. Overall less than 3% of workers over 16 years of age use public transit.

Hispanics and the Use of Public Transit

There seems to be a non-trivial relationship between percentage of workers using transit and the percentage of Hispanic population.

Figure 2.15: Scatter Plot Showing Percentage Hispanic Population And Percentage Of Workers Using Public Transit, Two Corridors, Vermont, And Ventura Separated



Source: Census 2000

Looking at the two corridors separately, the relationship still holds for both the Ventura and Vermont corridors. Considering the overall Hispanic population in Ventura corridor is very low, the existence of a non-trivial relationship indicates that the increase in Hispanic population is likely to indicate an increase in transit use among the working population.

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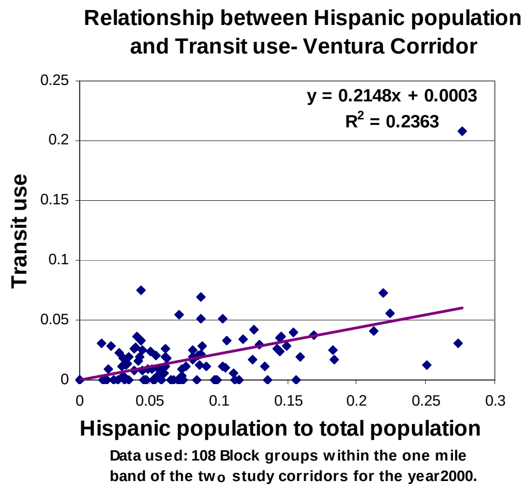
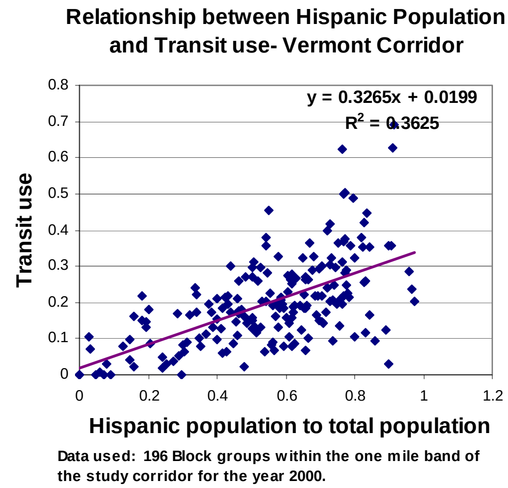
[5] Refer Transit study based on HOBBAD survey, chapter 4 of the same report.

Figure 2.15 (cont.)





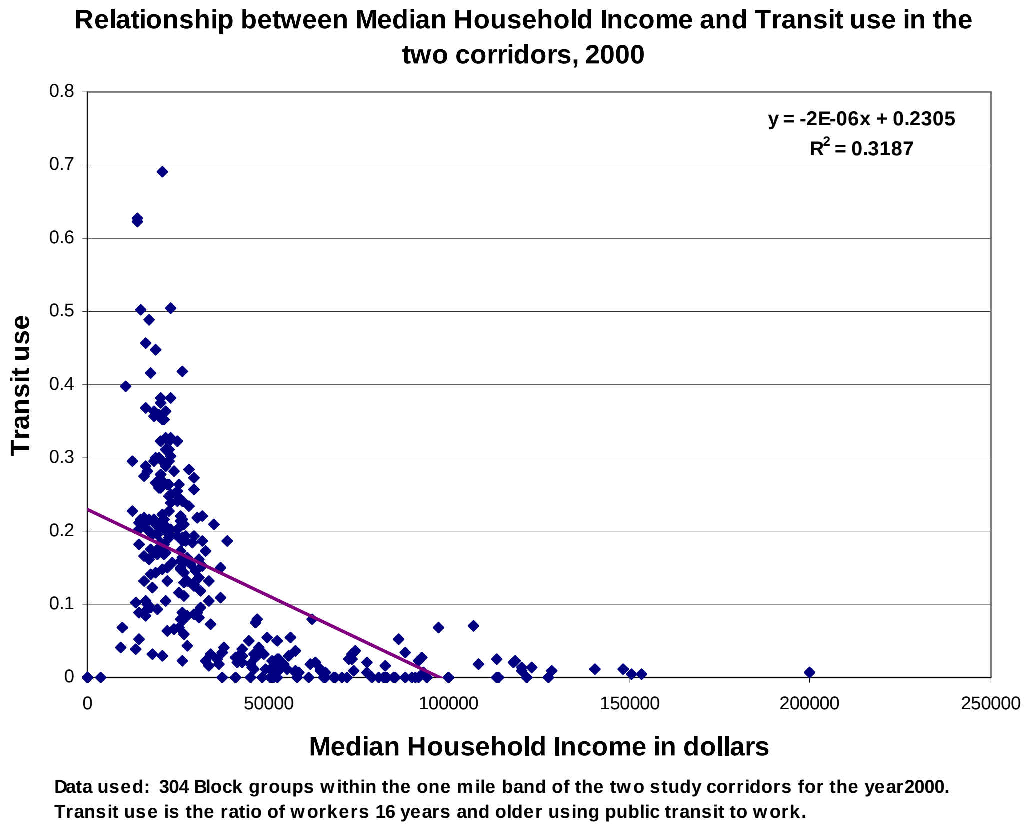
Source: Census 2000

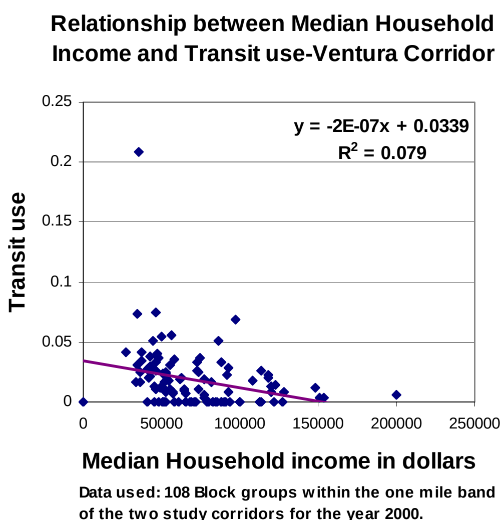
Median household income and public transit use

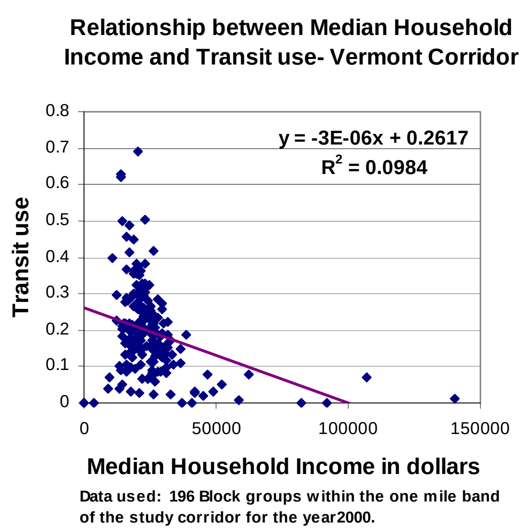
The two corridors display relationship between median household income and public transit use. There is a decrease in public transit use with increase in household income. The two corridors show no relationship of transit use with household income when viewed separately, as there may be other factors that might explain this.

Ethnicity seems to have a more significant role in terms of relationship to work related transit use than income. However there is larger proportion of population with low levels of household income in the Vermont corridor and has a higher percentage of transit users (22.2%) amongst worker population. The combination of both these factors may have a role in determining transit ridership.

Figure 2.16: Scatter Plot Showing Median Household Income And Percentage Of Workers Using Public Transit, Two Corridors, Vermont, And Ventura Separated







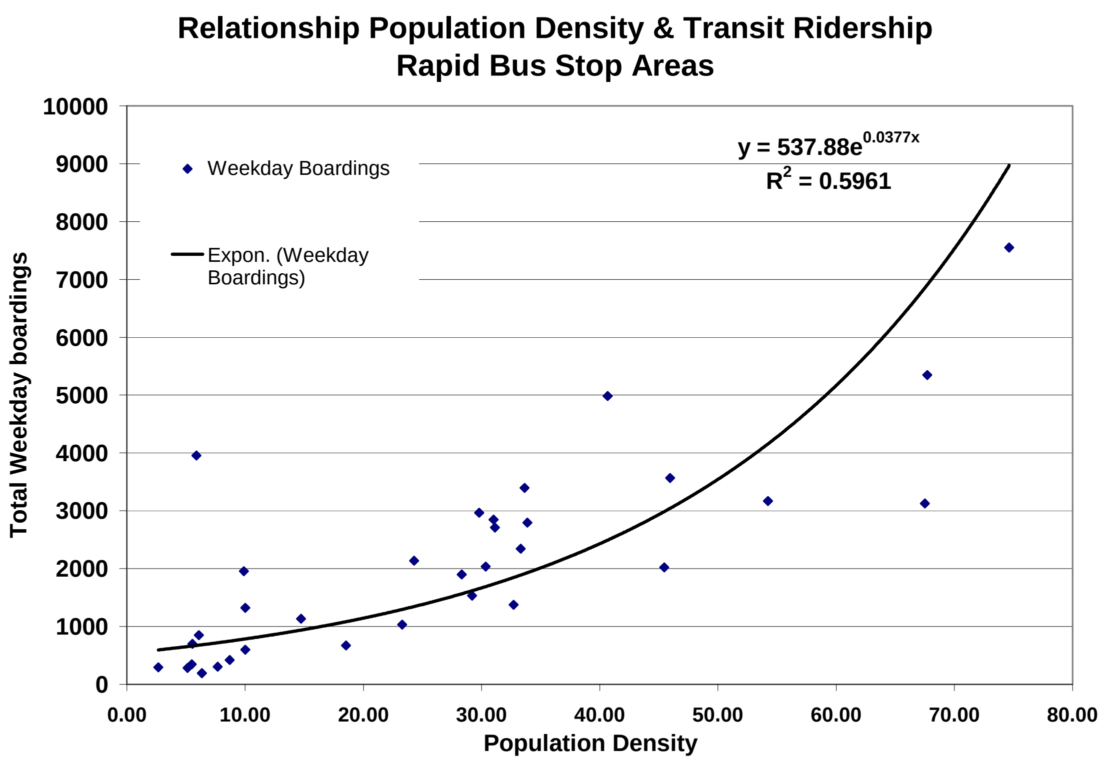
Source: Census 2000, Block groups as units of analysis

2.14 Conclusions

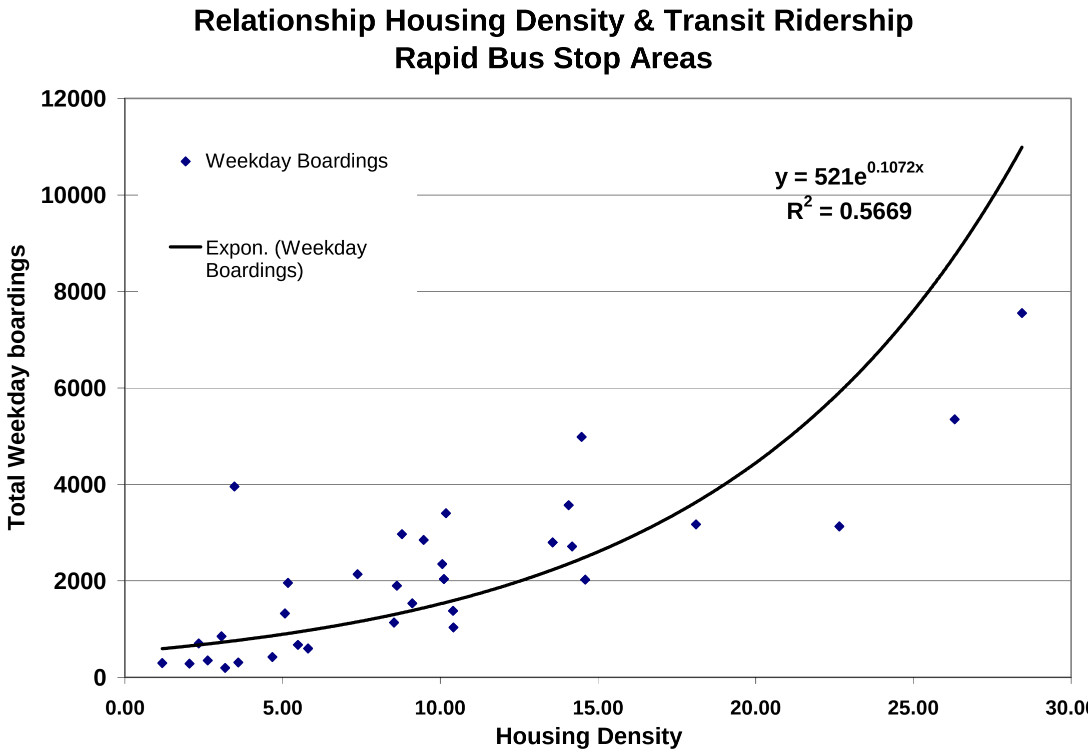
Vermont and Ventura corridors show differences in terms of population characteristics and housing. Vermont has considerable population below $15,000 median household income. Most of the people live in multifamily housing and have lower vehicle ownership. Ventura corridor residents are comparatively richer, live in single family and larger multifamily developments, and have higher car ownership rates. Vermont corridor is a transit commuter generator, as many of the public transit users are workers who live within the corridor. Ventura corridor has very few transit users living within the corridor. Social factors that contribute to transit ridership increases are due to transit dependency as in the case of low income families and families with no vehicles. Vermont corridor is clearly a transit dependant corridor. Multifamily type of housing, which is 70% of total housing in Vermont corridor, contributes to 22% of workers using public transport, compared to Ventura corridor where about 40% of population live in multifamily housing and contribute merely to 2.3% of workers using public transit.

In this chapter we conclude however both population and housing density positively affect transit ridership and are significant as shown in scatter plots below.

Figure 2.17: Scatter Plot Showing Population Density And Transit Ridership In Rapid Bus Stop Areas



Source: Census 2000



The relationship between percentage of workers using public transit and density may not be a linear relationship (Figure 2.14) as other factors like availability of presence of bus and metro rail stations, transit linkages etc. becomes influential. We ran multiple regression models to find the relationship between transit ridership/boarding data on several factors covered in Chapter 5.

Hispanic population seem likely to contribute to public transit users amongst workers, (figure 2.15), the overwhelming effects of income may play a role also as decrease in median household income increases worker population using public transit (figure 2.16). In the multiple regression models both these factors turned insignificant which makes the relationship of population characteristics and transit ridership more complicated and location factors alone may dominate (See Chapter 5).

Some contradictory factors in the results: The mild decreases in transit use over 1990 to 2000 point to changes in transit use with increasing incomes of the working population in the two corridors. Workers living in the corridor increase, however, within individual households there is a reduction of transit use.

Limitations of this analysis

Location, influence of land use and availability transit linkages are other factors that increase transit ridership analyzed in the subsequent Chapters 3 and 4.

The increases in transit trips are attributable to other transit users on the corridor attracted towards destinations within the corridor, especially shopping, offices, recreation and connecting hub for other lines or metro stations. In the above study, our analysis was limited to census population data which included only percentage of workers using public transit, who are mainly residents of the corridor. A more nuanced study of adjoining land uses and the relationship with the transit ridership data of the lines crisscrossing the corridor tells a different story. The following Chapter 3 looks at land use mix around the major intersections of the corridor and the subsequent Chapter 4 on the relationship between existing transit infrastructure such as bus-stops and bus lines with transit ridership.

Chapter 3: Land Use Analysis

3.1 Purpose

This chapter looks at the distribution of different land use types within the corridor that may influence transit ridership. Studies show land use analysis is useful in determining activities that contribute to trip making. We have considered residential areas to contribute to trip origins and commercial services, industrial, open spaces and recreation activities contributing to trip destinations.[1] The greater the intensity of use the greater the volume of trip generated or attracted. For example, in case of residential land, in low density and single family uses the trip generation is reduced considerably compared to multi-family residential areas. Furthermore, compact developments with a mix of uses contribute to increased trips generated. We also look at the possibility whether transit ridership would increase as the mix of land uses and intensity of activity within the land use increases.

3.2 Data And Units Of Analysis

We used the 2000SCAG land use data for the one mile band along the Vermont and Ventura corridors. We also used combined block group data in the 33 individual bus stop areas for comparing the land use distributions under various classifications.

3.3 Key Findings

Land Use Mix

We discuss key differences in the land use distribution within the two corridors. There is more land under commercial and services in Vermont corridor as compared to Ventura corridor. Land under open space is significantly higher in Ventura corridor than Vermont corridor. However, land under retail commercial is higher in Ventura corridor compared to Vermont corridor. Ventura corridor has almost 60% of land under single family residential compared to Vermont which has 17-20%. The difference in the ratios between half mile and the one mile band shows that there are increases of about 7% in Vermont corridor and 10% in the Ventura corridor in terms of commercial and services land use and, decreases of 8% in Vermont corridor and 10% in Ventura corridor in terms of residential land use as we move closer to the corridor. In terms of retail and office commercial an increase of 5% in Vermont corridor and 11% in Ventura corridor is noticed as we move closer to the corridor.

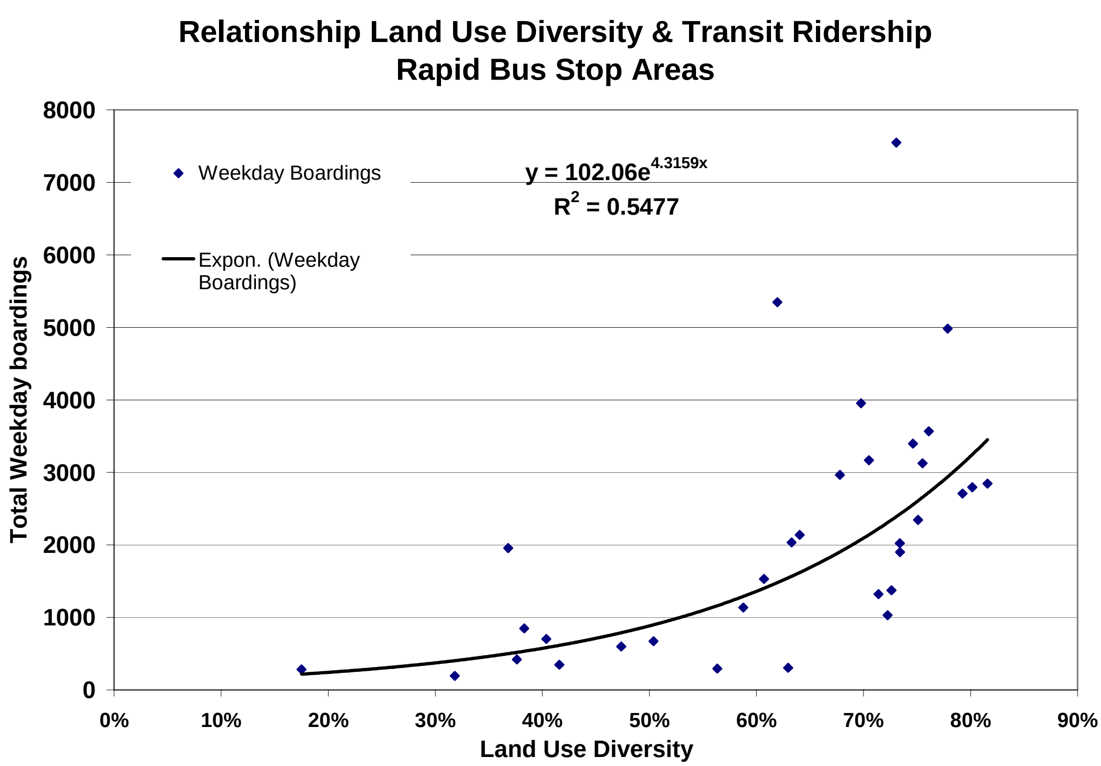
The underutilized sites adjoining older strip development are potential sites for development. The absence of accessible open spaces and other pedestrian amenities, and the large amount of grey fields,(large surface parking lots, vacant buildings) indicate potential sites for improving quality of built environment in addition to increasing residential capacity through infill developments.

[1] Based on previous studies

Advantages of Mixed Use

We found that there is a non-trivial relationship between land use diversity and transit ridership as the diversity and evenness of land use increases, transit ridership increases.

Figure 3.1: Relationship Of Land Use With Transit Ridership, 2000



Note on Land use Diversity Index (LD): We used the Simpson's diversity index in calculating land use diversity.[2] It measures both the distribution and the evenness of the individual land uses within the mix. The formula used to calculate this index is explained as follows: the square of the individual land use areas (a) divided by the square of the total area (A) is the measure of the individual (Ia) land use to the whole; the sum of these individual measures is the inverse of the diversity measure. Subtracting the inverse measure from 1 gives the land use diversity index of the total area [in this case the block groups within half mile radius of the bus stop intersection]. In calculating LD we have included uses that are conducive for mixed use developments: Residential- Single Family Residential, Mixed Residential, Multi-family residential, in commercial and services-Retail stores and ommercial services, Educational institutions, Public facilities, Other commercial, General office use, Special use facilities, Mixed commercial and industrial, Mixed Urban, Open space and Recreation.

[2] http://www.offwell.free-online.co.uk/simpsons.htm, note there are many measures to calculate species diversity in specific wild life habitats. This measure captures both richness and evenness of species diversity, here we have used it for land uses.

Land Use Diversity =LD = 1- [Sum (Ia_1 , Ia_2 , Ia_3 , …….Ia_n)]
Individual areas= Ia_1….. Ia_n= $(a_1)^2/A^2$, $(a_2)^2/A^2$, $(a_3)^2/A^2$, …….$(a_n)^2/A^2$

The greater the value of Land Use Diversity greater the mix of land use in the area. The values range from 0 to 1, where 1 denotes maximum possible diversity. For the above graph we have used percentages or multiple of 100 of the calculated value.

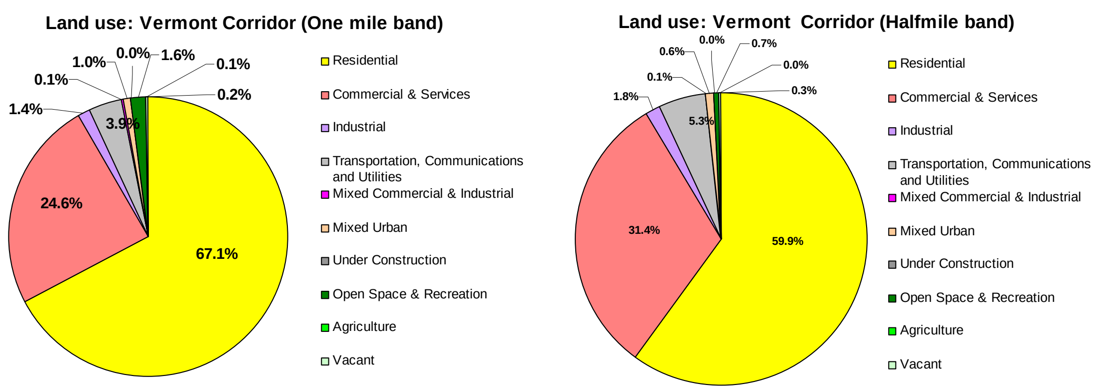
We also found that the transit ridership increases as non-residential land use increases or land use under multifamily residential increases. The complicated relationship is better discerned in our regression models in Chapter 5.

We ascertained the impact of each land use on ridership running a regression model. Regressing major land use types (excluding areas under construction, agriculture, vacant, open space and recreation) on transit ridership, we found retail commercial and other commercial consistently significant. Since we found that population and housing density contribute to increase in transit ridership (refer Chapter 1 and Chapter5 for multiple regressions) increasing service employees working in retail commercial and other commercial, is likely to increase transit ridership.

3.4 Land Use Distribution in the Two Corridors

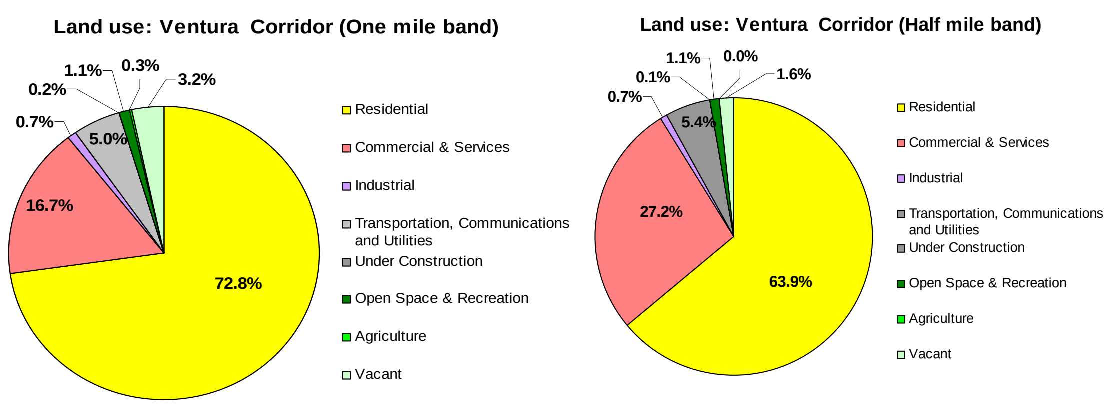
The two corridors show differences in the distribution of land uses (Figure 3.2). Using the 2000 SCAG land use information classification, both corridors show predominant distribution of land use under residential with Vermont at 67% and Ventura at 73%.[3] Within a half mile band there is a marginal decrease in residential land use. The land under commercial use is considerably more within the half mile band compared to a one mile band for the entire corridor; in the Ventura corridor it is 27.2 % and in the Vermont corridor it is 31.4 %, offering destination points for commuters.

Figure 3.2: Overall Land Use Distribution, Vermont Corridor, 2000



Source: SCAG Land use data, 2000

Figure 3.3: Overall Land Use Distribution, Ventura Corridor, 2000



Source: SCAG, Land use data, 2000

Vermont has 1.6% of land area under open space and recreation, within a one-mile band, compared to Ventura which has 1.1 % area under open space. Ventura corridor has

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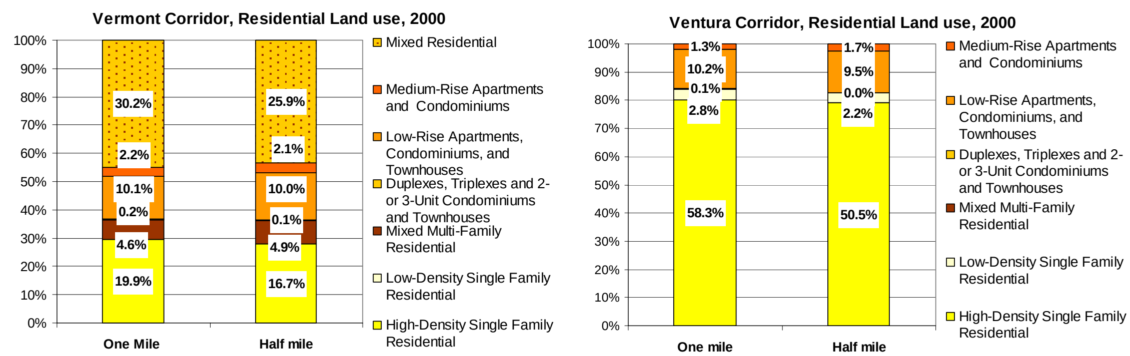
[3] The SCAG land use areas include the areas under roads and streets, it excludes only the ROWs of major transportation corridors, such as freeways, rail corridors etc.

considerable area vacant (3.2%) compared to a low of 0.2 % in Vermont corridor, due to large areas falling under the northern slopes of Santa Monica hills.

Residential land use

Within the one-mile band stretch for the entire corridor length, there is a larger distribution of land under single family residential in the Ventura corridor, 60% compared to a low of 20% in Vermont corridor. Further the percentage of mixed and multifamily residential area is about 11.7% in the Ventura corridor, and 47.2% in the Vermont corridor. Vermont is clearly a high density residential corridor compared to the Ventura corridor.

Figure 3.4: Comparison Of Residential Land Use In Vermont & Ventura Corridors, 2000

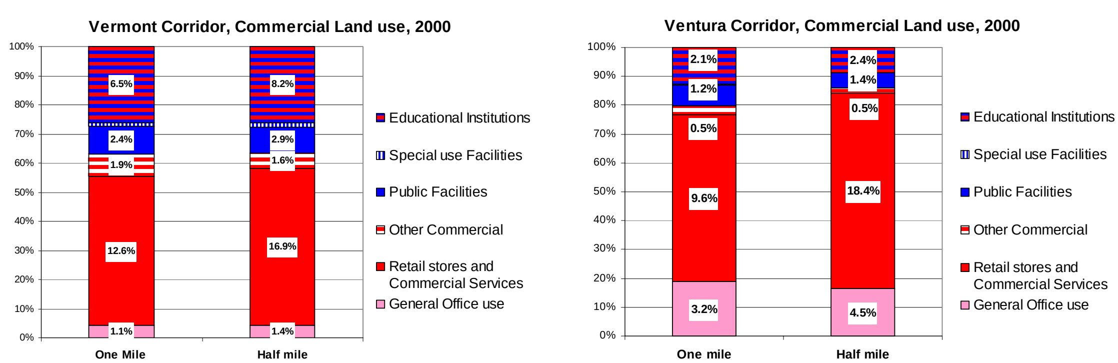


Source: SCAG, 2000

Commercial Land Use

Ventura corridor has more land, nearly 23.5% under retail commercial and offices within the half mile band compared to 19.9% for Vermont corridor.

Figure 3.5: Comparison Of Commercial Land Use In Vermont & Ventura Corridors, 2000



Source: SCAG, 2000

Figure 3.6: Land Use Map, Vermont Corridor 2000

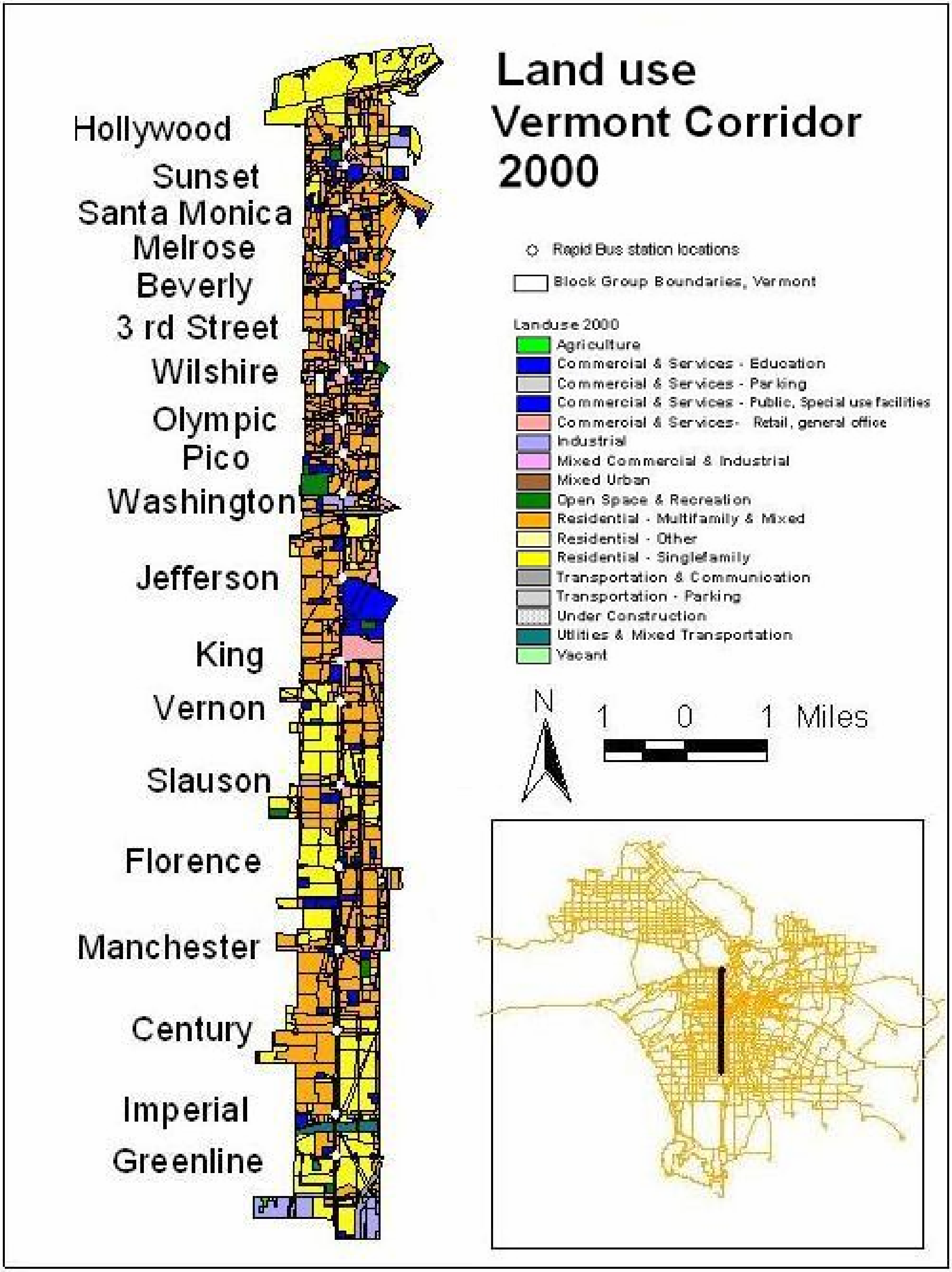
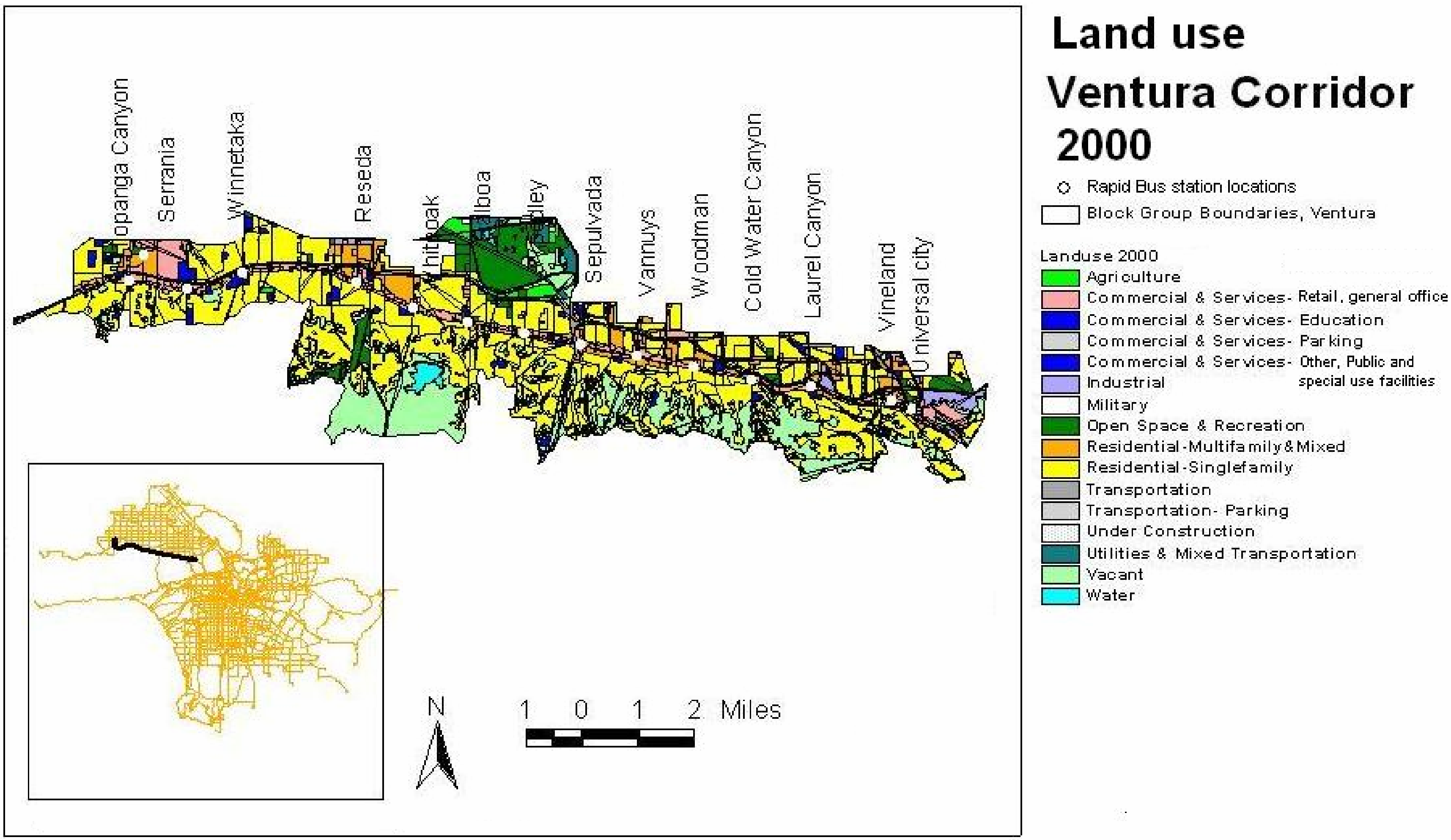


Figure 3.7: Land Use Map, Ventura Corridor 2000



3.5 Land Use Mix Around Rapid Bus Stop Areas

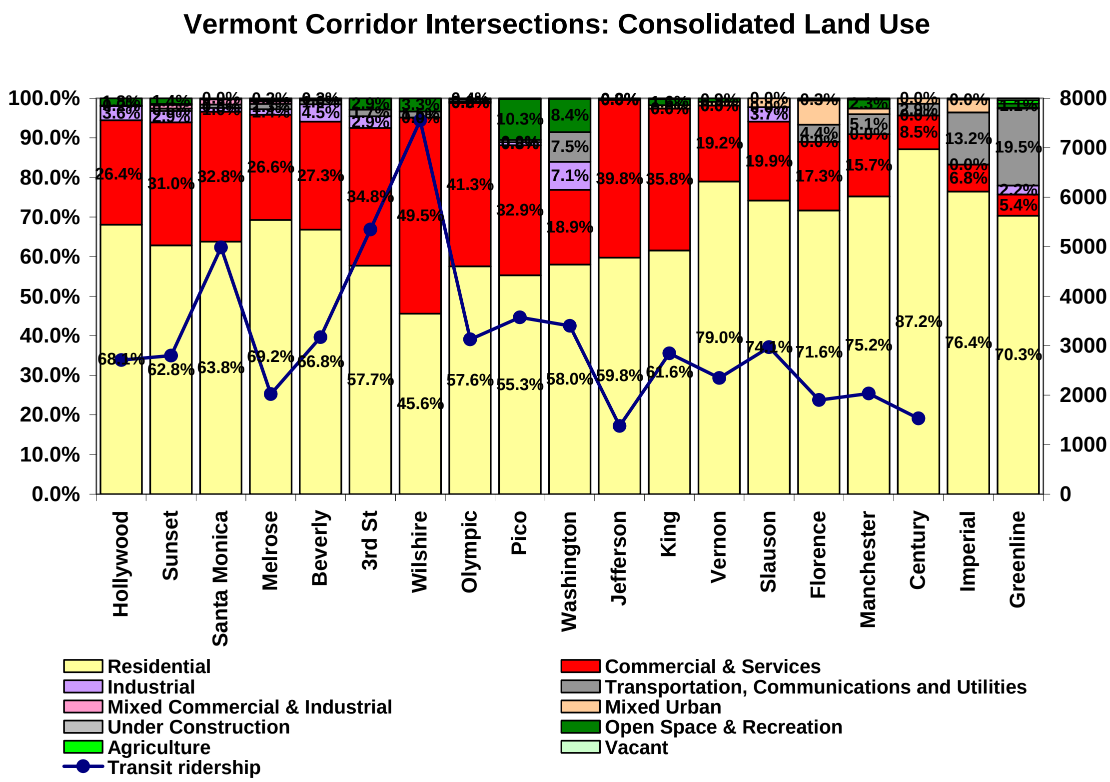
The land use mix around individual stops shows variations from being predominantly residential to predominantly commercial, services, and/or industrial oriented. There are residential station areas such as Century, Vernon, Slauson, Florence, Manchester, Imperial, and Green line in the Vermont corridor. Similarly, in Ventura corridor, residential station areas are Winnetka, Woodley, Van Nuys, Vineland, White Oak, and Balboa. The predominantly commercial, services and industrial station areas are Wilshire, Olympic, and King in Vermont corridor, and Topanga, Serrania, Reseda, Van Nuys and Universal City in the Ventura corridor.

The residential areas are considered as trip generators and the commercial, services and industrial uses are trip attractors. Further, our study identifies the distribution of older commercial areas and low density commercial areas which provide opportunities as infill sites for higher density developments.

Vermont Corridor Rapid Bus Stop Areas

The mix of residential and commercial/industrial land uses show a trend along the rapid bus stop areas of the corridor– Wilshire is the midway point with equal portions of both categories and gradual increases in residential areas toward the north and south along the Vermont corridor.

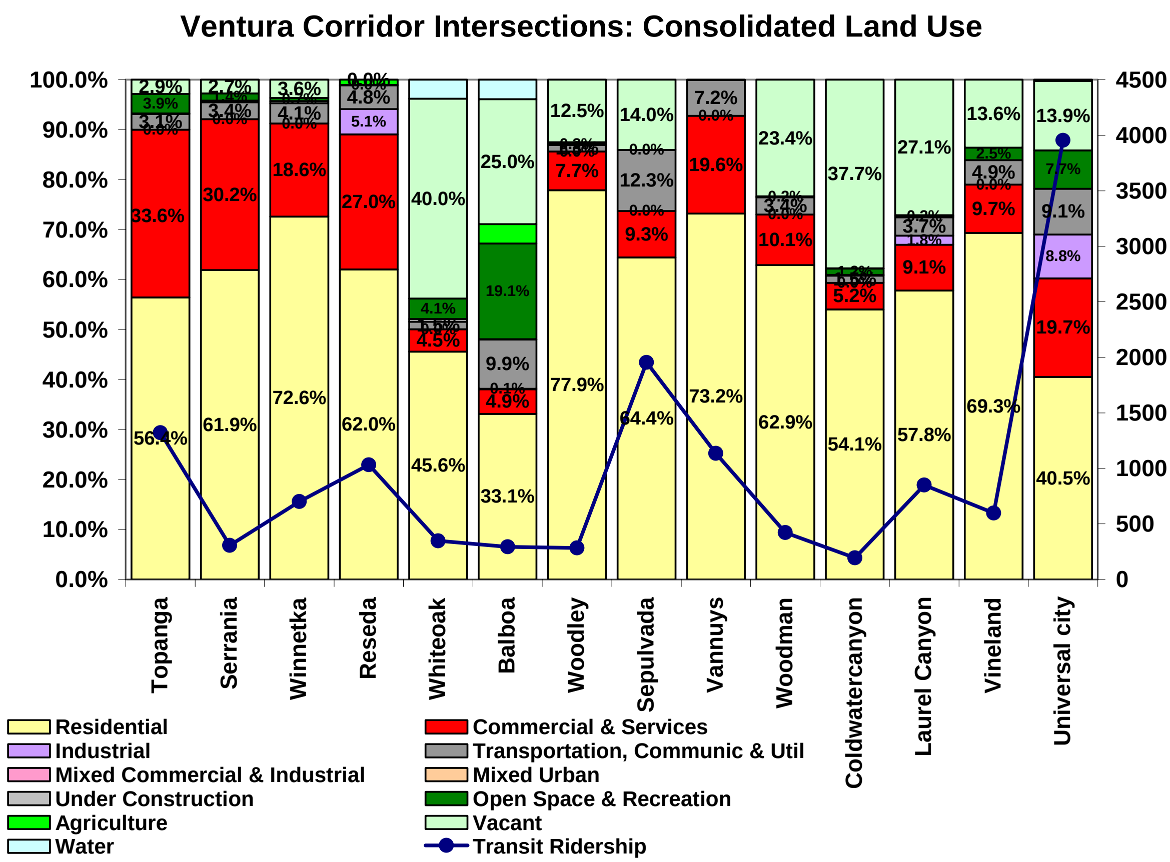
Figure 3.8: Land Use Distributions At Bus Stop Areas, Vermont Corridor, 2000
Source : SCAG



Residential use varies from low of 45% at Wilshire intersection to 87% around Century intersection, retail use varies from a high of 49% at Wilshire intersection to low of 5.4% around the Green line intersection. Hollywood, Sunset, Santa Monica, Beverly, 3rd Street, Wilshire, Washington, Slauson, and Green line rapid bus stop areas show industrial clusters as part of the mix.

Ventura Corridor Rapid Bus Stop Areas

Figure 3.9: Land Use Distributions At Bus Stop Areas, Ventura Corridor, 2000



Source : SCAG

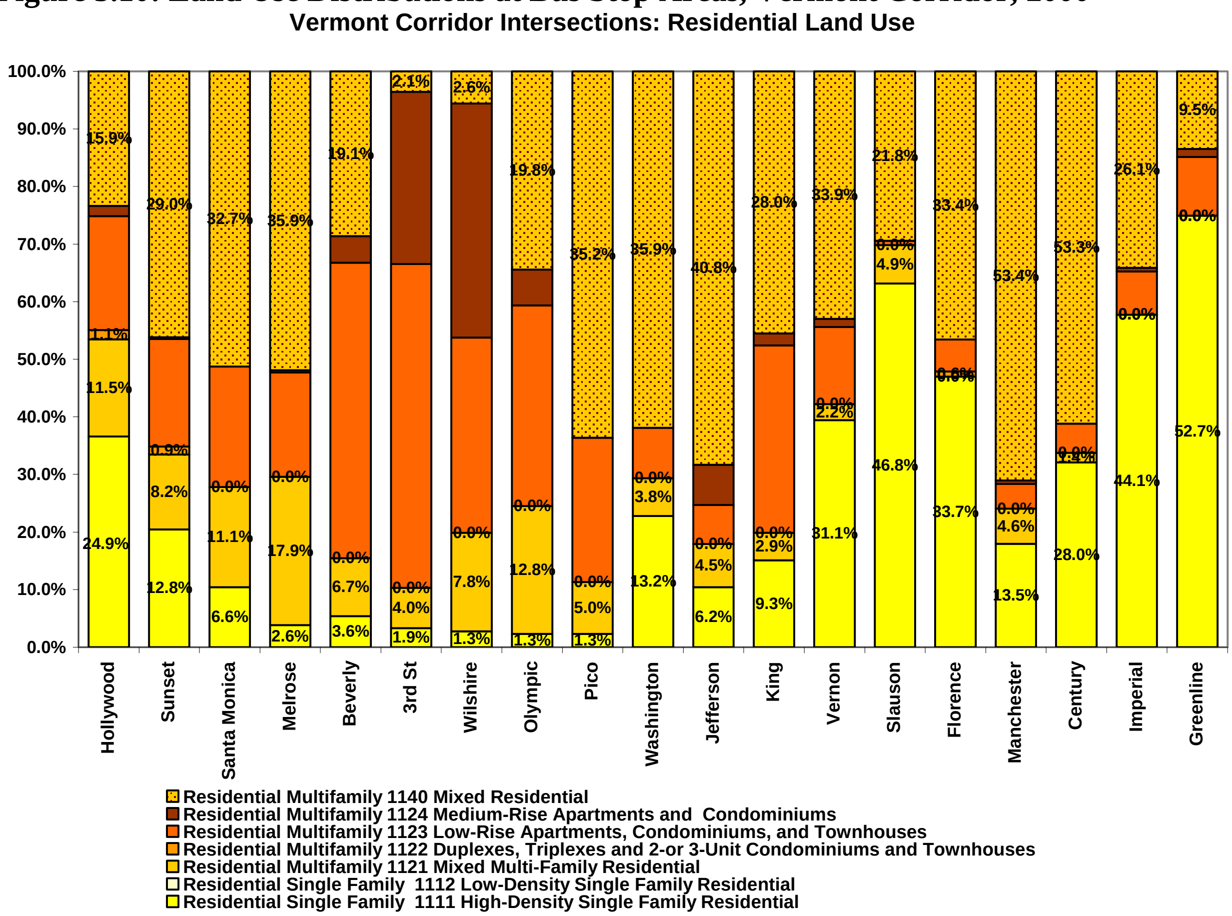
The rapid bus stop areas on the Ventura corridor show a mix in residential and commercial use varying from a residential high of 78% (Woodley) and low of 40.5 % (Universal City), commercial high of 33.6% (Topanga) and low of 4.5% (White Oak). Reseda, Laurel Canyon, Universal City contain industrial clusters as well.

Residential Land Use

Vermont Corridor

Vermont corridor rapid bus stop areas show considerable proportion of multifamily of which mixed residential forms a major portion showing diversity in the units in structure and type. The highest proportion of multifamily residential of 95% is found around the 3rd Street intersection and a low of 17% around Green line intersection. Large proportion of medium rise and low rise apartments and condominiums are found in Melrose, Beverly, 3rd Street, Wilshire, and Olympic rapid bus stop areas, corresponding to the proximity to metro rail stations. The proportion of single family residential area increases as one moves northward or southward from 3rd Street/Wilshire rapid bus stop areas which forms the node for the densest developments.

Figure 3.10: Land Use Distributions at Bus Stop Areas, Vermont Corridor, 2000

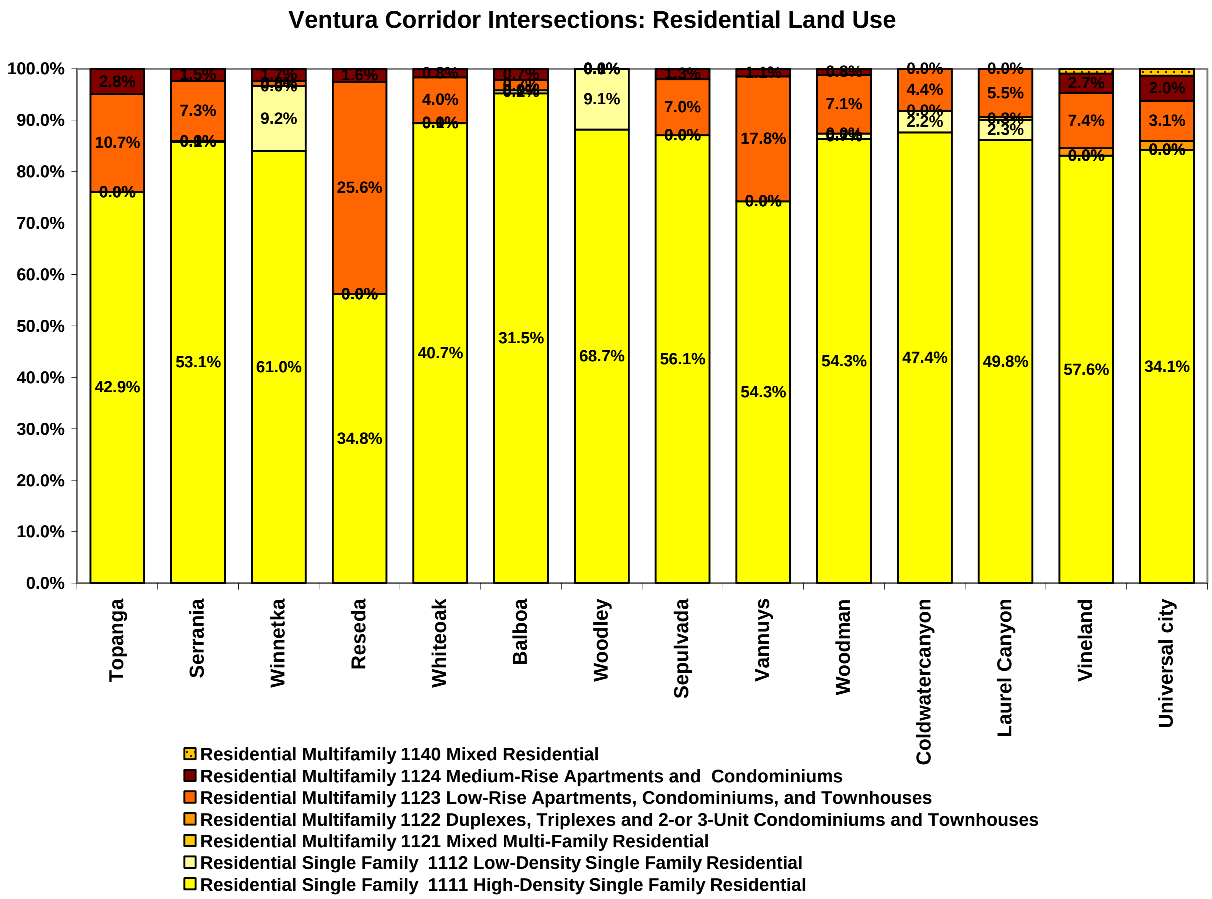


Source: SCAG

Ventura Corridor

The area under multifamily residential is considerably smaller in the Ventura corridor varying from a high of 25.6% (Winnetka) to a low of 0% (Woodley).

Figure 3.11: Land Use Distributions at Bus Stop Areas, Ventura Corridor, 2000



Source: SCAG

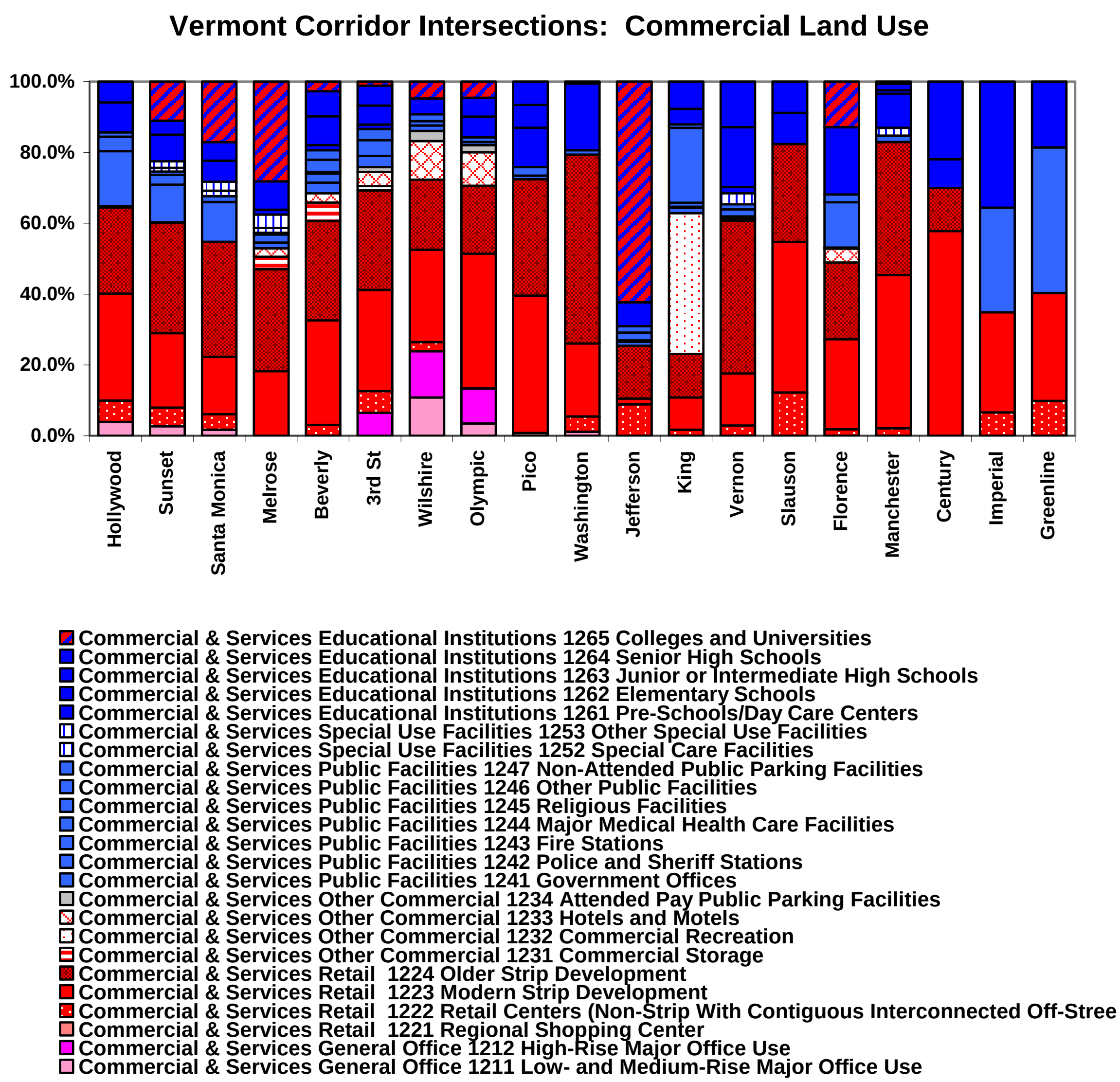
Commercial Land Use

Both corridors show a mix of commercial land uses- educational institutions, public facilities, hotels motels, commercial recreation, older strip and newer retail centers. Retail areas form the major portion under this category, followed by office commercial and educational facilities, public facilities. Attendant paid public parking facilities form a minor portion of the land use, as most parking areas are included within the retail, office commercial areas.

Vermont Corridor

The largest proportion of retail land uses lie around Washington, Pico, Slauson, and Manchester rapid bus stop areas. The older strip accounts for more than 50% of all the retail in these rapid bus stop areas showing potential for mixed use redevelopment. Special uses, public facilities, general office commercial form smaller portion of most rapid bus stop areas. Jefferson lies close to the university area and more than 60% of commercial area comes under this facility. 3rd Street, Wilshire, Olympic are major office areas, while Hollywood, Sunset, Santa Monica are minor office rapid bus stop areas.

Figure 3.12: Commercial Land Use at Bus Stop Areas, Vermont Corridor, 2000

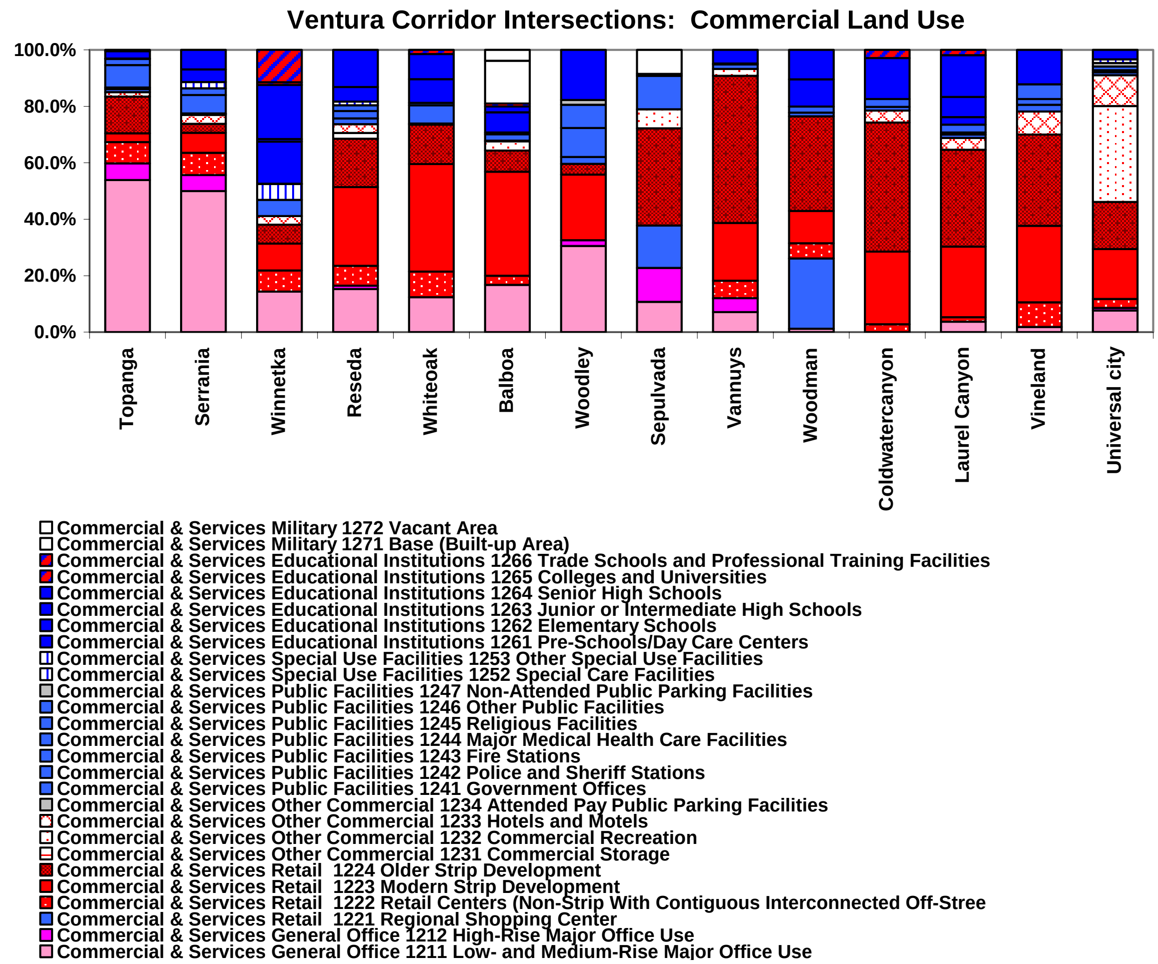


Source: SCAG

Ventura Corridor

The proportion of retail commercial area varies from high of almost 80% around Laurel Canyon and a low of10% around Serrania. Van Nuys, Sepulveda, Woodman, Coldwater Canyon, Laurel Canyon, and Vineland rapid bus stop areas contain large areas under older strip retail and have potential sites that could see an increase in density. Topanga, Woodley, Sepulveda are major office rapid bus stop areas, while Sepulveda and Woodman contain regional retail centers. Universal City forms the recreation hub in the corridor.

Figure 3.13: Commercial Land Use at Bus Stop Areas, Ventura, 2000



Source: SCAG

Open Space and Recreation

Vermont Corridor

Olympic and Pico rapid bus stop areas have at least 8% to 10% area dedicated for open spaces and recreation while almost all other rapid bus stops lack open spaces.

Ventura Corridor

Balboa (19.9%) and Universal City (7.7%) rapid bus stop areas have large areas dedicated to open spaces and recreation while all others rely on private vacant land for open space. Topanga, Serrania, Winnetka, and Reseda rapid bus stop areas clearly lack sufficient open spaces.

3.6 Regression Model

We regressed the dependant variable Transit Ridership on various independent land use variables. Retail stores and Commercial services, Other Commercial & Services were both significant variables contributing to increase in transit ridership.

Table 3.1: Regression Results – Transit Ridership And Land Use

R^2 Adjusted R^2 F	**0.87** 0.79 5.26
Intercept	-607.263 -1.00
Mixed & Multifamily Residential	898.695 0.60
General Office use	4177.601 0.86
Retail stores and Commercial services	15755.97 **3.23****
Other Commercial	**19374.58** **2.53***
Public Facilities	-5675.01 -0.42
Special use Facilities	-54870.3 -0.70
Educational Institutions	184.1318 0.04
Military	70355.37 0.60
Industrial	8819.726 0.91
Transportation, Communications and Utilities	4617.127 0.83
Mixed Commercial & Industrial	162020.3 1.37
Mixed Urban	18841.45 1.10

*P<= 0.05
**P<=0.01
Note: Transit ridership is the total of average weekday boardings of all the lines passing the intersection.
Retail commercial includes- Regional Shopping Center, Retail Centers (Non-Strip With Contiguous Interconnected Off-Street parking), Modern Strip Development, Older Strip Development,
Other commercial includes -Commercial Storage, Commercial Recreation, Hotels and Motels, Attended Pay Public Parking Facilities

3.7 Conclusions

Transit ridership increases as land use diversity or land use mix increases, especially employment in retail and other commercial services contributes to an increase in ridership levels. In combination with high population and housing density, mixed use developments that support businesses with large service employees will ensure high transit ridership.

The analyses of land uses within the corridor show location of potential sites for high density residential and mixed use commercial. Land uses that are potential sites for such adaptations are older strip commercials, parking lots, and low density residential areas in multifamily zones, vacant lands adjoining these areas, under utilized sites in all land use categories in general. The typology and mix of uses for different intersections vary and the possible design strategies for each intersection would vary. The nodes we have identified range from downtown high density to low density mixed use, institutional to predominantly commercial or residential. As example, we have simulated detailed design proposals for two rapid bus stop areas, Florence/Vermont and Van Nuys/Ventura in Chapter 6.

We include some of our recommendations here:

- Mix of uses may not be restricted to individual parcels or lots (building types) but different land uses should be allowed in adjoining parcels within a walking radius from bus stops
- Higher density residential alternatives have to follow specific locale characteristics in order to face minimum resistance from existing communities. Here, a mixture of housing typologies could be incorporated as infill developments within existing vacant sites and underutilized sites. Further low-density single story structures could be densified by adding units to the floors above.
- Reorientation and rearrangements of uses within lots, especially reorientation of parking areas within existing developments and bringing in retail fronts to pedestrian access creates more walkable commercial areas. Such measures not only enhance connectivity and access to public transport, but make transit stops attractive places as destinations.
- Involve local people, private developers, community organizations, and other stakeholders in developing individual areas.
- In order to effectively implement parking measures, we recommend multi-storey parking garages to be suitably located behind commercial strips, development of shared parking and park and ride lots, and care to be taken to limit curb-cuts from the main avenues or streets. To encourage restaurant, cafes and other pedestrian friendly uses, parking reductions of up to 25% may be considered in shared parking lots between residential, office, and other establishments.
- We recommend pedestrian and bike way trails be integrated with the proposed changes in land use and building types within the corridor.

- Allow density bonuses for affordable housing the use of RAS zoning within a one mile band of the corridor.
- We recommend implementation of granny flats, and flats over garage with adequate design review process within large single family zones in both corridors.

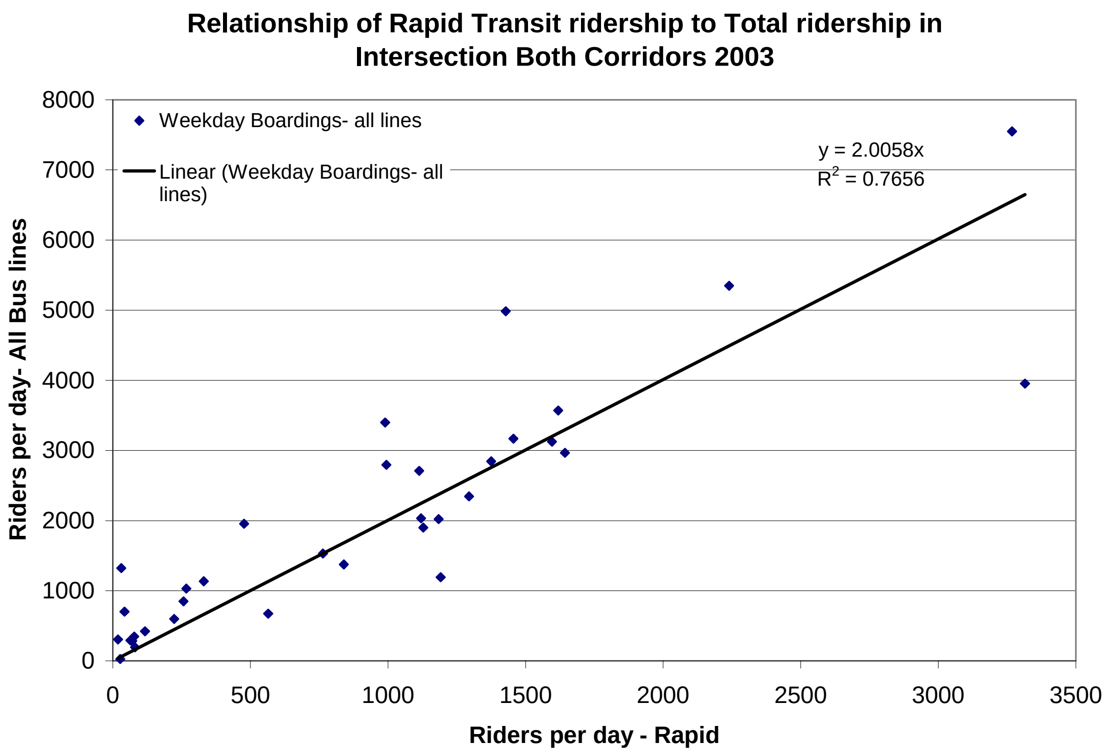
Chapter 4: Transit Linkages and Ridership in the Metro Rapid Bus Stop Areas

We used boarding and alighting data from Metro for different lines in the region. This chapter presents ridership data for all bus lines that crisscross the 33 rapid bus stop intersections. We also provide maps showing transit infrastructure such as bus stops and metro stations. Total transit activity in each stop includes persons boarding and alighting at all the stops in one intersection. We used this variable as our dependant to run multiple regression models in our later Chapter 5.

4.1 Transit Ridership Levels For All Bus Lines And Rapid Transit Lines In Vermont And Ventura Corridors

There is an increase in transit ridership overall with an increase in rapid transit ridership. This relationship persists at individual corridor level for both Vermont and Ventura corridors (figures 4.2and 4.3).

Figure 4.1: Scatter Plot Showing Comparison Of Transit Ridership On Rapid Bus Lines And All Lines Combined



Source: Metro, Weekday boardings

Figure 4.2: Scatter Plot Showing Comparison Of Transit Ridership In Rapid Bus Stop Areas For All Lines And Rapid Line, Vermont Corridor, 2003

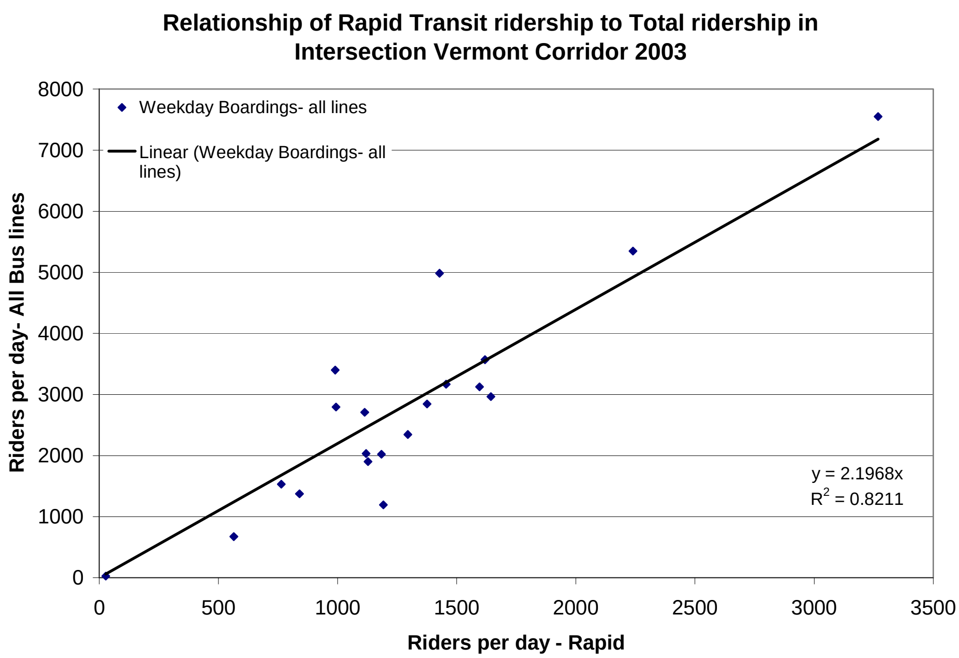
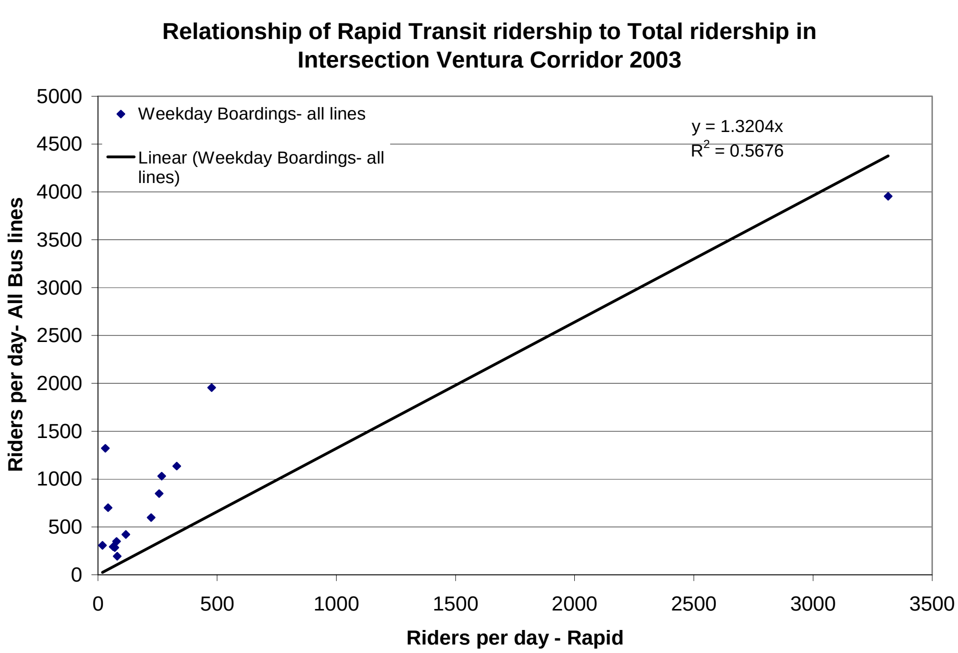


Figure 4.3: Scatter Plot Showing Comparison Of Transit Ridership In Rapid Bus Stop Areas For All Lines And Rapid Line, Ventura Corridor, 2003

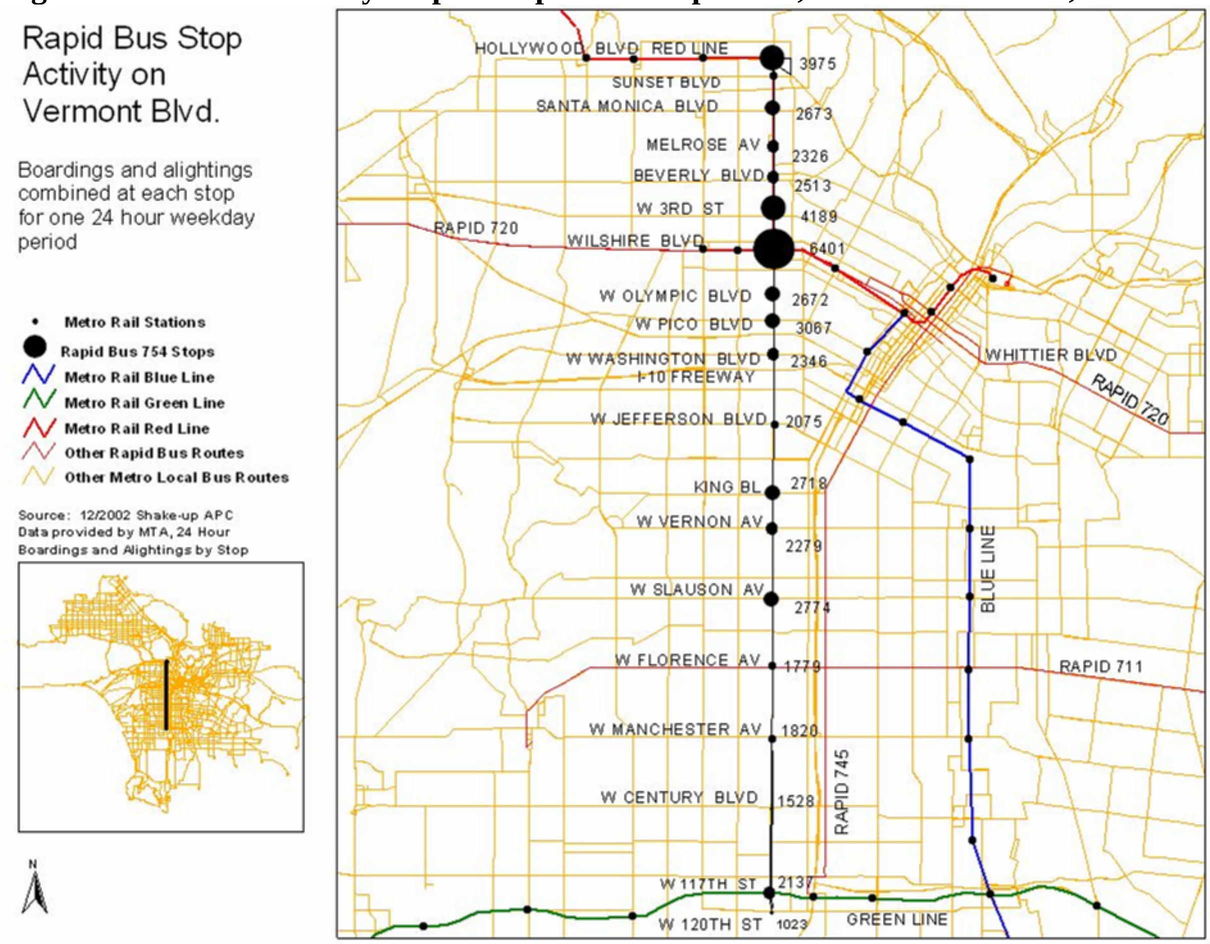


Source: Metro, Weekday boardings

4.2 Bus Activity In Vermont & Ventura Corridors

The rapid bus stop activity maps (Figures 4.4 and 4.5) show the intensity of bus transit ridership at station areas within the corridors. Each rapid station area has total transit riders representing boarding and alighting for a 24-hour weekday period representing the activity levels at each station area.[1] The busiest station areas are within the Vermont corridor. Bus stops south of the I-10 Freeway on the Vermont corridor tend to be less busy compared to stops that lie north of the freeway. Wilshire station area is the busiest bus stop area, with the metro rail Red Line and other bus transit linkages.

Figure 4.4: Transit Activity Map In Rapid Bus Stop Areas, Vermont Corridor, 2002



Source: Metro 2002 ● 6000 Boardings

Activity levels on Ventura corridor tend to be more spread out. The metro rail Red Line at Universal City station has significant boarding and alighting activity. Bus stop areas close to the Red Line also have higher activity levels station areas connecting to other rapid routes (Line 761 - Van Nuys and Sepulveda). Reseda bus stop area also

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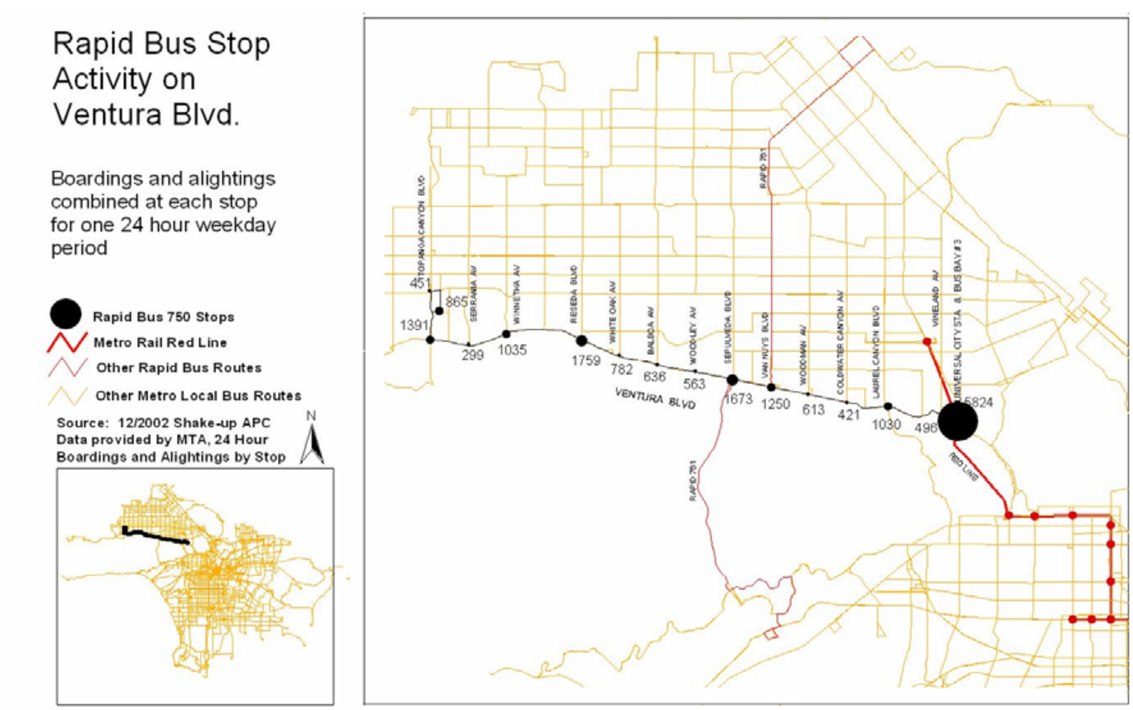
[1] . Based on the January 2003 data provided by the Los Angeles County Metropolitan Transportation Authority (now Metro). The radii of the solid black circles on each stop are increased according to scale.

experienced high activity levels for reasons specifically related to the presence of high density multifamily housing and also shows high correlation with workers using public transit as per demographic data (Refer Chapter 2).

Figure 4.5: Transit Activity Map In Rapid Bus Stop Areas, Ventura Corridor, 2002



Source: Metro, 2002 ● 6000 Boardings

4.3 Rapid Bus Transit Ridership Flow

The analysis of bus rapid transit ridership is based on boarding and alighting data for different station areas. The flow analysis indicates the stretches in which buses run with fuller capacity within the corridors.

Vermont Corridor

In case of Vermont corridor, overall transit ridership is much higher within the stretch north and south of Jefferson bus stop area as is the case for Wilshire station area.[2] Ridership overall in the southern half of the corridor tends to be much lower. Looking at the activity map in addition to the ridership maps (Figures 4.4 and 4.6), most commuters alight on Slauson and Vernon stations or north of the I-10 Freeway. Thus buses run to fuller capacity between Slauson through King and remain so until north of the I-10 freeway while station areas in between see little activity. Both northbound and southbound ridership levels are very similar.

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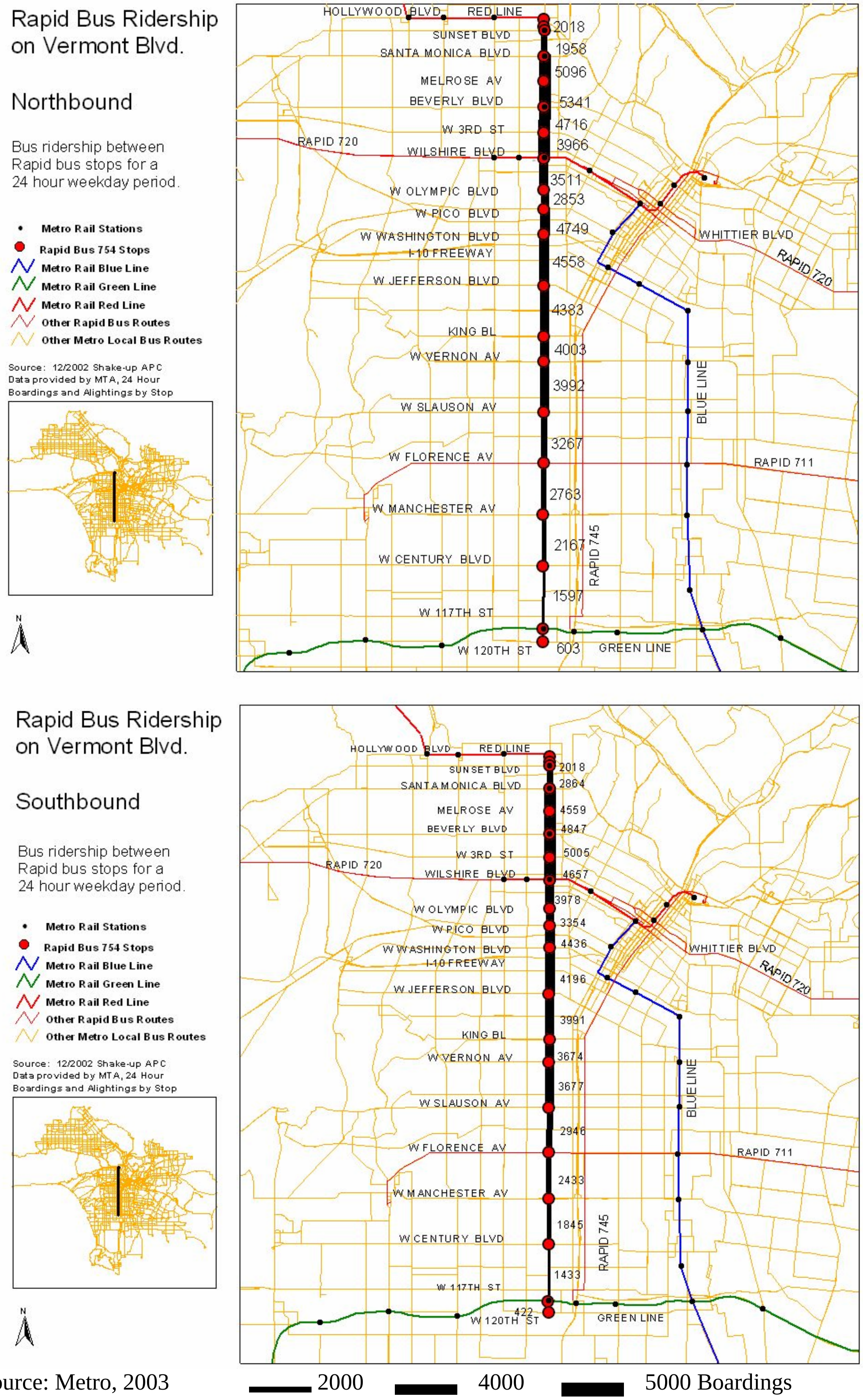
[2]. January 2003 data was provided by the LACMTA. Ridership numbers are displayed next to the linkages between Rapid bus stops. The line thickness represents the number of riders according to scale. Data is represented separately for eastbound and westbound or northbound and southbound.

Figure 4.6: Transit Flow Map Along Rapid Bus Routes, North And South Bound, Vermont Corridor, 2003

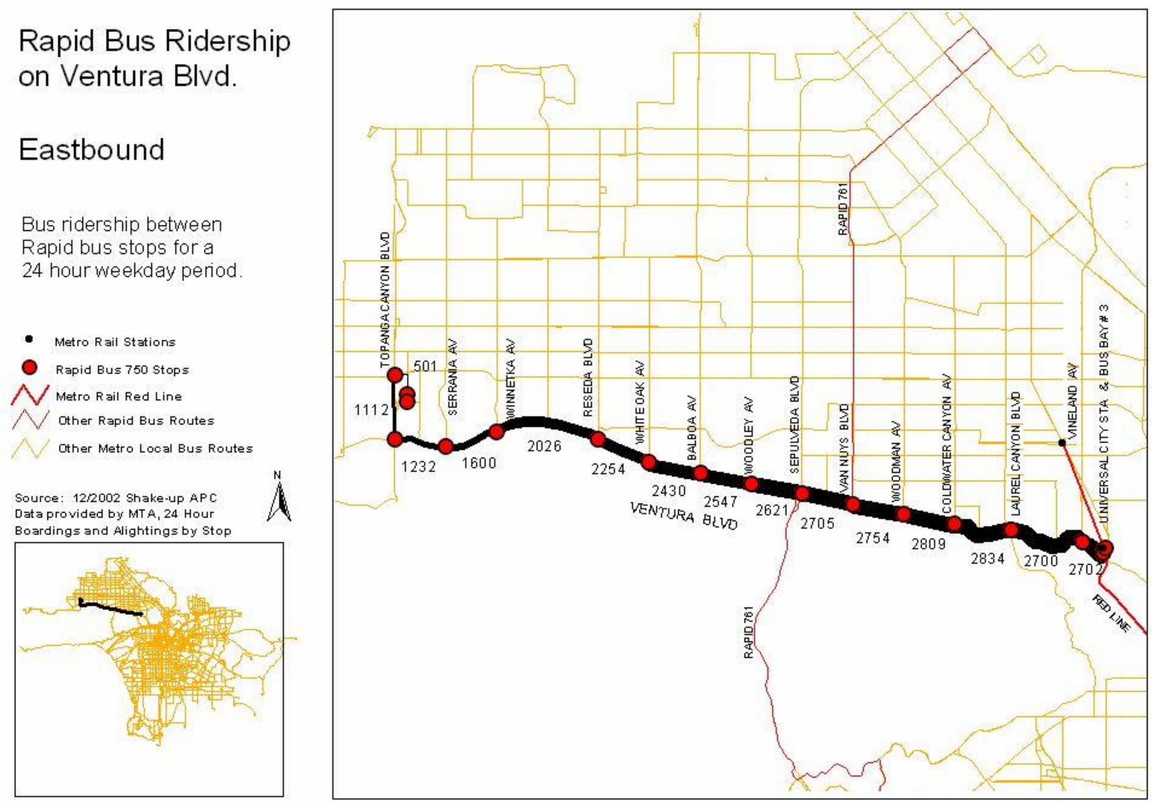


Source: Metro, 2003

Ventura Corridor

Ventura corridor experiences high ridership levels on the eastern parts of the route, particularly near the Red Line subway station. The flow thickness show high ridership towards the eastern direction of the Ventura corridor. The high ridership levels are maintained until Sepulveda and Van Nuys, bus stop areas where people alight and board on to different lines. Most transit users come from outside the corridor, as they are using the Ventura rapid route to connect to the Red Line and travel farther. Moderate ridership levels are maintained between Reseda Boulevard and Winnetka, and Reseda and White Oak. The flow is similar on both eastbound and westbound directions of the Ventura rapid bus route.

Figure 4.7: Transit Flow Map, Along Rapid Bus Routes, Ventura Corridor, 2003



Source: Metro, 2003 — 1000 — 2000 — 3000 Boardings

Source: Metro, 2003 — 1000 — 2000 — 3000 Boardings

4.4 Transit Linkages on the Vermont and Ventura Corridors

Transit linkage levels[3] include the total number of transit lines and the Rapid Bus line within the immediate area of the Rapid Bus Stop. It is a rough measure as we do not weight any given line in terms of frequency, speed or boardings. They include metro local bus routes, metro limited bus routes, other metro rapid bus routes, metro Rail, DASH, commuter express, and other municipal services.

Highest levels of transit linkages lie in the northern and the southern part of Vermont corridor. With the exception of the I-105 Freeway area, the corridor is served with fewer lines limiting connections for transfer passengers (Figure 4.8). This is also possibly one the reasons for lower transit ridership levels in these stretches. Hollywood, Sunset, and Wilshire have good connectivity as bus stop areas with maximum transit linkages. King and Florence in the southern part are highly connected bus stop areas. Santa Monica, Vernon, Slauson, and Manchester bus stop areas have moderate linkages. The Ventura Corridor (Figure 4.9) does not have a well connected transit system in comparison to Vermont corridor. Few station areas show moderate connectivity on the Ventura corridor. They are Topanga Canyon to the west, Sepulveda and Van Nuys in the middle, and Laurel Canyon to the east. Universal City station area has high transit linkage level. Unless more bus routes are allocated, the connectivity and transit linkages will remain the same, along with ridership levels.

[3] The number of transit linkages is represented by the diameter of the black circle on each Rapid bus stop.

Figure 4.8: Transit Linkages Map, Vermont Corridor, 2003

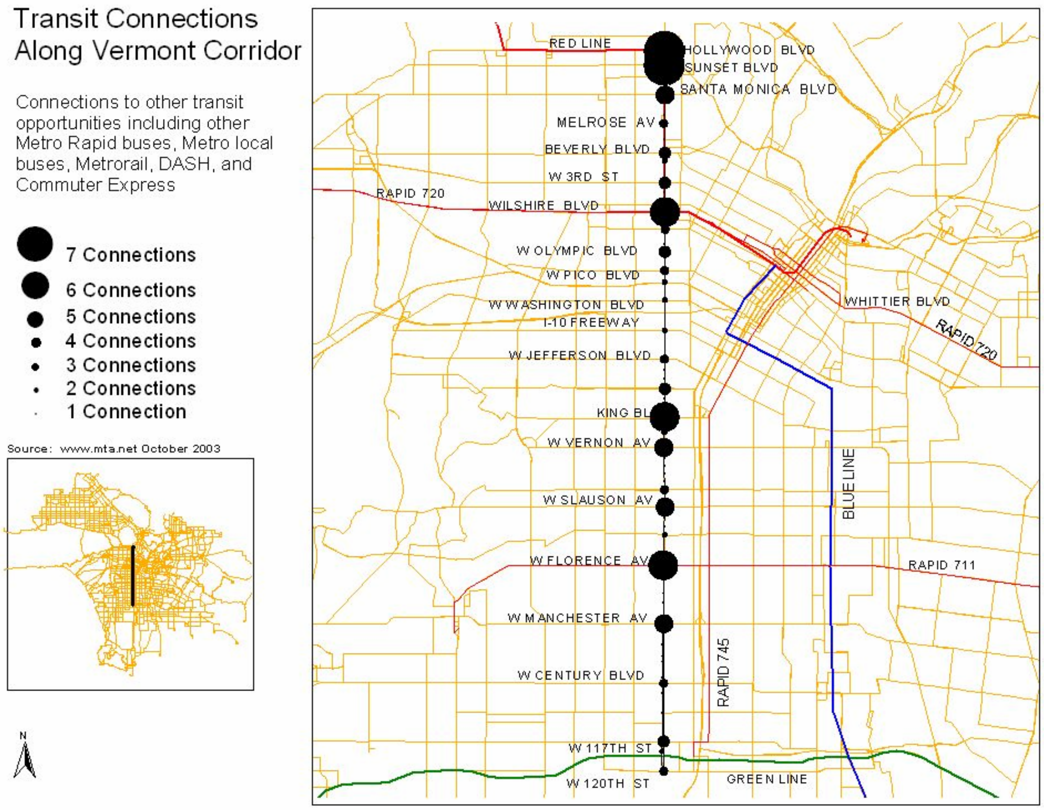
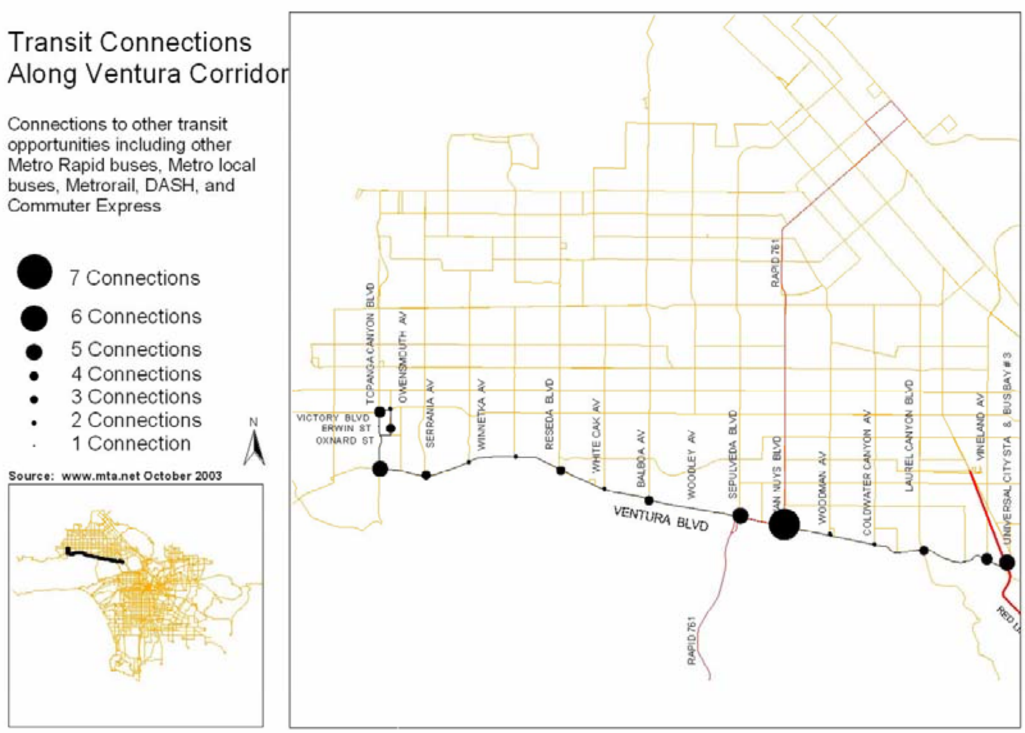


Figure 4.9: Transit Linkages Map, Ventura Corridor, 2003



Source: Metro, 2003

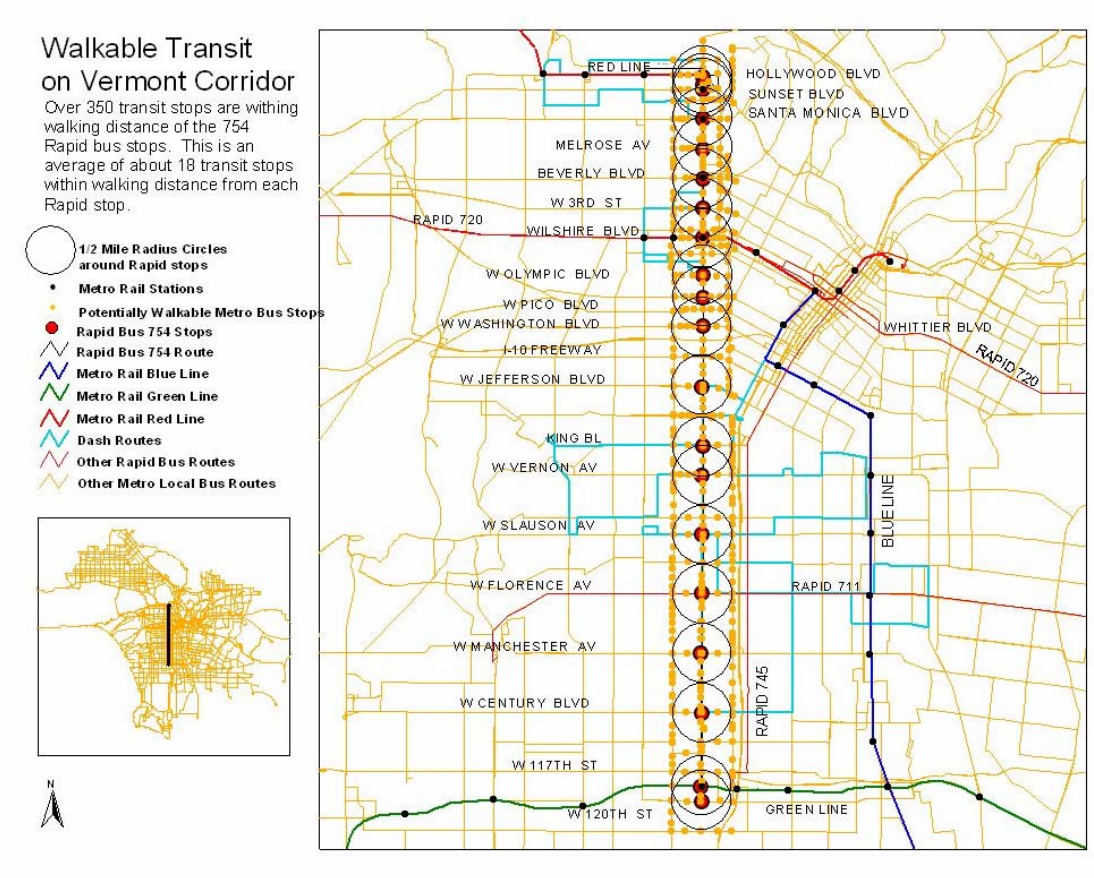
4.5 Bus Stop Density In Rapid Bus Stop Areas On The Two Corridors

The bus stop density maps show all local bus stops and rapid bus stops within walking distance of the rapid bus stop area. The walking distance is a half mile radius, 2,640 feet, a reasonable walking distance to connect to another transit stop. Taking the bus instead of walking to transit stations becomes more popular at the distance of 3000 feet.[4] Additionally, metro rail stations, rapid bus and local metro bus lines and DASH routes are also shown.

Vermont Corridor

Vermont Boulevard has very dense transit linkages north of the I-10 Freeway. This is easily seen in the transit linkages map.

Figure 4.10: Bus Stop Density Map, Vermont Corridor, 2003



Source: Metro, 2003

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[4] The information has been collated from MTA, and LA DOT route maps. Untermann, R. 1984. *Accommodating the Pedestrian: Adapting Towns and Neighborhoods for Walking and Bicycling.* New York: Van Nostrand Reinhold.

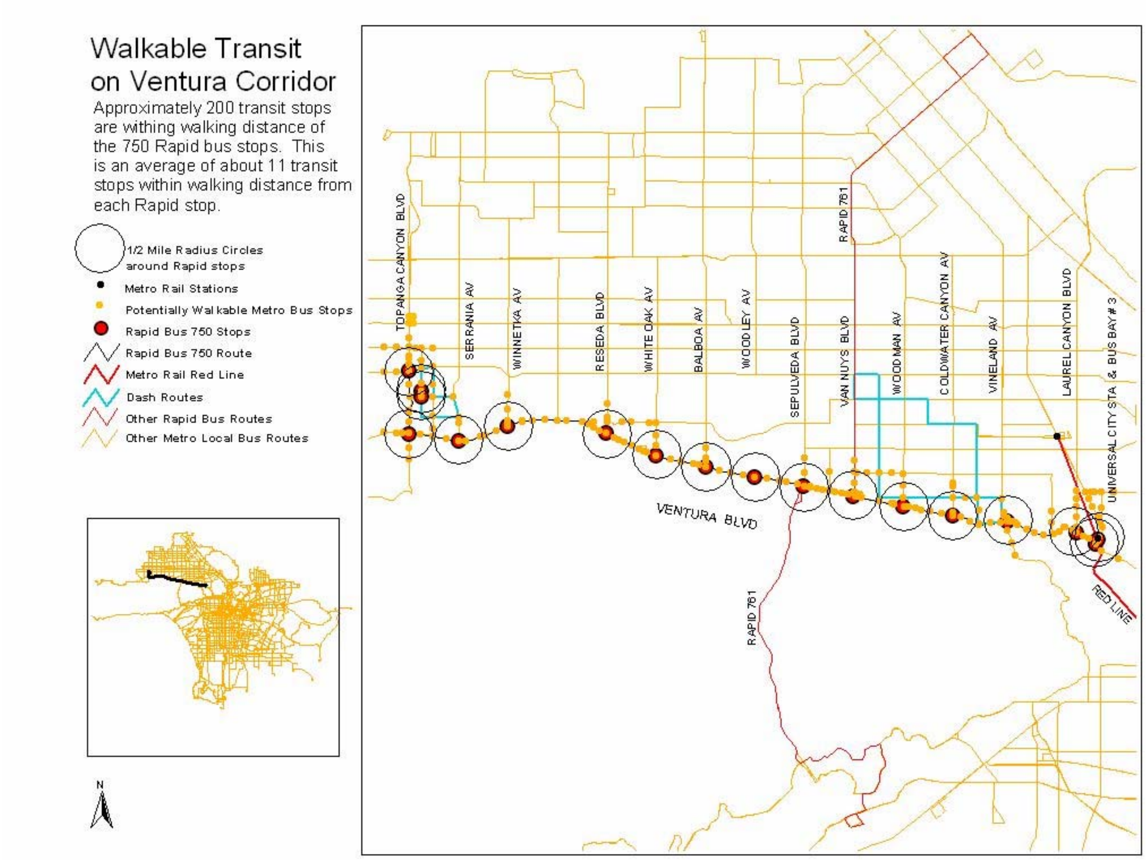
Ventura Corridor

The density of transit stops is far less on Ventura corridor compared to Vermont. In addition, two significantly large areas on the Ventura corridor are not within reasonable walking distance of any rapid bus stop, stretches between Winnetka and Reseda and between Laurel Canyon and Vineland rapid bus stop areas.

Bus stop densities are higher as one moves closer to metro rail stations. In the Vermont corridor higher bus stop densities follow the northern Red line stations and south towards the Green line station and the areas in between have far fewer stops.

In case of Ventura corridor the areas surrounding the end points of the rapid line Topanga and Universal City and rapid bus stop areas of Van Nuys and Sepulveda show higher bus stop densities. Reseda with higher density multifamily housing also shows higher bus stop density.

Figure 4.11: Bus Stop Density Map, Ventura Corridor, 2003



Source: Metro, 2003

4.6 Home Bound Origin and Destination (HOBAD) Maps

HOBAD maps were used to find the number of commuters from residents living within the study corridors. This was done for Ventura corridor alone, and we found that 11% of those using the rapid line live within the corridor.[5] In the eastbound direction, 65% of the origins are from outside of the corridor; 44% of the boardings occurred outside of the corridor, the rest were linked trips. In the case of westbound rapid bus (route 750), 89% of the origins occurred outside the corridor while 82% of the boardings occurred outside of the corridor. Thus, more transit users travel from the east, towards Ventura corridor to shop or do business. For westbound destinations, 55% who board live within the corridor while 78% are traveling from outside of the corridor. There is a flow of transit users who travel to the corridor via the rapid bus and then travel farther after alighting from the system. This is different in the case of eastbound transit traffic, where 70% of destinations are outside the corridor and 58% of alighting is outside of the corridor. Most transit users are merely passing through the corridor to connect to other lines.

4.7 Relationship of Transit Ridership and Population Density

Vermont corridor

There is a relationship between population density and transit ridership levels at the bus stop areas as shown in Figure 4.12 on Vermont corridor.

Ventura Corridor

On Ventura corridor (Figure 4.13) the relationship is affected by connectivity or transit linkages as well, especially Van Nuys and Sepulveda station areas.

[5] The HOBAD maps contain information taken from onboard surveys, origin and destination of transit users of two rapid lines of the corridor. The maps were analyzed to define if the queried item occurred within the corridor or outside the corridor. Within the corridor was defined as if the TAZ (Transportation Analysis Zone) was touching the boulevard in question, and all else was defined as outside the corridor. The data were tallied and then totaled. The result defined the user trips from within or outside the corridor.

Figure 4.12: Population Density And Transit Ridership At Bus Stop Areas, Vermont Corridor

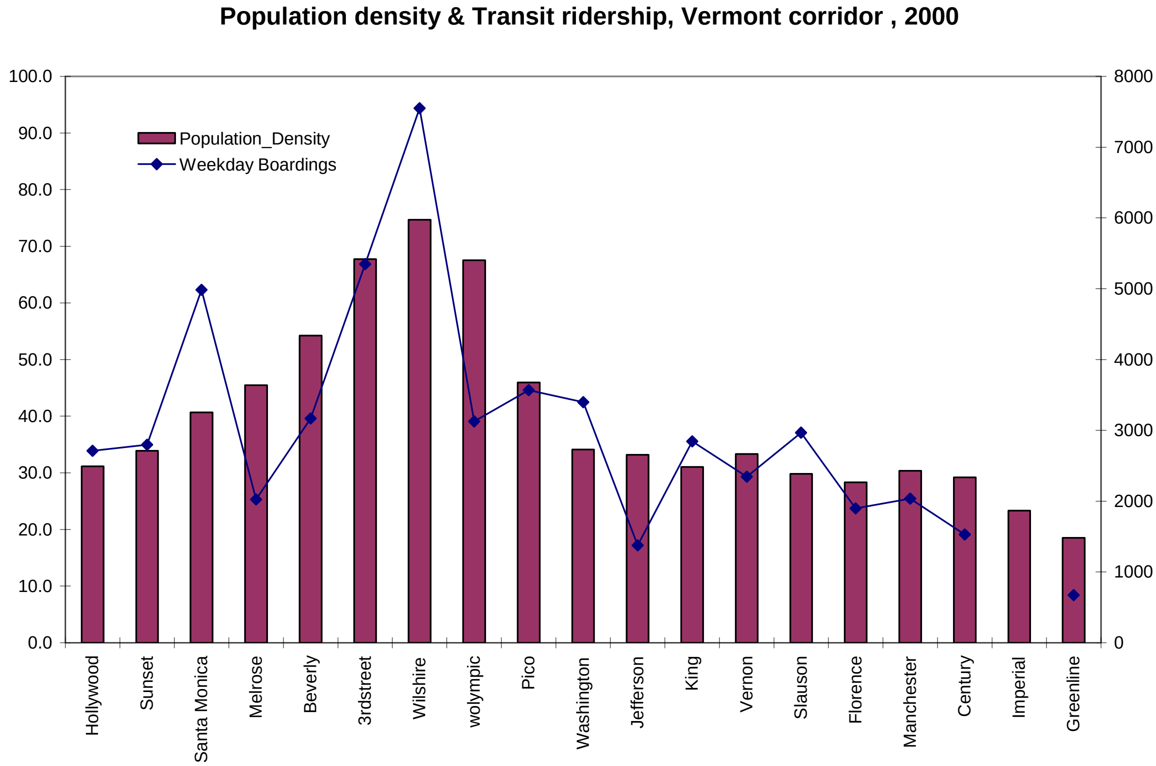
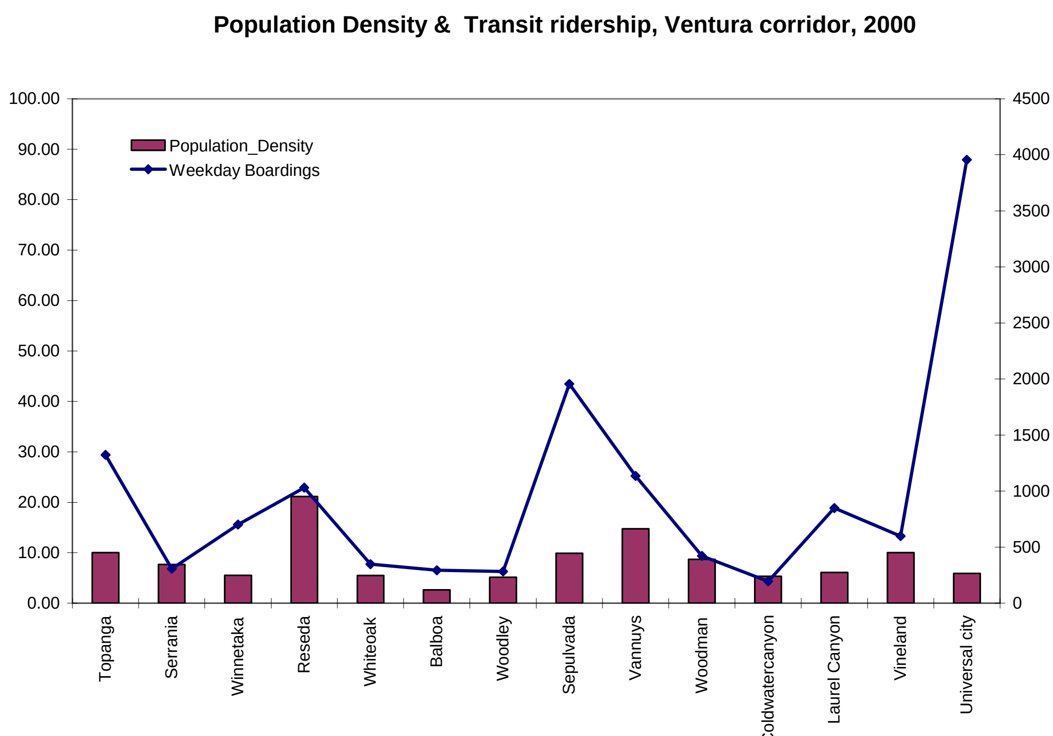


Figure 4.13: Population Density and Transit Ridership at Bus Stop Areas, Ventura Corridor



Source: Census, 2000, Metro, 2003

Chapter 5: Estimates for Transit Ridership

The previous chapters looked at the effects of socio-economic variables i.e. population, land use, and transit infrastructure, separately. In this section multiple regression analysis is used to explain effect of different urban form, demographic, and transit infrastructure variables on total weekday boardings on rapid bus corridors for individual bus station areas, including all lines that pass through the intersection. Further we have predicted the average ridership increases with increase in housing density for the corridor bus stop areas.

5.1 Purpose

We discerned different effects of the key variables on transit ridership and also explained the relationship between the different key variables. The analysis is used to predict changes in policy measures that can affect transit ridership within Vermont, Ventura, and similar corridors. Increase in housing densities, new employment centers with mixed use developments, improved transit infrastructure, and parking reductions in residential and commercial areas are seen as positive policy measures not only to address current problems within the city but to increase overall transit ridership. Targeting underutilized land, housing shortages, and housing affordability—especially with regards to work force housing are examples of other relevant policy objectives. Our purpose is to find the extent to which transit ridership increases from incremental changes in these policy measures. We have used variables such as housing density, employment density, transit linkages, availability of metro rail, and average vehicle ownership per household to predict transit ridership. We have also explained the reasons for including them and excluding others in the following section.

5.2 Data Sources And Units Of Analysis

The half-mile radius that represents the walkable area around rapid bus stop intersection has been considered as the individual unit of analysis. There are 33 bus stop areas in both the corridors; 19 in Vermont and 14 in Ventura corridor. Five bus stop areas of Vermont corridor are metro rail station accessible. They are Wilshire, Beverly, Santa Monica and Hollywood stations of the Red Line and the Vermont station of the Green Line. Universal City is the only bus stop area with metro rail station in the Ventura corridor. The station area is represented by the total area in block groups that intersected the half-mile radius around the intersection of the rapid bus stop. Pooled data was used for key demographic variables from this information. In case of employment the pooled data were taken from census tracts intersecting the bus stop area.

5.3 Methodology

In order to predict transit ridership, multiple regression models were run for rapid bus stop areas in Vermont and Ventura corridors; combined and individually. Population density, housing density, employment density, percentage of non-residential area, land use mix, vehicle ownership, presence of metro rail, transit linkages were some of the key variables considered for the models as they represented trip generating and trip attracting characteristics of a given area.

Simple correlations are used to explain the relationship between the different key variables. We also ran regressions on indicators separately to test their significance on transit ridership.

5.4 Effects Of Various Variables On Transit Ridership

Effect of Population Density

Population density is significant in all models when station areas in Vermont and Ventura corridors are reviewed in aggregate. Population density is significant in Vermont corridor and not significant in Ventura corridor when the station areas were considered separately. Here the observations are few in number and we realize the model may have reliability problems; however population density remains consistently significant when all station areas are considered.

Effect of Housing Density and Multifamily Land Use

We measured intensity of residential development in two ways, housing density, and the extent of multi-family residential land use. Both these measures are significant in the Vermont corridor. Housing density is significant in Ventura corridor indicating the absence of significant multifamily housing in this corridor.

Effect of Employment Density

We find a positive relationship between higher employment density and transit use taking all station areas into consideration. The variable is significant in Vermont corridor only.

Effect of Non-residential Land Use

Non-residential land use in combination with population density was used to test the effects of trip attraction, after controlling for the presence of metro rail, and percentage of multifamily. Non-residential land use variable is significant only in Vermont corridor and not in Ventura corridor.

Effect of Land Use Mix

We tested the effects of mixed land uses on transit ridership. Land use mix was defined using Simpson's diversity index method, where a single measure was computed using the areas under different land uses. The formula measures both the variety and distributive aspects amongst the different land uses in an area. For example more land uses and equal distribution amongst them would yield higher diversity value. Land use diversity index ranges from 0 to 1, one indicating high diversity, 0 indicating no diversity. Land use diversity is significant indicating a positive relationship with rapid transit ridership, when tested alone. In the model testing the combined effects of population density and land use mix, population density was the only significant variable, while land-use mix or diversity had no effect.

Effect of Metro Rail and Transit Linkages

The presence of metro rail station is significant within the different models when tested with most other factors. The variable “transit linkages” measures the total number of connections available within the intersection where the rapid bus stops are also located. This variable tested significant in almost all models. For example in Ventura corridor, only the Metro rail station availability and transit linkages measure showed significant relationship with ridership measured as boarding ridership, while population density did not.

Effect of Vehicle Ownership

The percentage of households with no vehicles tested significant only in Vermont corridor. The percentage of households without vehicles is very small and likely with insignificant variance in Ventura corridor and does not appear to have any influence on transit ridership. However, the measure vehicles per household showed significant relationship, with higher vehicles per household there is a decrease in transit ridership. In effect, people living in higher density housing with fewer cars per household are likely to use transit, and are possible contenders for housing in our study corridors for increasing transit ridership.

Effect of Ethnicity and Income

We find that the effect of individual population characteristics such as ethnicity is a relevant factor and is significant when regressed individually but lacks effect within the combined models. We found a similar situation with income variable. It is possible that the relationships are complex with likely interaction effects between some of these variables. Possible auto correlation between population or housing density with Hispanic population and also with lower income groups is also quite likely.

We therefore choose <u>not to control</u> for these variables in the models chosen.

5.5 Description Of The Models

Transit Ridership = f (Residents, Employment, Transit infrastructure, Vehicle ownership)

Transit Ridership = f (Housing density, Employment density or Non residential area, Number of transit linkages, Availability of metro rail, Number of vehicles per household)

We hypothesize that housing density, employment density, and availability of transit infrastructure determine boardings on transit.

Our dependant variable transit ridership calculated as weekday boardings of all bus lines passing the bus stop area intersection is regressed on a combination of independent variables, housing density, employment density, transit linkages or availability of metro rail station, and number of vehicles per household.[1] The 33 rapid bus stop station areas in Vermont and Ventura corridor are our units of analysis.

5.6 Model Results For All 33 Rapid Bus Stop Areas

In our first model housing density, employment density and transit linkages we find housing density and transit linkages are significant variables, having positive effect on transit ridership, while employment density is insignificant.

Our second model considered a combination of housing density, non-residential land use and transit linkages. Housing density, non-residential land uses and transit linkages are all significant with positive influences to transit ridership.

Table 5.1: Model Results For 33 Rapid Bus Stop Areas Combined
Dependent variable - Station area weekday boardings

Parameter	Model 1	Model 2a	Model 2b	Model 3	Model 4	Model 5	Model 5a	Model 6
R^2 Adjusted R^2 F	0.72 0.69 24.7***	0.74 0.71 27.2***	0.75 0.71 20.8***	0.75 0.73 29.9***	0.81 0.79 42.4***	0.77 0.75 34.0***	0.79 0.77 27.2***	0.78 0.76 35.0***
Intercept	-445.69 -0.98	-1490.98 -2.18	408.48 0.21	4583.75 4.06*	5120.23 7.04	-211.36 -0.38	1959.55 1.27	2110.66 1.34
Housing density	149.52 3.71***	182.03 7.13***	141.89 3.08**			172.98 7.35***	120.69 2.89**	128.93 3.09**
Employment Density	18.33 1.17			45.11 4.4***	36.96 3.99***			
Non-residential area (%)		2661.21 1.91	2966.45 2.08*			1212.08 0.91	1686 1.26	
Transit linkages	223.53 2.00	221.11 2.06*	185.64 1.65	157.06 1.45				
Metro rail					1404.77 3.45**	1467.06 3.22**	1404.10 3.13**	1571.74 3.64***
Vehicles per household			-1136 -1.04	-2808.66 -4.5***	-2822.44 -5.62***		-1404.27 -1.50	-1126.95 -1.23

*P <= 0.05
** P <= 0.01
*** p < = 0.001

[1] We controlled for many factors such as income levels, percentage Hispanic population and so on and found they were insignificant, compared to our other key variables such as population density, housing density, etc.

As a subset of the second model, we tested the relationship of transit ridership with housing density, employment density, transit linkages with vehicle ownership, and found housing density and non-residential land use to be significant. Transit linkages and vehicle ownership were not significant.

Our third model used employment density, presence of metro rail, and number of vehicles per household as independent variable on transit ridership.[2] All three variables are significant in this model. Employment density and metro rail add transit riders and while vehicle ownership per household decreases ridership.

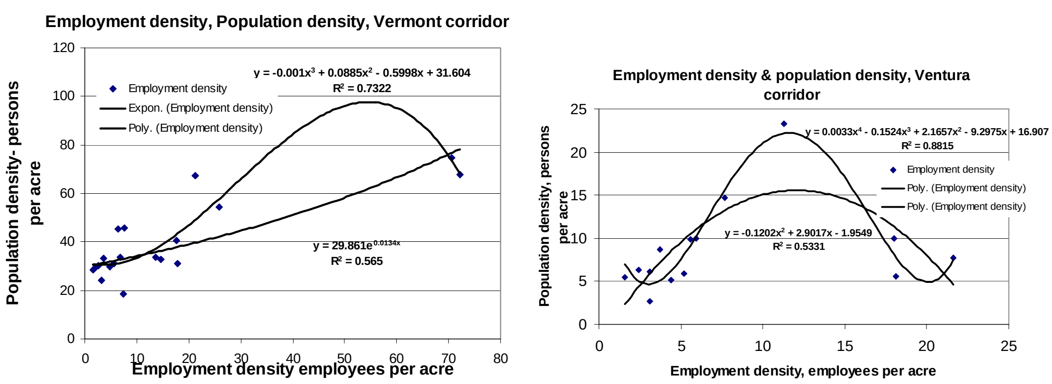
The only model that tested housing density with land use mix showed housing density as the only significant variable. Better indicators of mixed use area characteristics may be needed to increase its explanatory power as we did see it positively influencing transit ridership when tested alone. We have not used this model to predict ridership, however we find the concept of mixed use worthy of study in future work.

5.7 Model Results For Vermont And Ventura Corridors Separately

The model combining the effects of population density, employment density and transit linkages shows different outcomes. Vermont corridor station areas retain the significant variables, however for Ventura station areas only the transit linkages variable is significant.

Further explanation is due here. The relationship of population density and employment density is not simple. There seems to be non-linear relation ship between the two variables that seem to have interacting effects while viewing the Vermont and Ventura corridor station areas separately (Figure 5.1).

Figure 5.1: Influence Of Population Density And Employment Density On Transit Ridership In Vermont And Ventura Corridors



The population density increases with employment density up to an employment density of 10 persons per acre and above which population density falls with increasing employment density. This appears intuitive because of the economics of land use in the

[2] While using transit linkages instead of availability of metro rail, the variable was not significant.

proximity of large employment centers. However the thresholds for these changes are different in the two corridors. It is much higher for the Vermont corridor.

Looking at the results of the model for Ventura station areas, availability of transit infrastructure measured as transit linkages or metro rail station is the only significant variable. Instead of density, increased connectivity increases transit ridership in the Ventura corridor. Vermont corridor shows increases in ridership with increases in employment density and housing density. It is however important not to ignore the effects of decreases due to presence of residents with higher vehicle ownership. By attracting households with fewer cars and with the parking reductions given to housing developments along the transit corridor, we would add more transit riders.

5.8 Predicted Transit Ridership Using The Combined Model

The increase in ridership levels for one unit increase in gross housing density showed the following results. The variations in the different models are not all that significant. We realized that the results are robust considering the different parameters used in the multiple regression models. It would be safe to assume that there is an increase of anywhere between 120 to 180 weekday boardings for every unit increase in gross housing density within a one mile radius of an average bus-stop area- served with at least 3 transit linkages including the rapid bus route and an employment density of 12.6 persons per acre.

Table 5.2: Predicted Transit Ridership In Bus Stop Area Without Metro Rail

Housing Density	**Metro Rail**	**Model 1**	**Model 2a**	**Model 2b**	**Model 5a**	**Model 5b**	**Model 6**
For every One Unit Increase in Gross Housing density	**Predicted Increase in Ridership**	**150**	**182**	**142**	**173**	**121**	**129**

Figure 5.2: Predicted Increases In Rapid Bus Stop Areas Without Metro Rail

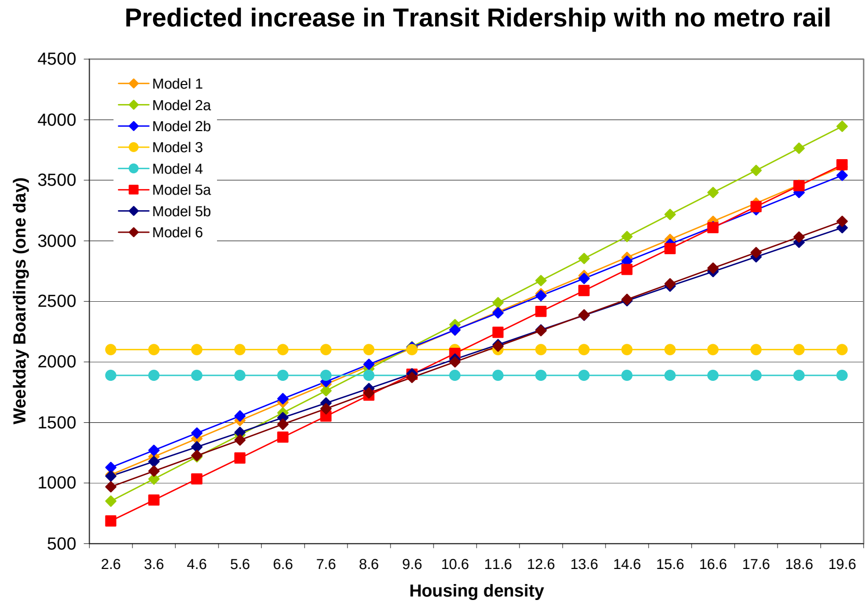
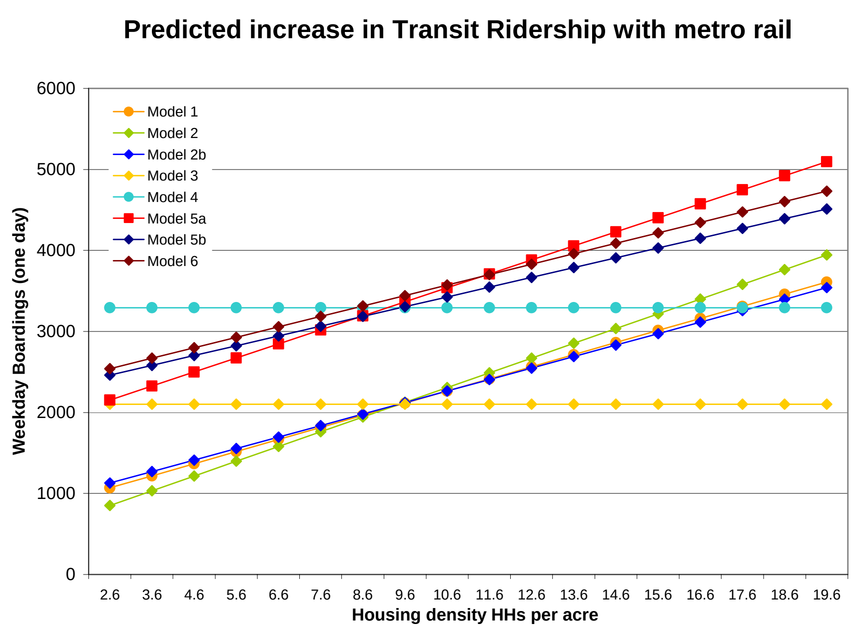


Figure 5.3: Predicted Increases In Rapid Bus Stop Areas With Metro Rail



Chapter 6: Design Proposal

This project shows that by increasing density along transit corridors of Ventura and Vermont transit ridership increases and the need for housing units in Los Angeles is addressed. Yet, the question is how can we increase density in these corridors within the parameters of existing zoning in Los Angeles, and at the same time improve the quality of the built environment and the quality of life of current and potential new residents?

In order to demonstrate how this can be done, we have selected two important intersections in the corridors to develop urban design proposals.

The proposals exemplify the transit-oriented and pedestrian-friendly transformations that can take place along the corridors. Aside from the urban morphology created, information is given regarding the density, number and types of housing units, commercial area, parking spaces, and other development parameters of the design proposals. The developments facing the corridor are mixed use, providing a varied combination of housing, commercial, office and community services. Not only would this mixed use condition create a lively area, but more importantly, it would provide new pedestrian and transit trip origins and destinations for local trips that can alleviate regional transportation demands.

The study also revealed that the current conditions of the streets, sidewalks, open spaces, and transit stops and stations along these two corridors are not appropriate for heavy pedestrian traffic. As every transit trip starts and ends with a pedestrian trip, we recommend that appropriate attention is granted to making the streets, sidewalk, open spaces, and transit stops and stations in these corridors as functional, comfortable and pleasing as possible, to both promote and sustain pedestrian usage.

The proposals suggest that patterns of urban design and development can significantly impact transportation patterns.

In the following section, we examine the characteristics of existing TOD best practices. We have selected two intersections on Vermont and Ventura rapid bus corridors to calculate development potential under different scenarios to generate alternative design solutions for increased density. The selection was based on current moderate levels of bus activity and potential for increase in the vacant parcels and underutilized sites within a quarter mile of the intersections.

6.1 Precedents

California Transit-Oriented Development

This study examines the transit-oriented development in twenty-one station areas, most of which are located in the Bay Area and Southern California regions. The station area refers to an area of approximately one-half mile radius around a transit station. The data shows that higher use of public transit is related to higher residential density and higher ratio of commercial land use and lower household income.[1]

Comparing the demographic, commuter, and land use characteristics of different stations we find there is no consistent relationship between higher density and transit ridership. Presence of commercial areas along with residential in general is a requirement for increased ridership. Further differences were based on the location of the station area; city center, suburb and so on. Heavy rail station areas tend to have higher boardings compared to bus or commuter rail and support high density mixed use developments.

- Higher densities lead to higher rates of transit ridership especially in central locations with mixed use developments.

- We find variations in the relationship between residential density and transit ridership. The greatest benefits come from low to moderate densities, say from an average of 6 to 14 units per acre.

Use of Public Transit	Residential Density
12%-32%	3.71-26.89
5%-12%	4.10-9.42
0-5%	2.91-5.07

The limited densities in the projects are usually thought of as a result of zoning limitations imposed by local government. Market demand and preference of the developers are other main factors affecting density.

- Higher percentage of residential land use does not always yield higher use of public transit. (For example, the Wrigley Market Place, Village Green, Village of La Mesa).

[1] Data Source: California Transit-Oriented Development (TOD) Searchable Database, http://transitorienteddevelopment.dot.ca.gov/, Feb. 2004.

- Higher ridership levels occur with higher commercial land use, which also means that more employment opportunities are provided in those regions.

- In general, TOD yields significant increase in the use of public transit, if it is accompanied by other land use measures which attract employment growth or large concentration of employment and mixed uses near stations. (Such as the Emeryville, Gateway Plaza- Union Station, Downtown Plaza- St Rose of Lima Park).

We find variations in the relationship between median income and transit use.

Use of Public Transit	Median household income
12%-32%	\$13,000-\$63,000
5%-12%	\$26,000-\$70,000
0-5%	\$29,000-\$87,000

- Higher use of public transit is associated with lower household income, with high residential density and low auto ownership. Lower-income areas are natural markets for public transit services, and neighborhood retail and commercial services. At city center locations higher median income also contribute to increased ridership

Housing Types, Density and Related Development

A remodeling of housing-form has been underway in the central cities and suburban communities in the United States. Increased housing price has generated the demand for higher-density housing because of soaring land cost, rising labor expense, and higher housing demand. That is not simply a response to affordability issues, but reflects people's increasing acceptance and preference.[2] Many people like to live within the city to reduce home-to-work commute and have more leisure time, and accessibility to transit, educational and cultural amenities.

The purpose of building higher density housing is not only to deal with density successfully, but also to improve quality of the built environment. Typology of housing such as single-family, townhouse, condominium, and apartment suggests certain density. Even as other factors such as the size of the building, the ratio of parking spaces required per unit, the type of parking, the amount of exterior space assigned to private dwelling units and to public use, provide constraints to what can be built on individual parcels.

In order to effectively utilize the zoning and the allocated FAR, modification of height, set backs, parking requirements may be required.

To create a coherent, well-defined built environment, new development should blend with existing neighborhood features. Moreover, higher-density housing will have better chances of being accepted when it is accompanied by community amenities, property maintenance, and other community services.

[2] Wentling, Density by Design, 1988, p2.

- Medium-density, single-family housing can blend into lower-density single-family neighborhoods. It will support transit while addressing housing preferences. Housing development such as small-lot villa, wide-lot singles, and zero-lot-line houses are obvious approaches to increasing density, while maintaining strong single-family home neighborhood characteristics.

- Compact, transit-supportive development can provide flexibility needed for infill sites. Neighborhood-scale commercial and public use should be encouraged to promote transit use and walking. Buildings with pedestrian friendly commercial, entertainment facilities on the first story and residential, on the upper story are suitable in such sites.

- Low-density single-family development and multifamily development can be combined in one community to achieve an average density that can support transit.

- The location selection and design concept play important roles for developing higher-density multifamily housing. Land surrounding commercial and employment center, or educational center, in designated mixed-use areas can be zoned for multifamily housing use. Housing types such as townhouses, courtyard and terraced apartments, and mixed-use apartments can offer promise for successful integration into a community.

Design Characteristics

Housing developments having the same average density can appear very different, depending on design. Wentling has suggested some common design qualities that are helpful for higher-density housing types.[3]

- Human Dimension - Large building should be reduced to identifiable human-dimension elements with comfortable features that encourage interaction among residents.

- Spatial Quality - The standards of space quality needs more attention in higher-density projects. Continuity of street grid is promoted to facilitate public transit.

- Regional Fit - Housing is shaped by available building materials, climate, social traditions, ethnic heritage, and other local features. Higher density developments are better accepted when they are compatible and blend well with the existing neighborhood feature.

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[3] Wentling, *Density by Design*, 1988, p171.

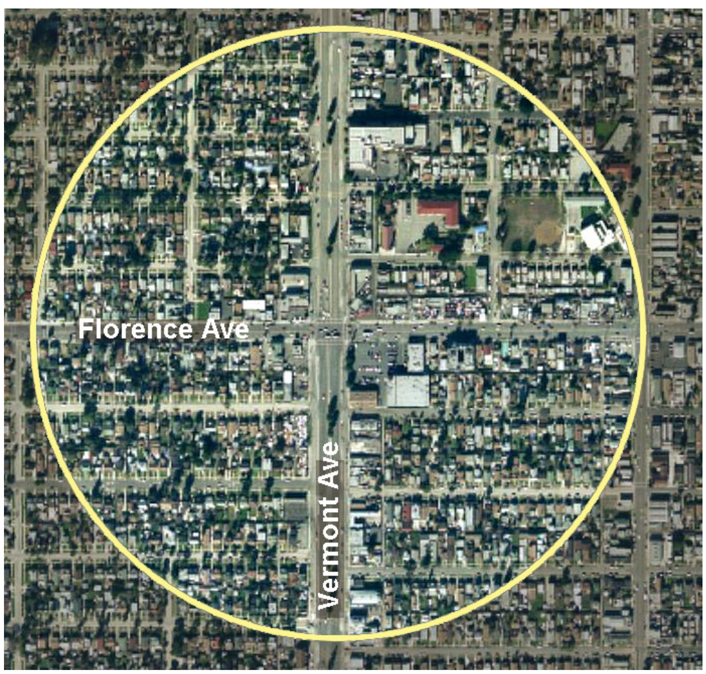
6.2 Physical Context Of Selected Intersections

We chose four intersections along Vermont Avenue and Ventura Boulevard as examples for further study. They are: Vermont/Florence, Vermont/Wilshire, Ventura/Van Nuys, and Ventura/Laurel Canyon. The data shows higher transit activity at the Wilshire intersection in the Vermont corridor and Van Nuys intersection in the Ventura corridor, and lower transit use at Florence in the Vermont corridor and Laurel Canyon in Ventura corridor. We selected them based on the variations in terms of land uses and built form. We see them as potential sites to demonstrate future growth scenarios and mixed use and higher density developments within existing zoning constraints.

Aerial Photos

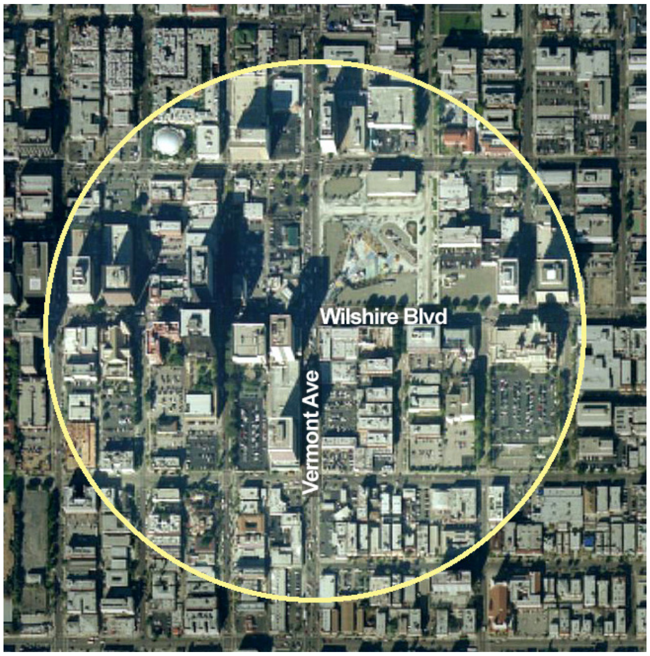
The aerial photos show the physical context of the four intersections and were used to determine existing development potential. In the case of Vermont/Florence (Figure 6.1), the built environment is dominated by single- and multi-family housing, and commercial strips along Vermont Avenue and Florence Avenue.

Figure 6.1: Aerial Photo Of Vermont/Florence



Source: http://globexplorer.com/

Figure 6.2: Aerial Photo Of Vermont/Wilshire



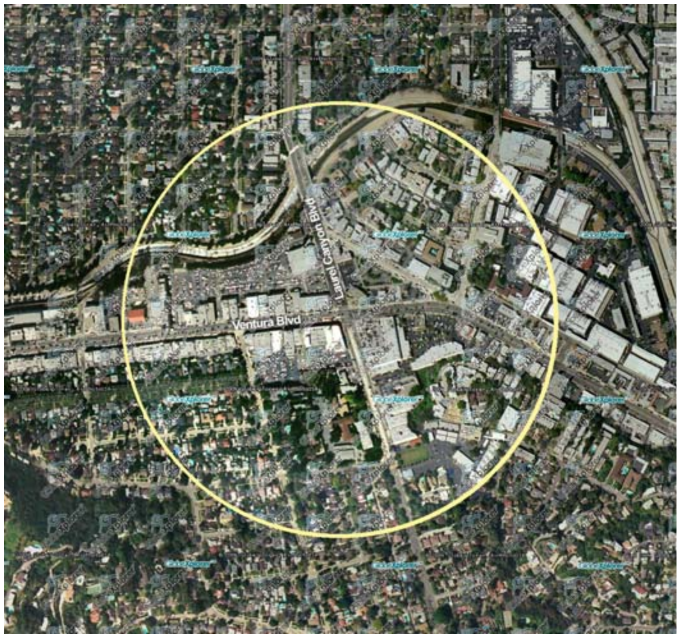
Source: http://globexplorer.com/

In the case of Vermont/Wilshire (Figure 6.2), the majority of the buildings are large scale commercial buildings and multi-family apartment buildings. On Ventura Boulevard, the two station areas (Figures 6.3 & 6.4) show a mix of commercial strip shopping malls, and single-and multi-family housing.

Figure 6.3: Aerial Photo Of Ventura/Van Nuys

Source: http://globexplorer.com/

Figure 6.4: Aerial Photo Of Ventura/Laurel Canyon



Source: http://globexplorer.com/

One common characteristic of these station areas is that there are many vacant lots along the corridors of Vermont Avenue and Ventura Boulevard. These "missing teeth" affect the continuity of pedestrian activities and reduce retail's appeal for pedestrians. The circle shows a quarter mile range from the intersection, a distance that can be walked by foot in approximately 5 minutes.

Land Use

Vermont/Florence has more residential use (including single- and multi-family) than commercial use. We consider Vermont/Florence to be a potential candidate for denser transit-orient development. Vermont/Wilshire is dominated by regional commercial use. Station areas such as Ventura/Van Nuys and Ventura/Laurel Canyon have a complicated mix of residential and commercial use, at the same time, their special street grids and topographic characteristics also require different approaches for future development.

Table 6.1 and Figure 6.5 illustrate existing built area utilization in the four station areas. The Vermont/Florence station has lower density multi-family residential and commercial use, while Vermont/Wilshire presents a more developed built environment with 76.8 units/acre density for multi-family housing and 48.9 units/acre density for mixed-use. The Ventura/Van Nuys and Ventura/Laurel Canyon have similarly moderate residential densities, but different circumstances of mixed-use development.

Table 6.1: The Site And Built-Up Area Ratios of the Rapid Bus Stop Intersections
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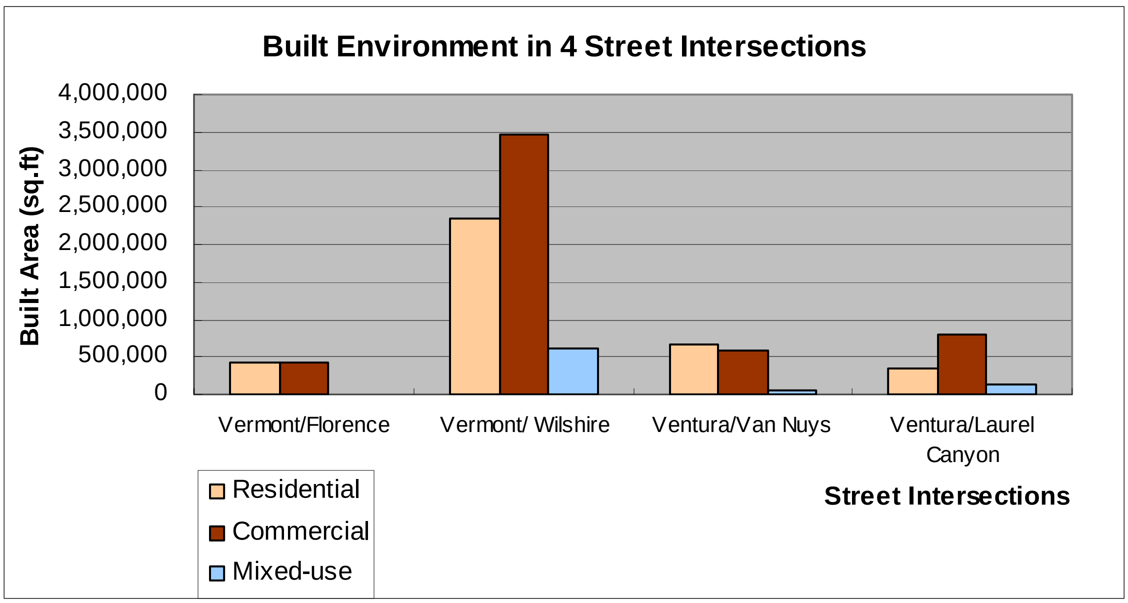
Street Intersection Areas	Residential			Commercial	Mixed-use	
	Multi-family		Single-family			
	FAR	Density (units/acre)	Density (units/acre)	FAR	FAR	Density (units/acre)
Vermont/Florence	0.25	11.2	7.6	0.27	-	-
Vermont/ Wilshire	1.36	76.8	-	1.47	1.11	48.9
Ventura/Van Nuys	0.59	26.0	6.0	0.45	0.53	28.4
Ventura/Laurel Canyon	0.50	26.3	6.0	0.56	0.52	9.0

Source: ZIMAS, http://zimas.lacity.org/

Figure 6.5: Built Area Under Different Land Uses Within The Rapid Bus Stop Intersections



Source: ZIMAS, http://zimas.lacity.org/

6.3 Urban Design Proposal

Based on the analysis of the station areas along the existing corridors, it is evident that transit-oriented development will considerably improve mobility options. New in-fill, mixed-use, higher density development offer possibilities of increasing bus transit ridership.

In this section, we present several scenarios that propose compact and mixed-use development within the four station areas. Bringing denser communities closer to the station nodes, the new development aims to encourage people to ride mass transit more and drive their cars less.[4] At the same time, the proposals intend to bring back the more traditional urban values of walkable neighborhoods by offering pedestrian-friendly environments.

Guidelines

Mixed use development

- Mix retail, commercial and residential uses, which should mutually support each other
- Medium to high density developments
- Mix uses in districts or within the same buildings
- Provide safe and convenient connections between different uses

Transit-friendly environment

- Provide continuous, convenient linkages between residential and business development, public facilities, open spaces and transit stops
- Ensure wide, safe sidewalks, and crosswalks
- Accommodate both pedestrian and bicyclists
- Provide transit service amenities, such as shelter, waiting area, seating and lighting
- Improve the appearance of transit stops
- Avoid blank facades of buildings along streets
- Provide street trees, landscaping and public open spaces

Transit-oriented parking

- Provide park and ride facilities adjacent to transit stops
- Encourage ridesharing and offer incentives for ridesharing
- Encourage shared parking facilities
- Consider parking reduction for mixed-use development
- Provide clearly defined pedestrian path in parking lots
- Add perimeter landscaping and screening for existing parking lots

The current zoning allows for higher density developments with modifications in terms of allowing residential use in commercial zones. The recent introduction of the Residential Accessory Zoning (RAS) ordinance provides for increases in FAR and height based on existing commercial zoning category. We apply them on transit corridors to facilitate channeling future growth in this direction.

Proposed Development

Based on existing residential and commercial development and allowable FAR by the City, we forecast future development for the four station areas in two different scenarios with FAR values of 2.0 and 3.0 (maximum allowable with current zoning).

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[4] Bernick, *Transit Villages in the 21st Century,* 1997. , [5] Morris, Marya(edit), Creating Transit-supportive Land-use Regulations, Chicago, IL: American Planning Association, Planning Advisory Service, 1996.

The scenarios including residential development in commercial zones (Table 6.2), uses FAR value of 2.0 to 3.0 in scenario 1 and 2 respectively. The total developable area corresponds to the maximum total development area with current FAR limits. With different mix of 1-bedroom, 2-bedroom and 3-bedroom housing, we can estimate a range of future developable housing units and density. We foresee locating parking in the basement with parking reductions of up to 1 to 1.5 cars per unit with TOD designation.

Figure 6.6 illustrates the average increase of density in the four street intersections. Vermont/Florence shows the most potential for higher density housing development.

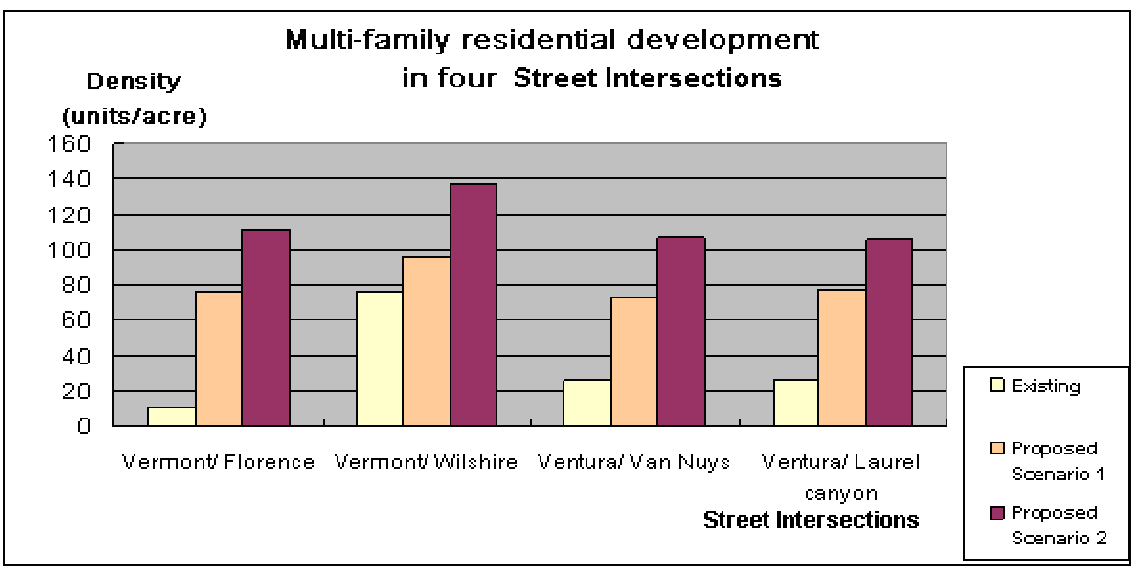
Table 6.2: Residential Density Calculations Under Different Scenarios

Station Areas	Residential Development					
	Scenario 1			Scenario 2		
	Developable Area (sq.ft)	Density (units/acre)	FAR	Developable Area (sq.ft)	Density (units/acre)	FAR
Vermont/Florence	3,063,359	58~93	2.00	4,813,5828	85-139	3.00
Vermont/ Wilshire	1,098,547	84~107	2.00	2,814,640	121~153	3.00
Ventura/Van Nuys	1,623,989	59~87	2.00	2,775,516	82~131	3.00
Ventura/Laurel Canyon	1,076,542	61~92	2.00	1,792,425	85~126	3.00

Note: 1. Developable area excludes the existing built area in the parcels considered for development ,
2. Density was calculated based on Developable Area for living= Total area -Circulation area= Total area* (1-20%)
3. Living area considered for housing units 1 BR.=750 sq.ft., 2 BR.=1100 sq.ft., 3 BR.=1300 sq.ft.

Source: ZIMAS, http://zimas.lacity.org/

Figure 6.6: Hypothetical Density For The Rapid Bus Stop Intersections Based On City Of Los Angeles Zoning



We present three alternatives for future scenarios under commercial and mixed-use for the four station areas. The three scenarios use FAR 1.5, 3.0 and 3.0 based on maximum allowable in commercial and multifamily residential zones respectively, and they would provide exclusive commercial, mixed use with 1/3 commercial and 2/3 residential, and mixed use with 1/4 commercial and 3/4 residential respectively. Using the same approach as in Table 6.4, we can estimate the future developable commercial areas, housing units and corresponding density. Under the same conditions, the data show that Vermont/Florence and Venture/Van Nuys would become more developable for exclusive commercial use.

Table 6.3: Hypothetical Density For The Rapid Bus Stop Intersections Based On City Of Los Angeles Zoning

Station Areas	**Commercial and Mixed-use Development**							
	Scenario 1 current Zoning (exclusive commercial.)		Scenario 2 RAS 3* (1/3 commercial., 2/3 residential)			Scenario 3 RAS 3* (1/4 commercial.,3/4 residential)		
	Developable Area (sq.ft.)	FAR	Developable Area (sq.ft.)	Density (Housing units/acre)	FAR	Developable Area (sq.ft.)	Density (Housing units/acre)	FAR
Vermont/Florence	1,422,754	1.50	3,158,383	49~84	3.00	3,158,383	55~95	3.00
Vermont/ Wilshire	901,505	1.50	3,624,276	27~47	3.00	3,624,276	31~53	3.00
Ventura/Van Nuys	1,405,041	1.50	3,406,974	40~74	3.00	3,406,974	45~84	3.00
Ventura/Laurel Canyon	1,036,665	1.50	3,809,771	38~72	3.00	3,809,771	43~81	3.00

Note: *RAS3 applies to R3 zones which include multifamily residential with limited commercial uses.

1. Developable area excludes the existing built area in the parcels considered for development ,
2. Density was calculated based on Developable Area for living= Total area -Circulation area= Total area* (1-20%)
3. Living area considered for housing units 1 BR.=750 sq.ft., 2 BR.=1100 sq.ft., 3 BR.=1300 sq.ft.

Source: ZIMAS, http://zimas.lacity.org/

Development Alternatives For Two Intersections On Vermont And Ventura Corridor

We simulate design alternatives for two Rapid Bus Stop Intersections from the selected intersections. Data for Vermont/Florence and Ventura/Van Nuys shows large areas for potential development (Table 6.3) and present strong potential for higher-density development and future growth. Therefore, we have selected the intersections of Vermont/Florence and Ventura/Van Nuys as examples for design proposals.

The intent of these proposals is to show future scenarios of how urban redevelopment can occur in these intersection areas if land were used more efficiently to accommodate greater number of activities while making the new development fit with its context and to improve the quality of the built environment.

Design Proposal for Vermont/Florence Station Area

Existing Built Environment

The Vermont/Florence station area is a typical lower-density neighborhood that has primarily residential use coupled with commercial and retail use along the corridor (Figure 6.7, 6.8). The residential areas are one-story single-family housing (with 7.6 units per acre in density) located west of Vermont Ave., and one- or two-story multi-family housing (with 11.2 units per acre in density) located east of Vermont Ave (Figure 6.9, 6.10). The major existing commercial/retail use includes fast-food restaurant, grocery store, motel, gas station, car wash station, etc.

Figure 6.7: Existing Plan – Vermont/Florence

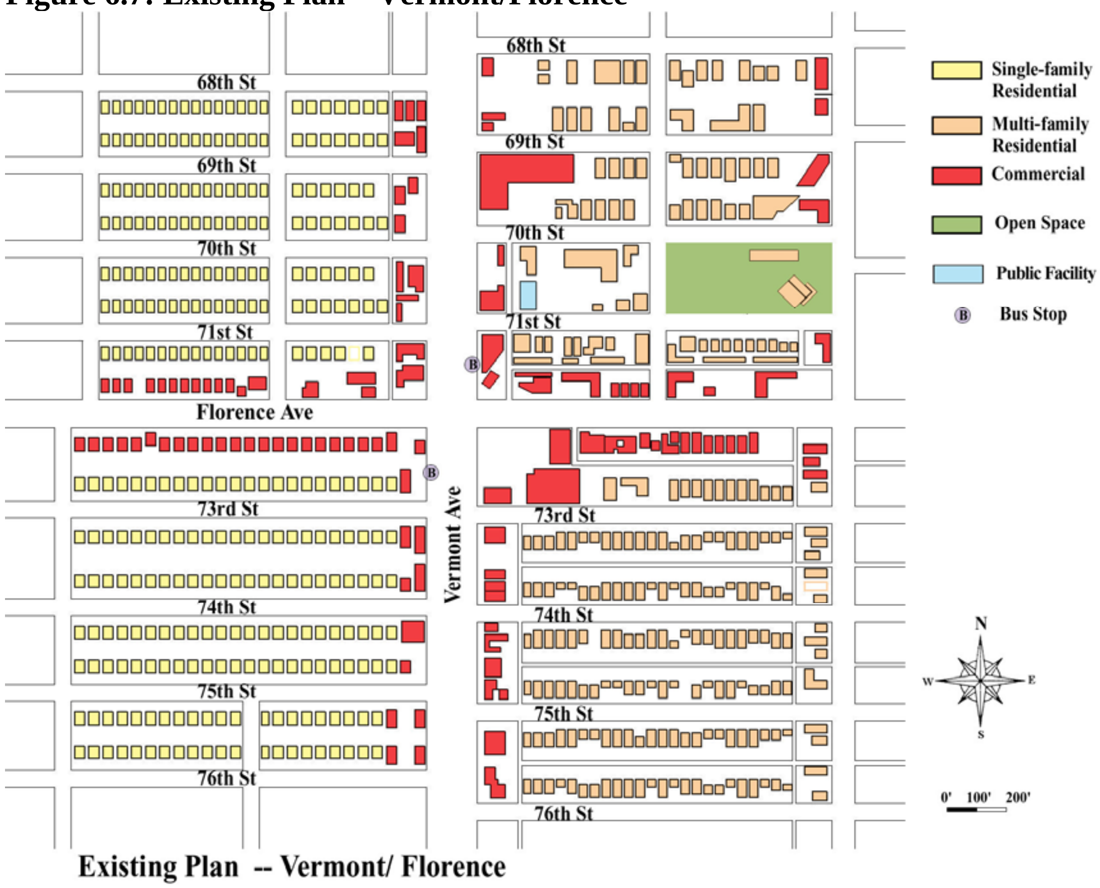
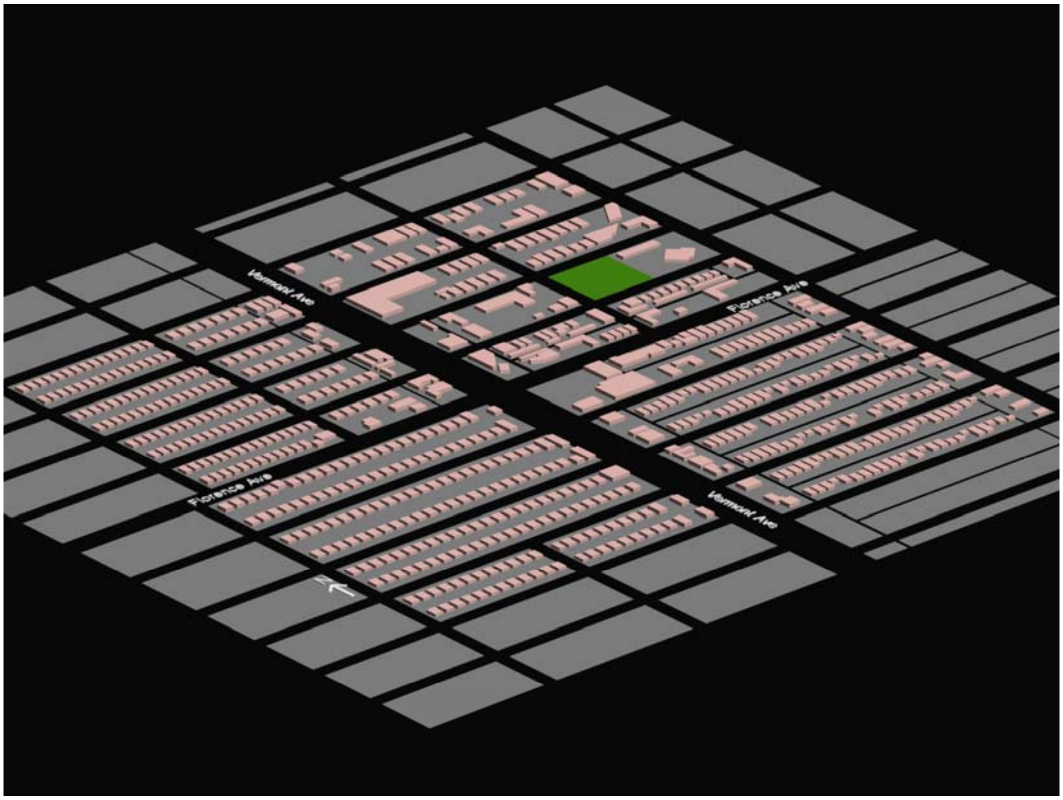


Figure 6.9: Multi-family housing on north 74th St., facing east.

Figure 6.10: Single-family housing on north 69th St., facing west

Figure 6.8: Existing Building Model – Vermont/Florence



Figures 6.11 to 6.16 of Vermont Corridor show potential areas for site development and improvement. There are vacant sites and neglected stores in the station area (Figure 6.11, 6.12). On the other hand, some substantial properties (Figure 6.13, 6.14) could help frame the street, such as the Theater & Church, the Pacific Bell building, and the grocery store on the southeast corner of Vermont/Florence. Because the nearest Blue Line rail station (Florence/Graham) is about 2.8 miles away from Vermont/Florence intersection, riding bus is the only choice for the transit-dependent population in the area (Figure 6.15).

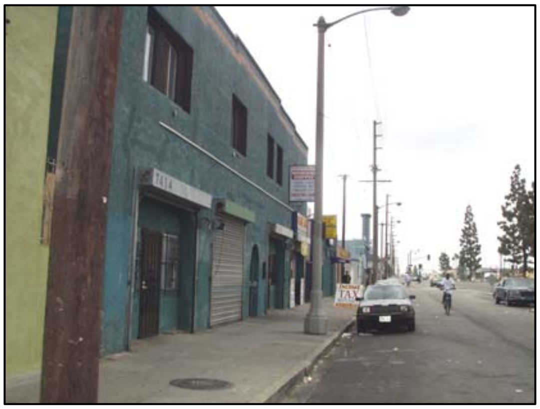


Figure 6.11: Vacant Stores at east Vermont Ave., facing south

Figure 6.12: Vacant site at the east side of Vermont Ave.

Figure 6.13: Theatre & church at the east side of Vermont Ave is landmark building in the area

Figure 6.14: Pacific Bell new building at the east side of Vermont Ave

Figure 6.15: Bus stop on the east side of Vermont, facing north

Figure 6.16: Vermont Ave at Florence facing north.

Design Proposal

The plan proposes residential development coupled with mixed-use commercial and retail use in the station area. The intent is to create higher density housing along east of Vermont Ave., while providing housing above ground-floor retail along Vermont Ave. and Florence Ave. Although the majority of the existing multi-family residential and commercial areas need to be remodeled, some substantial properties would be retained to continue serving the neighborhood (Figures 6.17, 6.18). Two types of design concepts are used, one is three to four stories of residential with underground parking, and the other is two to three stories of residential above ground-floor retail.

Figure 6.17: Proposed Plan – Vermont/Florence

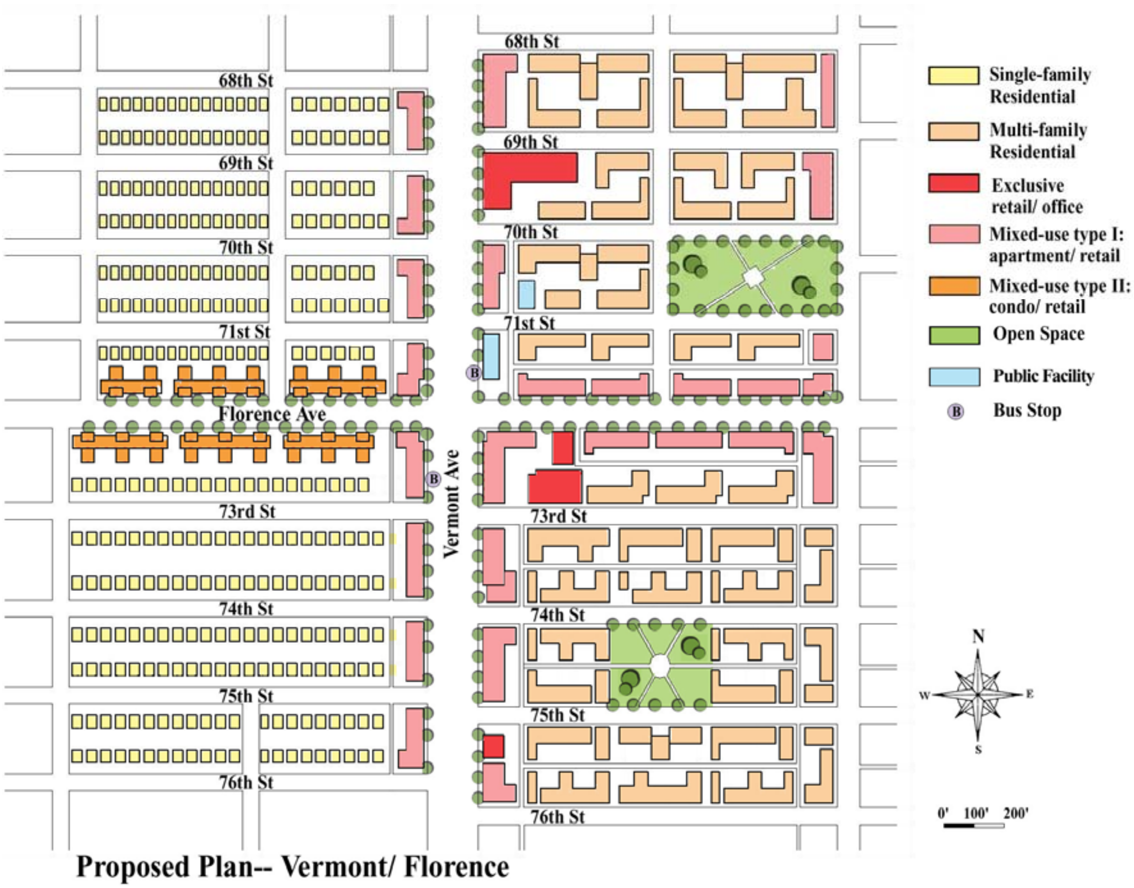
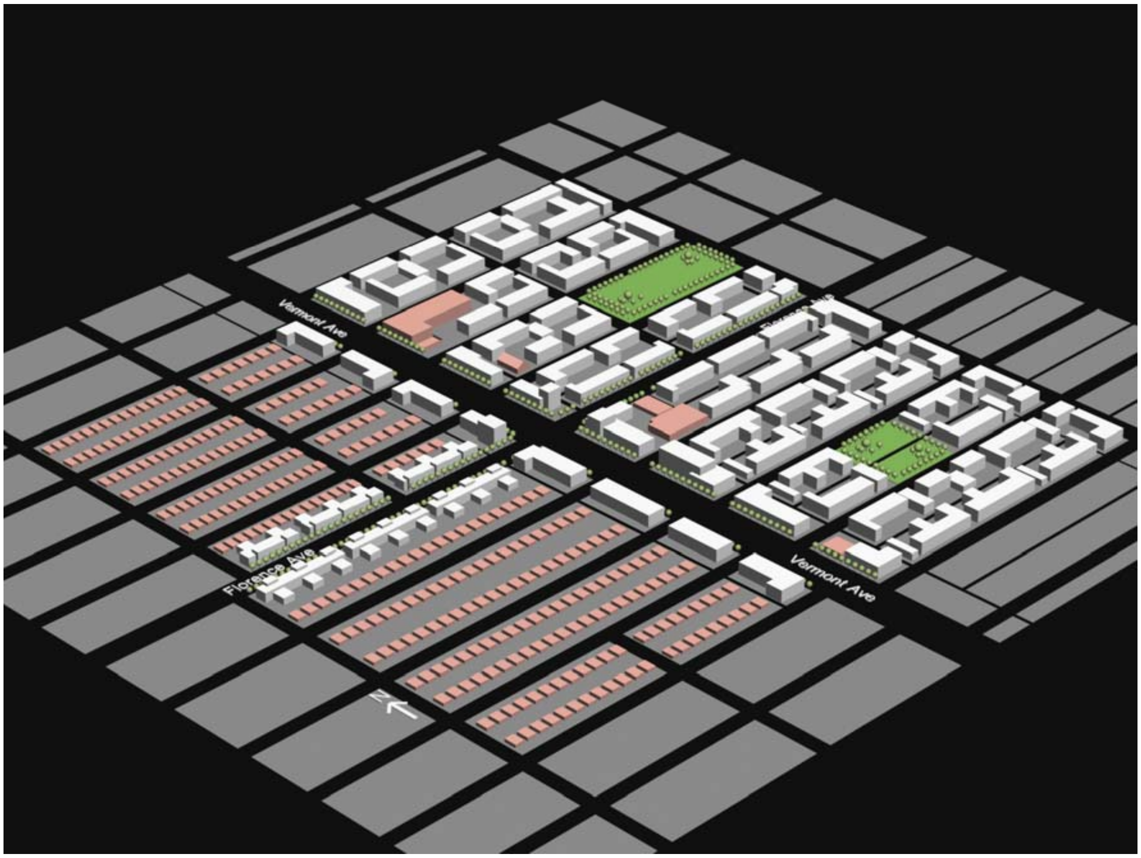


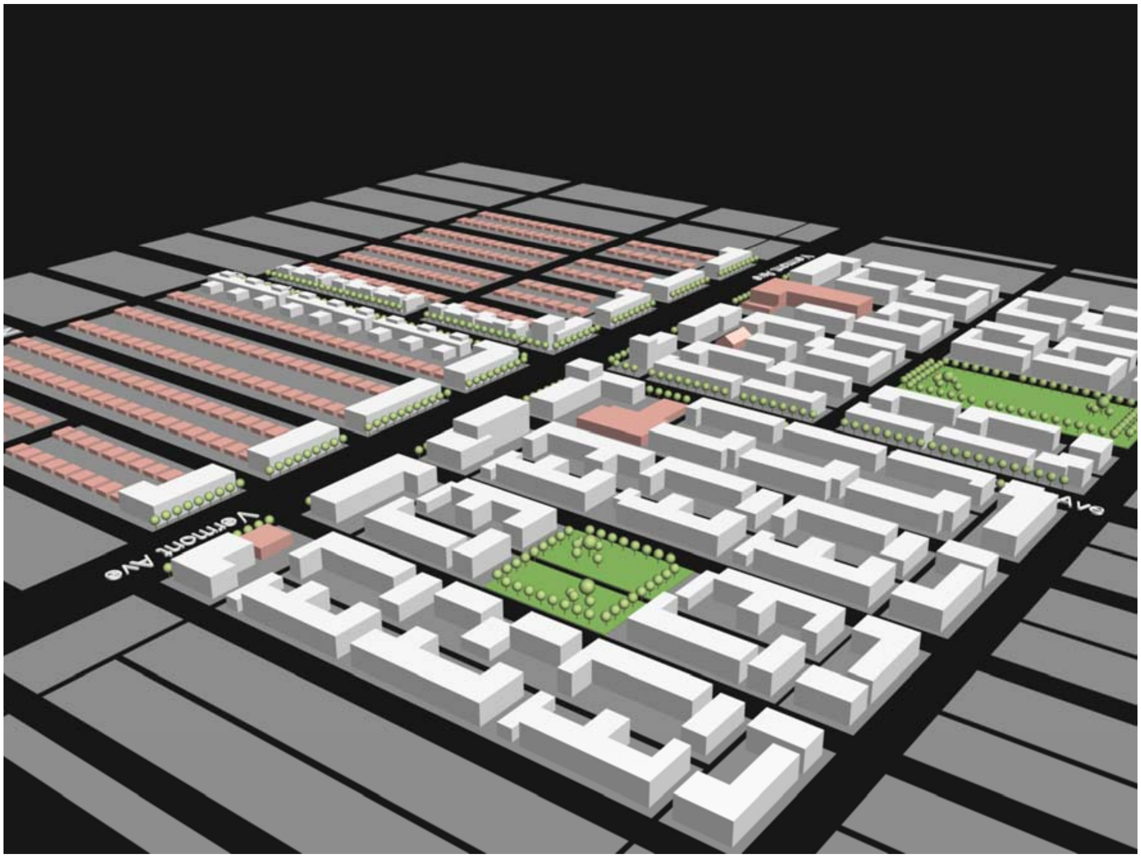
Figure 6.18: Proposed Development Model – Vermont/Florence



Retained Building   Proposed Building

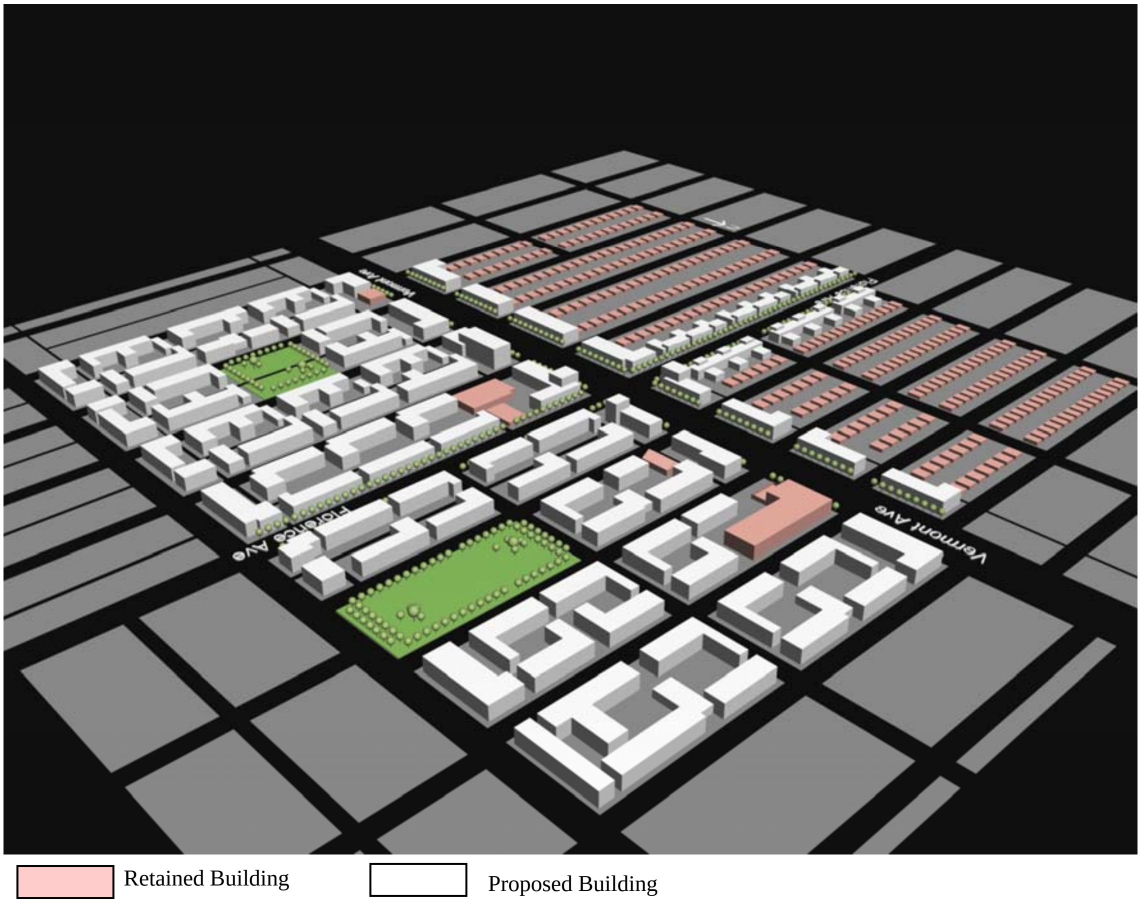
The structure of the urban space is remodeled to establish a hierarchy of spaces of different sizes that not only have individual enclosed space, but also are related to each other. Therefore, this proposal selects courtyard housing as a major housing type to create a more humane, and a more community-centered urban environment. The courtyard enveloped by three or four story apartments becomes a major organizing element which connects the private dwelling units, the public streets, and open spaces (Figure 6.19, 6.20).

Figure 6.19: Proposed Development Perspective 1 – Vermont/Florence



Retained Building   Proposed Building

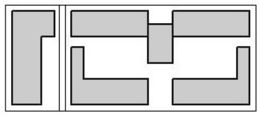
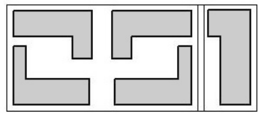
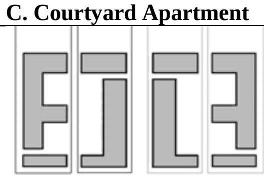
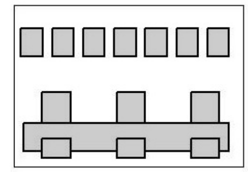
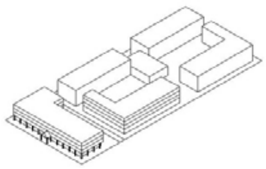
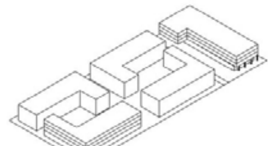
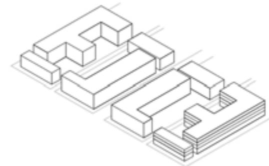
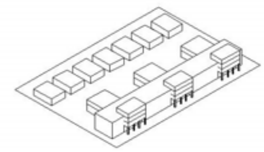
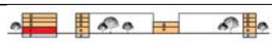
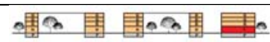
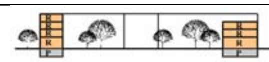
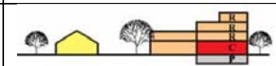
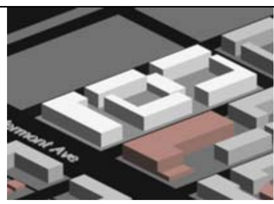
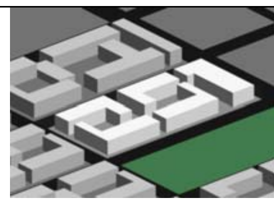
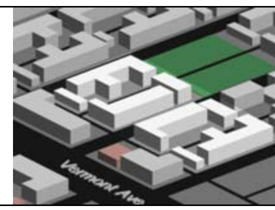
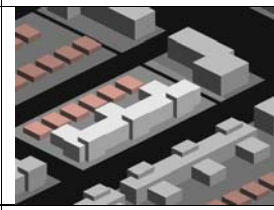
Figure 6.20: Proposed Development Perspective 2 – Vermont/Florence



The commercial and retail uses along Vermont and Florence Avenues will provide a variety of establishments to serve the surrounding community. The major uses would include restaurants, grocery, banks, cafés, laundry shops, bookstores, furniture stores, post offices, etc. Some buildings may consider combining small business offices such as personal and business services, amusement and recreation, hotel, health services, accounting, and other professions. At the northeast corner of the intersection, a cultural facility such as a library or movie theater is suggested. Given the proximity to bus stops, the library or theater and the plaza would become a major gathering place for the surrounding community.

Four types of prototypical blocks are proposed for the future development (Table 6.4). The type A, B and C are rental apartments with density in the range of 53-58 units per acre; while type D is ownership condo with density of 32 units per acre.

Table 6.4: Prototypical Blocks, Design Proposal, Vermont/Florence Intersection

	A. Mixed-use Apartment	**B. Mixed-use Apartment**	**C. Courtyard Apartment**	**D. Terraced Condo**
Plan				
Model				
Section				
Application				
Site Area	173, 388 sq.ft.	152, 256 sq.ft.	178, 898 sq.ft.	38, 425 sq.ft.
Total units	197	194	239	24
Density	50 units per acre	55 units per acre	58 units per acre	28 units per acre
FAR	1.90	2.03	1.91	1.66
Building Coverage	49%	51%	41%	48%
Residential: Commercial	93: 7	94: 6	100: 0	75: 25
Residential Parking	197	194	239	36
Commercial Parking	68	50	-	45

Notes:

1. Mixed-use Apartment: Commercial on 1st Floor, residential above
2. Based on census data, average household size= 3.69 in the station area. So suggested average apartment area per unit: 1145sq.ft, average condo area per unit: 1500 sq.ft.
3. Parking:
   - Apartment: 1 space per unit
   - Condo: 1.5 space per unit
   - Commercial: 3 space per 1000 sq.ft.
4. Parking modes:
   - Commercial: above-ground parking including on-street and off-street parking
   - Residential: above and underground parking

Using these prototypical blocks, the proposed station area would become a higher-density, mixed-use neighborhood with average density of 46 units per acre (Table 6.5). The streetscape would experience change once the higher density apartments are built (Figure 29). At the same time, the bus stop facilities would require improvements such as shelters, larger waiting areas, and more seating.

Table 6.5: Vermont Florence Intersection Development

Development Using Prototypical Blocks in Vermont / Florence Station Area							
Blocks	**lot Area (sq.ft)**	**Multi-family Residential**			**Commercial**		
		New development	**Livable area**	**Units**	**Retained Area (sq.ft)**	**New development**	**Total development**
1	168,237	261,024	208,819	182	0	11,456	11,456
2	155,478	271,767	217,414	190	0	19,912	19,912
3		-	-		0	-	-
4	126,668	225,137	180,110	157	0	12,883	12,883
5	173,742	249,714	199,771	174	0	22,766	22,766
6	160,284	152,884	122,307	107	110,000	0	110,000
7	151,938	191,824	153,459	134	0	14,188	14,188
8	132,158	225,337	180,270	157	0	13,886	13,886
9	28,839	39,492	31,594	28	0	13,164	13,164
10	29,131	40,158	32,126	28	0	13,386	13,386
11	29,199	40,158	32,126	28	0	13,386	13,386
12	60,677	114,475	91,580	80	0	26,537	26,537
13		-	-	-	-	-	-
14		-	-	-	-	-	-
15		-	-	-	-	-	-
16	58,449	104,286	83,429	73	0	22,549	22,549
17	338,624	404,622	323,698	283	52,960	42,674	95,634
18	346,690	619,343	495,474	433	0	39,781	39,781
19	349,464	419,115	335,292	293	11,522	38,120	49,642
20	349,611	575,332	460,266	402	0	36,425	36,425
21	165,609	254,064	203,251	178	0	19,509	19,509
22	27,508	57,228	45,782	40	0	19,076	19,076
23	25,574	46,152	36,922	32	0	15,384	15,384
24	29,429	54,888	43,910	38	0	18,296	18,296
25		-	-	-	-	-	
Total (sq.ft)	**2,907,309**	**4,347,000**	**3,477,600**	**3,037**	**174,482**	**413,378**	**587,860**
FAR & Density (units/acre)		**FAR= 1.70 Density= 46 units/acre**					

Source: ZIMAS, http://zimas.lacity.org/

Figure 6.21: Vermont Florence Intersection Streetscape - Existing And Proposed

Existing

Proposed The image shows visualization of a proposed transformation of the streetscape along Vermont Corridor (Source: the Bryson at City place, Dallas, TX)

Design Proposal For Ventura/Van Nuys Station Area

Existing Built Environment

The Ventura/Van Nuys station area shows a more complicated mix of commercial strip shops and malls, and single-and multi-family housing (Figure 6.22, 6.23). Along Ventura Blvd. and Van Nuys Blvd., there are considerable parking lots which violate the continuity of the pedestrian paths and spaces. The two gas stations are significant properties just at the southeast and northwest corner of the Ventura/Van Nuys intersection (Figure 6.24, 6.25). They have become focal points of vehicular activity and have negative impacts on the pedestrian-friendly environment.

Although the network of pedestrian paths is not so continuous in the station area, the retail shops are attractive because of the rich façade decorations. The bus stops also welcome riders with well-designed shelters and significant symbols (Figure 6.26, 6.27).

Figure 6.22: Existing Plan—Ventura/Van Nuys

Existing Plan-- Ventura / Van Nuys

Figure 6.23: Existing Building Model - Ventura/Van Nuys

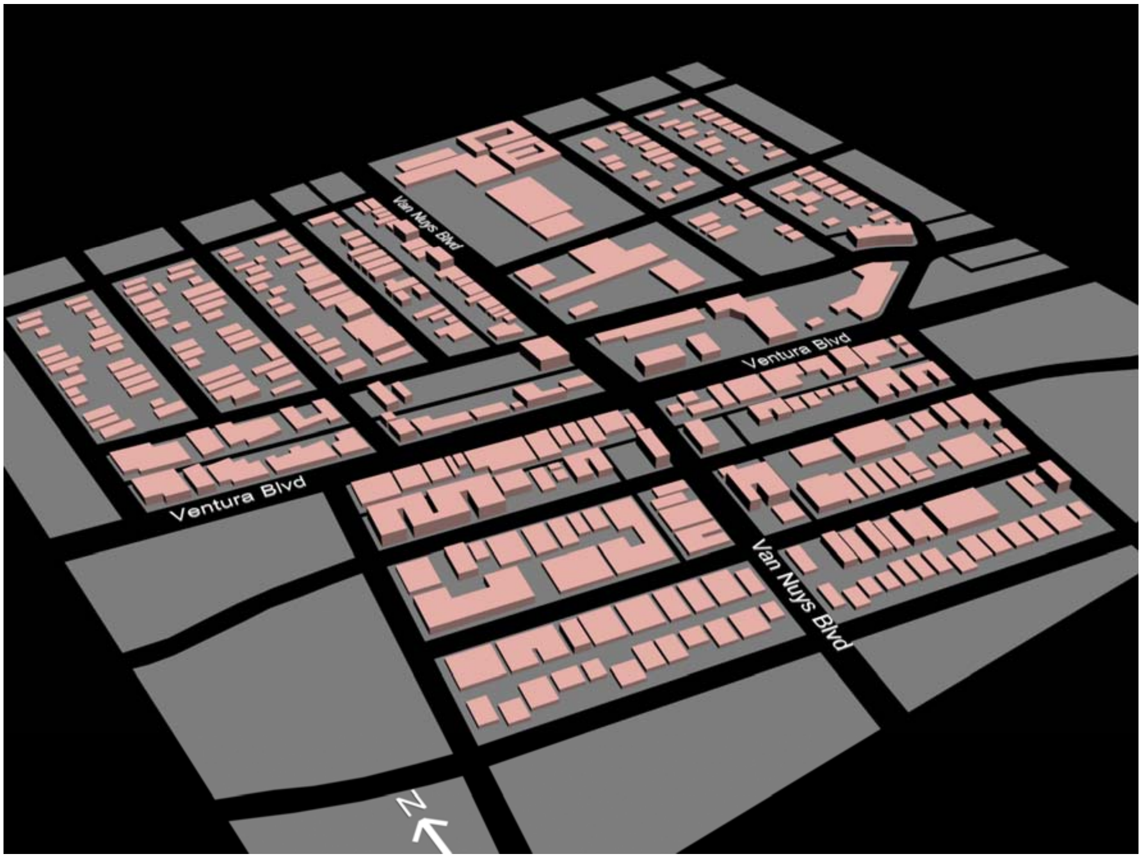


Figure 6.24: Gas Station at northwest corner, Ventura/ Van Nuys

Figure 6.25: Parking lot on Vesper Ave

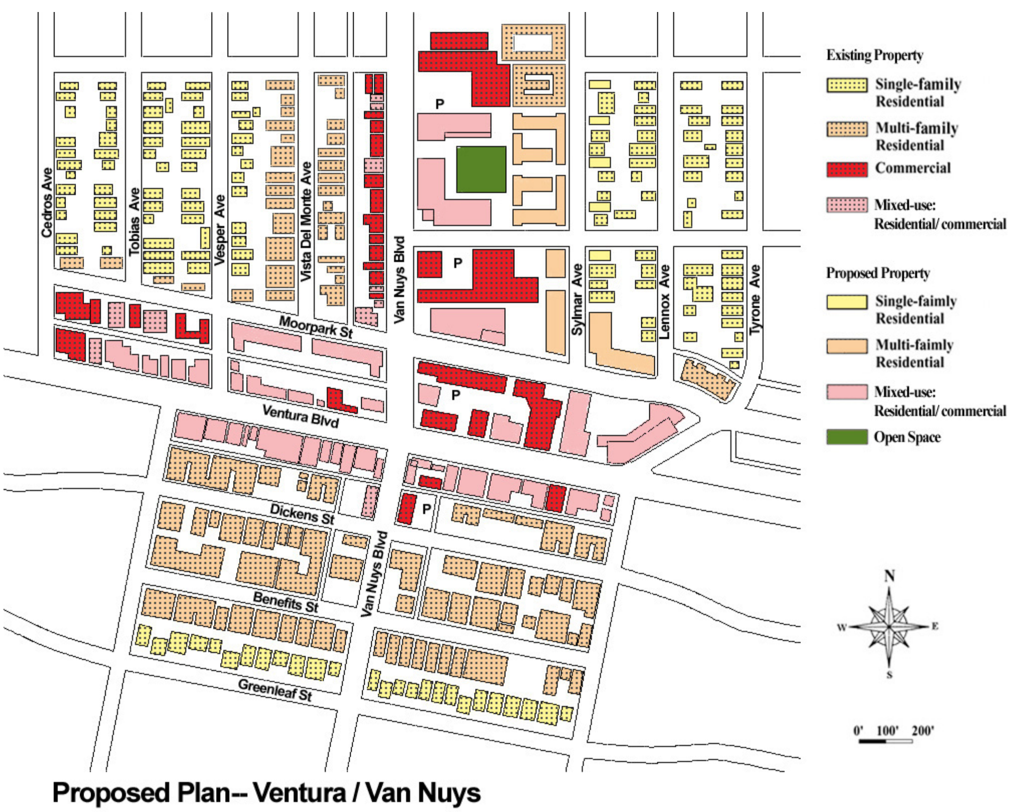
Figure 6.26: Retail shops on Ventura Blvd south.

Figure 6.27: Bus stop at southeast corner Ventura/ Van Nuys

Design Proposal

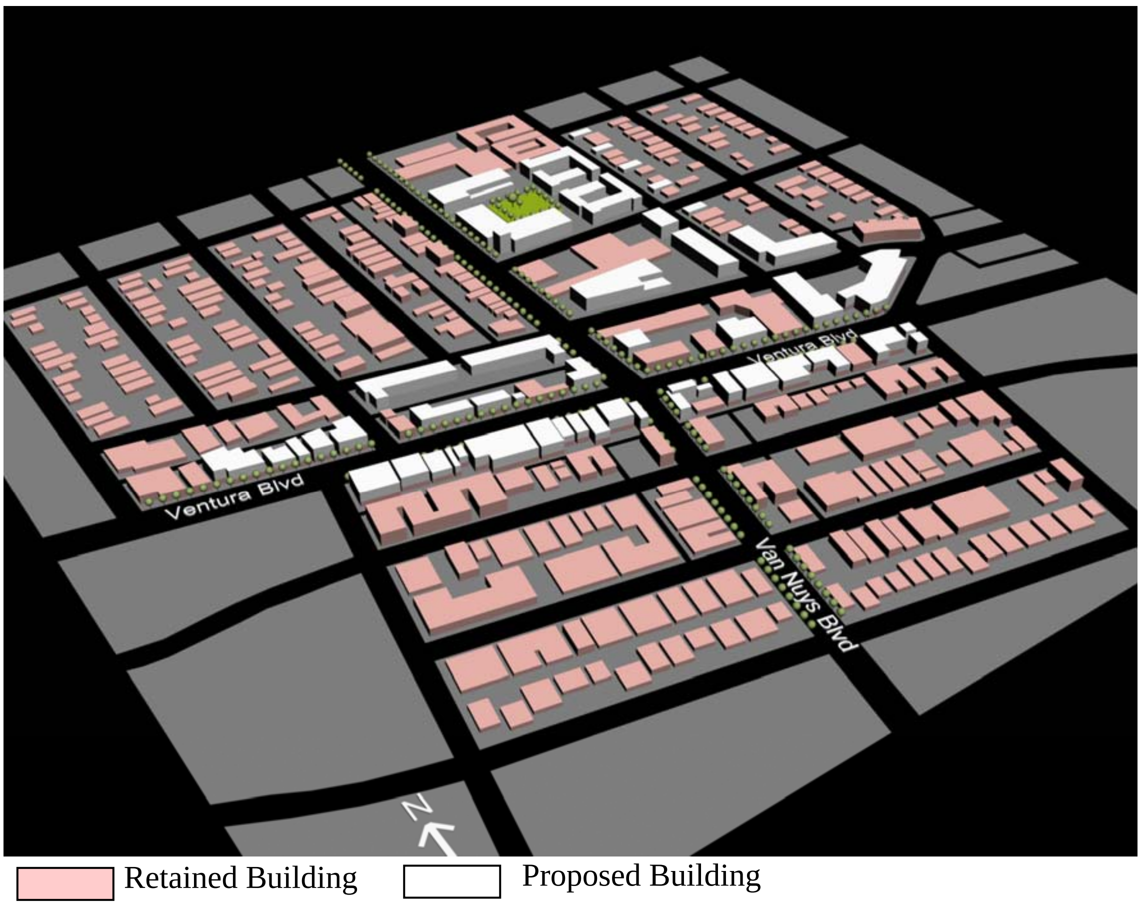
This plan proposes infill development along the commercial and retail strips on Ventura Blvd., while adding more dwelling units above the commercial buildings. In the northeast portion of the station area, medium-density multi-family housing fills the existing parking lots. The housing provides a gradual transition between single-family residential and the more intense commercial/residential mixed development. The intent of this plan is to cluster mixed-use buildings and activities for increased continuity and convenience for a more transit-friendly environment.

Figure 6.28: Proposed Plan—Ventura/Van Nuys



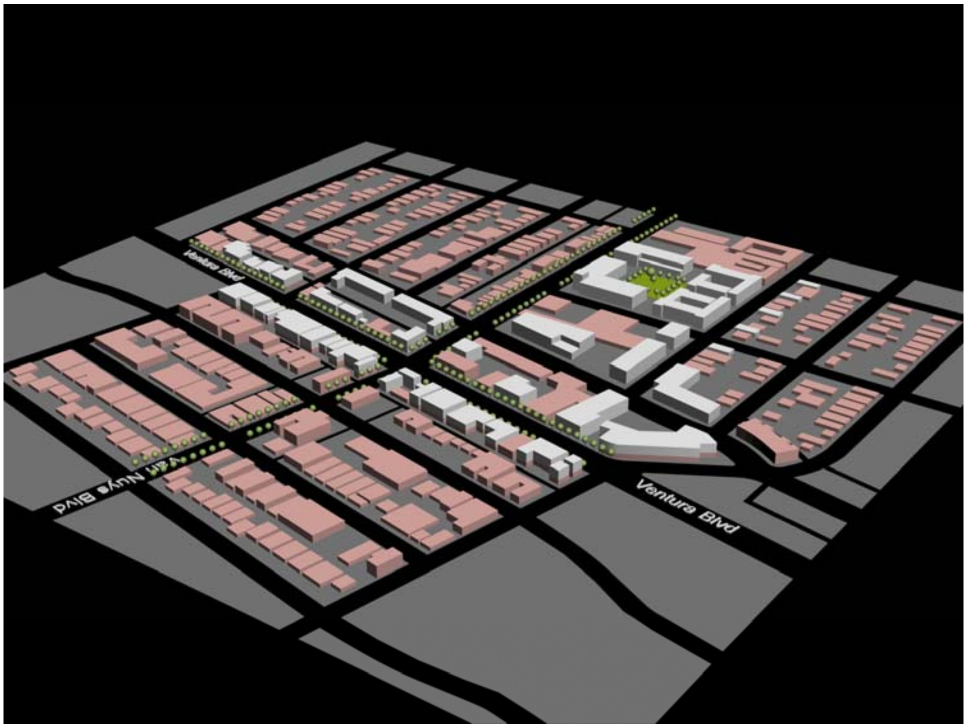
Two or three stories of residential use is added to the existing commercial and retail buildings, which help form continuous street facade on both sides of Ventura Blvd. The sites of the gas stations and the parking lots are filled by higher-density courtyard housing and mixed-use developments. All these proposed transformation are intended to attract more people to shop, live and work near the station area while improving their mobility options.

Figure 6.29: Proposed Development Model - Ventura/Van Nuys



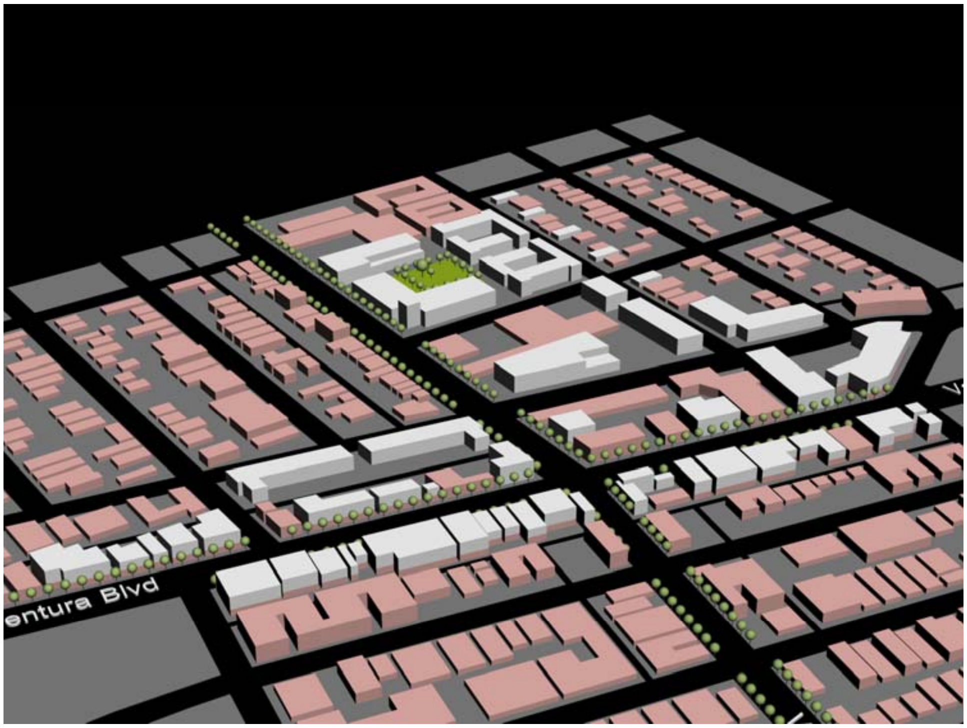
The prototypical blocks (Table 6.6) show significant increases in density for the intersection retaining the existing built fabric. Adaptive reuse and infill developments both provide increased residential apartments and also make it possible to have small offices, other commercial establishments that generate foot traffic and transit traffic. The buildings are brought to street edge to enhance pedestrian character and quality of built environment in the vicinity of the bus stop area. Smaller mixed use buildings are proposed along the strip commercial on Ventura corridor, retaining the existing scale of street edge. Larger apartment complexes are located at the corners emphasizing the street edge and the interior of the intersection. Landscaped courtyards increase the acceptability of dense buildings, providing community common recreation areas attractive to families with young children.

Figure 6.30: Proposed Development Perspective 2 - Ventura/Van Nuys



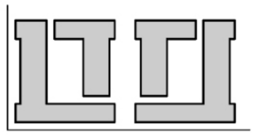
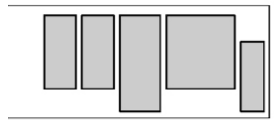
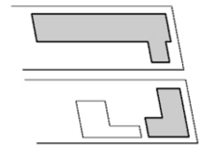
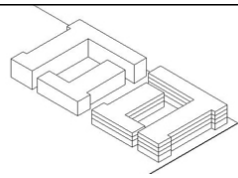
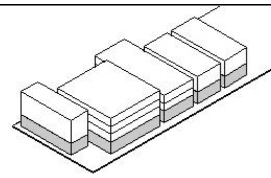
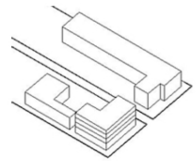
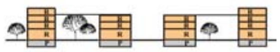
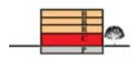
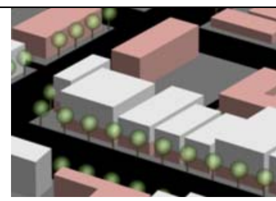
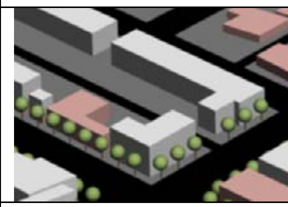
Retained Building   Proposed Building

Figure 6.31: Proposed Development Perspective 3 - Ventura/Van Nuys



Retained Building   Proposed Building

Table 6.6: Prototypical Blocks, Design Proposal, Ventura/Van Nuys Intersection

	A. Infill Apartment	B. Added Apartment	C. Mixed-use Apartment
Plan			
Model			
Section			
Application			
Site Area	101,410 sq.ft.	29,636 sq.ft.	55,519 sq.ft.
Total units	119	32	43
Density	51 units per acre	47 units per acre	24 units per acre
FAR	1.90	2.33	1.66
Building Coverage	47%	58%	42%
Residential: Commercial	100:0	75: 25	75:25
Residential Parking	119	32	39
Commercial Parking	0	52	69

Notes:
1. Mixed-use Apartment: Commercial on 1st Floor, residential above
2. Suggested average apartment area per unit: 1300 sq.ft.
3. Parking:
- Apartment: 1 space per unit
- Commercial: 3 space per 1,000 sq.ft.

4. Parking modes:
- Commercial: above-ground parking including on-street and off-street parking
- Residential: above-and underground parking

Figure 6.32: Illustration Of Transit Corridor Development

Source: Citizen Planner Institute

Figure 6.33: Examples Of Varying Densities on Existing Corridors

Paseo Colorado, Pasadena

Birch Street, Downtown Brea

6.4 Conclusion

In this study, we have explored the development opportunity for increased bus ridership along Vermont and Ventura corridors. The proposed infill, higher-density, and mixed-use redevelopment illustrates potential scenarios of how the two corridors could be used more effectively and efficiently to accommodate everyday activities, and especially public transit. We believe the design solutions would help people imagine the possible future development potential in the corridors, and assist in improving the quality of the urban built environment.

Chapter 7: Implementation

Although the concept of TCD is intuitive enough, implementing such pattern of development is quite challenging especially from a physical, socio-economic, and cultural perspective.

Assembling land in existing corridors is a major challenge. Fragmented and multiple ownership patterns compound the problem of expedited land assembly. In addition, relocation of existing businesses or stoppage of business due to construction is expensive and contentious. Narrow parcel width and shallow depth of parcels in some of the City corridors might also act as barriers to new mixed use developments. The design solutions required to accommodate higher density and parking in a constrained space may significantly increase the development cost making it prohibitive to build in the corridor.

Most of the growth is occurring outside Los Angeles County in the Inland Empire. Affordability and choice in the suburban housing market is driving this trend. Clearly, our preference for low-density single-family detached housing and automobile-dependent land use patterns do little to promote higher density inner city living on the corridors.

Other factor that may impede transit corridor development is the NIMBY (Not In My Backyard) residents in these corridors. NIMBY's equate higher density with increased traffic and are resistant to any new development in their neighborhoods. There is a general belief that higher densities will affect the quality of life and any addition of rental or affordable housing will further erode property values. Such sentiment is especially strong in single-family neighborhoods and can have a detrimental effect on any proposed higher density TCD. Overcoming this NIMBY sentiment is a major challenge that requires public outreach and education on the merits of compact and smart growth transit oriented developments.

Despite the impediments, perceived and otherwise, there are signs that the City is more receptive to transit corridor developments. Recently, the City of Los Angeles policy environment has undergone favorable changes with the introduction of four new zoning ordinances: Residential Accessory Services (RAS), Adaptive Reuse, Infill Development, and Density Bonus for Affordable Housing. These changes promote development in the corridors and offer communities an alternative to the impacts of low-density suburban sprawl and automobile-dependent land use patterns.

Corridors such as Sunset, Santa Monica, and Wilshire are prime examples which are well served by transit and where new higher density developments have taken root. Similarly, other corridors in the City will undergo an evolutionary process of reinvention as older underutilized strip malls or parking lots are stripped away for highest and best use. Market forces stimulated by public policy will be the catalyst for such change.

As mentioned before, the County and City are for the most part built out and there is very little vacant land for new development. Based on our analysis, the opportunity for new development lies in the major commercial corridors that are home to greyfields, brownfields, vacant lots, and/or underutilized commercial space. Another favorable factor supporting the concept of TCD is the tremendous demand for housing, both market-rate and affordable in the City and County. Mixing residential and commercial uses on the corridor creates an opportunity to alleviate housing demand, achieve a jobs-housing balance, increase transit ridership, and establish a population base on the corridor that supports existing retail and services. Such a strategy creates a "win-win" outcome for public and private sector alike.

Implementing this strategy requires demonstrable successes that can be replicated by developers in different parts of the City. Density bonuses, relaxation of parking requirements, expedited permitting and processing, use of location efficient mortgages, better transit service, and other incentives are some of the tools that can stimulate TCD. It is our expectation that the densification of the underutilized commercial corridors will create vibrant local economies, increase opportunities for market and affordable housing, revitalize retail, and lead to a fuller use of transit lines and increased ridership, a trend that we have already observed in higher density bus station areas.

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