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# Chittenden County Decision Support System

## Task 1.2: Influences on Land Use and Development

FINAL REPORT

SUBMITTED BY ICF CONSULTING

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## EXECUTIVE SUMMARY

Policy-makers and the general public have expressed growing concern for the uncertainties surrounding the potential positive and negative influences that major transportation projects in Chittenden County may have on development, land use, and physical form patterns. To address this concern, Chittenden County's planning agencies, in partnership with the Vermont Agency of Transportation (VTrans), are developing planning tools that will predict, characterize, and identify potential strategies for mitigating the impact of transportation projects on regional development and improve planning decision-making. One of these planning tools is the Decision Support System (DSS), a set of linked land use and transportation models. This review of influences on transportation behavior and land use is the first document developed as part of DSS development. The review had two goals.

*Goal 1:* Provide background on the influences on transportation behavior and land use in Chittenden County.

*Result:* Review of local data and national studies suggests that Chittenden County is experiencing many of the same trends in transportation behavior and land use as the rest of the United States, and that Chittenden County is subject to many of the same influences on transportation behavior and land use as the rest of the country. The use of national inputs to the Decision Support System (DSS), where local inputs are not available or are not easily obtained, will thus be appropriate in many cases.

*Goal 2:* Help assess whether the indicators being proposed for use in the Decision Support System captured the important influences on transportation behavior and land use.

*Result:* We believe that the draft list of indicators currently under discussion does capture the important general factors.

## INTRODUCTION

The demand for travel is different than the demand for most goods and services in that it is a “derived” demand. Kenneth Small writes:

Travel is a derived demand: it is normally undertaken not for its own consumption value, but rather to facilitate a complex and partially varied set of activities such as work, recreation, shopping, and home life. This observation links the study of travel demand to studies of labor supply, firms' choices of technologies, and urban development.<sup>1</sup>

Therefore, travel demand must be considered as part of a complex system that includes land use and development. Transportation investments make certain areas more accessible and therefore more attractive for development. However, transportation infrastructure is only one of many important influences on land use development. Other important influences include demographics, economics, water & sewer infrastructure, and land use regulation. This report discusses these influences in the context of Chittenden County, referring to national studies of these influences where appropriate.

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<sup>1</sup> Small, Kenneth A. *Urban Transportation Economics*, p. 5. Luxembourg: Harwood Academic Publishers, 1992.

## INFLUENCES ON TRANSPORTATION BEHAVIOR AND LAND USE

This report discusses major influences on transportation behavior and land use in two steps. First, it reviews general trends and influences, first on land use, and then on transportation behavior. Second, the report looks in detail at how four types of cross-cutting influences—demographics, economic trends, changes in the transportation market, and regulation—affect both transportation behavior and land use in Chittenden County, using local data where possible. The report, then, follows the following outline.

### *General trends*

1. Social factors affecting land use patterns
  - ◆ Strong market for large owner-occupied single-family housing
  - ◆ Importance of perceived school quality and property taxes in residential choice
  - ◆ Growth of suburbs vs. urban core vs. rural areas
2. General trends in, and influences on, transportation behavior
  - ◆ Increase in labor force participation, especially among women
  - ◆ Declining cost for car travel relative to income
  - ◆ Increase in auto availability
  - ◆ Land use changes
  - ◆ Induced traffic

### *Cross-cutting influences and their effects in Chittenden County*

1. Demographics:
  - ◆ Decrease in household size
  - ◆ Increase in auto availability nearly to the point of universality
2. Economic trends:
  - ◆ Long term economic growth and possible effects of a recession
  - ◆ Information economy
  - ◆ Service economy (decline in traditional manufacturing)
  - ◆ 24x7 economy with flexible and variable work schedules
  - ◆ Shift in retailing toward big box stores and malls
  - ◆ Partial resurgence of traditional downtowns
3. The transportation market and transportation conditions:
  - ◆ Transportation investments
  - ◆ Impact of transportation facilities on property values
  - ◆ Interstate exits as growth hot spots – Exits 12, 14, and 16
  - ◆ High level of service for auto travel relative to other modes

- ◆ Increased congestion
- ◆ Lack of viable alternatives to the single occupant vehicle

4. Regulation:

- ◆ Zoning, and regulations encouraging low-density single uses and large setbacks
- ◆ Parking requirements
- ◆ Barriers to “brownfield” development
- ◆ Relative ease of “greenfield” permitting outside currently congested areas

## GENERAL TRANSPORTATION AND LAND USE TRENDS AND INFLUENCES

### 1. Social factors affecting land use patterns

The ideal of a house in the country is a strong, although certainly not ubiquitous, part of American culture. This ideal is especially strong in Vermont because the ideal has historically been realized. As population has grown, the house in the country has been sought farther and farther from the regional center. Many factors influence people’s choice of place to live. A recent survey of Vermont residents identified specific influences on residential location. In order of decreasing significance, these factors included: cost of housing, natural beauty, privacy, safety, neighborhood appearance, size of lots, traffic, views, access to work, noise, and several other factors<sup>2</sup>.

Municipal governments have often facilitated settlement patterns farther from regional centers. Prior to Act 60, but in cases still today, multi-family housing and other forms of less-expensive housing have been viewed as unattractive in terms of tax base. More expensive housing is generally placed on larger and more expensive lots. Communities with more expensive housing traditionally have spent more on their schools, and this has attracted families interested in similar housing.

In Chittenden County, residential land use is often dispersed, away from the heavily traveled roadways, and much of it has taken place in rural areas on relatively large lots. Large “tract” developments are less common in Chittenden County than most other areas. Research conducted by the Vermont Forum on Sprawl found that “nearly 40% of the [Vermont] land newly developed between 1982 and 1992 was formerly cropland and pastures.” Further, “...smaller, unconnected blocks of land [less than 10 acres] have been developed more rapidly... than larger, contiguous blocks.”<sup>3</sup>

The Vermont Forum on Sprawl characterizes the suburban towns experiencing unprecedented development as New Growth Towns. Generally, relative to the entire state, these areas have absorbed the most population growth over the past 30 years. Often, these towns are located near traditional market centers. New growth towns in Chittenden County include Colchester, Essex Town, Jericho, Milton, Richmond, Shelburne, South Burlington, and Williston. The second fastest growing class of towns is outlying communities, or towns located at a considerable distance from regional centers.<sup>4</sup> This pattern mirrors larger national trends. Over the last 30 years, most households have preferred to locate in an outlying area, generally about 30 miles

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<sup>2</sup> Vermont Forum on Sprawl , *Vermonters’ Attitudes on Sprawl, Exploring Sprawl*, number 1. Complete report at [www.vtsprawl.org/Newsletter1/CompleteRpt.html](http://www.vtsprawl.org/Newsletter1/CompleteRpt.html) .

<sup>3</sup> Vermont Forum on Sprawl , *Economic, Social, & Land Use Trends Related to Sprawl in Vermont, Exploring Sprawl*, 6th issue. At [www.vtsprawl.org/Newsletter6/CompleteRpt.html](http://www.vtsprawl.org/Newsletter6/CompleteRpt.html).

<sup>4</sup> Vermont Forum on Sprawl, August 1999

from a major city, and to live in low-density, single-family housing subdivisions<sup>5</sup>. Changes in the national economy and social attitudes contribute to the dispersal of urban development. Because land is a “normal good” in economists’ terms, increases in income lead to increases in the demand for land. Historically, increases in income led to greater demand for large homes and lot sizes.<sup>6</sup> In turn, single-family detached homes on large lots became increasingly associated with monetary success and social prestige. This combination of rising incomes and changing values helped encourage land use patterns marked by low-density development and a strong reliance on the automobile.

A survey of Vermont residents conducted in 2000 indicated a possible shift in preference away from these development patterns in Chittenden County. The results indicated approximately 45% of those surveyed in the county would choose to locate in an urban area or village close to public transportation, work, and shopping over locating in an outlying area with longer commutes to work but more yard space.<sup>7</sup>

Finally, central city problems, real and perceived, also contribute to movement from city centers. From 1960 to 1990, population growth in Chittenden County shows a movement away from the urban core. The combined population of Burlington and Winooski remained nearly constant between 1960 and 2000, while population increased by 173% in the remaining towns of Chittenden County.<sup>8</sup> Empirical studies of the suburbanization process support theories that central city attributes have had some effect on the pace of suburbanization.<sup>9</sup> The appeal of newer and larger homes and lots in suburban areas, coupled with issues of race, ethnicity, education, and safety, has contributed to considerable out-migration from urban cores. Fiscal problems in central cities, including high taxes and in some cases lower-quality schools and services, also have led many people to leave for the suburbs.<sup>10</sup> A study of 121 metropolitan areas for the period 1970-75 found that cities experienced relatively rapid suburbanization if their central area had (1) a relatively old housing stock, (2) relatively high taxes, and (3) a relatively large African-American population. In addition, the larger the number of suburban governments from which to choose, the more rapid the suburbanization.<sup>11</sup>

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<sup>5</sup> See: Morrill, R. L. 1991. “Myths about metropolis” In J.F. Hart (ed.) *Our Changing Cities*. Johns Hopkins Univ. Press: Baltimore, MD; Fuguitt, G. V. and D. L. Brown. 1990. “Residential preferences and population redistribution: 1972-1988,” *Demography* 27(4): 589-600.

<sup>6</sup> On the other hand, as real income increases, so should the opportunity cost of commuting. As a result, an increase in income should also lead to greater demand for dwellings close to work, all else equal. However, increases in income occurred concurrently with reductions in travel costs associated with highway development. As a result, increased opportunity costs of commuting have been minimized.

<sup>7</sup> Justin Dextradeur, *Summary of 2000 Vermonter Poll Sprawl Section*, p. 5, University of Vermont Center for Rural Studies.

<sup>8</sup> Population counts for 1980 and 1990 are from: 1993, *Vermont Population Projections, 1990-2012*, Vermont Health Care Authority, p.68. Population counts for 1960 and 1970 are from 1960 and 1975, *Vital Statistics*, Vermont Department of Health.

<sup>9</sup> See: Michael Wasylenko, “Disamenities, Local Taxation, and the Intrametropolitan Location of Households and Firms,” *Research in Urban Economics*, Vol. 4., ed. Robert Ebel, Greenwich, CN: JAI Press, 1984; Katherine Bradbury, Anthony Downs, and Kenneth Small, *Urban Decline and the Future of American Cities*, Washington, DC: Brookings Institution, 1982; Frey, W.H., “Central City White Flight: Racial and Non-Racial Causes,” *American Sociological Review*. 44, 1979, pp. 425-88; Grubb, W.N. 1982, “The Flight to the Suburbs of Population and Employment, 1960-1970,” *Journal of Urban Economics*, 11: 348-67.

<sup>10</sup> The causality goes both ways: fiscal problems can lead to suburbanization, and suburbanization can contribute to central-city fiscal problems.

<sup>11</sup> Bradbury, Katherine, Anthony Downs, and Kenneth Small. *Urban Decline and the Future of American Cities*. Washington, DC: Brookings Institution, 1982.

## 2. General trends in, and influences on, transportation behavior

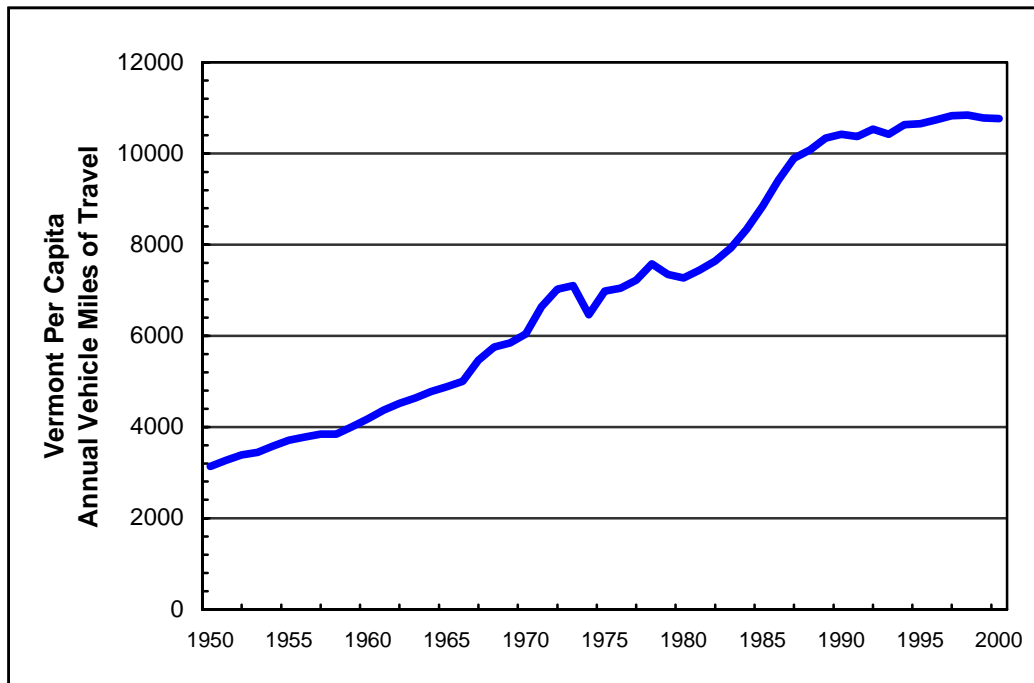
This section discusses sources of changes in travel behavior, particularly the recent substantial increase in vehicle miles traveled (VMT). This discussion draws primarily on national sources, with a discussion of specific Chittenden County trends in the following section.

VMT growth can be attributed to a variety of factors, including:

- ◆ Demographic and market changes that allow more families to own multiple cars and lead more individuals to drive on a regular basis: roughly 36% of growth, as explained below.
- ◆ Development patterns that lead to increases in the number and average distance of trips: 38%.
- ◆ Additional trips unaccounted for by the first two changes account for the remaining 25%; a significant portion of these increased trips and likely a majority of the associated mileage can be attributed to increased road capacity that encourages additional travel—“induced traffic”.

Figure 1 illustrates the growth in VMT in Vermont over the past 50 years.

Figure 1: Vermont per Capita Vehicle Miles of Travel (Vermont Agency of Transportation, US Census Bureau)



### Demographic and Market Changes

VMT growth has occurred in response to several factors, including changes in the profile of the workforce and in general demographics. As the baby boom generation came of age, large numbers of people were thrown into the driving population at one time, causing VMT numbers to escalate. Female participation in the labor force has increased dramatically in recent decades, putting more drivers on the road in general, and during peak commute times in particular. According to the Nationwide Personal Transportation Survey

(NPTS), women workers as a percentage of women aged 16 or older grew from 37 percent to 59 percent between 1969 and 1995. By 1995, women were driving approximately 60-70 percent as many miles as men do. This gap continues to close as women's participation in the workforce increases.<sup>12</sup>

A combination of rising incomes and falling fuel prices also affected VMT. As household incomes increased and both vehicle costs and fuel prices fell on a quality- and inflation-adjusted basis over the past several decades, families became better able to afford one or more cars.<sup>13</sup> In 1969, 48 percent of all households owned one vehicle. By 1995, the figure dropped to 32 percent, while the proportion of households with two and three cars increased.<sup>14</sup>

### ***Development Patterns***

Observed VMT growth can be only partially attributed to demographic factors. Changing development and commuting patterns also play a significant role. The 1990 NPTS found that between 1983 and 1990, only 36 percent of VMT growth was associated with demographic change. The remainder can be attributed to changes in land use patterns that have increased average trip distances (38 percent) and in the number of trips made (25 percent).<sup>15</sup>

Figure 2 below illustrates the effect of increasing development density on travel behavior using data from the 1995 NPTS. As density increases, the number of person trips remains about the same while the person miles traveled, vehicle trips, and vehicle miles traveled all decrease substantially. Higher density areas are more likely to include viable alternatives to driving, as is illustrated by the decrease in vehicle trips. In addition to decreasing vehicle trips, the actual vehicle miles of travel decreased approximately 45% from the lowest density of development (0-99 units/sq mi) to the highest density of development of 3000 or more units per square mile (about 5 or more units/acre). Low-density areas are less likely to include alternatives to driving, and are associated with higher VMT.

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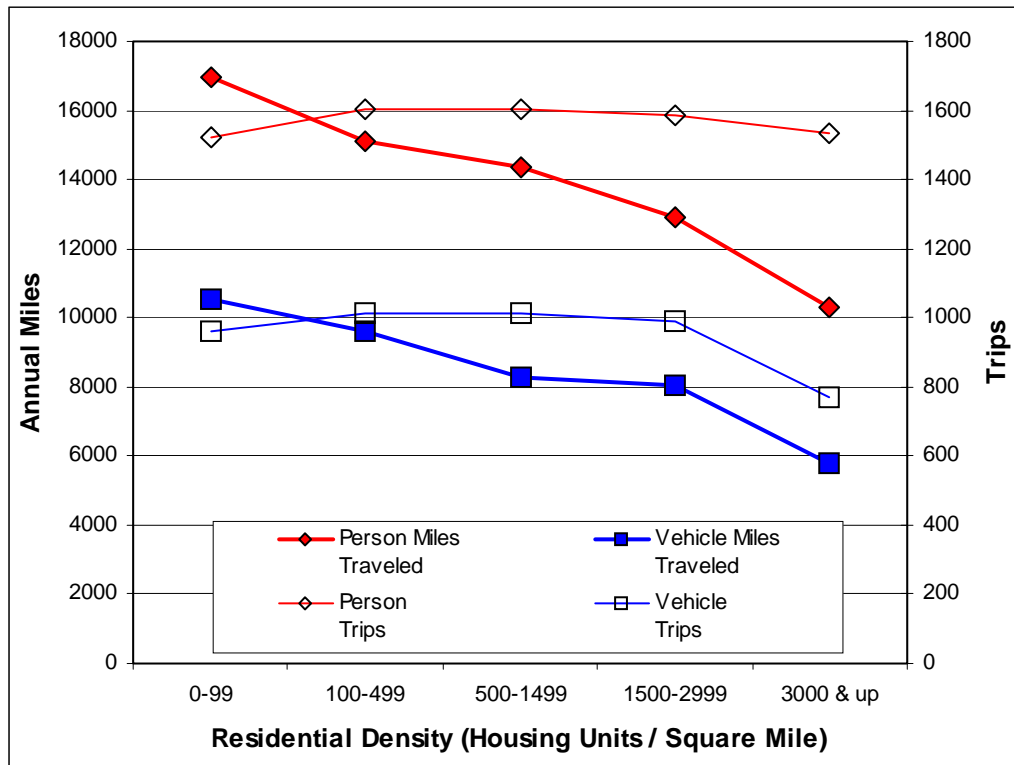
<sup>12</sup> U.S. Department of Transportation, Federal Highway Administration, "1995 Nationwide Personal Transportation Survey."

<sup>13</sup> Charles River Associates. *Trends in Single Occupant Vehicle and Vehicle Miles of Travel Growth in the United States*, prepared for the Transit Cooperative Research Program, TCRP H-13B, Transportation Research Board of the National Academy of Sciences, April 1998.

<sup>14</sup> U.S. DOT, FHWA, "1995 Nationwide Personal Transportation Survey."

<sup>15</sup> U.S. DOT, FHWA, "1990 Nationwide Personal Transportation Survey".

Figure 2: 1995 NPTS Annualized Individual Travel by Residential Density<sup>16</sup>



Numerous studies have found a direct relationship between development patterns and the amount of driving done. Nationally, from 1983 to 1995, the average length of work trips increased by 36 percent (from 8.5 to 11.6 miles), reflecting the fact that jobs and housing have become increasingly segregated from one another in recent years.<sup>17</sup>

The CCMPO study, “Regional Indicators: Measuring Our Progress Toward Chittenden County’s 20-Year Transportation Goals” (July 2000) found that only 35% of new households and 52% of new jobs located within growth centers between 1993 and 1998. At the same time, VMT increased 7%. These simultaneous trends imply a growing disconnect between development patterns and transportation efficiency.

Calculations by 1000 Friends of Wisconsin illustrate the impact of development patterns on VMT. The chart below describes the impact if 4,000 new housing units were to be developed at each of the specified densities. Fuel consumption was assumed to be 29 miles per gallon, or the equivalent of a Ford Taurus.<sup>18</sup>

<sup>16</sup> Ross, Catherine L, Anne E Dunning, *Land Use Transportation Interaction: An Examination of the 1995 NPTS Data*, Georgia Institute of Technology, prepared for FHWA, October 1997.

<sup>17</sup> US DOT, FHWA, *Our Nation’s Travel: 1995 NPTS Early Results Report*, 1997. Note that some of the increase in work trip lengths could be associated with trip chaining or other issues associated with measuring trip lengths.

<sup>18</sup> This chart was extrapolated from projections of VMT based on housing density developed in research done by John Holtzclaw. See “Using Residential Patterns and Transit to Decrease Auto Dependence and Costs” prepared for the Natural Resources Defense Council by John Holtzclaw, June 1994.

Density	Land Used	VMT per year	Fuel per year
1 lot per 5 acres	20,000 acres	120,000,000	4,137,930
1 lot per acre	4,000 acres	110,000,000	3,793,100
8 lots per acre	500 acres	60,000,000	2,068,960
50 units per acre	80 acres	32,000,000	1,103,440

### *Induced Traffic*

“Induced traffic” describes traffic growth produced by the addition of road capacity. Adding capacity (supply) reduces the cost of vehicle travel, particularly the cost of travel time. When cost goes down, demand goes up. As travel time and monetary costs fall, people travel more.

Increased road capacity can have multiple effects on behavior. People may change their travel route, timing, vehicle occupancy, or mode choice. They may change trip frequency and switch to new destinations. Of these effects, increases in trip making and mode switches most clearly contribute to induced traffic.

Different types of induced traffic are believed to occur in the short term and long term. In the short term, people may make more trips or switch from transit or carpools to driving alone because of faster traffic. In the long term, reduced travel costs encourage more dispersed land use patterns that, in turn, can increase trip lengths and vehicle dependency.<sup>19</sup>

Although most studies agree that induced demand is a likely product of capacity addition, debate continues on the mechanisms. Cervero and Hansen, most recently, observe: “The statistical relationship between road supply and traffic is not the result of a simple, one-way causal link between the former and the latter but rather a simultaneous relationship in which more traffic also causes more roads. The transportation planning and programming process is designed to anticipate and respond to changes in traffic.”<sup>20</sup>

### *Analyses of Impacts of New Lane-Miles*

Probably the best-known U.S. quantification of induced travel is by Hansen and Huang,<sup>21</sup> who used time-series data and multiple regression to estimate the traffic effects of changes in road capacity. The statistically robust results showed that induced travel can occur and can absorb all new capacity: for each 1 percent increase in highway miles, vehicle miles traveled on state highways increase, on average, by 0.6 to 0.7 percent at the county level, and by 0.9 percent at the metropolitan level. The full increase in VMT materializes within five years of the change in road supply.<sup>22</sup>

New road capacity does not simply affect travel on the new road or new lanes. A decision to use a new road probably means a decision to use a road connecting to it. Thus, a capacity increase can lead to travel growth on other roads as well as on new roads or lanes. Hansen and Huang found that: “...adding lane miles in a given county increases VMT throughout the wider region. This will occur if, for example,

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<sup>19</sup> *Expanding Metropolitan Highways: Implications for Air Quality and Energy Use*, Transportation Research Board Special Report 245, Washington, DC: National Academy Press, 1995.

<sup>20</sup> Robert Cervero and Mark Hansen, “Road Supply-Demand Relationships: Sorting Out Causal Linkages,” Institute of Transportation Studies, University of California, Berkeley, October 2000, p. ii.

<sup>21</sup> Mark Hansen and Yuanlin Huang, “Road Supply and Traffic in California Urban Areas,” *Transportation Research-A*, 31:3 (1997), pp. 205-218.

<sup>22</sup> Hansen investigates whether and how the effect grows over time, using lagged and unlagged models. He finds that the effect does grow.

increasing the capacity of a highway in a given county induces commuting to or through that county from other counties in the region.”<sup>23</sup>

Hansen’s 2000 paper with Cervero lowered his induced travel estimate, and included an analysis of the effect of travel on road building: “Using a panel data set consisting of 22 years of observations for 34 California urban counties, we estimate an elasticity of VMT with respect to lane-miles of 0.56 and an elasticity of lane-miles with respect to VMT of 0.33.”<sup>24</sup> Vehicle miles traveled represents general travel demand, and lane miles of road represents road capacity. Using the results of Hansen’s analysis, a 10% increase in lane-miles would be followed by a 5.6% increase in VMT, while a 10% increase in VMT would be followed by a 3.3% increase in lane-miles of road, thus illustrating the simultaneous relationship between travel and road capacity.

### *Synthesis of Evidence on Induced Traffic*

Goodwin’s “Empirical Evidence on Induced Traffic: A Review and Synthesis” surveys additional evidence for induced traffic. Where others used a traditional multiple regression approach, Goodwin assembled evidence for induced travel from studies in several fields.<sup>25</sup>

Goodwin drew evidence from studies on several subjects: the cost of car use, travel time budgets, the value of time, and other multiple regression studies. Together, those studies supported “an elasticity of traffic volume with respect to travel speed of about –0.5 in the short term and up to –1.0 in the long term.” That is, in the short term, a 1 percent decrease in travel time will result in a 0.5 percent increase in vehicle travel. Over the long term, a 1 percent improvement in travel time will cause a 1 percent increase in VMT.

Goodwin’s review led in part to a significant change in British national policy on the evaluation of road projects. The British government announced in December 1994: “there is likely to be a significant proportion of schemes where there is a real possibility of extra traffic,” and ordered re-review of construction proposals to take into account the induced travel.<sup>26</sup>

### *Other Studies of Induced Travel*

Hansen and the U.S. Transportation Research Board (TRB), a unit of the National Academy of Sciences, have, like Goodwin, reviewed various empirical studies of induced travel. The reviews fundamentally agree in finding consistent evidence for induced travel in response to road improvements. The TRB Report, *Expanding Metropolitan Highways: Implications for Air Quality and Energy Use*, concluded: “The evidence from the studies reviewed here supports the view that highway capacity additions can induce new trips, longer trips, and diversions from transit.”<sup>27</sup>

The assembled evidence, then, suggests that induced travel is a real and significant response to new road construction. How large is this response in comparison to other drivers of VMT growth? Kevin Heanue of the Federal Highway Administration estimates that induced demand is responsible for between 6% and 22%

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<sup>23</sup> Hansen and Huang, 1997. p. 213.

<sup>24</sup> Cervero and Hansen, 2000, p. ii.

<sup>25</sup> Phil Goodwin, “Empirical Evidence on Induced Traffic,” *Transportation*, Vol. 23, No. 1, Feb. 1996, pp. 35-54.

<sup>26</sup> Standing Advisory Committee on Trunk Road Assessment, *Trunk Roads and the Generation of Traffic*, UK Department of Transportation, HMSO (London), 1994.

<sup>27</sup> Transportation Research Board, *Expanding Metropolitan Highways: Implications for Air Quality and Energy Use*, TRB Special Report 245, Washington, DC: National Academy Press, 1995, p. 162.

of all VMT growth, with the likely range between 11 and 22%.<sup>28</sup> Most recently, Cowart and Noland analyzed “metropolitan level data compiled by the Texas Transportation Institute for their annual congestion report.... The effect of lane mile additions on VMT growth is forecast and found to account for about 15% of annual VMT growth with substantial variation between metropolitan areas. This effect appears to be closely correlated with percent growth in lane miles, suggesting that rapidly growing areas can attribute a greater share of their VMT growth to growth in lane miles.”<sup>29</sup>

### ***Trends in Vehicle Travel – Conclusion***

Literature on trends in vehicle travel shows that numerous factors, including demographic and market shifts, contributed to recent increases in VMT. Studies also show that increases in VMT cannot be entirely explained by those factors and that changes in development patterns and road building have had a particularly significant impact on VMT growth.

## **CROSS-CUTTING INFLUENCES AND THEIR EFFECTS IN CHITTENDEN COUNTY**

### **1. Demographics**

Demographic changes — particularly population growth, household growth, and employment growth — are a fundamental cause of travel growth and land use changes.

#### ***Chittenden County trends***

Demographic changes occur gradually. Therefore, demographic data and forecasts are discussed for the period 1960 – 2030. Data on population, aging of the population, and household size were collected from the US Census data<sup>30</sup> and Vermont Departments of Health and Employment and Training.<sup>31</sup> Population projections were also collected from the economic and demographic forecast for Chittenden County by Economic & Policy Resources (“EPR”)<sup>32</sup>.

Total population in Chittenden County has grown at an average of 1.71% per year between 1960 and 2000. However, the most rapid growth was in the 1960s. The growth rate has slowed gradually and averaged 1.07% per year in the 1990s (Figure 3).

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<sup>28</sup> Heanue, Kevin, 1998, Highway Capacity and Induced Travel: Issues, Evidence and Implications, Transportation Research Circular, no. 481, Transportation Research Board, National Research Council.

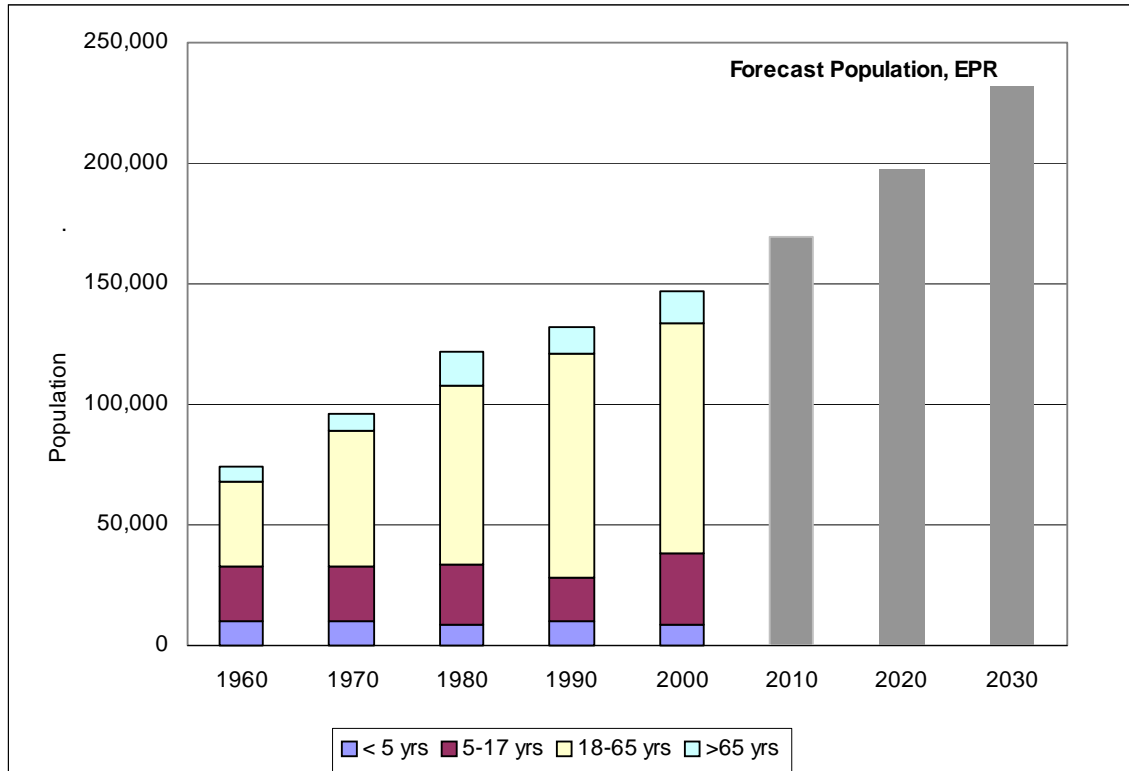
<sup>29</sup> Noland, Robert B., and William A. Cowart, “Analysis of Metropolitan Highway Capacity and the Growth in Vehicle Miles of Travel”, *Transportation*, (2000) 27(4): 363-390.

<sup>30</sup> *County and City Data Book*, Bureau of Census, US Government Printing Office, Washington, D.C.

<sup>31</sup> *An Economic-Demographic Profile, Northwestern Vermont*, Vermont Dept of Employment & Training, Montpelier, VT, 1999, 2000.

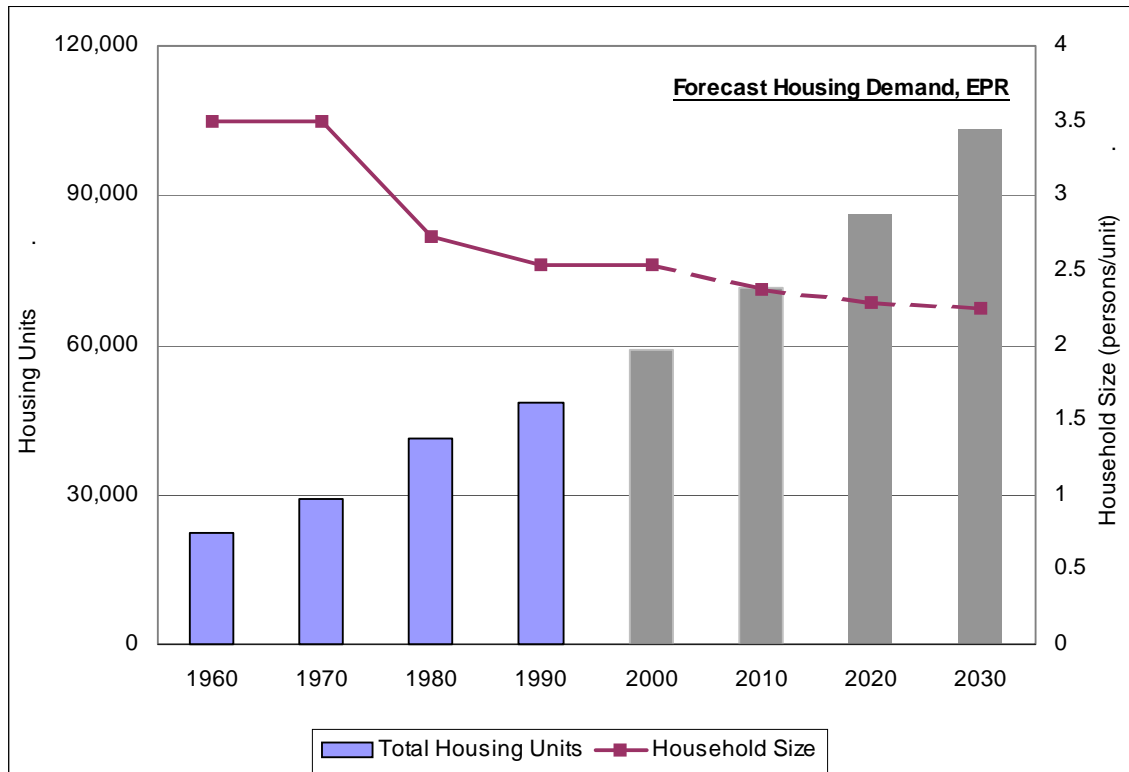
<sup>32</sup> *Economic and Demographic Forecast, Northwestern Vermont*, Economic & Policy Resources, Williston, VT, 2000.

Figure 3: Chittenden County Population, by Age Group (US Census, VT Dept of Health)



During the same period, there has been even more rapid growth in housing units averaging 2.60% per year over the period 1960-1990, and apparently almost as rapidly during the 1990s. More recently, "between 1982 and 1997 the total acreage of developed land increased by 30.8% while total population growth increased by only 13.6%." (Vermont Forum on Sprawl, 2001). This development pattern has been accompanied by a steady decrease in household size. Household size in 1960 was 3.5 persons per unit, while the 1990 household size is 2.5 persons per unit (Figure 4).

Figure 4: Chittenden County Total Housing Units and Household Size (US Census, VT DET, EPR)



In addition to general increases in population and housing, labor force participation has increased. Women in particular have substantially increased their workforce participation. Between 1960 and 1990, the female workforce has increased from 36% to 48% of the overall employed workers in the county. Although 2000 data are not yet available, it is clear that this trend has continued.

These demographic changes have been accompanied by a change to near universal auto availability among Chittenden County drivers. In a 1998 survey of Chittenden County residents conducted for the CCMPO, there were 1.03 vehicles per licensed driver and 1.99 vehicles per household, on average. Less than 1 percent of households with a licensed driver had no cars available, and these households all had a single license-holder. While 12 percent of the households have fewer vehicles than licensed drivers, these households have an average of 1.62 vehicles per household. Chittenden County trends have followed national trends in terms of increasing ownership and availability, although Chittenden County is ahead of national auto ownership rates: the 1995 National Personal Transportation Survey found 0.89 vehicles per licensed driver, and 1.78 vehicles per household.<sup>33</sup>

### ***Influence on land use***

These demographic trends have tended to be decentralizing. Growth in households, and decrease in household size, both increase travel demand as two small households tend to make more trips than a single household with the same number of people. Further, there is a strong correlation between labor

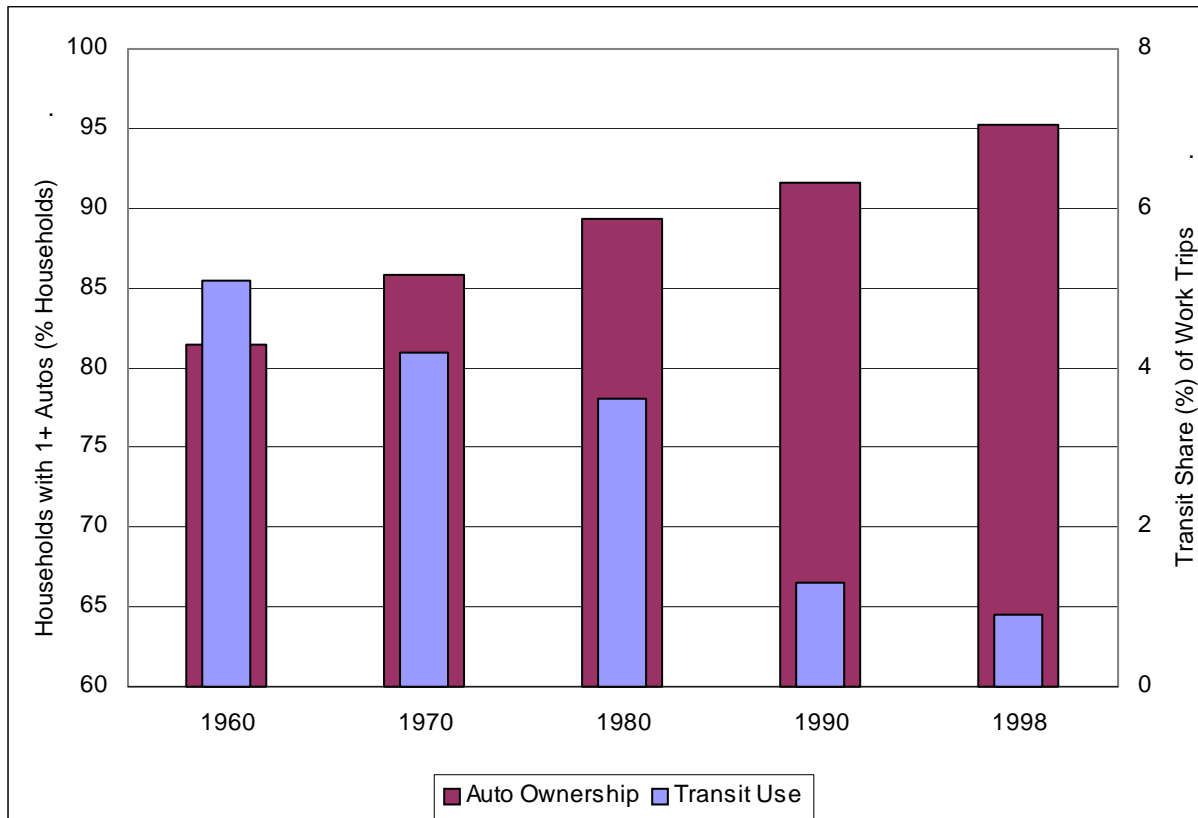
<sup>33</sup> Don Pickrell and Paul Schimek, “Trends in Personal Motor Vehicle Ownership and Use: Evidence from the Nationwide Personal Transportation Survey”, U.S. DOT Volpe Center, April 23, 1998

force participation and auto availability; a job both pays for the car and often requires that a car be available. Chittenden's demographic trends, then, have worked in combination to produce rapid increases in auto ownership and travel. Once the car is available, it tends to be used, enabling retailers and employers to locate further from traditional centers, and further from employees and customers.

These demographic trends have not been necessarily decentralizing. Depending on their family structure, smaller households, for example, might tend to prefer more compact development, all else being equal. However, the above trends tend to produce increases in automobile trips, all else being equal.

In the same period that automobiles have become more ubiquitous in Chittenden County households, use of public transportation for work trips has shown a steady decline from 5.1% in 1960 to 0.9% in the 1998 household survey (Figure 5). Excluding school bus trips, the transit mode share for non-work trips is even smaller.

Figure 5: Chittenden County Growth in Auto Use & Decline in Transit Use (US Census)



See: US Census County & City Data Book (for respective census cycles).

Although the relationship is two-directional, with location being a strong predictor of auto ownership and use, auto ownership and use also influences land use. All else being equal, a household whose members all have access to a car will be more likely to choose a home that is less centrally located; and the more members of a community have access to autos, the less likely that retailers and employers will locate in central, urban areas.

Population growth by itself is likely neutral with respect to land use patterns. Growth does not necessarily mean decentralization; until recently, growth was a force for centralization as it created critical masses of buying power that led to the formation of centers. Similarly, population loss does not necessarily mean de-centralization; indeed, most US metropolitan areas have become more decentralized even as they have lost population. Rather, because it is easier to guide newcomers than to re-locate existing homes and businesses, new growth can be a powerful tool in shaping a region. Nonetheless, when population growth occurs in the context of other decentralizing forces, it tends to follow those forces.

## **2. Economic trends**

The demographic factors described above are closely tied to economic trends in employment and workforce characteristics. The recent analysis of these trends included in the EPR economic and demographic forecast as well as state and regional issues are discussed below.

### ***Chittenden County trends***

The EPR demographic forecasts above are developed from economic forecasts of regional jobs. Without a strong economy, there will be less job growth and less population growth than projected. This section discusses economic trends in both quantitative and qualitative terms. Quantitative measures include employment growth and shifts between manufacture, service, and other sectors. This is coupled with a qualitative review of the history of how commercial and retail development has shifted from downtowns to suburban locations.

According to US Economic Census data history and the EPR economic forecasts, Chittenden County employment demand has steadily increased and will continue to grow in the near future. In addition to this growth, Chittenden County has been a regional employment center, drawing employees from surrounding regions, evidenced by the fact that employment demands have consistently exceeded the available resident workforce. Figure 6, following, shows the broad distribution of commuters into Chittenden County, and Figure 7 shows the consistent need to “import” workers into the county. It should be noted that this figure represents only commuting trips, thereby accounting only for approximately 25% of all vehicle trips. The remaining 75% of vehicle trips are not depicted in Figure 6.

Figure 6: Origin of Chittenden County employees

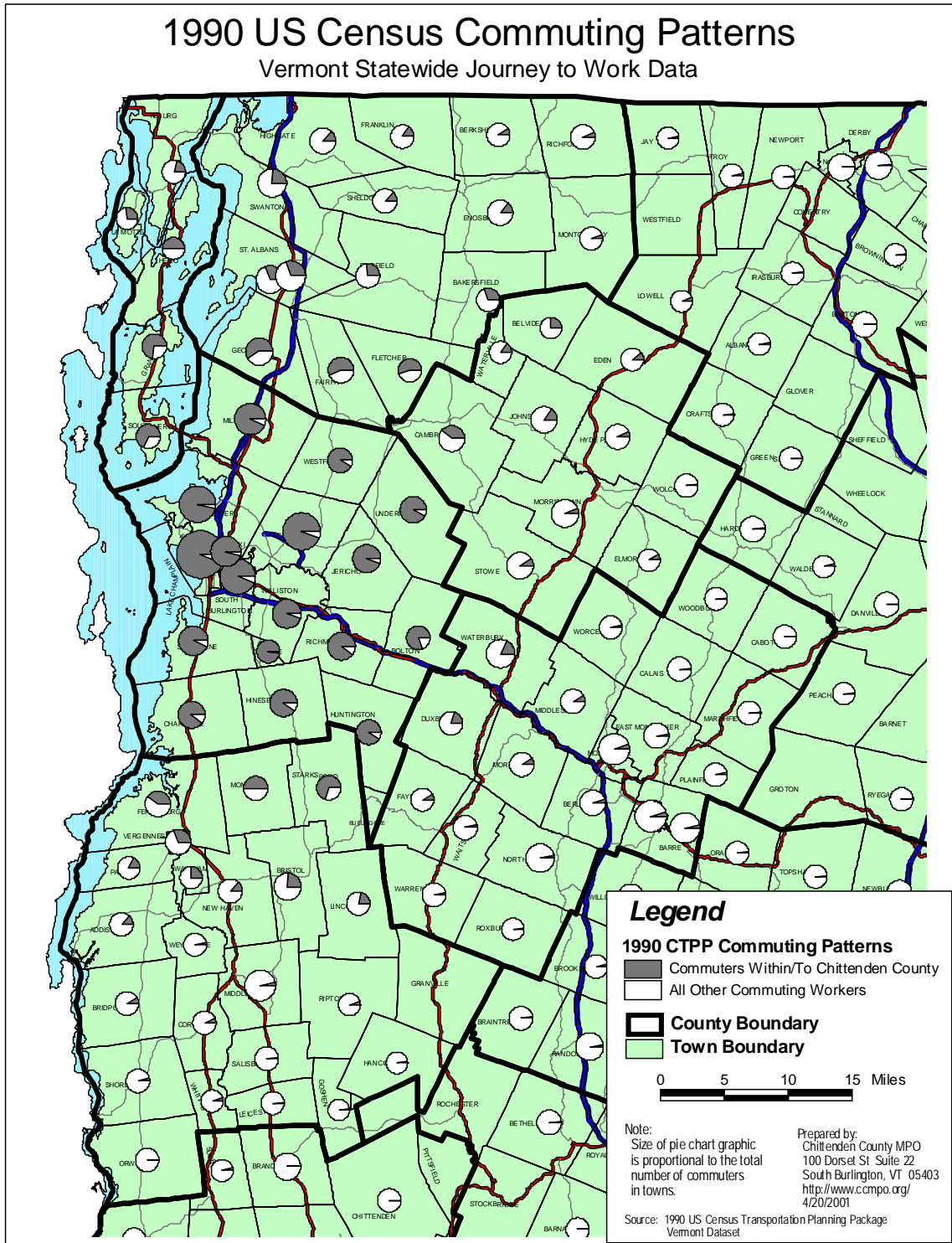
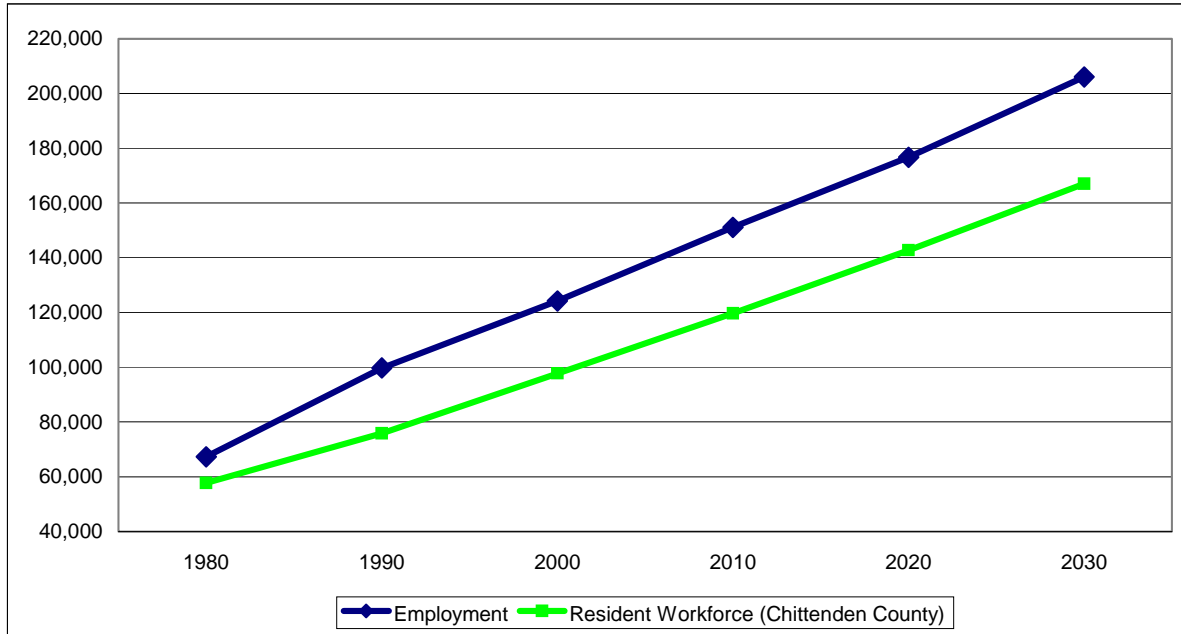


Figure 7: Chittenden County Employment Growth & Resident Work Force (US Census, VT DET, EPR)



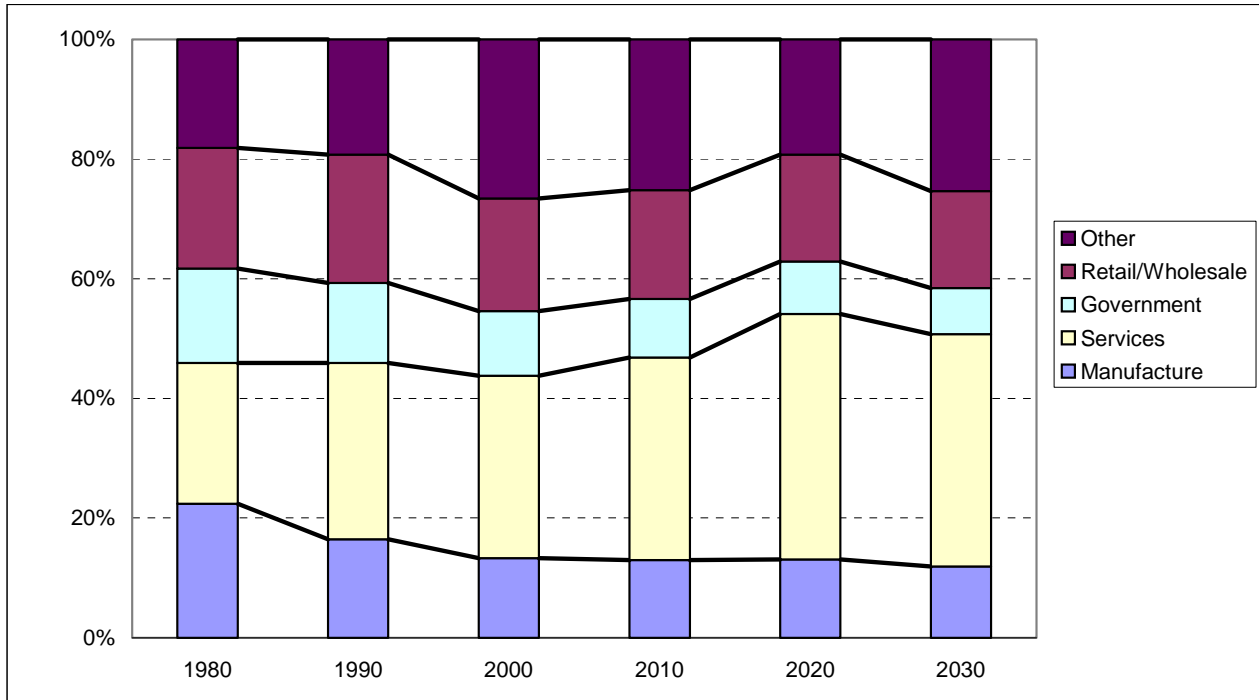
While this projection is being used for long range planning purposes, it is important to recognize that future employment growth may be considerably different. The trends in Figure 8 are consistent with the sustained boom period of the last few years, but could be impacted by a regional or national economic downturn, at least over the intermediate 5-10 year period. Demographic variables based on the economic projections, such as housing demand, are equally uncertain.

Employment trends among respective economic sectors also provide information about sector growth or decline. Historic employment figures and forecasts are summarized in Figures 8 and 9. All sectors listed in the table have been increasing and are projected to increase. While these sectors increase, relative workforce share indicates a shift in the economic base. The sector with the largest share is the service industry, with projected increases in the near future. Manufacturing is also projected to continue to grow, but the relative share of employees is decreasing. The workforce share for manufacturing has declined from 25% in 1960 to approximately 22% in 1980 and 15% in 2000.

Figure 8: Chittenden County Employment History and Forecasts, by Economic Sector (EPR)

Chittenden County Employment						
	1980	1990	2000	2010	2020	2030
Place of Employment						
Manufacture	15,041	16,396	16,520	19,585	24,957	26,497
Retail/Wholesale	13,552	21,408	23,358	27,464	34,126	36,059
Services	15,816	29,419	37,891	51,232	78,166	86,402
Government	10,635	13,272	13,409	14,773	16,697	17,251
Other	12,195	19,181	33,025	38,058	36,637	56,420
<b>TOTAL EMPLOYED</b>	<b>67,239</b>	<b>99,676</b>	<b>124,203</b>	<b>151,112</b>	<b>190,583</b>	<b>222,629</b>

Figure 9: Percentile Distribution of Employment, By Economic Sector (EPR)



The new ability of businesses to flourish throughout Chittenden County also indicates shifts in the economy. Historically, a business would need to be geographically close to its most critical resource for production or providing services. Burlington was historically dependent on Lake Champlain as a transportation corridor for goods and raw materials. The city and county growth patterns reflected industrial development along the lakefront and lower density agricultural and forestry industries in the rest of the county. For example, banks and financial institutions would need to be in downtowns where financial and population densities could support the businesses, or a lumber mill or a factory would need reliable sources of power, labor, and a transportation network, which would limit potential sites.

Improvements in communication, utilities, and transportation have not eliminated businesses' need to locate near infrastructure and workforce. However, the ubiquity of many kinds of infrastructure has substantially broadened locational choices. These same improvements have helped remove physical proximity to customers as a requirement for many businesses. ("Ubiquity of infrastructure" also includes roads to bring workers from further distances, but this subject is discussed in detail in the Transportation section, below.)

The trend in retail sales illustrates this shift in commercial development to the outlying suburban towns. Over the past 20 years, retail sales in Burlington and Winooski have remained fairly constant, while the rest of the county has experienced a surge in retail sales (taking inflation into account). In 1992, the total retail sales in Burlington and Winooski amounted to about \$385 million, compared to retail sales of \$966 million in the remainder of Chittenden County. These data do not account for the more recent retail growth in Williston<sup>34</sup>.

<sup>34</sup> *Census of Retail Trade, Chittenden County*, U.S. Department of Commerce, Bureau of the Census, Census of Retail Trade.

Finally, job growth has been a goal of the State of Vermont and many Chittenden County municipalities. The Vermont Economic Development Authority (VEDA) provides financial support that will “contribute to the creation and retention of quality jobs in Vermont.” (VEDA mission statement) VEDA programs aid in developing, enhancing, or maintaining agricultural, commercial and industrial institutions. VEDA currently has over \$33 million dollars in loans to over 130 Vermont companies, and also provides assistance for assisting farmers and agricultural facilities. Between 1996 and 2000, loans for industrial and commercial businesses accounted for 96% of all VEDA loans in Chittenden County.<sup>35</sup> This suggests a large state financial commitment to non-agricultural development in Chittenden County.

### ***Influence on land use***

The decline of manufacturing, and the decreasing dependence of that manufacturing on locations near the Lake and other central transportation corridors, was obviously a twin boost to decentralization. The shift to services added to that trend, as many information-based service industries do not require a central location at all thanks to communications technologies.

The shift towards a “24x7” economy can have both centralizing and decentralizing effects. “24-hour cities” tend to develop in denser, more pedestrian- and transit-friendly patterns (although some causality also goes the other way, with denser, mixed-use cities more likely to develop a 24-hour economy). In either case, we are seeing the resurgence of traditional downtowns in some places both as an effect of the 24x7 economy, and as people decide that they miss the qualities that only such a dense, walkable environment can provide.

On the other hand, trips of all kinds are much more spread out during the day than in the past, and a smaller number of workers are on fixed shifts. These changes make it more difficult to provide and use transit service, again. Increasing auto ownership again is a fundamentally decentralizing force, in that it facilitates these trends, even if it does not cause them.

Economic factors have encouraged large retail development to occur in greenfields. The economic burdens to provide adequate parking, maintain good transportation levels of service, and construct or rehabilitate a building can be significantly higher in a downtown setting. At times, public funds have been used to assist in development costs, for example:

- ◆ Burlington Square Mall: In order to make the site attractive to a potential anchor store, public funds were used to build a public parking structure to serve the mall.
- ◆ Burlington Waterfront: In conjunction with the private sector development of the waterfront, federal funds have been earmarked for a multi-modal transit center. This property will provide transit service and limited parking for the surrounding public and private properties.

While these examples illustrate where public funds have been made available, the majority of developers find it more attractive to construct new big-box stores in greenfields. With lower land values and good transportation and utilities infrastructure, large-scale retail is able to develop a site that serves their needs more readily than in a downtown. Many retailers are part of a national chain that prefers to maintain similar site and building layout, minimizing design and construction costs. Property with good transportation access, high visibility, and proximity to successful retail centers can attract very high prices.

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<sup>35</sup> See VEDA web site: [www.state.vt.us/veda/programs.htm](http://www.state.vt.us/veda/programs.htm).

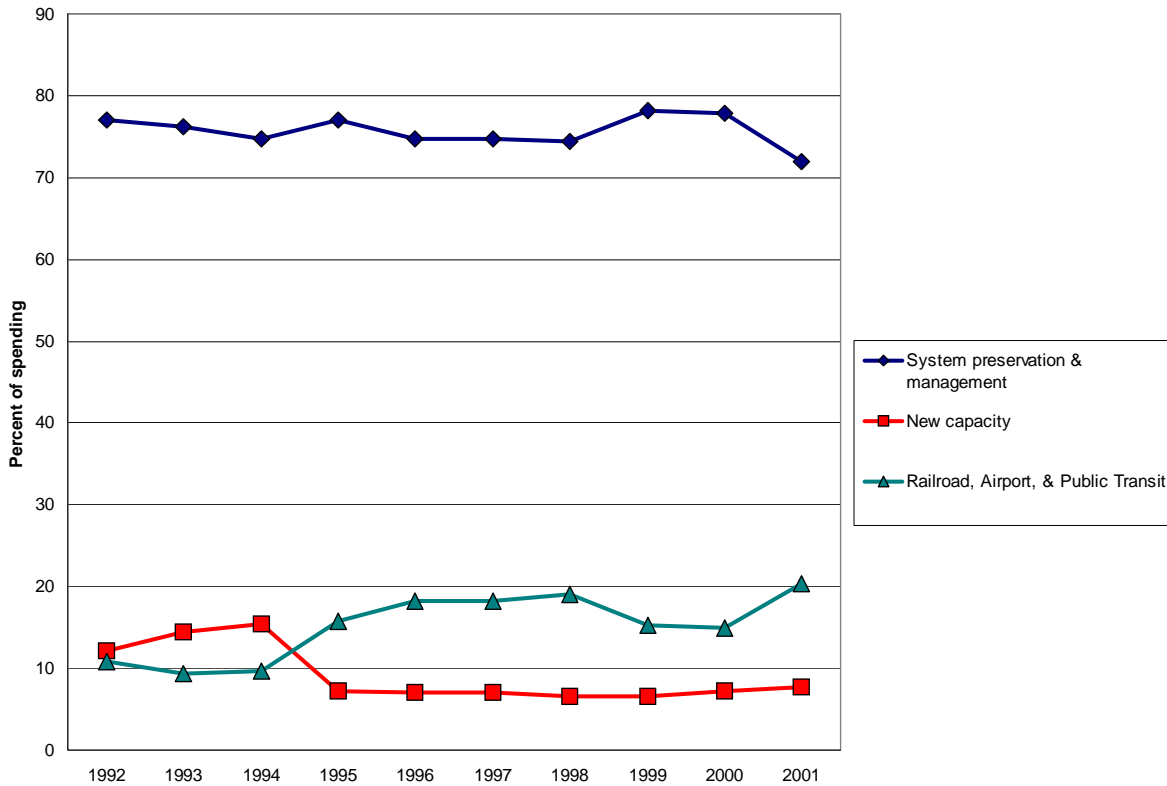
### 3. Transportation investments

For most non-agricultural or non-natural resource land to have value for developed land uses, it must be accessible. For most commercial land uses, the more access provided by the transportation system, the higher the value. For residential uses, the relationship is less strong. A certain remoteness or aesthetic character may add value to land, but access to employment and/or services continues to be important for the majority of buyers. In most cases, then, transportation investments significantly impact land use values and thus choices. Put another way, land has intrinsic value, but its value may be more-or-less enhanced by transportation infrastructure. Transportation infrastructure/accessibility is only one factor in residential value. More important, this may not be the most influential factor in residential land value.

#### Chittenden County trends

Most government transportation spending is for the highway system. An analysis of Vermont Agency of Transportation annual budget indicates that the major share of statewide transportation allocations is devoted to highways: between 80% and 85% since 1995. Of that, the portion spent on new capacity has varied between 6.5% and 7.8% of the total budget since 1995.<sup>36</sup> (Figure 10)

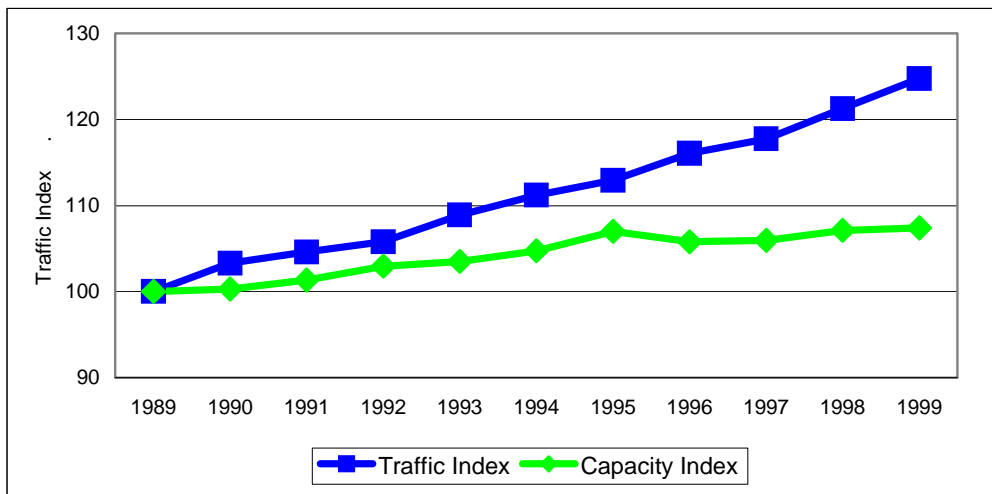
Figure 10: Vermont Agency of Transportation Statewide Budget Allocations



<sup>36</sup> Marvin Kingsbury, VTrans, personal communication with David Roberts. See also Champlain Initiative, Sustainability and Growth Center Team. *The Case for A Healthy Community: The History of Sprawl in Chittenden County*, p. 35, 1999.

Increasing auto use has been outpacing increases in road capacity, increasing congestion. The best measure of roadway capacity is lane miles, i.e. length of roadway times the number of lanes. Data for lane miles are not readily available in Chittenden County. The most similar data available are for total centerline miles of roadway. Since the great majority of roadways in Chittenden County have only 2 lanes, this indicator has grown at a very similar rate to the desired variable, lane miles. Therefore, we use an index constructed from total centerline miles as a proxy for roadway capacity. Between 1989 and 1999, vehicle traffic increased by a compound rate of 2.2 percent per year, while highway miles (representing capacity) grew by 0.7 percent per year (Figure 11). As suggested in the discussion on induced travel, the causal relationship between these highway miles and VMT is complicated and most likely works both ways.

Figure 11: Comparison of Capacity Index (Highway Miles) to Traffic Index (Daily Traffic Volume) for State Highways in Chittenden County (1989 = 100)



Given these population and employment forecasts, it is likely that traffic in the county will continue to grow at a faster rate than roadway capacity. Chittenden County roadways will become increasingly congested.

### *Influence on land use*

New highways open up land for development by increasing the accessibility of locations that once were remote or difficult to reach. The development of highways and trunk roads helped residential development expand into rural areas. Any rail or transit investment that opened new land to development would have similar effects. Although rail used to be used to bring access to previously largely inaccessible land, in recent decades rail and transit generally has only added access to previously road-accessible land. The discussion here thus focuses on the effects of increasing accessibility through roads, although increasing accessibility through any means will generally have the effect of increasing the attractiveness of the newly accessible land, and increasing travel to it.

Accessibility is one factor that affects the desirability and therefore the price of land. All else being equal, reduced travel costs increase the relative value of land at the periphery of a metropolitan area to urban residents and workers. The increased value leads potential residents to outbid farmers for land near the urban region's edge. At the same time, transportation infrastructure enables more land to be available for development. The availability of more land allows people to use more transportation and land resources without an increase in transport cost. However, "where transport prices do not reflect full social and

environmental costs, the land market can generate inefficient land-use patterns.”<sup>37</sup> “Full social and environmental costs” include all of the negative impacts caused by transportation but which are not paid by the user, such as air emissions, polluted water runoff, habitat impacts, and noise.

Decreased transportation costs affect business location decisions as well. One of the basic tenets of classical location theory, well articulated since the 1920s, is the influence of transport costs on a company’s choice of location. As the relative importance of transportation costs decreased (both due to lower transportation costs and economic shifts from manufacturing to services), transportation’s role diminished in location choices, and more locations become viable site alternatives. Reduced transportation costs thus greatly facilitated the dispersal of employment.

For manufacturers, improvements in highway connections simplified the use of trucks for intercity traffic. As manufacturers switched from trains and ships to trucks, they were freed from dependence on railheads and ports, generally located near the city centers, and were able to move manufacturing facilities to sites accessible to interstate highways. The shift to trucks thus facilitated the evolution from concentric development around major transport facilities (the port and rail yard), to axial and polycentric patterns.<sup>38</sup>

Firms with highly skilled work forces have also changed their locational patterns in recent years. Because these firms draw employees from the entire metropolitan area, they need to locate at a point accessible from all points in the area. Before the highway, the city center was the most accessible location. In the modern automobile city, firms may choose to locate in the urban core, but often they are drawn to locations along an urban highway or suburban beltway, since such sites are accessible to a large population via automobile. This produces new outer rings of land-use development, and edge cities.<sup>39</sup> This change is further reinforced by the tendency for the peripheral suburbs to contain a relatively high proportion of wealthy, well-educated, well-trained workers.<sup>40</sup>

Non-retail employment centers have also been attracted to greenfields. This reflects a national trend toward commercial “campuses,” but is also made possible by transportation facilities that give these developments access to employees. Two large-scale examples in Chittenden County are the IBM facility in Essex and Williston, and the Husky facility in Milton. However, these design values also are exhibited in many smaller projects.

Finally, increased congestion in currently developed areas can help push development further away from those areas as firms and residents seek less congested areas.

In sum, highways loosen ties of both residents and businesses to central business districts, allowing the suburbanization of industry and residences. Highways facilitated similar suburbanization of retailers. When shoppers have access to private vehicles, suburban stores may be more accessible than city locations. As residential suburbanization occurred, many retailers followed consumers out to the suburbs to be closer to

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<sup>37</sup> World Bank, *Sustainable Transport: Priorities for Policy Reform*, Washington, D.C.: 1996, p. 61.

<sup>38</sup> Button, K.J. *Transport Economics*. Hampshire, England: Gower Publishing Co. Ltd., 1982, p. 261-263.

<sup>39</sup> R. Burchell, “Understanding Sprawl.” *On the Ground*. Vol. 2, No. 2, 1996.

<sup>40</sup> Largely in consequence of standard rent-bid curves that have been influenced by auto ownership patterns, mortgage subsidies, and rent control and public housing policies, among other factors such as school quality, perceptions of crime, and racial bias. US EPA. *Our Built and Natural Environments: A Technical Review of the Interactions between Land Use, Transportation and Environmental Quality*. EPA 231-R-00-005. January 2001.

their markets.<sup>41</sup> A prime example in Chittenden County is the strong retail growth in the vicinity of I-89 exits 12, 14, and 16.

#### **4. Regulation**

Population growth, economic change, and transportation investments can have centralizing or decentralizing tendencies, but those tendencies can only express themselves if allowed to by the regulatory environment.

##### *Chittenden County trends and influences on land use*

The most important influence on land use is arguably zoning. While zoning is not always determinative, it sets general directions for growth. Figure 12 on the next page gives a broad view of the zoning patterns in Chittenden County.

In addition to zoning, there are significant regulatory influences at the local municipal level in Chittenden County, and in Vermont's Act 250 process.

As in the rest of the United States, Chittenden County's local municipal plans, subdivision regulations, and zoning ordinances have changed over time to allow, and in some cases require, low-density, single-use development. Past zoning practices have required separate districts with unique regulations guiding the use of the land in that district. The primary feature of these zoning regulations was to separate human activities, thereby necessitating both a means to travel from one activity to another<sup>42</sup>. Typical zoning features include single-use zoning, minimum lot sizes, density restrictions, setback requirements, and parking requirements.<sup>43</sup> As land uses are spread apart, more infrastructure is needed to create access to each district and to support the extent of developed land uses.

Minimum parking standards, put in place to reduce parking problems, encourage vehicle travel and increase the cost of development<sup>44</sup>, driving development toward cheaper land on the urban fringe. Similarly, zoning that separates residences from commercial and office development often makes mixed-use communities impossible. The walkable neighborhoods with neighborhood stores that were once common would be illegal to build in many places today.

Many municipalities have recently begun changing their ordinances to address criticisms that these zoning characteristics have produced undesirable results. A major focus of these changes is to attempt to focus higher density, mixed use development in certain areas. South Burlington City Center and Essex Town Center are especially strong examples.

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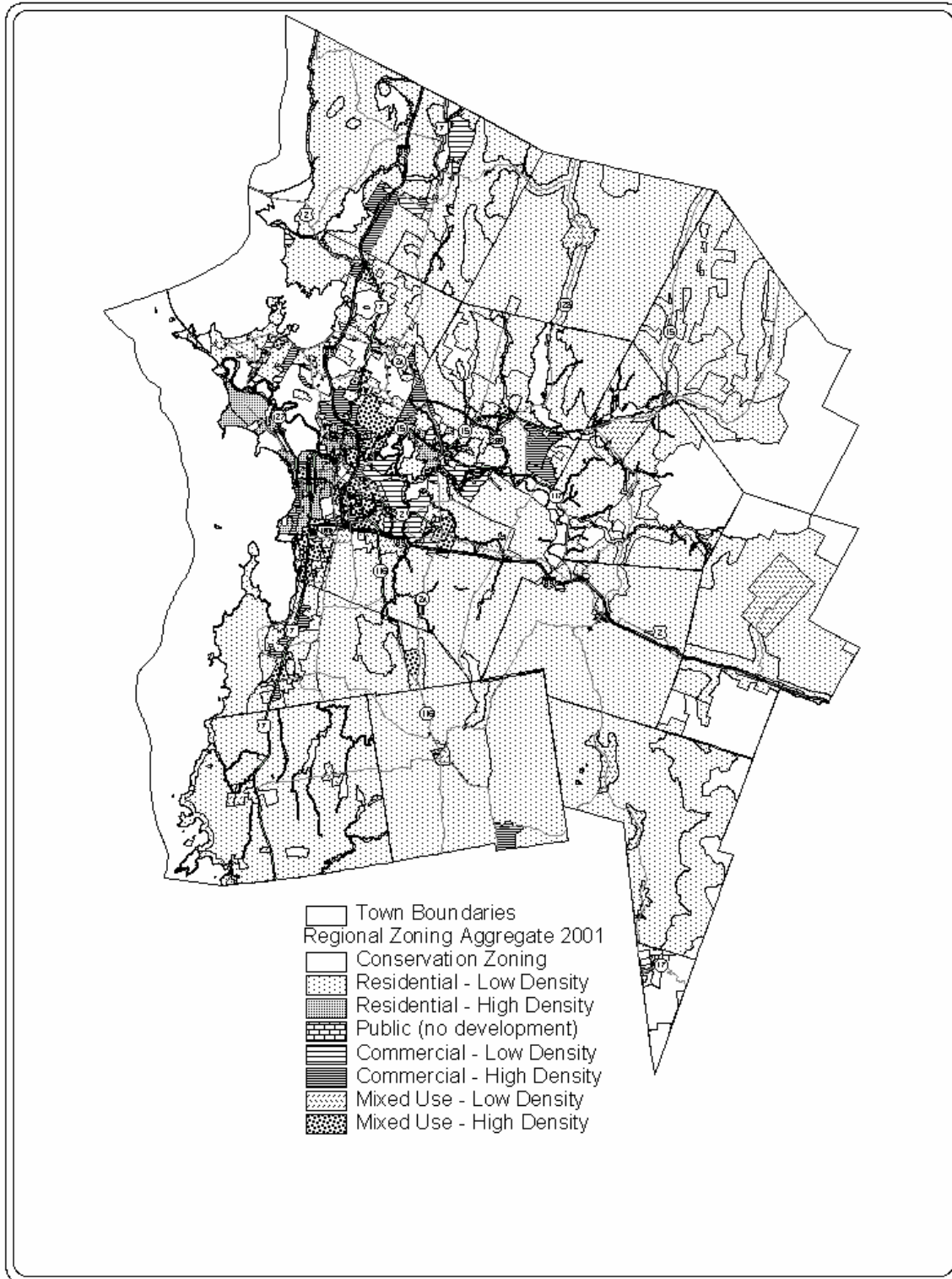
<sup>41</sup> *Ibid.*

<sup>42</sup> James Howard Kunstler, *Home From Nowhere*, Simon & Schuster, 1998.

<sup>43</sup> Champlain Initiative, Sustainability and Growth Center Team, *The Case for A Healthy Community: The History of Sprawl in Chittenden County*, p. 36-42, 1999.

<sup>44</sup> Donald Shoup, "An Opportunity to Reduce Minimum Parking Requirements," *Journal of the American Planning Association*, Winter 1995, pp. 14-28; Richard W. Willson, "Suburban Parking Requirements: A Tacit Policy for Automobile Use and Sprawl," *Journal of the American Planning Association*, Vol. 61, No. 1 Winter 1995, pp. 29-42.

Figure 12: Generalized and aggregated Chittenden County zoning districts (CCRPC)



A new planning initiative in the City of Burlington, the Legacy Project, could have a large influence on residential land use development in Chittenden County. Over the past few decades, Burlington's population has remained fairly constant as population occupying new housing was balanced by decreased household size in the older housing stock. The Legacy planning project concluded that the city should encourage additional infill development within the city when possible. With Burlington more or less "built out", increasing population will require increased housing density and changes in the municipal plan and local ordinances.

Act 250, Vermont's Land Use and Development Law, plays a strong role in review of larger projects in Chittenden County and also helps to provide some consistency in how projects are reviewed in different municipalities. Act 250 requires that certain kinds of development and subdivision plans obtain a land use permit prior to construction. To obtain a permit, developers or landowners apply to the District Environmental Commission administering the law in that particular district (in Chittenden County, this is the Essex Junction Regional Office).

The Commission must base its review and decision on Act 250's 10 criteria. Primarily, these focus on the development or subdivision's projected impacts on air and water quality, water supplies, traffic, educational and municipal services, and historic and natural resources, including scenic beauty and necessary wildlife habitat. Developments must also conform to local and regional land-use plans. The 10 criteria are listed and explained in the state's Act 250 brochure, which can be found at <http://www.state.vt.us/envboard/publications/Act250.pdf>.<sup>45</sup>

Act 250 includes air quality analysis requirements for projects with more than 1,000 parking spaces.<sup>46</sup> Chittenden County is currently in attainment of the National Ambient Air Quality Standards, thus reducing the impact of federal regulatory issues associated with air quality conformity analysis many other urban areas in the US face. One of the challenges in Act 250 is that projects that have regional benefits may still have significant localized impacts. A recent example is the Winooski redevelopment project. It includes high-density, mixed-use development with good pedestrian and transit access. Nevertheless, it will produce a large volume of traffic within a small area. Local, regional, and state officials have increasingly evaluated such projects from a regional perspective and approved them.

Regionalism can occur in several forms, with varying impacts on travel behavior. As economies regionalize, people generally must travel longer distances to reach services that used to be located in smaller, closer towns. Without sufficient public transit, this trend on its own leads to greater auto dependency and driving. If the newly regionalized services are clustered and centrally located, they could in many cases be transit served, or walk-served after a single auto trip. However, in current trends large regional services such as big boxes are not always "centrally" located and thus are not easily transit served.

Chittenden County has also seen increased efforts to redevelop old industrial sites or "brownfields." These properties have been unattractive to developers for a variety of regulatory reasons, including uncertainty

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<sup>45</sup> 2001 amendments to Act 250 are discussed in a June 29, 2001 memo from Marcy Harding, Chair, Vermont Environmental Board. (<http://www.state.vt.us/envboard/docs/h475sum.pdf>) The 10 criteria remain.

<sup>46</sup> Further regulations that apply to many larger institutional or commercial developments stem from air pollution standards. The Vermont Agency of Natural Resources (ANR) maintains Air Pollution Control Regulations, which requires pollution source permits for institutions planning to utilize large boilers, large power generators or large parking areas (greater than 1,000 parking spaces). Recognition of these larger developments as potential air pollution sources does serve to regulate the overall size of developments. For example, developers who are aware of the ANR permit requirements for properties with greater than 1,000 parking spaces might try to limit development size to use up to 999 parking spaces, thus not exceeding the air pollution source permit requirement threshold.

about liability, and cleanup requirements that did not vary with intended use (that is, re-use as an industrial site required the same level of clean-up as re-use as a residential site). New federal and state initiatives have lowered regulatory barriers and made substantial funding available for brownfields redevelopment. The State of Vermont is also working to assist in brownfield redevelopment. A current goal of Vermont's Agency of Commerce and Community Development is to: "Increase the awareness among local officials and private developers about the incentives and tools available for brownfield redevelopment."

### *National policy influences on Chittenden land use*

Federal policy plays an important role in shaping land use. After World War II, federal funding for highway construction opened vast areas of land for development. A survey of experts by the Federal National Mortgage Association ("Fannie Mae") declared, "More than any other single measure, the 1956 [Interstate] act created the decentralized, automobile-dependent metropolis we know today."<sup>47</sup>

Efforts to promote homeownership—through the G.I. Bill of Rights and mortgage subsidies, for example—encouraged movement to new subdivisions. In addition, the federal tax deduction of interest paid on home loans provides a subsidy for homeownership. Federal mortgage programs promote housing consumption and increase the relative attractiveness of the suburbs.

The federal government also subsidized suburban development by funding the construction of new water and sewer infrastructure. The effect of subsidizing any kind of infrastructure is to subsidize the type of growth that depends on that infrastructure, which in this case was growth on the urban edge.<sup>48</sup>

## **CONCLUSION**

The interactions between transportation and land use, and the many forces that act on each system, defy brief summary. For the purposes of CCRPC and CCMPO's effort to model important influences on the transportation-land use system, the above review suggests the following:

- ◆ Land use is driven most directly by economics. The value of commercial parcels in particular is driven largely by their accessibility, which in turn is determined by the transportation system. A location without access is less desirable for development.

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<sup>47</sup> The methodology is described thus: "In an effort to better understand the most significant influences on the American city and metropolitan development during the past 50 years and into the next millennium, the Fannie Mae Foundation commissioned a survey that asked urban scholars to rank the key influences shaping the American metropolis.

"We called on Dr. Robert Fishman to lead this effort. Dr. Fishman is a professor of history at Rutgers University and Public Policy Scholar at The Woodrow Wilson International Center for Scholars in Washington, DC.

"Dr. Fishman and 10 urban specialists developed a list of 25 possible influences on the American metropolis in the past century, and a list of 19 likely influences of the future. They surveyed 149 urban and regional historians, planners, and practitioners and asked them to rank the 10 most powerful influences, looking back 50 years and forward through the next century."

Robert Fishman, "The American Metropolis at Century's End: Past and Future Influences." Washington, DC: Fannie Mae Foundation, Winter, 1999.

<sup>48</sup> Water and sewer infrastructure, and accompanying regulations about density of development allowed without sewers, can have a substantial impact on development opportunities regardless of what level of government pays for them. Considering the role of water and sewer infrastructure in determining development patterns is beyond the scope of this report.

- ◆ Once land is accessible, the regulatory environment, the economic environment, and the social environment jointly determine its value, and the use to which it is put. All three of these determinants of land value and use interact with each other as well.

One goal of this review of influences on transportation behavior and land use was to assess whether the indicators being proposed for use in the Decision Support System captured the important factors. We believe that the working list of indicators does capture the important general factors, in covering:

1. General land use
2. Housing
3. Employment
4. Transportation

In particular, the DSS' Attractiveness Index will show and capture the link between demographics, economics, and regulation, and transportation and land use patterns. In particular, the DSS will use travel times as a proxy for accessibility, and accessibility in conjunction with other factors as an input to "attractiveness" and/or "development pressure". Further, because the DSS will consider future land use plans when allocating land uses, the DSS will report what development currently exists and what is allowable in each analysis cell (which will range from 50-200 acres countywide). The DSS will represent the most comprehensive modeling tool for planning purposes available in the region, and one of the more advanced such tools in use anywhere.