

Effects of Suburbanization on Carbon Emissions from 1970 to 1990 in Montgomery County, Maryland

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I pledge on my honor that I have not given or received any unauthorized assistance on this examination.

I. Introduction

The decades following World War II saw a mass migration of middle class Americans from urban areas to the newly emerging suburbs. Developers bought up farmland within close proximity of urban centers and converted it into low-density housing. There are several (sometimes conflicting) theories regarding the driving forces behind the move. Some contend that social factors such as race and crime were behind the “white flight from blight” in the city, while others assert that customary factors such as differing income levels naturally led to the move away from the city.¹ Whatever the reasons behind the migration, statistics prove that it did indeed occur. In 1970, only sixty-nine percent of the American population lived in metropolitan statistical areas (MSA); by 1990, that number had dramatically increased to seventy-seven percent.² This drastic change in population altered the suburban landscape, affecting not only population numbers but also development patterns, population density, and social norms.

This pattern of migration to the suburbs partially resulted from an increase in automobile usage in the late twentieth century. From 1952 to 1965, private vehicle ownership increased from sixty-five percent to seventy-four percent, and has since climbed to even higher percentages.³ Reasons for this corresponding relationship between suburbanization and automobile usage are manifold. As the majority of suburban residents were of the upper middle

1 Peter Mieszkowski et al., “The causes of metropolitan suburbanization,” *The Journal of Economic Perspectives* 7, no. 3 (1993), <http://www.owl.net.rice.edu/~econ461/papers/mieszko2.pdf>.

2 Ibid

3 Karen A. Kopecky et al., “A quantitative analysis of suburbanization and the diffusion of the automobile.” Retrieved from the MPR Archive, no. 13258 (February 2009), http://mpr.ub.uni-muenchen.de/13258/1/MPRA_paper_13258.pdf

class, they possessed enough income to purchase automobiles in the first place.⁴ The development of highways and enhancements of existing roads further improved speed of transportation and created more incentive for having a car. The substantial distance between a suburban home and the workplace also made daily automobile use mandatory for suburban residents.⁵

However, as millions of people made the move to the suburbs and subsequently adopted this routine, its serious environmental consequences soon became apparent. Not only did the development of the suburbs and the related highway infrastructure fragment and destroy natural habitats, but the cars driven by commuters also came to be responsible for about one-quarter of humanity's carbon dioxide emissions.⁶ This makes the personal automobile the world's single greatest polluter, due simply to the compound effect of millions of drivers.⁷ Along with carbon dioxide, cars also emit carbon monoxide, nitrogen oxides, sulfur oxides, and unburned hydrocarbons, all of which are toxic to humans and animals.⁸

This trend is exacerbated by the commuter culture ingrained in American suburbs. Urban sprawl, the negatively connotative term given to the process of suburbanization,⁹ merits research for the potentially disastrous problems it presents to the environment and, ultimately, people. It is vital and necessary to contribute to this ongoing field of research because of these devastating consequences.

4 Ibid

5 Ibid

6 U.S. Environmental Protection Agency, Office of Mobile Sources, "Automobile Emissions: An Overview," 1994. <http://www.epa.gov/oms/consumer/05-autos.pdf>.

7 Ibid

8 Ibid

9 Randall Crane et al., "Traffic and sprawl: evidence from U.S. Commuting, 1985 to 1997," *Planning and Markets* 6 (2003), <http://www-pam.usc.edu/volume6/v6i1a3s1.html>.

This paper examines the specific case of Montgomery County, Maryland over the course of its suburbanization. The main question for this project is: how did the surge of suburbanization affect automobile usage and rising carbon emission rates in Montgomery County alone? As the most significant instances of suburbanization in Montgomery County were recorded in the latter half of the twentieth century, we chose the years 1970 to 1990 as the period in which to concentrate our research. Another benefit of examining this period is the availability of automobile emissions data, which was not reliably collected until the founding of the EPA in 1970.

To begin answering such a research question, we first had to establish three statements to be true: one, that suburbanization did occur in Montgomery County; two, that automobile usage rates changed in some way as a result of this suburbanization; and three, that carbon emission rates were consequently altered as well. Since our literature review asserted all three statements to be factual, we were then able to look at primary documents to further enrich our research. As defined by Gordon Marshall writing in the *Dictionary of Sociology*, suburbanization is “the process by which cities expand peripherally, initially by out-migration of population and economic activity from dense urban cores, to less dense contiguous settlements.”¹⁰ Census data documenting an increase in population, as well as topographical maps showing an expansion of housing between the years 1970 and 1990, helped prove that suburbanization occurred in Montgomery County during the period examined. Visits to the Waters House History Center and the Jane C. Sween Library, both branches of the Montgomery County Historical Society, yielded

10 Gordon Marshall, "Suburbanization," in *A Dictionary of Sociology*, 1998. Retrieved April 02, 2010 from Encyclopedia.com, <http://www.encyclopedia.com/doc/1O88-suburbanization.html>.

further information on the history of Montgomery County and helped to trace its development from an agricultural county to its current status as one of the wealthiest counties in the nation.

Once we confirmed the existence of suburbanization, we determined its relationship to automobile usage rates by examining data concerning transportation in the period 1970 to 1990. For example, reports logging the construction and expansion of highways built across or near Montgomery County helped show the increasing necessity for roads because of an overlying dependence on automobiles for transportation. In this aspect, the Montgomery County Planning Department and the resources it maintains were an invaluable source for our research. Finally, to ascertain the effect that automobile usage patterns had on increasing carbon emission rates, we analyzed files on air pollution statistics in Montgomery County found in the Maryland Room (at the University of Maryland campus). Throughout the entire research process, we consulted a number of peer-reviewed journals and articles to help further build a solid background of the matter of suburbanization in a larger context.

Our research question is significant because it examines the connection between the lifestyle we live within our community and the harm it is inflicting on the environment. Every member of our group is personally connected to our research project. Growing up in suburbia, we all have first-hand experience of our reliance on the automobile. Cars serve as the means to get us to school and our parents to work, among a multitude of other things. It is crucial for our group, as suburban Americans, to analyze the impact *we* have been making on the environment around us.

There is research that links the vague trend of suburbanization with environmental

damage, but the specificity of our study demonstrates the effects that our own community has had on its surroundings, hopefully alerting us to the dangers of our own actions and encouraging a sense of personal responsibility. By answering this question, we hope to add new research to the current field, and bring our society one step closer to appreciating the problem of rising carbon emission rates.

II. The History of Suburbanization in America

What exactly is suburbanization? The generally accepted definition of suburbanization is the “spreading of urban population and employment from central cities to satellite communities called suburbs.”¹¹ It differs crucially from the concept of urbanization in that urbanization indicates the process of building skyward, while suburbanization signifies instead a growth that spreads outward and horizontal from said urban center. Available space in the world is finite, a predicament intensified by the rapid increase of the human population. To accommodate the housing needs of a rising population, two options exist: we can either build up, as in the case of urbanization, or we can build out, in the opposing case of suburbanization.

In the recent decades, clear trends have shown that Americans have preferred the latter. Former vice-president Al Gore provides a brief overview of and explanation for the phenomenon when he proclaims that: “In the past fifty years, we've built flat, not tall: because land is cheaper the further out it lies, new office buildings, roads, and malls go farther and farther out,

¹¹ Karen A. Kopecky et al., “A quantitative analysis of suburbanization and the diffusion of the automobile.” Retrieved from the MPR Archive, no. 13258 (February 2009), http://mpr.ub.uni-muenchen.de/13258/1/MPRA_paper_13258.pdf

lengthening commutes and adding to pollution.”¹² Though the social and specifically environmental consequences of suburbanization are addressed later in this paper, in this quotation, Gore critically emphasizes the “flat, not tall” aspect of suburbanization that has become such a predominant trend in construction patterns in the past century. The reasons for this horizontal expansion away from cities are manifold and date back two millennia.

One such reason, as was mentioned before, is the rapid and arguably uncontrollable growth of population. Population increase and the dilemmas it causes are not only a recent occurrence. This accelerated pace at which the human population has been growing has proven to be a consistent problem since the beginning of history, so much so that Ancient Roman emperors took it upon themselves to issue edicts limiting the expansion of cities within the empire’s domain.¹³ Fifteen hundred years later, London officials did the same thing, in fear of the potential health consequences caused by a rapid increase of population.¹⁴ However, one major historical event, the Industrial Revolution, accelerated its rate to unprecedented levels, encouraging people to move away from the cities and into the surrounding countryside. The rapid development of manufacturing, trade, and commerce during the Industrial Revolution of the eighteenth and nineteenth centuries sparked numerous innovations in business and technology and transformed Western society into a culture of consumption.¹⁵ Out of the Industrial Revolution emerged the middle class, a socioeconomic group consisting of factory

12 M.E. Kahn, “The environmental impact of suburbanization,” *Journal of Policy Analysis and Management* 19, no. 4 (2000), <http://www.jstor.org/stable/pdfplus/3325575.pdf>.

13 Michael Batty et al., “Traffic, urban growth, and suburban sprawl.” *Center for Advanced Spatial Analysis*, no. 70 (November 2003), <http://eprints.ucl.ac.uk/216/1/paper70.pdf>

14 Ibid

15 Ibid

managers, doctors, lawyers, teachers, and others, whose movement out of the cities made them the first modern enactors of large-scale suburbanization. And move they did. Between 1830 and 1860, the American cities of Boston, New York, and Philadelphia all saw a higher growth rate in their suburbs than in the cities themselves.¹⁶

In addition to producing the people that would ultimately play a significant role in the move to suburbia, the Industrial Revolution provided something equally or perhaps even more important: a means to get there. The nineteenth century oversaw remarkable improvements in the area of transportation. The advent of the commuter railway and the city street car (or trolley) made travel substantially easier and more efficient, thus empowering and encouraging dissatisfied city dwellers to make the move toward the greener, quieter lifestyle of the suburbs.¹⁷ Additionally, people were making more than they did before, as the Industrial Revolution and its immense overhaul of the worldwide economy led to a significant increase in real income.¹⁸ For once, travel was efficient, public, and inexpensive.¹⁹ All these aforementioned factors combined to make the overall effect of the Industrial Revolution enormous. Indeed, during the heart of the transformation in the nineteenth century, more people were leaving the city, the center of industry, than living in it.²⁰

By the 1920s, America was already a dazzling place. “The Roaring Twenties” saw the birth of jazz music, the newly-assertive “flapper” woman, raucous dance-halls and pubs, and the

16 Karen A. Kopecky et al., “A quantitative analysis of suburbanization and the diffusion of the automobile.” Retrieved from the MPR Archive, no. 13258 (February 2009), http://mpr.ub.uni-muenchen.de/13258/1/MPRA_paper_13258.pdf

17 Ibid

18 Ibid

19 Ibid

20 Ibid

emergence of a consumer culture.²¹ Mass production allowed manufactured goods to be purchased at very cheap prices. Items, especially automobiles, that once seemed luxurious were now easily obtainable by the average American. The invention of the automobile in the early twentieth century vitally altered the existing landscape. Its introduction meant that mechanized transportation could now be privatized and accessed for use more easily than ever before.²² Yet while the impact of this new mode of transportation was felt all around the industrialized world, no country embraced the car more strongly than the United States.²³ To Americans, the car symbolized freedom and success while encouraging individual achievement and private ownership. The beneficial aspects of the motor vehicle caused Americans to increasingly rely on it as a way of life, a dependence that would soon become entwined with the progress of suburbanization. Significantly, since 1920, at least over fifty percent of American households have possessed a private car.²⁴ In 1970, fifty years later, eighty-two percent of Americans owned an automobile, while twenty-three percent of those owners possessed at least one other car as well.²⁵ These statistics clearly show how ingrained the automobile became in American culture. By all accounts, this heavy reliance on automobiles is without a doubt one of the main reasons why the United States is the most suburbanized nation on the Earth. Other reasons also

21 David E. Nye, *Consuming Power: a Social History of American Energies* (Cambridge: the MIT Press, 2001), 158-183.

22 Karen A. Kopecky et al., "A quantitative analysis of suburbanization and the diffusion of the automobile." Retrieved from the MPR Archive, no. 13258 (February 2009), http://mpr.ub.uni-muenchen.de/13258/1/MPRA_paper_13258.pdf

23 Ibid

24 Michael Batty et al., "Traffic, urban growth, and suburban sprawl," *Center for Advanced Spatial Analysis*, no. 70 (November 2003), <http://eprints.ucl.ac.uk/216/1/paper70.pdf>

25 Karen A. Kopecky et al., "A quantitative analysis of suburbanization and the diffusion of the automobile." Retrieved from the MPR Archive, no. 13258 (February 2009), http://mpr.ub.uni-muenchen.de/13258/1/MPRA_paper_13258.pdf

contribute towards explaining why American cities have significantly higher rates of urban sprawl than other high-income countries, a trend that has proved evident particularly in the past fifty years.²⁶ For one, the United States possesses much more land area than its European counterparts; inherently, more open space allows for simple, cheap, and substantial horizontal expansion.²⁷ America, aptly nicknamed the “Melting Pot” of the world, is a drastically more diverse country with people from myriad backgrounds.²⁸ As is discussed later in this paper, class strife, racial tensions, and inner city crime played a large part in the collective move out of the urban inner city and, therefore, the eventual suburbanization of America. Lastly, the United States possessed the infrastructure necessary for urban sprawl to occur in the first place. Outlying areas beyond the central city were easily accessible by the mid-twentieth century, largely due to the Interstate Highway System implemented by the Eisenhower administration.²⁹ The construction of highways were also extremely effective at decentralizing concentrated urban centers; for every new freeway that crosses through the central region of the city, that concentrated area sees an eighteen percent decrease in residents.³⁰ As such, the overall combination of the United States' infrastructure, diversity, abundance of land, and automobile culture facilitated greater horizontal expansion than that of its counterparts.

Specific instances that figured into the progress of suburbanization, such as the Industrial

26 Peter Mieszkowski et al., “The causes of metropolitan suburbanization,” *The Journal of Economic Perspectives* 7, no. 3 (1993), <http://www.owlnet.rice.edu/~econ461/papers/mieszko2.pdf>

27 Ibid

28 Ibid

29 Ibid

30 Karen A. Kopecky et al., “A quantitative analysis of suburbanization and the diffusion of the automobile.” Retrieved from the MPR Archive, no. 13258 (February 2009), http://mpr.ub.uni-muenchen.de/13258/1/MPRA_paper_13258.pdf

Revolution and improvements in transportation, have, thus far, already been explicated. Suburbanization, however, can also be explained in the theoretical realm. By the late twentieth century, two main schools of thought dominated the study of suburbanization, and while each took drastically different approaches toward explaining its causes, their ideas overlap to some degree.³¹ To broadly summarize the theories, one approach, called the natural evolution theory, states that horizontal expansion is a natural process of cities, while the other model, called the fiscal-social problems theory, states that the wealthy leave the suburbs in order to escape the social and economic strife of the central city.³²

The natural evolution model, perhaps the more logic-based approach, asserts that the city houses the industry and the businesses first and foremost. Only after businesses have been firmly implanted do developers turn their attention to residential housing, which subsequently spread “inside-out” from the already constructed center of the city.³³ These new residential housing units, adapting to the abundance of open space around them, are generally built larger and more elaborate than those in the central city. As a result, they are also naturally more expensive and attract the attention of the wealthier city dwellers who can afford them.³⁴ Lower-income groups are left behind in the central city, as they do not have the financial means to join the movement of residency toward the outskirts of town. The result of this exodus of wealthier citizens to the suburbs is known as a phenomenon called “income-stratified neighborhoods.”³⁵

31 Peter Mieszkowski et al., “The causes of metropolitan suburbanization,” *The Journal of Economic Perspectives* 7, no. 3 (1993), <http://www.owlnet.rice.edu/~econ461/papers/mieszko2.pdf>

32 Ibid

33 Ibid

34 Ibid

35 Ibid

In summary, the natural evolution theory posits that, because of the pattern in which houses are built, the majority of poor citizens live in high-density housing in the center of cities, while the upper classes, largely due to their income advantage, are able to move out of the structural confinements of city life. That, in essence, is how post-WWII suburbanization came about according to the natural evolution theory.

Meanwhile, the fiscal-social problems theory contradicts the first by alleging that the process of urban sprawl is not as “natural” as the previous approach asserts. Instead, it proposes that suburbanization can be explained by racial and economic strife in the city. Because of the intransigent nature of these social and environmental tensions found in the inner city, a seemingly ceaseless cycle emerges: the wealthier city residents flee to the suburbs to avoid the said tension, which leaks the input of money from the central city area and further regresses the quality of life there, which in turn causes ever more migration from the city center.³⁶ The term “white flight” famously describes this phenomenon of outward motion of white Americans because of social issues and their desire for a homogenous community of only whites.³⁷ Ultimately, the inherent differences between the two theories is that one states that the move to the suburbs was in tune with population growth and the availability of open space, while the other asserts that racial and economic tensions dictate human migration. While the causes of suburbanization are integral in understanding urban sprawl, the effects of such sprawl are specifically what we examined in this project.

The consequences of suburbanization can be divided up into three categories: structural,

36 Ibid

37 Ibid

social, and environmental. We examined each closely for the damage – or, contrarily, the improvements – caused by horizontal residential expansion. First, the structural effects of urban sprawl are not insignificant. To begin with, suburbs are a severely inefficient way of constructing a city.³⁸ Instead of industry, utilities, and residents all occupying an area of close proximity to one another – which is, essentially, the definition of a city – suburbanization encourages people to live a considerable distance away from daily essentials. Instead of walking two blocks to the nearby grocery store, a suburbanite must drive to the nearest shopping center in order to purchase groceries. Urban sprawl is therefore loosely defined as “uncoordinated growth,”³⁹ as it wastes time and provides weak infrastructure. It must be noted, however, that simultaneously, it possesses some positive aspects as well. For example, industry and jobs are following the people out of the city and into the suburbs. Roughly seventy percent of metropolitan residents live outside the city proper, and sixty percent of the jobs have joined them in the outlying areas.⁴⁰ In general, though, as can be seen, decentralization is a process occurring in every aspect of the city, and one that contributes to an overall inefficient lifestyle.

While the social effects of suburbanization are more subtle than the tangible structural consequences of urban sprawl, on close examination the two have actually had an equally substantial impact on Americans. As previously discussed, a probable cause of horizontal expansion has to do with racial problems. The “white flight” to the suburbs only aggravates

38 Michael Batty et al. “Traffic, urban growth, and suburban sprawl.” *Center for Advanced Spatial Analysis*, no. 70 (November 2003), <http://eprints.ucl.ac.uk/216/1/paper70.pdf>

39 Ibid

40 Peter Mieszkowski et al., “The causes of metropolitan suburbanization,” *The Journal of Economic Perspectives* 7, no. 3 (1993), <http://www.owl.net.rice.edu/~econ461/papers/mieszko2.pdf>.

these ethnic tensions.⁴¹ Suburbanization further encourages the forming of homogeneous communities, a living arrangement that on the surface seems innocent, but in reality causes the residents to suffer socially due to the “segregation of social interaction.”⁴² Upon closer inspection, the suburbs and the homogeneous environments they promote have a decisively negative effect on social relations between ethnicities, racial groups, and classes.

First and foremost, this paper discusses the environmental effects of urban sprawl. Numerous statistics constituting quantitative data correspond to the fact that the environment has been harmed in large part due to urban sprawl. In 1950, fifty-seven percent of residents living in American metropolitan areas lived in central cities. In 1990, that number shrank to thirty-seven percent because of the move to the suburbs.⁴³ Considering the fact that suburbanites drive thirty-one percent more than their central city-dwelling counterparts,⁴⁴ it can be seen that more people live in the suburbs than in the city proper, and that the former drive cars more often than the latter. This discrepancy is a recipe for an environmental disaster, considering that one gallon of gas actually produces twenty pounds of harmful emissions.⁴⁵

What does this mean in qualitative terms? Thanks to automobile emissions, suburbanization is degrading air quality, as car exhaust releases detrimental greenhouses gasses into the air.⁴⁶ The automobile does not act as the lone culprit of urban sprawl. The act of

41 Michael Batty et al., “Traffic, urban growth, and suburban sprawl.” *Center for Advanced Spatial Analysis*, no. 70 (November 2003), <http://eprints.ucl.ac.uk/216/1/paper70.pdf>

42 Ibid

43 M.E. Kahn, “The environmental impact of suburbanization,” *Journal of Policy Analysis and Management* 19, no. 4 (2000), <http://www.jstor.org/stable/pdfplus/3325575.pdf>.

44 Ibid

45 Ibid

46 Ibid

clearing land to make room for these new residences destroys the natural habitats of the flora and fauna living in the area. The American countryside is being wiped out of existence, and there are no signs of letting up. There is a strong correlation between low population density and increased car use,⁴⁷ so we can assert that more suburbanization leads to more harmful emissions. Pollution is increasing, and in the United States automobile ownership has almost reached full capacity, meaning one car per capita.⁴⁸ As outlined above, urban sprawl is clearly affecting the environment of our country. As such, our project asks to what exact extent is suburbanization affecting the environment of our county. We look specifically at Montgomery County, a region that has mirrored the country's industrial development and further experienced rapid increases of growth in the past century, for a potential answer.

III. The History of Suburbanization in Montgomery County

Located in western Maryland and a little ways north of the capital in Washington, D.C., Montgomery County is a prime example of the process of suburbanization that swept over the country in the twentieth century. Though today it boasts one of the highest median income levels across the country, its beginnings were much more humble. Its ultimate development from a rural and agriculture-based terrain to a wealthy community of suburbs dependent on automobiles mirrors much of the sentiments and progress that occurred in the United States during the same

47 Karen A. Kopecky et al., "A quantitative analysis of suburbanization and the diffusion of the automobile." Retrieved from the MPR Archive, no. 13258 (February 2009), http://mpr.ub.uni-muenchen.de/13258/1/MPRA_paper_13258.pdf.

48 Michael Batty et al., "Traffic, urban growth, and suburban sprawl," *Center for Advanced Spatial Analysis*, no. 70 (November 2003), <http://eprints.ucl.ac.uk/216/1/paper70.pdf>.

periods of time.

Like the country itself in the colonial days before it became the United States of America, Montgomery County began as a rural stretch of woody land. In 1634, Henry Fleete, a young Englishman in search of adventure, provided the first written account of it, declaring in his diary that “this place is without question the most pleasant in all this country...the river aboundeth in all manner of fish...and for deer, buffalos, bears, and turkeys, the woods do swarm with them and the soil is exceedingly fertile.”⁴⁹ He added toward the end of his entry in a perhaps unknowingly prophetic move that it was also “most convenient for habitation” for English settlers, most likely acknowledging the aggressive British colonialism that was simultaneously taking place.⁵⁰

At the time, the only human inhabitants of the land consisted of Indians, primarily the Piscataway Indians of the Algonquin nation, who occupied the eastern shore of the Potomac River.⁵¹ The land, however, served primarily as a temporary hunting ground for the Indians, and little evidence exists of permanent Indian settlements.⁵² Montgomery County in its earliest documented days was therefore largely uncultivated and existed entirely in its natural element, undisturbed by any extensive human-made constructions. However, such quiet did not last long. George Calvert, First Baron of Baltimore, was granted a charter for the colony of Maryland in 1632,⁵³ though it was not until 1688 that the first patent for land was passed.⁵⁴ It was not until

49 Grace G.D. Peter, *A Portrait of Old Georgetown* (Richmond: Dietz Press, Incorporation, 1951), 35.

50 Ibid, 16

51 Jane C. Sween, *Montgomery County, Two Centuries of Change* (Woodland Hills: Windsor Publications, 1984), 11.

52 Ibid, 11.

53 Ibid, 13.

54 *Montgomery County, Maryland: Our History and Government* (Rockville: Montgomery County, Maryland and The Montgomery County Historical Society, 1999), <http://www.montgomerycounty.gov/Content/culture/images/history.pdf>.

still later in the early eighteenth century that settlers of English or Scottish descent — younger sons who had inherited the land, indentured servants, and thrill seekers alike — arrived and began constructing homes and farms in earnest to begin a life on the new land.⁵⁵

Small towns and settlements that would eventually form the core of Montgomery County started cropping up in the early eighteenth century. Rockville, for example, was formed in 1717, Frederick in 1745, and Georgetown⁵⁶ following soon after in 1751.⁵⁷ It was during that period of time that George Washington, upon visiting the terrain that would ultimately become Gaithersburg, commented that it was “rather hilly, lands good and well timbered.”⁵⁸ The structure and shape of these rudimentary beginning towns differed drastically from what they are like today. Homes were cabins, consisting of one or two rooms and a loft.⁵⁹ The population was spread over a large area, and no government existed in the early years. Instead, each small community existed as rudimentary forms of settlements, functioning isolated and scattered from the others, in part due to a lack of a means of communication as well as the severe lack of people with which to communicate.⁶⁰ It was not until 1807 that the first regular mail coaches began to run between Georgetown and Frederick, providing a slow but feasible attempt at communication

55 Jane C. Sween, *Montgomery County, Two Centuries of Change* (Woodland Hills: Windsor Publications, 1984), 17.

56 Georgetown is a city located between Montgomery County and Washington, D.C. Before it was ceded in 1971 along with other portions of Montgomery County to officially assimilate into and form the new District of Columbia, it was a separate municipality counted as a part of Montgomery County.

57 *Gaithersburg, the Heart of Montgomery County: A History Commemorating Gaithersburg's Charter Centennial* (*Gaithersburg: The City of Gaithersburg, 1978*), 21.

58 *Ibid*, 16.

59 *Montgomery County, Maryland: Our History and Government* (Rockville: Montgomery County, Maryland and The Montgomery County Historical Society, 1999), <http://www.montgomerycounty.gov/Content/culture/images/history.pdf>.

60 *Ibid*

between towns.⁶¹ As for the county itself, Montgomery County was officially established on September 6, 1776, when the Maryland Constitutional Convention passed a bill sponsored by Thomas Sprigg Wootton that divided Frederick County into three parts and effectively created two new counties in the form of Montgomery and Washington, and was thusly drawn into existence: “Beginning at the east side of the mouth of Rock Creek on the Potomac River, and running thence with the said river to the mouth of the Monocacy, then with a straight line to Parr's Spring, from thence with the lines of the county to the beginning, shall be and is hereby erected into a new county called Montgomery.”⁶²

Montgomery County fostered an agriculturally-based environment from the start. Yearly conditions were ideal for such an industry. Rainfall recorded at a steady forty inches per year and was, for the most part, consistent throughout all the seasons;⁶³ the growing season clocked in at an average 170 to 200 days,⁶⁴ and the climactic conditions of mostly warm and fairly humid weather allowed the cultivation of all major crops except cotton.⁶⁵ Despite this, tobacco still thoroughly dominated the agricultural life in Maryland and Virginia, and was undoubtedly the “money crop” in the earliest days of Montgomery County.⁶⁶ The predominance of tobacco in the County's agricultural industry was due to a variety of reasons, the foremost being efficiency, for no other colonial crop made such productive use of cleared lands and provided as great a return

61 Ibid

62 Jane C. Sween, *Montgomery County, Two Centuries of Change* (Woodland Hills: Windsor Publications, 1984), 36.

63 *Gaithersburg, the Heart of Montgomery County: A History Commemorating Gaithersburg's Charter Centennial* (*Gaithersburg: The City of Gaithersburg, 1978*), 32.

64 Ibid, 35.

65 Ibid, 32.

66 David O. Percy, *The Production of Tobacco Along the Colonial Potomac*, National Colonial Farm Research Report No. 1 (Accokeek: Accokeek Foundation, 1979), 8.

for the labor as tobacco did.⁶⁷ Taking into account the time period and the state of the settlers' status as a colony under Great Britain as well, tobacco was deemed in Great Britain a necessary and “acceptable” product for her colonies to produce.⁶⁸ Tobacco production in Montgomery County increased rapidly, and by 1750, it was a large contributor to the 70 million pounds of tobacco grown in Maryland overall.⁶⁹ Though tobacco eventually declined as the predominant crop, ceding its place to other crops such as corn, oats, and, most significantly, wheat, which emerged in the 1820s as the most important crop in Montgomery County,⁷⁰ the County still remained firmly rooted in its agricultural traditions. During the 1840s the Society of Friends, or the Quakers, introduced new agricultural practices such as crop rotation, deeper plowing, and fertilization which further revitalized the industry.⁷¹ By 1854, Montgomery County's agricultural industry was so profitable that it was proclaimed a “model county, in the whole routine of agricultural improvements of the day”, its system for “renovating poor lands, [its] selection of fertilizers, and [its] mode of applying them” having spread and been adopted by farmers as far away as Delaware.⁷²

Even so, the growth of agriculture in the eighteenth and nineteenth centuries would not have been as extensive nor as successful without the aid of transportation, or, more specifically,

67 Ibid, 8.

68 Ibid, 8.

69 Ibid, 10.

70 William Offutt, *A History of Montgomery County* (Rockville: The Montgomery County Historical Society, n.d.), 13.

71 *Montgomery County, Maryland: Our History and Government* (Rockville: Montgomery County, Maryland and The Montgomery County Historical Society, 1999), <http://www.montgomerycounty.gov/Content/culture/images/history.pdf>

72 Chauncey P. Holcomb, “Address before Montgomery County, Maryland, Agricultural Society” (report presented at the Annual Exhibition of the Agricultural Society, Rockville, Maryland, September 14, 1854).

improvements in transportation. The state of transportation modes lacked severely in Montgomery County; for much of the nineteenth century, residents primarily had to travel either by foot or depend heavily on horses.⁷³ Indeed, the first paved road in the County, a turnpike from Rockville to Georgetown, was chartered in 1806⁷⁴ and completed only in 1829.⁷⁵ Even then, its conditions, as well as those of the few other roads constructed in the County, were poor and crude, making it barely navigable for most travelers.⁷⁶ The consequences of this were severe: not only was regular travel in and out of the County exceedingly difficult, the substandard state of the roads further made it troublesome to haul the homegrown crops in Montgomery County into the outside market to sell.⁷⁷ For a society so dependent on agriculture as its principal form of profit, the implications of these obstacles were potentially disastrous.

Two new major forms of transportation emerged in the nineteenth century and tried to alter the existing pattern of lamentable transportation conditions, the first of which was the Chesapeake & Ohio Canal that began construction in 1828 and was completed in 1850.⁷⁸ Based on the idea that it would enhance trade between the Potomac and the Ohio River Valley, it ultimately succeeded for the most part, creating jobs such as that of the lockkeeper and

73 *Montgomery County, Maryland: Our History and Government* (Rockville: Montgomery County, Maryland and The Montgomery County Historical Society, 1999), <http://www.montgomerycounty.gov/Content/culture/images/history.pdf>.

74 T.H.S. Boyd, *the History of Montgomery County, Maryland, from its earliest settlement in 1650 to 1879* (Baltimore: Regional Publishing Company, 1979), 74.

75 P. Chickering, "The Evolution of the Central Business District of Rockville, Maryland: 1938 – 1988". Diss., University of Maryland, College Park, 1988.

76 Jane C. Sween, *Montgomery County, Two Centuries of Change* (Woodland Hills: Windsor Publications, 1984), 46.

77 *Ibid*, 46.

78 *Montgomery County, Maryland: Our History and Government* (Rockville: Montgomery County, Maryland and The Montgomery County Historical Society, 1999), [h <http://www.montgomerycounty.gov/Content/culture/images/history.pdf>](http://www.montgomerycounty.gov/Content/culture/images/history.pdf).

increasing the in and out-flow of trade that permeated the County.⁷⁹

The second novel mode of transportation to materialize in Montgomery County was the railroad, in the form of the Baltimore and Ohio Railroad, on which work officially began on July 4, 1828.⁸⁰ More commonly known as the B&O Railroad, it was historically significant for myriad reasons. It was not only one of the oldest railroads in the United States, but it was also the first common carrier railroad.⁸¹ Its heightened speed and efficiency, improvements even over those of the canal, made it attractive to almost every region remotely involved in its construction. After one of the branches had extended to Frederick, for example, agriculture in Frederick boomed, as the railroad transported grain and flour that both supplied the area and created export trade.⁸² Yet the railroad itself was distant from much of Montgomery County, until development plans for the railroad's further extensions changed in the mid-1800s.⁸³ The Metropolitan Branch, as the new extension was later called, was devised to run from Washington, D.C. to Point of Rocks, Maryland, and would cut a straight line through the Gaithersburg portion of Montgomery County, much to the excitement of its residents.⁸⁴ Construction of the Metropolitan Branch was completed in Gaithersburg on February 8, 1873 amid much fervor; that day the headline of the *Sentinel* newspaper proclaimed "Last Rail Laid, at Gaithersburg", and the newspaper itself even

79 Jane C. Sween, *Montgomery County, Two Centuries of Change* (Woodland Hills: Windsor Publications, 1984), 50.

80 *Gaithersburg, the Heart of Montgomery County: A History Commemorating Gaithersburg's Charter Centennial* (Gaithersburg: The City of Gaithersburg, 1978), 82.

81 *Ibid*, 83.

82 *Ibid*, 83.

83 *Ibid*, 84.

84 *Ibid*, 85.

dedicated an entire section to the event.⁸⁵ The existence of the B&O Railroad and its close proximity to Montgomery County soon proved monumentally beneficial. The trade that the railroad was able to facilitate brought an almost immediate boom to the dairy and agricultural industries, and encouraged growth and prosperity in Montgomery County in general.⁸⁶

The construction of the railroad also had crucial consequences for housing patterns in Montgomery County at the time, inducing a “rural real estate boom”⁸⁷ as the accessibility of the railroad made it possible for developers to build a rapidly increasing number of residential homes.⁸⁸ As a result, suburbs at Takoma Park, Silver Spring Forest Glen, and Beallesville nearly doubled in size, while old Georgetown disappeared in favor of a new, more modern Georgetown situated next to the railroad.⁸⁹ Perhaps the impact of the railroad can best be explained by John T. DeSillum, a prominent home-owner in Gaithersburg, who in 1891 professed:

“This formerly humble town has since the competition of the railroad developed a trade and importance hitherto thought impossible. More wheat is being annually delivered here than was formerly grown in the whole county. A merchant mill can now produce 150 barrels daily capacity, and our trade in cereals, fertilizers, lumber, and coal, to name only a few, has increased still further.”⁹⁰

In specific numbers, the opening of the metropolitan railroad contributed to a marked increase—over a half million dollars total—being spent yearly by the residents of the County on the

85 *Gaithersburg, the Heart of Montgomery County: A History Commemorating Gaithersburg's Charter Centennial* (Gaithersburg: The City of Gaithersburg, 1978), 91.

86 *Ibid*, 97.

87 *Ibid*, 97.

88 *Montgomery County, Maryland: Our History and Government* (Rockville: Montgomery County, Maryland and The Montgomery County Historical Society, 1999), <http://www.montgomerycounty.gov/Content/culture/images/history.pdf>.

89 *Gaithersburg, the Heart of Montgomery County: A History Commemorating Gaithersburg's Charter Centennial* (Gaithersburg: The City of Gaithersburg, 1978), 101.

90 *Ibid*, 121.

purchase of lime, phosphates, bone, and other such fertilizers.⁹¹ The increase in spending was subsequently put into farming and resulted in the production of, for example, eighteen to fifty bushels of wheat and thirty to sixty bushels of corn per acre, which in turn induced an increase in employment for over thirty mills.⁹²

By 1910, the total number of miles of road amounted only to 830, of which ninety-nine miles were stone roads of “varying degrees of excellence.”⁹³ Furthermore, for every mile of stone road, there were seven and a half miles of dirt road.⁹⁴ A 1912 rural survey of the County concluded that Montgomery is “not to any considerable extent a manufacturing county”.⁹⁵ Meanwhile in 1910, the total value of farm property was an immense \$21,000,000 and the total population numbered around 32,089. Indeed, by then Montgomery County was still considered, qualitatively and mathematically,⁹⁶ rural by definition.⁹⁷

Yet how did this primarily agriculturally-based community in Montgomery County transition into the manufacturing, middle-class society of the late twentieth century? Montgomery County residents' overall change in attitude had already taken root and was beginning to change in the late 1800s, correspondingly shifting positively with the American

91 T.H.S. Boyd, *the History of Montgomery County, Maryland, from its earliest settlement in 1650 to 1979* (Baltimore:Regional Publishing Company, 1979), 110.

92 Ibid, 110.

93 *A Rural Survey in Maryland* (New York City: the Department of Church and County Life of the Board of Home Mission of the Presbyterian Church, 1912), 25.

94 Ibid, 25.

95 Ibid, 26.

96 The density of the rural population for the entire state of Maryland in 1910, according to the Census definition of “rural” was 64.1 inhabitants per square mile. The density of the total population of Montgomery County in 1910, as shown by the 1910 Census, was 32,089 people. Meanwhile, the total land area of the County amounted to 521 square miles. This leads to a density of 61.4 inhabitants per square mile in Montgomery County, a number less than the density (64.1/sq. Mile) of the rural population in Maryland in 1910.

97 *A Rural Survey in Maryland* (New York City: the Department. of Church and County Life of the Board of Home Mission of the Presbyterian Church, 1912), 30.

Industrial Revolution and the nation's increasingly "pro-business sentiments" in an "age of materialism."⁹⁸ By 1850, already eighty industrial establishments⁹⁹ existed in the county, and the introduction of the railroad as well as other advanced modes of travel thrust the enthusiasm for a new, modern society onwards. The first electric streetcars began operating in 1888, and within five years there were dozens of electric railway lines stretching into Montgomery County from most of the larger, more prominent cities.¹⁰⁰ By 1920, the fastest growing areas were those along the streetcar lines in Bethesda and Silver Spring, for, like the railroad, the trolley line increased accessibility and encouraged people who were not farmers to reside in the County.¹⁰¹

The County's close proximity to and association with Washington, D.C., the capital of the United States, also proved to be a driving factor in its change of demographics and industry. Workers looking for work in the Federal Government considered the County's relatively close distance to the capital an advantage, while families—mostly wealthy ones—who wished a "pleasant" retreat from the day-to-day banalities and discomforts of Washington looked toward Montgomery County, a nearby, quieter alternative, to reside.¹⁰² Correspondingly, though available lots for housing were initially small and inexpensive, developers quickly realized that more affluent buyers could be attracted.¹⁰³ Brochures with such flashy titles as, "How to Get

98 *Montgomery County, Maryland: Our History and Government* (Rockville: Montgomery County, Maryland and The Montgomery County Historical Society, 1999), <http://www.montgomerycounty.gov/Content/culture/images/history.pdf>.

99 In this case, "industrial establishments" include, but are not limited to, mills, small factories, and tanneries.

100 William Offutt, *A History of Montgomery County* (Rockville: The Montgomery County Historical Society, n.d.), 26.

101 *Ibid.*, 27.

102 S. Wheeler, "A Sociological Study for a Community: Rockville, Maryland." (Diss., University of Maryland, College Park, March 12, 1971), 4.

103 Jane C. Sween, *Montgomery County, Two Centuries of Change* (Woodland Hills: Windsor Publications, 1984), 6 62.

Health, Wealth, and Comfort: Peerless Rockville,” “Gaithersburg, Maryland: Its' Advantages,” and “Takoma Park: the Sylvan Suburb of the National Capital” were among many of the ways they attempted to draw the wealthier into the County.¹⁰⁴ As the Federal Government began decentralizing its operations in the latter years of the Great Depression, one of the places to which it looked to move its agencies was the nearby Montgomery County,¹⁰⁵ which in turn drew more federal workers to permanently reside in the County.¹⁰⁶ The attraction of the capital was such that, by the mid-1900s, fifty percent of Rockville's residents either worked in Washington, D.C. or for a Federal Government office elsewhere.¹⁰⁷

The immediate period after World War II saw a dramatic change in population. Between 1940 and 1950, the population of Montgomery County doubled to 154,000, and by 1960, it had doubled again to 328,000. The 1960s were further witness to a sweeping change toward suburbanization. It was a period during which 22,000 homes and apartments were built in the Wheaton-Silver Spring region, 14,356 new homes were constructed in the Rockville region, and the Potomac region saw an increase from 956 homes in 1950 to 3,309 homes in 1970.¹⁰⁸ The County was truly becoming a suburb.

Finally, just as we used suburbanization in Montgomery County as a case study for

104 Ibid, 62.

105 A number of significant Federal agencies were moved during this time period, including the National Institute of Health (NIH) now located in Bethesda and Rockville. Still later during the 1960s and 1970s, more agencies including the Department of Energy, Bureau of Standards, and a large part of the Department of Health and Human Services were also moved to locations in Montgomery County.

106 P. Chickering, “The Evolution of the Central Business District of Rockville, Maryland: 1938 – 1988.” (Diss., University of Maryland, College Park, 1988), 12.

107 Ibid, 12.

108 William Offutt, *A History of Montgomery County* (Rockville: The Montgomery County Historical Society, n.d.), 26.

suburbanization across the nation in this paper, here we used Rockville in the 1960s—arguably the hub of activity in the County as its town center—as a case study for Montgomery County in the 1960s to more succinctly examine the growing signs of suburbia that took place there in that same decade. In 1860, Rockville's population totaled a grand 363 inhabitants, a number which had increased to 1,100 by 1900 and 1,460 by 1930. Yet the most dramatic increase in population took place between 1950 and 1970; the 6,934 population in 1950 experienced a 276.3% increase to 26,090 in 1960, which then nearly doubled to 41,564 inhabitants by 1970.¹⁰⁹ Furthermore, in 1960, 2.1% of the population was foreign born, 37.9% was native, 27.9% were migrants to Rockville after 1958, being either out of state or out of county, and 32.1% was intra-county migration. Overall, this amounts to 70% of the population that moved to Rockville after 1958.¹¹⁰ The Rockville population in 1960 was undoubtedly middle-class as well. The median income was \$4,738, which was high by 1960 standards, while the median cost for housing was \$14,700, which was, again, high by 1960 standards.¹¹¹ As such, Rockville in 1960 showed all the signs of experiencing suburbanization. Its middle-class society, buoyed by rapidly increasing population growth from migration, set up the stage for its transition into an unmistakably fixed suburban community from 1970 to 1990.

109 S. Wheeler, "A Sociological Study for a Community: Rockville, Maryland." (Diss., University of Maryland, College Park, March 12, 1971), 5.

110 Ibid, 5.

111 Ibid, 6-8.

IV. The Effect of Suburbanization on Automobile Usage in Montgomery County

With the advent of suburbanization, many lifestyle changes came along as well. One of the major changes that are characteristic of this time period is patterns of automobile usage. In order to analyze the effect that suburbanization had on automobile usage in Montgomery County during our time period of 1970 to 1990 in particular, we gathered data from traffic volume maps and topographical maps. Additionally, we looked at automobile usage statistics for the United States as a whole in order to confirm that Montgomery County followed similar trends.

The first sets of data that we analyzed were collected by the Maryland State Highway Administration (SHA). The Administration collected data regarding Average Annual Daily Traffic (AADT) using the seventy-nine automated traffic recorders (ATR), 3000 program count stations, and seven toll count stations, all found throughout the state of Maryland. The AADT that appear on the map are not exact, but rather are estimates which were derived from combining several sets of data.¹¹²

Since these maps were divided by county, it was simple enough to track the traffic patterns in Montgomery County. We looked at the maps over the years for which data was collected during our time period, which in this case was 1980-1990.¹¹³ Here we provide a few examples of data tracked in certain areas of the county, including specific points in Gaithersburg, Damascus, and Montgomery Village. We pinpointed one specific location within each area which we were then able to track over time. We chose these places because data was consistently

112 *Montgomery County Traffic Volume, 1980-1990*. Map. Baltimore City: Maryland Department of Transportation. marylandroads.com/Traffic_Volume_Maps/Traffic_Volume_Maps.pdf.

113 Our period of investigation was 1970–1990, however, unfortunately, there was no data before 1980 available to us.

collected in each location, making it easier to track. These areas reflect just three instances of the overall trends of increased automobile usage that we found throughout Montgomery County. The maps that we focused on were from the years of 1980, 1982, 1985, 1987, and 1990.¹¹⁴ By utilizing the data given, we created a chart of the locations we pinpointed and subsequently analyzed the percentage increase in all three locations. We determined both the total percentage increase from 1980 to 1990 of AADT as well as the percent increase or decrease from year to year (See Figure 1 below).

AADT → Year	Gaithersburg, Seneca Creek (Increased by)	Damascus, Etchison (Increased by)	Montgomery Village, Goshen (Increased by)
1980	1900	1000	4700
1982	2000 (5%)	1125 (12.5%)	4900 (4.3%)
1985	2600 (30%)	1400 (24.4%)	6475 (32.1%)
1987	4675 (80%)	1550 (10.7%)	5975 (-7.7%)
1990	4375 (-6.4%)	1825 (17.7%)	8000 (33.9%)
TOTAL % increase from 1980-1990	130.3%	82.5%	70.2%

Figure 1. Data chart detailing the Average Annual Daily Traffic and related statistics in the years 1980-1990 in three separate regions of Montgomery County. Source: Maryland Department of Transportation

In the area of Gaithersburg, we pinpointed Seneca Creek as our point of comparison over the years. As evident in the chart, this place saw an overall increase in AADT of 130.3% from 1980 to 1990. While there was a drop from 1987 to 1990 of 6.4%, the AADT steadily increased for the rest of the years.¹¹⁵ The next spot that we focused on was Etchison in Damascus. Over the years, this spot saw a total increase in AADT of 82.5%. While the overall percentage increase

114 Ibid

115 Ibid

was not as high as that of Seneca Creek, the AADT also steadily increased throughout the data collection period, with no years in which a decrease was observed.¹¹⁶ Finally, we examined the area of Montgomery Village in Goshen. This location saw an overall total increase of 70.2%. There was a decrease in AADT by 7.7% from 1985 to 1987, but otherwise the AADT at this site steadily increased.¹¹⁷

The patterns in the data from these AADT maps are very enlightening. Though some trends appear more dramatic than others, all areas graphed showed a strong overall increase in AADT between the period of 1980–1990. Clearly, as suburbanization took hold in Montgomery County, highways were frequented more and more often.

The next data we looked at were the Geographic Information Systems (GIS) maps. These GIS maps are a series of topographical maps that show the development in housing over time. Since McKeldin Library at the University of Maryland campus had the maps for Montgomery County across multiple years, we were able to trace the levels of development of geographical areas over time. On these maps, a purple-colored section denoted a newly constructed area as of the time the map was created.

These maps were critical for our research in several ways. For this part of our analysis, we utilized the maps in order to track the development of highway expansion in Montgomery County. We also found drastic increases in housing developments. We examined specific places within the broader scope of Montgomery County, including Seneca Creek,¹¹⁸ Montgomery

116 Ibid

117 Ibid

118 U.S. Forest Service, “Gaithersburg,” 1:24000. Edited by the Geological Survey, 1971.

Village,¹¹⁹ and Muddy Branch.¹²⁰ Here, we focused on the changes within these three areas between the 1971 and 1983 maps. (In the following images, the maps from 1971 appear on the left and the maps from 1983 are on the right.)

The first area that we focused on was Seneca Creek, located in Gaithersburg (see Figure 2).¹²¹ Here we found new residential roads as well as new housing developments in the 1983 map that were not yet built in 1971. Additionally, the extension of previously built residential roads was also evident.



Figure 2. GIS Map of Seneca Creek, Montgomery County (1971 and 1983). Source: U.S. Forest Service

U.S. Forest Service, "Gaithersburg," 1:24000. Edited by the Geological Survey, 1983.

119 Ibid

120 Ibid

121 U.S. Forest Service, "Gaithersburg," 1:24000. Edited by the Geological Survey, 1971.

U.S. Forest Service, "Gaithersburg," 1:24000. Edited by the Geological Survey, 1983.

The next area that we focused on was Montgomery Village in Rockville (see Figure 3).¹²² These maps reflected a major extension of the highway in the area between 1971 and 1983. According to the map, in 1971 Montgomery Village Avenue was partially built, with the rest of the path for the road in the preparation stages. By 1983, Montgomery Village Avenue, by then the main road that ran through the area, appeared to be complete, creating another highway for increasing automobile traffic. Also shown in this map is a heavy increase in new housing developments that appear in the 1983 map, but not in the 1971 map.



Figure 3. GIS Map of Montgomery Village, Montgomery County (1971 and 1983). Source: U.S. Forest Service

¹²² U.S. Forest Service, "Rockville," 1:24000. Edited by the Geological Survey, 1971.
U.S. Forest Service, "Rockville," 1:24000. Edited by the Geological Survey, 1983.

The last area we examined in the GIS maps was Muddy Branch, also located in Rockville (See Figure 4).¹²³ Between the 1971 and 1983 maps, the most notable feature was the major amount of housing developments that appeared in the latter map. Also in the 1983 map were new roads that wound their ways through the new housing areas. In 1971 it appears that the foundations for these roads and housing developments were laid, and by 1983 they seem to be fully developed.



Figure 4. GIS Map of Muddy Branch, Montgomery County (1971 and 1983). Source: U.S. Forest Service

All of the patterns that we found in these GIS maps showing new housing developments, highways, and residential roads springing up outside of the city itself reflect the trends of

123 Ibid

suburbanization over time. This information integrates well with our data concerning increased automobile usage. The amount of daily traffic increased around the same time that the roadways were constructed and the highway was expanded. Also as mentioned previously, the GIS maps show the trend of developers creating new housing areas near the highway itself.

After looking at data specific to Montgomery County, we examined automobile usage data across the country. The trends that we found in Montgomery County were also apparent in the data for the entire nation. The two main charts that we refer to in this section are both from the Historical Statistics of the United States, Millennial Edition, a “compendium of statistics from over 1000 sources last updated in the distant 1975” that constitutes the “standard source for the quantitative facts of American history”.^{124 125}

This first table that we used in our analysis is entitled “Consumption Expenditures on Consumer Durables by Major Commodity group from 1869-1986”.¹²⁶ This chart details quantitative data on the consumption expenditures on consumer durables by major commodity group from 1869-1986. Among these consumption expenditures is the category of “Automobiles and parts” as well as “Other motor vehicles” that was relevant to our research. Efficiently laid out in the form of a data table, this shows in plain numbers the drastic increase in the number of automobiles and parts being bought.

124 *Table Cd411-423*. Chart. Cambridge: Cambridge University Press
hsus.cambridge.org/HSUSWeb/search/searchessaypdf.do?id=Cd411-423.

125 *Table Df38-47*. Chart. Cambridge: Cambridge University
 Press. hsus.cambridge.org/HSUSWeb/search/searchessaypdf.do?id=Df38-47.

126 *Table Cd411-423*. Chart. Cambridge: Cambridge University Press.
hsus.cambridge.org/HSUSWeb/search/searchessaypdf.do?id=Cd411-423

Further, this gives us an understanding of the trends occurring in the United States as a whole. According to the trends evident in the chart, it is clear that consumption of automobiles and automobile parts was on the rise from 1970-1990, just as it was in Montgomery County at that time. It must also be taken into account, however, that these numbers record only the automobiles and parts bought, not used. Additionally, automobile production companies would also figure into these statistics, in addition to the parts bought by regular consumers themselves.

According to our analysis based on this chart,¹²⁷ the combined consumption of automobiles and parts and other motor vehicles for the United States rose from \$33,008 million in 1970 to \$171,323 million in 1986, a 419% overall increase. At first glance this seems like an explosion of consumption of automobiles, but again, we have to remember that this does not necessarily reflect the usage of these purchased automobiles. Additionally, these numbers must be taken with the knowledge of the total overall consumption in America at the time: In 1970 the total consumption was \$83,072 million, and by 1986 it skyrocketed to \$379,677 million – an overall rate of change of 357%. Even if not perfect, this information is still useful in that it tells us that there was a trend of Americans buying more automobiles and other motor vehicles.

The second chart we looked at is entitled “Domestic Intercity Passenger Traffic by Type of Transportation (including private automobile), from 1939-1996”.¹²⁸ This chart details quantitative data on domestic intercity passenger traffic by type of transportation, from 1939-1996. Among the types of transportation listed are: private automobile, airways, buses, railroads,

127 Ibid

128 *Table Df38-47*. Chart. Cambridge: Cambridge University Press.

hsus.cambridge.org/HSUSWeb/search/searchessaypdf.do?id=Df38-47

and inland waterways. Using this, we can easily see how the usage rate of private automobiles has changed in relation to the usage rates of other forms of transportation as the landscape of the country itself changed. Helpfully, the table included percentage as well as volume to document the changes, so as to further clarify the situation for us. This table documented usage rates in the entire United States.

In this chart, the volume of intercity traffic was recorded for the nation. The units for this data were given in billion passenger-miles. The document described passenger-miles as “one passenger carried one mile.”¹²⁹ In terms of transportation by private automobile, it started out in 1970 at 1,026.0 and increased to 1,638.8 by 1990, which reflects an overall increase of approximately sixty percent. For all modes of transportation combined, the total in 1970 is 1,180.8, which increased to 2033.9 in 1990. This is a seventy-two percent increase in overall transportation in America in the twenty year period. This shows that in total, the rate of overall travel in the US increased at a higher rate than transportation by private automobile.

Additionally in this chart, the percentage of automobiles versus other modes of transportation was recorded. It appears that the percentage of transportation by private automobile actually decreased from 86.89% in 1970 to 80.57% in 1990. Conversely, there seems to be a clear increase in airway travel, starting at 10.04% in 1970 and increasing to 17.65% of all transportation in 1990.

This is an interesting pattern. Since the volume of total transportation in America

129 Ibid

increased at a higher rate than the volume of private automobile traffic, the percentage of private automobile traffic as part of total transportation decreased. With this came the increase in air travel. However, these statistics still correlated with our data from Montgomery County: the volume of automobile traffic clearly increased in both instances, even if nationally automobile travel became a smaller percentage of total transportation overall.

V. The Environmental Effects of Suburbanization in Montgomery County and in the Nation

The suburbanization of Montgomery County caused a vast increase in the number of homes and automobiles in this area. Both of these require a significant expenditure of energy every day. In Montgomery County, as in most areas across the country, the majority of residential electricity comes from the combustion of coal. Automobiles are powered by petroleum. These two fossil fuels are the source for about two-thirds of the energy consumed in this country, largely due to their use across the residential and transportation sectors. Increases in the number of homes and automobiles per capita accounted for more than forty percent of the increase in energy consumption in developed countries from 1970 to 1990.¹³⁰ The effect of the new homes that were built in this time period was compounded by their spatial arrangement. The fact that the homes in the suburbs appearing across the nation were built at a very low density and apart from their corresponding urban centers indirectly caused a huge increase in

130 D.E. Pataki et al., "Urban ecosystems and the North American carbon cycle," *Global Change Biology* 12, (2006), <http://ddr.nal.usda.gov/bitstream/10113/28668/1/IND43844126.pdf>.

national energy use and pollution. The driving force behind the energy consumption and atmospheric impacts brought about by sprawl was the explosive growth of automobile use.¹³¹

The increased energy use brought on by suburbanization on a national scale caused substantial atmospheric pollution. Fossil fuels like coal and petroleum are burned because they contain hydrocarbons, which release a high yield of stored chemical energy when they combust. This process releases carbon dioxide but also many chemicals that are far more toxic and environmentally persistent. This occurs because of impurities in the fuel or its incomplete combustion. In any case, the conditions typical of suburbs, including low-density development and disconnected street networks, consistently predict greater emissions of these fossil fuel byproducts.¹³² Urban sprawl has a well-documented link to increasing fossil fuel emissions per capita.¹³³ Low-density neighborhoods produce far more emissions than high-density neighborhoods with equivalent home energy needs. So what is the reason for this relationship between suburbanization and pollution? Simply put, suburbanization increases automobile use, and more automobile use means more fossil fuel combustion and therefore more emissions. Inhabitants of the suburbs are highly dependent on automobiles for travel and typically use their cars for each outing, whether it be a one-mile long or a twenty-nine mile long trip. The commute from the suburbs to the city can be dozens of miles long, taking more than an hour each way; it is

131 David J. Cieslewicz, "The environmental impacts of sprawl," in *Urban Sprawl Causes, Consequences, and Policy Responses* (New York: Urban Institute, 2002), 23.

132 D.E. Pataki et al., "Urban ecosystems and the North American carbon cycle," *Global Change Biology* 12, (2006), <http://ddr.nal.usda.gov/bitstream/10113/28668/1/IND43844126.pdf>.

133 Howard Frumkin et al., *Urban Sprawl and Public Health: Designing, Planning, and Building for Healthy Communities* (Melbourne: Island Press, 2004), 152.

energy intensive due to traffic, the vast distance traversed, and the often-circuitous nature of the route. According to Diane Pataki, a doctor of ecology at the University of California – Irvine, “reductions in density and increases in the spatial extent of settlements and road networks result in increasing commuting distances, vehicle miles traveled, and related vehicular emissions.”¹³⁴ Therefore, the massive growth of the suburbs in the second half of the twentieth century meant that huge numbers of people began to drive many miles every single day. In fact, between 1969 and 1990, the number of miles driven per capita grew by seventy-two percent.¹³⁵ This is why, collectively, automobile emissions have had a substantial effect on the atmosphere. The more vehicles there are, and the more they are driven, the greater their contribution to air pollution in a given area.¹³⁶

Automobiles are certainly the most environmentally destructive aspect of suburbanization. Although the effects of the emissions from any individual car are insignificantly small, every car releases a minute amount of carbon monoxide, nitrogen oxides, sulfur dioxide, hydrocarbons, and lead (until the use of this additive was completely phased out in 1986) along with the main chemical in their exhaust, carbon dioxide. As a result, the personal automobile is the single greatest atmospheric polluter in the United States. It is much more significant than pollution from point sources like industrial smokestacks because of the sum effect of the millions of vehicles being used each day. According to the EPA, “driving a private car is probably a

134 D.E. Pataki et al., “Urban ecosystems and the North American carbon cycle,” *Global Change Biology* 12, (2006), <http://ddr.nal.usda.gov/bitstream/10113/28668/1/IND43844126.pdf>.

135 David J. Cieslewicz, “The environmental impacts of sprawl,” in *Urban Sprawl Causes, Consequences, and Policy Responses* (New York: Urban Institute, 2002), 27.

136 Howard Frumkin et al., *Urban Sprawl and Public Health: Designing, Planning, and Building for Healthy Communities* (Melbourne: Island Press, 2004), 152.

typical citizen's most 'polluting' activity."¹³⁷ Although more than half of fossil fuel emissions come from the transportation sector, a chunk of this is caused by airplanes and ships and therefore cannot be considered a consequence of suburbanization. However, between one-third¹³⁸ and forty percent¹³⁹ of humanity's air pollution is coming from cars and trucks. The United States contributes thirty-four percent of world automobile pollutants, even though it houses less than five percent of the world population.¹⁴⁰ This is because the U.S. has the most suburbanized, automobile-dependent landscape in the world, and therefore makes use of an extraordinary number of personal cars.

Automobile emission rates rose steadily throughout the second half of the twentieth century. They continue to rise every year and they are now higher than they have ever been. Furthermore, emissions caused by transportation are growing faster than any other type of pollution.¹⁴¹ How is this possible if automobile engines are cleaner and more efficient every year? Since the EPA-mandated reductions in vehicle emissions in the 1970s, current engines are emitting, on average, sixty-one percent less carbon monoxide and eighty percent fewer hydrocarbons (the EPA does not control carbon dioxide emissions).¹⁴² Nonetheless, the number of miles driven per capita has consistently outpaced improvements in fuel efficiency and

137 U.S. Environmental Protection Agency, Office of Mobile Sources, "Automobile Emissions: An Overview," 1994. <http://www.epa.gov/oms/consumer/05-autos.pdf>.

138 David J. Cieslewicz, "The environmental impacts of sprawl," in *Urban Sprawl Causes, Consequences, and Policy Responses* (New York: Urban Institute, 2002), 23-38.

139 D.E. Pataki et al., "Urban ecosystems and the North American carbon cycle," *Global Change Biology* 12, (2006), <http://ddr.nal.usda.gov/bitstream/10113/28668/1/IND43844126.pdf>.

140 David J. Cieslewicz, "The environmental impacts of sprawl," in *Urban Sprawl Causes, Consequences, and Policy Responses* (New York: Urban Institute, 2002), 24.

141 Ibid, 25.

142 Ibid, 25.

pollution reduction. The EPA's efforts "since 1970 have greatly reduced typical vehicle emissions. In those same years, however, the number of miles we drive has more than doubled. The increase in travel has offset much of the emission control progress."¹⁴³ As fuel efficiency increases, drivers can afford to drive greater distances and choose more distant residences. Development is occurring further and further from urban centers. There are currently more than 230 million automobiles in the United States alone.¹⁴⁴ As the suburbs grow, so does the number of cars and the amount of per capita driving, and as a consequence, the rate of atmospheric pollution as well.

Our investigation of primary sources confirmed these patterns. We analyzed raw air pollution data published in the records of the Maryland Air Quality Data Reports.¹⁴⁵ We also studied historical census¹⁴⁶ and traffic statistics data¹⁴⁷ for Montgomery County. We found a monumental growth of the population during the years 1970-1990, and confirmed that sprawling development occurred by analyzing Geological Survey maps. We also found a rapidly increasing amount of traffic on the roads of Montgomery County. We predicted the existence of a relationship between the growth of traffic and the amount of carbon emissions due to the combustion of fossil fuels. Even though atmospheric carbon dioxide is one of the most

143 U.S. Environmental Protection Agency, Office of Mobile Sources, "Automobile Emissions: An Overview," 1994. <http://www.epa.gov/oms/consumer/05-autos.pdf>.

144 David J. Cieslewicz, "The environmental impacts of sprawl," in *Urban Sprawl Causes, Consequences, and Policy Responses* (New York: Urban Institute, 2002), 24.

145 Air Management Administration Department of the Environment. "Maryland Air Quality Data Report."

146 Census Archives census.gov/popest/archives/1980s/, census.gov/popest/archives/pre-1980/e7079co.txt

147 *Montgomery County Traffic Volume, 1980-1990*. Map. Baltimore City: Maryland

important greenhouse gases, we decided not to track it because there are a plethora of natural sources, so its presence cannot be assumed to be the result of human activity. Instead, we chose to study the atmospheric carbon monoxide levels throughout this period. Carbon monoxide is a byproduct of the explosions in an internal combustion engine. It is a deadly poisonous gas formed when there is insufficient oxygen for the combustion reaction to produce carbon dioxide.

In a hypothetical, “perfect” internal combustion engine, there are no harmful byproducts:

fuel (hydrocarbons) + air (oxygen and nitrogen) ==>> carbon dioxide + water + unaffected nitrogen
--

But in a typical internal combustion engine, harmful chemicals are produced:

fuel + air ==>> carbon dioxide + water + <u>nitrogen oxides</u> + <u>unburned hydrocarbons</u> + <u>carbon monoxide</u>
--

Regular atmospheric testing results did not exist for carbon monoxide in Montgomery County before the 1980s, so we studied the range from 1980-1990. In Rockville, a rapidly growing suburb, the annual total of carbon monoxide emissions rose each year from 1983-1988, the only years for which this data was available in the Maryland Air Quality Data Reports. (See Figure 5 below)

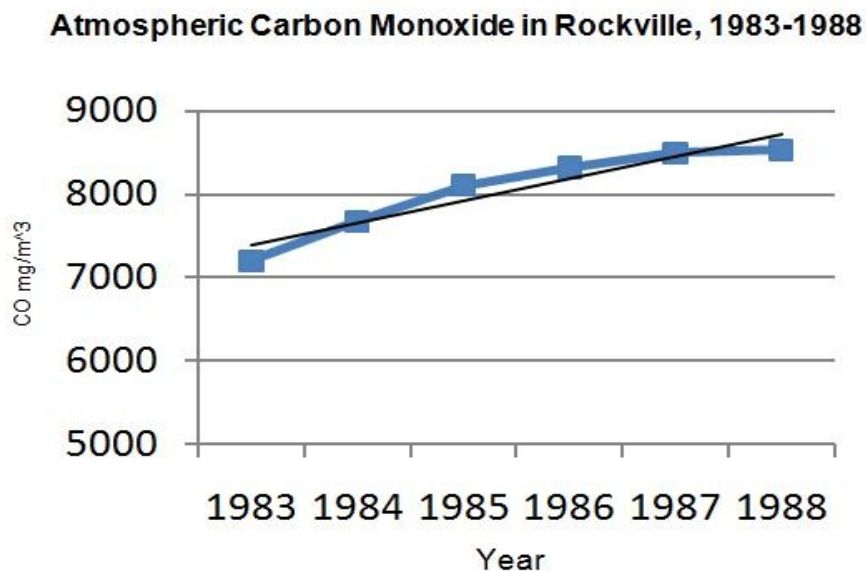


Figure 5. A graph documenting the change in the level of atmospheric carbon monoxide found in Rockville between 1983 and 1988. Source: Maryland Air Management Administration Department of the Environment.

The growth in carbon monoxide emissions during this time is explained by the increasing quantity of traffic in the area. However, we believe that the EPA standards and the catalytic converters introduced in the late 1970s were responsible for gradually decelerating emission rates in the 1980s.

Over the next twenty-five years, the developed area of this country is expected to increase by seventy-nine percent.¹⁴⁸ The carbon emissions produced by cars and light trucks are projected to leap by fifty-five percent over the next ten years if the current trends in buyer preferences and the growth of per capita driving continue.¹⁴⁹

¹⁴⁸ D.E. Pataki et al., "Urban ecosystems and the North American carbon cycle," *Global Change Biology* 12, (2006), <http://ddr.nal.usda.gov/bitstream/10113/28668/1/IND43844126.pdf>.

¹⁴⁹ David J. Cieslewicz, "The environmental impacts of sprawl," in *Urban Sprawl Causes, Consequences, and Policy Responses* (New York: Urban Institute, 2002), 31.

So how can we combat ever-accelerating suburbanization, automobile use, and pollution? The only answer seems to be through rethinking our spatial planning. The density of our residences must increase, and public transportation must be improved. The Smart Growth Initiative has been enacted in Montgomery County to slow down development. Developers are required to build some inexpensive housing as a part of each project. This tactic prevents the formation of income-stratified communities and glaring economic boundaries, while providing low-cost housing to the public at no cost to the county government and taxpayers. In addition, the statute encourages developers to build in towns and cities rather than on the outskirts.¹⁵⁰ In almost every place in America, city taxes make it cheaper to build outside the cities, which has been a significant cause for suburban development. Although this initiative does not solve all of Montgomery County's problems, it is a good example of how it is up to community members to take responsibility for the zoning and development of their area before it gets out of hand.

V. Conclusion

“If you are going to build something in the air, it is always better to build castles than houses of cards,” said Georg C. Lichtenberg. But what if you weren't aiming for the sky? What if land, sprawling seemingly endlessly outwards, was your end goal? What would you get then? The suburbs of this modern time and age would be your answer. In the past century, the growth of the human population has expanded exponentially, and accommodations for such growth have

¹⁵⁰ Anthony Downs, “Some realities about sprawl and urban decline,” *Housing Policy Debate* 10, no. 4, 1999, knowledgeplex.org/kp/text_document_summary/scholarly_article/relfiles/hpd_1004_downs.pdf

resulted, ultimately, in what is called “suburbanization” today. Reasons for this increasingly evident pattern of construction are myriad and stretch back into the depths of history; most notably, they include the improvement of transportation, a rise in income level leading to the emergence of a new middle-class, a shift in American industry from agriculture toward manufacturing, and, finally, the simple need to utilize as much land as possible for housing in order to sustain the rapid spurts of population growth.

Montgomery County, in particular, shows characteristics of these standard causes of suburbanization. In the years since its founding in 1776, and, indeed, even before that, it has transitioned through a remarkable series of changes. From a plain land of woody, rambling hills, to a disjointed group of isolated settlements that were essentially only a “scattering of small clearings in the forest,”¹⁵¹ to a prospering agriculturally-based society throughout the nineteenth century, it ultimately emerged in the mid-twentieth century as a distinct realm of middle-class suburbia, and stands today as one of the top-ten wealthiest counties in the nation.¹⁵² It has mirrored the nation's trend toward suburbanization: improvements in transportation, for example, came in the form of the C&O Canal, the B&O Railroad, and, perhaps most crucially, the private motor vehicle. The County's close proximity to the nation's capital in Washington, D.C. also constituted a major factor in its rise to suburbia, as people looking for jobs in the Federal Government were willing to settle in the County, reassured in part by the ease of travel between the two regions that the automobile promised. Likewise, wealthy families looking for a respite from the daily hardships and confinements of the inner city of the capital found in Montgomery County the ideal alternative, and subsequently contributed to the climb of income level as well as

151 *Gaithersburg, the Heart of Montgomery County: A History Commemorating Gaithersburg's Charter Centennial* (Gaithersburg: The City of Gaithersburg, 1978), 14.

152 Erica Mitrano, “Calvert, Charles Among 25 Richest Counties in the U.S.,” *The Washington Post*, April 1, 2010, <http://www.washingtonpost.com/wp-dyn/content/article/2010/03/30/AR2010033003483.html>

the ascent and, ultimately, permeation of the middle class in the County.

With such a parallel between Montgomery County and the country's respective evolutions of suburbanization, then, we looked to use the County as a case study for studying suburbanization's effects on car usage and carbon emissions, and subsequently asked: how did the surge of suburbanization affect automobile usage and rising carbon emission rates in Montgomery County alone? Notably, we chose 1970–1990 as the period upon which to concentrate, as those years marked the era during which suburbs were just beginning the process of becoming permanently engrained in the country's culture. Not only did we hope to add to and strengthen the growing field of study on urban sprawl and the apparently grim realities it holds for the environment—an issue particularly relevant today in the face of global environmental issues such as global warming and heightening concerns over the rapidly depleting health of our natural world in general—we also hoped to contribute on a more personal level to Montgomery County itself, as a few of our members call it their home.

The results of our project corroborated with existing data, and we ultimately found that suburbanization contributed to an influx of automobile usage rates as well as rising carbon emission rates in Montgomery County. Upon establishing a positive correlation between urban sprawl, automobile usage, and carbon emissions, our group set out to quantify the environmental consequences of suburbanization specifically in Montgomery County. By looking at census data, we concluded that the population of the county was steadily increasing during the twenty years of our study. This new growth spurred widespread automobile use, and by looking at several different maps of the area, our team asserted that road traffic was on also on the rise from 1970–1990; ultimately, this surge in road traffic was one that would lead to an increase in carbon

emissions and consequently harm the environment, as we showed by using the case study of Montgomery County, Maryland.

Today, a suburban community would, in all probability, consist of a series of medium sized houses, with their white picket fences and green lawns lined in a row down the street. They are not castles, or even houses of cards, by any means. But they are places that people call home; as such, fine attention must be paid towards the balance between humankind's undeniable need for housing and the detrimental environmental effects that emanate from such needs. A possible future avenue of research on this topic would be to compare the suburbanization rates of Montgomery County to those of other counties in Maryland and to various cities across America. This study would reveal crucial information about the extent of urban sprawl across our nation. The quicker we identify the problem, the more tools we have to fix it.

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