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Vanishing Open Spaces

POPULATION GROWTH AND SPRAWL IN AMERICA

by Leon Kolankiewicz, Roy Beck and Anne Manetas

April 2014

ABOUT THE AUTHORS

LEON KOLANKIEWICZ is a national environmental/natural resources planner and a former planner with the Orange County (CA) Environmental Management Agency. He has a B.S. in forestry and wildlife management from Virginia Tech and an M.S. in environmental planning from the University of British Columbia. He has worked as an environmental professional for three decades in three countries and 35 states, including stints with the U.S. Fish and Wildlife Service, National Marine Fisheries Service, Alaska Department of Environmental Conservation, Alaska Department of Fish and Game, University of Washington, University of New Mexico, and as a Peace Corps Volunteer promoting natural resources conservation in Honduras. He has written or edited more than 200 articles, reports, conservation plans, and environmental impact statements, and is the author of *Where Salmon Come to Die: An Autumn on Alaska's Raincoast* (Pruett, 1993) and a contributor to *Life on the Brink: Environmentalists Confront Overpopulation* (University of Georgia Press, 2012). He was co-author of 2001 and 2003 studies on sprawl in the previous decades.

ROY BECK was one of the nation's first environment-beat newspaper reporters in the 1960s. A graduate of the University of Missouri School of Journalism, he won national awards for his coverage of urban expansion issues, including honors from the U.S. Environmental Protection Agency and the Izaak Walton League. A former Washington correspondent for Newhouse Newspapers, he is the author of four public policy books. His articles have appeared in scores of magazines, newspapers and journals, including the *Atlantic Monthly, the Journal of Policy History* and the *Encyclopedia Britannica's Annals of America*. He has lectured widely on the ethical aspects of U.S. population issues. He was co-author of 2001 and 2003 studies on sprawl in the previous decades. He is President of the NumbersUSA Education & Research Foundation in Arlington, Va., which he founded in 1996 to educate on the recommendations of two federal commissions on sustainability and economic justice.

ANNE MANETAS is vice president and deputy director of NumbersUSA Education & Research Foundation. A graduate of the College of William and Mary, she has worked for two decades in Washington D.C. with organizations dealing with the effects of population growth on the environment and quality of life. She was project director of the 2001 and 2003 studies on sprawl in the previous decades. She runs NumbersUSA's program of tracking the role of each Member of Congress in forcing or reducing U.S. population growth.

VICTORIA DIGGS and **BRIAN SCHOEPFER** are former NumbersUSA interns with the Stanback Conservation Summer Internships of Duke University's Nicholas School of the Environment and Earth Sciences.

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HOW AN EXPLODING U.S. POPULATION IS DEVOURING THE LAND THAT FEEDS AND NOURISHES US

by

Leon Kolankiewicz, Roy Beck and Anne Manetas

Research Assistants:

Victoria Diggs and Brian Schoepfer of Duke Univeristy

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VANISHING OPEN SPACES

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How an Exploding U.S. Population Is Devouring the Land that Feeds and Nourishes Us

Executive Summary

The massive destruction of America's open spaces continued during the first decade of this new century. In just the eight years from 2002 to 2010, over **8.3 million acres** (approximately 13,000 square miles) of farmland and natural habitat succumbed to the bulldozer's blade. That is an area larger than the entire state of Maryland – cleared, scraped, filled, paved and built over – in less than a decade.

This update of our **previous studies about sprawl** at the end of the 20th century relies on the latest painstaking surveys by government agencies. They have tracked how, since the beginning of the 21st century, America's population is growing by tens of millions more residents and sprawling over vast new expanses of woodlands, wetlands, fields and pastures. These are the open spaces on which the country's human residents depend for food, fiber and the nourishment of their spirits, and to which the non-human inhabitants often tenuously cling for life itself.

This study finds that around **70% of those losses** around Urbanized Areas over the last decade were related to the nation's continuing trend of high population growth. Yet, there is little sign that the nation is ready to substantially change this population trend – or even to much discuss it – although the open-space destruction it is driving is not sustainable over the long term.

Sprawl Data and Analysis for Each City (2000-2010)

Residents of all 497 of the **Urbanized Areas** designated by the U.S. Bureau of Census can find in this report answers to the following questions about your home city over the past decade:

- **TOTAL SPRAWL**: How many square miles of farmland and natural habitat were destroyed as your city expanded outward? Where does that rank among all other cities in open-space loss? (See **Appendix E**.)

- **PER CAPITA SPRAWL**: Is the average resident of your city requiring more or less developed land to provide for all residential, commercial, occupational, educational and

other urban needs? What was the percentage change? How does the amount of land "consumed" by each resident rank with all other cities? (See **Appendix F**.)

- **POPULATION GROWTH**: What is the amount and rate of population growth, and how does that rate rank with all other cities? (See **Appendix G**.)

- **APPORTIONED FACTORS BEHIND THE LOSS**: How much of the destruction of open space around your city was related to an increase in per capita land consumption and how much was related to population growth? (See **Appendix E**.)

State-by-State Sprawl Data and Analysis (2002-2010 and 1982-2010)

The word "sprawl" is not a precise term. But we do indeed use **the term "Overall Sprawl"** in a precise way in this study – it is the amount of rural land lost to development.

Roughly 85 percent of all destruction of farmland and natural habitat nationwide occurred around the edges of the 497 mostly-sprawling Urbanized Areas. And much of the rest of the losses are due to urban residents' demands for rural second homes, rural recreation development and rural transportation.

The change of open space to development beyond the Urbanized Areas is tracked through a vast and complex **data gathering system of the U.S. Department of Agriculture**. It allows us to provide the following data and analysis about the 48 contiguous states (excluding Alaska and Hawaii):

- TOTAL STATEWIDE SPRAWL: How many square miles of farmland and natural habitat were destroyed statewide in both urban and rural areas in the 1982-2010 period and the most recent 2002-2010 period? How did each state rank in comparison to the amount of open space lost in other states? (See **Table 12** on p. 61.)

- RATE OF STATEWIDE SPRAWL: What was the percentage rate of open space destruction in each state, and how did that rank with other states? (See **Table 11** on p. 58.)

- APPORTIONING FACTORS BEHIND STATEWIDE LOSS: How much of the destruction of open space in each state was related to an increase in per capita land consumption and how much was related to population growth? (See **Table 10** on p. 56.)

- STATE POPULATION GROWTH: How much did the populations of each state grow between 1982-2010 and 2002-2010? How did the states compare with each other in terms of overall, absolute population growth and percentage rate of growth in these time periods? (See **Appendix H**.)

Population Growth Takes Lead in Driving Sprawl

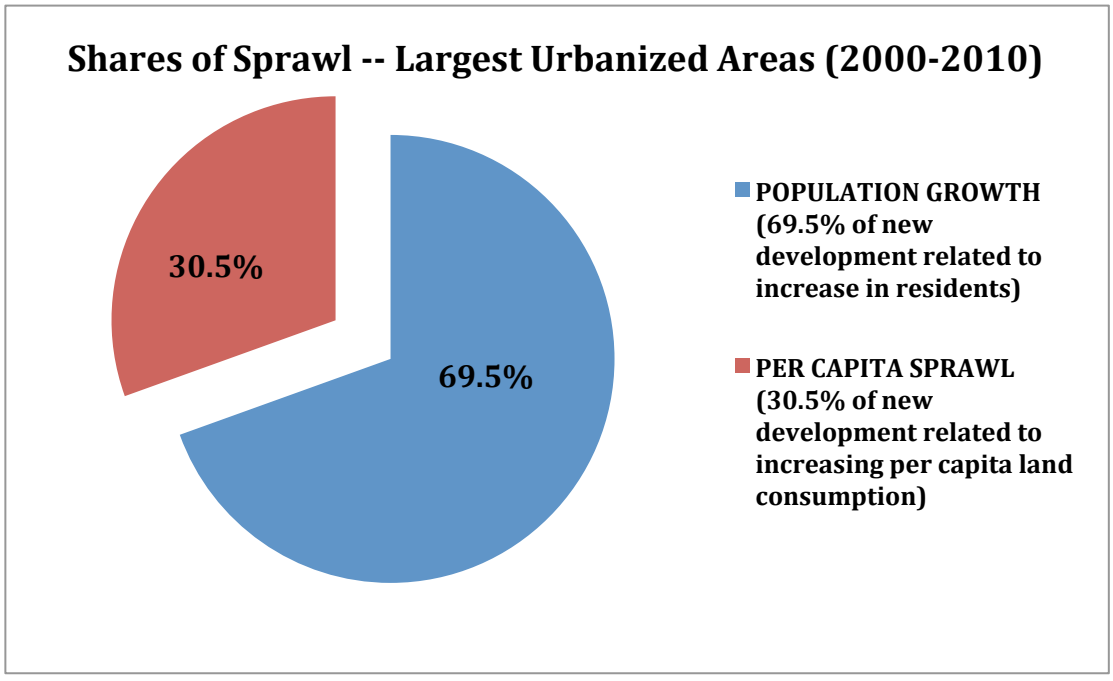
Much like our original studies in the 2000 to 2003 period, this update attempts to move beyond what has often been an abstract and non-quantitative discussion about the loss of farmland, natural habitat and open space and about how much to blame population growth, development decisions and Americans' personal consumption desires.

The good news during the last decade was that the galloping **hyper-sprawl of the 1990s calmed significantly**. The primary reason was that the rate of per capita land consumption stopped increasing as rapidly as it had over much of the post-World War II era. Indeed, by one measure, the average urban resident increased his or her amount of urbanized land by a relatively modest three percent. That change combined with a continuation of the largest numerical population growth in U.S. history to drive open-space destruction at higher volume than any time other than the 1990s.

Our multi-faceted and scientific calculations – described in detail in the main report and in the appendices – discovered that just about exactly half **the sprawl from the 1970s through the 1990s** was related to population growth.

But in the past decade, it appears that around 70 percent of sprawl in the Urbanized Areas is now related to population growth. (The U.S. Department of Agriculture's **statewide data** are even more startling, indicating that around 90 percent of combined urban and rural open-space loss is related to population growth.)

Figure ES-1. Percentages of Overall Sprawl Related to Population Growth and Per Capita Sprawl in the 96 Largest Urbanized Areas



This suggests that in Urbanized Areas population growth had twice as much or more influence on sprawl as all **the many factors behind per capita land consumption growth** [1] combined. Those factors include:

- **Development** (consumer preferences for size and type of housing and yards, commercial developer preferences, government planning and zoning, level of affluence)
- **Transportation** (subsidies and planning, consumer preferences, price of gasoline)
- **Quality of existing communities** and ability to hold onto their residents (schools, crime, cultural harmony, parks, infrastructure, jobs)
- **Number of people per household** (marriage and divorce rate, recent fertility rate, independence of young adults)

Our report shows several methods of testing these results, including **scatter plots**, a **mathematical formula** designed to apportion responsibility for growing use of natural resources (including land) between an increasing population and increasing per capita consumption of that resource, and others.

Despite the reliability and usefulness of all those methods of analysis, most Americans can probably gain a fairly accurate impression about the relative importance of population growth and per capita land consumption growth by simply looking at the rates of growth of each factor side by side. **Table ES-1** does that for the 10 Urbanized Areas that destroyed more open space than all others in the last decade. Other Urbanized Areas may have had more rapid percentage sprawl, but these 10 spread out over the most square miles – 3,171 square miles in all from 2000 to 2010.

Population growth was the obvious dominant factor in most of those cities. As explained in the main report and appendices, a one percent growth in population has the same effect on Overall Sprawl as a one percent growth in per capita land consumption, all other things being equal. **Table ES-1** shows that the two factors grew at relatively even – and slow – rates in Philadelphia, and that only in Chicago was per capita consumption growth a significantly larger factor than population growth.

Many of our findings about the relationship between population growth and sprawl may strike the reader as unsurprising and as simple common sense. We agree that, for example, it just makes sense that the cities with the largest population growth would tend to have the largest sprawl. But the need for this study is found in the fact that few in the news media or in organizations that express concern about the loss of farmland and natural habitat identify population growth as a major factor, or even a factor to be modified at all.

We find similar results when expanding the scope to the 100 largest Urbanized Areas of 2000 (four of which by 2010 were merged into others by the Census Bureau). We find that in

Table ES-1. Per Capita Sprawl Compared with Population Growth in USA's Ten Largest Sprawlers (2000-2010)

Urbanized Area	% Growth in Per Capita Land Consumption	% Growth in Population
1. Atlanta, GA	5%	29 %
2. Dallas-Fort Worth-Arlington, TX	2%	24%
3. Houston, TX	-1%	29%
4. Phoenix-Mesa, AZ	15%	25%
5. Chicago, IL-IN	11%	4%
6. Charlotte, NC-SC	4%	65%
7. Austin, TX	9%	51%
8. Raleigh, NC	-1%	63%
9. San Antonio, TX	11%	32%
10. Philadelphia, PA-NJ-DE-MD	4%	6%

Source: U.S. Census Bureau data

these cities combined, the rate of population growth was three times higher the rate of per capita land consumption growth.

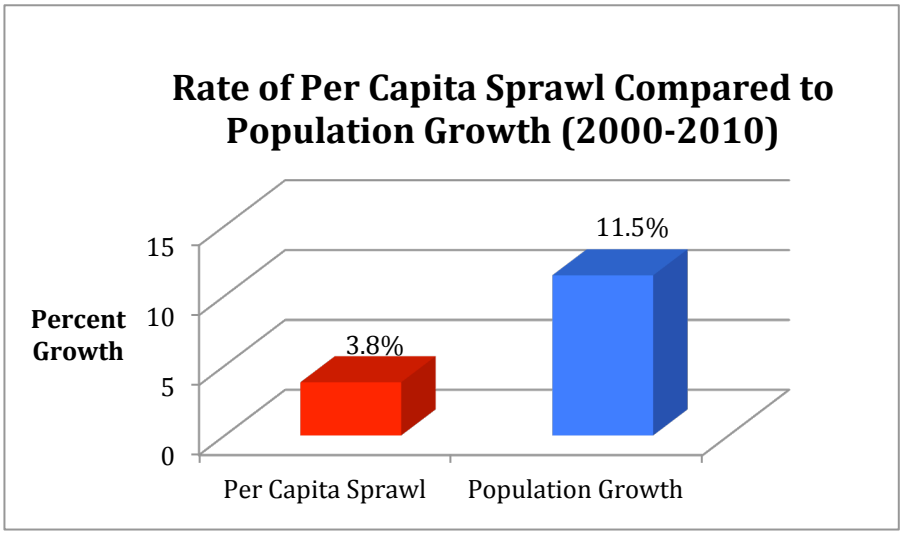
The 3.8% increase in per capita land consumption during the 2000-2010 decade compares with the 11.5% increase in population (See **Figure ES-2**). That slowing of consumption growth would appear to be the result of a combination of factors, including **smart growth efforts**, higher gasoline prices, fiscal and budgetary constraints (limiting new road-building, for example), various changes in the per capita factors listed earlier, and the recession-inducing mortgage meltdown.

Cumulative Results of Sprawl Are Piling Up For Farm and Forest

The **country's cropland** provides a frightening example of where these trends will lead if dramatic changes are not made. In 1980, we had an average of 1.9 acres of cropland for each American. But 90 million more people have been added to the country since then. Not only are there far more people to share the cropland, but there is far less cropland to share because of the way cities have sprawled to accommodate the extra population.

By 2010, the average amount of cropland per American had fallen from 1.9 acres to 1.2 acres. If this trend were to continue, there would be only 0.7 acre of cropland per American

Figure ES-2. Per Capita Sprawl vs. Population Growth in Largest UAs, 2000-2010



Source: U.S. Census Bureau data

in 2050 and only 0.3 acre in 2100. That seems unfathomable, but it is the trajectory the country is traveling.

From 1982 to 2010, **41.4 million acres** (approximately 65,000 square miles) – an area equivalent to the state of Florida – of previously undeveloped non-federal rural land was paved over to accommodate our growing cities. Of these 41 million lost acres of open space, over 17 million acres were forestland, 11 million acres cropland, and 12 million acres pasture and rangeland.

As the **Natural Resources Conservation Service** of the U.S. Department of Agriculture put it in their 2007 summary report that reviewed the 1982-2007 quarter-century:

> "The net change of rural land into developed land has averaged 1.6 million acres per year over the last 25 years, resulting in reduced agricultural land, rangeland, and forest land. Loss of prime farmland, which may consist of agriculture land or forest land, is of particular concern due to its potential effect on crop production and wildlife."

The NRCS also observed that "more than one-third of all land that has ever been developed in the lower 48 states was developed during the last quarter-century."

The total area of developed land grew from 71.9 million acres (112,356 square miles) in 1982 to 113.3 million acres (177,096 square miles) in 2010. This latter area is about equal in size to the entire states of Maine, New Hampshire, Vermont, Massachusetts, Connecticut, Rhode Island, Delaware, New York, and Pennsylvania. All of this land was developed from either agricultural land or natural habitat.

Since the NRCS began its National Resources Inventory (NRI) in 1982, its data reveal that every new person added to the United States population entails on average **the elimination of about half an acre of farmland or natural habitat**.

Sprawl and the loss of open spaces themselves **don't get nearly the attention from the news media**, politicians and national public interest groups that they did a decade ago. But the losses have not stopped. These losses continue to mount and to fuel numerous local controversies and are factors in many of the nation's most pressing environmental challenges.

According to the World Wildlife Fund, habitat loss poses the greatest threat to endangered species. The United States is home to over 1,000 endangered or threatened animal and plant species that are seriously harmed by ever-encroaching development. **Figure 4** (see page 12) shows the breakdown in the types of rural land developed between 1982 and 2007 in 5-year increments. As is evident, the single greatest type of land developed in each period was forest land. Forest land is, of course, **wildlife habitat**. More broadly, it is a type of "natural capital" that provides a range of ecological services and socioeconomic benefits, among them climate regulation, watershed protection, soil conservation, flood prevention, streamflow moderation, wood products, **aesthetic qualities**, and it serves as a magnet for outdoor recreation such as hunting, fishing, hiking, and wildlife observation and photography.

National Opinion Survey for This Study Finds Americans Concerned

With the subject of sprawl largely absent from the news for several years now, we commissioned Pulse Opinion Research to **poll likely American voters on their attitudes**. The full survey and results can be viewed in Appendix K. Key findings:

- 92% say it is important (71% "very important") to protect farmland from development to ensure the ability to feed the U.S. population in the future.
- By a 3-1 margin, Americans think it is unethical to pave over good cropland rather than being legitimate to provide housing for a growing population.
- Most Americans feel a **spiritual or emotional uplift** from time spent in natural areas, and 85% say it is important (48% say "very important") to be able to get to natural areas fairly quickly from where they live.
- 85% say the loss of 17 million acres of woodlands over the last three decades is a significant problem for wildlife.

Solutions

This report cites some of the **measures that local officials can implement** to try to stop the growth in per capita land consumption that leads to destruction of farmland and natural habitat (see page 71).

It also discusses **ways that local officials trying to protect surrounding open spaces can slow local population growth** through such means as requiring developers to pay the full costs of the population growth they attract (developer's or impact fees).

But beyond the short term, local officials supportive of growth control can hope only to slow population growth in their jurisdictions if national population continues to increase by some 2.5 to 3 million additional residents each year. These 25-30 million additional Americans each decade will nearly all settle in some community, inevitably leading to additional sprawl as far and as long as the eye can see.

Nearly all **long-term population growth** in the United States is in the hands of federal policy makers, because nearly all long-term population growth is related to federal immigration policies that have increased the **annual settlement of immigrants** from one-quarter million in the 1950s and1960s to more than a full million per year since 1990. Until the numerical level of national immigration is addressed, even the best local plans and political commitment will be unable to stop sprawl. Any serious efforts to halt the loss of farmlands and wildlife habitats must include reducing the volume of U.S. population growth. And a **presidential commission on sustainability** concluded that the U.S. population cannot be stabilized without deep reductions in annual legal immigration and more effective control of illegal immigration.

The Population and Consumption Task Force of President Clinton's Council on Sustainable Development concluded in 1996: "This is a sensitive issue, but reducing immigration levels is a necessary part of population stabilization and the drive toward sustainability."

That would appear to be a popular option among most Americans, according to this study's national survey (**Appendix K**):

- 68% of likely voters said the government should "reduce immigration to slow down population growth."
- In light of concerns about sprawl, 40% of respondents said they would like annual immigration to be cut from one million a year to either 100,000 or zero per year. (63% said cut immigration at least in half to 500,000 a year.)

On a local level, the sprawl pressures of population growth are similar regardless of where the new residents originate – from another state or another continent. But very few Urbanized Areas are likely to be able to subdue population growth and sprawl if the federal government continues policies that add around 20 million people to the nation each decade (through immigration and births to immigrants), all of whom have to settle in some locality.

Vanishing Open Spaces

How an Exploding U.S. Population Is Devouring the Land that Feeds and Nourishes Us

A report on the pre-eminent role played by population growth in the loss to urbanization of farmland, natural habitat, and the open spaces that provide renewal for the human spirit

1. INTRODUCTION

In the late 1990s and early 2000s, more than a decade ago, this report's authors were encouraged by like-minded scientists, academics, planners, and conservationists around the country to explore and quantify the role of population growth in urban sprawl. At the time, in both academic and government research on the subject, as well as in the popular press and the pronouncements of anti-sprawl activist organizations, if population was mentioned at all, it was typically to dismiss or minimize its importance as a causal agent of sprawl. Yet intuitively and logically, it seemed there should be a correlation to some extent between the population size of a city and the extent of the physical area it occupied. Likewise, it seemed that a city's rate of population growth – how quickly it was adding residents per year or per decade – should have some bearing on how rapidly it was sprawling outwards, that is, on the rate at which rural land or open space at its perimeter was being converted into urban or built-up land.

As related subsequently in this report, we eventually found the approaches, data, and methodology by which to derive credible estimates of population growth's effect on sprawl around the country.

While there is more than one way to define sprawl, our studies consider it to be the conversion of open spaces like farmland and natural habitat into developed land holding man-made structures and surfaces on the expanding edges of urban areas or elsewhere.

Much like the original study, this update attempts to move beyond what has often been an abstract and non-quantitative discussion about the loss of farmland, natural habitat and open space and about how much to blame population growth, development decisions and Americans' personal consumption desires. This update uses the most recent data from the same reliable, authoritative government agency sources and applies the same methods as our original study in quantifying the roles of the two Overall Sprawl factors: increase in per capita land consumption and population growth.

1.1 Still a Problem After All These Years (and Americans Still Concerned)

When the first edition of this study was published in 2001, sprawl was a hot topic with many environmental organizations, and the general public worried about the impacts of ever-expanding cities and the nation's steadily disappearing rural land.[1] Thirteen years later, sprawl is still devouring valuable farm and forestland, but national environmental groups, by and large, have shifted their focus to global issues and away from the loss of habitat and open space due to the unsustainable growth of cities.

Despite our nation's many economic setbacks over the last decade, sprawl continues to be a major threat to rural land and natural habitats in the United States. In fact, in just the eight years from 2002 to 2010 over 8.3 million acres (approximately 13,000 square miles) – an area larger than Maryland – of previously undeveloped land succumbed to the bulldozer's blade.

Although sprawl by name is not much seen in the news these days, the results of sprawl continue to fuel numerous local controversies and are a factor in many of the nation's most pressing environmental challenges. Americans remain concerned, according to a 2014 national poll of likely voters.[2] When asked about the Maryland-size loss of farmland and natural habitat in the last decade, 77% of Americans said it is a problem (42% said it is a "major problem"). Moreover, 85% said the loss of wildlife habitat due to sprawl is a significant problem (53% said "very significant").

As our citizens seek better economic opportunities, new sprawling cities have emerged in traditionally less developed areas of the country. This new development puts pressure on natural resources, habitats, and species in many ecologically sensitive areas. It is for these reasons that the authors of the original study decided an updated edition was in order.

This update examines the quantity and rate of rural land lost to development surrounding Urbanized Areas (entities defined by the Census Bureau as central cities and the contiguous development of their suburbs). We examine the factors in the sprawl of the 96 largest Urbanized Areas (UAs), which correspond to the 100 cities studied in 2001. In those 96 UA's alone, more than 5.1 million acres (8,000 square miles) of the surrounding rural land were lost to urbanization during the last decade of Census research (2000-2010). We also look at all 497 UAs in the U.S. and determine the degree to which population growth and

[1] David P. Fan, David N. Bengston, Robert S. Potts, Edward G. Goetz. 2005. The Rise and Fall of Concern about Urban Sprawl in the United States: An Updated Analysis. Bengston, David N., tech. ed. 2005. Policies for managing urban growth and landscape change: a key to conservation in the 21st Century. Gen. Tech. Rep. NC-265. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Research Station. 51 pp.

[2] Pulse Opinion Research. 2014. Sprawl & Population National Poll – Survey of 1,000 Likely Voters. Conducted April 1-2, 2014. Margin of Sampling Error, +/- 3 percentage points with a 95% level of confidence. See Appendix K for entire poll.

increasing per capita land consumption (decreasing density) each "drove" their sprawl from 2000 to 2010.

This update also includes changes in the amount of Developed Land in the 48 contiguous states as delineated by the National Resources Inventory (NRI) of the Natural Resources Conservation Service (NRCS) of the U.S. Department of Agriculture.

Although rates (percentage increases) of sprawl are important, the most significant environmental fact about a city's sprawl – or a state's increase in developed land – is the actual area in acres or square miles of rural land that has been urbanized or developed.

Table 1 lists the top 10 Urbanized Areas that eliminated the most rural land over the past decade (2000-2010). Clearing, scraping, paving, and building over thousands of square miles of America's woodlands, wetlands, croplands, prairies, pastures, range, deserts, and fields, they truly earned the dubious distinction as the nation's "Top Sprawlers." It is noteworthy, and surely not a coincidence, that four of the Top Ten Sprawlers are in Texas, the state that grew far more (adding the greatest number of people) than any other state in the country from 2000 to 2010 – 4.2 million compared to California's 3.2 million and Florida's 2.8 million.

Table 1. USA's Top Sprawlers: Urbanized Areas with Greatest Sprawl in Square Miles (2000 to 2010)

Urbanized Area	**Sprawl** (sq. miles)
1. Atlanta, GA	683
2. Dallas-Fort Worth-Arlington, TX	372
3. Houston, TX	365
4. Phoenix-Mesa, AZ	348
5. Chicago, IL-IN	320
6. Charlotte, NC-SC	307
7. Austin, TX	205
8. Raleigh, NC	199
9. San Antonio, TX	190
10. Philadelphia, PA-NJ-DE-MD	182
Total sprawl from top 10 cities	**3,171**

Source: U.S. Census Bureau Urbanized Area data

According to the Census Bureau, America's ten most populous UAs in 2010 were:

Table 2. USA's Top Ten Most Populous Urbanized Areas in 2010

Urbanized Area	Population in 2010
1. New York – Newark, NY-NJ-CT	18,351,295
2. Los Angeles – Long Beach – Anaheim, CA	12,150,996
3. Chicago, IL-IN	8,608,208
4. Miami, FL	5,502,379
5. Philadelphia, PA-NJ-DE-MD	5,441,567
6. Dallas – Fort Worth – Arlington, TX	5,121,892
7. Houston, TX	4,944,332
8. Washington, DC-VA-MD	4,586,770
9. Atlanta, GA	4,515,419
10. Boston, MA-NH-RI	4,181,019
Total Population in 2010	**73,403,877**

Source: U.S. Census Bureau Urbanized Area data

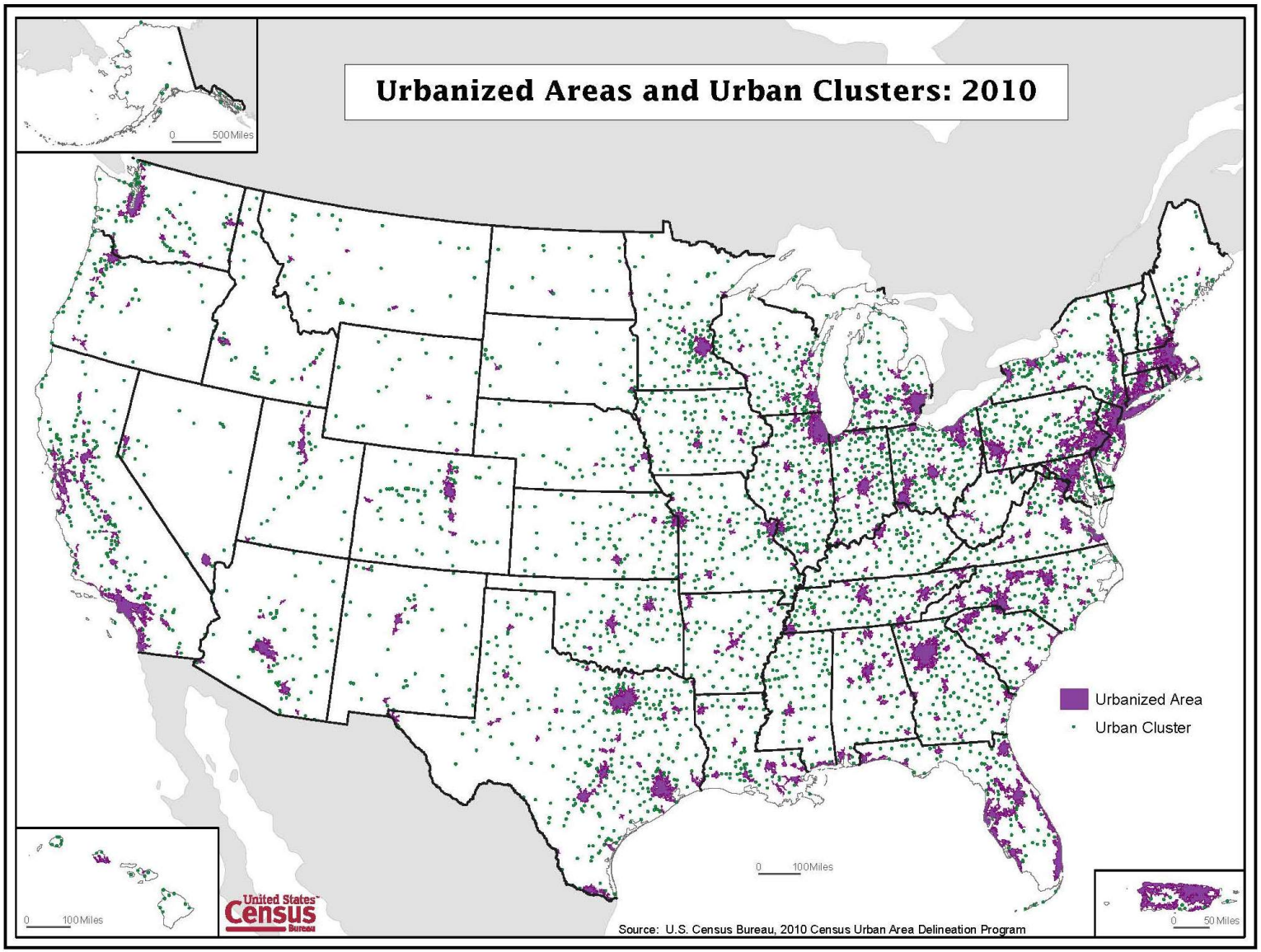
Five UAs are found in both **Table 1** and **Table 2;** that is they are Top 10 in both aggregate, cumulative population size and 2000-2010 land area sprawl: Atlanta, Dallas – Fort Worth – Arlington, Houston, Chicago, and Philadelphia.

Five other UAs were among the ten most populous in 2010, but not among the ten largest 2000-2010 sprawlers: New York-Newark; Los Angeles-Long Beach-Anaheim; Miami; Washington, DC; and Boston.

Conversely, five other UAs were among the top ten sprawlers from 2000-2010 but not the top ten most populous UAs: Phoenix-Mesa, Charlotte, Austin, Raleigh and San Antonio. *These five consumed land at the combined rate of approximately 220 acres per day for each and every one of the 3,650 days between 2000 and 2010.*

Figure 1 is a map that provides a sense of scale, depicting the size, shape, and location of 486 Urbanized Areas and 3,087 Urban Clusters (smaller urban zones/population centers also

Figure 1. Nationwide Distribution and Pattern of Urbanized Areas and Urban Clusters in 2010



Source: U.S. Census Bureau

designated and delineated by the Census Bureau) within the United States as a whole in 2010, after more than a century of continuous population growth and urban expansion. Of particular note is the nearly unbroken band of urbanization (conurbation) stretching from Virginia across eight additional states (Maryland, Delaware, Pennsylvania, New Jersey, New York, Connecticut, Massachusetts, and Rhode Island) all the way to New Hampshire. On this map, land in the more thinly populated West (except for the West Coast proper) does indeed appear much less dominated by urbanization.

Figure 2 is a composite satellite image of the United States (with portions of Canada and Mexico) at night. The brightly lit areas correspond closely to **Figure 1**'s densely populated Urbanized Areas, and are heavily concentrated along the East, West, and Gulf Coasts as well as portions of the South and margins of the Great Lakes. Similarly, Figure 2's bands of relative darkness that predominate in the West match Figure 1's more widely scattered UAs and Urban Clusters and reflect the widespread presence of uninhabitable deserts, rugged mountains, and vast irrigated agricultural hinterlands that produce food for the masses congregated in America's teeming cities.

Figure 2. Composite Satellite Image of the United States at Night

To provide a background for comparisons, the rest of this section summarizes our findings for the period before 2001. Section 2 then describes our methodology, sources and definitions. Then, our findings for the period after 2000 begin with Section 3.

1.2 Findings of Our Previous National Sprawl Studies in 2001 and 2003

Our two national sprawl studies – conducted more than a decade ago (published in 2001 and 2003) – were titled "Weighing Sprawl Factors in Large U.S. Cities: A report on the nearly equal roles played by population growth and land use choices in the loss of farmland and natural habitat to urbanization"[3] and "Outsmarting Smart Growth: Population Growth, Immigration, and the Problem of Sprawl."[4] They made a number of key findings and conclusions which are summarized here and listed in their entirety in Appendix I.

The two main findings from the 2001 study on the 100 largest Urbanized Areas in the U.S. were the following:

> **(1) Per Capita Sprawl:** About half the sprawl nationwide appeared to be related to the land-use and consumption choices that lead to an increase in the average amount of urban land per resident.
>
> **(2) Population Growth:** The other half of sprawl was related to the increase in the number of residents within those 100 Urbanized Areas.

"On average, there are more of us, and each of us is using more urban land, and therein lie the two halves of the problem," wrote the authors in the 2001 study. These findings then led the authors to the following conclusions:

- The toll of urban sprawl on ecosystems, farmland and scenic open spaces cannot be substantially halted unless anti-sprawl efforts include a two-pronged attack using both land-use/consumption tools and population tools.

- Although the circumstances of each city are different, the power of both sprawl factors is potentially the same in each. Every city that wishes to restrain its land expansion will need to continually keep in mind the impacts on sprawl of both growth factors.

[3] Kolankiewicz, L. and R. Beck. 2001. Weighing Sprawl Factors in Large U.S. Cities: A report on the nearly equal roles played by population growth and land use choices in the loss of farmland and natural habitat to urbanization. Analysis of U.S. Bureau of the Census Data on the 100 Largest Urbanized Areas of the United States. March 19. NumbersUSA: Arlington, VA. 64 pp. Available at: https://www.numbersusa.com/content/resources/publications/publications/studies/weighing-sprawl-factors-large-us-cities.html.

[4] Beck, R., L. Kolankiewicz, and S. Camarota. 2003. Outsmarting Smart Growth: Population Growth, Immigration, and the Problem of Sprawl. Washington, DC: Center for Immigration Studies. Center Paper 22. August. 122 pp. Available at: http://www.cis.org/sites/cis.org/files/articles/2003/sprawl.html.

- The forces driving overall national population growth cannot be ignored as contributors to sprawl, since national population growth manifests itself as growth in local communities.

The 2001 study concluded that cities with either, 1) no growth in population or, 2) no growth in per capita land consumption, still had sprawl. However, cities that had both types of growth had far higher sprawl.

The main emphasis of the later 2003 study "Outsmarting Smart Growth" was an analysis of sample data from the National Resource Conservation Service's NRI that estimated the increase in developed land from 1982-1997. That study reached these findings:

- The more a given state's population grew, the more the state sprawled.

- Nationally, population growth accounted for 52 percent of the loss of rural land between 1982 and 1997, while increases in per-capita land consumption accounted for 48 percent.

- Population growth accounted for more than half of sprawl in five of the 10 states that lost the most land, while increases in per-capita land use accounted for more than half of sprawl in the other five worst sprawling states.

- In the 1990s, new immigration and immigrant fertility accounted for most of the 33-million increase in the U.S. population. By 2002, the more than 1.5 million legal and illegal immigrants who settled in the country each year along with 750,000 yearly births to immigrants caused 87 percent of the annual increase in the U.S. population.

- Contrary to the common perception, about half the country's immigrants lived in the nation's suburbs. The pull of the suburbs is even greater in the second generation. Of the children of immigrants who settled down and purchased a home, only 24 percent did so in the nation's central cities.

- The suburbanization of immigrants and their children was a welcome sign of integration. But it also meant they contribute to sprawl just like other Americans.

"In short," concluded the 2003 study, "Smart Growth efforts to slow or stop the increase in per capita land use are being negated by population growth. Immigration-driven population growth, in effect, is 'out-smarting' Smart Growth initiatives by forcing continued rural land destruction."

An update of the 2003 Beck-Kolankiewicz-Camarota study is necessary to understand how the relative roles of both Population Growth and Per Capita Sprawl have changed over the past decade. The findings of this update will be useful to policy makers, planners, open space advocates, and conservationists as they continue to grapple with the problem of sprawl in our cities and states.

1.3 Paving Over Farmland, Wildlife Habitat, and Open Space that Rejuvenates the Human Spirit

One of the primary concerns about urban sprawl has been that it is replacing our nation's forests, wetlands, and prime farmland with subdivisions, new and expanded roads, strip malls, and business parks. In fact, from 1982 to 2010, 41.4 million acres (approximately 65,000 square miles) – an area about equivalent to the state of Florida – of previously undeveloped non-federal rural land was paved over to accommodate our growing cities.[5] Of these 41 million acres lost – or "converted" as land managers and planners generally refer to it – over 17 million acres were forestland, 11 million acres cropland, and 12 million acres pasture and rangeland.

As the NRCS put it in their 2007 summary report, reviewing the 1982-2007 quarter-century:

> "The net change of rural land into developed land has averaged 1.6 million acres per year over the last 25 years, resulting in reduced agricultural land, rangeland, and forest land. Loss of prime farmland, which may consist of agriculture land or forest land, is of particular concern due to its potential effect on crop production and wildlife."[6]

Figure 3 shows the increase in developed land from 1982 to 2010, as tracked by the NRCS and the NRI initially in 5-year intervals, and later more frequently. The total area of developed land grew from 71.9 million acres (112,356 square miles) in 1982 to 113.3 million acres (177,096 square miles) in 2010. This latter area is about equal in size to the states of Maine, New Hampshire, Vermont, Massachusetts, Connecticut, Rhode Island, Delaware, New York, and Pennsylvania, in other words, all of New England and then some. All of this land was originally developed from either agricultural land or natural habitat. As the NRCS observes: "more than one-third of all land that has ever been developed in the lower 48 states was developed during the last quarter-century."

The annual increase in Developed Land over this 28-year period varied from 760,000 acres to 2,159,000 acres, and averaged 1.5 million acres/year. The low of 760,000 acres/year was the annual average for the 2007-2010 period, corresponding to the Great Recession.

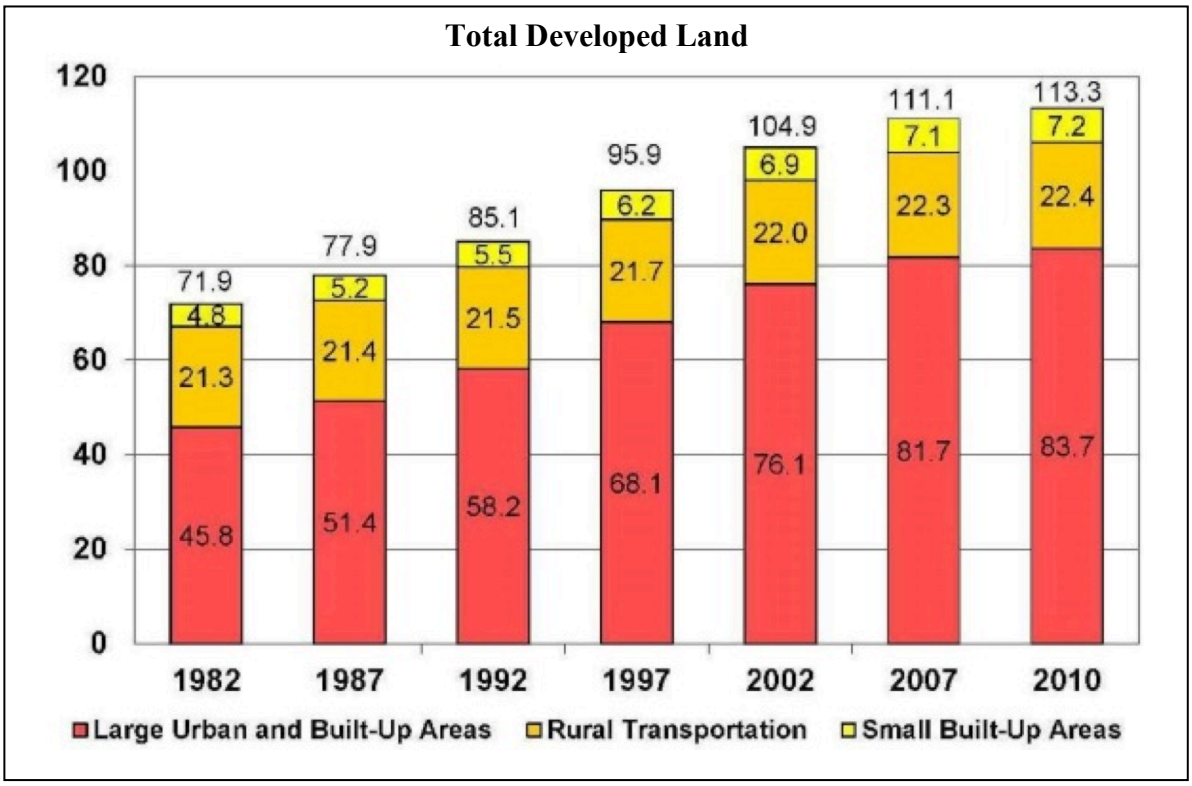
The right column of **Table 3** shows the average amount of open space that was developed to accommodate the addition of each extra person to the U.S. population during the designated period. The land developed for each additional resident in the United States ranged from a

[5] U.S. Department of Agriculture. 2013. *Summary Report: 2010 National Resources Inventory*. Natural Resources Conservation Service (NRCS), Washington, DC, and Center for Survey Statistics and Methodology, Iowa State University, Ames, Iowa. Available on the World Wide Web at: http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1167354.pdf.

[6] Natural Resources Conservation Service (NRCS). 2013. 2007 National Resources Inventory: Development of Non-Federal Rural Land. March.

low of 0.3 acre during the 2007-2010 period to a high of 0.85 acre during the 1992-1997 period. The average was 0.53 acre for the entire 28-period of study. In essence, every additional person added to the United States population entails the development of about half an acre of farmland or natural habitat.

Figure 3. Change in Developed Land, 1982-2010



Source: NRCS, 2013. *Summary Report: 2010 National Resources Inventory*.

Table 3 dissects the data presented in **Figure 3**.

Table 3. Increase in Developed Land and Developed Land Per Capita, 1982-2010

Period	Period Growth in Developed Land (thousand acres)	Annual Growth in Developed Land (thousand acres)	Added Acreage for Each Person Added to Population During Period Shown	
1982-1987	6,025	1,205	1982-1987: 0.58	1982-1992: 0.58
1987-1992	7,205	1,441	1987-1992: 0.57	
1992-1997	10,796	2,159	1992-1997: 0.85	1992-2002: 0.65
1997-2002	9,007	1,801	1997-2002: 0.45	
2002-2007	6,121	1,224	2002-2007: 0.45	2002-2010: 0.39
2007-2010	2,281	760	2007-2010: 0.30	

Within the overall open-space acreage threatened by sprawl are some of our nation's most critical natural habitats. According to the World Wildlife Fund, it is habitat loss that poses the greatest threat to endangered species. The United States is home to over 1,000 endangered or threatened animal and plant species that are seriously harmed by ever-encroaching development. Eliminating forests and wetlands not only threatens native species, but has serious human health, safety, and economic consequences as well. Wetlands are important filters that clean pollutants out of our water. Wetlands can also moderate the devastating effects of floods by acting as natural buffers, soaking up and storing floodwaters. And according to the EPA nearly two-thirds of all fish we consume spend some portion of their lives in wetlands, which often serve as "nurseries" for juveniles. Paving over our nation's breadbasket and valuable habitats with unrelenting sprawl entails serious long-term economic and human health and safety costs that we simply cannot afford.

American sprawl is more than a domestic issue. It also has global implications. The relentless and accelerating disappearance of natural habitats dominated by communities of wild plants and animals, replaced by biologically impoverished artificial habitats dominated by human structures and communities, contributes cumulatively to what may become a "state shift" or "tipping point" in Earth's biosphere. This would be an uncontrollable, rapid transition to a less desirable condition in which the biosphere's ability to sustain us and other species would be severely compromised. A 2012 paper in the prestigious British scientific journal *Nature* reviews the evidence that: "…such planetary scale critical transitions have occurred previously in the biosphere, albeit rarely, and that humans are now forcing another such transition, with the potential to transform Earth rapidly and irreversibly into a state unknown in human experience."[7]

Figure 4 shows the breakdown in the types of rural land developed between 1982 and 2007 in 5-year increments. As is evident, the single greatest type of land developed in each period was forest land. Forest land is, of course, wildlife habitat. More broadly, it is a type of "natural capital" that provides a range of ecological services and socioeconomic benefits, among them climate regulation, watershed protection, soil conservation, flood prevention, streamflow moderation, wood products, aesthetic qualities, and serving as a magnet for outdoor recreation such as hunting, fishing, hiking and wildlife observation and photography.

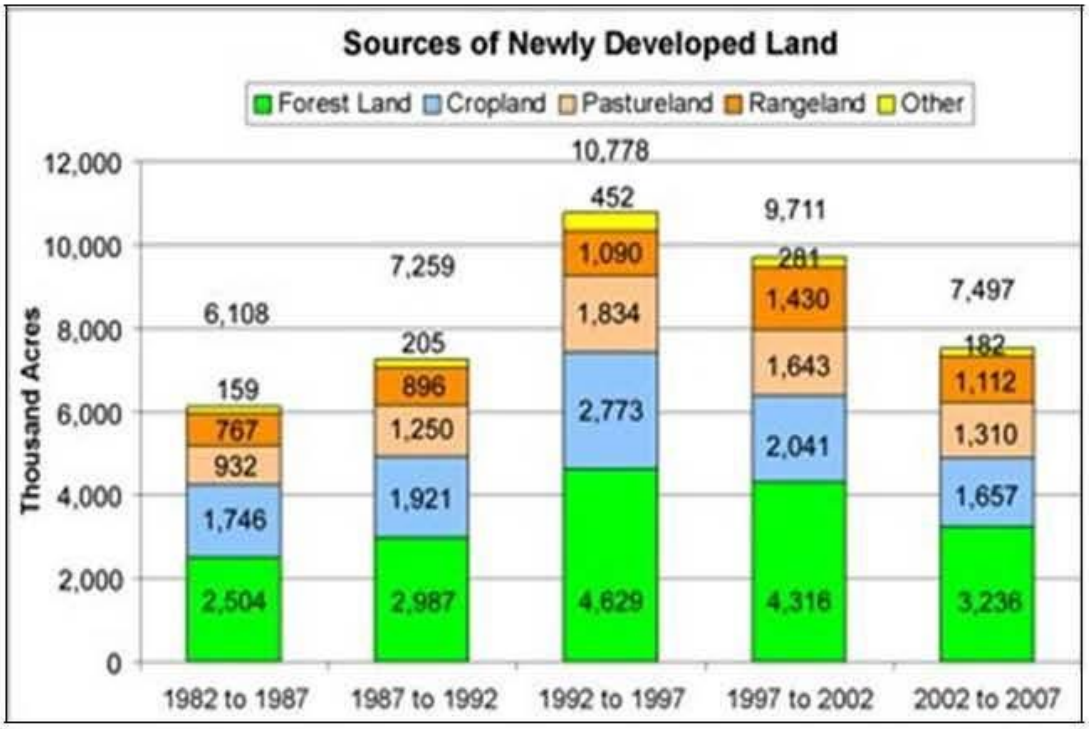
1.4 National Security Implications of Farmland Loss

Development is not the only factor responsible for the degradation and disappearance of high-quality agricultural land. Arable land is also vulnerable to other damaging natural and anthropogenic forces such as soil erosion from wind and water, and salinization and waterlogging from irrigation, which can compromise the fertility, productivity, and depth of soils, and possibly even lead to their premature withdrawal from agriculture. Many of these

[7] Barnosky, A.D. et al. 2012. "Approaching a state shift in Earth's biosphere." *Nature*, Vol. 486, 7 June.

adverse effects are due to over-exploitation by intensive agricultural practices needed to constantly raise agricultural productivity (yield per acre) in order to provide ever more food for America's and the world's ever-increasing populations and more meat- and dairy-intensive diets.

Figure 4. Area of Newly Developed Land, by Major Type, 1982-2007



Thus, the potent combination of unrelenting development and land degradation from soil erosion and other factors is reducing America's productive agricultural land base even as the demands on that same land base from a growing population are increasing. The NRI estimates that the amount of cropland in the United States declined from 420 million acres in 1982 to 361 million acres in 2010, a decrease of nearly 60 million acres (14 percent) in just 28 years (**Figure 5**). Some of this cropland (cumulatively, 27 million acres in 2010) was withheld from active farming with federal government support and subsidies and placed into the Conservation Reserve Program (CRP), but these tend to be marginal or fragile sites on which cultivation is not deemed to be sustainable in any case. Even with the federal ethanol mandate and strong financial incentives over much of the last decade to grow corn in order to produce ethanol as fuel for vehicles, the amount of cropland dropped by seven million acres in the eight years between 2002 and 2010, increasing slightly between 2007 and 2010.[8] The land uses into which cropland was converted are depicted in **Figure 6**.

[8] Op. cit. Footnote #5.

Figure 5. Area of Cropland in the United States, 1982-2010

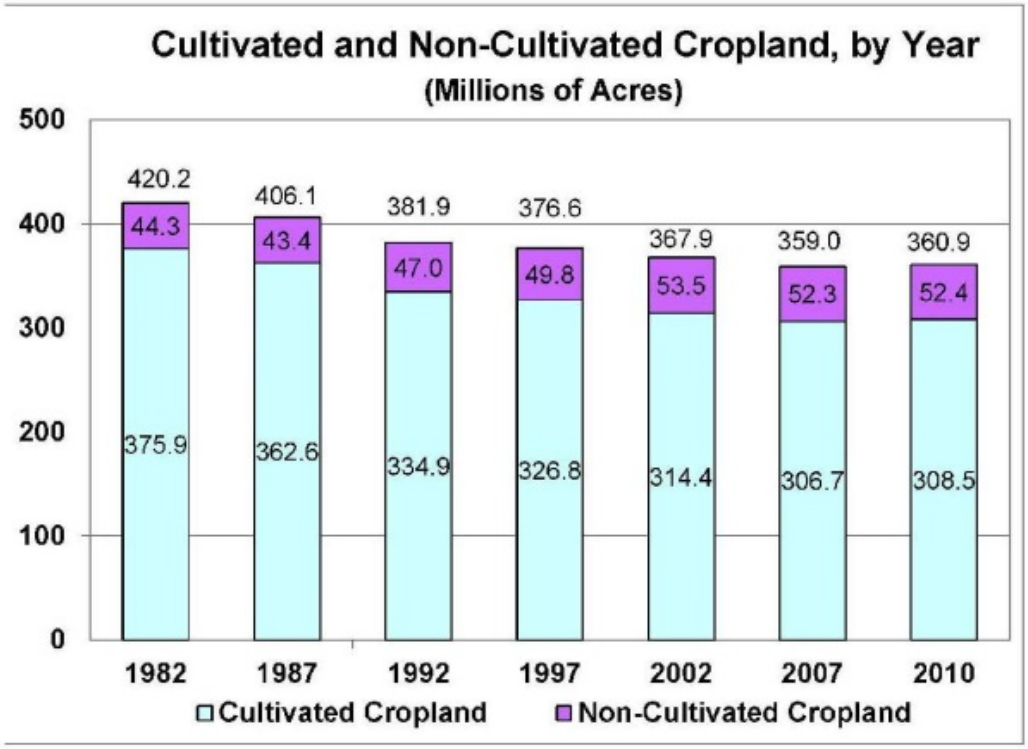
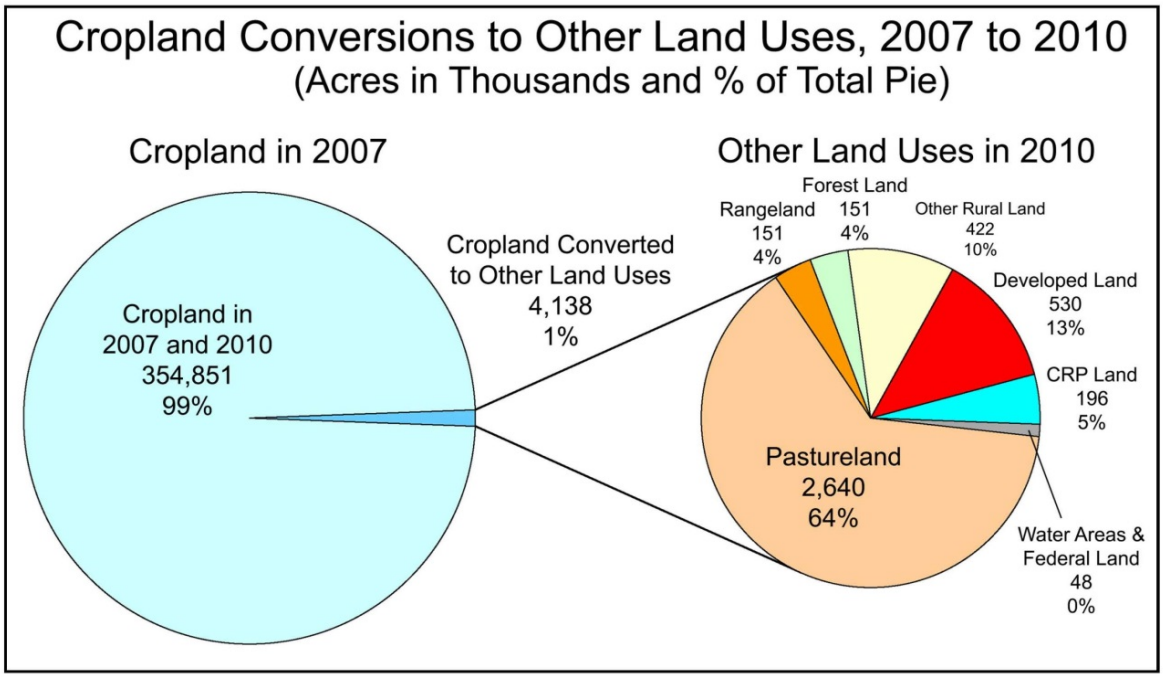


Figure 6. Cropland Converted to other Land Uses from 2007 to 2010



If the same rate of cropland conversion and loss that prevailed from1982 to 2010 were to continue to the year 2100, the United States will have lost an additional 193 million acres of its remaining 361 million acres of cropland, for a total cumulative loss of 253 million acres. Only 168 million acres would then remain – about 40 percent of the original allotment – and none of this acreage would be in pristine condition after two centuries or so of intensive exploitation. Its soils and nutrients, while perhaps not exhausted, would require even greater inputs of costly fertilizers. Two of the most crucial fertilizers – ammonium nitrate, produced from natural gas, and phosphorus, produced from phosphate mines – may be far more expensive, perhaps prohibitively so, in 2100 than at present, due to the inexorable depletion of the highest-quality reserves of these non-renewable resources.

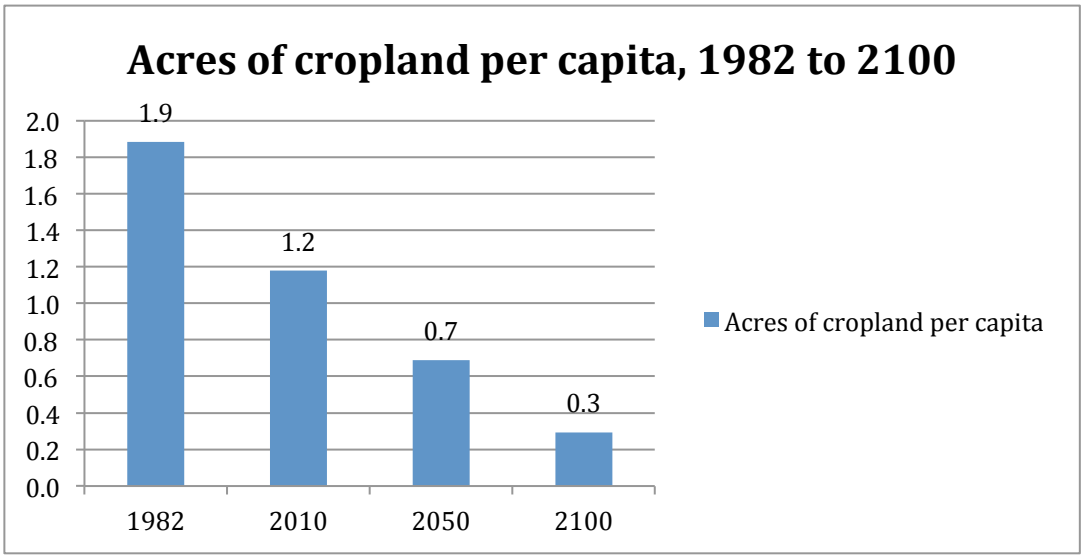
Table 4 shows the amount of cropland per capita in the United States in 1982, 2010, and projected to 2050 and 2100, assuming the same rate of cropland decline from 1982 to 2010 and using the most recent Census Bureau projections. Available cropland will have declined from 1.9 acres per person in 1982 to 0.3 acre per person in 2100, an 84 percent decrease. **Figure 7** graphically depicts this striking loss in the form of a bar chart.

Table 4. Projected Long-term Decline in Cropland per Person

Year	Cropland in 48 contiguous states (millions of acres)	U.S. Population in Millions (48 states)	Acres of cropland per capita
1982	420	225	1.9
2010	361	306	1.2
2050	276[1]	400[2]	0.7
2100	168[1]	571[2]	0.3

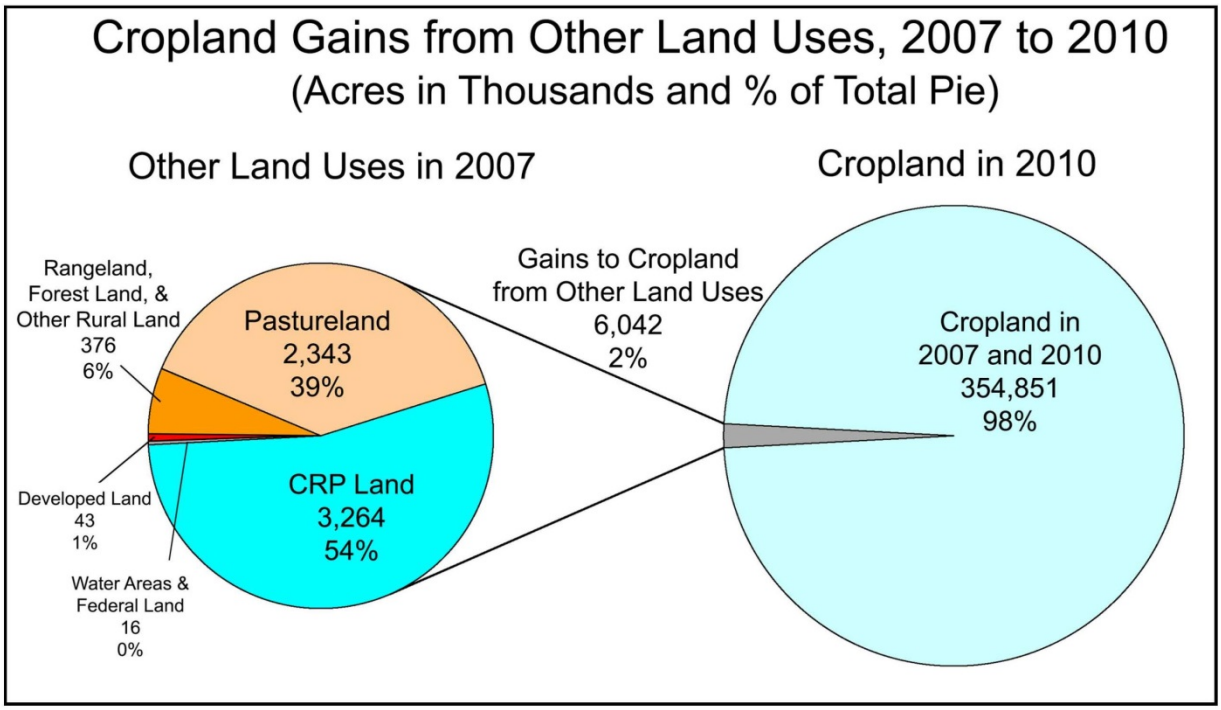
[1]Projected using annual rate of cropland loss from 1982-2010 (2.1 million acres)
[2]Most recent projections from the United States Census Bureau

Figure 7. Projected Long-term Decline in Cropland per Person



However, this dire scenario is unlikely to come to pass, even if the United States continues to reject population stabilization as an acceptable course of action or to enact more aggressive farmland protection measures. This because rising demand and prices for foodstuffs would increase the value of land maintained as cropland vis-à-vis developed land, and because conversion from other types of lands to cropland, including pastureland, rangeland, forested land and other natural areas, would certainly occur (**Figure 8**). This actually did happen from 2007 to 2010, during which the area in cropland increased by 1.9 million acres; most of this was CRP land called back into production because high agricultural commodity prices encouraged farmers to plant it. Again, in an ideal world, erosive or sensitive CRP lands should *not* be cultivated and would best be conserved as wildlife habitat; that is why the voluntary Conservation Reserve Program was established in the first place in the 1980s.

Figure 8. Cropland Gains from other Land Uses, 2007-2010



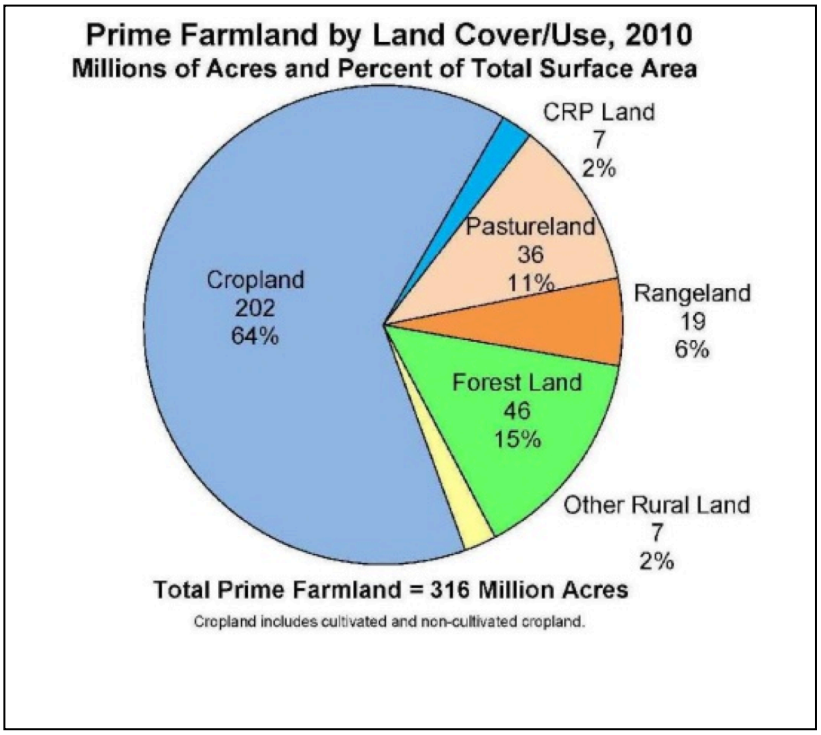
Source: NRCS, 2013. *Summary Report: 2010 National Resources Inventory*.

Furthermore, the decrease from 1982 to 2010 in the acreage of highest quality soils classified as Prime Farmland, which constitutes only 23 percent (or 316 million acres) of the non-Federal rural land base was "only" 13 million acres, compared to the nearly 60-million-acre decrease in cropland. NRCS states that "most of this loss was due to development." As shown in **Figure 9,** not all designated Prime Farmland is cultivated as cropland; indeed, only 64 percent of it is cropland; the rest is in other non-developed land uses or cover types.

Nevertheless, given the projected decline in cropland per capita, that is, the acreage of land on which to cultivate grains and other crops for each resident, biotechnology will have to

work miracles in constantly raising yields per acre in order to maintain the diverse, meat-and-dairy-rich diet Americans came to expect in the late 20th century.

Figure 9. Prime Farmland by Type in 2010



Source: NRCS, 2013. *Summary Report: 2010 National Resources Inventory*.

Ominous, divergent trends – an increasing population, a decreasing arable land base, diversions of water supplies needed for irrigated agriculture to urban populations, and a modern, mechanized agriculture that is heavily dependent on limited fossil fuels at all stages – have led some scientists to conclude that someday within this century the United States may cease to be a net food exporter.[9] Food grown in this country would be needed for domestic consumption. By mid-century, the ratio of arable land per capita may have dropped to the point that, "the diet of the average American will, of necessity, include more grains, legumes, tubers, fruits and vegetables, and significantly less animal products."[10] While this may in fact constitute a healthier diet, it would also represent a significant loss of choice for a country that has always prided itself on its abundant agriculture, plentiful consumer options, and comparative freedom from want.

[9] Pimentel, D. and M. Giampietro. 1994. "Food, Land, Population and the U.S. Economy." Washington, D.C.: Carrying Capacity Network; David Pimentel and Marcia Pimentel. 1997. "U.S. Food Production Threatened by Rapid Population Growth." Washington, D.C.: Carrying Capacity Network; D. Pimentel, M. Whitecraft, Z. R. Scott, L. Zhao, P. Satkiewicz, T. J. Scott, J. Phillips, D. Szimak, G. Singh, D. O. Gonzalez, and T. L. Moe. 2010. Will Limited Land, Water, and Energy Control Human Population Numbers in the Future? *Human Ecology*. 12 August.

[10] Pimentel and Giampietro. 1994. See footnote #8.

Preserving farmland and maintaining its fertility is more than a question of producing an adequate supply of food and engendering a healthy diet for Americans, it is a matter of national security. According to Brig. Gen. (Ret.) W.E. King, Ph.D., P.E., Dean of Academics, U.S. Army Command and General Staff College, Fort Leavenworth, Kansas, without a sustainable environment and resources that meet basic human needs, instability and insecurity will be the order of the day.[11] The World Food Summit held in Rome, Italy in 1996 revived interest in the issue of food security, and thus, in farmland preservation because of its bearing on food security.[12] As Oxford ecology professor Norman Meyers noted in a now-classic 1986 article:

> "…national security is not just about fighting forces and weaponry. It relates to watersheds, croplands, forests, genetic resources, climate and other factors that rarely figure in the minds of military experts and political leaders…"[13]

One of the lasting effects on the world food system of the global crisis in food prices from 2007 to 2008 has been the accelerating acquisition of farmland in poorer countries by wealthier countries which seek to ensure their food supplies. As the International Food Policy Research Institute states:

> "Increased pressures on natural resources, water scarcity, export restrictions imposed by major producers when food prices were high, and growing distrust in the functioning of regional and global markets have pushed countries short in land and water to find alternative means of producing food."[14]

By 2009, foreign governments and investors had already purchased more than 50 million acres (78,000 square miles) of farmland – an area the size of Nebraska – in Africa and Latin America.[15]

Finally, U.S. agriculture and related food industries contribute nearly $1 trillion to our national economy annually. They comprise more than 13 percent of the GDP and employ 17

[11] King, W.E. A Strategic Analytic Approach to the Environmental Security Program for NATO. W. Chris King, Ph.D. P.E.is Brigadier General, US Army retired and Dean of Academics, US Army Command and General Staff College, Fort Leavenworth, Kansas.
[12] Tweeten, L. 1998. Food Security and Farmland Preservation. *Drake Journal of Agricultural Law*. 3:237-250.
[13] Meyers, N. 1986. The Environmental Dimension to Security Issues. *The Environmentalist*. 6(4): 251-257; Liotta, P.H., et al. (eds.). 2007. Proceedings of the NATO Advanced Research Workshop on Environmental Change and Human Security: Recognizing and Acting on Hazard Impacts. Newport, Rhode Island, 4-7 June 2007.
[14] International Food Policy Research Institute. 2009. "Land grabbing" by foreign investors in developing countries. Available online at: http://www.ifpri.org/publication/land-grabbing-foreign-investors-developing-countries.
[15] Leahy, S. 2009. Wealthy Countries and Investors Buying Up Farmland in Poor Countries. Available online at: http://stephenleahy.net/2012/05/17/wealthy-countries-and-investors-buying-up-farmland-in-poor-countries/.

percent of the labor force. World demand for U.S. agricultural exports is only expected to increase over the foreseeable future due to a rapidly growing world population, increasing demand for meat and dairy products, and expanding global markets.[16]

Americans are not unaware of these national security implications, according to a national poll[17] of likely voters in 2014 (see Appendix K for the entire poll results):

QUESTION: How important is it to protect farmland from development so the United States is able to produce enough food to completely feed its own population in the future?

71% - Very important
21% - Somewhat important (92% very or somewhat important)
6% - Not very important
0% - Not important at all
2% - Not sure

When asked about having enough food left over to provide to other nations, not as many Americans appear to have a sense of urgency related either to national security or humanitarian issues, but few thought it unimportant.

QUESTION: How important is it for the United States to have enough farmland to be able to feed people in other countries as well as its own?

26% - Very important
46% - Somewhat important (72% very or somewhat important)
19% - Not very important
6% - Not important at all
2% - Not sure

The poll found most Americans consider the treatment of good cropland to be not just a practical issue but one of ethics. The poll forced people to choose between the practical need for more housing (a pressure that exists in nearly every Urbanized Area in the country) and the ethics of destroying food-producing land to provide more housing. The high level (22%) answering "not sure" indicates that a lot of people haven't thought about this tradeoff between two things they probably think of as "good" or that they are unwilling to choose.

QUESTION: Which do you agree with more: That it is unethical to pave over and build on good cropland or that the need for more housing is a legitimate reason to eliminate cropland?

[16] American Farmland Trust. 2013. Farmland Protection. Available on the World Wide Web at: http://www.farmland.org/programs/protection/.
[17] Op. cit. Footnote #2, Pulse Opinion Research. Appendix K includes the entire poll's results.

59% - It is unethical to pave over and build on good cropland
19% - The need for more housing is a legitimate reason to eliminate cropland
22% - Not sure

1.5 Physiological and Psychological Benefits of Open Space

Open space, parks, green spaces, natural areas – including wetlands, riparian corridors, farmland, beaches, rivers, lakes, the ocean, fields and forests – provide demonstrable mental and physical health benefits. They have proven to be preventative measures that can actually lower health care costs and reduce the need for health interventions. Exploring or even just gazing upon natural areas – such as a forest-covered mountain range next to a city – gives human beings a sense of perspective, continuity in a changing world, spiritual renewal, well-being, and a feeling of harmony with the world around us. The presence of open space within and adjacent to our urban areas – and the assurance that this open space will outlast us – serves to counter-balance the stress and strain of modern life.

Figure 10. Central Park has been called a "green oasis" in New York City

Contact with nature and open space provides both physiological and psychological benefits. Research on the physiological benefits of open space has centered on how direct or indirect (vicarious) experience with vegetated and/or natural landscapes reduces stress, and anxiety.[18]

[18] Rubenstein, N.R. The Psychological Value of Open Space. Chapter 4 in *The Benefits of Open Space*. The Great Swamp Watershed Association. 1997. Available on the World Wide Web at: http://www.greatswamp.org/publications/rubinstein.htm.

A series of studies spanning nearly 20 years in the seventies and eighties linked photo simulations of natural settings to reduced stress levels as measured by heart rate and brain waves. One study revealed that subjects experienced more "wakeful relaxation" in response to slides showing vegetation only and vegetation with water as compared with urban scenes without vegetation. These data were corroborated by attitude measures which indicated lower levels of fear and sadness when experimental subjects observed nature-related slides, as opposed to urban slides.[19] In studies of hospital patients, recovery was faster, there were fewer negative evaluations in patient reports, and there was less use of analgesic drugs among post-surgery patients with views of exterior greenery than among control group patients with views of buildings.[20]

In other research, breast cancer survivors who engaged in personally enjoyable and nature-related "restorative activities" showed dramatic effects on their cognitive process and quality of life.[21] At the end of three months, the experimental group showed significant improvements in attention and self-reported quality of life measures; they had begun a variety of new projects. Control group members, meanwhile, who had been given no advice regarding nature exposure activities, continued with deficits in measures of attention, had started no new projects, and had lower scores on quality of life measures. This research underscored that difference between nature as an amenity and as a human need. As one reviewer of the study observed:

> "People often say that they like nature; yet they often fail to recognize that they need it...Nature is not merely 'nice.' It is not just a matter of improving one's mood, rather it is a vital ingredient in healthy human functioning."[22]

There is an important distinction between nature as amenity and nature as need. As one book affirms:

> "Viewed as an amenity, nature may be readily replaced by some greater technological achievement. Viewed as an essential bond between human and other living things, the natural environment has no substitutes."[23]

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[19] Ulrich, R. 1979. Visual landscapes and psychological well-being. *Landscape Research*, 4(1): 17-23.
[20] Ulrich, R. 1983. Aesthetic and affective response to natural environment. Chapter 3 in I. Altman, & J. F. Wohlwill (Eds.), *Human Behavior and Environment*: Volume 6 (pp. 85-126). New York: Plenum Press; Ulrich, R. 1984. Views through a window may influence recovery from surgery. *Science*, 224, 420-421.
[21] Cimprich, B. E. 1990. Attentional fatigue and restoration in individuals with cancer. Unpublished Doctoral Dissertation, University of Michigan.
[22] Kaplan, S. (1992). The Restorative Environment: Nature and human experience. In D. Relf (ed.), *The Role of horticulture in human well-being and social development: A National Symposium* [Proceedings of Conference Held 19-21 April 1990, Arlington, VA] (pp. 134-142). Portland, OR: Timber Press.
[23] Kaplan, R., & Kaplan, S. (1989). *The Experience of nature: A Psychological perspective*. New York: Cambridge University Press.

While there are many anecdotal reports connecting the natural environment or open space to everything from increased self-esteem to stress reduction, there are few studies attempting to categorize the many phrases used to identify the worth of a walk in the woods or a day bird-watching beside a marsh.[24] Few studies track long-term longitudinal effects on changed attitudes and behavior. While it is difficult to characterize and quantify the long-term manner in which lives are modified, it is easy to acquire narrative accounts about the effect of a favorite overlook, trail, or patch of woods on one's psyche. One of the best known of such testimonials is from pioneering naturalist-conservationist John Muir:

> "Climb the mountains and get their good tidings. Nature's peace will flow into you as sunshine flows into trees. The winds will blow their own freshness into you, and the storms their energy, while cares will drop away from you like the leaves of Autumn."

Natural settings are unparalleled in their ability to furnish solitude and privacy. They also have "existence value," that is, there is value to knowing that they are simply *there* and to the very idea that we *could* get away into them, if we so chose; this is a value in and of itself, which provides for a psychological "time-out" and a sense of wellbeing.

A 2014 national survey[25] of Americans found most of them at least superficially recognizing the value of non-developed open spaces for their emotional well-being.

QUESTION: Do you feel an emotional or spiritual uplift from time spent in natural areas like woodlands and open grasslands?

70% - Yes
18% - No
12% - Not sure

An even larger majority of Americans indicated to pollsters that they want to have easy access to open spaces, something that is increasingly difficult because so many Americans live in the midst of giant metropolitan areas far from the urban edges where they can encounter nature.

QUESTION: How important is it that you get to natural areas fairly quickly from where you live?

48% - Very important
37% - Somewhat important (85% very or somewhat important)
11% - Not very important
2% - Not important at all
2% - Not sure

[24] Op. cit. Footnote #18, Rubenstein.
[25] Op. cit. Footnote #2, Pulse Opinion Research.

1.6 Why Americans Still Don't Like Sprawl

While not garnering the media attention they once did, the topics of urban sprawl and the environment remain a major concern to many American citizens. A 2013 Earth Day poll conducted on attitudes towards environmental issues indicated that 80% of those polled believe that it is important to protect our natural environment.[26] According to the Land Trust Alliance, voters still care deeply about conserving our remaining natural land, approving over 80% of land conservation measures on the ballot around the country in November 2012.[27] The 46 measures passed nationally provide a total of $767 million to protect and improve water quality, acquire new parks and open space, and conserve working farms and ranches. Many of the referenda won by landslides – 27 measures passed with at least 65% of the vote. National and regional non-governmental land conservancies such as The Nature Conservancy, the Trust for Public Land, and the New Mexico Land Conservancy continue to garner substantial public support.

Urban sprawl also imposes significant economic and financial costs on the public. These costs are often hidden in the form of taxpayer subsidies to build new roads, water supply systems, sewage collection and treatment systems, and schools to accommodate runaway growth.[28]

In essence, Americans still value our rural land, oppose longer commute times to work and to daily, weekly, and monthly open-space destinations, increased environmental degradation, and higher economic costs, all of which are part of the price tag of sprawling urban development.

As noted earlier, the 2014 polling[29] found sizeable majorities of Americans who feel strongly about the need to protect farmland and natural habitats for themselves, for their fellow Americans and for the nation's wildlife. In general, Americans see sprawl as a threat to their quality of life. Polling found most Americans expect a continuation of recent trends to make life where they live "worse." Few things affect the day-to-day quality of life of modern-day Americans as much as changes in traffic and commuting. Asked if a continuation of recent trends would make traffic "much worse," 68% said yes, while only 20% said they thought the government would "be able to build enough extra transportation capacity to accommodate the extra people." (Poll results are shown in their entirety in Appendix K.)

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[26] Omnibus Poll of 1000 adults on April 9-10, 2013 with a margin of error of +/- 3.7%. Available at http://big.assets.huffingtonpost.com/toplines_earthday411.pdf.

[27] Land Trust Alliance. 2012. Voters Approve 81% of Land Conservation Ballot Measures. Available at: http://www.landtrustalliance.org/policy/public-funding/voters-enthusiastically-approve-new-spending-on-conservation-nationwide.

[28] Eben Fodor. 1999. *Better Not Bigger: How to Take Control of Urban Growth and Improve Your Community*. New Catalyst Books; Eben Fodor. 2012. "The Myth of Smart Growth." Available at: www.fodorandassociates.com/Reports/Myth_of_Smart_Growth.pdf

[29] Op. cit. Footnote #2, Pulse Opinion Research. Also see Appendix K.

2. THE FACTORS IN SPRAWL

Over the past few decades, dozens of diverse factors have been suggested as causes of America's relentless, unending sprawl, defined here as the expansion of urban land at the expense of rural land.

1. One factor is population growth.
2. All the other factors combine to increase per capita land consumption.

This study examines the relative importance of those two overall factors.

2.1 Sprawl Defined

The word "sprawl" is not a precise term. But we do indeed use the term "Overall Sprawl" in a precise way in this study – it is the amount of rural land lost to development.

Fortunately, it is easy to measure the amount of Overall Sprawl because of two distinct, painstaking processes conducted by two unrelated federal agencies: the U.S. Census Bureau (Census) and the Natural Resources Conservation Service (NRCS) of the U.S. Department of Agriculture (USDA). Using data from decennial censuses, Census has tabulated changes in the size and shape of the nation's Urbanized Areas (UAs) every 10 years for more than a half a century (since 1950), while the NRCS has estimated changes in the size and shape of America's Developed Lands every five years for more than a quarter-century (since 1982).

The Census Bureau uses a rather complicated but consistent set of conditions to measure the spread of cities into surrounding rural land. Census defines the contiguous developed land of a central city and its suburbs an "Urbanized Area." It is possible to measure sprawl from decade to decade by calculating the change in overall acreage of a specific UA.

The NRCS uses remote sensing, survey, and statistical techniques to derive estimates of changes in land use on the nation's non-federal lands. Built-up or developed lands are one of the categories of land use NRCS delineates.

Defining sprawl by the Census standards has some limitations that are discussed in Appendix D (along with a description of the difference between an Urbanized Area and a Metropolitan Statistical Area). But the UA delineations, coupled with the NRI surveys, are unequalled as uniform quantitative longitudinal measures of rural urbanization by cities and towns in all regions of the country.

2.2 Our Two Main Data Sources

Urbanized Area data from the 2000-2010 Census and Developed Land data from the 2002-2010 National Resources Inventories served as our main data sources for the current update

of our prior 2001 and 2003 sprawl studies. While the Census data pertain to a discrete list of designated cities, the NRI data furnish a portrait that also includes development in places outside of the boundaries of the Census Bureau's UAs. Therefore, we were able to assess and include traditional sprawl and development within large American cities as well as the more diffuse development and sprawl dispersed across entire states, as evidenced in the NRI data. The NRI refers to these areas of more dispersed development as "Small Built-up Areas." In 2010, Small Built-up Areas comprised 7.2 million acres or about six percent of the total of 113.3 million acres of Developed Land in the contiguous United States.

This study provides an update on the amount of sprawl over the most recent periods for which the most comprehensive government data are available: 2000-2010 for UAs and 2002-2010 for Developed Lands. Urbanized Area data are calculated only once every 10 years. Thus, our study can assess the march of sprawl up until 2010.

NRI data available span uninterrupted from 1982-2007 in five 5-year intervals (1982-1987, 1987-1992, 1992-1997, 1997-2002, 2002-2007), although the most recent interval is three years (2007-2010). These data quantify how much rural land was converted into developed or built-up land over these discrete time intervals, as well as over the 28-year time period in its entirety. Therefore, we are able to see how sprawl has consistently impacted areas outside of the Census' Urbanized Areas over the last 28 years.

2.2.1 Census Bureau's Urbanized Areas

The U.S. Census Bureau classifies geographic areas of the United States as either urban or rural. Urban places are those characterized by densely developed land; they include residential, commercial, industrial and other non-residential urban land uses.[30]

The Census Bureau has been making these classifications for a long time: it first defined urban places in reports following the 1880 and 1890 censuses. It adopted the current minimum population threshold for urban areas of 2,500 a century ago back in the 1910 Census; any incorporated place that contained at least 2,500 people within its boundaries was designated as urban. All territories outside of these urban places, regardless of their population densities, were considered rural.[31]

Census started designating densely populated Urbanized Areas of 50,000 or more residents beginning with the 1950 Census, accounting for the increased presence of densely inhabited suburban development on the periphery of large cities. Outside of UAs, the Bureau continued to identify as urban any incorporated place or census designated place of at least 2,500 and less than 50,000 people.

[30] U.S. Census Bureau. 2013. 2010 Census Urban and Rural Classification and Urban Area Criteria. Accessed at: http://www.census.gov/geo/reference/ua/urban-rural-2010.html
[31] U.S. Census Bureau. 2010 Census Urban Area FAQs. Accessed at: http://www.census.gov/geo/reference/ua/uafaq.html.

Beginning with the 2000 Census, the Bureau introduced the concept of "urban clusters" (UCs), replacing urban places located outside of UAs. These are defined based on the same criteria as UAs, but represent areas containing at least 2,500 and less than 50,000 people. "Rural" areas continue to be defined as any population, housing, or territory outside of urban areas.

According to the Census Bureau, in the 2010 Census, an urban area consists of a "densely settled core of census tracts and/or census blocks that meet minimum population density requirements, along with adjacent territory containing non-residential urban land uses as well as territory with low population density included to link outlying densely settled territory with the densely settled core."[32] In essence, UAs represent America's "urban footprint."[33]

For the 2010 Census, the Bureau utilized Geographic Information System (GIS) software from the world's largest developer and supplier of GIS software, the Environmental Systems Research Institute, Inc. (ESRI) to delineate the nation's urban areas.[34]

The initial delineation of an urbanized core includes census tracts or blocks with a population density of 1000 people per square mile (ppsm). Adjacent tracts or blocks with a density of 500 ppsm are then added iteratively. Impervious qualifying blocks are also added iteratively to the UA. These are areas of impervious ground surface (covered with pavement or structures) that support non-residential urban land use such as commercial or industrial; they have low population density because they are non-residential, but they are functionally part of the urban landscape. The Bureau uses an ESRI tool called ArcGIS Spatial Analyst to analyze the Multi-Resolution Land Characteristics Consortium (MRLC) National Land Cover Database (NLCD) 2006 impervious 30-meter raster dataset. Holes or enclaves in the polygon less than five square miles in area that are completely surrounded by qualifying land are filled in, and counted as part of the UA.[35]

UA delineation may also employ "hops" and "jumps." These are a means of connecting outlying densely settled territory with the main body of the UA or UC. A hop is a connection from one urban area core to other qualifying urban territory along a road connection of half a mile (0.5 mile) or less in length; multiple hops may be made along any given road corridor. This criterion recognizes that alternating patterns of residential development and non-residential development are a typical feature of urban landscapes.

A jump is a connection from one urban area core to other qualifying urban territory along a road connection between 0.5 mile and 2.5 miles in length; only one jump may be made along

[32] See note 24.
[33] U.S. Census Bureau. 2011. The Use of ESRI Software in the Delineation of Urban Areas for the 2010 Census. PowerPoint presentation at the ESRI International User Conference July 12th, 2011.
[34] Ibid.
[35] Ibid.

any given road connection. The jump concept has been part of the UA delineation process since the 1950 Census. It provides a means for recognizing that urbanization may be offset by intervening areas that have not yet developed. The Census Bureau changed the maximum jump distance criterion from 1.5 miles to 2.5 miles between the 1990 and 2000 censuses.[36]

The Census Bureau lists a number of revealing facts and figures about UAs in 2010:

- **3,573**: Total number of 2010 Census urban areas in the United States
  - **486**: Number of Urbanized Areas (UAs)
  - **3,087**: Number of Urban Clusters (UCs)
- **71.2%**: Percent of U.S. population living within Urbanized Areas
- **80.7%**: Percent of the U.S. population that is urban
- **16**: Number of UAs with populations of 2,500,000 or more
- **41**: Number of UAs with populations of 1,000,000 or more
- **179**: Number of UAs with populations of 200,000 or more
- **36**: Number of new UAs between 2000 and 2010
- **2,534.4** persons per square mile: Overall Urbanized Area population density in the U.S.

Between 2000 and 2010, the country's urban population grew by 12.1%, in comparison with total U.S. population growth of 9.7% during the same period. In other words, America's urban areas grew at a faster pace than the country as a whole, continuing a demographic trend – a relative shift or migration of the population from rural to urban areas – that has been underway for more than a century. This trend is evident around the entire world.

2.2.2 Natural Resources Conservation Service's National Resources Inventory and Developed Lands

The National Resources Inventory (NRI) is based on rigorous scientific and survey protocols. The U.S. Department of Agriculture's NRCS began developing the NRI in 1977 in response to several Congressional mandates. The first NRI published in 1982 used most of the survey methodology and protocols utilized by earlier inventories. However, the scope and sample size of the 1982 NRI were expanded to meet the demands of the Soil and Water Resources Conservation Act (RCA) of 1977, as well as to better address emerging issues like the permanent loss of agricultural lands to nonagricultural uses, such as transportation, industry, commercial and residential land uses.[37]

[36] Ibid.
[37] U.S. Department of Agriculture. 2009. *Summary Report: 2007 National Resources Inventory*, Natural Resources Conservation Service, Washington, DC, and Center for Survey Statistics and Methodology, Iowa State University, Ames, Iowa. 123 pages. http://www.nrcs.usda.gov/technical/NRI/2007/2007_NRI_Summary.pdf.

The NRI covers the entire surface area (both land and water) of the United States, including all 50 states, Puerto Rico, the U.S. Virgin Islands, and certain Pacific Basin islands. The sample includes all land ownership categories, including federal lands (e.g., national parks, national wildlife refuges, national forests, Bureau of Land Management lands, military installations), although NRI data collection activities have historically focused on non-federal lands. Sampling is conducted on a county-by-county basis, using a stratified, two-stage, area sampling scheme. The two-stage sampling units are nominally square segments of land and points within these segments. The segments are typically half-mile-square parcels of land equal to 160-acre quarter-sections (a section is a square of territory one mile on each side, and comprising one square mile or 640 acres in area) in the Public Land Survey System, but there are a number of exceptions in the western and northeastern U.S. Three specific sample points are selected for most segments, although two are selected for 40-acre segments in irrigated portions of some western States, and some segments originally contained only one sample point.[38]

The 1997 NRI sample contained about 300,000 sample segments and 800,000 sample points. Whereas the NRI was conducted every five years up to 1997, an annual or continuous approach was begun in 2000. Each year a subset of between 71,000 and 72,000 segments from the 1997 sample is selected for observation. The subset is selected using a "supplemented panel rotation" design, meaning that a "core panel" of about 40,000 segments is observed each year along with a different supplemental or rotation panel chosen for each year.

The NRI survey system uses points as the sampling units rather than farms or fields, because land use and land unit boundaries often change in some parts of the country. Utilizing points has allowed the survey process to generate a database with dozens of factors or data elements that are properly correlated over many years. Thus, analyses and inferences based on these data are using proper combinations of longitudinal data.[39]

Data for the initial 1982 NRI were collected by thousands of field staff of the Soil Conservation Service (SCS – precursor agency to NRCS), whose efforts were supplemented by contractors and employees of other agencies working under SCS supervision. Data collection began in the spring of 1980 and ran for more than two years, finishing in the autumn of 1982. For the 1987 NRI, data were also collected by teams of trained personnel. Remote sensing techniques (via aircraft or satellite) were used to update 1982 conditions for about 30 percent of the sample sites. Reliance upon remote sensing increased during the 1990s. Beginning in 2000, special high-resolution imagery was obtained for each NRI sample site.[40]

[38] Ibid.
[39] Ibid.
[40] Ibid.

In 2004, NRCS established Remote Sensing Laboratories (RSLs) in Greensboro, NC; Fort Worth, TX; and Portland, OR. These three labs were designed, equipped, and staffed to take advantage of modern geospatial technologies, enabling efficient collection and processing of NRI survey data. The RSLs are now staffed with permanent employees whose full-time job is NRI data collection and processing.[41]

A number of quality control and quality assurance (QCQA) processes are conducted by NRCS and contract staff as well as by the Statistical Unit and NRCS resource inventory specialists. Many of these QCQA processes are embedded within the survey software developed by NRCS and the Statistical Unit. The QCQA processes ensure that differences in the data over time reflect actual changes in resource conditions, rather than differences in the perspectives of two different data collectors, or changes in technologies and protocols.

One of the special features of the NRI is its genuine longitudinal nature, that is, its reliability and consistency through time, so that users of this dataset can be confident that, for example, differences in the area of developed land shown for 2007 and 1997 accurately reflect true differences "on the ground" or in reality. Even though many operational features of the NRI survey program have evolved over the years, processes have been implemented to ensure that data contained within the 2007 NRI database are longitudinally consistent. Data collection protocols always include review and editing of historical data for the particular NRI sampling units being observed.[42]

NRI's broadest classification divides all U.S. territory into three categories: federal land, water areas, and non-federal land. Non-federal land is broken out into developed and rural. Rural lands are further subdivided into cropland, Conservation Reserve Program (CRP) land, pastureland, rangeland, forestland, and other rural land. In the present study we are concerned only with developed land.

NRI's category of developed land differs from that used by other federal data collection entities. While other studies and inventories emphasize characteristics of human populations (e.g., Census of Population) and housing units (e.g., American Housing Survey), for the NRI, the intent is to identify which lands have been permanently eliminated from the rural land base. The NRI Developed Land category includes: (a) large tracts of urban and built-up land; (b) small tracts of built-up land less than 10 acres in size; and (c) land outside of these built-up areas that is in a rural transportation corridor (roads, interstates, railroads, and associated rights-of-way).

2.3 Population Growth

A city or state's population grows based on personal behavior – births and in-migration – and on local and national governmental actions. Looking more closely, the net increase (or

[41] Ibid.
[42] Ibid.

decrease) in population in any given time period (e.g., one year, one decade) is due to the number of births minus the number of deaths plus the number of in-migrants minus the number of out-migrants.

An urban area's population growth today is much more likely to be the result of enticing residents from elsewhere. Local and state governments can and do create many incentives that encourage people to move into a city. These include aggressive campaigns to persuade industries to move their jobs from another location, public subsidies for the infrastructure that supports businesses, expansion of water service and sewage lines into new areas, new housing developments and new residents, and general public relations that increase the attractiveness of a city to outsiders. Even without trying, a city can attract new residents just by maintaining amenities and a high quality of life, especially if the nation's population is growing significantly, as continues to be the case today.

2.4 Per Capita Land Consumption

Per capita land consumption statistics are a useful way to understand the combined power of numerous land use and consumption choices that lead to urban sprawl. [See Appendix F for the per capita numbers for the Largest Urbanized Areas and Appendices B and C for how the statistic is calculated.] When Census Bureau data show that per capita land consumption in

Table 5. Per Capita Land Consumption in the USA's Top Sprawlers (2010)

Urbanized Area	Fraction of Acre per Resident
1. Atlanta, GA	0.375
2. Dallas-Fort Worth-Arlington, TX	0.222
3. Houston, TX	0.215
4. Phoenix Mesa, AZ	0.202
5. Chicago, IL-IN	0.182
6. Charlotte, NC-SC	0.380
7. Austin, TX	0.246
8. Raleigh, NC	0.375
9. San Antonio, TX	0.217
10. Philadelphia, PA-NJ-DE-MD	0.233

Houston is 0.215 acre, that means it takes just less than a quarter of an acre to provide the average Houston resident with space for housing, work, retail, transportation, education, religious and other private assembly, government, recreation and all other urban needs.

Table 5 shows the variation of per capita land use among the nation's top 10 sprawlers. The average Chicago resident has a little less than two-tenths (0.2) of an acre, while the average Atlanta resident lives off over a third (0.33+) of an acre.

The increase in per capita land consumption (Per Capita Sprawl) is an important cause of Overall Sprawl in many urban areas. Census data on the nation's Urbanized Areas allow us to track the change in per capita land consumption from decade to decade.

At a minimum, the per capita land consumption figure reflects the combined outcome of all the following individual and institutional choices and factors:

- Development
    - Consumer preferences for size and type of housing and yards
    - Developer preferences for constructing housing, offices and retail facilities
    - Governmental subsidies that encourage land consumption, and fees and taxes that discourage consumption
    - Quality of urban planning and zoning
    - Level of affluence
- Transportation
    - Governmental subsidies and programs for highways, streets and mass transit
    - Consumer preferences favoring the mobility and flexibility offered by using private vehicles rather than public transit
    - Price of gasoline (cheap gas encourages sprawl)
- Quality of existing communities and ability to hold onto their residents
    - Quality of schools
    - Reality and perceptions concerning crime and safety
    - Ethnic and cultural tensions or harmony
    - Quality of government leadership
    - Job opportunities
    - Levels of pollution
    - Quality of parks, other public facilities and infrastructure
- Number of people per household
    - Marriage rate and average age for marriage
    - Divorce rate
    - Recent fertility rate
    - Level of independence of young adults
    - Level of affluence enabling single people to live separately

2.5 Measuring Overall Sprawl

Using both the Census Bureau (Urbanized Area) and National Resources Inventory (Developed Land) data, we were able to measure the overall amount different places around the nation sprawled, along with what fraction or percentage of that sprawl could be attributed to population growth and what portion was a result of an increase in per capita land use.

With the Census Bureau Urbanized Areas, the Overall Sprawl was measured by calculating the change in the land area of each of the UAs from the 2000 Census to the 2010 Census. Meanwhile, the NRI provided the exact data on how many acres of rural land had been converted into developed land in 5-year increments within their 25-year time span.

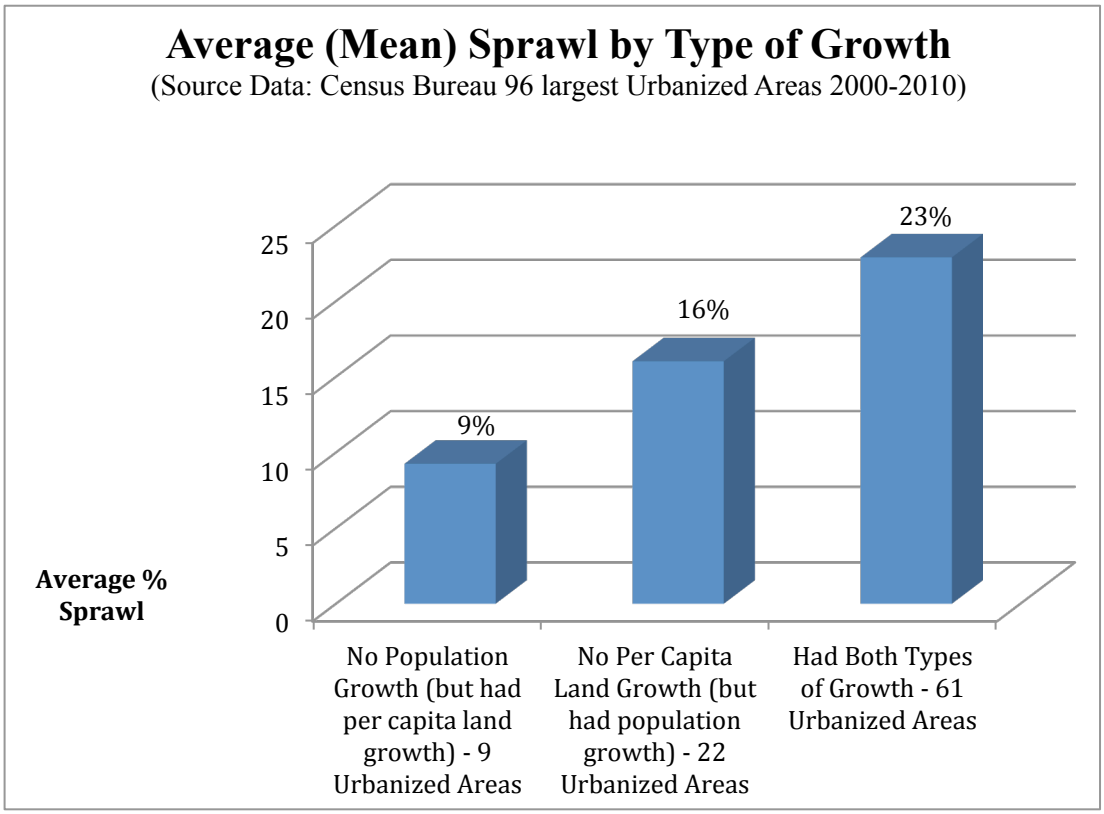
We were able to compare changes in urbanized or developed land area across different time periods for the same city or state as well as make comparisons between cities and states, as to which sprawled the most and which sprawled the least.

3. FINDINGS

This study focuses on the loss of previously undeveloped land (including cropland, range, pasture, forest, and other natural habitat and open space) in the contiguous 48 United States (excluding Alaska and Hawaii). At its most basic level, there are three reasons for an increase in developed land: 1) each individual, on average, is consuming more land; 2) there are more people; or 3) a combination of the two factors is working together to create sprawl. This study attempts to quantify the relative roles the two fundamental factors behind sprawl: rising per capita land consumption and population growth.

Figure 11 is a 3-D bar chart of the largest Urbanized Areas that visually depicts the three situations just described. The first (leftmost) vertical bar or column represents the nine UAs that had growth in per capita land consumption but no population growth between 2000 and 2010. These nine UAs averaged 9% sprawl. The second (middle) column represents the 22 UAs with population growth but no growth in per capita land consumption. These 22 UAs averaged 16% sprawl. The column to the right represents the 61 UAs with both population growth and per capita land consumption growth. These 61 UAs averaged 23% sprawl. Not shown in **Figure 11** are four UAs that had neither population growth nor per capita land growth; indeed both population and per land consumption declined in these four UAs. The average amount of sprawl in these four UAs was -3.5%, that is, they actually decreased in area.

Figure 11. Average Sprawl of Urbanized Areas by Three Types of Growth, 2000-2010

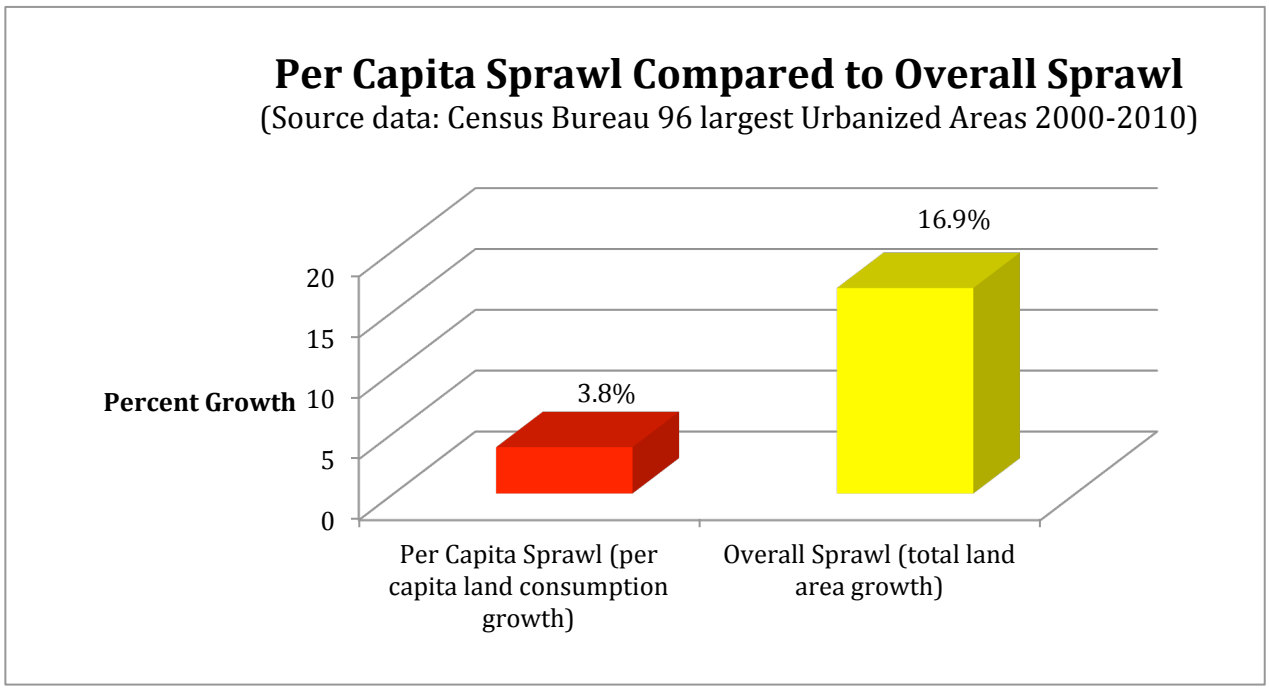


3.1 Urbanized Areas

3.1.1 Per Capita Sprawl and Overall Sprawl

Many respected environmental organizations and urban planners contend that implementing Smart Growth, New Urbanism, and LEED building strategies into our new and existing cities is the best way to rein in sprawl in our cities. However, this is based on the premise that it is only or primarily our land-use choices alone that cause America's sprawl. As our study a decade ago showed, Per Capita Sprawl alone could not explain Overall Sprawl in America's largest urbanized areas. By comparing the percentage of per capita land consumption with the percentage growth of Overall Sprawl in the nation's largest Urbanized Areas from 2000 to 2010 in **Figure 12**, we find that very few of the Per Capita Sprawl percentages are even close to as high as the Overall Sprawl percentage. This is not to denigrate Smart Growth, New Urbanism, and the LEED program, but to recognize their limitations. These multi-faceted, multi-jurisdictional approaches have indeed slowed the pace at which sprawl is converting the countryside into pavement and buildings over the last decade. Given incessant population growth, however, they will only be capable of slowing sprawl, not stopping it.

Figure 12. Per Capita Sprawl vs. Overall Sprawl



Description**:** The growth in per capita land consumption reflects the combined effects of land use planning, government subsidies, urban policies and individual consumption decisions that determine residential densities.

Figure 12 shows that for the largest UAs, Per Capita Sprawl was a relatively insignificant 3.8%. Overall land consumption increased by more than four times as much – 16.9%. For example, Cincinnati's per capita land consumption increased by 8.5%, but it sprawled by more than twice as much: 17.3%. The difference was far wider in many cities; in Charlotte, per capita land consumption grew 3.6% while overall land consumption grew 70.5% – almost twenty times as much. In some instances, per capita land consumption actually decreased – by 9.7% in the case of Albuquerque – while Overall Sprawl still increased by 11.9%.

Even the best Smart Growth, New Urbanism, and LEED[43] strategies were able to engineer only so much population density. As long as population is still growing, the land area taken up by our cities will almost certainly continue to grow.

[43] LEED stands for Leadership in Energy & Environmental Design. According to the U.S. Green Building Council, LEED "is transforming the way we think about how our buildings and communities are designed, constructed, maintained and operated across the globe. Comprehensive and flexible, LEED is a green building tool that addresses the entire building lifecycle recognizing best-in-class building strategies." http://www.usgbc.org/leed

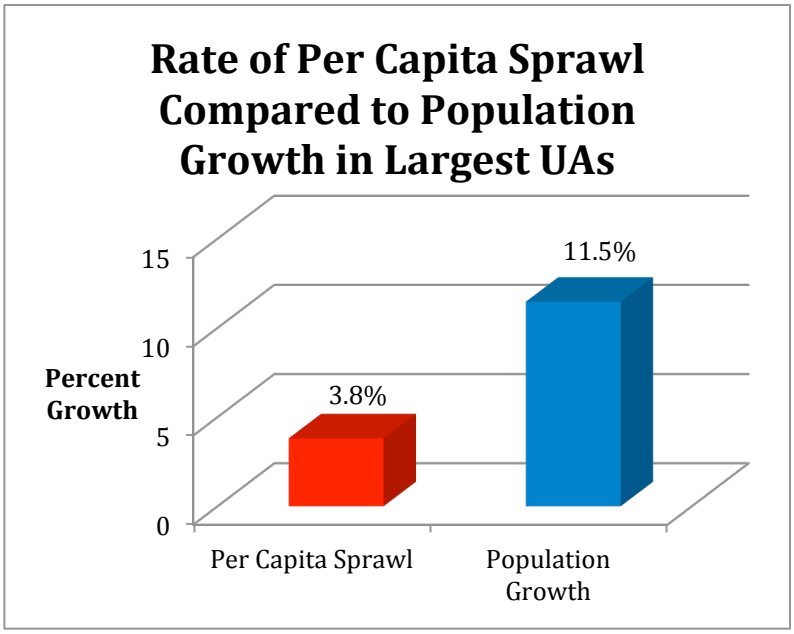
3.1.2 Per Capita Sprawl vs. Population Growth

Since all Overall Sprawl is explained by the combination of population change and per capita consumption change, we can learn much about their relative roles by simply lining up those percentages side by side.

Figure 13 aggregates the 96 largest UAs (formerly the 100 largest) and finds that their average population change was 11.5% while their per capita land change was 3.8%. Thus we can see that the rate of population growth was nearly three times as much as of a factor as the rate of per capita land change in urban sprawl nationwide.

Even after just a cursory examination of **Figures 12 and 13**, it should be obvious not only that Per Capita Sprawl cannot account for all or even most of Overall Sprawl, but that for UAs between 2000 and 2010 it does not appear to be nearly as significant a factor in generating sprawl as Population Growth is. Subsequent sections will explore this finding further by apportioning responsibility for sprawl in cities and states between Population Growth and Per Capita Sprawl by using another methodology.

Figure 13. Per Capita Sprawl vs. Population Growth in 96 Largest UAs, 2000-2010

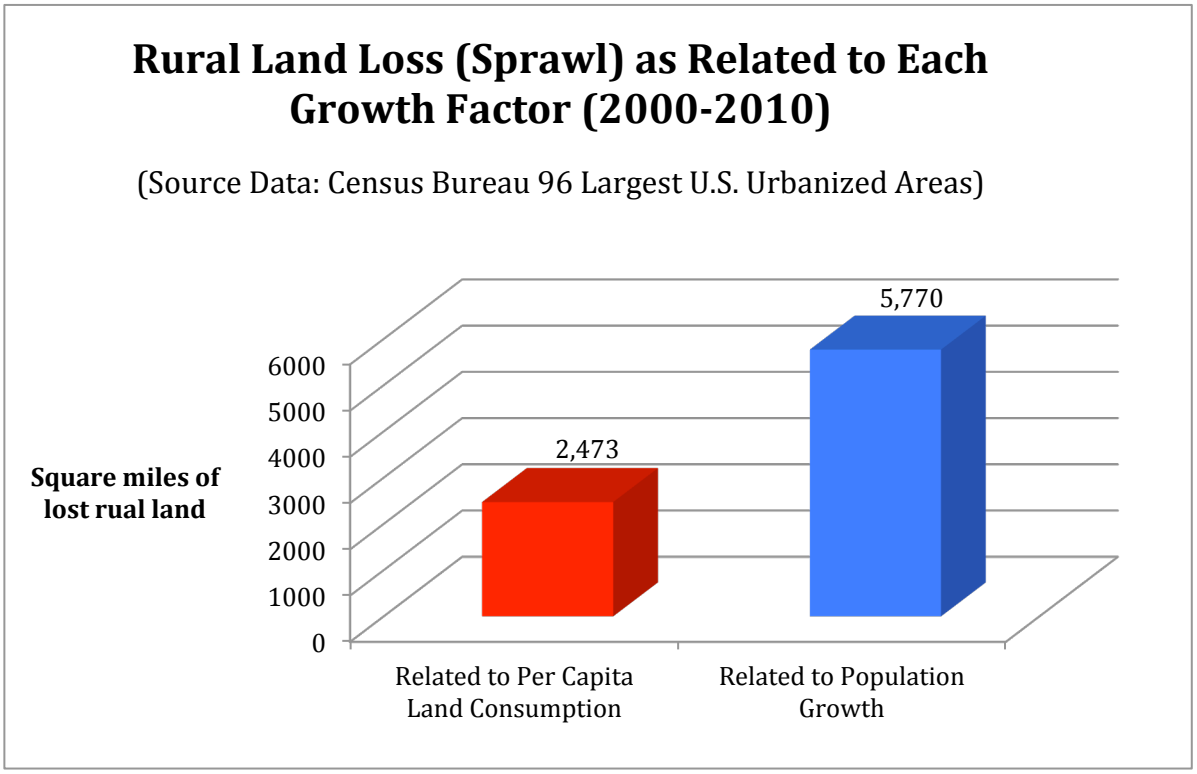


Description: When comparing the growth rates of the two factors behind Overall Sprawl we find that population growth was nearly three times greater than per capita land consumption from 2000 to 2010.

Since our primary concern is the ongoing loss of rural lands – agricultural lands, natural habitats, and other open space – to development and sprawl, it is worth seeing how much of this loss is related to Per Capita Sprawl and how much to Population Growth. **Figure 14** indicates that population growth in the largest UAs is responsible for more than twice as

much loss of rural land as Per Capita sprawl or rising land consumption per capita: 5,770 square miles vs. 2,473 square miles.

Figure 14. Rural Land Lost to Per Capita Sprawl vs. Population Growth



The findings of the current updated study broadly reinforce one of the conclusions of our original sprawl studies a decade ago – that when investigating the causes of sprawl, and presenting findings, it is best to avoid absolutes or categorical statements. Unlike some who have looked into the sprawl phenomenon, we attribute sprawl neither to population growth exclusively nor declining density exclusively, that is, to increasing per capita land consumption. Once again, our findings are unequivocal that both factors are involved and important, although it is evident that over time the population growth factor has increased via-a-vis the Per Capita Sprawl factor.

Figure 15 compares the rates of sprawl when the largest UAs are divided into groups based on the rate of population growth from 2000-2010. On average, cities that added more population clearly sprawled over greater area. Strikingly, cities that experienced no population growth sprawled by only 9%, compared to 66% for those whose populations grew by more than 50%.

Figure 15. Cities with More Population Growth Experienced More Sprawl

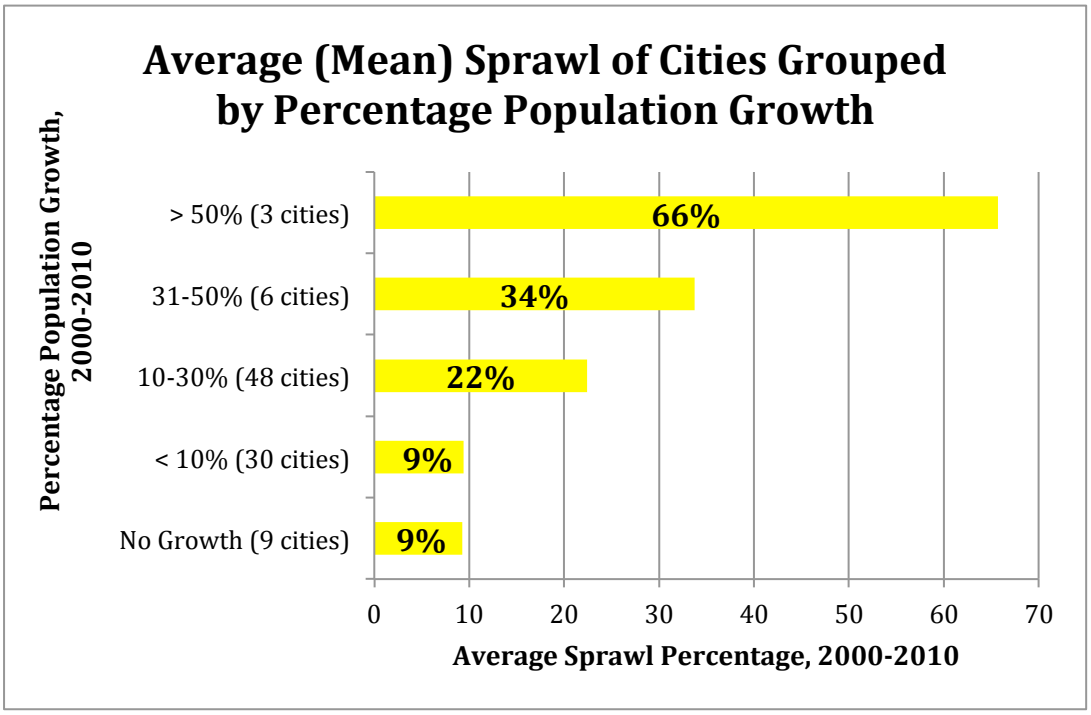
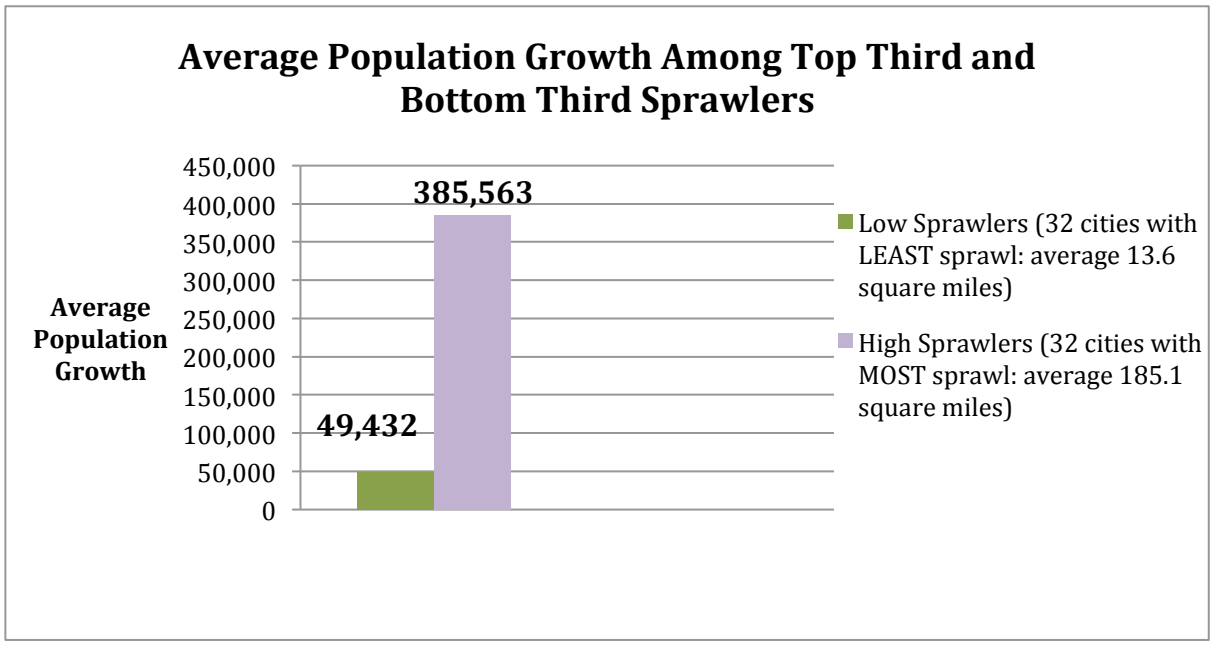


Figure 16 displays the results of another grouping that once again demonstrates population growth's preeminent role in driving sprawl. This figure highlights the amount of population growth in the top third of sprawling cities versus the bottom third of sprawling cities.

Figure 16. Population Growth in Top Sprawlers Compared to Lowest Sprawlers



The 32 cities with the most sprawl (185.1 square miles on average) between 2000 and 2010 had average population growth of more than 385,000. In contrast, the 32 cities with the least sprawl (just 13.6 square miles on average) averaged less than 50,000 population growth during the same decade.

3.1.3 Relative Weight of Sprawl Factors in Largest Urbanized Areas

To better understand and quantify the respective roles of population growth and per capita land consumption in generating Overall Sprawl, we can use a more mathematically sophisticated method that is sometimes used to apportion consumption of natural resources between two or more factors. Dr. John Holdren, Assistant to the President for Science and Technology and Director of the White House Office of Science and Technology Policy since 2009, developed and applied this methodology in a scientific paper evaluating how much of the increase in energy consumption in the United States in recent decades was due to population growth, and how much to increasing per capita energy consumption.[44] This "Holdren method" can be applied to virtually any type of resource in which use of the resource in question is increasing over time, and the number of resource consumers is changing, the amount of the resource being used by each consumer on average is changing, or both.

This study, as did our studies a decade ago, applies this method to sprawl. Rural, undeveloped land is thus the resource in question. As in the case of looking at energy consumption, the issue here is how much of the increased total consumption of rural land (Overall Sprawl) is related to per capita land consumption (Per Capita Sprawl) and how much is related to the increase in the number of land consumers (Population Growth).

Table 6 applies the Holdren method to the 10 largest sprawlers. In the case of Atlanta, 15% of its Overall Sprawl was related to, or explained by, increases in per capita land consumption, and 85% was related to Atlanta's population growth over the past decade. It shows how much of the sprawl in the top ten sprawling cities in the country is related to

[44] John P. Holdren. 1991. "Population and the Energy Problem." *Population and Environment*, Vol. 12, No. 3, Spring 1991. Prior to becoming Director of the White House Office of Science and Technology Policy in the Obama Administration in 2009, Holdren was Teresa and John Heinz Professor of Environmental Policy and Director of the Program on Science, Technology, and Public Policy at Harvard University's Kennedy School of Government, as well as Professor of Environmental Science and Public Policy in the Department of Earth and Planetary Sciences at that university. Trained in aeronautics/ astronautics and plasma physics at MIT and Stanford, he co-founded and for 23 years co-led the campus-wide interdisciplinary graduate degree program in energy and resources at the University of California, Berkeley. On April 12, 2000 he was awarded the Tyler Prize for Environmental Achievement at the University of Southern California, which administers the award. The Tyler Prize is the premier international award honoring achievements in environmental science, energy, and medical discoveries.

population growth and how much is related to growth in per capita land consumption (declining population density).

Table 6. Sources of Sprawl in USA's Top Ten Sprawling Urbanized Areas, 2000-2010

Urbanized Area	% of Total Sprawl Related to POPULATION	% of Total Sprawl Related to GROWTH IN PER CAPITA LAND CONSUMPTION
1. Atlanta, GA	85%	15%
2. Dallas-Fort Worth-Arlington, TX	90%	10%
3. Houston, TX	100%	0%
4. Phoenix--Mesa, AZ	61%	39%
5. Chicago, IL–IN	25%	75%
6. Charlotte, NC–SC	93%	7%
7. Austin, TX	83%	17%
8. Raleigh, NC	100%	0%
9. San Antonio, TX	74%	26%
10. Philadelphia, PA–NJ–DE–MD	57%	43%

Source: U.S. Census Bureau data

Given this apportionment or breakdown, opponents of sprawl in the nation's worst sprawling Urbanized Area, for example, can know that nearly their entire problem has been the inability to stabilize the Atlanta area's population. In contrast, a relatively small part of the problem (15%) has been the inability to stabilize the per capita land use of the area.

Table 7 expands this exercise to the 100 most populated cities in our 2001 study (now 96 cities in the current study due to merging of several UAs as a result of continuing growth and development over the last couple of decades). The Urbanized Areas are listed in alphabetical order. The numbers in the second column show how they rank with all 497 UAs in terms of Total Sprawl (the number of square miles of farmland, habitat and other open space they converted to urban use).

Table 7. Sources of Sprawl in USA's 96 Most Populous Urbanized Areas, 2000-2010

Urbanized Area	National Ranking (No. 1 is Worst)	Total Sprawl (square miles), 2000-2010	% of Total Sprawl Related to Growth in POPULATION	% of Total Sprawl Related to Growth in PER CAPITA LAND CONSUMPTION
Akron, OH	198	17.6	0%	100%
Albany–Schenectady, NY	252	11.5	100%	0%
Albuquerque, NM	130	26.6	100%	0%
Allentown–Bethlehem, PA–NJ	60	56.8	80%	20%
Atlanta, GA	1	682.8	85%	15%
Austin, TX	7	204.9	83%	17%
Bakersfield, CA	123	28.1	100%	0%
Baltimore, MD	101	34.3	100%	0%
Baton Rouge, LA	40	86.1	81%	19%
Birmingham, AL	17	137.8	40%	60%
Boston, MA–NH–RI	18	137.3	48%	52%
Bridgeport–Stamford, CT–NY	426	0.9	100%	0%
Buffalo, NY	227	13.2	0%	100%
Charleston–N. Charleston, SC	52	62.4	100%	0%
Charlotte, NC–SC	6	306.6	93%	7%
Chattanooga, TN–GA	265	10.1	100%	0%
Chicago, IL–IN	5	319.9	25%	75%
Cincinnati, OH–KY–IN	25	116	49%	51%
Cleveland, OH	22	125	0%	100%
Colorado Springs, CO	*	-9.5	N/A	N/A
Columbia, SC	27	111.1	78%	22%

Urbanized Area	National Ranking (No. 1 is Worst)	Total Sprawl (square miles), 2000-2010	% of Total Sprawl Related to Growth in POPULATION	% of Total Sprawl Related to Growth in PER CAPITA LAND CONSUMPTION
Columbus, OH	26	112.8	75%	25%
Corpus Christi, TX	267	10	98%	2%
Dallas–Fort Worth–Arlington, TX	2	372.1	90%	10%
Dayton, OH	124	27.9	35%	65%
Denver–Aurora, CO	11	169.1	61%	39%
Des Moines, IA	55	60.3	54%	46%
Detroit, MI	45	75.7	0%	100%
El Paso, TX–NM	429	31.5	100%	0%
Flint, MI	362	4.8	0%	100%
Fresno, CA	104	32.7	78%	22%
Grand Rapids, MI	153	23.2	64%	36%
Greenville, SC	34	93.7	81%	19%
Harrisburg, PA	74	51.3	92%	8%
Hartford, CT	82	46.9	87%	13%
Honolulu, HI	198	16.1	100%	0%
Houston, TX	3	364.8	100%	0%
Indianapolis, IN	14	152.8	82%	18%
Jackson, MS	43	81.7	45%	55%
Jacksonville, FL	24	119.8	74%	26%
Kansas City, MO–KS	35	93.4	74%	26%
Knoxville, TN	30	98.7	100%	0%

Urbanized Area	National Ranking (No. 1 is Worst)	Total Sprawl (square miles), 2000-2010	% of Total Sprawl Related to Growth in POPULATION	% of Total Sprawl Related to Growth in PER CAPITA LAND CONSUMPTION
Lansing, MI	165	21.3	30%	70%
Las Vegas–Henderson, NV	20	130.9	96%	4%
Little Rock, AR	71	52.7	79%	21%
Los Angeles–Long Beach–Santa Ana, CA	48	68.1	75%	25%
Louisville, KY–IN	41	85.4	60%	40%
McAllen, TX	87	44.2	100%	0%
Memphis, TN–MS–AR	32	97.5	40%	60%
Miami, FL	23	122.5	100%	0%
Milwaukee, WI	57	58.6	44%	56%
Minneapolis–St. Paul, MN	21	127.6	78%	22%
Mobile, AL	247	12.0	48%	52%
Nashville-Davidson, TN	19	132.7	96%	4%
New Haven, CT	171	20.8	82%	18%
New Orleans, LA	68	53.6	0%	100%
New York–Newark, NY–NJ–CT	31	97.6	100%	0%
Ogden–Layton, UT	93	37.5	100%	0%
Oklahoma City, OK	39	88.3	59%	41%
Omaha, NE–IA	85	44.9	81%	19%
Orlando, FL	15	144.5	96%	4%
Oxnard, CA	287	8.7	78%	22%
Pensacola, FL–AL	226	13.3	84%	16%

Urbanized Area	National Ranking (No. 1 is Worst)	Total Sprawl (square miles), 2000-2010	% of Total Sprawl Related to Growth in POPULATION	% of Total Sprawl Related to Growth in PER CAPITA LAND CONSUMPTION
Philadelphia, PA–NJ–DE–MD	10	181.9	57%	43%
Phoenix–Mesa, AZ	4	347.6	61%	39%
Pittsburgh, PA	70	52.8	0%	100%
Portland, OR–WA	76	50.4	100%	0%
Providence, RI–MA	89	41.4	18%	82%
Raleigh, NC	8	198.5	100%	0%
Richmond, VA	64	55.4	100%	0%
Riverside–San Bernardino, CA	28	106.2	100%	0%
Rochester, NY	119	29.3	39%	61%
Sacramento, CA	29	102	87%	13%
St. Louis, MO–IL	33	94.7	32%	68%
Salt Lake City, UT	80	47.2	75%	25%
San Antonio, TX	9	189.5	74%	26%
San Diego, CA	*	-49.9	N/A	N/A
San Francisco–Oakland, CA	*	-3.0	N/A	N/A
San Jose, CA	133	25.9	83%	17%
Scranton, PA	244	12.1	0%	100%
Seattle, WA	61	56.7	100%	0%
Shreveport, LA	113	30.6	45%	55%
Spokane, WA–ID	166	21.2	100%	0%
Springfield, MA–CT	90	39.6	66%	34%

Urbanized Area	National Ranking (No. 1 is Worst)	Total Sprawl (square miles), 2000-2010	% of Total Sprawl Related to Growth in POPULATION	% of Total Sprawl Related to Growth in PER CAPITA LAND CONSUMPTION
Stockton, CA	188	18.2	76%	24%
Syracuse, NY	201	15.3	30%	70%
Tampa–St. Petersburg, FL	13	154.7	96%	4%
Toledo, OH–MI	92	38.1	5%	95%
Trenton, NJ	225	13.4	73%	17%
Tucson, AZ	54	62.1	81%	19%
Tulsa, OK	46	74.5	64%	36%
Virginia Beach, VA	*	-11.4	N/A	N/A
Washington, DC–VA–MD	12	165.0	100%	0%
Wichita, KS	98	35.2	63%	37%
Worcester, MA–CT	67	53.8	64%	36%
Youngstown, OH–PA	228	12.8	0%	100%
All 96 (formerly 100) Largest UAs	–	**8,243**	**69.5%**	**30.5%**

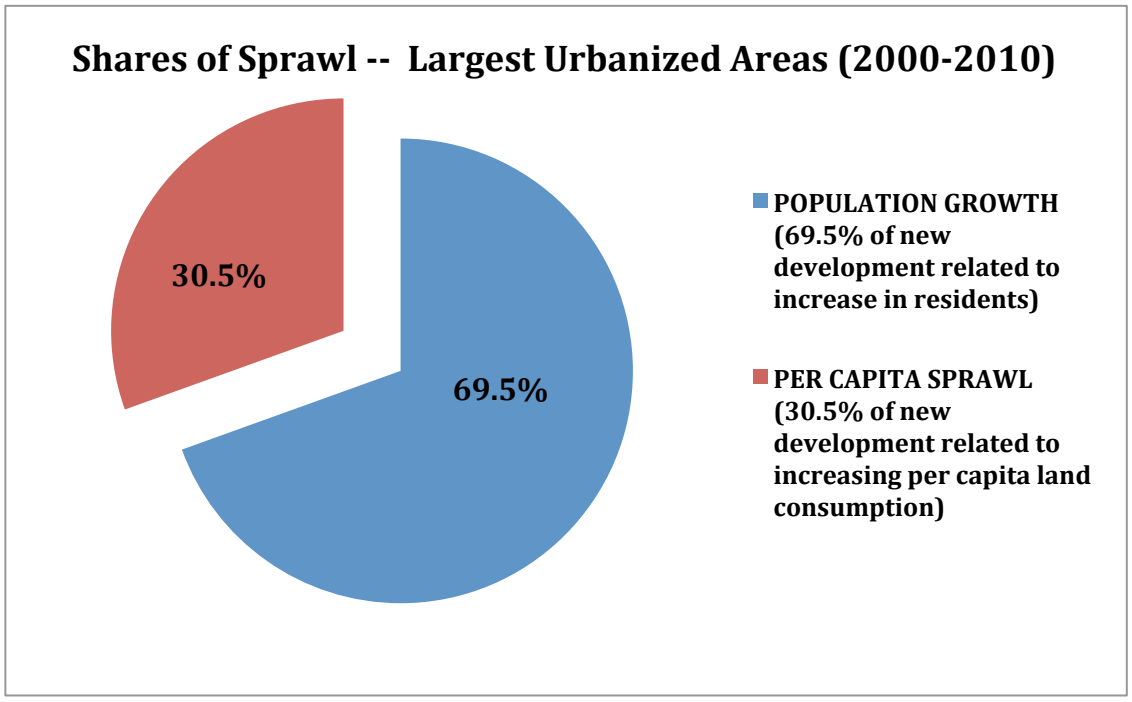
Source: U.S. Census Bureau data

* These cities are not ranked because the Census Bureau reports they had no sprawl in the decade. In fact, they are shown as having less developed land in 2010 than in 2000. While it is possible for an Urbanized Area to reduce its developed land by converting large swaths of previously developed acreage to a natural state, the reduction shown in most of the Urbanized Areas was on paper only, the result of changes in calculations and criteria by the government. See Appendix D.

Figure 17 illustrates the results of applying the Holdren method to the entire population and land area of the 96 largest Urbanized Areas (corresponding to the 100 largest UAs in the 1990 UA delineation and our earlier 2001 and 2003 studies). Of the 57,055 square miles of total sprawl, 30.5% of the lost rural land was related to the growth in per capita land consumption by the residents of those cities. In contrast, 69.5% of the lost rural land, more than two-thirds, was related to the fact that an additional 17 million people net, moved into or were born in those cities.

It is worth noting that from 1970 to 1990, for these same UAs, Population Growth accounted for about half of Overall Sprawl, and Per Capita Sprawl for the other half. For the most recent 2000-2010 period, in contrast, Population Growth has obviously become the dominant factor, accounting for about seven out of every ten acres converted from rural land to urban land. Thus, the clear trend is that of the two fundamental factors that are responsible for sprawl around the largest American cities, over time the role of population growth has increased vis-à-vis the role of per capita land consumption. Population growth is now a more important driver of sprawl than per capita land consumption, indeed, more than twice as important.

Figure 17. Percentages of Sprawl Related to Population Growth and Per Capita Sprawl in 96 Largest Urbanized Areas



Source: U.S. Census Bureau, 96 largest Urbanized Areas, 2000-2010

Description: About thirty percent of the sprawl in the nation's largest cities was related to increasing per capita land consumption. About seventy percent of the sprawl was related to population growth.

3.1.4 Relative Weight of Sprawl Factors in All Urbanized Areas

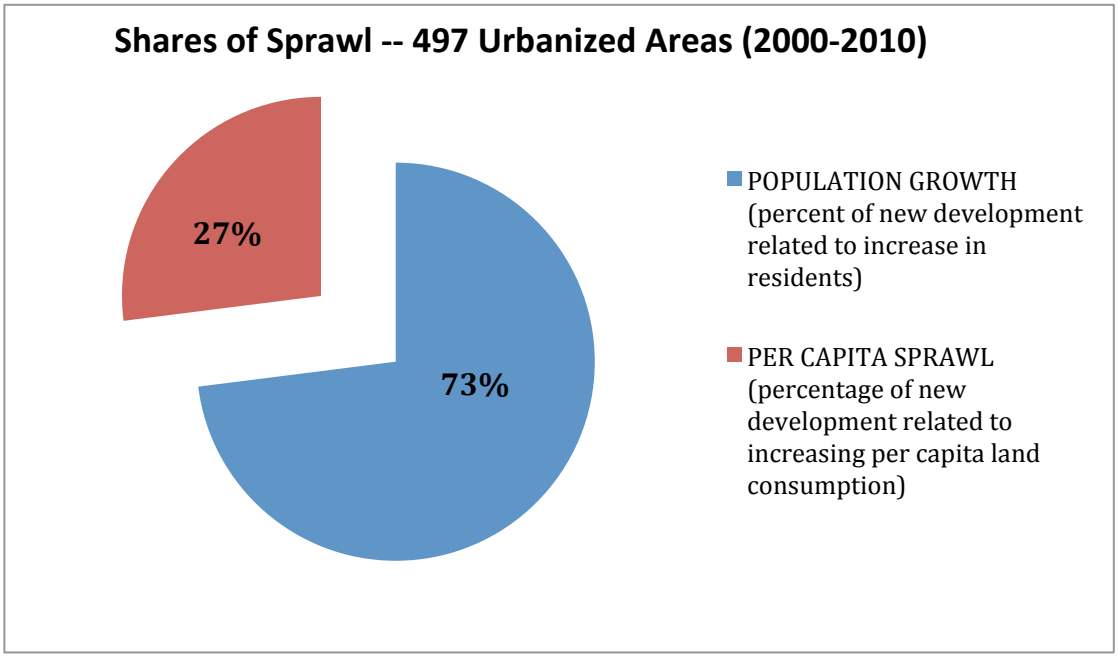
While examining the largest Urbanized Areas gives a good overview of factors contributing to sprawl, it provides only a partial snapshot of the entire problem. In fact, many of our fastest growing cities are located in the nation's smaller UAs. By applying the Holden method to all 497 of the Census Bureau's UAs, we can obtain a more complete portrait of the roles that population growth and per capita land consumption play in contributing to sprawl.

Apportioning sprawl in all Urbanized Areas further reinforces role of Population Growth in Overall Sprawl.

In extending the Holdren method to all 497 of the U.S. Census Bureau's designated Urbanized Areas, we find that the role of population growth in Overall Sprawl is even greater than it is in the largest UAs. **Figure 18** shows us that of the aggregate 8,844,435 acres of rural land lost to sprawl between 2000 and 2010, 73 percent, or roughly 6,450,000 acres, were lost due to population increase. Only 27%, or roughly 2,000,000 acres, were lost due to the increase in per capita land consumption between 2000 and 2010.

Appendix E contains a table that includes all 497 designated UAs in the United States, showing the percentage of Overall Sprawl due to Population Growth and Per Capita Sprawl.

Figure 18. Percentages of Sprawl Related to Population Growth and Per Capita Sprawl in All 497 Urbanized Areas



Source: U.S. Census Bureau, All Urbanized Areas, 2000-2010

Description: About one-quarter of the sprawl in the nation's largest cities was related to increasing per capita land consumption. Almost three-quarters of the sprawl was related to population growth.

3.2 Developed Land in the 48 Contiguous States

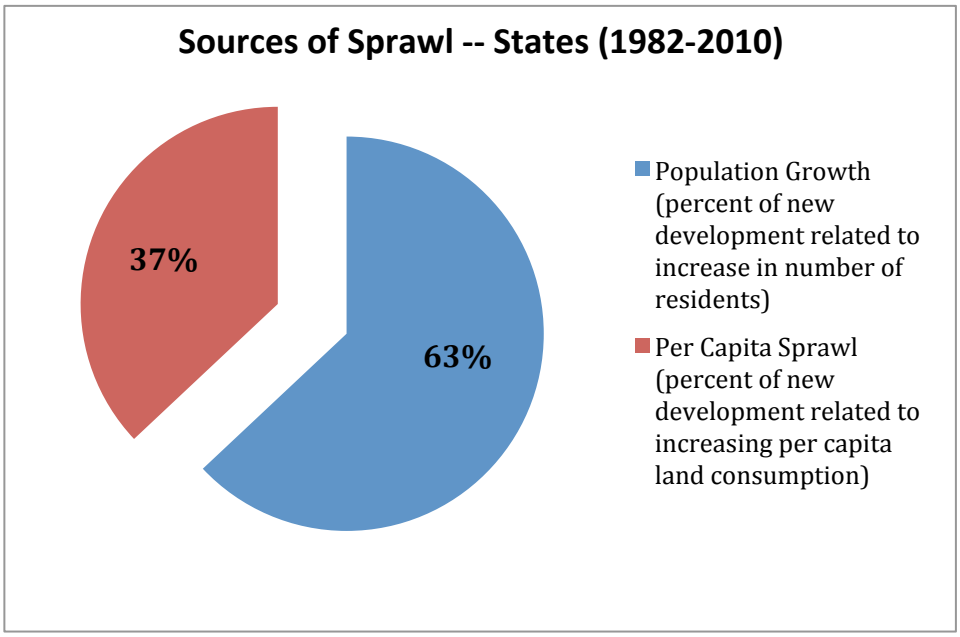
If the Census Bureau Urbanized Areas data were exaggerating the contribution of population growth to sprawl, applying the Holdren method to the National Resources Conservation Service's National Resources Inventory results would likely give us a significantly lower figure.

Unlike the Census Bureau data, the NRCS survey picks up development such as weekend cottages and second homes that are built by city residents far enough into the country that they don't get included in the data on expanding Urbanized Areas (because they don't have permanent residential populations). The NRI includes them in the "Small Built-up Areas" category. The NRI survey also captures all the rural land that succumbs to the development of recreational areas, resorts, roads, manufacturing, parking areas, and sprawling towns under 50,000 residents. In essence, using the NRI data on Developed Land allows us to capture the full extent of Overall Sprawl and development in the 48 contiguous states.

3.2.1 Developed Land from 1982 to 2010

When we applied the Holdren apportioning method to the NRI data on Developed Land, the results were similar to those of our study of the largest Urbanized Areas using Census data. **Figure 19** shows that over the entire 28-year period between 1982 and 2010, greater than six out of every ten acres developed (63%) was associated with population growth and four out of every ten acres developed (37%) was associated with growing per capita land consumption or Per Capita Sprawl.

Figure 19. Sources of Sprawl in 48 Contiguous States, 1982-2010



Source: National Resources Inventory 1982-2010

Table 8 shows total sprawl in the 48 contiguous states from 1982 to 2010, and the percentages of that total sprawl associated with either population growth or Per Capita Sprawl (growth in per capita land consumption).

Table 8. Sources of Sprawl in the 48 Contiguous States, 1982-2010

State	Total Sprawl (square miles), 1982-2010	% of Total Sprawl Related to Growth in POPULATION	% of Total Sprawl Related to Growth in PER CAPITA LAND CONSUMPTION
Alabama	1,964	35%	65%
Arizona	1,763	100%	0%
Arkansas	967	58%	42%
California	3,323	97%	3%
Colorado	1,093	100%	0%
Connecticut	366	53%	47%
Delaware	203	68%	32%
Florida	4,168	88%	12%
Georgia	3,735	74%	26%
Idaho	537	100%	0%
Illinois	1,228	44%	56%
Indiana	1,134	50%	50%
Iowa	462	32%	68%
Kansas	604	86%	14%
Kentucky	1,515	27%	73%
Louisiana	1,008	10%	90%
Maine	551	29%	71%
Maryland	830	69%	31%
Massachusetts	1,001	28%	72%

State	Total Sprawl (square miles), 1982-2010	% of Total Sprawl Related to Growth in POPULATION	% of Total Sprawl Related to Growth in PER CAPITA LAND CONSUMPTION
Michigan	2,153	21%	79%
Minnesota	1,079	74%	26%
Mississippi	1,097	31%	69%
Missouri	1,302	60%	40%
Montana	361	84%	16%
Nebraska	230	100%	0%
Nevada	497	100%	0%
New Hampshire	507	56%	44%
New Jersey	1,038	38%	62%
New Mexico	941	67%	33%
New York	1,555	32%	68%
North Carolina	3,771	65%	35%
North Dakota	119	7%	93%
Ohio	2,033	19%	81%
Oklahoma	1,034	43%	57%
Oregon	673	100%	0%
Pennsylvania	2,529	15%	85%
Rhode Island	91	34%	66%
South Carolina	2,020	55%	45%
South Dakota	233	98%	2%
Tennessee	2,274	49%	51%
Texas	5,591	94%	6%
Utah	646	89%	11%

State	Total Sprawl (square miles), 1982-2010	% of Total Sprawl Related to Growth in POPULATION	% of Total Sprawl Related to Growth in PER CAPITA LAND CONSUMPTION
Vermont	204	47%	53%
Virginia	2,027	70%	30%
Washington	1,439	100%	0%
West Virginia	813	0%	100%
Wisconsin	1,196	57%	43%
Wyoming	245	42%	58%
Total Sprawl	**64,147**	**63%**	**37%**

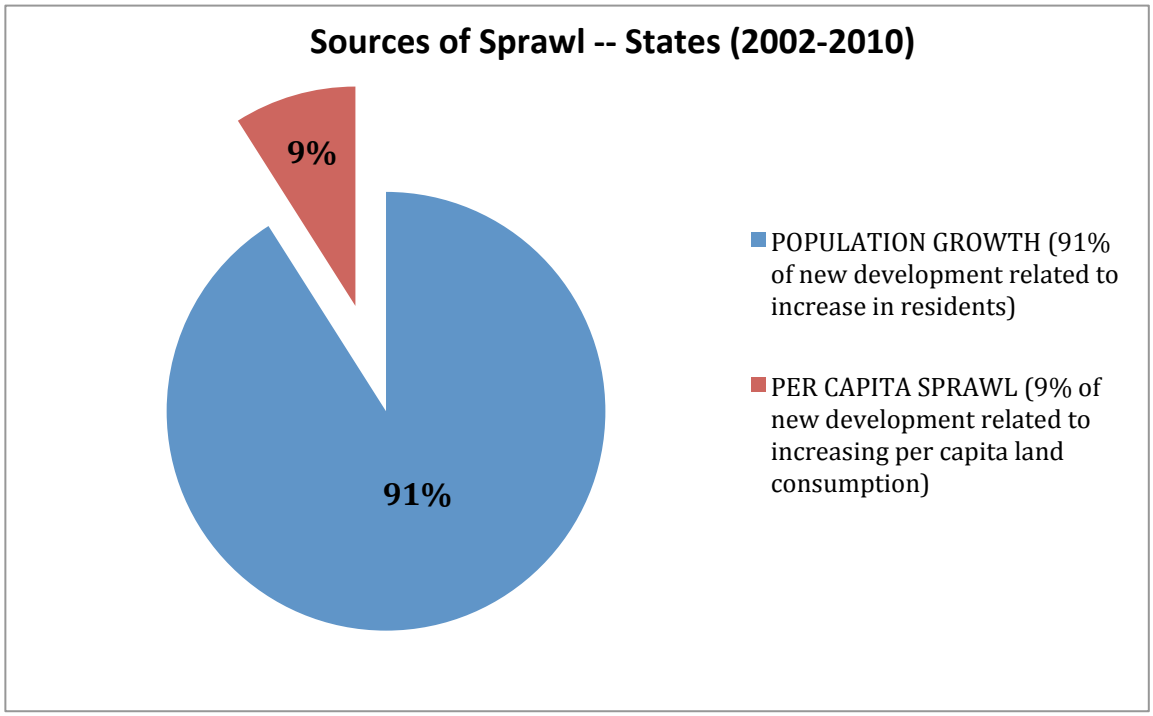
Source: NRCS National Resources Inventory

3.2.2 Developed Land from 2002 to 2010

If we examine the most recent 8-year period, from 2002-2010, the role of the Population Growth factor is higher than the average for the entire 28-year period. Whereas the 28-year average was 63% from 1982 to 2007, Population Growth accounted for 91% of the conversion from rural land to developed land from 2002 to 2010 (**Figure 20**). This is even higher than the results for the 2000-2010 period for all 497 Urbanized Areas, which was 73% (Figure 18). Thus, it is evident that the relative importance of population growth in driving urban sprawl and land development has trended upward over time, to the extent that in the first decade of the 21st century, population growth now accounts between seven to nine out of every ten acres of land developed or urbanized in the United States. The Census Bureau Urbanized Area data sets and the NRCS National Resources Inventory Developed Land data sets corroborate one another in confirming this broad trend.

Table 9 shows total sprawl in each of the 48 contiguous states from 2002 to 2010, and the percentages of that total sprawl associated with either Population Growth or Per Capita Sprawl (growth in per capita land consumption). As would be expected from **Figure 20**, which aggregates or lumps all of the states together and shows that the percentage of total sprawl due to population growth was higher from 2002 to 2010 than it was for the entire 28-year period (1982-2010), we observe that in most individual states, the percentage of sprawl related to population growth from 2002 to 2010 is higher than it was across the entire 28-year period (1982-2010). In other words, we can infer that the role of population growth in driving the nation's sprawl has increased over time.

Figure 20. Sources of Recent Sprawl in the 48 Contiguous States, 2002-2010



Description: The NRI calculates the conversion of rural land to developed land in 49 states and U.S. territories. Included in this figure are the 48 coterminous states. These data indicate that from 2002 to 2010 approximately one-tenth of the loss of rural land nationwide was related to an increase in developed land per person, and about nine-tenths of the loss was related to population growth.

Table 9. Sources of Recent Sprawl in the 48 Contiguous States, 2002-2010

State	Total Sprawl (square miles), 2002-2010	% of Total Sprawl Related to Growth in POPULATION	% of Total Sprawl Related to Growth in PER CAPITA LAND CONSUMPTION
Alabama	386	75%	25%
Arizona	490	100%	0%
Arkansas	278	75%	25%
California	656	91%	9%
Colorado	198	100%	0%
Connecticut	63	91%	9%
Delaware	61	75%	25%

State	Total Sprawl (square miles), 2002-2010	% of Total Sprawl Related to Growth in POPULATION	% of Total Sprawl Related to Growth in PER CAPITA LAND CONSUMPTION
Florida	853	100%	0%
Georgia	646	100%	0%
Idaho	124	100%	0%
Illinois	283	36%	64%
Indiana	275	72%	28%
Iowa	148	77%	23%
Kansas	136	100%	0%
Kentucky	236	80%	20%
Louisiana	229	19%	81%
Maine	104	32%	68%
Maryland	150	92%	8%
Massachusetts	132	36%	64%
Michigan	321	0%	100%
Minnesota	177	100%	0%
Mississippi	265	38%	62%
Missouri	325	75%	25%
Montana	113	100%	0%
Nebraska	67	100%	0%
Nevada	137	100%	0%
New Hampshire	86	44%	56%
New Jersey	106	72%	28%
New Mexico	143	100%	0%
New York	248	30%	70%

State	Total Sprawl (square miles), 2002-2010	% of Total Sprawl Related to Growth in POPULATION	% of Total Sprawl Related to Growth in PER CAPITA LAND CONSUMPTION
North Carolina	581	100%	0%
North Dakota	19	100%	0%
Ohio	381	18%	81%
Oklahoma	311	76%	24%
Oregon	128	100%	0%
Pennsylvania	341	62%	38%
Rhode Island	17	0%	100%
South Carolina	354	100%	0%
South Dakota	38	100%	0%
Tennessee	434	96%	4%
Texas	1,572	100%	0%
Utah	203	100%	0%
Vermont	36	28%	72%
Virginia	413	100%	0%
Washington	271	100%	0%
West Virginia	0	41%	59%
Wisconsin	304	59%	41%
Wyoming	80	100%	0%
Total Sprawl	**12,917**	**91%**	**9%**

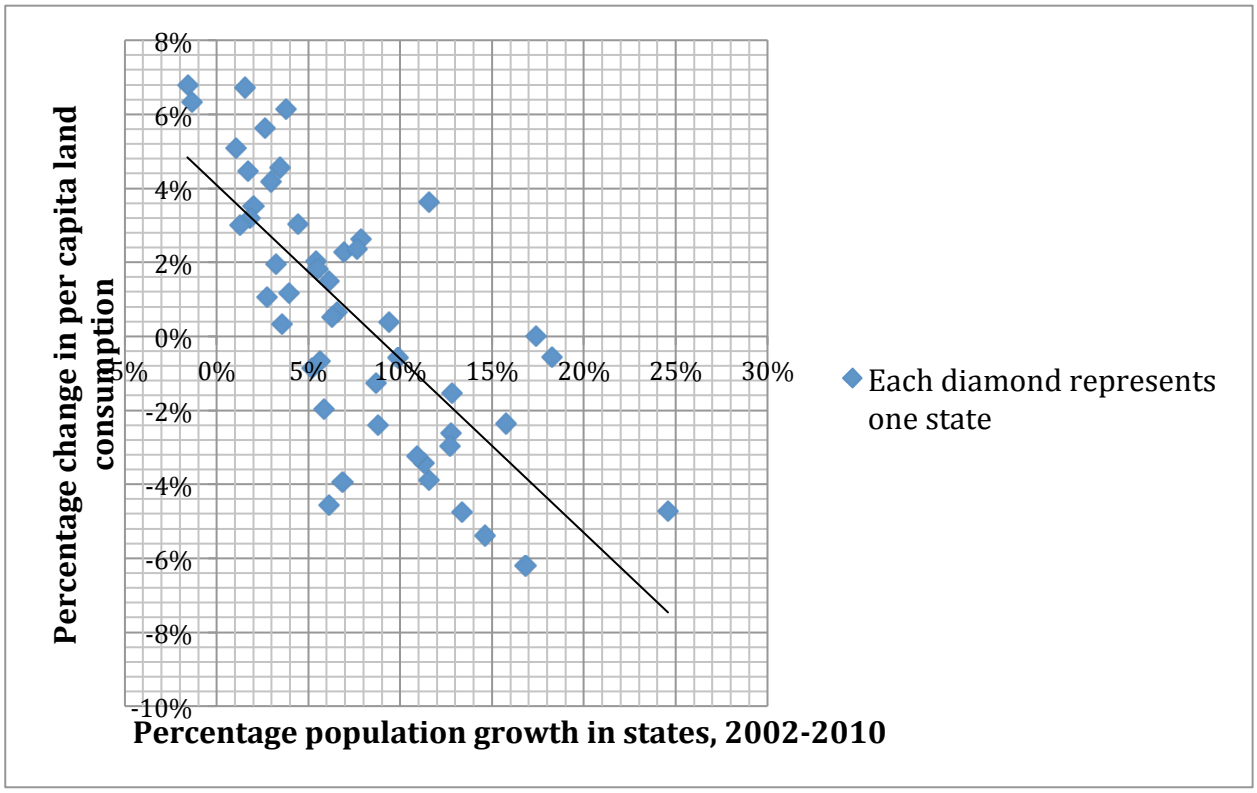
Source: NRCS, 2013. *Summary Report: 2010 National Resources Inventory*

3.2.3 Scatter Plot of Population Growth and Per Capita Land Growth

Another useful way to examine the relationships between the factors in sprawl is by using scatter plot analysis. **Figure 21** is a scatter plot that examines the relationship between each state's percentage population growth on the x-axis (horizontal axis) and the percentage

increase in per capita land use on the y-axis (vertical axis). The scatter plot has a "best fit" line that shows the linear relationship between the data points. The downward or negative slope of this line shows us that there is a negative or inverse relationship between the rate of increase of population growth and the rate of increase in per capita land use – that is, states whose populations were growing quickly had less growth in per capita land consumption in that same period.

Figure 21. Scatter Plot of Population Growth vs. Per Capita Land Increase



Source: U.S. Census Bureau and National Resources Inventory

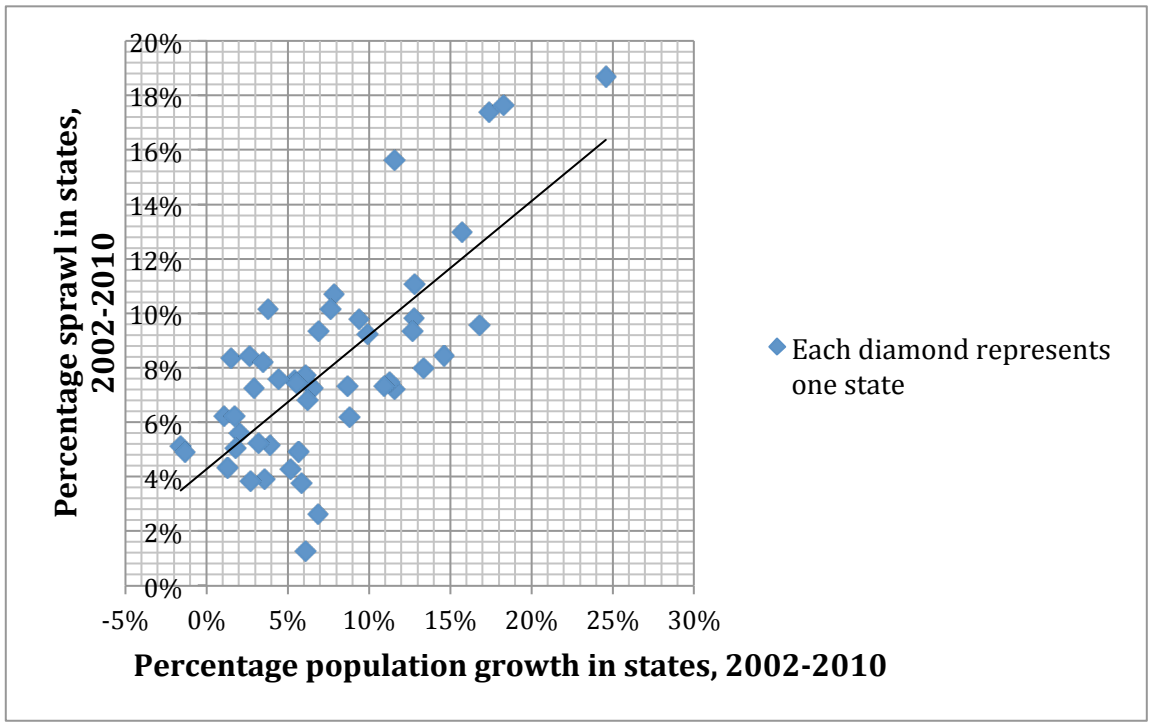
These results are not unexpected, and this correlation could be explained a number of ways. States experiencing high influxes and/or overall growth in population could be pursuing more aggressive land use and zoning or "smart growth" policies to deal with the pressure of high population growth and the economic and fiscal costs of rapid sprawl. It could also be that the populations moving to these states are often pursuing better economic opportunities. When they first arrive, new citizens may be more likely to settle into higher-density and less expensive existing housing before moving out to the sprawl-inducing suburbs.

In contrast, those states with less population growth may be subject to less political pressure to enact land use and zoning regulations and smart growth policies that would have the net effect of increasing residential and development densities.

3.2.4 Scatter Plot of Population Growth and Sprawl

We can also use a scatter plot to explore the relationship between the increase in each state's population and its percentage sprawl. The upward trending "best fit" line for **Figure 22** indicates that there is a positive relationship between population increase and Overall Sprawl. States with more population growth were also states where more land is being developed. These results are not surprising, but if sprawl and population growth were not related, as some have always contended, the trend line would be flat or negative. While this scatter plot alone does not prove that population growth causes sprawl, it does strongly suggest and reinforce the hypothesis that the two are closely correlated.

Figure 22. Scatter Plot of Population Growth vs. Sprawl in 48 States, 2002-2010



Sources: Census Bureau and National Resources Inventory

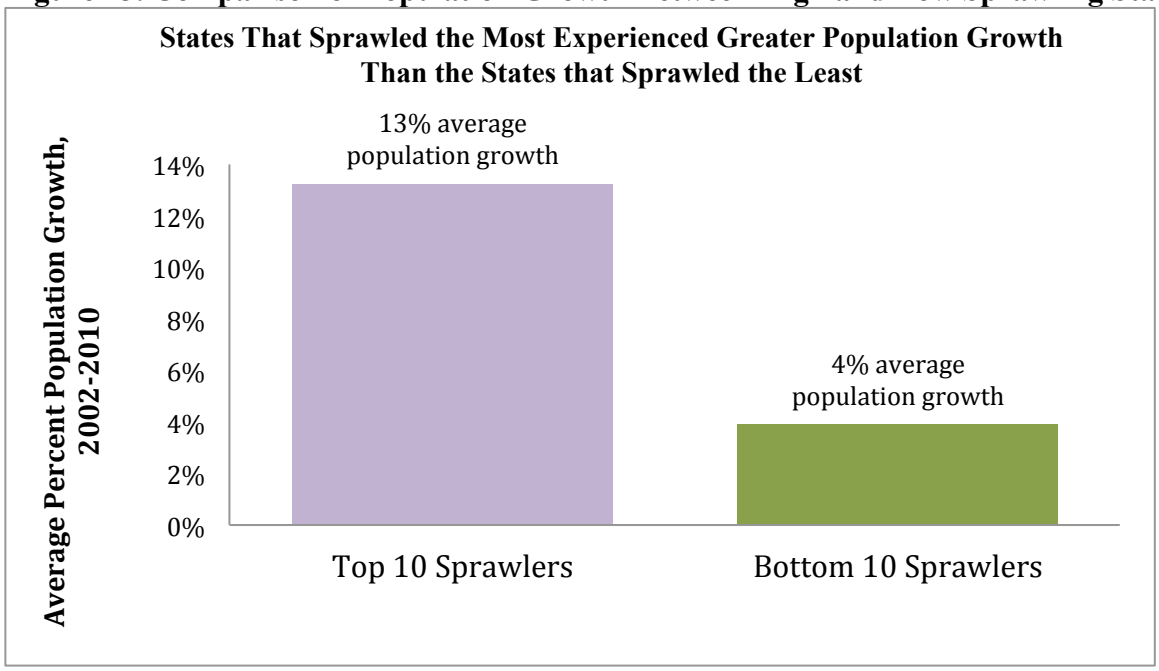
3.3 Trends

3.3.1 Temporal Trends

From 2000 to 2010 the most significant factor contributing to Overall Sprawl in the United States was the addition of more than 17 million new residents to our nation's Urbanized Areas, and the additional nine million residents who settled elsewhere. Per Capita Sprawl was halted in 192 of our cities, and was responsible for less than 30% of Overall Sprawl in Urbanized Areas during the same period of study.

NRCS data on sprawl in the contiguous 48 states from 2002-2010 were also consistent with our findings for the cities. From 2002-2010 population growth was the most important factor in the loss of non-federal rural land, accounting for 91 percent of new development. The ten states experiencing the most sprawl by percentage (Nevada, Utah, Arizona, Delaware, Texas, Florida, Arkansas, Oklahoma, Mississippi, and Georgia) had populations that grew on average more than three times as fast as the ten least sprawling states by percentage (Massachusetts, Minnesota, Rhode Island, New York, Kansas, Connecticut, New Jersey, Nebraska, South Dakota and North Dakota) (**Figure 23**).

Figure 23. Comparison of Population Growth Between High and Low Sprawling States



Description: The populations of ten states experiencing the most sprawl by percentage (Nevada, Utah, Arizona, Delaware, Texas, Florida, Arkansas, Oklahoma, Mississippi, and Georgia), grew on average more than three times faster than the ten least sprawling states (Massachusetts, Minnesota, Rhode Island, New York, Kansas, Connecticut, New Jersey, Nebraska, South Dakota and North Dakota)

Figure 24 looks at the same data and the same 2002-2007 time period from a different angle.

Figure 24. Comparison of Sprawl in Slow-Growing vs. Fast-Growing States

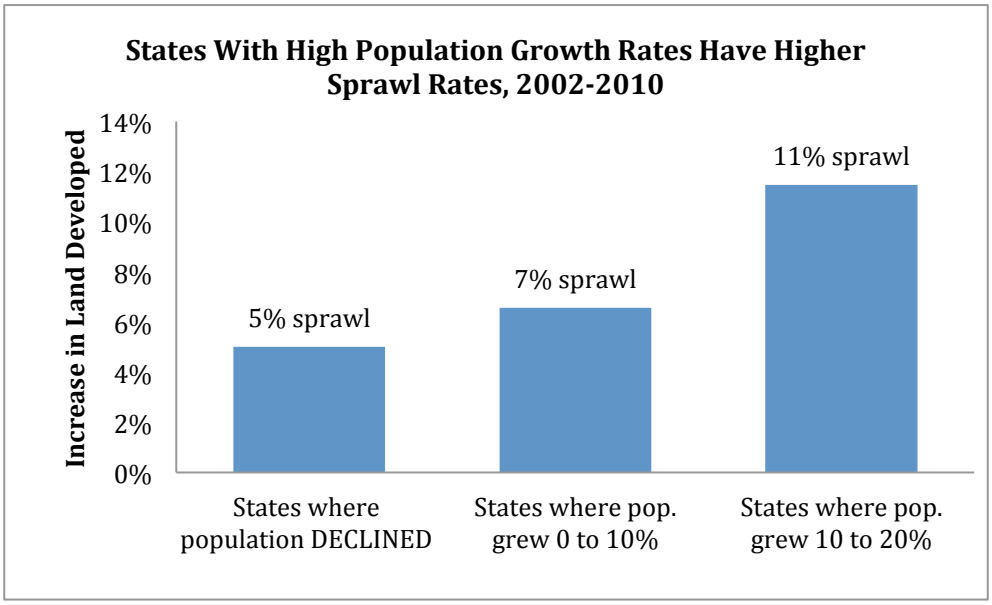


Table 10 ranks the states according to their sprawl rate from 2002 to 2010, from highest to lowest, by percentage. Table 10 also includes the entire 28-year, 1982-2010 period, so that for each state, the percent sprawl and ranking are provided for the entire extended period of study.

Table 10. Sprawl in 48 States, Ranked by Percentage

Ranking (by percentage) 2002-2010	Total Sprawl (percentage), 2002-2010 Recent	State	Total Sprawl (percentage), 1982-2010 Overall	Total Sprawl Ranking by Percentage, 1982-2010
1	18.7%	Nevada	134.3%	1
2	17.6%	Utah	90.8%	7
3	17.4%	Arizona	114.0%	2
4	15.6%	Delaware	81.8%	12
5	13.0%	Texas	69.1%	17
6	11.1%	Florida	94.9%	6
7	10.7%	Arkansas	50.7%	28

Ranking (by percentage) 2002-2010	Total Sprawl (percentage), 2002-2010 Recent	State	Total Sprawl (percentage), 1982-2010 Overall	Total Sprawl Ranking by Percentage, 1982-2010
8	10.2%	Oklahoma	44.4%	32
9	10.2%	Mississippi	61.7%	18
10	9.8%	Georgia	106.8%	3
11	9.8%	Tennessee	87.8%	8
12	9.6%	Idaho	61.2%	19
13	9.4%	Alabama	77.0%	14
14	9.3%	South Carolina	95.2%	5
15	9.3%	Virginia	71.1%	15
16	8.5%	North Carolina	102.2%	4
17	8.4%	Maine	69.9%	16
18	8.4%	Louisiana	51.5%	27
19	8.2%	New Hampshire	80.5%	13
20	8.0%	Wyoming	29.2%	41
21	7.7%	Kentucky	85.3%	9
22	7.6%	Wisconsin	38.5%	36
23	7.6%	Indiana	40.6%	34
24	7.5%	New Mexico	84.4%	10
25	7.4%	Missouri	38.4%	37
26	7.3%	Washington	57.1%	23
27	7.3%	Montana	27.9%	42
28	7.3%	West Virginia	82.1%	11
29	7.2%	California	52.0%	26
30	7.2%	Colorado	59.1%	20

Ranking (by percentage) 2002-2010	Total Sprawl (percentage), 2002-2010 Recent	State	Total Sprawl (percentage), 1982-2010 Overall	Total Sprawl Ranking by Percentage, 1982-2010
31	6.8%	Maryland	54.4%	25
32	6.2%	Vermont	49.4%	29
33	6.2%	Ohio	45.4%	31
34	6.2%	Oregon	44.0%	33
35	5.6%	Illinois	29.9%	40
36	5.2%	Pennsylvania	58.5%	21
37	5.2%	Iowa	18.1%	46
38	5.1%	Michigan	48.3%	30
39	5.1%	Massachusetts	57.6%	22
40	4.9%	Minnesota	40.2%	35
41	4.9%	Rhode Island	34.0%	39
42	4.3%	New York	35.1%	38
43	4.3%	Kansas	22.3%	44
44	3.9%	Connecticut	27.8%	43
45	3.8%	New Jersey	56.4%	24
46	3.8%	Nebraska	14.1%	47
47	2.6%	South Dakota	18.4%	45
48	1.3%	North Dakota	8.4%	48

Sources: NRCS National Resources Inventory; U.S. Census Bureau

Table 11 arranges the states according to the amount they sprawled from 2002 to 20010, from highest to lowest, in terms of total or overall area, not percentage. Table 11 also includes the entire 28-year, 1982-2010 period, so that for each state, the amount of sprawl and ranking are provided for the entire extended period of study.

Table 11. Sprawl in 48 States, Ranked by Area

Ranking (by area) 2002-2010	Total Sprawl (square miles), 2002-2010 Recent	State	Total Sprawl (square miles), 1982-2010 Overall	Total Sprawl Ranking by Area, 1982-2010
1	1,572	Texas	5,591	1
2	853	Florida	4,168	2
3	656	California	3,323	5
4	646	Georgia	3,735	4
5	581	North Carolina	3,771	3
6	490	Arizona	1,763	13
7	434	Tennessee	2,274	7
8	413	Virginia	2,027	10
9	386	Alabama	1,964	12
10	381	Ohio	2,033	9
11	354	South Carolina	2,020	11
12	341	Pennsylvania	2,529	6
13	325	Missouri	1,302	17
14	321	Michigan	2,153	8
15	311	Oklahoma	1,034	25
16	304	Wisconsin	1,196	19
17	283	Illinois	1,228	18
18	278	Arkansas	967	28
19	275	Indiana	1,134	20

Ranking (by area) 2002-2010	Total Sprawl (square miles), 2002-2010 Recent	State	Total Sprawl (square miles), 1982-2010 Overall	Total Sprawl Ranking by Area, 1982-2010
20	271	Washington	1,439	16
21	265	Mississippi	1,097	21
22	248	New York	1,555	14
23	236	Kentucky	1,515	15
24	229	Louisiana	1,008	26
25	203	Utah	646	33
26	198	Colorado	1,093	22
27	177	Minnesota	1,079	23
28	150	Maryland	830	30
29	148	Iowa	462	39
30	143	New Mexico	941	29
31	137	Nevada	497	38
32	136	Kansas	604	34
33	132	Massachusetts	1,001	27
34	128	Oregon	673	32
35	124	Idaho	537	36
36	122	West Virginia	813	31
37	113	Montana	361	41
38	106	New Jersey	1,038	24
39	104	Maine	551	35
40	86	New Hampshire	507	37
41	80	Wyoming	245	42
43	63	Connecticut	366	40

Ranking (by area) 2002-2010	Total Sprawl (square miles), 2002-2010 Recent	State	Total Sprawl (square miles), 1982-2010 Overall	Total Sprawl Ranking by Area, 1982-2010
44	61	Delaware	203	46
45	38	South Dakota	233	43
46	36	Vermont	204	45
47	19	North Dakota	119	47
48	17	Rhode Island	91	48

Sources: NRCS National Resources Inventory, Census Bureau

Overall, two main temporal trends are evident in both the Census Bureau's UA data set and the NRI's Developed Land data set (displayed graphically in the **Figure 3** bar chart). The first trend, supported primarily by the NRI data, is that Overall Sprawl may have peaked in the late 1990s but continued into the late 2000s at a very high rate that still exceeded that experienced in the 1980s and early 1990s (**Table 12**). The second temporal trend is that the role of the population growth factor has increased markedly over time, from approximately half (50%) in the 1970-1990 period to roughly 70% in the 2000s. The Census Bureau and NRCS data, obtained in such different manners, are remarkably consistent in this regard.

Table 12. 25-year Trend of Growth in States' Developed Land in 5-Year Increments

Period	Increase in Developed Land (Overall Sprawl) in 1,000s of acres	Increase in Developed Land (Overall Sprawl) in square miles
1982-1987	6,108	9,544
1987-1992	7,259	11,342
1992-1997	10,778	16,841
1997-2002	9,711	15,173
2002-2007	7,497	11,714

Source: National Resources Inventory, 2010

Table 13 contains data on Urbanized Areas for the 1970-1990 period and the most recent 2000-2010 period and allows us to compare the first and second trends city by city and in aggregate.

Table 13. Largest Cities Sprawl Data, 1970-1990 vs. 2000-2010

Urbanized Area	Sprawl per Decade, 1970-1990 (sq. miles)	% Sprawl explained by Population Growth, 1970-1990	Sprawl per Decade, 2000-2010 (sq. miles)	% Sprawl explained by Population Growth, 2000-2010
Akron, OH	26.8	0%	17.6	0%
Albany-Schenectady, NY	29.1	14%	11.5	100%
Albuquerque, NM	55.7	76%	26.6	100%
Allentown, PA-NJ	21.8	33%	56.8	80%
Atlanta, GA	350.9	64%	682.8	85%
Austin, TX	93.7	65%	204.9	83%
Bakersfield, CA	20.6	100%	28.1	100%
Baltimore, MD	141.5	28%	34.3	100%
Baton Rouge, LA	50.5	49%	86.1	81%
Birmingham, AL	87.1	19%	137.8	40%
Boston, MA-NH-RI	113.4	15%	137.3	48%
Bridgeport-Stamford, CT-NY	6.0	2%	0.9	100%
Buffalo, NY	35.9	0%	13.2	0%
Charleston-North Charleston, SC	75.9	59%	62.4	100%
Charlotte, NC-SC	120.9	59%	306.6	93%
Chattanooga, TN-GA	70.1	36%	10.1	100%
Chicago, IL-IN	153.7	5%	319.9	25%
Cincinnati, OH- KY-IN	88.3	21%	116.0	49%
Cleveland, OH	-5.1	NA	125.0	0%
Colorado Springs, CO	43.3	81%	-9.5	NA
Columbia, SC	47.8	47%	111.1	78%
Columbus, OH	55.2	47%	112.8	75%
Corpus Christi, TX	12.6	100%	10.0	98%
Dallas-Fort Worth-Arlington, TX	186.2	100%	372.1	90%
Dayton, OH	24.6	0%	27.9	35%
Denver-Aurora, CO	83	83%	169.1	61%
Des Moines, IA	25.3	36%	60.3	54%
Detroit, MI	123.7	0%	75.71	0%
El Paso, TX-NM	50.5	63%	31.5	100%
Flint, MI	33.7	0%	4.8	0%
Ft. Lauderdale-Hollywood-Pompano, FL[1]	26.8	100%	NA	NA
Fresno, CA	57.5	100%	32.7	78%
Grand Rapids, MI	38.5	50%	23.2	64%
Greenville, SC	38.6	62%	93.7	81%
Harrisburg, PA	35.7	30%	51.3	92%
Hartford, CT	55.4	26%	46.9	87%
Honolulu, HI	11.9	100%	16.1	100%
Houston, TX	319.4	70%	364.8	100%
Indianapolis, IN	43.9	53%	152.8	82%
Jackson, MS	72.4	38%	81.7	45%
Jacksonville, FL	78.2	90%	119.8	74%
Kansas City, MO-KS	134.3	34%	93.4	74%
Knoxville, TN	66.4	50%	98.7	100%

Urbanized Area	Sprawl per Decade, 1970-1990 (sq. miles)	% Sprawl explained by Population Growth, 1970-1990	Sprawl per Decade, 2000-2010 (sq. miles)	% Sprawl explained by Population Growth, 2000-2010
Lansing, MI	12.7	49%	21.3	30%
Las Vegas-Henderson, NV	55.0	100%	130.9	96%
Little Rock, AR	52.0	43%	52.7	79%
Los Angeles-Long Beach-Anaheim, CA	196.9	100%	68.1	75%
Louisville/Jefferson County, KY- IN	36.1	7%	85.4	60%
McAllen, TX	45.8	79%	44.2	100%
Memphis, TN-MS-AR	72.8	39%	97.5	40%
Miami, FL	47.0	100%	122.5	100%
Milwaukee, WI	27.8	0%	58.6	44%
Minneapolis-Saint Paul, MN-WN	170.8	51%	127.6	78%
Mobile, AL	30.3	50%	12.0	48%
Nashville-Davidson, TN	70.0	72%	132.7	96%
New Haven, CT	40.2	46%	20.8	82%
New Orleans, LA	43.1	20%	53.6	0%
New York-Newark, NY-NJ-CT	270.7	0%	97.6	100%
Ogden-Layton, UT	46.0	60%	37.5	100%
Oklahoma City, OK	153.9	47%	88.3	59%
Omaha, NE-IA	20.9	42%	44.9	81%
Orlando, FL	131.5	97%	144.5	96%
Oxnard, CA	22.8	100%	8.7	78%
Pensacola, FL-AL	44.5	49%	13.3	84%
Philadelphia, PA	206.2	11%	181.9	57%
Phoenix-Mesa, AZ	176.8	92%	347.56	61%
Pittsburgh, PA	90.9	0%	52.8	0%
Portland, OR-WA	60.6	94%	50.4	100%
Providence, RI- MA	27.3	31%	41.4	18%
Raleigh, NC	52.7	76%	198.5	100%
Richmond, VA	79.1	47%	55.4	100%
Riverside-San Bernardino, CA	75.2	100%	106.2	100%
Rochester, NY	37.2	7%	29.3	39%
Sacramento, CA	44.9	100%	102.0	87%
St. Louis, MO-IL	133.8	7%	94.7	32%
Salt Lake City-West Valley City, UT	34.9	100%	47.2	75%
San Antonio, TX	107.6	56%	189.5	74%
San Diego, CA	154.8	100%	-49.9	NA
San Francisco-Oakland, CA	96.6	78%	-3.0	NA
San Jose, CA	30.6	100%	25.9	83%
Scranton, PA	10.2	0%	12.1	0%
Seattle, WA	87.4	97%	56.7	100%
Shreveport, LA	26.1	20%	30.6	45%
Spokane, WA	17.9	52%	21.2	100%
Springfield, MA-CT	32.1	15%	39.6	66%
Stockton, CA	13.5	84%	18.2	76%
Syracuse, NY	18.7	10%	15.3	30%
Tacoma, WA[2]	52.1	68%	NA	NA
Tampa-St. Petersburg, FL	179.4	85%	154.7	96%
Toledo, OH- MI	14.0	2%	38.1	5%
Trenton, NJ	15.2	22%	13.4	73%
Tucson, AZ	70.9	79%	62.1	81%

Urbanized Area	Sprawl per Decade, 1970-1990 (sq. miles)	% Sprawl explained by Population Growth, 1970-1990	Sprawl per Decade, 2000-2010 (sq. miles)	% Sprawl explained by Population Growth, 2000-2010
Tulsa, OK	62.2	47%	74.5	64%
Virginia Beach, VA [3]	110.7	85%	-11.4	NA
Washington, DC-MD-VA	225.1	47%	165.0	100%
West Palm Beach-Boca Raton, FL[1]	85.1	100%	NA	NA
Wilmington, DE-NJ-MD-PA[4]	19.7	36%	NA	NA
Wichita, KS	39.0	36%	35.2	63%
Worcester, MA- CT	27.2	49%	53.8	64%
Youngstown, OH-PA	19.4	0%	12.8	0%
TOTAL AGGREGATE SPRAWL OF LARGEST 100 URBANIZED AREAS	**7,273**	**51%**	**8,243**	**70%**

[1] Absorbed into Miami UA by 2000 and 2010 UA delineations.
[2] Absorbed into Seattle UA by 2000 and 2010 UA delineations.
[3] Listed as Norfolk-Virginia Beach-Newport News, VA in 1970 and 1990 Census UA designations.
[4] Absorbed into Philadelphia UA by 2000 and 2010 UA delineations

Looking at the aggregate figures in the bottom row of Table 10, we see that sprawl per decade in the largest American cities averaged 7,273 square miles per decade in the 1970-1990 period and 8,243 square miles in the 2000-2010 decade. The percentage of sprawl related to population growth rose from 51% in the 1970-1990 period to 70% in the 2000-2010 period.

The upshot is that while sprawl may have slowed slightly in recent years, it still continues at a very high, environmentally destructive, and unsustainable rate, and more than twice as much of is due to population growth than to all other factors combined.

3.3.2 Regional Trends

Of the 12 geographic regions this study chose to identify and examine using the 2002-2010 NRI data for the 48 contiguous states, in only two was the majority of sprawl due to increasing per capita land consumption (**Table 14**). Even in these two regions, population growth accounted for almost half (more than 40 percent) of all sprawl. In the Northeast Region (New England plus New York and New Jersey), population growth accounted for 43 percent of Overall Sprawl while increasing per capita land consumption accounted for 57 percent. In the Great Lakes region, population growth was related to 45 percent of sprawl and increasing per capita land consumption was related to 55 percent of sprawl. In each of the other 10 geographic regions, population growth was the main factor (accounting for at least 50%) contributing to Overall Sprawl. In most of these regions, it was a much more important factor in generating additional sprawl than increasing per capita land consumption, and in five of the regions, population growth accounted for virtually all (100 percent) of the additional sprawl that occurred in states between 2002 and 2010.

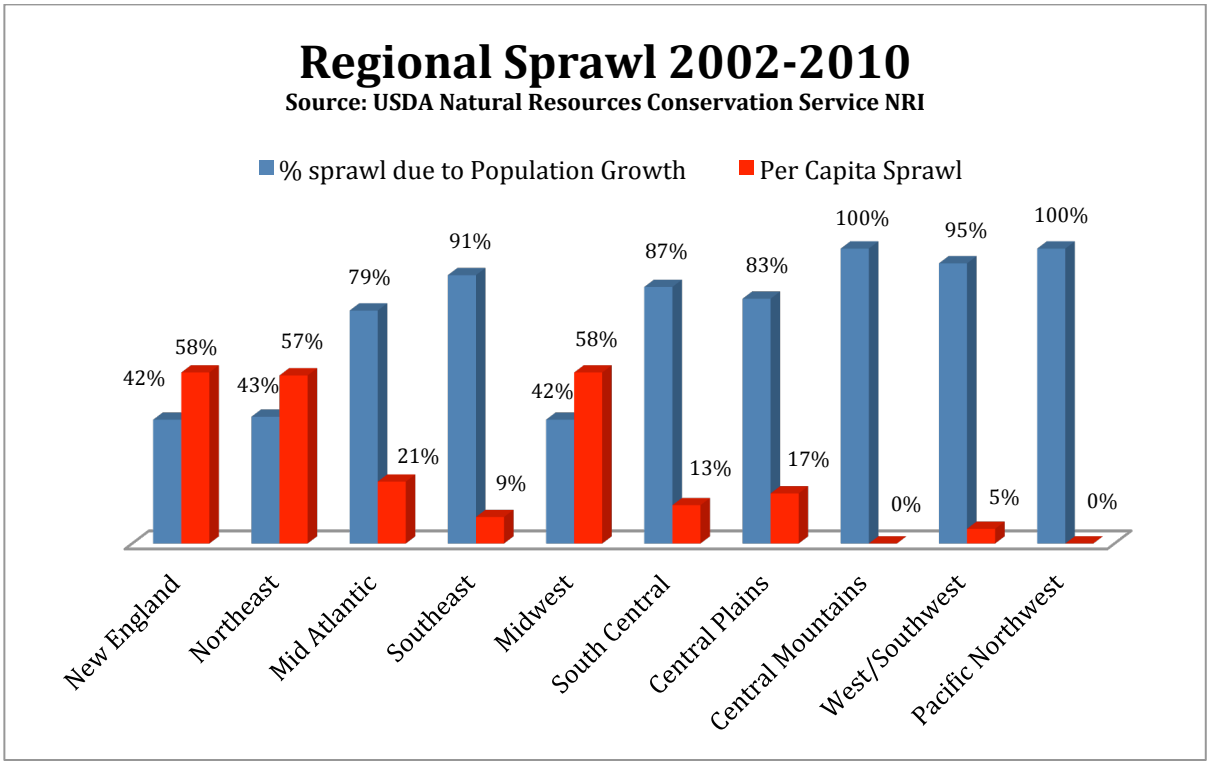
Table 14. Sources of Sprawl by Region, 2002-2010*

Region Name	States Included	% of Total Sprawl Related to POPULATION GROWTH	% of Total Sprawl Related to GROWTH IN PER CAPITA LAND CONSUMPTION
Northeast	Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island, Vermont	43%	57%
Chesapeake Bay Watershed	Delaware, Maryland, Virginia, West Virginia	92%	8%
Old South	Alabama, Arkansas, Georgia, Louisiana, Mississippi, North Carolina, South Carolina, Tennessee	83%	17%
Civil War Border States	Kentucky, Missouri	77%	23%
Great Lakes	Illinois, Indiana, Michigan, Minnesota, Ohio, Pennsylvania, Wisconsin	45%	55%
Great Plains	Iowa, Kansas, Nebraska, North Dakota, Oklahoma, South Dakota	85%	15%
Desert Southwest	Arizona, Nevada, New Mexico, Utah	100%	0%
Rocky Mountain West	Colorado, Idaho, Montana, Wyoming	100%	0%
Pacific Northwest	Oregon, Washington	100%	0%
Texas	Texas	100%	0%
California	California	91%	9%
Florida	Florida	100%	0%

*In this analysis, the percentages of sprawl between 2002 and 2010 for every state in each region were summed and divided by the number of states in the region to obtain the mean figure for the region. This is a *weighted average* or *weighted mean*. This means that states with a greater amount of sprawl had a proportionately greater influence in determining the regional average percentages of Overall Sprawl related to population growth and increasing land consumption per capita.

Figure 25 uses a different regional breakdown corresponding to the regions of the Environmental Protection Agency (EPA), yet the results are broadly similar to those shown in **Table 12**. In seven of 10 regions in this figure, population growth is by far the dominant factor. In contrast, in those three regions where Per Capita Sprawl is dominant, it is by much smaller amounts, 58%-42% in both New England and the Midwest, and 57%-43% in the Northeast. The three regions in which Per Capita Sprawl was dominant sprawled a total of 2,533 square miles from 2002 to 2010, while the seven regions in which Population Growth was the dominant factor sprawled a total of 10,828 square miles.

Figure 25. Sources of Sprawl by EPA Region, 2002-2010*



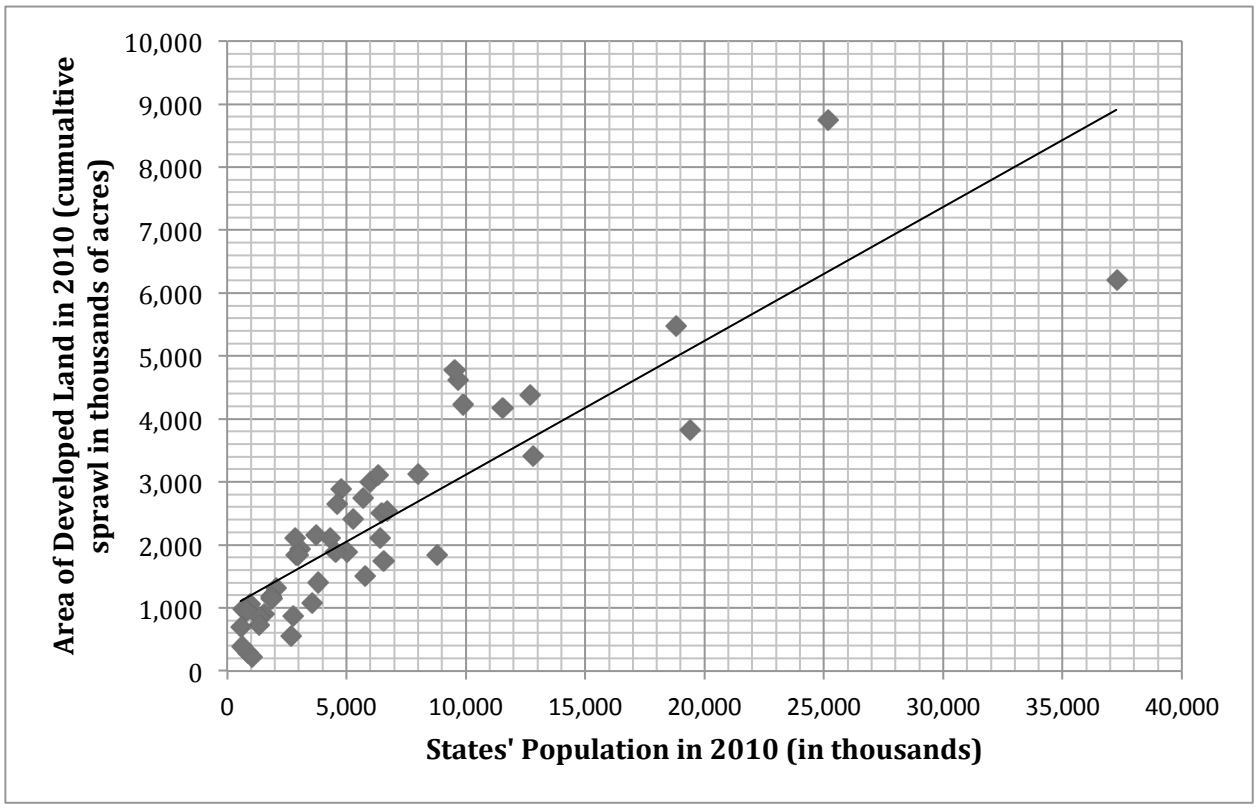
*In this analysis, the percentages of sprawl between 2002 and 2010 for every state in each region were summed and divided by the number of states in the region to obtain the mean figure for the region. This is a *weighted average* or *weighted mean*. This means that states with a greater amount of sprawl had a proportionately greater influence in determining the regional average percentages of Overall Sprawl related to population growth and increasing land consumption per capita.

4. CONCLUSIONS AND POLICY IMPLICATIONS

4.1 Conclusions

There is a broad correlation between population size and sprawl: generally, the larger a city or state's population, the larger the land area it will sprawl across. This is shown clearly in **Figure 26**, a simple scatter plot of the 48 contiguous states' cumulative populations and developed land areas in 2010. The positive (upward tilting toward the right) slope of the best-fit line means that as a state's population increases, the area of built-up, developed land increases as well. This demolishes the whimsical notion entertained by some that there is no connection between population size or growth rates and environmental impact.

Figure 26. Cumulative Developed Land Area (Sprawl) is a Function of Population Size



Source: U.S. Census Bureau; NRCS, 2013. *Summary Report: 2010 National Resources Inventory*

Sprawl continues to devour rural land around cities and in states throughout the country at a very rapid rate.

Although the pace of sprawl may have peaked in the late 1990s and early 2000s, as recently as the late 2000s and in all likelihood today as well, sprawl continues at a rate that exceeds that of even the 1980s and early 1990s. At this pace, sprawl would continue to convert an

additional 15 million acres (23,000 square miles) of agricultural land and wildlife habitat into built-up land every decade. By 2050, another 60 million acres (92,000 square miles) of rural lands will have been paved or covered with subdivisions, office parks, and commercial strips, at great cost to our agricultural potential, wildlife habitat, livability, and general environmental quality.

Smart growth efforts, higher gasoline prices, fiscal and budgetary constraints (limiting new road-building, for example), and the recession-inducing mortgage meltdown may have all played roles in slowing the rate of sprawl late in the first decade of this century. The extent to which any of these and still other unforeseen factors may affect the rate of sprawl in the coming decades is unknown and unpredictable. Yet as more and more of Rural America succumbs to development – chipped away and clogged with roads, vehicles, people, facilities and infrastructure – at some point it will not be possible to maintain this rapid rate of sprawl simply because other critical land uses – e.g., high-value cropland; national and state parks, forests, and wildlife refuges; mines; watersheds and reservoir buffer zones; utility corridors; military bases and arsenals – will represent a larger and larger fraction of the remaining undeveloped land. In the West, water scarcity is also likely to restrict far-flung, never-ending development.

The role of population growth in driving sprawl has increased over the last several decades.

From 1970 to 1990, our earlier studies – based on two independent, longitudinal datasets, delineations, and methodologies – from two distinct federal agencies and research programs – the Census Bureau's Urbanized Areas and the USDA's National Resources Inventory – showed clearly on a nationwide scale, that population growth and increasing per capita land consumption (what we referred to as "land use choices") were each responsible for about half of the sprawl America was then experiencing.

In contrast, in the present study, using more recent data from the same two agencies and same two long-term data gathering programs, population growth, during the decade just passed (2000-2010), accounted for approximately 70-90% of sprawl; declining density or increasing per capita land consumption accounted for about 10-30%. The relative role of the population growth factor has increased by about 20-40 percentage points (from 50 to 70-90) over the four-decade period from 1970 to 2010 that the study encompasses.

Attempts to direct development to limited areas are not enough to offset population growth.

A central goal of Smart Growth is to preserve open space, farmland, natural beauty and critical environmental areas by preventing declining density. Thus, places where population density increases should be hailed as success stories. Between 2000 and 2010, there were 192 urbanized areas (39% of all UAs) whose density either remained the same or increased – in

other words, their per capita land consumption remained constant or decreased. However, many of these cities still experienced significant sprawl, a couple of thousand square miles in total between 2000 and 2010. No city better exemplifies this phenomenon than **Portland, Oregon**.

Despite being lauded for its urban growth boundary (UGB), extensive light rail infrastructure, and high-density mixed-use developments, even Portland could not contain its own sprawl. Between 2000 and 2010, the Portland UA decreased its per capita land consumption by 5.31% from 0.1916 acre per person to 0.1814 acre per person. However, despite this modest gain in population density over the decade, the Portland UA still sprawled outward an additional 50.4 square miles. The addition of 266,760 people during the decade was more than enough to wipe out the increased population density and cause the city area to swell by an additional 11%. While the UGB and other smart growth initiatives have certainly slowed the pace of sprawl in Portland, some contend that they have driven up real estate and housing prices within the city. This has led to spill-over sprawl in other nearby cities as people seek sanctuary from higher home prices. Supporting this contention is the nearby city of Salem, Oregon, whose urbanized area population grew by 14% from 2000 to 2010, and which has quickly become the second largest city in Oregon.

Of the 192 Urbanized Areas in America which over the last decade experienced a decline in per capita land area, **Raleigh, North Carolina** is another informative example of the limits of gradually shrinking the acreage afforded to each person in which to live, work, shop, play. Per capita land consumption decreased by 0.00298 acre. At the same time, the population grew by over 300,000 people, causing the Raleigh Urbanized Area to become more densely populated. But despite Raleigh's drop in per capita acreage, its 63% increase in population caused it to sprawl out over 198.5 square miles in these 10 years.

The drop in per capita land consumption can be explained by the efforts of city planners to tame sprawl by directing development toward certain centers within the Urbanized Area. These were not enough to prevent the construction of new suburban neighborhoods, the development of retail centers, and the creation of roads and highways to connect these sprawl products.

In the first edition of this study more than a decade ago, 18 of the 100 largest Urbanized Areas had reduced per capita land consumption, and during that time period all 18 of those Urbanized Areas still experienced Overall Sprawl. Between 2000 and 2010, 26 Urbanized Areas had a decline in their per capita land consumption, and 22 of those cities experienced Overall Sprawl. The four areas that did not sprawl saw a decrease in their total urbanized land area by an average of 18.5 square miles. While it is encouraging to see that some cities are stopping both their per capita and Overall Sprawl, 22 of the nation's major cities that stopped per capita growth still sprawled in an unsustainable manner. A stronger approach

must be taken towards suppressing sprawl before our already dwindling rural lands disappear altogether.

Stabilized population alone does not prevent sprawl.

In **Pittsburgh, Pennsylvania**, many local officials see population growth as a driver of economic development and an indicator of the vibrancy of the locales they represent. This mentality is seen in the aggressive campaigns and taxpayer subsidies that local officials use to attract new residents. However, economic growth does not necessarily require growing populations and sprawling cities. According to a 2010 report by Eben Fodor and Associates, cities experiencing rapid population growth had higher rates of unemployment and were more affected by the 2007 recession than were cities with slower growth rates.

This can be seen in urbanized areas like Pittsburgh, which have benefited from a stabilized population in recent years. From 2000 to 2010, Pittsburgh experienced no population-induced sprawl and had a relatively low level of Overall Sprawl. One benefit Pittsburgh has seen from a stabilized population is that it has an unemployment level of only 6.6%, well below the national rate. Energized largely by strong gains in the education, healthcare, financial, and natural gas industries, Pittsburgh has been able to distance itself from both the image of the "smoky city" of steel mills and the image of the city of shut-down steel mills.

Pittsburgh has also been making headlines in the 2000s as one of the country's most livable cities. In 2011 *The Economist* Intelligence Unit named it America's most livable city, and the 29th most livable city in the world. Despite having a stable population and diverse economy, the Pittsburgh Urbanized Area sprawled over an additional 52.8 square miles in the last decade. The reason was high levels of Per Capita Sprawl. One possible culprit could be that Pittsburgh has fewer people per household than the nationwide average. This means that the population of Pittsburgh requires more dwellings and more area for the same population size than do other American cities of comparable population size. Also, the decline of the steel industry left parts of the city abandoned as "brownfields", driving residents to build outward into the suburbs. Cases like Pittsburgh highlight the necessity of a two-pronged approach to addressing both population growth – undertaken primarily at a national level, not a local one – and per capita consumption sprawl.

4.2 Policy Implications

In order for local, state, and national policy makers to reduce the negative impacts of sprawl and over-development, they must adopt a two-pronged approach. Building on the findings of our original studies a decade ago, and using the same analysis of U.S. Census Bureau and U.S. National Resource Conservation Service data, this study provides further evidence of the necessity for such a two-pronged approach in order to effectively combat sprawl. Furthermore this study found that the role of population growth in contributing to Overall Sprawl has increased from roughly half, when the original study was conducted, to

contributing about 70% of Overall Sprawl in the Urbanized Areas and about 90% in the country as a whole. These findings further reinforce the need for measures that both reduce wasteful over-consumption of our land and resources as well as others that address the large population boom that persists in our country.

While the findings of this study directly challenge the assumptions of many Smart Growth and New Urbanism advocates that population growth plays only a small role in Overall Sprawl, they do not discount the necessity for smarter urban planning that reduces per capita land consumption. The results of this study suggest that about 10-30% of recent sprawl was caused by a complicated array of zoning laws, infrastructure subsidies, and complex socioeconomic forces. Efforts to make cities and communities more space-efficient and livable are certainly needed, but they largely ignore the main concern that sprawl is eating away at our country's remaining undeveloped lands.

Following the logic of this study's findings it isn't hard to conclude that even the most aggressive and well-intentioned policies promoting smarter growth, better urban planning, and higher residential densities cannot escape the immense population pressures facing many communities around our rapidly growing nation. Portland, with its Urban Growth Boundary and extensive light rail system, has aggressively pursued anti-sprawl measures. Yet, despite their best efforts the city still sprawled significantly, due entirely to the addition of nearly 300,000 new residents. It seems as though even the best-intentioned and politically palatable urban planning policies, are only able to slow, not halt, Urban Sprawl. Using this approach, a given patch of open space beyond the existing periphery of a typical rapidly expanding city would fall to sprawl in ten years instead of seven, but fall to sprawl it would. Under Smart Growth alone, city boundaries will never stop devouring countryside.

Simply stated, the results of this study indicate that population growth has more than twice the impact on sprawl as do all other factors combined. Neglecting the population factors in the anti-sprawl fight would be to ignore more than two-thirds of the problem.

4.2.1 Local Influence on Sprawl

Local policy makers truly trying to curb sprawl in our cities have a number of policy actions to pursue. While most local officials see population growth as an indicator of the vibrancy and vitality of their respective communities, there is little evidence to suggest that unfettered population growth is any of those things. Well-known sprawl critic and urban planner Eben Fodor challenged this very notion in his 2010 study "Relationship between Growth and Prosperity in 100 Largest U.S. Metropolitan Areas."

Fodor's study found that rapidly expanding metropolitan areas did not hold up well in terms of standard economic indicators such as unemployment, per capita income, and poverty rates in comparison with slower growing metropolitan areas. Yet, despite this, local officials and city planners continue to offer subsidies and tax breaks to attract new residents, investment

and development. Many times these subsidies are born unfairly by existing residents, who see their property taxes rise and are stuck with the bill to pay for sprawling highways, new schools, water and waste water treatment, and energy grids farther from the urban core.

Cities such as San Francisco, Portland and much of the Northeast have overly complicated zoning laws that drive up home prices. New immigrants and low income families are being priced out and into the more affordable suburbs and Sunbelt cities. This can be especially seen in the sprawling cities of Texas like Houston and Dallas. Both cities are rapidly expanding due to a large influx of immigrants and young professionals seeking the cheap housing and favorable business climate. Sprawl in the Sunbelt, and especially the Southwest, is of particular concern because of the hot desert climates of many of these cities. Southwestern metropolises like Phoenix are some of the most energy intensive cities and their growth puts added pressure on already scant water resources. In order for cities to properly address sprawl, taxpayer subsidies need to be removed and the true costs of development need to be borne by those developing the land. Also, as Harvard economist Edward Glaeser suggests, the true social costs of activities such as driving should be paid for. More sensible planning policies and zoning ordinances can help curb sprawl and prevent population booms in areas not suited to handle large populations.

4.2.2 National Influence on Population Growth

Beyond the short term, local officials supportive of growth control can hope only to slow population growth in their jurisdictions if national population continues to increase by some 2.5 to 3 million additional residents each year. These 25-30 million additional Americans each decade will nearly all settle in some community, inevitably leading to additional sprawl as far and as long as the eye can see.

In essence there are only three sources of national population growth: native fertility (in conjunction with slowly increasing life spans), immigration, and immigrant fertility. We know the following about their contribution to long-term growth:

- Native fertility: At 1.9 births per woman, it remains below the replacement level of 2.1 and has not been a source of long-term population growth in the U.S since 1971.

- Immigration: The sole source of long-term population growth in the United States is immigration, due both to new immigrants (arriving at about four times higher than the "replacement level" where immigration equals emigration) and to immigrants' fertility, which despite declines during the recession has remained well above replacement level.

Thus, long-term population growth in the United States is in the hands of federal policy makers. It is they who have increased the annual settlement of immigrants from one-quarter million in the 1950s and1960s to over a million since 1990. Until the numerical level of

national immigration is addressed, even the best local plans and political commitment will be unable to stop sprawl. Any serious efforts to halt the loss of farmland and wildlife habitat must include reducing the volume of population growth, which requires lowering the level of immigrants entering the country each year unless Americans and immigrants decide to move to a one-child per woman average.

A far more sustainable immigration level would be the approximately half-million a year recommended in 1995 by the bi-partisan U.S. Commission on Immigration Reform, established by President Clinton and chaired by former Congresswoman Barbara Jordan.

That would appear to be a popular option among most Americans. The 2014 Pulse Opinion Research poll of likely voters nationwide found that reducing immigration was a popular policy choice among most when linked with the goal of slowing down U.S. population growth (see Appendix K for the full survey).

> QUESTION: Census data show that since 1972, the size of American families has been at replacement-level. But annual immigration has tripled and is now the cause of nearly all long-term population growth. What should the government do?
>
> 68% - Reduce immigration to slow down population growth
> 18% - Keep immigration the same and allow population to double this century
> 4% - Increase immigration to more than double the population
> 10% - Not sure

When informed that immigration levels currently are around one million a year, voters were asked by pollsters what level they would prefer. Only 21% chose keeping it at one million or increasing it. But 63% of voters said they preferred to cut immigration by at least half, which would put immigration at about the level advocated by the Jordan Commission.

This lower level of immigration at around 500,000 a year would drive far less sprawl than the present levels exceeding a million a year. But unless Americans decide to lower their birth rates to far below replacement level, the 500,000 a year would still drive considerable population growth and sprawl indefinitely.[45]

That is why another federal commission recommended far greater reductions in immigration. The President's Council on Sustainable Development in 1996 recommended that the United States stabilize its population in order to meet various environmental and quality-of-life goals, and it called for reducing immigration to a level that would allow for a stable

[45] Camarota, Steve, *Projecting Immigration's Impact on the Size and Age Structure of the 21st Century American Population*, Center for Immigration Studies, December 2012

population. At current just below-replacement native fertility rates, that would require a return down to at least the quarter-million level of immigration in the 1950s and 1960s.

The Population and Consumption Task Force of President Clinton's Council on Sustainable Development concluded in 1996: "This is a sensitive issue, but reducing immigration levels is a necessary part of population stabilization and the drive toward sustainability."[46]

The 2014 Pulse Opinion Research poll did not give voters a choice of 250,000, but 40% of voters chose the options of 100,000 or zero. The full results on "how many legal immigrants should the government allow each year" were:

7% - Two million
14% - One million
23% - Half a million
20% - 100,000
20% - Zero
16% - Not sure

In our 2003 study, we devoted several pages to our findings on ways in which an Urbanized Area's population growth from immigrants would have either a greater or lesser effect on sprawl than a net population growth of the same size from U.S.-born residents. We could find no precise method of quantification but concluded that the various factors largely balanced each other.

A key way in which growth from immigration has a somewhat smaller effect on sprawl is the lower average income level and, thus, a lower consumption level of the average immigrant. But we found that an assumption about immigrants having less of an effect because they presumably prefer central cities to suburbs was false. The majority of immigrants now live in suburbs where the sprawl occurs.[47] And the adult children of immigrants were found to be just as likely to shun living in core cities as the adult children of natives. In fact, the lower incomes were causing immigrants to move to the edges of cities and even to rural settlements beyond the cities to find cheaper housing.

Nonetheless, it is important to note that the sprawl that occurs because of high immigration levels has nothing to do with the quality of immigrants as people or individuals but

[46] President's Council on Sustainable Development. 1996. *Population and Consumption Task Force Report.* 1996. Co-Chairs: Dianne Dillon-Ridgley, Co-Chair, Citizen's Network for Sustainable Development and Timothy E. Wirth, Under Secretary for Global Affairs, U.S. Department of State.
[47] Jill H. Wilson and Audrey Singer. October 2011. *Immigrants in 2010 Metropolitan America: A Decade of Change*. Metropolitan Policy Program at Brookings. Available online at http://www.brookings.edu/~/media/research/files/papers/2011/10/13%20immigration%20wilson%20singer/1013_immigration_wilson_singer.pdf.

everything to do with the quantity of population growth that occurs because of immigration. This can be seen by simply observing that cities with high population growth have high amounts of sprawl, regardless of whether most of the incoming new residents come from another region of the United States (such as Oregon) or from another continent (such as California).

On a local level, the sprawl pressures of population growth are similar regardless of where the new residents originate. But very few Urbanized Areas are likely to be able to subdue population growth and sprawl if the federal government continues policies that add around 20 million people to the nation each decade, all of whom have to settle in some locality. The reality – which can only be mitigated but not eliminated by good planning or Smart Growth – is that these localities all occupy lands that were formerly productive agricultural lands or irreplaceable natural habitats.

Appendix A
Glossary

Central Place – The Census Bureau delineates an urbanized area (UA) as one or more "central places" and the "urban fringe" (the adjacent densely settled surrounding territory) that together contain a minimum of 50,000 residents. A central place functions as the dominant center of each UA. The identification of a UA central place permits the comparison of this dominant center with the remaining territory in the UA. A central place generally is the most densely populated and oldest city in a metropolitan area.

Density – Shorthand for population density, or the number of residents per unit area, usually measured in number of residents per acre or square mile. Density is the mathematical inverse or opposite of land consumption per person (per capita). For example, a density of five persons or residents per acre equals 3,200 per square mile. This in turn equals a per capita land consumption of 0.2 acre per person.

Developed Land – As defined by the U.S. Department of Agriculture's Natural Resources Conservation Service in its National Resources Inventories (NRIs), issued every five years since 1982, built-up or paved land that is at least one-quarter acre in area. Developed land can include built-up areas outside of urbanized areas, towns, or cities. The NRI Developed Land category includes: (a) large tracts of urban and built-up land; (b) small tracts of built-up land less than 10 acres in size; and (c) land outside of these built-up areas that is in a rural transportation corridor (roads, interstates, railroads, and associated rights-of-way).

Foreign Born – Describing a person born in a country other than the United States. Excludes those born abroad to American parents. Can be used as a noun or an adjective.

High-Density – A large number of residents per unit area, usually measured in terms of residents per acre or square mile. While there is no one precise, agreed-upon criterion or threshold of high-density residential development, a density of approximately 5,000 per square mile would be considered relatively high-density.

Holdren Method – Mathematical methodology for determining the percentages of Overall Sprawl attributable to Per Capita Sprawl and Population-driven Sprawl, in other words, to increasing per capita land consumption (decreasing population density) and to population growth.

Hop – a connection from one urban area core to other qualifying urban territory along a road connection of half a mile (0.5 mile) or less in length; multiple hops may be made along any given road corridor. This criterion recognizes that alternating patterns of residential development and non-residential development are a typical feature of urban landscapes.

Immigration – Permanent movement (i.e., settlement) of a foreign-born person to the United States either with permission from U.S. authorities (legal immigration) or without such permission (illegal immigration).

Immigrant Fertility – Fertility of foreign-born immigrants to the United States, usually expressed in terms of the Total Fertility Rate (TFR) of women, which is the average total number of children born to women of a defined group during the course of their reproductive years.

Jump – a connection from one urban area core to other qualifying urban territory along a road connection between 0.5 mile and 2.5 miles in length; only one jump may be made along any given road connection.

Low-Density – Relatively low population density, or low number of residents per unit area (acre or square mile). Urban / suburban densities of 1,000-2,000 per square mile would be considered low-density, though still enough to qualify as urban.

Native Born – A person born in the United States.

Natural Habitat – That portion of rural or undeveloped land that consists of upland and bottomland forests, woodlands, savanna, scrub-shrub, natural grasslands or prairie, wetlands (marshes, swamps, bogs), ponds, watercourses, deserts, alpine meadow and tundra. Natural habitats support wildlife and provide other ecosystem services. They may be in public or private ownership.

New Urbanism – A movement that sees urban centers as potentially vibrant communities that can mix and harmonize residential and commercial uses in clever and innovative ways to make cities satisfying and safe places to live and work. New urbanism supports such concepts as higher density in urban cores, mixed uses, mass transit, close proximity of dwellings to workplace, walkable communities, bicycle lanes, community gardens, and others. New urbanism sees relentless sprawl in America as one consequence of the abandonment of our central cities.

Per Capita Land Consumption – Average amount of land used by each resident of an urbanized area or developed area. Includes not just residential land but all developed land used by urban residents, including commercial, institutional, small park, transportation (e.g., streets, roads, railroads, freeways, parking lots), and industrial land uses.

Open Space – Land lacking significant built structures or pavement. Includes rural and undeveloped lands and natural habitat outside of urban boundaries; also includes larger natural areas, parks and green space within urban areas, such as golf courses and extensive lawns or gardens. Yards or wooded lots on quarter-acre lots in residential areas would not qualify as open space.

Overall Sprawl – See "sprawl" below. Overall sprawl is the sum of Per Capita Sprawl and Population-driven sprawl [the total amount of open space converted to development over a period of time].

Per Capita Sprawl – Sprawl that is driven by increase in per capita land consumption, that is, land consumption per resident, of an urbanized area, developed area, city or town; Per Capita

Sprawl is measured in terms the increase in acres or square miles of developed or urbanized acres of land per person. Per Capita Sprawl and population-driven sprawl add up to 100 percent of Overall Sprawl.

Population-driven Sprawl – Sprawl that is driven by increase in the population of an urbanized or developed area. Population-driven and Per Capita Sprawl add up to 100 percent.

Population Growth – Increase in the number of residents of a given area, such as a town, city, urbanized area, state, or country over time. Population growth is equal to the total births of native-born residents minus the total deaths of native-born residents minus the emigration of native-born residents PLUS total immigration of the foreign born plus births to the foreign born minus deaths of the foreign born minus emigration of the foreign born (i.e., return to the country of their birth or a third country). In recent decades, annual population growth in the United States as a whole has been running about 2.5 million to 3 million per year on average, or roughly 30 million per decade.

Rural Land – Undeveloped lands outside of urban areas, including farmland, pastureland, rangeland, and natural or semi-natural habitats, like forests, woodlands, wetlands, grasslands or prairie, and deserts. Rural lands may be flat or mountainous, and publicly or privately owned.

Smart Growth – The use of a variety of land-use, planning, statutory, regulatory, taxing, and other tools by federal and state governments and local jurisdictions (municipalities) to reduce haphazard, low-density, and poorly planned development in a given region.

Smart Growth Movement – A loose, eclectic coalition of environmentalists, local growth-control activists, New Urbanists, municipal and regional planners, think-tanks, the federal government and many state governments, and even some home-builders united by their interest in slowing the rate of sprawl, and making existing communities more sustainable and livable.

Sprawl – As defined in this study, the increase in the physical area of a town or city over time – outward expansion – as undeveloped or rural land at its periphery is permanently converted to developed or urbanized land as population and/or per capita land consumption grow. More specifically, in this study, sprawl is 1) the increase in the area of the Census Bureau's Urbanized Areas, as delineated every 10 years in the decadal censuses, and/or 2) the increase in the area of a state's area of Developed Land, as determined by the Natural Resources Conservation Service.

Suburbs – Residential or commercial zones on the outskirts of a central city or town; generally corresponds to "urban fringe." Tend to have a lower population density than the central place or urban core, though not always, as when downtown districts are dominated by office, institutional, and commercial zones.

Urban Core – Used in this report as another description for "central location" as defined by the Census Bureau. The urban core is the entire city that anchors a metropolitan area, and usually is at its center. It generally is the oldest, most densely populated and most built-up portion of an urbanized area.

Urban Fringe – Built-up areas near the edge of an urbanized area, generally with lower population density than the urban core; generally corresponds to the inner and outer suburbs of a town or city.

Urban Sprawl – See "sprawl."

Urbanized Area – As defined by the U.S. Census Bureau, an area of contiguous census blocks or block groups with a population of at least 50,000 and an average population density of at least 1,000 residents per square mile.

Appendix B
Calculating Per Capita Land Consumption

The per person land consumption in each state or Urbanized Area can be expressed as:

(1) $a = A / P$

where:

a = area of developed or urbanized land area for the average resident
A = Area of total developed or urbanized land in a state
P = Population of that state

For example, in 2010 Oregon had 3,831,074 residents and approximately 1,407,600 developed acres. Thus, per capita developed land use for all purposes was around 0.367 acre (between one-third and four-tenths of an acre) per resident.

The land used per person is the total developed land area divided by the total number of people. This is the inverse of population density, which is the number of people per unit area of land. When per capita land consumption goes up, density goes down; when per capita land consumption goes down, density goes up.

The developed land area of any given state can be expressed as:

(2) $A = P \times a$

This can be stated as: the total developed area in square miles (or acres) of a state can be simply expressed or "factored" into the product of the Population of the state (*viz*., *P*) multiplied by the per capita urban land consumption (*viz*., a). This second equation (2) is the basis for attributing or apportioning the shares of sprawl (viz. growth in *A*) back onto two contributing factors, the growth in *P* and the growth in *a*.

Appendix C
Apportioning Shares of Overall Sprawl Between Population Growth and Per Capita Sprawl

A methodology for quantifying the respective contributions of population growth and changes in per capita consumption of any type of resource use was outlined in a 1991 paper by physicist John Holdren ("Population and the Energy Problem." *Population and Environment*, Vol. 12, No. 3, Spring 1991). Although Dr. Holdren's 1991 paper dealt specifically with the role of population growth in propelling the increase in U.S. energy consumption, the same methodology can also be applied to many types of population and resource consumption analyses.

In the case of sprawl, the resource under consideration is rural land, namely the expansion over time in the total acreage of rural land urbanized or converted into developed land and subsequently used for urban purposes, such as for housing, commerce, retail, office space, education, light and heavy industry, transportation, and so forth.

As stated in Appendix B, the total land area developed in a city (urbanized area) or state can be expressed as:

(1) $A = P \times a$

Where:

A = Area of total are (in acres or square miles) of development in city or state
P = Population of that city or state
a = area of city or state used by the average resident (per capita land use)

Following the logic in Holdren's paper, if over a period of time Δt (e.g., a year or a decade), the population grows by an increment ΔP and the per capita land use changes by Δa, the total urbanized land area grows by ΔA, expressed as:

(2) $A + \Delta A = (P + \Delta P) \times (a + \Delta a)$

Subtracting eqn. (1) from eqn. (2) and dividing through by A to compute the relative change (i.e., $\Delta A/A$) in urbanized land area over time interval Δt yields:

(3) $\Delta A/A = \Delta P/P + \Delta a/a + (\Delta P/P) \times (\Delta a/a)$

Now equation (3) is quite general and makes no assumption about the growth model or time interval. On a year-to-year basis, the percentage increments in P and a are small (i.e., single digit percentages), so the second order term in equation (3) can be ignored. Hence following the Holdren paradigm, eqn. (3) states that the percentage growth in urbanized land area (viz., 100 percent x $\Delta A/A$) is the sum of the percentage growth in the population (100

percent x $\Delta P/P$) plus the percentage growth in the per capita land use (100 percent x $\Delta a/a$). Stated in words, equation (3) becomes:

(4) *Overall percentage land area growth = Overall percentage population growth + Overall percentage per capita growth*

In essence, the Holdren methodology quantifies population growth's share of total land consumption (sprawl) by finding the ratio of the overall percentage change in population over a period of time to the overall percentage change in land area consumed for the same period. This can be expressed as:

$$\text{(5)} \quad \textit{Population share of growth} = \frac{\textit{(Overall percentage population growth)}}{\textit{(Overall percentage land area growth)}}$$

The same form applies for per capita land use:

$$\text{(6)} \quad \textit{Per capita land use share of growth} = \frac{\textit{(Overall \% per capita land use growth)}}{\textit{(Overall \% land area growth)}}$$

The above two equations follow the relationship based on Prof. Holdren's equation (5) in his 1991 paper. A common growth model follows the form (say for population):

$$\text{(7)} \quad P(t) = P_0 (1 + g_p)t$$

Where $P(t)$ is population at time t, P_0 is the initial population and g_p the growth rate over the interval. Solving for g_p the growth rate yields:

$$\text{(8)} \quad \ln (1 + g_p) = (1/t) \ln (P(t)/P_0)$$

Since $\ln (1 + x)$ approximately equals x for small values of x, equation (8) can be written as:

$$\text{(9)} \quad g_p = (1/t) \ln (P(t)/P_0)$$

The same form of derivation of growth rates can be written for land area (A) and per capita land use (a)

$$\text{(10)} \quad g_A = (1/t) \ln (A(t)/A_0)$$

$$\text{(11)} \quad g_a = (1/t) \ln (a(t)/a_0)$$

These three equations for the growth rates allow the result of equation (4) to be restated as:

$$\text{(12)} \quad gP + g_a = g_A$$

Substituting the formulae (equations 9 through 11) for the growth rates and relating the initial and final values of the variables P, a and A over the period of interest into equation (12), the actual calculational relationship becomes:

(13) ln (*final population / initial population*) + ln (*final per capita land area / initial per capita land area*) = ln (*final total land area / initial total land area*)

In other words, the natural logarithm (ln) of the ratio of the final to initial population, plus the logarithm of the ratio of the final to initial per capita land area (i.e., land consumption per resident), equals the logarithm of the final to the initial total land area.

In the case of Iowa from 2002 to 2010, this formula would appear as:

(14) ln (*3,046,355 residents / 2,931,084 residents*) + ln (*0.6345 acre per resident / 0.6272 acre per resident*) =ln (*1,932,900 acres / 1,838,300 acres*)

Computing the ratios yields:

(15) ln (1.0393) + ln (1.0117) = ln (1.0515)

0.0386 + 0.0116 = 0.0502

Then applying equations (5) and (6), the percentage contributions of population growth and per capita land area growth are obtained by dividing (i.e., normalizing to 100 percent) each side by 0.05018:

(16) $\frac{0.0386}{0.0502} + \frac{0.0116}{0.0502} = \frac{0.0502}{0.0502}$

Performing these divisions yields:

(17) 0.77 + 0.23 = 1.0

Thus, we note that in the case of the Iowa from 2002 to 2010, the share of sprawl due to population growth was 73 percent [100 percent x (0.0386 / 0.0502)], while declining density (i.e., an increase in land area per capita) accounted for 23 percent [100 percent x (0.0116/ 0.0502)]. Note that the sum of both percentages equals 100 percent.

Appendix D
Anomalies – Urbanized Areas with populations that grew but areas that shrank

From 2000 to 2010 the Virginia Beach, VA, Colorado Springs, CO, San Diego, CA, and San Francisco- Oakland, CA Urbanized Areas were all found to make both large gains in population, while at the same time losing overall urban area.

In each of these areas, the reduction in developed urban land was on paper only, the result of changes in calculations by the government. Although it is possible for an Urbanized Area to reduce its developed land by returning large swaths of previously developed acreage to a natural state, that was not the case with the four Urbanized Areas that the government shows as having shrunk in land use over the last decade.

The cause for these anomalies can be traced to changes in the delineation criteria for the 2010 Census from the 2000 Census. The most notable of these changes is the use of census tracts rather than block groups for establishing initial urban cores. One consequence of these changes was for initial urban cores to decrease in territory for the 2010 Census from the 2000 Census.

In the case of Virginia Beach the decrease in area can be attributed to Williamsburg, VA being recognized as its own UA for the first time in 2010. In the 2010 Census the initial urban cores for Virginia Beach were smaller than in 2000, allowing a gap of low population density and impervious surface to form between Virginia Beach and Williamsburg that could not be bridged by a jump or hop.

The San Diego UA's loss in overall area can be explained by the loss of the majority of

Census Tracts, Blocks, and Block Groups

A **census tract** is a geographic area defined for the purpose of taking a census. Usually census tract boundaries coincide with the limits of cities, towns, or other municipalities. Several tracts typically exist within a single county. However, in unincorporated census tract boundaries are often arbitrary, except for coinciding with political lines.

Census tracts are divided into **block groups** and these are further subdivided into **census blocks**. According to the Census Bureau, tracts are "designed to be relatively homogeneous units with respect to population characteristics, economic status, and living conditions." On average, about 4,000 inhabitants live in a census tract.

While censuses are conducted the world over, and have been carried out for centuries, the concept of the census tract was developed in the United States, where it was first applied in the 1910 decadal census.

A **census block** is the smallest geographic unit used by the Census Bureau for tabulation of 100-percent data (data collected from all houses, rather than a sample of houses). Several blocks comprise a **block group**. There are on average about 39 blocks per block group, but this varies. Blocks typically have a four-digit number, where the first digit indicates which block group the block is in. For example, census block 3019 would be in block group 3. There are about 8,200,000 blocks in the U.S.

Block boundaries are typically streets, roads or creeks. The size of census block populations varies considerably. There are about 2,700,000 blocks with zero inhabitants, while a block that is entirely occupied by an apartment complex might have several hundred inhabitants.

Camp Pendleton military base in the 2010 Census. In the 2010 Census only two small portions of Camp Pendleton qualified as being urban. Only the southern qualifying portion of the base was included in the San Diego UA, with the rest of the area being counted in the Mission Viejo-Lake Forest-San Clemente UA.

Similar to San Diego, the Colorado Springs UA lost much of its area due to the Air Force Academy being designated as its own Air Force Academy, CO Urban Cluster. (A designated Urban Cluster (UC) is an urban area with a population of at least 2,500 and less than 50,000 people.)

For the San Francisco-Oakland UA the loss in area can be attributed to the use of census tracts rather than block groups when delineating urban cores. This led to a loss of territory, as well as many previously included enclaves and indentations no longer qualifying in the urban territory. Another contributing factor was the southern boundary of the San Francisco-Oakland UA being adjusted northward, to ensure that Palo Alto be included only in the San Jose, CA Urbanized Area.

Source:

Christopher J. Henrie. U.S. Census Bureau, Geography Division, Geographic Standards and Criteria. "Urban Area Data Anomalies." Email message to Brian S. Schoepfer, NumbersUSA. 5 June 2013.

Appendix E
Total Sprawl and Rank in All 497 Urbanized Areas, 2000-2010

Table E-1. Alphabetical List of all 497 Census Bureau's Urbanized Areas, Their Sprawl 2000-2010, and Shares Apportioned between Population Growth and Per Capita Sprawl

Urbanized Area	Total Sprawl (square miles), 2000-2010	Sprawl Ranking* (No. 1 is worst)	% of Total Sprawl Related to POPULATION GROWTH	% of Total Sprawl Related to GROWTH IN PER CAPITA LAND CONSUMPTION
Aberdeen–Bel Air South–Bel Air North, MD	29.1	120	81%	19%
Abilene, TX	7.2	319	22%	78%
Aguadilla–Isabela–San Sebastián, PR	-0.3	*	N/A	N/A
Akron, OH	17.6	192	0%	100%
Albany, GA	5.0	359	5%	95%
Albany, OR	7.7	303	77%	23%
Albany–Schenectady, NY	11.5	252	100%	0%
Albuquerque, NM	26.6	130	100%	0%
Alexandria, LA	7.2	317	46%	54%
Allentown, PA–NJ	56.8	60	80%	20%
Alton, IL–MO	3.6	380	0%	100%
Altoona, PA	-0.2	*	N/A	N/A
Amarillo, TX	7.1	323	100%	0%
Ames, IA	7.4	311	45%	55%
Anchorage, AK	6.1	334	100%	0%

Urbanized Area	Total Sprawl (square miles), 2000-2010	Sprawl Ranking* (No. 1 is worst)	% of Total Sprawl Related to POPULATION GROWTH	% of Total Sprawl Related to GROWTH IN PER CAPITA LAND CONSUMPTION
Anderson, IN	2.7	400	0%	100%
Anderson, SC	5.2	353	99%	1%
Ann Arbor, MI	30.8	109	35%	65%
Anniston–Oxford, AL	8.5	291	49%	51%
Antioch, CA	21.1	168	81%	19%
Appleton, WI	30.7	110	40%	60%
Arecibo, PR	-6.7	*	N/A	N/A
Arroyo Grande–Grover Beach, CA	4.6	365	41%	59%
Asheville, NC	58.1	59	95%	5%
Athens-Clarke County, GA	18.8	184	89%	11%
Atlanta, GA	682.77	1	85%	15%
Atlantic City, NJ	4.3	367	100%	0%
Auburn, AL	9.9	269	98%	2%
Augusta-Richmond County, GA–SC	27.7	127	100%	0%
Austin, TX	204.9	7	83%	17%
Avondale–Goodyear, AZ	58.5	58	97%	3%
Bakersfield, CA	28.1	123	100%	0%
Baltimore, MD	34.3	101	100%	0%
Bangor, ME	3.8	377	40%	60%
Barnstable Town, MA	-8.9	*	N/A	N/A

Urbanized Area	Total Sprawl (square miles), 2000-2010	Sprawl Ranking* (No. 1 is worst)	% of Total Sprawl Related to POPULATION GROWTH	% of Total Sprawl Related to GROWTH IN PER CAPITA LAND CONSUMPTION
Baton Rouge, LA	86.1	40	81%	19%
Battle Creek, MI	1.9	413	0%	100%
Bay City, MI	0.6	431	0%	100%
Beaumont, TX	10.3	263	51%	49%
Beckley, WV	20.9	170	75%	25%
Bellingham, WA	12.6	233	100%	0%
Beloit, WI–IL	6.5	329	59%	41%
Bend, OR	3.3	391	100%	0%
Benton Harbor–St. Joseph–Fair Plain, MI	1.3	422	0%	100%
Billings, MT	7.2	318	92%	8%
Binghamton, NY–PA	-2.3	*	N/A	N/A
Birmingham, AL	137.8	17	40%	60%
Bismarck, ND	4.8	361	67%	33%
Blacksburg, VA	24.9	140	66%	34%
Bloomington, IN	1.8	415	100%	0%
Bloomington–Normal, IL	12.0	245	59%	41%
Bloomsburg–Berwick, PA	7.4	314	41%	59%
Boise City, ID	25.2	137	100%	0%
Bonita Springs, FL	36.8	96	100%	0%
Boston, MA–NH–RI	137.3	18	48%	52%
Boulder, CO	-0.4	*	N/A	N/A

Urbanized Area	Total Sprawl (square miles), 2000-2010	Sprawl Ranking* (No. 1 is worst)	% of Total Sprawl Related to POPULATION GROWTH	% of Total Sprawl Related to GROWTH IN PER CAPITA LAND CONSUMPTION
Bowling Green, KY	9.0	285	100%	0%
Bremerton, WA	19.0	181	73%	27%
Bridgeport–Stamford, CT–NY	0.9	426	100%	0%
Bristol–Bristol, TN–VA	12.8	230	77%	23%
Brownsville, TX	24.2	142	77%	23%
Brunswick, GA	0.4	434	0%	100%
Buffalo, NY	13.2	227	0%	100%
Burlington, NC	25.7	134	72%	28%
Burlington, VT	-0.1	*	N/A	N/A
Camarillo, CA	0.7	428	425%	0%
Canton, OH	22.9	156	31%	69%
Cape Coral, FL	138.5	16	87%	13%
Cape Girardeau, MO–IL	10.0	268	35%	65%
Carbondale, IL**	N/A	N/A	N/A	N/A
Carson City, NV	-5.0	*	N/A	N/A
Cartersville, GA	12.4	238	100%	0%
Casa Grande, AZ	5.9	339	100%	0%
Casper, WY	4.2	370	75%	25%
Cedar Rapids, IA	24.1	143	40%	60%
Chambersburg, PA	10.0	266	94%	6%
Champaign, IL	5.9	340	100%	0%

Urbanized Area	Total Sprawl (square miles), 2000-2010	Sprawl Ranking* (No. 1 is worst)	% of Total Sprawl Related to POPULATION GROWTH	% of Total Sprawl Related to GROWTH IN PER CAPITA LAND CONSUMPTION
Charleston, WV	-15.2	*	N/A	N/A
Charleston–North Charleston, SC	62.4	52	100%	0%
Charlotte, NC–SC	306.6	6	93%	7%
Charlottesville, VA	-2.9	*	N/A	N/A
Chattanooga, TN–GA	10.1	265	100%	0%
Cheyenne, WY	1.3	423	100%	0%
Chicago, IL–IN	319.9	5	25%	75%
Chico, CA	-0.5	*	N/A	N/A
Cincinnati, OH–KY–IN	116.0	25	49%	51%
Clarksville, TN–KY	30.7	111	80%	20%
Cleveland, OH	125.0	22	0%	100%
Cleveland, TN	6.4	331	100%	0%
Coeur d'Alene, ID	5.1	357	100%	0%
College Station–Bryan, TX	22.3	161	69%	31%
Colorado Springs, CO	-9.5	*	N/A	N/A
Columbia, MO	10.3	262	100%	0%
Columbia, SC	111.1	27	78%	22%
Columbus, GA–AL	10.9	256	59%	41%
Columbus, IN	1.4	421	100%	0%
Columbus, OH	112.8	26	75%	25%
Concord, CA	27.3	129	75%	25%

Urbanized Area	Total Sprawl (square miles), 2000-2010	Sprawl Ranking* (No. 1 is worst)	% of Total Sprawl Related to POPULATION GROWTH	% of Total Sprawl Related to GROWTH IN PER CAPITA LAND CONSUMPTION
Concord, NC	89.0	38	92%	8%
Conroe–The Woodlands, TX	91.6	36	85%	15%
Conway, AR	16.4	196	74%	26%
Corpus Christi, TX	10.0	267	98%	2%
Corvallis, OR	-7.9	*	N/A	N/A
Cumberland, MD–WV–PA	-0.1	*	N/A	N/A
Dallas–Fort Worth–Arlington, TX	372.1	2	90%	10%
Dalton, GA	26.4	131	99%	1%
Danbury, CT–NY	8.1	297	100%	0%
Danville, IL	-1.1	*	N/A	N/A
Daphne–Fairhope, AL	22.8	158	77%	23%
Davenport, IA–IL	14.4	213	31%	69%
Davis, CA	0.5	432	100%	0%
Dayton, OH	27.9	124	35%	65%
Decatur, AL	30.1	115	41%	59%
Decatur, IL	9.1	284	0%	100%
DeKalb, IL	7.9	300	56%	44%
Delano, CA	4.0	375	62%	38%
Deltona, FL	6.9	325	100%	0%
Denton–Lewisville, TX	23.6	148	100%	0%
Denver–Aurora, CO	169.1	11	61%	39%

Urbanized Area	Total Sprawl (square miles), 2000-2010	Sprawl Ranking* (No. 1 is worst)	% of Total Sprawl Related to POPULATION GROWTH	% of Total Sprawl Related to GROWTH IN PER CAPITA LAND CONSUMPTION
Des Moines, IA	60.3	55	54%	46%
Detroit, MI	75.71	45	0%	100%
Dothan, AL	2.0	412	100%	0%
Dover, DE	30.6	112	100%	0%
Dover–Rochester, NH–ME	2.9	397	100%	0%
Dubuque, IA–IL	3.6	383	35%	65%
Duluth, MN–WI	4.2	371	29%	71%
Durham, NC	25.0	139	100%	0%
East Stroudsburg, PA–NJ	11.5	253	100%	0%
Eau Claire, WI	11.5	251	65%	35%
El Centro–Calexico, CA	13.5	223	100%	0%
El Paso de Robles (Paso Robles)–Atascadero, CA	0.7	429	100%	0%
El Paso, TX–NM	31.5	106	100%	0%
Elizabethtown–Radcliff, KY	13.5	224	48%	52%
Elkhart, IN–MI	14.4	212	53%	47%
Elmira, NY	3.2	393	14%	86%
Erie, PA	3.5	387	22%	78%
Eugene, OR	18.3	187	42%	58%
Evansville, IN–KY	13.1	228	67%	33%
Fairbanks, AK	12.0	246	88%	12%
Fairfield, CA	13.6	217	41%	59%

Urbanized Area	Total Sprawl (square miles), 2000-2010	Sprawl Ranking* (No. 1 is worst)	% of Total Sprawl Related to POPULATION GROWTH	% of Total Sprawl Related to GROWTH IN PER CAPITA LAND CONSUMPTION
Fajardo, PR	7.6	309	50%	50%
Fargo, ND–MN	24.5	141	50%	50%
Farmington, NM	-8.2	*	N/A	N/A
Fayetteville, NC	30.9	108	68%	32%
Fayetteville–Springdale–Rogers, AR–MO	78.9	44	98%	2%
Flagstaff, AZ	2.4	406	100%	0%
Flint, MI	4.8	362	0%	100%
Florence, AL	10.5	259	42%	58%
Florence, SC	8.5	289	100%	0%
Florida–Imbéry–Barceloneta, PR	-3.6	*	N/A	N/A
Fond du Lac, WI	8.5	290	26%	74%
Fort Collins, CO	26.0	132	91%	8%
Fort Smith, AR–OK	15.5	200	58%	42%
Fort Walton Beach–Navarre–Wright, FL	24.0	144	100%	0%
Fort Wayne, IN	36.9	95	36%	64%
Frederick, MD	-5.3	*	N/A	N/A
Fredericksburg, VA	12.5	236	100%	0%
Fresno, CA	32.7	104	78%	22%
Gadsden, AL	12.3	239	21%	79%
Gainesville, FL	9.6	271	100%	0%

Urbanized Area	Total Sprawl (square miles), 2000-2010	Sprawl Ranking* (No. 1 is worst)	% of Total Sprawl Related to POPULATION GROWTH	% of Total Sprawl Related to GROWTH IN PER CAPITA LAND CONSUMPTION
Gainesville, GA	35.9	97	100%	0%
Gastonia, NC–SC	19.8	177	100%	0%
Gilroy–Morgan Hill, CA	7.1	320	88%	12%
Glens Falls, NY	6.2	333	79%	21%
Goldsboro, NC	9.2	281	28%	72%
Grand Forks, ND–MN	7.7	306	21%	79%
Grand Island, NE	5.5	349	48%	52%
Grand Junction, CO	22.8	159	96%	4%
Grand Rapids, MI	23.2	153	64%	36%
Grants Pass, OR	1.8	416	100%	0%
Great Falls, MT	2.4	404	16%	84%
Greeley, CO	7.5	310	100%	0%
Green Bay, WI	22.9	157	40%	60%
Greensboro, NC	49.7	78	49%	51%
Greenville, NC	20.3	176	91%	9%
Greenville, SC	93.7	34	81%	19%
Guayama, PR	0.3	435	100%	0%
Gulfport, MS	29.6	117	8%	92%
Hagerstown, MD–WV–PA	56.6	62	76%	24%
Hammond, LA	27.9	125	98%	2%
Hanford, CA	2.3	409	100%	0%

Urbanized Area	Total Sprawl (square miles), 2000-2010	Sprawl Ranking* (No. 1 is worst)	% of Total Sprawl Related to POPULATION GROWTH	% of Total Sprawl Related to GROWTH IN PER CAPITA LAND CONSUMPTION
Hanover, PA	9.4	278	100%	0%
Harlingen, TX	23.6	147	60%	40%
Harrisburg, PA	51.3	74	92%	8%
Harrisonburg, VA	5.9	341	100%	0%
Hartford, CT	46.9	82	87%	13%
Hattiesburg, MS	30.0	116	47%	54%
Hazleton, PA	2.4	407	100%	0%
Hemet, CA	7.3	315	100%	0%
Hickory, NC	50.8	75	57%	43%
High Point, NC	18.9	183	100%	0%
Hilton Head Island, SC	25.7	135	100%	0%
Hinesville, GA	4.0	376	16%	84%
Holland, MI	11.3	254	40%	60%
Homosassa Springs–Beverly Hills–Citrus Springs, FL**	N/A	N/A	N/A	N/A
Hot Springs, AR	-0.4	*	N/A	N/A
Houma, LA	14.5	210	81%	19%
Houston, TX	364.75	3	100%	0%
Huntington, WV–KY–OH	23.6	149	66%	34%
Huntsville, AL	52.6	72	100%	0%
Idaho Falls, ID	13.5	221	84%	16%
Indianapolis, IN	152.8	14	82%	18%

Urbanized Area	Total Sprawl (square miles), 2000-2010	Sprawl Ranking* (No. 1 is worst)	% of Total Sprawl Related to POPULATION GROWTH	% of Total Sprawl Related to GROWTH IN PER CAPITA LAND CONSUMPTION
Indio–Cathedral City, CA	45.2	84	81%	19%
Iowa City, IA	9.8	270	92%	8%
Ithaca, NY	-5.1	*	N/A	N/A
Jackson, MI	6.1	335	20%	80%
Jackson, MS	81.7	43	45%	55%
Jackson, TN	12.4	237	36%	64%
Jacksonville, FL	119.8	24	74%	26%
Jacksonville, NC	7.2	316	92%	8%
Janesville, WI	1.4	420	100%	0%
Jefferson City, MO	1.8	414	100%	0%
Johnson City, TN	19.0	182	85%	15%
Johnstown, PA	-4.2	*	N/A	N/A
Jonesboro, AR	7.0	324	100%	0%
Joplin, MO	7.1	322	100%	0%
Juana Díaz, PR	16.2	197	94%	6%
Kahului, HI	3.4	389	100%	0%
Kailua (Honolulu County)–Kaneohe, HI	6.4	330	0%	100%
Kalamazoo, MI	23.9	145	55%	45%
Kankakee, IL	9.6	272	77%	23%
Kansas City, MO–KS	93.4	35	74%	26%
Kennewick–Pasco, WA	17.7	191	100%	0%

Urbanized Area	Total Sprawl (square miles), 2000-2010	Sprawl Ranking* (No. 1 is worst)	% of Total Sprawl Related to POPULATION GROWTH	% of Total Sprawl Related to GROWTH IN PER CAPITA LAND CONSUMPTION
Kenosha, WI–IL	9.1	283	57%	43%
Killeen, TX	20.7	172	92%	8%
Kingsport, TN–VA	15.6	199	72%	28%
Kingston, NY	9.2	280	30%	70%
Kissimmee, FL	53.5	69	100%	0%
Knoxville, TN	98.7	30	100%	0%
Kokomo, IN	0.8	427	0%	100%
La Crosse, WI–MN	10.6	258	49%	51%
Lady Lake–The Villages, FL	21.1	167	100%	0%
Lafayette, IN	9.4	277	100%	0%
Lafayette, LA	54.0	66	97%	3%
Lafayette–Louisville–Erie, CO	8.3	294	100%	0%
Lake Charles, LA	34.9	99	23%	77%
Lake Havasu City, AZ	2.7	401	100%	0%
Lake Jackson–Angleton, TX	7.9	301	9%	91%
Lakeland, FL	25.4	136	100%	0%
Lancaster, PA	48.1	79	100%	0%
Lancaster–Palmdale, CA	25.1	138	100%	0%
Lansing, MI	21.3	165	30%	70%
Laredo, TX	23.2	154	68%	32%
Las Cruces, NM	0.6	430	100%	0%

Urbanized Area	Total Sprawl (square miles), 2000-2010	Sprawl Ranking* (No. 1 is worst)	% of Total Sprawl Related to POPULATION GROWTH	% of Total Sprawl Related to GROWTH IN PER CAPITA LAND CONSUMPTION
Las Vegas–Henderson, NV	130.9	20	96%	4%
Lawrence, KS	7.7	304	34%	66%
Lawton, OK	-11.1	*	N/A	N/A
Lebanon, PA	15.3	202	46%	54%
Lee's Summit, MO	18.6	185	72%	28%
Leesburg–Eustis–Tavares, FL	23.4	151	100%	0%
Leominster–Fitchburg, MA	2.4	405	93%	7%
Lewiston, ID–WA	-0.1	440	N/A	N/A
Lewiston, ME	14.8	*	N/A	N/A
Lexington Park–California–Chesapeake Ranch Estates, MD	14.9	206	87%	13%
Lexington-Fayette, KY	18.0	189	63%	37%
Lima, OH	6.0	336	0%	100%
Lincoln, NE	10.4	260	100%	0%
Little Rock, AR	52.7	71	79%	21%
Livermore, CA	3.6	381	51%	49%
Lodi, CA	-7.6	*	N/A	N/A
Logan, UT	5.6	347	100%	0%
Lompoc, CA	-49.4	*	N/A	N/A
Longmont, CO	3.6	382	100%	0%
Longview, TX	32.4	105	48%	52%
Longview, WA–OR	6.0	338	28%	72%

Urbanized Area	Total Sprawl (square miles), 2000-2010	Sprawl Ranking* (No. 1 is worst)	% of Total Sprawl Related to POPULATION GROWTH	% of Total Sprawl Related to GROWTH IN PER CAPITA LAND CONSUMPTION
Lorain–Elyria, OH	12.6	235	0%	100%
Los Angeles–Long Beach–Anaheim, CA	68.1	48	75%	25%
Los Lunas, NM	33.6	102	86%	14%
Louisville/Jefferson County, KY–IN	85.4	41	60%	40%
Lubbock, TX	21.9	162	62%	38%
Lynchburg, VA	14.3	214	95%	5%
Macon, GA	17.5	193	9%	91%
Madera, CA	-0.2	*	N/A	N/A
Madison, WI	37.1	94	70%	30%
Manchester, NH	15.1	205	51%	49%
Mandeville–Covington, LA	19.2	180	100%	0%
Manhattan, KS	5.0	358	57%	43%
Mankato, MN	5.6	345	84%	16%
Mansfield, OH	-0.4	*	N/A	N/A
Manteca, CA	8.2	295	100%	0%
Marysville, WA	8.3	293	100%	0%
Mauldin–Simpsonville, SC	27.7	128	100%	0%
Mayagüez, PR	-6.6	*	N/A	N/A
McAllen, TX	44.2	87	100%	0%
McKinney, TX	47.0	81	100%	0%

Urbanized Area	Total Sprawl (square miles), 2000-2010	Sprawl Ranking* (No. 1 is worst)	% of Total Sprawl Related to POPULATION GROWTH	% of Total Sprawl Related to GROWTH IN PER CAPITA LAND CONSUMPTION
Medford, OR	6.0	337	100%	0%
Memphis, TN–MS–AR	97.5	32	40%	60%
Merced, CA	11.6	250	77%	23%
Miami, FL	122.5	23	100%	%
Michigan City–La Porte, IN–MI	5.7	343	0%	100%
Middletown, NY	3.1	396	100%	0%
Middletown, OH	8.1	298	21%	79%
Midland, MI	14.2	215	47%	53%
Midland, TX	7.6	308	100%	0%
Milwaukee, WI	58.6	57	44%	56%
Minneapolis–St. Paul, MN–WI	127.6	21	78%	22%
Mission Viejo–Lake Forest–San Clemente, CA	13.6	218	96%	4%
Missoula, MT	8.8	286	77%	23%
Mobile, AL	12.0	247	48%	52%
Modesto, CA	5.8	342	100%	0%
Monessen–California, PA	8.2	296	78%	22%
Monroe, LA	3.5	385	54%	46%
Monroe, MI	2.5	402	0%	100%
Montgomery, AL	54.8	65	66%	34%
Morgantown, WV	3.4	390	100%	0%
Morristown, TN	14.4	211	30%	70%

Urbanized Area	Total Sprawl (square miles), 2000-2010	Sprawl Ranking* (No. 1 is worst)	% of Total Sprawl Related to POPULATION GROWTH	% of Total Sprawl Related to GROWTH IN PER CAPITA LAND CONSUMPTION
Mount Vernon, WA	2.8	399	100%	0%
Muncie, IN	3.7	379	0%	100%
Murfreesboro, TN	-11.0	*	N/A	N/A
Murrieta–Temecula–Menifee, CA	66.1	49	100%	0%
Muskegon, MI	12.7	232	35%	65%
Myrtle Beach–Socastee, SC–NC	89.5	37	88%	12%
Nampa, ID	23.4	152	100%	0%
Napa, CA	2.3	408	53%	47%
Nashua, NH–MA	44.6	86	49%	51%
Nashville-Davidson, TN	132.7	19	96%	4%
New Bedford, MA	-7.4	*	N/A	N/A
New Bern, NC	9.1	282	100%	0%
New Haven, CT	20.8	171	82%	18%
New Orleans, LA	53.6	68	0%	100%
New York–Newark, NY–NJ–CT	97.60	31	100%	0%
Newark, OH	6.7	327	48%	52%
Norman, OK	14.6	209	46%	54%
North Port–Port Charlotte, FL	29.6	118	100%	0%
Norwich–New London, CT–RI	29.0	122	89%	11%
Ocala, FL	23.1	155	100%	0%
Odessa, TX	5.7	344	100%	0%

Urbanized Area	Total Sprawl (square miles), 2000-2010	Sprawl Ranking* (No. 1 is worst)	% of Total Sprawl Related to POPULATION GROWTH	% of Total Sprawl Related to GROWTH IN PER CAPITA LAND CONSUMPTION
Ogden–Layton, UT	37.5	93	100%	0%
Oklahoma City, OK	88.3	39	59%	41%
Olympia–Lacey, WA	13.6	219	100%	0%
Omaha, NE–IA	44.9	85	81%	19%
Orlando, FL	144.5	15	96%	4%
Oshkosh, WI	4.2	369	32%	68%
Owensboro, KY	-4.7	*	N/A	N/A
Oxnard, CA	8.7	287	78%	22%
Palm Bay–Melbourne, FL	12.2	240	100%	0%
Palm Coast–Daytona Beach–Port Orange, FL	65.8	50	68%	32%
Panama City, FL	-9.8	*	N/A	N/A
Parkersburg, WV–OH	-8.1	*	N/A	N/A
Pascagoula, MS	5.5	348	0%	100%
Pensacola, FL–AL	13.3	226	84%	16%
Peoria, IL	20.4	175	50%	50%
Petaluma, CA	2.8	398	46%	54%
Philadelphia, PA–NJ–DE–MD	181.9	10	57%	43%
Phoenix–Mesa, AZ	347.6	4	61%	39%
Pine Bluff, AR	1.7	417	0%	100%
Pittsburgh, PA	52.8	70	0%	100%
Pittsfield, MA	-0.3	*	N/A	N/A
Pocatello, ID	1.1	424	100%	0%

Urbanized Area	Total Sprawl (square miles), 2000-2010	Sprawl Ranking* (No. 1 is worst)	% of Total Sprawl Related to POPULATION GROWTH	% of Total Sprawl Related to GROWTH IN PER CAPITA LAND CONSUMPTION
Ponce, PR	-13.9	*	N/A	N/A
Port Arthur, TX	59.7	56	35%	65%
Port Huron, MI	4.9	360	8%	92%
Port St. Lucie, FL	39.1	91	100%	0%
Porterville, CA	-0.6	*	N/A	N/A
Portland, ME	12.1	243	87%	13%
Portland, OR–WA	50.4	76	100%	0%
Portsmouth, NH–ME	49.8	77	71%	29%
Pottstown, PA	23.9	146	100%	0%
Poughkeepsie–Newburgh, NY–NJ	62.2	53	88%	12%
Prescott Valley–Prescott, AZ	12.2	242	100%	0%
Providence, RI–MA	41.4	89	18%	82%
Provo–Orem, UT	84.0	42	67%	33%
Pueblo, CO	20.5	173	31%	69%
Racine, WI	3.6	384	42%	58%
Raleigh, NC	198.5	8	100%	0%
Rapid City, SD	11.9	248	60%	40%
Reading, PA	3.2	394	100%	0%
Redding, CA	0.4	433	100%	0%
Reno, NV–CA	45.8	83	78%	22%
Richmond, VA	55.4	64	128%	0%

Urbanized Area	Total Sprawl (square miles), 2000-2010	Sprawl Ranking* (No. 1 is worst)	% of Total Sprawl Related to POPULATION GROWTH	% of Total Sprawl Related to GROWTH IN PER CAPITA LAND CONSUMPTION
Riverside–San Bernardino, CA	106.2	28	100%	0%
Roanoke, VA	12.2	241	60%	40%
Rochester, MN	10.3	261	72%	28%
Rochester, NY	29.3	119	39%	61%
Rock Hill, SC	34.4	100	91%	9%
Rockford, IL	13.9	216	98%	2%
Rocky Mount, NC	5.2	355	85%	15%
Rome, GA	6.8	326	28%	72%
Round Lake Beach–McHenry–Grayslake, IL–WI	19.5	179	100%	0%
Sacramento, CA	102.0	29	87%	13%
Saginaw, MI	-2.5	*	N/A	N/A
Salem, OR	6.7	328	100%	0%
Salinas, CA	4.1	372	36%	64%
Salisbury, MD–DE	27.8	126	100%	0%
Salt Lake City–West Valley City, UT	47.2	80	75%	25%
San Angelo, TX	1.1	425	100%	0%
San Antonio, TX	189.5	9	74%	26%
San Diego, CA	-49.9	*	N/A	N/A
San Francisco–Oakland, CA	-3.0	*	N/A	N/A
San Germán–Cabo Rojo–Sabana Grande, PR	5.2	354	81%	19%

Urbanized Area	Total Sprawl (square miles), 2000-2010	Sprawl Ranking* (No. 1 is worst)	% of Total Sprawl Related to POPULATION GROWTH	% of Total Sprawl Related to GROWTH IN PER CAPITA LAND CONSUMPTION
San Jose, CA	25.9	133	83%	17%
San Juan, PR	-25.0	*	N/A	N/A
San Luis Obispo, CA	5.6	346	32%	68%
San Marcos, TX	1.6	418	100%	0%
Santa Barbara, CA	-3.9	*	N/A	N/A
Santa Clarita, CA	22.4	160	100%	0%
Santa Cruz, CA	3.5	388	65%	35%
Santa Fe, NM	7.7	305	67%	33%
Santa Maria, CA	-6.4	*	N/A	N/A
Santa Rosa, CA	-4.0	*	N/A	N/A
Sarasota–Bradenton, FL	56.3	63	74%	26%
Saratoga Springs, NY	8.6	288	100%	0
Savannah, GA	63.1	51	46%	54%
Scranton, PA	12.1	244	0%	100%
Seaside–Monterey, CA	-2.0	*	N/A	N/A
Seattle, WA	56.7	61	100%	0%
Sebastian–Vero Beach South–Florida Ridge, FL	15.2	204	100%	0%
Sebring–Avon Park, FL	11.7	249	100%	0%
Sheboygan, WI	7.7	307	15%	85%
Sherman, TX	4.1	373	81%	19%
Shreveport, LA	30.6	113	45%	55%

Urbanized Area	Total Sprawl (square miles), 2000-2010	Sprawl Ranking* (No. 1 is worst)	% of Total Sprawl Related to POPULATION GROWTH	% of Total Sprawl Related to GROWTH IN PER CAPITA LAND CONSUMPTION
Sierra Vista, AZ	-50.2	*	N/A	N/A
Simi Valley, CA	4.4	366	73%	27%
Sioux City, IA–NE–SD	1.6	419	12%	88%
Sioux Falls, SD	18.5	186	68%	32%
Slidell, LA	2.4	403	100%	0%
South Bend, IN–MI	5.3	351	18%	82%
South Lyon–Howell, MI	7.8	302	100%	0%
Spartanburg, SC	52.5	73	68%	32%
Spokane, WA	21.2	166	100%	0%
Spring Hill, FL	31.3	107	100%	0%
Springfield, IL	5.2	352	85%	15%
Springfield, MA–CT	39.6	90	66%	34%
Springfield, MO	28.8	122	100%	0%
Springfield, OH	5.1	356	0%	100%
St. Augustine, FL	8.4	292	100%	0%
St. Cloud, MN	10.8	257	80%	20%
St. George, UT	11.3	255	100%	0%
St. Joseph, MO–KS	3.2	395	63%	37%
St. Louis, MO–IL	94.7	33	32%	68%
State College, PA	7.4	312	69%	31%
Staunton–Waynesboro, VA**	N/A	N/A	N/A	N/A

Urbanized Area	Total Sprawl (square miles), 2000-2010	Sprawl Ranking* (No. 1 is worst)	% of Total Sprawl Related to POPULATION GROWTH	% of Total Sprawl Related to GROWTH IN PER CAPITA LAND CONSUMPTION
Stockton, CA	18.2	188	76%	24%
Sumter, SC	21.0	169	33%	67%
Syracuse, NY	15.3	201	30%	70%
Tallahassee, FL	12.6	234	100%	0%
Tampa–St. Petersburg, FL	154.7	13	96%	4%
Temple, TX	12.8	231	85%	15%
Terre Haute, IN	10.2	264	73%	27%
Texarkana–Texarkana, TX–AR	6.4	332	75%	25%
Texas City, TX	17.5	194	38%	62%
Thousand Oaks, CA	-0.6	*	N/A	N/A
Titusville, FL	-1.5	*	N/A	N/A
Toledo, OH–MI	38.1	92	5%	95%
Topeka, KS	9.4	279	41%	59%
Tracy, CA	9.5	274	71%	29%
Trenton, NJ	13.4	225	73%	27%
Tucson, AZ	62.1	54	81%	19%
Tulsa, OK	74.5	46	64%	36%
Turlock, CA	7.1	321	100%	0%
Tuscaloosa, AL	13.5	222	100%	0%
Twin Rivers–Hightstown, NJ	5.3	350	0%	100%
Tyler, TX	32.8	103	55%	45%

Urbanized Area	Total Sprawl (square miles), 2000-2010	Sprawl Ranking* (No. 1 is worst)	% of Total Sprawl Related to POPULATION GROWTH	% of Total Sprawl Related to GROWTH IN PER CAPITA LAND CONSUMPTION
Uniontown–Connellsville, PA	-5.8	*	N/A	N/A
Urban Honolulu, HI	16.1	198	100%	0%
Utica, NY	7.4	313	27%	73%
Vacaville, CA	2.1	411	40%	60%
Valdosta, GA	17.8	190	76%	24%
Vallejo, CA	8.1	299	18%	82%
Victoria, TX	-22.0	*	N/A	N/A
Victorville–Hesperia, CA	42.9	88	100%	0%
Villas, NJ	-4.9	*	N/A	N/A
Vineland, NJ	0.3	436	100%	0%
Virginia Beach, VA	-11.4	*	N/A	N/A
Visalia, CA	23.5	150	100%	0%
Waco, TX	20.5	174	46%	54%
Waldorf, MD	21.8	163	100%	0%
Walla Walla, WA–OR	4.7	364	100%	0%
Warner Robins, GA	19.7	178	100%	0%
Washington, DC–VA–MD	164.96	12	100%	0%
Waterbury, CT	-7.6	*	N/A	N/A
Waterloo, IA	9.5	275	28%	72%
Watertown, NY	17.0	195	41%	59%
Watsonville, CA	3.7	378	57%	43%

Urbanized Area	Total Sprawl (square miles), 2000-2010	Sprawl Ranking* (No. 1 is worst)	% of Total Sprawl Related to POPULATION GROWTH	% of Total Sprawl Related to GROWTH IN PER CAPITA LAND CONSUMPTION
Wausau, WI	9.5	273	40%	60%
Weirton–Steubenville, WV–OH–PA	0.0	437	N/A	N/A
Wenatchee, WA	4.7	363	100%	0%
West Bend, WI	15.2	203	100%	0%
Westminster–Eldersburg, MD	4.3	368	100%	0%
Wheeling, WV–OH	-7.3	*	N/A	N/A
Wichita Falls, TX	-1.6	*	N/A	N/A
Wichita, KS	35.2	98	63%	37%
Williamsburg, VA**	N/A	N/A	N/A	N/A
Williamsport, PA	-0.5	*	N/A	N/A
Wilmington, NC	14.9	207	100%	0%
Winchester, VA	4.0	374	100%	0%
Winston-Salem, NC	71.2	47	100%	0%
Winter Haven, FL	30.2	114	100%	0%
Woodland, CA	3.5	386	36%	64%
Worcester, MA–CT	53.8	67	64%	36%
Yakima, WA	9.5	276	80%	20%
Yauco, PR	-17.3	*	N/A	N/A
York, PA	13.6	220	100%	0%
Youngstown, OH–PA	12.8	229	0%	100%
Yuba City, CA	3.3	392	100%	0%

Urbanized Area	Total Sprawl (square miles), 2000-2010	Sprawl Ranking* (No. 1 is worst)	% of Total Sprawl Related to POPULATION GROWTH	% of Total Sprawl Related to GROWTH IN PER CAPITA LAND CONSUMPTION
Yuma, AZ–CA	21.3	164	79%	21%
Zephyrhills, FL	2.3	410	100%	0%
All Urbanized Areas in USA	**13,586.2**	**N/A**	**73%**	**27%**

* These cities are not ranked because the Census Bureau reports they had no sprawl in the decade. In fact, they are shown as having less developed land in 2010 than in 2000. While it is possible for an Urbanized Area to reduce its developed land by converting large swaths of previously developed acreage to a natural state, the reduction shown in most of the Urbanized Areas was on paper only, the result of changes in calculations by the government.

**No comparable data for Census 2000

Source: U.S. Census Bureau, http://www.census.gov/geo/reference/ua/urban-rural-2010.html

Appendix F
Per Capita Land Consumption and Percent Sprawl in the Largest Urbanized Areas

Table F-1 – Per Capita Sprawl in USA's Most Populous Urbanized Areas, 2000-2010

Urbanized Area	Per Capita Land Consumption, 2010 (acres)	Per Capita Land Consumption, 2000 (acres)	% Change in Per Capita Land Consumption, 2000-2010
Akron, OH	0.37	0.35	6%
Albany–Schenectady, NY	0.32	0.33	-2%
Albuquerque, NM	0.22	0.24	-10%
Allentown–Bethlehem, PA–NJ	0.33	0.32	4%
Atlanta, GA	0.37	0.36	4%
Austin, TX	0.25	0.23	9%
Bakersfield, CA	0.17	0.18	-5%
Baltimore, MD	0.21	0.21	-1%
Baton Rouge, LA	0.39	0.37	5%
Birmingham, AL	0.45	0.38	20%
Boston, MA–NH–RI	0.29	0.28	4%
Bridgeport–Stamford, CT–NY	0.32	0.34	-4%
Buffalo, NY	0.26	0.24	8%
Charleston–N. Charleston, SC	0.34	0.35	-2%
Charlotte, NC–SC	0.38	0.37	4%
Chattanooga, TN–GA	0.50	0.54	-7%
Chicago, IL–IN	0.18	0.16	11%

Urbanized Area	Per Capita Land Consumption, 2010 (acres)	Per Capita Land Consumption, 2000 (acres)	% Change in Per Capita Land Consumption, 2000-2010
Cincinnati, OH–KY–IN	0.31	0.29	8%
Cleveland, OH	0.28	0.23	20%
Colorado Springs, CO[1]	0.21	0.27	-21%
Columbia, SC	0.44	0.41	8%
Columbus, OH	0.24	0.22	6%
Corpus Christi, TX	0.24	0.24	0%
Dallas–Fort Worth–Arlington, TX	0.22	0.22	2%
Dayton, OH	0.31	0.29	6%
Denver–Aurora, CO	0.18	0.16	12%
Des Moines, IA	0.29	0.24	18%
Detroit, MI	0.23	0.21	11%
El Paso, TX–NM	0.20	0.21	-4%
Flint, MI	0.42	0.41	5%
Fresno, CA	0.17	0.16	5%
Grand Rapids, MI	0.32	0.31	3%
Greenville, SC	0.51	0.48	7%
Harrisburg, PA	0.37	0.37	2%
Hartford, CT	0.36	0.35	1%
Honolulu, HI	0.14	0.14	-1%
Houston, TX	0.21	0.22	-1%
Indianapolis, IN	0.30	0.29	5%

Urbanized Area	Per Capita Land Consumption, 2010 (acres)	Per Capita Land Consumption, 2000 (acres)	% Change in Per Capita Land Consumption, 2000-2010
Jackson, MS	0.44	0.35	26%
Jacksonville, FL	0.32	0.30	7%
Kansas City, MO–KS	0.29	0.27	4%
Knoxville, TN	0.50	0.52	-3%
Lansing, MI	0.32	0.29	11%
Las Vegas–Henderson, NV	0.14	0.14	2%
Little Rock, AR	0.38	0.37	5%
Los Angeles–Long Beach–Santa Ana, CA	0.09	0.09	1%
Louisville, KY–IN	0.31	0.29	8%
McAllen, TX	0.31	0.38	-18%
Memphis, TN–MS–AR	0.30	0.26	14%
Miami, FL	0.14	0.15	-1%
Milwaukee, WI	0.25	0.24	7%
Minneapolis–St. Paul, MN	0.25	0.24	3%
Mobile, AL	0.44	0.42	3%
Nashville-Davidson, TN	0.37	0.37	1%
New Haven, CT	0.35	0.34	1%
New Orleans, LA	0.18	0.13	43%
New York–Newark, NY–NJ–CT	0.12	0.12	0%
Ogden–Layton, UT	0.25	0.28	-8%
Oklahoma City, OK	0.31	0.28	10%

Urbanized Area	Per Capita Land Consumption, 2010 (acres)	Per Capita Land Consumption, 2000 (acres)	% Change in Per Capita Land Consumption, 2000-2010
Omaha, NE–IA	0.24	0.23	4%
Orlando, FL	0.25	0.25	1%
Oxnard, CA	0.15	0.14	2%
Pensacola, FL–AL	0.44	0.43	1%
Philadelphia, PA–NJ–DE–MD	0.23	0.22	4%
Phoenix–Mesa, AZ	0.20	0.18	15%
Pittsburgh, PA	0.33	0.31	7%
Portland, OR–WA	0.18	0.19	-5%
Providence, RI–MA	0.29	0.27	7%
Raleigh, NC	0.37	0.38	-1%
Richmond, VA	0.33	0.34	-3%
Riverside–San Bernardino, CA	0.18	0.19	-3%
Rochester, NY	0.29	0.27	6%
Sacramento, CA	0.17	0.17	3%
St. Louis, MO–IL	0.27	0.26	8%
Salt Lake City, UT	0.17	0.17	5%
San Antonio, TX	0.22	0.20	11%
San Diego, CA[1]	0.16	0.19	-15%
San Francisco–Oakland, CA[1]	0.10	0.10	-2%
San Jose, CA	0.11	0.11	2%
Scranton, PA	0.29	0.26	9%

Urbanized Area	Per Capita Land Consumption, 2010 (acres)	Per Capita Land Consumption, 2000 (acres)	% Change in Per Capita Land Consumption, 2000-2010
Seattle, WA	0.21	0.23	-6%
Shreveport, LA	0.40	0.36	10%
Spokane, WA–ID	0.27	0.27	-1%
Springfield, MA–CT	0.36	0.34	4%
Stockton, CA	0.16	0.15	5%
Syracuse, NY	0.30	0.29	6%
Tampa–St. Petersburg, FL	0.25	0.25	1%
Toledo, OH–MI	0.30	0.26	18%
Trenton, NJ	0.23	0.22	4%
Tucson, AZ	0.27	0.26	4%
Tulsa, OK	0.33	0.30	9%
Virginia Beach, VA[1]	0.23	0.24	-5%
Washington, DC–VA–MD	0.18	0.19	-2%
Wichita, KS	0.29	0.27	7%
Worcester, MA–CT	0.40	0.37	7%
Youngstown, OH–PA	0.40	0.35	14%
All 96 (formerly 100) Largest UAs	0.22*	0.21*	5%*

Source: U.S. Census Bureau data, Urbanized Areas 2010

* The "All 96" data were calculated by aggregating the land areas and populations and dividing the former by the latter.

Appendix G
Population Growth and Rank in All 497 Urbanized Areas, 2000-2010

Table G-1. Alphabetical List of 497 Urbanized Areas, their Population Growth from 2000 to 2010, and ranking by aggregate amount and percentage change

Urbanized Area	Total Population Growth, 2000-2010	Ranking by Total Population Growth	% Population Increase (or change) from 2000 to 2010	Ranking by Percentage Population Increase
Aberdeen--Bel Air South--Bel Air North, MD	39,153	136	22.4%	165
Abilene, TX	3,380	405	3.2%	407
Aguadilla--Isabela--San Sebastián, PR	7,110	348	2.4%	418
Akron, OH	-716	*	-0.1%	*
Albany, GA	329	438	0.3%	438
Albany, OR	14,804	273	35.1%	75
Albany--Schenectady, NY	36,015	145	6.4%	356
Albuquerque, NM	143,127	36	23.9%	152
Alexandria, LA	4,300	391	5.5%	366
Allentown, PA--NJ	88,243	71	15.3%	231
Alton, IL--MO	-765	*	-0.9%	*
Altoona, PA	-2,590	*	-3.1%	*
Amarillo, TX	17,339	253	9.7%	312
Ames, IA	9,712	323	19.2%	191

Urbanized Area	Total Population Growth, 2000-2010	Ranking by Total Population Growth	% Population Increase (or change) from 2000 to 2010	Ranking by Percentage Population Increase
Anchorage, AK	25,499	197	11.3%	286
Anderson, IN	-8,905	*	-9.2%	*
Anderson, SC	5,266	377	7.5%	350
Ann Arbor, MI	22,118	216	7.8%	349
Anniston--Oxford, AL	3,956	398	5.2%	370
Antioch, CA	60,043	98	27.6%	119
Appleton, WI	28,471	179	15.2%	235
Arecibo, PR	-6,472	*	-4.4%	*
Arroyo Grande--Grover Beach, CA	4,450	390	9.4%	319
Asheville, NC	59,078	101	26.7%	124
Athens-Clarke County, GA	22,272	213	20.9%	175
Atlanta, GA	1,015,579	2	29.0%	112
Atlantic City, NJ	21,222	224	9.3%	320
Auburn, AL	14,604	274	24.3%	146
Augusta-Richmond County, GA--SC	51,157	115	15.2%	233
Austin, TX	460,496	10	51.1%	34
Avondale--Goodyear, AZ	129,166	41	190.3%	2
Bakersfield, CA	127,869	45	32.3%	90
Baltimore, MD	127,309	47	6.1%	359
Bangor, ME	2,227	424	3.8%	392

Urbanized Area	Total Population Growth, 2000-2010	Ranking by Total Population Growth	% Population Increase (or change) from 2000 to 2010	Ranking by Percentage Population Increase
Barnstable Town, MA	3,028	411	1.2%	431
Baton Rouge, LA	115,290	54	24.1%	149
Battle Creek, MI	-742	*	-0.9%	*
Bay City, MI	-3,463	*	-4.7%	*
Beaumont, TX	8,618	333	6.2%	358
Beckley, WV	17,162	254	36.6%	66
Bellingham, WA	30,149	172	35.8%	71
Beloit, WI--IL	7,373	346	13.1%	258
Bend, OR	26,269	188	45.7%	46
Benton Harbor--St. Joseph--Fair Plain, MI	-723	*	-1.2%	*
Billings, MT	14,456	276	14.4%	245
Binghamton, NY--PA	-800	*	-0.5%	*
Birmingham, AL	85,880	74	12.9%	260
Bismarck, ND	6,964	350	9.3%	321
Blacksburg, VA	31,306	168	54.7%	30
Bloomington, IN	16,201	262	17.5%	209
Bloomington--Normal, IL	20,185	229	18.0%	205
Bloomsburg--Berwick, PA	5,373	376	11.1%	288
Boise City, ID	77,059	81	28.3%	115
Bonita Springs, FL	89,047	69	40.3%	54
Boston, MA--NH--RI	148,535	35	3.7%	394

Urbanized Area	Total Population Growth, 2000-2010	Ranking by Total Population Growth	% Population Increase (or change) from 2000 to 2010	Ranking by Percentage Population Increase
Boulder, CO	2,292	423	2.0%	421
Bowling Green, KY	19,992	230	34.3%	80
Bremerton, WA	20,610	227	11.6%	283
Bridgeport--Stamford, CT--NY	34,421	156	3.9%	390
Bristol--Bristol, TN--VA	11,029	308	18.9%	195
Brownsville, TX	51,809	113	31.3%	94
Brunswick, GA	-629	*	-1.2%	*
Buffalo, NY	-40,797	*	-4.2%	*
Burlington, NC	25,663	196	27.2%	121
Burlington, VT	3,375	406	3.2%	404
Camarillo, CA	8,974	327	14.3%	246
Canton, OH	12,650	295	4.8%	377
Cape Coral, FL	200,533	30	60.8%	23
Cape Girardeau, MO--IL	5,932	366	12.6%	263
Carbondale, IL**	N/A	N/A	N/A	N/A
Carson City, NV	-184	*	-0.3%	*
Cartersville, GA	18,792	242	55.8%	27
Casa Grande, AZ	21,516	219	72.2%	14
Casper, WY	6,829	351	11.8%	275
Cedar Rapids, IA	22,510	211	14.5%	244
Chambersburg, PA	13,015	289	34.4%	79

Urbanized Area	Total Population Growth, 2000-2010	Ranking by Total Population Growth	% Population Increase (or change) from 2000 to 2010	Ranking by Percentage Population Increase
Champaign, IL	423	220	17.3%	214
Charleston, WV	-29,792	*	-16.3%	*
Charleston--North Charleston, SC	124,994	49	29.5%	105
Charlotte, NC--SC	490,515	9	64.6%	19
Charlottesville, VA	10,910	309	13.4%	255
Chattanooga, TN--GA	37,603	141	11.0%	291
Cheyenne, WY	5,386	375	7.9%	347
Chicago, IL--IN	300,304	20	3.6%	395
Chico, CA	8,955	329	10.0%	309
Cincinnati, OH--KY--IN	121,565	52	8.1%	344
Clarksville, TN--KY	36,880	143	30.3%	101
Cleveland, OH	-5,974	*	-0.3%	*
Cleveland, TN	8,585	334	14.8%	243
Coeur d'Alene, ID	23,578	206	31.5%	92
College Station--Bryan, TX	38,845	138	29.3%	108
Colorado Springs, CO	93,287	65	20.0%	184
Columbia, MO	25,969	194	26.3%	126
Columbia, SC	129,240	40	30.7%	97
Columbus, GA--AL	11,278	306	4.7%	380
Columbus, IN	4,706	386	9.4%	318

Urbanized Area	Total Population Growth, 2000-2010	Ranking by Total Population Growth	% Population Increase (or change) from 2000 to 2010	Ranking by Percentage Population Increase
Columbus, OH	234,842	26	20.7%	179
Concord, CA	63,344	93	11.5%	284
Concord, NC	99,824	58	86.8%	9
Conroe--The Woodlands, TX	150,493	34	168.3%	3
Conway, AR	21,386	221	48.7%	37
Corpus Christi, TX	26,144	190	8.9%	325
Corvallis, OR	4,204	392	7.2%	353
Cumberland, MD--WV--PA	-216	*	-0.4%	*
Dallas--Fort Worth--Arlington, TX	976,233	3	23.6%	154
Dalton, GA	27,573	185	47.8%	39
Danbury, CT--NY	13,681	280	8.9%	326
Danville, IL	-2,227	*	-4.2%	*
Daphne--Fairhope, AL	19,273	234	50.6%	35
Davenport, IA--IL	9,425	326	3.5%	399
Davis, CA	6,772	353	10.3%	306
Dayton, OH	20,647	226	2.9%	412
Decatur, AL	18,121	246	34.6%	77
Decatur, IL	-2,591	*	-2.7%	*
DeKalb, IL	12,740	292	22.8%	160

Urbanized Area	Total Population Growth, 2000-2010	Ranking by Total Population Growth	% Population Increase (or change) from 2000 to 2010	Ranking by Percentage Population Increase
Delano, CA	14,860	271	37.6%	62
Deltona, FL	34,456	155	23.3%	158
Denton--Lewisville, TX	66,351	91	22.1%	167
Denver--Aurora, CO	389,314	13	19.6%	188
Des Moines, IA	79,565	78	21.5%	171
Detroit, MI	-169,287	*	-4.3%	*
Dothan, AL	7,989	339	13.1%	257
Dover, DE	45,725	126	70.3%	16
Dover--Rochester, NH--ME	7,631	344	9.5%	315
Dubuque, IA--IL	2,567	418	3.9%	389
Duluth, MN--WI	2,113	426	1.8%	425
Durham, NC	59,806	99	20.8%	177
East Stroudsburg, PA--NJ	13,652	281	33.6%	84
Eau Claire, WI	11,459	304	12.5%	266
El Centro--Calexico, CA	54,718	110	103.3%	6
El Paso de Robles (Paso Robles)--Atascadero, CA	10,326	317	18.9%	196
El Paso, TX--NM	128,285	42	19.0%	192
Elizabethtown--Radcliff, KY	8,963	328	13.9%	251
Elkhart, IN--MI	12,366	300	9.4%	316
Elmira, NY	824	434	1.2%	432
Erie, PA	1,807	428	0.9%	433

Urbanized Area	Total Population Growth, 2000-2010	Ranking by Total Population Growth	% Population Increase (or change) from 2000 to 2010	Ranking by Percentage Population Increase
Eugene, OR	23,372	207	10.4%	302
Evansville, IN--KY	17,362	252	8.2%	341
Fairbanks, AK	12,587	297	24.2%	148
Fairfield, CA	21,237	223	18.9%	194
Fajardo, PR	6,630	355	8.4%	333
Fargo, ND--MN	34,199	157	24.0%	150
Farmington, NM	-245	*	-0.5%	*
Fayetteville, NC	33,914	159	12.3%	269
Fayetteville--Springdale--Rogers, AR--MO	122,498	51	71.0%	15
Flagstaff, AZ	14,907	270	26.1%	130
Flint, MI	-8,878	*	-2.4%	*
Florence, AL	5,775	369	8.1%	343
Florence, SC	22,243	214	33.0%	87
Florida--Imbéry--Barceloneta, PR	2,936	412	4.3%	383
Fond du Lac, WI	4,843	384	9.7%	313
Fort Collins, CO	57,708	105	27.9%	118
Fort Smith, AR--OK	16,477	258	15.5%	229
Fort Walton Beach--Navarre--Wright, FL	39,176	135	25.7%	132
Fort Wayne, IN	25,733	195	8.9%	324
Frederick, MD	22,432	212	18.8%	197

Urbanized Area	Total Population Growth, 2000-2010	Ranking by Total Population Growth	% Population Increase (or change) from 2000 to 2010	Ranking by Percentage Population Increase
Fredericksburg, VA	44,136	128	45.5%	47
Fresno, CA	99,705	59	18.0%	204
Gadsden, AL	2,463	420	4.0%	387
Gainesville, FL	28,273	181	17.7%	206
Gainesville, GA	42,166	132	47.6%	41
Gastonia, NC--SC	28,088	183	19.9%	185
Gilroy--Morgan Hill, CA	13,793	279	16.3%	225
Glens Falls, NY	7,816	341	13.6%	253
Goldsboro, NC	3,139	410	5.4%	368
Grand Forks, ND--MN	4,697	387	8.3%	338
Grand Island, NE	4,941	382	10.9%	292
Grand Junction, CO	35,762	147	38.7%	59
Grand Rapids, MI	30,855	169	5.7%	362
Grants Pass, OR	6,709	354	15.3%	232
Great Falls, MT	820	435	1.3%	430
Greeley, CO	23,946	204	25.5%	135
Green Bay, WI	19,204	235	10.3%	307
Greensboro, NC	43,926	129	16.4%	224
Greenville, NC	33,739	161	40.1%	55
Greenville, SC	98,298	62	32.5%	88

Urbanized Area	Total Population Growth, 2000-2010	Ranking by Total Population Growth	% Population Increase (or change) from 2000 to 2010	Ranking by Percentage Population Increase
Guayama, PR	2,400	421	3.1%	409
Gulfport, MS	3,194	408	1.6%	428
Hagerstown, MD--WV--PA	62,370	95	51.8%	32
Hammond, LA	24,171	203	55.6%	28
Hanford, CA	18,302	245	26.3%	127
Hanover, PA	17,605	250	36.2%	70
Harlingen, TX	24,893	200	22.5%	164
Harrisburg, PA	81,692	77	22.5%	163
Harrisonburg, VA	14,137	278	26.9%	123
Hartford, CT	73,324	84	8.6%	330
Hattiesburg, MS	18,893	240	30.7%	96
Hazleton, PA	5,081	380	9.8%	310
Hemet, CA	46,179	124	39.4%	56
Hickory, NC	24,387	202	13.0%	259
High Point, NC	33,641	162	25.3%	136
Hilton Head Island, SC	34,598	154	100.6%	7
Hinesville, GA	1,096	433	2.2%	420
Holland, MI	8,020	338	8.7%	328
Homosassa Springs--Beverly Hills--Citrus Springs, FL**	N/A	N/A	N/A	N/A
Hot Springs, AR	3,358	407	6.5%	355

Urbanized Area	Total Population Growth, 2000-2010	Ranking by Total Population Growth	% Population Increase (or change) from 2000 to 2010	Ranking by Percentage Population Increase
Houma, LA	18,946	239	15.0%	238
Houston, TX	1,121,823	1	29.4%	107
Huntington, WV--KY--OH	25,087	199	14.1%	249
Huntsville, AL	73,439	83	34.4%	78
Idaho Falls, ID	23,760	205	35.5%	73
Indianapolis, IN	268,564	23	22.0%	168
Indio--Cathedral City, CA	90,724	68	35.6%	72
Iowa City, IA	21,374	222	25.1%	138
Ithaca, NY	133	439	0.3%	439
Jackson, MI	2,007	427	2.3%	419
Jackson, MS	58,841	102	20.1%	183
Jackson, TN	6,794	352	10.4%	301
Jacksonville, FL	182,924	31	20.7%	178
Jacksonville, NC	9,905	322	10.4%	303
Janesville, WI	3,624	402	5.5%	365
Jefferson City, MO	4,819	385	9.0%	323
Johnson City, TN	17,959	248	17.5%	208
Johnstown, PA	-7,099	*	-9.3%	*
Jonesboro, AR	13,615	282	26.3%	128
Joplin, MO	10,686	313	14.8%	241

Urbanized Area	Total Population Growth, 2000-2010	Ranking by Total Population Growth	% Population Increase (or change) from 2000 to 2010	Ranking by Percentage Population Increase
Juana Díaz, PR	26,093	191	47.6%	40
Kahului, HI	15,435	268	38.1%	61
Kailua (Honolulu County)--Kaneohe, HI	-4,048	*	-3.4%	*
Kalamazoo, MI	21,742	218	11.6%	282
Kankakee, IL	16,853	255	25.9%	131
Kansas City, MO--KS	157,673	33	11.6%	281
Kennewick--Pasco, WA	57,124	107	37.1%	63
Kenosha, WI--IL	13,122	288	11.8%	276
Killeen, TX	49,654	119	29.6%	104
Kingsport, TN--VA	10,805	312	11.3%	287
Kingston, NY	3,984	397	7.5%	351
Kissimmee, FL	127,404	46	68.3%	17
Knoxville, TN	138,866	37	33.1%	86
Kokomo, IN	-1,557	*	-2.4%	*
La Crosse, WI--MN	10,902	310	12.1%	270
Lady Lake--The Villages, FL	62,270	96	122.8%	4
Lafayette, IN	21,987	217	17.5%	210
Lafayette, LA	74,641	82	41.9%	52
Lafayette--Louisville--Erie, CO	19,020	238	31.5%	93
Lake Charles, LA	10,463	316	7.9%	348

Urbanized Area	Total Population Growth, 2000-2010	Ranking by Total Population Growth	% Population Increase (or change) from 2000 to 2010	Ranking by Percentage Population Increase
Lake Havasu City, AZ	10,640	314	24.9%	139
Lake Jackson--Angleton, TX	1,414	432	1.9%	422
Lakeland, FL	63,109	94	31.6%	91
Lancaster, PA	78,450	79	24.3%	147
Lancaster--Palmdale, CA	77,687	80	29.5%	106
Lansing, MI	13,500	283	4.5%	381
Laredo, TX	60,144	97	34.3%	81
Las Cruces, NM	24,414	201	23.4%	156
Las Vegas--Henderson, NV	571,654	7	43.5%	50
Lawrence, KS	8,406	336	10.6%	299
Lawton, OK	4,901	383	5.5%	367
Lebanon, PA	13,405	284	21.1%	174
Lee's Summit, MO	29,796	173	53.9%	31
Leesburg--Eustis--Tavares, FL	33,840	160	34.7%	76
Leominster--Fitchburg, MA	4,017	396	3.6%	396
Lewiston, ID--WA	1,607	430	3.2%	405
Lewiston, ME	8,830	331	17.5%	211
Lexington Park--California--Chesapeake Ranch Estates, MD	15,679	266	36.3%	69
Lexington-Fayette, KY	39,269	134	15.7%	228
Lima, OH	-1,219	*	-1.7%	*
Lincoln, NE	32,137	166	14.2%	248

Urbanized Area	Total Population Growth, 2000-2010	Ranking by Total Population Growth	% Population Increase (or change) from 2000 to 2010	Ranking by Percentage Population Increase
Little Rock, AR	71,057	88	19.7%	186
Livermore, CA	6,422	359	8.5%	332
Lodi, CA	-14,997	*	-17.9%	*
Logan, UT	18,796	241	24.7%	142
Lompoc, CA	-4,158	*	-7.5%	*
Longmont, CO	17,968	247	24.6%	143
Longview, TX	20,814	225	26.7%	125
Longview, WA--OR	3,509	403	5.8%	361
Lorain--Elyria, OH	-12,630	*	-6.5%	*
Los Angeles--Long Beach--Anaheim, CA	361,509	15	3.1%	410
Los Lunas, NM	27,657	184	76.6%	11
Louisville/Jefferson County, KY--IN	108,964	56	12.6%	264
Lubbock, TX	35,131	152	17.4%	213
Lynchburg, VA	17,922	249	18.2%	202
Macon, GA	2,400	422	1.8%	426
Madera, CA	20,386	228	35.1%	74
Madison, WI	72,128	86	21.9%	169
Manchester, NH	14,828	272	10.3%	305
Mandeville--Covington, LA	26,059	192	41.5%	53
Manhattan, KS	7,951	340	17.0%	215

Urbanized Area	Total Population Growth, 2000-2010	Ranking by Total Population Growth	% Population Increase (or change) from 2000 to 2010	Ranking by Percentage Population Increase
Mankato, MN	10,469	315	22.2%	156
Mansfield, OH	-4,448	*	-5.6%	*
Manteca, CA	32,402	165	63.3%	22
Marysville, WA	30,768	170	26.9%	122
Mauldin--Simpsonville, SC	42,746	130	54.9%	29
Mayagüez, PR	-9,778	*	-8.2%	*
McAllen, TX	205,681	29	39.3%	57
McKinney, TX	115,505	53	211.8%	1
Medford, OR	25,301	198	19.7%	187
Memphis, TN--MS--AR	87,970	73	9.1%	322
Merced, CA	26,486	186	24.0%	151
Miami, FL	583,343	6	11.9%	273
Michigan City--La Porte, IN--MI	-174	*	-0.3%	*
Middletown, NY	8,310	337	16.6%	221
Middletown, OH	3,148	409	3.3%	401
Midland, MI	9,627	324	19.5%	190
Midland, TX	18,586	243	18.7%	198
Milwaukee, WI	67,563	89	5.2%	371
Minneapolis--St. Paul, MN--WI	262,297	25	11.0%	290
Mission Viejo--Lake Forest--San Clemente, CA	50,666	116	9.5%	314

Urbanized Area	Total Population Growth, 2000-2010	Ranking by Total Population Growth	% Population Increase (or change) from 2000 to 2010	Ranking by Percentage Population Increase
Missoula, MT	12,666	294	18.2%	201
Mobile, AL	8,578	335	2.7%	415
Modesto, CA	47,227	122	15.2%	234
Monessen--California, PA	9,578	325	17.0%	217
Monroe, LA	2,715	415	2.4%	417
Monroe, MI	-1,913	*	-3.6%	*
Montgomery, AL	67,015	90	34.0%	82
Morgantown, WV	14,353	277	25.6%	134
Morristown, TN	4,668	388	8.6%	331
Mount Vernon, WA	11,792	302	23.0%	159
Muncie, IN	-93	*	-0.1%	*
Murfreesboro, TN	-2,627	*	-1.9%	*
Murrieta--Temecula--Menifee, CA	211,736	28	92.1%	8
Muskegon, MI	6,551	357	4.2%	385
Myrtle Beach--Socastee, SC--NC	92,320	66	75.1%	12
Nampa, ID	55,590	109	58.0%	25
Napa, CA	4,046	395	5.1%	374
Nashua, NH--MA	29,245	176	14.8%	240
Nashville-Davidson, TN	219,652	27	29.3%	109
New Bedford, MA	2,713	416	1.9%	423
New Bern, NC	11,715	303	30.2%	102

Urbanized Area	Total Population Growth, 2000-2010	Ranking by Total Population Growth	% Population Increase (or change) from 2000 to 2010	Ranking by Percentage Population Increase
New Haven, CT	31,525	167	5.9%	360
New Orleans, LA	-109,580	*	-10.9%	*
New York--Newark, NY--NJ--CT	551,434	8	3.0%	411
Newark, OH	6,067	365	8.7%	329
Norman, OK	17,420	251	20.1%	182
North Port--Port Charlotte, FL	47,120	123	38.5%	60
Norwich--New London, CT--RI	36,030	144	20.8%	176
Ocala, FL	50,367	118	47.3%	42
Odessa, TX	15,010	269	13.5%	254
Ogden--Layton, UT	128,093	43	30.7%	98
Oklahoma City, OK	114,502	55	15.3%	230
Olympia--Lacey, WA	32,791	163	22.8%	161
Omaha, NE--IA	98,385	61	15.7%	227
Orlando, FL	353,085	16	30.5%	100
Oshkosh, WI	3,425	404	4.8%	376
Owensboro, KY	2,878	413	4.3%	384
Oxnard, CA	29,669	174	8.8%	327
Palm Bay--Melbourne, FL	59,502	100	15.1%	236
Palm Coast--Daytona Beach--Port Orange, FL	93,711	64	36.7%	65
Panama City, FL	10,861	311	8.2%	339
Parkersburg, WV--OH	-18,376	*	-21.5%	*

Urbanized Area	Total Population Growth, 2000-2010	Ranking by Total Population Growth	% Population Increase (or change) from 2000 to 2010	Ranking by Percentage Population Increase
Pascagoula, MS	-3,762	*	-6.9%	*
Pensacola, FL--AL	16,284	261	5.0%	375
Peoria, IL	19,749	231	8.0%	346
Petaluma, CA	4,120	394	6.9%	354
Philadelphia, PA--NJ--DE--MD	292,488	21	5.7%	364
Phoenix--Mesa, AZ	722,065	4	24.8%	140
Pine Bluff, AR	-5,089	*	-8.7%	*
Pittsburgh, PA	-19,283	*	-1.1%	*
Pittsfield, MA	6,352	362	12.0%	271
Pocatello, ID	7,311	347	11.7%	279
Ponce, PR	-45,498	*	-23.3%	*
Port Arthur, TX	38,494	140	33.6%	85
Port Huron, MI	620	436	0.7%	435
Port St. Lucie, FL	105,273	57	38.9%	58
Porterville, CA	10,011	320	16.6%	220
Portland, ME	15,834	265	8.4%	335
Portland, OR--WA	266,760	24	16.9%	218
Portsmouth, NH--ME	37,288	142	73.2%	13
Pottstown, PA	34,085	158	46.3%	45
Poughkeepsie--Newburgh, NY--NJ	71,584	87	20.3%	180

Urbanized Area	Total Population Growth, 2000-2010	Ranking by Total Population Growth	% Population Increase (or change) from 2000 to 2010	Ranking by Percentage Population Increase
Prescott Valley--Prescott, AZ	22,835	209	36.9%	64
Providence, RI--MA	16,408	259	1.4%	429
Provo--Orem, UT	179,139	32	59.0%	24
Pueblo, CO	13,199	287	10.7%	294
Racine, WI	4,155	393	3.2%	403
Raleigh, NC	343,364	18	63.4%	21
Rapid City, SD	14,471	275	21.7%	170
Reading, PA	25,990	193	293	10.8%
Redding, CA	12,464	298	11.8%	274
Reno, NV--CA	88,452	69	29.1%	111
Richmond, VA	134,720	38	16.5%	223
Riverside--San Bernardino, CA	425,850	12	28.3%	116
Roanoke, VA	12,669	293	6.4%	357
Rochester, MN	16,406	260	18.0%	203
Rochester, NY	26,176	189	3.8%	393
Rock Hill, SC	34,989	153	50.0%	36
Rockford, IL	26,449	187	9.8%	311
Rocky Mount, NC	6,586	356	10.7%	296
Rome, GA	2,564	419	4.4%	382
Round Lake Beach--McHenry--Grayslake, IL--WI	63,525	92	28.0%	117
Sacramento, CA	330,136	19	23.7%	153

Urbanized Area	Total Population Growth, 2000-2010	Ranking by Total Population Growth	% Population Increase (or change) from 2000 to 2010	Ranking by Percentage Population Increase
Saginaw, MI	-14,720	*	-10.4%	*
Salem, OR	29,403	175	14.2%	247
Salinas, CA	5,636	372	3.2%	408
Salisbury, MD--DE	38,655	139	65.1%	18
Salt Lake City--West Valley City, UT	133,593	39	15.1%	237
San Angelo, TX	5,015	381	5.7%	363
San Antonio, TX	430,656	11	32.4%	89
San Diego, CA	282,310	22	10.6%	298
San Francisco--Oakland, CA	52,607	112	1.6%	427
San Germán--Cabo Rojo--Sabana Grande, PR	5,260	378	4.7%	379
San Jose, CA	126,184	48	8.2%	340
San Juan, PR	-68,270	*	-3.1%	*
San Luis Obispo, CA	5,721	371	10.7%	295
San Marcos, TX	5,493	374	11.6%	280
Santa Barbara, CA	-402	*	-0.2%	*
Santa Clarita, CA	88,172	72	51.7%	33
Santa Cruz, CA	6,355	361	4.0%	386
Santa Fe, NM	8,947	330	11.1%	289
Santa Maria, CA	10,150	318	8.4%	334
Santa Rosa, CA	22,823	210	8.0%	345

Urbanized Area	Total Population Growth, 2000-2010	Ranking by Total Population Growth	% Population Increase (or change) from 2000 to 2010	Ranking by Percentage Population Increase
Sarasota--Bradenton, FL	84,031	76	15.0%	239
Saratoga Springs, NY	12,928	290	25.3%	137
Savannah, GA	51,791	114	24.8%	141
Scranton, PA	-3,735	*	-1.0%	*
Seaside--Monterey, CA	-11,266	480	-9.0%	483
Seattle, WA	347,188	17	12.8%	262
Sebastian--Vero Beach South--Florida Ridge, FL	28,460	180	23.5%	155
Sebring--Avon Park, FL	16,502	257	36.6%	67
Sheboygan, WI	2,713	417	4.0%	388
Sherman, TX	5,732	370	10.2%	308
Shreveport, LA	23,104	208	8.4%	336
Sierra Vista, AZ	5,804	368	12.4%	268
Simi Valley, CA	12,861	291	11.5%	285
Sioux City, IA--NE--SD	375	437	0.4%	437
Sioux Falls, SD	32,508	164	26.2%	129
Slidell, LA	11,225	307	14.0%	250
South Bend, IN--MI	1,667	429	0.6%	436
South Lyon--Howell, MI	13,370	285	12.6%	265
Spartanburg, SC	35,728	149	24.6%	144
Spokane, WA	52,989	111	15.8%	226

Urbanized Area	Total Population Growth, 2000-2010	Ranking by Total Population Growth	% Population Increase (or change) from 2000 to 2010	Ranking by Percentage Population Increase
Spring Hill, FL	46,027	125	45.0%	48
Springfield, IL	-800	*	5.1%	*
Springfield, MA--CT	47,690	120	8.3%	337
Springfield, MO	58,720	104	27.3%	120
Springfield, OH	-4,428	*	-4.9%	*
St. Augustine, FL	15,654	267	29.3%	110
St. Cloud, MN	19,316	233	21.2%	173
St. George, UT	35,740	148	57.1%	26
St. Joseph, MO--KS	3,945	399	5.1%	372
St. Louis, MO--IL	73,044	85	3.5%	397
State College, PA	16,153	263	22.7%	162
Staunton--Waynesboro, VA**	N/A	N/A	N/A	N/A
Stockton, CA	57,191	106	18.3%	200
Sumter, SC	8,787	332	13.7%	252
Syracuse, NY	10,050	319	2.5%	416
Tallahassee, FL	35,963	146	17.6%	207
Tampa--St. Petersburg, FL	379,431	14	18.4%	199
Temple, TX	18,453	244	25.7	133
Terre Haute, IN	13,366	286	16.8%	219
Texarkana--Texarkana, TX--AR	5,874	367	8.1%	342

Urbanized Area	Total Population Growth, 2000-2010	Ranking by Total Population Growth	% Population Increase (or change) from 2000 to 2010	Ranking by Percentage Population Increase
Texas City, TX	9,966	321	10.3%	304
Thousand Oaks, CA	3,821	401	1.8%	424
Titusville, FL	1,464	431	2.8%	414
Toledo, OH--MI	4,635	389	0.9%	434
Topeka, KS	7,592	345	5.3%	369
Tracy, CA	28,549	178	48.4%	38
Trenton, NJ	28,196	182	10.5%	300
Tucson, AZ	122,743	50	17.0%	216
Tulsa, OK	97,150	63	17.4%	212
Turlock, CA	30,397	171	43.7%	49
Tuscaloosa, AL	22,226	215	19.0%	193
Twin Rivers--Hightstown, NJ	-5,940	*	-8.5%	*
Tyler, TX	28,753	177	28.3%	114
Uniontown--Connellsville, PA	-7,072	*	-12.1%	*
Urban Honolulu, HI	84,277	75	11.7%	278
Utica, NY	3,919	400	3.5%	400
Vacaville, CA	2,877	414	3.2%	406
Valdosta, GA	19,438	232	33.7%	83
Vallejo, CA	6,107	364	3.8%	391
Victoria, TX	2,154	425	3.5%	398

Urbanized Area	Total Population Growth, 2000-2010	Ranking by Total Population Growth	% Population Increase (or change) from 2000 to 2010	Ranking by Percentage Population Increase
Victorville--Hesperia, CA	128,018	44	63.9%	20
Villas, NJ	-1,259	*	-2.4%	*
Vineland, NJ	6,535	358	7.4%	352
Virginia Beach, VA	45,227	127	3.2%	402
Visalia, CA	99,410	60	82.8%	10
Waco, TX	19,180	236	12.5%	267
Waldorf, MD	35,154	151	47.0%	43
Walla Walla, WA--OR	12,439	299	28.7%	113
Warner Robins, GA	42,271	131	46.5%	44
Washington, DC--VA--MD	652,850	5	16.6%	222
Waterbury, CT	5,509	373	2.9%	413
Waterloo, IA	5,120	379	4.7%	378
Watertown, NY	11,406	305	24.6%	145
Watsonville, CA	7,034	349	10.6%	297
Wausau, WI	6,411	360	9.4%	317
Weirton--Steubenville, WV--OH--PA	-2,821	*	-3.8%	*
Wenatchee, WA	11,802	301	21.3%	172
West Bend, WI	35,156	150	105.6%	5
Westminster--Eldersburg, MD	7,680	343	11.8%	277
Wheeling, WV--OH	-6,364	*	-7.3%	*

Urbanized Area	Total Population Growth, 2000-2010	Ranking by Total Population Growth	% Population Increase (or change) from 2000 to 2010	Ranking by Percentage Population Increase
Wichita Falls, TX	41	440	0.0%	440
Wichita, KS	50,569	117	12.0%	272
Williamsburg, VA**	N/A	N/A	N/A	N/A
Williamsport, PA	-2,551	*	-4.4%	*
Wilmington, NC	58,808	103	36.5%	68
Winchester, VA	15,890	264	29.7%	103
Winston-Salem, NC	91,734	67	30.7%	99
Winter Haven, FL	47,365	121	30.8%	95
Woodland, CA	6,345	363	12.9%	261
Worcester, MA--CT	56,632	108	13.2%	256
Yakima, WA	16,718	256	14.8%	242
Yauco, PR	-17,125	*	-15.9%	*
York, PA	39,142	137	20.3%	181
Youngstown, OH--PA	-29,887	*	-7.2%	*
Yuba City, CA	19,074	237	19.5%	189
Yuma, AZ--CA	40,317	133	42.5%	51
Zephyrhills, FL	12,630	296	23.4%	157
All Urbanized Areas in USA	**26,168,518**	**N/A**	**13.3%**	**N/A**

*These Urbanized Areas are not ranked because they had no population growth.

**No comparable data for Census 2000
Source: U.S. Census Bureau, http://www.census.gov/geo/reference/ua/urban-rural-2010.html

Appendix H
Population Growth and Rank in 48 Contiguous States, 1982-2010 (Table H-1) and 2002-2010 (Table H-2)

Table H-1. Alphabetical List of 48 Contiguous States, their Population Growth from 1982 to 2010, and ranking by aggregate or absolute amount and percentage change

State	Population 1982	Population 2010	Total Population Growth, 1982-2010	Ranking by Total Population Growth	% Population Increase (or change) from 1982 to 2010	Ranking by Percentage Population Increase
Alabama	3,925,266	4,779,736	854,470	24	22%	23
Arizona	2,889,861	6,392,017	3,502,156	6	121%	2
Arkansas	2,294,257	2,915,918	621,661	30	27%	21
California	24,820,009	37,253,956	12,433,947	1	50%	12
Colorado	3,061,564	5,029,196	1,967,632	9	64%	6
Connecticut	3,139,013	3,574,097	435,084	34	14%	36
Delaware	599,148	897,934	298,786	37	50%	13
Florida	10,471,407	18,801,310	8,329,903	3	80%	3
Georgia	5,649,792	9,687,653	4,037,861	4	71%	5
Idaho	973,721	1,567,582	593,861	31	61%	8
Illinois	11,423,412	12,830,632	1,407,220	15	12%	38
Indiana	5,467,922	6,483,802	1,015,880	21	19%	28
Iowa	2,888,189	3,046,355	158,166	42	5%	45
Kansas	2,401,202	2,853,118	451,916	33	19%	27
Kentucky	3,683,445	4,339,367	655,922	29	18%	31
Louisiana	4,352,608	4,533,372	180,764	41	4%	46

State	Population 1982	Population 2010	Total Population Growth, 1982-2010	Ranking by Total Population Growth	% Population Increase (or change) from 1982 to 2010	Ranking by Percentage Population Increase
Maine	1,136,684	1,328,361	191,677	39	17%	33
Maryland	4,282,923	5,773,552	1,490,629	13	35%	19
Massachusetts	5,771,222	6,547,629	776,407	26	13%	37
Michigan	9,115,198	9,883,640	768,442	27	8%	42
Minnesota	4,131,450	5,303,925	1,172,475	18	28%	20
Mississippi	2,556,777	2,967,297	410,520	35	16%	34
Missouri	4,929,451	5,988,927	1,059,476	20	21%	24
Montana	803,986	989,415	185,429	40	23%	22
Nebraska	1,581,780	1,826,341	244,561	38	15%	35
Nevada	881,537	2,700,551	1,819,014	10	206%	1
New [illegible]	947,719	1,316,470	368,751	36	39%	17
New Jersey	7,430,968	8,791,894	1,360,926	16	18%	29
New Mexico	1,363,823	2,059,179	695,356	28	51%	11
New York	17,589,738	19,378,102	1,788,364	11	10%	41
North [illegible]	6,019,101	9,535,483	3,516,382	5	58%	9
North Dakota	668,972	672,591	3,619	47	1%	47
Ohio	10,757,087	11,536,504	779,417	25	7%	43
Oklahoma	3,206,123	3,751,351	545,228	32	17%	32
Oregon	2,664,922	3,831,074	1,166,152	19	44%	16
Pennsylvania	11,845,146	12,702,379	857,233	23	7%	44

State	Population 1982	Population 2010	Total Population Growth, 1982-2010	Ranking by Total Population Growth	% Population Increase (or change) from 1982 to 2010	Ranking by Percentage Population Increase
Rhode Island	954,170	1,052,567	98,397	45	10%	40
South [illegible]	3,207,614	4,625,364	1,417,750	14	44%	15
South Dakota	690,597	814,180	123,583	43	18%	30
Tennessee	4,646,041	6,346,105	1,700,064	12	37%	18
Texas	15,331,415	25,145,561	9,814,146	2	64%	7
Utah	1,558,314	2,763,885	1,205,571	17	77%	4
Vermont	519,109	625,741	106,632	44	21%	25
Virginia	5,492,783	8,001,024	2,508,241	7	46%	14
Washington	4,276,552	6,724,540	2,447,988	8	57%	10
West Virginia	1,949,604	1,852,994	-96,610	48	-5%	48
Wisconsin	4,728,870	5,686,986	958,116	22	20%	26
Wyoming	506,400	563,626	57,226	46	11%	39
Contiguous 48 States	229,586,892	306,073,283	76,486,391	N/A	33%	N/A

Sources: 2010 Census population counts for states* and U.S. Census Bureau estimates for 1982

*Mackun, P., S. Wilson, T. Fischetti, and J. Goworowska. 2011. Population Distribution and Change: 2000 to 2010. 2010 Census Briefs. U.S. Census Bureau. Issued March 2011.

Table H-2. Alphabetical List of 48 Contiguous States, their Population Growth from 2002 to 2010, and ranking by aggregate or absolute amount and percentage change

State	Population 2002	Population 2010	Total Population Growth, 2002-2010	Ranking by Total Population Growth	% Population Increase (or change) from 2002 to 2010	Ranking by Percentage Population Increase
Alabama	4,471,006	4,779,736	308,730	19	7%	21
Arizona	5,444,881	6,392,017	947,136	6	17%	3
Arkansas	2,703,310	2,915,918	212,608	28	8%	19
California	34,963,856	37,253,956	2,290,100	2	7%	23
Colorado	4,507,762	5,029,196	521,434	11	12%	11
Connecticut	3,451,867	3,574,097	122,230	31	4%	35
Delaware	804,875	897,934	93,059	37	12%	12
Florida	16,667,906	18,801,310	2,133,404	3	13%	8
Georgia	8,591,169	9,687,653	1,096,484	5	13%	9
Idaho	1,342,103	1,567,582	225,479	27	17%	4
Illinois	12,578,317	12,830,632	252,315	22	2%	41
Indiana	6,151,102	6,483,802	332,700	16	5%	30
Iowa	2,931,084	3,046,355	115,271	34	4%	33
Kansas	2,712,383	2,853,118	140,735	30	5%	31
Kentucky	4,089,032	4,339,367	250,335	23	6%	25
Louisiana	4,465,490	4,533,372	67,882	39	2%	44
Maine	1,294,187	1,328,361	34,174	45	3%	40
Maryland	5,433,822	5,773,552	339,730	15	6%	24

State	Population 2002	Population 2010	Total Population Growth, 2002-2010	Ranking by Total Population Growth	% Population Increase (or change) from 2002 to 2010	Ranking by Percentage Population Increase
Massachusetts	6,431,788	6,547,629	115,841	33	2%	42
Michigan	10,043,737	9,883,640	-160,097	48	-2%	48
Minnesota	5,020,624	5,303,925	283,301	20	6%	28
Mississippi	2,859,196	2,967,297	108,101	35	4%	34
Missouri	5,676,209	5,988,927	312,718	17	6%	29
Montana	910,282	989,415	79,133	38	9%	18
Nebraska	1,725,545	1,826,341	100,796	36	6%	27
Nevada	2,167,645	2,700,551	532,906	10	25%	1
New Hampshire	1,272,185	1,316,470	44,285	43	3%	36
New Jersey	8,558,327	8,791,894	233,567	26	3%	39
New Mexico	1,850,562	2,059,179	208,617	29	11%	13
New York	19,132,542	19,378,102	245,560	24	1%	45
North Carolina	8,319,293	9,535,483	1,216,190	4	15%	6
North Dakota	633,861	672,591	38,730	44	6%	26
Ohio	11,414,816	11,536,504	121,688	32	1%	46
Oklahoma	3,485,515	3,751,351	265,836	21	8%	20
Oregon	3,521,520	3,831,074	309,554	18	9%	17
Pennsylvania	12,305,751	12,702,379	396,628	14	3%	37
Rhode Island	1,066,888	1,052,567	-14,321	47	-1%	47
South Carolina	4,104,683	4,625,364	520,681	12	13%	10

State	Population 2002	Population 2010	Total Population Growth, 2002-2010	Ranking by Total Population Growth	% Population Increase (or change) from 2002 to 2010	Ranking by Percentage Population Increase
South Dakota	761,995	814,180	52,185	42	7%	22
Tennessee	5,801,841	6,346,105	544,264	9	9%	16
Texas	21,730,350	25,145,561	3,415,211	1	16%	5
Utah	2,336,872	2,763,885	427,013	13	18%	2
Vermont	615,250	625,741	10,491	46	2%	43
Virginia	7,281,659	8,001,024	719,365	7	10%	15
Washington	6,061,872	6,724,540	662,668	8	11%	14
West Virginia	1,800,090	1,852,994	52,904	41	3%	38
Wisconsin	5,445,115	5,686,986	241,871	25	4%	32
Wyoming	497,204	563,626	66,422	40	13%	7
All 48 States	285,437,369	306,073,283	20,635,914		7%	

Appendix I
Findings of our Previous Sprawl Studies in 2001 and 2003

Our two sprawl studies – conducted more than a decade ago (published in 2001 and 2003) – were titled "Weighing Sprawl Factors in Large U.S. Cities: A report on the nearly equal roles played by population growth and land use choices in the loss of farmland and natural habitat to urbanization"[1] and "Outsmarting Smart Growth: Population Growth, Immigration, and the Problem of Sprawl."[2] They made a number of key findings and conclusions.

The two main findings from the 2001 study on the 100 largest Urbanized Areas in the U.S. were the following:

> **(1) Per Capita Sprawl:** About half the sprawl nationwide appears to be related to the land-use and consumption choices that lead to an increase in the average amount of urban land per resident (**Figure I-1**).
>
> **(2) Population Growth:** The other half of sprawl is related to the increase in the number of residents within those 100 Urbanized Areas.

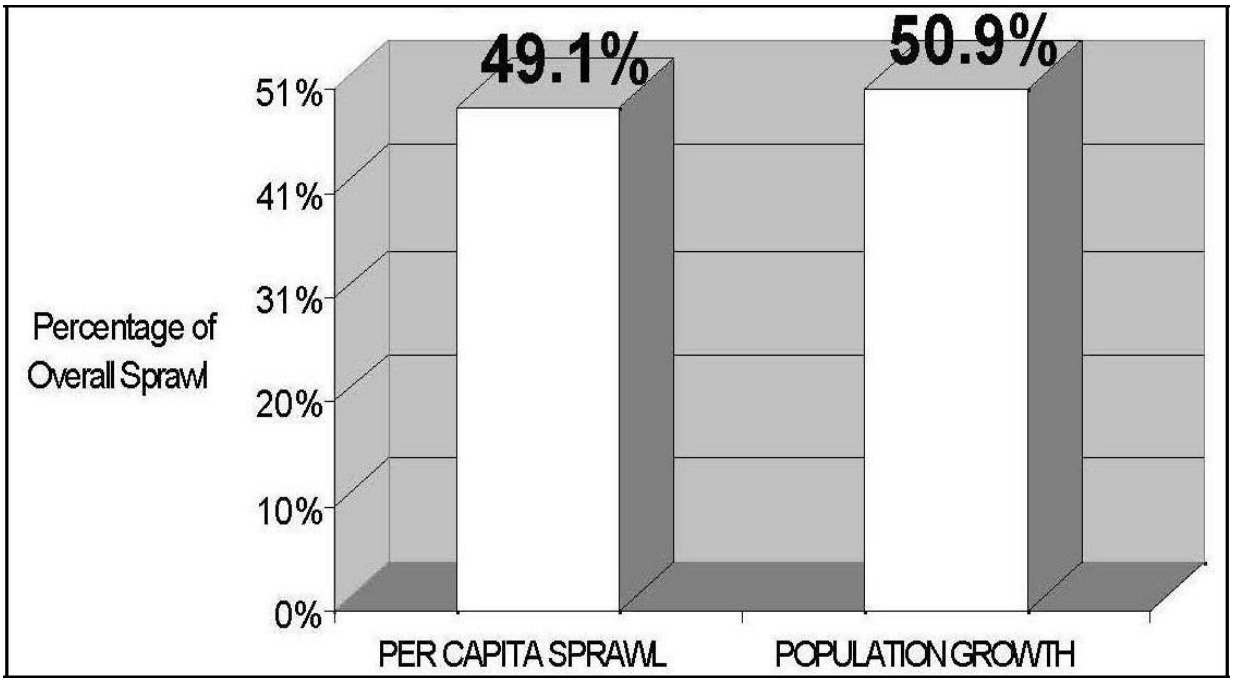
"On average, there are more of us, and each of us is using more urban land, and therein lie the two halves of the problem," wrote the authors in the 2001 study. These findings then led the authors to the following conclusions:

- The toll of urban sprawl on ecosystems, farmland and scenic open spaces cannot be substantially halted unless anti-sprawl efforts include a two-pronged attack using both land-use/consumption tools and population tools.
- Anyone advocating U.S. population stabilization who derides the importance of consumption and planning controls is ignoring half the story of American sprawl.
- Similarly, any Smart Growth advocate who relegates population growth to a side issue is turning a blind eye to half the problem and, thus, approximately half the solution, which is U.S. population stabilization.

[1] Kolankiewicz, L. and R. Beck. 2001. Weighing Sprawl Factors in Large U.S. Cities: A report on the nearly equal roles played by population growth and land use choices in the loss of farmland and natural habitat to urbanization. Analysis of U.S. Bureau of the Census Data on the 100 Largest Urbanized Areas of the United States. March 19. NumbersUSA: Arlington, VA. 64 pp. Available at: https://www.numbersusa.com/content/resources/publications/publications/studies/weighing-sprawl-factors-large-us-cities.html.

[2] Beck, R., L. Kolankiewicz, and S. Camarota. 2003. Outsmarting Smart Growth: Population Growth, Immigration, and the Problem of Sprawl. Washington, DC: Center for Immigration Studies. Center Paper 22. August. 122 pp. Available at: http://www.cis.org/sites/cis.org/files/articles/2003/sprawl.html.

Figure I-1. Sources of Urban Sprawl in 100 Largest Cities, 1970-1990



Source: Kolankiewicz and Beck (2001). Footnote #1.

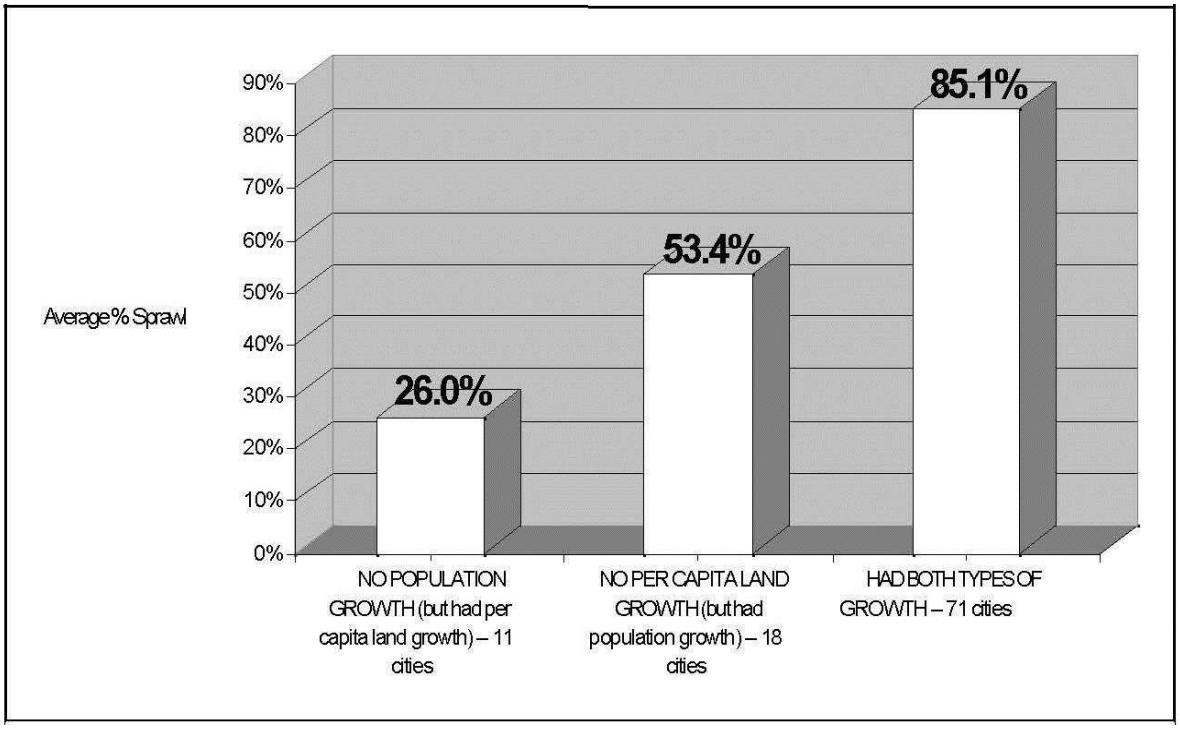
- Although the circumstances of each city are different, the power of both sprawl factors is potentially the same in each. Every city that wishes to restrain its land expansion will need to continually keep in mind the impacts on sprawl of both growth factors. Cities with no recent per capita land consumption growth should not throw away land-use tools, lest Per Capita Sprawl resume. And cities with no recent population growth will still need to be reminded regularly of the role population can play in sprawl, lest they inadvertently create incentives to promote population growth in the future.

- The forces driving overall national population growth cannot be ignored as contributors to sprawl, since national population growth manifests itself as growth in local communities.

The 2001 study concluded that cities with either, 1) no growth in population or, 2) no growth in per capita land consumption, still had sprawl. However, cities that had both types of growth had far higher sprawl (**Figure I-2**).

The main emphasis of the later 2003 study "Outsmarting Smart Growth" was analysis of sample data from the National Resource Conservation Service's NRI that estimated the increase in developed land from 1982-1997. That study reached these findings and conclusions:

Figure I-2. Average Sprawl Rate by Type of Growth, 100 Largest Cities, 1970-1990



Source: Kolankiewicz and Beck (2001). Footnote #1.

- The more a given state's population grew, the more the state sprawled (see **Figure I-3**). For example, states that grew in population by more than 30 percent between 1982 and 1997 sprawled 46% on average. In contrast, states that grew in population by less than 10% sprawled only 26% on average.

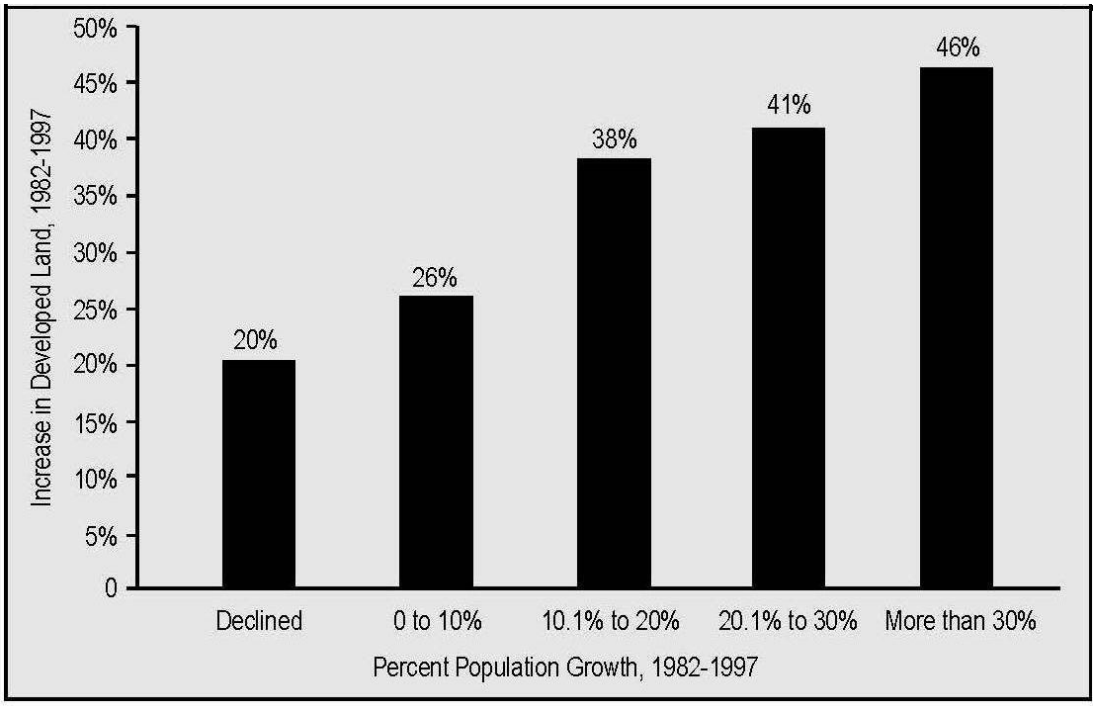
- On average, each 10,000-person increase in a state's population resulted in 1,600 acres of undeveloped rural land being developed, even controlling for other factors such as changes in population density.

- Apportioning the share of sprawl that is due to increases in population versus increases in per-capita land consumption shows that, nationally, population growth accounted for 52 percent of the loss of rural land between 1982 and 1997, while increases in per-capita land consumption accounted for 48 percent.

- While population growth is a key factor driving sprawl, our findings indicate that Smart Growth must also play a significant role in anti-sprawl efforts because per capita land use has been increasing. Between 1982 and 1997, land use per person rose 16 percent from 0.32 acres to 0.37 acres.

- There is significant variation between states in the factors accounting for sprawl. For example, population growth accounted for more than half of sprawl in five of the 10 states that lost the most land, while increases in per-capita land use accounted for more than half of sprawl in the other five worst sprawling states.

Figure I-3. Percentage Increase in Developed Land by State's Percentage Population Growth



Source: Beck, Kolankiewicz and Camarota (2003). Footnote #2.

- An examination of the nation's largest urban areas reveals the same pattern as in the states. Between 1970 and 1990, population growth accounted for slightly more than half of the expansion of urbanized land in the nation's 100 largest cities.

- In the 1990s, new immigration and immigrant fertility accounted for most of the 33-million increase in the U.S. population. Census Bureau data from 2002 indicate that the more than 1.5 million legal and illegal immigrants who settle in the country each year along with 750,000 yearly births to immigrants are equal to 87 percent of the annual increase in the U.S. population.

- Contrary to the common perception, about half the country's immigrants now live in the nation's suburbs. The pull of the suburbs is even greater in the second generation. Of the children of immigrants who have settled down and purchased a home, only 24 percent have done so in the nation's central cities.

- The suburbanization of immigrants and their children is a welcomed sign of integration. But it also means that they contribute to sprawl just like other Americans.

"In short," concluded the 2003 study, "Smart Growth efforts to slow or stop the increase in per capita land use are being negated by population growth. Immigration-driven population growth, in effect, is 'out-smarting' Smart Growth initiatives by forcing continued rural land destruction."

Appendix J
Advisors* to the 2001 study
"Weighing Sprawl Factors in Large U.S. Cities"

Urban Planning Oversight
Earl M. Starnes, *Ph.D., professor emeritus, urban and regional planning,* University of Florida
Eben Fodor, *urban planning consultant, Eugene (OR); author,* Better not Bigger: How to Take Control of Urban Growth and Improve Your Community
Gabor Zovanyi, *Ph.D., professor of urban planning*, Eastern Washington University
Robert Seaman, a*ssociate professor of environmental science,* New England College*; executive committee, American Society of Civil Engineers' Urban and Development Division*
Ruth Steiner, *Ph.D., professor of urban and regional planning,* University of Florida

Statistical Oversight
Alan J. Truelove, *Ph.D., statistician, retired professor,* University of the District of Columbia
B. Meredith Burke (1947-2002), *Ph.D., demographer*
Ben Zuckerman, *Ph.D.*, *professor of physics and astronomy,* UCLA*; member, UCLA Institute of the Environment*
David Simcox, *director, Migration Demographics*
Dick Schneider, *chair, Sierra Club Northern California Regional Sustainability Task Force*
Leon Bouvier (1922–2011), *Ph.D., demographer,* Old Dominion University (VA)
Mark C. Thies, *Ph.D., P.E., professor of chemical engineering,* Clemson University
Marshall Cohen, *Ph.D., professor emeritus of astronomy*, California Institute of Technology
Paul Nachman, *Ph.D., physicist*
Scott Briles, *Ph.D., engineer,* Los Alamos National Laboratory, University of California
Steven A. Camarota, *Ph.D., public policy analyst*
William E. Murray, Jr., *Ph.D., physicist*
Michael Mueller, *Ph.D., natural resource economist*

Continued on next page

***** The individuals on this list volunteered to provide advice and guidance to the 2001 Kolankiewicz-Beck sprawl study for NumbersUSA and to have their names listed prominently as Advisors inside the front cover.

The affiliations of the Advisors were listed for identification purposes only, and it was emphasized that the views in the report did not necessarily reflect the views either of the institutions listed alongside them or of all views of the Advisors. Several Advisors helped shape the methodology of the study during the 18 months it lasted, and also assisted with production of interim reports on California and Florida. As the national-level study neared completion, the authors sought the assurance of having many more Advisors with a broad array of expertise to read the results and examine the analysis and methodology. The authors gratefully acknowledged the detailed recommendations, rigorous reviews, and vigorous discussion from and among the Advisors.

Environmental and General Oversight

Albert Bartlett (1923-2013), *Ph.D., professor emeritus of physics,* University of Colorado
Betty B. Davis, *Ph.D.*, *psychologist*
Bill Smith, *Ph.D., dean, College of Global Economics, EarthNet Institute*
Craig Diamond, *adjunct faculty, environmental studies,* Florida State University*; technical advisor to the Sierra Club carrying capacity campaign*
David Pimentel, *Ph.D., professor of ecology and agricultural sciences,* Cornell University
Diana Hull*, Ph.D., behavioral scientist, retired,* Baylor College of Medicine
Edward G. Di Bella, *adjunct faculty,* Grossmont Community College (CA)*; president, Friends of Los Penasquitos Canyon Preserve*
Garrett Hardin (1915-2003), *Ph.D., professor emeritus of human ecology,* University of California, Santa Barbara
George Wolford, *Ph.D., president, EarthNet Institute*
Herbert Berry, *Ph.D., retired associate professor of computer information systems,* Morehead State University (KY)
James G. McDonald, a*ttorney, civil engineer*
Jeffrey Jacobs, *Ph.D.,* National Academy of Sciences
John Bermingham, *former Colorado state senator*
John Rohe, *attorney; board, Conservation News Service*
Linda Thom, *retired government budget analyst, Santa Barbara County (CA)*
Michael Hanauer, *member, Vision 2020, growth management project of Lexington, (MA)*
Ross McCluney, *Ph.D., principal research scientist, Florida Solar Energy Center,* University of Central Florida
Steve Miller, *former Las Vegas councilman, Clark County (NV) Regional Transportation Commissioner*
Stuart Hurlbert, *Ph.D., professor of biology,* San Diego State University
Terry Paulson, *Mayor Pro-tem, Aspen (CO) City Council*
Tom Reitter, *Livermore (CA) City Council*

Appendix K
2014 National Poll on Sprawl and Population

SPRAWL & POPULATION National Poll

Survey of 1,000 Likely Voters
Conducted April 1-2, 2014
By Pulse Opinion Research
NOTE: Margin of Sampling Error, +/- 3 percentage points with a 95% level of confidence

1* The U.S. Department of Agriculture calculates that over the last decade urban sprawl destroyed millions of acres of farmland and natural habitat equal in size to the entire state of Maryland. If this were to continue, would it be a major problem, somewhat of a problem, not much of a problem or not a problem at all?

42% A major problem
35% Somewhat of a problem
17% Not much of a problem
3% Not a problem at all
4% Not sure

GROUPINGS: 77% A major or somewhat PROBLEM
20% NOT MUCH or at all a problem

2* How important is it to protect farmland from development so the United States is able to produce enough food to completely feed its own population in the future?

71% Very important
21% Somewhat important
6% Not very important
0% Not important at all
2% Not sure

GROUPINGS: 92% Very or somewhat IMPORTANT
6% NOT VERY important

3* How important is it for the United States to have enough farmland to be able to feed people in other countries as well as its own?

26% Very important
46% Somewhat important
19% Not very important
6% Not important at all
2% Not sure

GROUPINGS: 72% Very or somewhat IMPORTANT
25% NOT VERY or at all important

4* Which do you agree with more: That it is unethical to pave over and build on good cropland or that the need for more housing is a legitimate reason to eliminate cropland?

59% It is unethical to pave over and build on good cropland
19% The need for more housing is a legitimate reason to eliminate cropland
22% Not sure

5* The government reports that to make room for growing cities the last three decades, 17 million acres of surrounding woodlands have been cut down. How significant a problem is this loss of natural wildlife habitat?

53% Very significant
32% Somewhat significant
11% Not very significant
1% Not at all significant
3% Not sure

GROUPINGS: 85% Very or somewhat SIGNIFICANT
12% NOT VERY or at all significant

6* Do you feel an emotional or spiritual uplift from time spent in natural areas like woodlands and open grasslands?

70% Yes
18% No
12% Not sure

7* How important is it that you can get to natural areas fairly quickly from where you live?

48% Very important
37% Somewhat important
11% Not very important
2% Not important at all
2% Not sure

GROUPINGS: Very or somewhat IMPORTANT
NOT VERY or at all important

8*A study of government data found that most of the development destruction of farmland and natural habitat over the last decade was related to rapid growth in the United States population. The Census Bureau projects the population is on pace to double this century. Would doubling the population in YOUR area make it better, worse or not much different?

9% Better
60% Worse
24% Not much different
7% Not sure

9* If the population in YOUR AREA were to double, would traffic become much worse or would the government be able to build enough extra transportation capacity to accommodate the extra people?

68% Traffic would become much worse
20% The government would be able to build enough extra transportation capacity to accommodate the extra people
13% Not sure

10* Over the rest of this century, would you prefer that the nation's population continue to double to 600 million, grow by half to 450 million, stay about the same as it is now at just over 300 million, or slowly become smaller?

9% Continue to double to 600 million
26% Grow by half to 450 million
43% Stay about the same at more than 300 million
12% Slowly become smaller
9% Not sure

GROUPINGS: 9% Continue present pace
81% Slow pace of growth by at least half

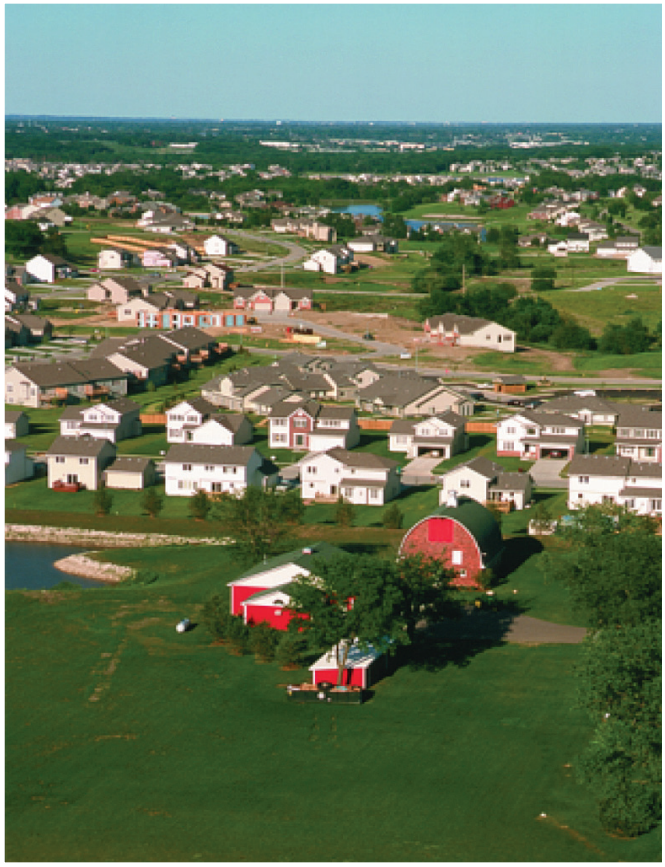
11* Census data show that since 1972, the size of American families has been at replacement-level. But annual immigration has tripled and is now the cause of nearly all long-term population growth. Does the government need to reduce immigration to slow down population growth, keep immigration the same and allow the population to double this century, or increase immigration to more than double the population?

68% Reduce immigration to slow down population growth
18% Keep immigration the same and allow population to double
4% Increase immigration to more than double the population
10% Not sure

12* Currently the government allows one million legal immigrants each year. How many legal immigrants should the government allow each year – two million, one million, a half-million, 100,000, or zero?

7% Two million
14% One million
23% Half a million
20% 100,000
20% Zero
16% Not sure

GROUPINGS: 21% Keep same level or increase
63% Cut immigration at least in half



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